ACADEMIC CURRICULA & SYLLABUS

POSTGRADUATE DEGREE PROGRAMMES

Master of Technology

Two Year

(Full Time)

Learning Outcome Based Education

Choice Based Flexible Credit System

Regulations 2020

SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

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

Kattankulathur, Chengalpattu District 603203, Tamil Nadu, India

M.Tech. in Structural Engineering

a) Vision of the Department

To become a frontier in various fields of Civil Engineering education and research to meet national and global challenges in accordance with the societal needs.

b) Mission of the Department

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

c) Program Educational Objectives (PEO)

PEO - 1	*The post graduates will exhibit professional skills in multiple domains of structural engineering to deal with practical problems individually in native and global scenarios.*
PEO - 2	*The post graduates will show their individual innate skills to initiate and to carry out research investigations to cater to national and global needs*
PEO - 3	*The post graduates will have ability to disseminate their research and practical solutions to native and global communities through reports and documentations*
PEO - 4	*The post graduates will have ability to pursue for their higher research degrees at various levels*
PEO – 5	*The post graduates will have an applicative knowledge of modern developments in systems and software fields*

d) Programme Outcomes (PO)

PO - 1	*An ability to independently carry out research /investigation and development work to solve practical problems.*
PO - 2	*An ability to write and present a substantial technical report/document.*
PO - 3	*Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.*

e) Mission of the Department to Program Educational Objectives (PEO) Mapping

	Mission Stmt. - 1	Mission Stmt. - 2	Mission Stmt. - 3
PEO - 1	3	2	3
PEO - 2	3	3	3
PEO - 3	3	3	3
PEO - 4	3	2	2
PEO – 5	3	2	3

3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation

f) Mapping Program Educational Objectives (PEO) to Program Outcomes (PO)

	Program Outcomes (PO)		
	1	2	3
PEO – 1	*3*	*3*	*3*
PEO – 2	*3*	*3*	*2*
PEO – 3	*3*	*3*	*2*
PEO – 4	*3*	*3*	*2*
PEO – 5	*3*	*2*	*2*

3 – High Correlation, 2 – Medium Correlation, 1 – Low Correlation

g) Programme Structure (71 Total Credits)

1. Professional Core Courses (C)
(6 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
20CEC501T	Matrix Computer Method of Structural Analysis	3	1	0	4
20CEC502T	Structural Dynamics	3	1	0	4
20CEC503T	Theory of Elasticity and Plasticity	3	1	0	4
20CEC504J	Finite Element Method with Computer Application	3	0	2	4
20CEC505T	Advanced Steel Structures	3	1	0	4
	Total Learning Credits				**20**

2. Professional Elective Courses (E)
(4 Courses of 4 credits)

Course Code	Course Title	Hours/ Week L	T	P	C
20MAE501T	Applied Mathematics	3	1	0	
20CEE501J	Advanced Reinforced Concrete Structures	3	0	2	4
20CEE502T	Aseismic Design of Structures	3	1	0	
20CEE503T	Stability of Structures	3	1	0	
20CEE504T	Mechanics of Structural Composite Materials	3	1	0	4
20CEE505T	Concrete Technology and Special Concretes	4	0	0	
20CEE506T	Maintenance and Rehabilitation of Structures	4	0	0	
20CEE507T	Prestressed Concrete Structures	3	1	0	4
20CEE601T	Design of Steel-Concrete Composite Structures	3	1	0	
20CEE602T	Offshore Structures	4	0	0	
20CEE603T	Experimental Techniques and Instrumentation	3	1	0	4
20CEE604T	Design of Reinforced Concrete Foundations	3	1	0	
20CEE605T	Design of Bridges	3	1	0	
20CEE606T	Design of Tall Buildings	3	1	0	
20CEE607T	Analysis and Design of Structural Sandwich Panels	3	1	0	4
20CEE608T	Advanced Analysis and Design for Wind Earthquake and Other Dynamic Loads	3	1	0	
20CEE609T	Design of Shell and Folded Plate Structures	3	1	0	4
20CEE610T	Computer Aided Design and Programming	3	1	0	
20CEE611T	Ancient Building Materials and Additives In the Conservation of Heritage Structures	4	0	0	
20CEE612T	Seismic Retrofit of Buildings	4	0	0	4
20CEE613T	Disaster Resistant Structures	4	0	0	
	Total Learning Credits				16

3. Skill Enhancement Course (S)

Course Code	Course Title	Hours/ Week L	T	P	C
20GNS501J	Research Publishing And Presenting Skills	1	0	2	2
20GNS502J	Research Methodology (Science and Technology)	2	1	2	4
	Total Learning Credits				**6**

4. Open Elective Courses (O)

Course Code	Course Title	Hours/ Week L	T	P	C
20CEO531T	Waste To Energy	3	0	0	3
	Total Learning Credits				**3**

5. Project Work (P)

Course Code	Course Title	Hours/ Week L	T	P	C
20CEP601L	Internship	0	0	8	4
20CEP603L	Project Work Phase I	0	0	12	6
20CEP604L	Project Work Phase II	0	0	32	16
	Total Learning Credits				26

6. Audit course
(2 Courses)

Course Code	Course Title	Hours/ Week L	T	P	C
20CEA531J	Disaster Management	1	0	1	0
20GNA511T	Constitution Of India	1	0	0	0
20GNA513J	Value Education	1	0	1	0
20GNA512L	Physical And Mental Health Using Yoga	0	0	2	0

7. Mandatory course

Course Code	Course Title	Hours/ Week L	T	P	C
20PDM501T	Carrer Advancement Course for Engineers -I	1	0	1	0
20PDM502T	Carrer Advancement Course for Engineers -II	1	0	1	0
20PDM601T	Carrer Advancement Course for Engineers -II	1	0	1	0

h) Implementation Plan

Semester - I

Code	Course Title	Hours/ Week L	T	P	C
20CEC501T	Matrix Computer Method of Structural Analysis	3	1	0	4
20CEC502T	Structural Dynamics	3	1	0	4
20CEC503T	Theory of Elasticity and Plasticity	3	1	0	4
20MAE501T	Applied Mathematics	3	1	0	
20CEE505T	Concrete Technology and Special Concretes	4	0	0	
20CEE506T	Maintenance and Rehabilitation of Structures	4	0	0	
20CEE502T	Aseismic Design of Structures	3	1	0	4
20CEE503T	Stability of Structures	3	1	0	
20CEE504T	Mechanics of Structural Composite Materials	4	0	0	
20CEE507T	Prestressed Concrete Structures	3	1	0	
20CEE501J	Advanced Reinforced Concrete Structures	3	0	2	
20GNS501J	Research Publishing and Presenting Skills	1	0	2	2
20PDM501T	Career Advancement Course For Engineers - I	1	0	1	0
	Audit Course - 1	1	0	1	0
	Total Learning Credits				18

Semester - II

Code	Course Title	Hours/ Week L	T	P	C
20CEC504J	Finite Element Method with Computer Application	3	0	2	4
20CEC505T	Advanced Steel Structures	3	1	0	4
20CEE506T	Design of Steel-Concrete Composite Structures	3	1	0	
20CEE507T	Offshore Structures	4	0	0	
20CEE601T	Experimental Techniques and Instrumentation	3	1	0	4
20CEE604T	Design of Reinforced Concrete Foundations	3	1	0	
20CEE605T	Design of Bridges	3	1	0	
20CEE606T	Design of Tall Buildings	3	1	0	
20CEE608T	Advanced Analysis and Design for Wind Earthquake and Other Dynamic Loads	3	1	0	4
20CEE613T	Disaster Resistant Structures	4	0	0	
20GNS502J	Research Methodology (Science and Technology)	2	1	2	4
20PDM502T	Career Advancement Course For Engineers - II	1	0	1	0
	Audit Course - 2	1	0	0	0
	Total Learning Credits				20

Semester - III					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CEE607T	Analysis and Design of Structural Sandwich Panels	3	1	0	4
20CEE609T	Design of Shell and Folded Plate Structures	3	1	0	
20CEE610T	Computer Aided Design and Programming	3	1	0	
20CEE611T	Ancient Building Materials and Additives In the Conservation of Heritage Structures	4	0	0	
20CEE612T	Seismic Retrofit of Buildings	4	0	0	
20CEE613T	Disaster Resistant Structures	4	0	0	
20CEP601L	Internship	0	0	8	4
20CEP603L	Project Work Phase I	0	0	12	6
20PDM601T	Career Advancement Course For Engineers - III	1	0	1	0
20CEO531T	Waste To Energy	3	0	0	3
Total Learning Credits					17

Semester - IV					
Code	Course Title	Hours/ Week			C
		L	T	P	
20CEP604L	Project Work Phase II	0	0	32	16
Total Learning Credits					16

i) Program Articulation Matrix

		Program Outcomes		
Course Code	Course Name	1	2	3
20CEC501T	Matrix Computer Method of Structural Analysis	3	3	2
20CEC502T	Structural Dynamics	3	3	2
20CEC503T	Theory of Elasticity and Plasticity	3	2	2
20CEC504J	Finite Element Method and Application	3	3	2
20CEC505T	Advanced Steel Structures	3	3	2
20MAE501T	Applied Mathematics	3	3	2
20CEE501J	Advanced Reinforced Concrete Structures	3	3	2
20CEE502T	Aseismic Design of Structures	3	3	2
20CEE503T	Stability of Structures	3	3	2
20CEE504T	Mechanics of Structural Composite Materials	3	3	2
20CEE505T	Concrete Technology and Special Concretes	3	3	2
20CEE506T	Maintenance and Rehabilitation of Structures	3	3	2
20CEE507T	Prestressed Concrete Structures	3	3	2
20CEE601T	Design of Steel-Concrete Composite Structures	3	3	2
20CEE602T	Offshore Structures	3	3	2
20CEE603T	Experimental Techniques and Instrumentation	3	3	2
20CEE604T	Design of Reinforced Concrete Foundations	3	3	2
20CEE605T	Design of Bridges	3	3	2
20CEE606T	Design of Tall Buildings	3	3	2
20CEE607T	Analysis and Design of Structural Sandwich Panels	3	3	2
20CEE608T	Advanced Analysis and Design for Wind Earthquake and Other Dynamic Loads	3	3	2
20CEE609T	Design of Shell and Folded Plate Structures	3	3	2
20CEE610T	Computer Aided Design and Programming	3	3	2
20CEE611T	Ancient Building Materials and Additives In the Conservation of Heritage Structures	3	3	2
20CEE612T	Seismic Retrofit of Buildings	3	3	2
20CEE613T	Disaster Resistant Structures	3	3	2
20CEO531T	Waste To Energy	3	3	3
20PDM501T	Carrer Advancement Course for Engineers -I	3	3	2
20PDM502T	Carrer Advancement Course for Engineers -II	2	3	2
20PDM601T	Carrer Advancement Course for Engineers -III	2	3	2
20CEA531J	Disaster Management	3	3	2
20GNA511T	Constitution Of India	3	3	2
20GNA513J	Value Education	-	2	2
20GNA512L	Physical And Mental Health Using Yoga	2	3	2
20CEP601L	Internship	3	3	2
20CEP603L	Project Work Phase I	3	3	2
20CEP604L	Project Work Phase II	3	3	3

Course Code	20CEC501T	Course Name	MATRIX COMPUTER METHOD OF STRUCTURAL ANALYSIS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Introduce fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices
CLR-2:	Impart knowledge about analysis of system through direct and element approach of flexibility method
CLR-3:	Analysis of structures by direct and element approach of stiffness method is to be included
CLR-4:	Programming techniques for simple problems and use of standard programmers to be practiced
CLR-5:	Awareness to the use of advanced techniques of matrix methods are to be created
CLR-6:	Acquaint the students with case studies on analysis and design scenarios using matrix methods

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	Understanding the Basics of Matrix methods and analysis	3	3	-
CO-2:	Introduction of flexibility matrix and methods and evaluation	3	3	-
CO-3:	Introduction of stiffness matrix and method sand evaluation	3	3	2
CO-4:	Analyse System programming, development and assemblage	3	3	2
CO-5:	Analyse advanced method of matrices and band width formation	3	3	2
CO-6:	Create Knowledge of different matrix methods	3	3	2

Duration (hour)		12	12	12	12	12
S-1	SLO-1	Matrix Fundamentals	Introduction to flexibility methods	Introduction to stiffness methods	System Programming	Introduction to Advanced Matrix problems
	SLO-2	Fundamentals of Matrix and different components	Formation of flexibility matrix	Formation of stiffness matrix	System Programming solution techniques	Advanced Matrix problems and equations
S-2	SLO-1	Force Measurement	Direct method applied to beams	Direct method applied to beams	Programming of solution techniques for simultaneous equation solution	Sub structuring techniques
	SLO-2	Problem 1 - Force Measurement	Direct method applied to beams – Problems-1	Direct method applied to beams – Problems-1	Programming of solution techniques for simultaneous equation solution – Cont'd	Sub structuring techniques - applications
S-3	SLO-1	Displacement Measurement	Direct method applied to frames	Direct method applied to frames	Matrix operations	Problems on Forces

Duration (hour)		12	12	12	12	12
	SLO-2	*Problem 1 - Displacement Measurement*	*Direct method applied to frames – Problems-1*	*Direct method applied to frames – Problems-1*	*Matrix assembly*	*Matrix formation with forces*
S-4	SLO-1	*Tutorial 1 – Force method*	*Tutorial 7 – Flexibility matrices*	*Tutorial 13 – Stiffness matrices*	*Tutorial 19 – Matrices in MS-Excel*	*Tutorial 25 – Sub structure problems*
	SLO-2	*Tutorial 2 – Displacement method*	*Tutorial 8 – Beams and frames*	*Tutorial 14 – Beams and frames*	*Tutorial: 20 – Basic MS-Excel operations*	*Tutorial 26 – Force matrix formation*
S-5	SLO-1	*Generalised or independent measurements*	*Relationship between element and system*	*Strain Energy*	*Simple program development for element stiffness matrix*	*Problems on Displacement*
	SLO-2	*Problems on Generalised or independent measurements*	*Relationship between element and System – Cont'd*	*Strain Energy in terms of stiffness coefficients*	*Simple program development for element stiffness matrix – Cont'd*	*Matrix formation with Displacement*
S-6	SLO-1	*Constrained or dependent measurements*	*Strain Energy*	*Relationship between element and systems*	*Stiffness matrix elements*	*Band width*
	SLO-2	*Problems on Constrained or dependent measurements*	*Strain Energy in terms of flexibility coefficients*	*Static loads condensation concepts*	*Stiffness matrix assemblage*	*Band width Analysis*
S-7	SLO-1	*Concept of flexibility usingsystems of springs*	*Introduction to Betti's Law*	*Staticcondensation techniques*	*Complete structure of a stiffness analysis program*	*Reduction Theory*
	SLO-2	*Problems on Concept of flexibility usingsystems of springs*	*Approach to equivalent joint load concept through Betti's Law*	*Derivations on Staticcondensation techniques*	*Complete structure of a stiffness analysis program with subroutines*	*Tri-diagnolisation technique*
S-8	SLO-1	*Tutorial 3 – Constrained measurements*	*Tutorial 9 – Betti's law application*	*Tutorial 15 – Condensation techniques*	*Tutorial 21 – Development of stiffness matrices*	*Tutorial 27 – Bandwidth formation*
	SLO-2	*Tutorial 4 – Flexibility systems*	*Tutorial 10 – Strain energy formation*	*Tutorial 16 – Strain energy equivalence*	*Tutorial 22 – Stiffness programming*	*Tutorial 28 – Bandwidth problems*
S-9	SLO-1	*Concept of stiffness usingsystems of springs*	*Problems in beams -1, including effect of temperature and sinking*	*Problems in beams -1, including secondary effects*	*Use ofGTSTRUDL*	*Band solvers*
	SLO-2	*Problems on Concept of stiffness usingsystems of springs*	*Problems in beams -2, including effect of temperature and sinking*	*Problems in beams -2, including secondary effects*	*Applications of GTSTRUDL in trusses, beams and frames.*	*Frontal solvers*
S-10	SLO-1	*Reciprocal relationships between stiffness and flexibility*	*Problems in frames -1, including effect of temperature and sinking*	*Problems in frames -1, including secondary effects*	*Use ofSTAAD Pro*	*Re analysis technique*
	SLO-2	*Reciprocal equations between stiffness and flexibility*	*Problems in frames -2, including effect of temperature and sinking*	*Problems in frames -2, including secondary effects*	*Applications of STADD Pro in trusses, beams and frames.*	*Transfer matrix method*
S-11	SLO-1	*Stiffness and flexibility in constrained measurements*	*Problems in trusses -1, including effect of temperature and sinking*	*Problems in Grid jointed trusses - 1, including secondary effects*	*Use ofSAP2000*	*Use of symmetry and anti-symmetry*

Duration (hour)		12	12	12	12	12
	SLO-2	*Rank of matrix*	*Problems in trusses -2, including effect of temperature and sinking*	*Problems in pin jointed trusses -2, including secondary effects*	*Applications of SAP2000 in trusses, beams and frames.*	*Problems on Transfer matrix method*
S-12	SLO-1	*Tutorial 5 – Reciprocal relationships of matrices*	*Tutorial 11 – Frame analysis*	*Tutorial 17 – Frame analysis*	*Tutorial 22 – demo of STAAD Pro*	*Tutorial 29 – Frontal solvers*
	SLO-2	*Tutorial 6 – Rank of matrix formation*	*Tutorial 12 – Truss analysis*	*Tutorial 18 – Pin-jointed truss analysis*	*Tutorial 22 – demo of SAP2000*	*Tutorial 30 – Band solvers*

Learning Resources	1. *Jack. C, McCormac, " Structural Analysis: Using Classical and Matrix Methods",John Wiley, Fourth Edition, 2007.* 2. *Rajasekaran.S, Sankarasubramanian.G, "Computational Structural Mechanics",Prentice Hall of India Pvt Ltd, New Delhi - 110 001, First Edition, 2001.* 3. *William McGuire, Richard. H, Gallagher and Ronald. D, Zieian "MatrixStructural Analysis, With MASTAN2", John Wiley, Second Edition, 2000.*	*4. Beaufit F.W et al. "Computer Methods of Structural Analysis", Prentice Hall,1970.* *5. John L.Meek, "Matrix Structural Analysis", Mc Graw Hill Book Company, 1971.* *6. Bathe K.J, and Wilson. E.L, "Numerical Methods in Finite Element Analysis",Prentice Hall, Engle Wood Cliffs, New Jersey, USA, 1976.* *7. Rubinstien. M.F, "Matrix Computer Analysis of Structures", Prentice Hall, 1966.*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Dr. G. V. Ramarao, Sr. Scientist, SERC, ramarao@serc.res.in	Dr. Praveen Nagarajan, Professor, NIT, praveen@nitc.ac.in	Dr. S. Senthilselvan, SRMIST
Mr. S. Kavin Kumar, Director, EPMCR Pvt. Ltd., kavinkumar@epmcr.co.in	Dr.Sivakumar Palaniappan, Asst. Prof., IITM, sp@iitm.ac.in	Dr. K.S. Satyanarayanan, SRMIST

Course Code	20CEC502T	Course Name	STRUCTURAL DYNAMICS	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	IS 1893 PART1 : 2018, IS875 PART III :1987, IS 4991 : 1968		

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Give students an understanding about the concept of Dynamics
CLR-2:	Introduce general theory of vibration and solve problems of single degree of freedom (SDOF) systems
CLR-3:	Solve dynamic problems in multi-degree of freedom (MDOF) systems
CLR-4:	Introduce dynamic analysis of continuous systems
CLR-5:	Apply structural dynamic principles to the analysis of structures for seismic and wind loading
CLR-6:	Introduce blast loading

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	Understand the concept and principles of dynamics	3	3	2
CO-2:	Evaluate different theories of vibration and different system with single degree of freedom	3	3	2
CO-3:	Evaluate the concept of Multiple degrees of freedom	3	3	2
CO-4:	Apply basic methods and techniques for analysis of continuous systems	3	3	2
CO-5:	Create method to be adopted for seismic and wind load analysis	3	3	2
CO-6:	Analyze with various ideas to design structure for blast load	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	Introduction	Transient state response	Modal superposition method	Dynamic Analysis	Quasi static method
	SLO-2	Fundamental objective of Structural Dynamics Analysis	Steady state response	Case on superposition	Response Spectrum Method	Illustration on quasi-static
S-2	SLO-1	Types of Prescribed Loadings	Damped system	Soil Structure Interaction effects	Evaluation of Displacements and Drift	Gust factor method
	SLO-2	Essential characteristics of Dynamic problem	In phase, Out of Phase displacement and Resonance.	Soil-Structure importance	Human Comfort criteria as per code	Problems on gust factor method
S-3	SLO-1	Discretization concepts	Vibration of machine foundation - vibration isolation.	Vibration analysis of Continuous system	Structural Control system	Evaluation of Gust Factor

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Methods of discretization*	*Vibration measuring instruments*	*Vibration analysis of dis-continuous system*	*Structural frame systems*	*Factor analysis*
S-4	SLO-1	*Tutorial 1 : Types of Loading & Demonstration*	*Tutorial 4: Matrices for spring mass system - Two and Three Degree system*	*Tutorial 7: Mode shape problem*	*Tutorial 10 : Problem on displacement calculations*	Tutorial 13 : Assignment on Wind Effects
	SLO-2					
S-5	SLO-1	*Single Degree of Freedom system: Differential equation of motion*	*Multiple Degrees of Freedom system : Two degrees of freedom*	*Simply supported beams*	*Passive Control system*	Blast loading
	SLO-2	*Newton's second law and D'Alemberts principle*	*Three Degree system*	*Transverse Vibration*	*Base Isolation*	*Blast effects*
S-6	SLO-1	*Free vibration*	*System property matrices*	Timoshenko beam	*Energy Dissipating devices*	Over ground structures
	SLO-2	*Undamped system*	*Matrices formulation*	Problems on Timoshenko beam	*Energy transfer*	Importance of Over ground structures
S-7	SLO-1	*Damped system and evaluation of damping constants*	Solution of Eigen value problem	Effect of axial loads.	*Active Control system*	Design parameters of Over ground structures
	SLO-2		*Eigen value problem methods*	*Effects of lateral loads*	*Passive control system*	Codal provisions on Over ground structures
S-8	SLO-1	*Tutorial 2 : Evaluation of Time period*	*Tutorial 5: Model Making - SDOF and MDOF System*	*Tutorial 8: Soil Structure Interaction Approaches - assignment*	*Tutorial 11 : Model for base isolation*	*Tutorial 14 : Models for wind effects*
	SLO-2	*Natural frequency of Spring mass system*				
S-9	SLO-1	*Critical damping*	Stodola method	*Analysis of undamped free vibration of beams*	*Analysis of Base Isolated System*	*Evaluation of Blast Load*
	SLO-2	*Under damped and Over damped conditions*	*Problems on stodola method*	*Natural frequency and mode shape*	*Problems on base isolated system*	*Codes on blast load*
S-10	SLO-1	*Logarithmic increment*	*Orthogonality conditions*	*Estimation of design forces of multistory buildings using Bureau of Indian Standards (BIS) codes*	*Wind effects on structures*	*Front, Roof and Rear Face of Buildings*
	SLO-2	*Logarithmic decrement*	*Orthogonality cases*	*Importance of BIS*	*Wind power*	*Analysis of different faces*
S-11	SLO-1	*Forced Vibration*	*Mode shape concepts*	*Determination of Base Shear*	*Static analysis for wind loads using BIS codes*	Underground structures
	SLO-2	*Undamped System ,*	*Mode shape importance*	*Equivalent static lateral force method*	*Dynamic analysis for wind loads using BIS codes*	*Assessment techniques*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-12	SLO-1	*Tutorial 3 : Vibration Isolation problem*	*Tutorial 6 : Drawing Mode Shapes for beam with different end conditions*	*Tutorial 9 : Seismic weight calculations*	*Tutorial 12 : Modeling of Energy Dissipating devices*	*Tutorial: 15:Assignment on Underground structures*
	SLO-2	*Working model - Vibration Isolation*				

Learning Resources	*1.Ray W Clough , Joseph Penizen, Dynamics of StructureMcGraw-Hill International,* *2.Anil. K, Chopra, "Dynamics of Structures" (Theory and Applications to Earthquake Engineering), Prentice Hall of India Private Limited. New Delhi, Second Edition, 2007.* *3.Mukhopadhyay, M., "Structural Dynamics", Ane Books, India, 2006.*	4.Paz. M, *"Structural Dynamics - Theory and Computations"*, Kluwer Acedamic Publishers, U.S.A, 2004 *5.Short course on Seismic Design of Reinforced Concrete Buildings, CEP, IIT, Kanpur, Dec.1995.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Mr. G. Jayaramalingam, Head – Civil & Structural, Reliance Retail Limited, jaya.ramalingam@ril.com	*Dr. S. Arul Jayachandran, Professor, IITM, aruls@iitm.ac.in*	*Prof. Augustine Maniraj Pandian,* SRMIST

Course Code	20CEC503T	Course Name	THEORY OF ELASTICITY AND PLASTICITY	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Develop systematic - knowledge of stress strain concept*
CLR-2:	*Familiarize with the fundamentals of two-dimensional problems*
CLR-3:	*Develop the knowledge about torsion for shapes like ellipse triangular and rectangular*
CLR-4:	*Introduce the energy theorem and the energy methods*
CLR-5:	*Problem solving in torsion*
CLR-6:	*Give introduction to the problems in plasticity*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding of stress strain concept and equilibrium conditions*	3	2	2
CO-2:	*Evaluate knowledge on fundamentals of two-dimensional problems*	3	2	2
CO-3:	*Apply concept in torsion like ellipse triangular and rectangular shape functions*	3	2	2
CO-4:	*Analysis using energy theorem and the energy methods*	3	2	2
CO-5:	*Able to evaluate the solution in torsion*	3	2	2
CO-6:	*Understand the problem in plasticity*	3	2	2

Duration (hour)		**Module 1 (12)**	**Module 2 (12)**	**Module 3 (12)**	**Module 4 (12)**	**Module 1 (12)**
S-1	SLO-1	*Introduction to theory of elasticity*	*Introduction to 2D problems in Cartesian coordinate system*	*Introduction to General solution for torsion problems*	*Introduction to energy method*	*Introduction to problems in plasticity-*
	SLO-2	*Assumption in theory of elasticity*	*Concepts of Airy's stress function*	*Torsion of prismatic bars*	*Concept of strain-energy method*	*Physical assumption*
S-2	SLO-1	*Concept of Stress at a point*	*Determination of stress field for various Polynomials*	*Torsion of prismatic bars by displacement (warping function) force*	*Strain energy under axial load*	*Criteria of yielding*
	SLO-2	*Finding the Stresses in 2D tetrahedron*	*Airy's stress function variable in polynomials for pure shear condition.*	*Torsion of prismatic bars by Prandtls stress function*	*Strain energy stored in a member under its self-weight*	*Theories of failure-Rankin's theory-Maximum strain theory/St.Venant's theory*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 1 (12)
S-3	SLO-1	*Determination of principal stress and direction*	*Airy's stress function variable in polynomials for bending condition.*	*Torsion of shafts of circular*	*Strain energy stored under bending*	*Haigh theory, von-mises theory and Tresca theory*
	SLO-2	*Stress transformation Matrix formation*	*Derivation of Biharmonic equation and check with compatibility equation.*	*Example: Finding the torsion in circular shaft*	*Strain energy shaft subjected to torsion*	*Example 1: Theories of failure*
S-4	SLO-1	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet 7*	*Tutorial: Problem solving using tutorial sheet 10*	*Tutorial: Problem solving using tutorial sheet 13*
	SLO-2					
S-5	SLO-1	*Derivation of Equilibrium equation 2D*	*Introduction to St.Venants Principle*	*Torsion for non circular cross sectional for elliptical shapes*	*Introduction to castiglano's theorem*	*Plastic problems of beams in bending*
	SLO-2	*Derivation of Equilibrium equation 3D*	*St.Venants tree usage in formulation of polynomial equations*	*Example: Finding the torsion in elliptical cross section*	*Castiglano's theorem 1*	*Assumptions in Plastic problems of beams in bending*
S-6	SLO-1	*Strain – Displacement relation application*	*Biharmonic equation solutions by method of polynomials*	*Example: Finding the shear stress and angle of twist for elliptical cross section*	*Castiglano's theorem 2*	*Idealised Stres-Strain curve*
	SLO-2	*Relationship between Strain – Displacement*	*Example 1: Polynomial of degree 1 and 2*	*Example: Finding the shear stress and angle of twist for elliptical cross section and compare it with strength of material approach*	*Introduction to Energy principle*	*Expression of moment in different stages of bending in plastic region*
S-7	SLO-1	*Concept of Generalized Hooke's law*	*Example 2: Polynomial of degree 3 and 4*	*Non circular cross sectional Rectangular shapes only*	*Principle of stationary potential energy*	*Shape factor*
	SLO-2	*Strain Invariants explanation and problems*	*Example 3: Polynomial of degree 5*	*Example : Finding the torsional effect for rectangular cross section*	*Maxwell reciprocal theorem statement*	*Shape factor calculation for rectangular section*
S-8	SLO-1	*Tutorial: Problem solving using tutorial sheet 2*	*Tutorial: Problem solving using tutorial sheet 5*	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet 11*	*Tutorial: Problem solving using tutorial sheet 14*
	SLO-2					
S-9	SLO-1	*Introduction to Plane strain and plane stress*	*Introduction to Bending of cantilever beam loaded at the end*	*Concept of Membrane analogy*	*Explanation on Principle of virtual work*	*Problems related to stages of bending*
	SLO-2	*Calculation of various Stress strain in different members*	*Assumptions and boundary conditions made in Bending of cantilever beam loaded at the end*	*Assumptions made in membrane analogy*	*Principle of complementary strain energy*	*Residual stresses in plastic bending*
S-10	SLO-1	*Compactability equation*	*Bending Derivation for a cantilever beam loaded at the end*	*Salient features of membrane analogy*	*Dummy load method concept*	*Plastic torsion*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 1 (12)
	SLO-2	*Derivation of Navier's equation*	*Introduction to Bending of simply supported beam loaded with uniformly distributed load*	*Derivation of membrane equation.*	*Formation of Finite Difference method*	*Example Problems in Plastic torsion*
S-11	SLO-1	*Introduction to Octahedral strain and Octahedral stress*	*Assumptions and boundary conditions made in Bending of simply supported beam loaded with uniformly distributed load*	*Torsion of thin rectangular sections*	*Concept of Rayleigh Ritz Methods*	*Residual stress in plastic torsion*
	SLO-2	*Example : Problems in octahedral strain and stress*	*Bending Derivation for a simply supported beam loaded with uniformly distributed load*	*Torsion of hollow thin walled sections.*	*Example Problems in Ritzs method*	*Sand heap analogy*
S-12	SLO-1	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet*	*Tutorial: Problem solving using tutorial sheet 1*	*Tutorial: Problem solving using tutorial sheet 15*
	SLO-2					

Learning Resources	1. *Richard.G, Budynas, "Advanced Strength and Applied Stress Analysis" Mc Graw-Hill, New Delhi, Second Edition, 2011.* 2. *Chakrabarty, "Theory of Plasticity", Tata McGraw Hill Book Co., New Delhi, Third Edition, 2006.* 3. *Mendelson.A., "Plasticity - Theory and Applications", Krieger Pub Co., Florida, U.S.A,Second edition,1983.*	4. *Chwo.P.C, and Pagano.N.J. "Elasticity Tensor, Dyadic and Engineering Applications", Van Nastrand. D, and Co., Inco. 1990.* 5. *"Applied Elasticity", Mc Graw Hill, New Delhi, 1990* 6. *Timoshenko.S, and Goodier .J.N, "Theory of Elasticity" Tata Mc Graw Hill Education., India, Third Edition, 2010.* 7. *Sadhusingh "Theory of Elasticity" Khanna Publishers, New Delhi, Fourth Edition, 2012.* 8. *https://nptel.ac.in/courses (Theory of Elasticity)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
	Total	**100 %**		**100 %**		**100 %**		**100 %**	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts

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Dr. G.V. Ramarao, Sr. Scientist, CSIR-SERC, ramarao@serc.res.in	*Dr. U. Saravanan, Professor, IITM, saran@iitm.ac.in*	*Mrs. S.Sivakamasundari, SRM IST*

Course Code	20CEC504J	Course Name	FINITE ELEMENT METHOD WITH COMPUTER APPLICATION	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	0	2	4

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

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Provide the fundamental concepts of variational methods
CLR-2:	Provide the fundamental concepts of finite element method
CLR-3:	Introduce the concept of discretization, boundary condition and shape function
CLR-4:	Develop the stiffness matrix for 2D and 3D elements
CLR-5:	Enable the students to formulate the problems into FEA
CLR-6:	Analyze the beam and frame in Excel and STADD pro

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	To understand the concept of mathematical model and solution for common engineering problems	3	3	2
CO-2:	To understand finite element method by various approaches	3	3	2
CO-3:	Development of discretization techniques for different elements	3	3	2
CO-4:	To evaluate the shape function for different elements	3	3	2
CO-5:	To apply to field problems	3	3	2
CO-6:	Understanding and usage of software's	3	3	2

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
S-1	SLO-1	Introduction to the methods of Engineering analogy	Concept of Displacement field, Compatibility criteria and Convergence criteria	Introduction to 2D rectangular element	Introduction to Jacobian operator	Application of finite elements analysis
	SLO-2	Introduction to Finite Element Analysis	Introduction to Bar Elements	Coordinate concept in2D rectangular element	Formulation of Jacobian Matrix	Introduction toTorsion
S-2	SLO-1	Different Stages of Finite Element Analysis	Simplex, Complex and Multiplex elements	Serendipity family elements	Example 1: Calculation of Jacobian matrix	Displacement approach for torsion problem
	SLO-2	Boundary Conditions in FEA	Introduction to Basic Equations and Shape Function	Example 1: Calculation of shape function for Serendipity elements	Introduction to numerical integration techniques	Concept of Stress approach in torsion analysis

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
S-3	SLO-1	*Essential Boundary Condition*	*Concept of Co-ordinate system and Relationship between the co-ordinate system*	*Lagrangian family elements*	*Types of numerical integration techniques*	*Warping function effect in member subjected to torsion.*
	SLO-2	*Natural Boundary Condition*	*Example 1: Shape function for 2 Noded bar element*	*Example 2: Calculation of shape function for Lagrangian elements*	*Example 1: Calculation of Single variable numerical integration*	*Derivation of torsion equation by displacement approximation by warping function*
S-4, S-5	SLO-1	*Lab1: Design of Singly Reinforced beam in excel*	*Lab 4: Design of Two way slab in excel*	*Lab 7: Design of Compression member in excel*	*Lab 10: Design of combined footing (Rectangular or Trapezoidal).*	*Lab 13: Design of 3D frame in Stadd-Pro*
	SLO-2					
S-6	SLO-1	*Boundary Value Problems Explanation*	*Development of stiffness matrix*	*Hermitian family elements*	*Example 2: Calculation of two variable numerical integration*	*Equation for 3 noded triangular element for analysis of torsion problem*
	SLO-2	*Concept of Piecewise approximation.*	*Example 1: Development of stiffness matrix for 2 Noded bar element*	*Example 3: Calculation of shape function for Hermitian elements*	*Introduction to 3D brick elements*	*Example 1: Torsion analysis by stress approach*
S-7	SLO-1	*Introduction to variational Methods*	*Example 2: Development of stiffness matrix for 3 Noded bar element*	*Quadrilateral element*	*Properties of eight nodded elements*	*Example 2: Torsion analysis by stress approach*
	SLO-2	*Finite Difference Method*	*Nodal load vector-Consistent and lumped load vector*	*Example 4: Calculation of shape function for Quadrilateral element*	*Concept of 3D brick element and its usage in Finite element analysis*	*Thermal conductivity steady state problems involving conduction and convection*
S-8	SLO-1	*Example problem : Finite Difference Method*	*Analysis of 2D truss and 3D truss*	*Degenerated elements*	*Concept of 8 noded brick element and its properties*	*Torsional analysis in prismatic members*
	SLO-2	*Rayleigh Ritz method*	*Example 1: Problems in truss analysis*	*Example 5: Calculation of shape function for Degenerated element*	*Shape function concept in 3D brick elements*	*Techniques for Non – linear Analysis*
S-9, S-10	SLO-1	*Lab2: Design of Doubly Reinforced beam in excel*	*Lab 5: Analysis of a beam for stiffness in excel*	*Lab 8:Design of Pile in Excel.*	*Lab 11: Analysis of 2D frame inStadd-Pro*	*Lab 14: Analysis of 3D frame subjected to wind load inStadd-Pro*
	SLO-2					
S-11	SLO-1	*Example problem 1: Rayleigh Ritz method*	*Introduction to Beam elements*	*Introduction to Iso, Sub and super - parametric element*	*Example 1: Derivation of shape function for the Eightnoded 3D Brick elements*	*Application to Plates & Shells*
	SLO-2	*Methods of weighted residual - Collocation, sub domain, Galerkin, least square methods*	*Example 1: Problems in beam element*	*Example 1: Development of stiffness matrix for Iso-parametric element*	*Example 2: Development of Stiffness matrix for the3D 8 nodedbirck element.*	*Choice of displacement function (C0, C1 and C2 type)*
S-12	SLO-1	*Example problem 1: Methods of weighted residual*	*Analysis of plane stain and plane stress conditions*	*Nodal load vector for quadrilateral element*	*Introduction to Twenty nodded 3D Brick elements*	*Steps to analyze the case study related to non linear problems*

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
	SLO-2	*Displacement model, stress model and hybrid models*	*Formulation of Shape function for CST elements.*	*Example 1: calculation of Nodal load vector for quadrilateral element*	*Example 1: Derivation of shape function for the Twenty nodded 3D Brick elements*	*Case Study 1*
S-13	SLO-1	*Principle of minimum potential energy- Principle of minimum complimentary potential energy*	*Formulation of Shape function for LST elements.*	*Concept of axisymmetric elements*	*Plate bending elements concept, Thin and thick plates*	*Case Study 2*
	SLO-2	*Hellinger - Reissner's principle - Steps in Finite Element Analysis.*	*Formulation of Shape function for QST elements.*	*Formation of stiffness matrix in axisymmetric elements*	*Mindlin's plate theory*	*Case Study 3*
S-14, S-15	SLO-1 SLO-2	*Lab3: Design of one way slab in excel*	*Lab 6: Analysis of truss for stiffness matrix calculation.*	*Lab 9: Design of rectangular Isolated footing*	*Lab 12: Analysis of 3D frame in Stadd-Pro*	*Lab 15: Response spectrum analysis of 3D frame in Stadd-Pro*

Learning Resources

1. *Krishnamoorthy C.S, "Finite Elements Analysis - Theory and Programming",Tata McGraw Hill publishing company limited, New Delhi, 2008.*
2. *Zienkiewicz. O. C, Taylor. R. L, Zhu. J.Z, "The Finite Element Method: Its Basis and Fundamentals: Its Basis and Fundamentals", Butterworth-Heinemann, Sixth Edition, 2005.*
3. *Krishnamoorthy.C. S, Rajeev. S, Arunachalam Rajaraman., " Computer Aided Design: Software And Analytical Tools", U.K, 2005.*
4. *Rajesekaran .S, "Finite Element Methods in Engineering Design", Wheeler Publishers, Allahabad, 1999*
5. *Chandrapatla. R.T, and Belagundu, A.D., "Introduction to Finite Elements in Engineering", Second Edition, Prentice Hall of India, 1997*
6. *Bathe. K.J, "Finite Element Procedures in Engineering Analysis", PHI, New Delhi, 1990.*
7. *Robert Davis Cook, David. S, Malkus, Michael. E, Plesha., "Concepts and Applications of Finite Element Analysis", John Wiley, , New York, Third Edition 1989.*
8. *Zienkiewicz .O.C, and Taylor. R.L, "The Finite Element Method", Vol.1, Basic Formulation and linear problems, Mc Graw Hill Limited, U.K. 1989.*
9. *Hans. R, Schwarz, "Finite Element Methods", Academic Press, 1988.*
10. *Bruce Irons and Shrire .N, "Finite Element Primer", Ellis Howood Limited, 1983.*
11. *Ernest Hinton. D. Owen, "Finite Element Programming", ACADEMIC Press INC, London, Fifth Edition, 1979.*
12. *Gallagher. R.H, "Finite Element Analysis - Fundamentals", Prentice Hall Inc. 1975.*
13. *https://nptel.ac.in/courses/ (Finite Element Analysis)*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand								
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze								
Level 3	Evaluate	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
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	Total	**100 %**		**100 %**		**100 %**		**100 %**	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. A. Sivaraman, design Manager, Utracon, sivaram@utracon.com	*Prof. A.M. Amit Shaw, Associate Professor, IIT-Kh, abshaw@civil.iitkgp.ac.in*	*Dr. K.S. Satyanarayanan*
Mr. S. Parthiban, Engineering Manager, L&T, spb@Intecc.com	*Dr. Amlan Kumar Sengupta, Professor, IITM, amlan@iitm.ac.in*	*Mrs. S.Sivakamasundari*

Course Code	20CEC505T	Course Name	ADVANCED STEEL STRUCTURES	Course Category	C	PROFESSIONAL CORE	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Introduce General principle in the design of steel structures*
CLR-2:	*Impart knowledge about Various types of connections*
CLR-3:	*Steel transmission line towers*
CLR-4:	*Plastic method of structural analysis*
CLR-5:	*Analysis and design of industrial structures*
CLR-6:	*Acquaint the students with case studies on different steel connections*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding basics of Steel connections and girders*	3	2	2
CO-2:	*Evaluate advanced calculations on connections*	3	3	2
CO-3:	*Evaluationof structural steel configuration and tower design*	3	3	2
CO-4:	*Apply plastic analysis and mechanism with application to different beam supports*	3	2	2
CO-5:	*Analyze assimilation of knowledge to industrial building and roof trusses*	2	2	2
CO-6:	*Create knowledge of different connections and industrial buildings*	2	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction to steel design*	*Simple connections and types*	*Basic structural Steel configurations*	*Introduction to plastic analysis*	*Introduction to Industrial buildings*
	SLO-2	*Advanced steel design concepts*	*Bolted connections*	*Free standing towers*	*Techniques in plastic analysis*	*Techniques on solving industrial building*
S-2	SLO-1	*Beams subjected to biaxial bending*	*Pinned and Welded Connections*	*Free guyed towers*	*Plastic Behaviour of Structural Steel*	*Dead loads, live loads on roofs*
	SLO-2	*Problem 1 - Beams subjected to biaxial bending*	*Bolted Connections- Load Transfer Mechanism*	*Loads on towers*	*Plastic theory*	*Wind loads on roofs*
S-3	SLO-1	*Built-up Purlins*	*Failure of Bolted Joints*	*Problem 1 – Tower design*	*Plastic hinge concept*	*Design wind speed and pressure*
	SLO-2	*Problem 1 - Built-up Purlins*	*Specifications for Bolted Joints*	*Problem 2 – Tower design*	*Plastic collapse load*	*Wind pressure on roofs*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Tutorial 1 – Beam bending*	*Tutorial 7 – Load-Transfer mechanism*	*Tutorial 13 – guyed towers*	*Tutorial 19 – Plastic analysis problem 1*	*Tutorial 25 – Wind speed cases*
	SLO-2	*Tutorial 2 – Purlin problem*	*Tutorial 8 – Bolted joints*	*Tutorial 14 – tower designs*	*Tutorial: 20 – Plastic analysis problem 2*	*Tutorial 26 – Loading cases and combinations*
S-5	SLO-1	*Various types and design*	*Bearing – Type Connections*	*Wind loads importance*	*Conditions of plasticanalysis*	*Wind effect on cladding*
	SLO-2	*Various design problems*	*Tensile Strength of Plate*	*Wind loads calculations*	*Theorem of Plastic collapse*	*Wind effect on louvers*
S-6	SLO-1	*Design of Wind girders*	*Strength and Efficiency of the Joint*	*Introduction to tower foundation design*	*Methods of Plastic analysis*	*Design of angular roof truss*
	SLO-2	*Problems on Design of Wind girders*	*Combined Shear and Tension*	*Procedures for tower foundation design*	*Plastic Mechanism Method*	*Design of angular roof truss – Cont'd*
S-7	SLO-1	*Problems 1 - Design of Wind girders*	*Slip – Critical Connections*	*Problem 1 - tower foundation design*	*Applicationto continuous beams*	*Braced and Unbraced structures*
	SLO-2	*Problems 2 - Design of Wind girders*	*Combined Shear and Tension for Slip Critical Connections*	*Problem 2 - tower foundation design*	*Problems in continuous beams*	*Bracing connections*
S-8	SLO-1	*Tutorial 3 – wind girders functionality*	*Tutorial 9 – Bearing connections*	*Tutorial 15 – wind load cases*	*Tutorial 21 – Plastic collapse scenarios*	*Tutorial 27 – Angular roof concepts*
	SLO-2	*Tutorial 4 – wind girder case study*	*Tutorial 10 – slip-critical connections*	*Tutorial 16 – factor of safety in winds*	*Tutorial 22 – Continuous beams*	*Tutorial 28 – Bracings importance*
S-9	SLO-1	*Beam-columns joints*	*Design of Groove welds*	*Design criteria for different configurations*	*Applicationto portal frames*	*Gable frames with gantry*
	SLO-2	*Problems on Beam-columns*	*Design of Fillet Welds*	*Steel configuration analysis*	*Problems Applicationto portal frames*	*Problems on gable frames*
S-10	SLO-1	*Problems on Beam-columns with various support conditions*	*Design of Intermittent fillet welds*	*Introduction to transmission line towers*	*Plastic design of continuous beams*	*Problem 1 – Gantry girder*
	SLO-2	*Design offoundations*	*Failure of Welds*	*Procedures for transmission line towers*	*Moment distribution*	*Problem 2 – Gantry girder*
S-11	SLO-1	*Design offoundations with lateral loads*	*Connections Subjected to Eccentric Shear*	*Problem 1 - transmission line towers*	*Analysis ofGable frames*	*Fire resistant design*
	SLO-2	*Problem on Design offoundations with lateral loads*	*Moment Resistant Connections*	*Problem 2 - transmission line towers*	*Instantaneous Centre of rotation*	*Fatigue resistant design*
S-12	SLO-1	*Tutorial 5 - Foundations*	*Tutorial 11 - welds*	*Tutorial 17 – steel configuration*	*Tutorial 23 – gable frame case study 1*	*Tutorial 29 – gantry girder*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Tutorial 6 – Lateral loads*	*Tutorial 12 – Moment resistant connections*	*Tutorial 18 – steel configuration tech*	*Tutorial 24 – gable frame case study 2*	*Tutorial 30 – gable frames*

Learning Resources	1. *Subramanian. N, "Design of Steel Structures: Theory and Practice", Oxforduniversity Press, U.S.A, Third Edition, 2011.* 2. *Duggal.S.K, "Design of Steel Structures", McGraw Hill New Delhi, 2010* 3. *Dayaratnam. P, "Design of Steel Structures," Chand. S, Limited, New Delhi.2008.* 4. *John. E, Lothers, "Structural Design in Steel", Prentice Hall, 1999.*	5. *Neal. B.G, "Plastic Method of Structural Analysis", Taylor & Francis, ThirdEdition, 1985.* 6. *6.Edwin .H, Gaylord, Charles .N, Gaylord, James .E, Stallmeyer, "SteelStructures", McGraw Hill, New* 7. *Delhi, 1980.* 8. *Ramchandra, "Design of Steel Structures", Vol I & II Standard Book House,Delhi, 1975.* 9. *8. Arya.S and Ajmani.J.L, "Design of Steel Structures", Nem Chand & Bros,Roorkee*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	-	*20%*	-	*20%*	-	*20%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
Mr. Sabari, Director, SP Structures, sabari@spstructures.com	Dr. P. Jayabalan, Professor, NITT, pjeya@nitt.edu	Dr. S. Senthilselvan, SRMIST
Mr. Cibi Jacob, Chief Consultant, Jacob Engineers, cibijacob@jacobengineers.in	Dr. Lakshmi Priya, Assistant Professor, IITM, lakshmipriya@iitm.ac.in	Dr. K.S. Satyanarayanan, SRMIST

Course Code	20MAE501T	Course Name	APPLIED MATHEMATICS	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*To learn the concept of One Dimensional wave equations and Diffusion equation*
CLR-2:	*To understand the concepts of Euler's equations*
CLR-3:	*To learn concepts of Fredholm and Volterra integral equations*
CLR-4:	*To learn the concepts of Probability, Correlation and Regression*
CLR-5:	*To learn the concept of ANOVA and Control Charts*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Students will be able to solve One Dimensional wave equations and Diffusion equation by using Laplace and Fourier Transform Techniques*	3	3	-
CO-2:	*Students become familiar with solving Euler's equations*	3	3	-
CO-3:	*Students will be able to understand and solve Fredholm and Volterra integral equations*	3	3	2
CO-4:	*Students will be able to understand the concepts of Probability, Correlation and Regression*	3	3	2
CO-5:	*Students become familiar with ANOVA table and Control Charts*	3	3	2

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*To refresh and enhance the Laplace transform*	*Euler's Equations*	*Introduction to Fredholm integral equations*	*Concepts of probability*	*Introduction Analysis of Variance*
	SLO-2	*To refresh and enhance the Fourier Transform Techniques*	*Euler's Equations*	*Introduction to Fredholm integral equations*	*Concepts of probability*	*Introduction Analysis of Variance*
S-2	SLO-1	*Solution of One Dimensional Wave Equation using Laplace Transform Methods*	*Solution of Euler's Equations*	*To solve Fredholm integral equations*	*Probability distributions*	*ANOVA - One way Classification*
	SLO-2	*Solution of One Dimensional Wave Equation using Laplace Transform Methods*	*Solution of Euler's Equations*	*To solve Fredholm integral equations*	*Probability distributions*	*ANOVA - One way Classification*
S-3	SLO-1	*More examples on One Dimensional Wave Equation using Laplace Transform Methods*	*Functional involving x, y, y'*	*Introduction to Volterra integral equations*	*Correlation*	*ANOVA - Two way Classification*

Duration (hour)		12	12	12	12	12
	SLO-2	*More examples on One Dimensional Wave Equation using Laplace Transform Methods*	*Functional involving x, y, y'*	*Introduction to Volterra integral equations*	*Correlation*	*ANOVA - Two way Classification*
S-4	SLO-1	*Tutorial 1: Solve One Dimensional Wave equations using Laplace Transforms*	*Tutorial4 : Solution of Euler's Equations*	*Tutorial 7 : Fredholm integral equations*	*Tutorial 10: Probability and Correlation*	*Tutorial 13: ANOVA TABLE*
	SLO-2	*Tutorial 1: Solve One Dimensional Wave equations using Laplace Transforms*	*Tutorial4 : Solution of Euler's Equations*	*Tutorial 7 : Fredholm integral equations*	*Tutorial 10: Probability and Correlation*	*Tutorial 13: ANOVA TABLE*
S-5	SLO-1	*To find displacements in Long string*	*To determine functional on higher order derivatives*	*To solve Volterra integral equations*	*Regression*	*More examples on ANOVA – One way and Two way Classification*
	SLO-2	*To determine the longitudinal vibration of an elastic bar*	*To determine functional on higher order derivatives*	*To solve Volterra integral equations*	*Regression*	*More examples on ANOVA – One way and Two way Classification*
S-6	SLO-1	*Solution of One Dimensional Diffusion Equation using Fourier Transform Methods*	*To calculate functional dependent on functions of independent variables*	*To find solution of integro-differentialequation*	*Multiple and Partial Correlation*	*Introduction and Control theory*
	SLO-2	*Solution of One Dimensional Diffusion Equation using Fourier Transform Methods*	*To calculate functional dependent on functions of independent variables*	*To find solution of integro-differentialequation*	*Multiple and Partial Correlation*	*Introduction and Control theory*
S-7	SLO-1	*Examples on One Dimensional Diffusion Equation using Fourier Transform Methods*	*More problems on calculate functional dependent on functions of independent variables*	*Green's function*	*Multiple and Partial Regression*	*Control Charts for X and R*
	SLO-2	*Examples on One Dimensional Diffusion Equation using Fourier Transform Methods*	*More problems on calculate functional dependent on functions of independent variables*	*Green's function*	*Multiple and Partial Regression*	*Control Charts for X and R*
S-8	SLO-1	*Tutorial 2: Solve One Dimensional Diffusion equations using Fourier Transforms*	*Tutorial 5: Functional Higher order*	*Tutorial 8: Solution of integro-differential equation*	*Tutorial 11: Regression*	*Tutorial 14: Problems based on X and R Chart*
	SLO-2	*Tutorial 2: Solve One Dimensional Diffusion equations using Fourier Transforms*	*Tutorial 5: Functional Higher Order*	*Tutorial 8 Solution of integro-differential equation*	*Tutorial 11: Regression*	*Tutorial 14: Problems based on X and R Chart*

Duration (hour)		12	12	12	12	12
S-9	SLO-1	*Solution of One Dimensional Diffusion Equation using Fourier Sine Transform Methods*	*Geodesics*	*Introduction to Fredholm equations with separable Kernel*	*Fitting of straight line*	*Control Charts for X and S*
	SLO-2	*Solution of One Dimensional Diffusion Equation using Fourier Sine Transform Methods*	*Geodesics*	*Introduction to Fredholm equations with separable Kernel*	*Fitting of straight line*	*Control Charts for X and S*
S-10	SLO-1	*More problems in One Dimensional Diffusion Equation using Fourier Sine Transform Methods*	*Rayleigh Ritz method*	*To solve Fredholm equations with separable Kernel*	*Fitting of parabola*	*p and np chart*
	SLO-2	*More problems in One Dimensional Diffusion Equation using Fourier Sine Transform Methods*	*Rayleigh Ritz method*	*To solve Fredholm equations with separable Kernel*	*Fitting of parabola*	*p and np chart*
S-11	SLO-1	*Solution of One Dimensional Diffusion Equation using Fourier Cosine TransformMethods*	*More Examples in Ritz method*	*Iterative methods*	*Maximum likely hood estimates-method of moments*	*c chart*
	SLO-2	*Solution of One Dimensional Diffusion Equation using Fourier Cosine TransformMethods*	*More Examples in Ritz method*	*Iterative methods*	*Maximum likely hood estimates-method of moments*	*c chart*
S-12	SLO-1	*Tutorial 3: Solve One Dimensional Diffusion equations using Fourier Sine and Cosine Transforms*	*Tutorial 6: Rayleigh Ritz method*	*Tutorial 9: Fredholm equations with separable Kernel*	*Tutorial 12: Fitting of Straight line and Parabola*	*Tutorial 15 : Problems based on c and np Chart*
	SLO-2	*Tutorial 3: Solve One Dimensional Diffusion equations using Fourier Sine and Cosine Transforms*	*Tutorial 6: Rayleigh Ritz method*	*Tutorial 9 Fredholm equations with separable Kernel*	*Tutorial 12: Fitting of Straight line and Parabola*	*Tutorial 15 : Problems based on c and np Chart*

Learning Resources	1. *Gupta, S.C., & Kapoor, V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Edition 2018* 2. *Dr.B.S.Grewal., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2019* 3. *M. B. K. Moorthy, "Advanced Mathematical Methods", Yesdee Publication, 2nd Edition, 2019.*	4. *Sankara Rao, K., "Introduction to Partial Differential Equations", PHI Publishing, 3rd Edition, 2011.* 5. *B. V Ramana*, "Higher Engineering Mathematics", McGraw Hill Publication, 2017

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%) #			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	40 %	-	30 %	-	30 %	-	30 %	-
	Understand								
Level 2	Apply	40 %	-	40 %	-	40 %	-	40 %	-
	Analyze								
Level 3	Evaluate	20 %	-	30 %	-	30 %	-	30 %	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.G. Arul Joseph, Assistant Professor , SRMIST, aruljosg@srmist.edu.in	1. Dr. Y.V.S.S. Sanyasiraju, IIT Madras, Chennai sryedida@iitm.ac.in	1. Dr.A.Govindarajan, SRMIST
2. Mr.V.Maheshwaran, CTS, Chennai maheswaran@yah oo.com	2. Dr.K.C.SivaKumar, IIT Madras, Chennai kcskumar@iit m.ac.in	2. Dr. N. Parvathi, SRMIST

Course Code	20CEE501J	Course Name	Advanced Reinforced Concrete Structures	Course Category	E	Professional Elective	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	*IS 456,SP-16,ACI 318, BS 8110, IS:13920, IS: 1893*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know the basic concepts of reinforced concrete members*
CLR-2:	*Develop an idea about the design of special R.C. elements*
CLR-3:	*Familiarize with design and detailing of flat slabs and flat plates*
CLR-4:	*Limit analysis of concrete beams and cast in situ frames*
CLR-5:	*Introduce the detailing and strengthening of existing structure*
CLR-6:	*Test RC Beams in laboratory*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Evaluate design RC elements for combined shear, torsion and bending*	3	3	-
CO-2:	*Evaluate and create design of special RC elements*	3	3	-
CO-3:	*Evaluate design flat slabs and plates*	3	3	2
CO-4:	*Evaluate design beams considering moment redistribution and cast in site frames*	3	3	2
CO-5:	*Understanding of existing elements ductile detailing and seismic resistance strengthening*	3	3	2
CO-6:	*Understanding the behavior of RC beams and slabs*	3	3	2

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
S-1	SLO-1	*Review of basic concepts*	*Introduction to special R.C. elements*	*Design of flat slab*	*Limit analysis of concrete beams*	*Design and detailing of structures*
	SLO-2	*Review of basic concepts*	*Behavior of slender columns*	*Design of flat slab*	*Limit analysis of concrete beams*	*Detailing for ductility in seismic zone*
S-2	SLO-1	*Behavior of reinforced concrete members considering flexure*	*Design of slender columns*	*Design of flat slab- Interior panel*	*Moment - rotation curves*	*Detailing for ductility*
	SLO-2	*Behavior of reinforced concrete members considering flexure*	*Design of slender columns*	*Design of flat slab- Interior panel*	*Moment - rotation curves*	*Detailing for ductility*

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
S-3	SLO-1	*Torsion combined with flexure and shear*	*Check for bucking of slender columns*	*Design of flat slab- exterior panel*	*Moment curvature relationship*	*Detailing for ductility as per IS code*
	SLO-2	*Torsion combined with flexure and shear*	*Check for bucking of slender columns*	*Design of flat slab- exterior panel*	*Moment curvature relationship*	*Detailing for ductility as per IS code*
S-4, S-5	SLO-1	*Design of concrete mixes LAB - 1*	*Test on RC column LAB - 7*	*Casting of RC slab LAB - 13*	*Casting of concrete cylinders LAB - 19*	*NDT-Rebound Hammer Test LAB - 25*
	SLO-2	*Design of concrete mixes LAB - 2*	*Test on RC column LAB - 8*	*Casting of RC slab LAB - 14*	*Casting of concrete cylinders LAB - 20*	*NDT-Rebound Hammer Test LAB - 26*
S-6	SLO-1	*Axial compression*	*Design of RC Walls*	*Design of flat plate*	*Moment redistribution in continuous beams*	*Field control of concrete*
	SLO-2	*Introduction - Deflection*	*Design of RC Walls*	*Design of flat plate*	*Moment redistribution in continuous beams*	*Field control of concrete*
S-7	SLO-1	*Short term and long deflection*	*Design of shear walls*	*Design of reinforcement and edge (spandrel) beam*	*Moment redistribution in continuous beams- three span*	*Fire resistance of buildings*
	SLO-2	*Short term and long deflection*	*Design of shear walls*	*Design of reinforcement and edge (spandrel) beam*	*Moment redistribution in continuous beams- three span*	*Fire resistance of buildings*
S-8	SLO-1	*Analysis for short term and long deflection*	*Design for boundary elements*	*Yield line theory- rectangular slabs*	*Baker's method of plastic design*	*Strengthening of existing structures*
	SLO-2	*Analysis for short term and long deflection*	*Design for boundary elements*	*Yield line theory - rectangular slabs*	*Baker's method of plastic design*	*Strengthening of existing structures*
S-9, S-10	SLO-1	*Design of concrete mixes-casting LAB - 3*	*Test on RC wall LAB - 9*	*Deflection test on RC slab LAB - 15*	*Young's modulus of concrete LAB - 21*	*NDT-Ultrasonic pulse velocity test LAB - 27*
	SLO-2	*Design of concrete mixes-casting LAB - 4*	*Test on RC wall LAB - 10*	*Deflection test on RC slab LAB - 16*	*Young's modulus of concrete LAB - 22*	*NDT-Ultrasonic pulse velocity test LAB - 28*
S-11	SLO-1	*Design of crack width as per IS-456-2000*	*Design of shear walls*	*Yield line theory - triangular slabs*	*Baker's method of plastic design*	*Strengthening of existing structures-beams*
	SLO-2	*Design of crack width as per IS-456-2000*	*Design of shear walls*	*Yield line theory- triangular slabs*	*Baker's method of plastic design*	*Strengthening of existing structures-beams*
S-12	SLO-1	*Design of crack width as per IS-456-2000*	*Design of deep beams.*	*Yield line theory- square slabs*	*Cast in–situ frames.*	*Strengthening of existing structures-columns*
	SLO-2	*Design of crack width as per IS-456-2000*	*Design of deep beams.*	*Yield line theory- circular slabs*	*Cast in–situ frames.*	*Strengthening of existing structures-columns*
S-13	SLO-1	*Comparative study with BS 8110 and ACI - 318.*	*Design of corbels*	*Hillerborg's strip method*	*Design of cast in–situ frames.*	*Design and detailing of structures according to different codes*

Duration (hour)		Module 1 (15)	Module 2 (15)	Module 3 (15)	Module 4 (15)	Module 5 (15)
	SLO-2	*Comparative study with BS 8110 and ACI - 318.*	*Design of corbels*	*Hillerborg's strip method*	*Design of cast in–situ frames.*	*Design and detailing of structures according to different codes*
S-14, S-15	SLO-1	*Flexure test on RC beam LAB - 5*	*Shear test on R.C beam LAB - 11*	*Flexure test on RC slab LAB - 17*	*Impact test on concrete LAB - 23*	*Pull out test on concrete LAB - 29*
	SLO-2	*Flexure test on RC beam LAB - 6*	*Shear test on R.C beam LAB - 12*	*Flexure test on RC slab LAB - 18*	*Impact test on concrete LAB - 24*	*Pull out test on concrete LAB - 30*

Learning Resources	*1. Varghese.P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, Second Edition, 2009.* *2. Pillai.S.V and Menon.D, "Reinforced Concrete Design", Tata McGraw Hill Book Co., first Edition, 2002.* *3. Purushothaman.P. "Reinforced Concrete Structural Elements", Behavior Analysis and Design. Tata Mc Graw Hill 1986.* *4. Park.R & Paulay.T, "Reinforced Concrete Structures", John Wiley and Sons, 1975.*	*5. N. Krishnaraju, "Advanced Reinforced Concrete Design (IS 456-2000)", Second Edition, 2013.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3# (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*10%*	*10%*	*15%*	*15%*	10%	10%	*15%*	*10%*
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	20%	20%	*20%*	*20%*
Level 3	Evaluate Create	*20%*	*20%*	*15%*	*15%*	20%	20%	*15%*	*20%*
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. R. Eswaran, Chief Engineering Manager, L&T, eswaran@lntecc.com	*1. Dr. R. Santhakumar, Professor, NITTTR, rsk65@nitttrc.ac.in*	*1. Dr. R. Ravi*
2. Mr. S. Kavin Kumar, Director, EPMCR, kavinkumar@epmcr.co.in	*2. Dr. Devdas Menon, Professor, IITM, dmenon@iitm.ac.in*	*2. Dr. P.R. Kannan Rajkumar*

Course Code	20CEE502T	Course Name	Aseismic Design of Structures	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING	Data Book / Codes/Standards	IS1893 PART 1 : 2018 , IS 13920 :2018		

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Develop a basic knowledge about Engineering Seismology*
CLR-2:	*Address concepts related to past earthquakes and performance of various materials under cyclic loading*
CLR-3:	*Create insights to the various structural systems*
CLR-4:	*Address concepts related to Seismic analysis and design*
CLR-5:	*Address about computing storey displacement, drift and detailing as per Indian Standards*
CLR-6:	*Acquaint the students with studies on Damage assessment and Retrofitting Techniques*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Understand the various causes and types of earthquake*	3	2	-
CO-2:	*Able to relate materials and structural performance with respect to the past earthquakes*	2	2	-
CO-3:	*Knowledge on various structural systems*	3	3	-
CO-4:	*Able to do seismic analysis of Structure*	2	3	2
CO-5:	*Apply the concept of Ductile detailing*	2	3	2
CO-6:	*Knowledge of basic assessment and Retrofitting Techniques*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction to engineering seismology*	*Structural Systems*	*Floating Column, Pounding, Soft Storey*	*Brick masonry*	*Damage Assessment procedure*
	SLO-2	*Plate Tectonics*	*Steel and Concrete*	*Short Column Effect*	*Behavior of Brick Masonry houses during earthquake*	*Assessment techniques*
S-2	SLO-1	*Causes of Earthquake*	*Vertical Frame systems*	*Seismic Design Philosophy*	*Ductile detailing*	*Non Destructive testing*
	SLO-2	*Types of Earthquake*	*Lateral Load resistant system*	*Seismic design importance*	*Ductile detailing of reinforced concrete structures subjected to seismic forces as per code*	*NDT Methods*
S-3	SLO-1	*Types of Faults*	*Rigid Frame*	*Construction materials, Capacity Design Concept*	*Flexural members – Longitudinal reinforcement*	*Retrofitting Techniques*
	SLO-2	*Elastic Rebound Theory*	*Braced Frame and its types, Staggered truss system*	*Quality Control in Construction*	*Web reinforcement*	*Retrofitting Materials*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Tutorial 1 – Earthquake intensity*	*Tutorial 4 – Frame system*	*Tutorial 7 – Short column effect study*	*Tutorial 10 - Ductility*	*Tutorial 13 - Retrofitting*
	SLO-2					
S-5	SLO-1	*Seismic Waves*	*Interacting System of Braced and Rigid frame, Outrigger and Belt Truss system*	*Importance of Flexibility*	*Column and Frame Members subjected to Bending and Axial Load*	*Local Retrofitting*
	SLO-2	*Measuring Instruments*	*Framed tube system and Truss tube system*	*Flexibility calculations*	*Longitudinal reinforcement*	*Global Retrofitting*
S-6	SLO-1	*Strong Ground Motion and its characteristics*	*Bundle tube system, Framed wall interactive system and In filled frames*	*Indian Seismic Code and its Importance*	*Transverse reinforcement*	*Structural Control system*
	SLO-2	*Magnitude and Intensity*	*Diagrid and Tensegrity structural system*	*Estimation of design forces of multistory buildings using Bureau of Indian Standards (BIS) codes*	*Special Confining reinforcement*	*Passive Control and Active Control system*
S-7	SLO-1	*Past earthquakes in India and World*	*Shear wall system*	*Determination of Base Shear*	*Column with varying stiffness*	*Base Isolation*
	SLO-2	*Seismic Zones of India*	*Hybrid Structural System*	*Equivalent static lateral force method*	*Column stiffness cases*	*Energy Dissipative devices*
S-8	SLO-1	*Tutorial 2 – Seismic zones*	*Tutorial 5 – Structural systems*	*Tutorial 8 – Various seismic codes comparison*	*Tutorial 11 – Reinforcement judgement*	*Tutorial 14 – Energy dissipation*
	SLO-2					
S-9	SLO-1	*Seismic Effects on Structures*	*Architectural Features affects Building during earthquake*	*Dynamic Analysis*	*Joints of Frames*	*Earthquake Effects on Non Structural Elements*
	SLO-2	*Structural importance*	*Retrofitting methods*	*Response Spectrum Method*	*Shear Walls*	*Protecting Non Structural elements*
S-10	SLO-1	*Cyclic Loading*	*Horizontal and Vertical Layout of buildings*	*Evaluation of Displacements and Drift*	*Flexural Strength*	*Essential features of confined masonry house*
	SLO-2	*Performance of Various materials under cyclic loading*	*Irregular Buildings*	*Human Comfort criteria as per code*	*Boundary elements*	*Seismic Design of Foundation*
S-11	SLO-1	*Masonry, steel*	*Torsional Irregularity, Plan Irregularity, Vertical Irregularity*	*Earthquake Effects on Reinforced Concrete Buildings*	*Coupled shear wall, Opening in walls,*	*Liquefaction of soil*
	SLO-2	*Concrete and soil*	*Mass Irregularity, Diaphragm Discontinuity, Out of plane offsets, Non parallel system*	*Earthquake Effects on Steel Buildings*	*Discontinuous walls and Construction Joints*	*Quality and Earthquake safety*
S-12	SLO-1	*Tutorial 3: Cyclic loading*	*Tutorial 6 – Irregular buildings*	*Tutorial 9 – Earthquake effects*	*Tutorial 12 – Joints assessment*	*Tutorial 15 – Soil liquefaction*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2					

Learning Resources	1. *1.Paulay. Tand Priestly. M.N.J, "Aseismic Design of Reinforced Concrete and Masonry Building", John Wiley and Sons, 1987.* 2. *2.Agarwal. P, and Shrikhande. M, "Earthquake Resistant Design of Structures" Prentice Hall of India, New Delhi, 2007*	3. *3.IITK-BMTPC Earthquake Tips:: Learning Seismic Design and Construction* 4. *4.Guidelines for - "Improving Earthquake Resistance of Housing", Building Materials and Technology Promotion Council, Ministry of Urban Development and Poverty Alleviation, Department of Urban Employment and Poverty Alleviation, Government of India, New Delhi, 1999 – 2000.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	20CEE503T	Course Name	Stability of Structures	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil Engineering		Data Book / Codes/Standards	IS 2210 – 1988 Criteria for design of reinforced concrete shell structures and folded plates	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Get exposed to the concept of stability*
CLR-2:	*Understand the characteristics of stability problems and methods used for stability analysis*
CLR-3:	*Understand the behavior of short and long columns with various end conditions*
CLR-4:	*Gain knowledge on behavior of beams subjected to torsional and lateral buckling*
CLR-5:	*Determine critical load for different shape plates with different boundary conditions*
CLR-6:	*Study about geometry of shells and to gain knowledge on membrane theory of shells*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Understand the concept and characteristics of stability problems*	3	3	2
CO-2:	*Analyze columns with different end conditions*	3	3	2
CO-3:	*Know the importance of torsional and lateral buckling on behavior of structural members*	3	3	2
CO-4:	*Analyze rectangular and circular plates for buckling load*	3	3	2
CO-5:	*Identify approximate methods and application of finite difference methods for stability analysis*	3	3	2
CO-6:	*Understand the behavior of shells and identify the theory required for stability analysis of thin shells*	3	3	2

Duration (Hour)		12	12	12	12	12
S-1	SLO-1	*Introduction to Concept of stability*	*Buckling of columns*	*Torsional buckling, Shear Centre - Definition*	*Buckling of plates*	*Introduction to shells*
	SLO-2	*Types of structural instability*	*Stability analysis for eccentrically loaded column*	*Torsional stiffness of member*	*Difference in behavior of columns and behavior of plates*	*Geometry of shells*
S-2	SLO-1	*Characteristics of stability problems*	*Analysis of hinged – hinged eccentrically loaded column*	*Torsional load – deformation characteristics of member*	*Behavior of plates and types of plates*	*Shells of revolution and important terminologies in shells*
	SLO-2	*Various methods of stability analysis*	*Analysis of fixed – free eccentrically loaded column*	*Uniform torsion – Definition and example*	*Small deflection theory of thin plates*	*Classification of shells*
S-3	SLO-1	*Equilibrium method of critical load analysis - Principle*	*Analysis of fixed – hinged eccentrically loaded column*	*Non - Uniform torsion – Definition and example*	*Assumptions and principle used in small deflection theory*	*Detailed classification of stressed skin surfaces*

Duration (Hour)		12	12	12	12	12
	SLO-2	*Finding critical load for various types of columns*	*Analysis of fixed column*	*Torsion equation for uniform torsion – circular and non-circular section*	*Governing differential equation for plates – Navier's solution*	*Analysis of cylindrical shells*
S-4	SLO-1	*Tutorial: Critical load – Fixed free, fixed column*	*Tutorial: Inelastic buckling of columns*	*Tutorial: Torsion equation for non-uniform torsion*	*Tutorial: Establishing equilibrium equation of in-plane forces*	*Tutorial: Analysis of doubly curved shells*
	SLO-2	*Tutorial: Critical load - Hinged and fixed – hinged columns*	*Tutorial: Column curve, Behavior of short column*	*Tutorial: Torsional buckling – equilibrium approach*	*Tutorial: Establishing equilibrium equation of bending moment*	*Tutorial: Elastic stability of shells*
S-5	SLO-1	*Energy approach - Principle*	*Stability analysis for short columns*	*Equation for torsional buckling of columns*	*Establishing equilibrium equation of shear force*	*Causes of instability in shells*
	SLO-2	*Critical load – Hinged column (Energy method)*	*Difference in stability analysis for long and short columns*	*Derivations on torsion*	*Establishing equilibrium equation of twisting moment*	*Buckling in various types of shells*
S-6	SLO-1	*Critical load – Fixed column (Energy method)*	*Double modulus theory and tangent modulus*	*Buckling load – members subjected to combined flexural and torsional buckling*	*Derivation of governing differential equation*	*Buckling in cylindrical shells*
	SLO-2	*Finding critical load for column with given deflected shape equation*	*Effective modulus – Definition and significance*	*Lateral buckling of beams*	*Navier's solution*	*Buckling in doubly-curvedshells*
S-7	SLO-1	*Comparison on critical load expression using energy and equilibrium method*	*Tangent modulus theory – Assumptions*	*Behavior of laterally supported and unsupported beams*	*Analysis of plates for critical load*	*Buckling in folded plates and Specifications for design of Reinforced Concrete shells using IS 2210 - 1988*
	SLO-2	*Application of energy approach for stability analysis*	*Finding effective modulus – Rectangular section*	*Analysis of beam subjected to bending*	*Critical load for rectangular plate with Simply supported ends*	
S-8	SLO-1	*Tutorial: Imperfection approach*	*Tutorial: Finding effective modulus – Idealized I section*	*Tutorial: Analysis of Simply Supported rectangular beam for critical moment*	*Tutorial: Critical load for rectangular plate with clamped ends*	*Tutorial: Governing equations for analysis of shells*
	SLO-2	*Tutorial: Analysis of crooked column – Equilibrium method*	*Tutorial: Beam - column*	*Tutorial: Assumptions made and deformation for lateral buckling analysis*	*Tutorial: Critical load for circular plate with clamped ends*	*Tutorial: Membrane analysis – Governing equation*
S-9	SLO-1	*Stability analysis – Imperfection approach*	*Behavior of beam – column member*	*Deriving equation for moments*	*Application of Navier's solution in finding critical load*	*Equation for membrane analysis*
	SLO-2	*Finding maximum deflection and moment for imperfect column*	*Objectives of beam – column analysis*	*Deriving equilibrium equation for lateral torsional buckling*	*Buckling shapes of plates*	*Bending analysis - Governing equation*
S-10	SLO-1	*Importance – Imperfection approach*	*Finding maximum deflection and maximum moment*	*Finding critical moment – lateral buckling*	*Critical load for plates with various end conditions – Navier's solutions*	*Equation for bending analysis*

Duration (Hour)		12	12	12	12	12
	SLO-2	*Dynamic method of stability analysis*	*Magnification and amplification factor for beam – column member*	*Finding critical stress – lateral buckling*	*Different shapes of buckling for plates – Example*	*Membrane equilibrium with axial symmetry*
S-11	SLO-1	*Application of De-Alembert's principle for stability analysis*	*Analysis of beam – column subjected to uniformly distributed load*	*Determination of buckling load*	*Introduction to finite difference method*	*Membrane theory - Application*
	SLO-2	*Derivation of Equilibrium equation (Dynamic approach)*	*Analysis of beam – column subjected to concentric load*	*Comparison on equilibrium equation between lateral buckling and lateral-torsional buckling*	*Application of finite difference method in stability analysis of plates*	*Membrane theory for anti-symmetrically loaded shells.*
S-12	SLO-1	*Tutorial: Dynamic method*	*Tutorial: Analysis of beam – column subjected to bending*	*Tutorial: Analysis of rectangular cantilever beam for critical moments*	*Tutorial: Finding critical load for rectangular plates using finite difference method*	*Tutorial: Stability analysis for thin shells*
	SLO-2	*Tutorial: Higher order differential equation for stability analysis*	*Tutorial: Concentric load placed at unequal distances*	*Tutorial: Analysis of rectangular cantilever beam for critical stress*	*Tutorial: Finding critical load for circular plates using finite difference method*	*Tutorial: Problems on thin shells*

Learning Resources

1. *Chajes, "A Principles of Structures Stability Theory", Prentice Hall, 1974.*
2. *Allen.H.G, and Bulson.P.S, "Background to Buckling", McGraw Hill Book Company, 1980.*
3. *Brush and Almorth, "Buckling of Bars, Plates and Shells", McGraw Hill book Company, 1975.*
4. *Seely, F.B, and Smith, J.O, "Advanced Mechanics of Materials", 2nd Edition, John Wiley and Sons, Inc., New York. 1952.*
5. *Timoshenko.S, and Woinowsby - Krieger.S, "Theory of Plates and Shells", 2nd Ed. McGraw - Hill Book Co., New York 1959.*
6. *Ashwini Kumar, "Stability Theory of Structures", Tata McGraw Hill Co., New Delhi, 1985.*
7. *N G R Iyengar, "Elastic stability of structural elements", Laxmi Publications, 2007*
8. *IS: 2210 – 1988, Indian Standard - Criteria for Design of Reinforced Concrete Shell Structures and Folded Plates, New Delhi.*
9. *NPTEL Course: Finite element method for vibration and stability analyses - https://nptel.ac.in/courses/105108141/*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (20%)		CLA – 3 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	**Practice**
Level 1	Remember	20 %	-	20 %	-	20 %	-	20 %	-
	Understand								
Level 2	Apply	30 %	-	30 %	-	30 %	-	30 %	-
	Analyze								
Level 3	Evaluate	50 %	-	50 %	-	50 %	-	50 %	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. *Mr. S. Kavin Kumar, Director, EPMCR, kavinkumar@epmcr.co.in*	2. *Dr. Phanisri Pradeep Pratapa, Assistant Professor, IITM, ppratapa@iitm.ac.in*	2. *Dr. S. Sindhu Nachiar, SRMIST*

Course Code	20CEE504T	Course Name	Mechanics of Structural Composite Materials	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

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

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Introduce students with the fundamentals of composites with applications*
CLR-2:	*Familiarize with micromechanical analysis of composites with processing*
CLR-3:	*Develop the knowledge about composite lamina and laminate analysis*
CLR-4:	*Familiarize with the problems of micro and macro mechanical analysis*
CLR-5:	*Introduce the students with the concept of analysis of composite beams with eigen value problems of laminated beams*
CLR-6:	*Develop the knowledge of structural composite materials*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the fundamentals of composites with applications*	2	3	1
CO-2:	*Able to understand the micromechanical analysis of composites with processing*	2	3	2
CO-3:	*Knowledge on lamina and laminate analysis*	3	3	2
CO-4:	*Able to familiarize with the problems of micro and macro mechanical analysis*	3	3	2
CO-5:	*Apply the concept of analysis of composite beams with Eigen value problems of laminated beams*	3	3	2
CO-6:	*Evaluate Knowledge of structural composite materials*	3	3	2

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*Students will be introduced with the different definitions related to mechanics of composite materials.*	*Students will gain the concept of processing of composites.*	*Students will be introduced to the concept of micro mechanical analysis of composites.*	*Students will know the different methods of analysis of laminated plates .*	*Different terms related to analysis of composite beams will be known to them.*
	SLO-2	*They will be familiar with the concept of fiber reinforced composites.*	*Students will be able to use a concept of processing a composite.*	*Students will be familiar with the concept of micro mechanical analysis of composites.*	*They will be able to apply the concepts. For solving problems.*	*Students will learn the difference between the isotropic beam and laminated beam*
S-2	SLO-1	*Different constituents of composites will be known to the students.*	*They will learn different procedures of processing FRPs.*	*They will learn about the elastic properties of a unidirectional lamina.*	*Students will learn on the assumptions of Classical laminated plate theory.*	*Students will be able to differentiate between isotropic beam and laminated beam.*

Duration (hour)		12	12	12	12	12
	SLO-2	*Different type of fibers as reinforcing materials will be known by them.*	*Students will be able to demonstrate different processes.*	*Students will be able to use the elastic properties of unidirectional lamina for laminates.*	*They will be introduced with the parameters of analysis.*	*Students will know the basic assumptions of developing formulae for analysis of composite beams*
S-3	SLO-1	*Students will be able to distinguish between different matrices including polymeric matrix.*	*Students will learn to select particular materials for processing.*	*They will gain knowledge on stress-strain relationship and engineering constants.*	*They will be introduced with the approach of CLT for laminated plates.*	*They will know the limitations and the scope of applying formulae for analyzing composite beams.*
	SLO-2	*Different types of FRPs will be known to them for different applications.*	*Students will be able to select particular method of processing for typical applications.*	*They will be able to apply the stress-strain relationship and various engineering constants for engineering purposes.*	*Students will be able to apply the concept of the CLT for laminated plate analysis.*	*They will be able to distinguish between the plate and the composite beam problems.*
S-4	SLO-1	*Tutorial – FRP and stresses*	*Tutorial – Selection of materials*	*Tutorial – Stress-strain relationships*	*Tutorial – Laminated plates*	*Tutorial – Analytical methods*
	SLO-2					
S-5	SLO-1	*Students will be able to distinguish between unidirectional, bi-directional and multi directional laminae.*	*They will be introduced with the different moulding.*	*The stress-strain relationship of a thin lamina will be added to the concepts of students.*	*Characteristic of flexure of laminated plates are to be added to the concepts of the students.*	*Students will be introduced analysis of laminated beams*
	SLO-2	*They will be able to understand the manufacturing of laminates and their relation between lamina and laminate.*	*They will be able to select particular moulding to their requirement.*	*Students will be able to apply the concept for analysis of laminae.*	*They will have concepts on assumptions of bending theory of plates.*	*They will be able to analyze laminated beams using the formulae.*
S-6	SLO-1	*Students will be capable of understanding FRP in terms of their characteristics.*	*Student will learn about the different procedure of moulding depending on the materials.*	*Students will acquire the knowledge of laminate-strain – displacement relationship.*	*They will be able to use the concepts for developing formation for flexural analysis of laminates.*	*They will be introduced with the flexural problems with different boundary conditions.*
	SLO-2	*They will be able to identify the characteristics which makes FRPs different from other materials.*	*They will be able to select one based on the manufacturing method.*	*Students will be able to apply that for laminate analysis.*	*Students will be able to analyze the laminated plates subjected to bending.*	*They will be to solve flexural problems of composite beams for three- point problems.*
S-7	SLO-1	*Concept of micro mechanics of composite materials will be gained by the students.*	*The concept of contact moulding will be gained by the student.*	*They will conceptualize equilibrium equations and laminate stiffness.*	*Students will learn the theory of shear deformation in laminated plates.*	*They will be able to use the idea for the analysis of composite beams for fourpoint problems.*
	SLO-2	*They will be able to correlate the micro mechanics with the macro mechanics of the composite material.*	*They will be able to understand the advantages, disadvantages and applicability of contact moulding.*	*Students will be able to use those concepts to solve problems on laminates.*	*Students will be able to deal with the problem of shear deformation in laminated plates.*	*They will be able to use the knowledge to solve practical problems.*
S-8	SLO-1		*Tutorial – Moulding procedures*			*Tutorial – Boundary conditions*

Duration (hour)		12	12	12	12	12
	SLO-2	*Tutorial – Lamina and laminates*		*Tutorial – Laminate equilibrium stiffness*	*Tutorial – Theory of shear deformation*	
S-9	SLO-1	*Typical composite materials will be in their concept.*	*Students will gain the concept of Compression moulding.*	*They will learn to determine the lamina stress – strain.*	*Students will be introduced with the theory of higher order shear deformation.*	*Students will be introduced to eigen value concepts.*
	SLO-2	*They will be able to select typical composite materials as per requirement.*	*They will be able to use the concept of compression moulding for practical purposes.*	*They will be able to determine the strain and stress of lamina.*	*They will use the concept to solve the problem of higher order shear deformation of laminated plate.*	*Students will gain the knowledge about physical significance of eigen values in structural elements.*
S-10	SLO-1	*They will be able to know about the properties of typical composite materials.*	*Students will learn the process of filament winding.*	*Students will learn about coupling effects and various types of laminate configurations.*	*Basic concept of layer wise theory will be acquired by the students.*	*Students will be introduced to eigen value problems on beams made of conventional materials.*
	SLO-2	*Students will be able to differentiate between the isometric and the composite materials.*	*Students will be able to select filament winding for manufacturing as per need.*	*They will be able to demonstrate coupling effects and differentiate various types of laminate configurations.*	*They will be able to conceive the layer-wise theory.*	*Students will be gain wider knowledge on eigen value problems in structural Engineering.*
S-11	SLO-1	*Students will learn about the different applications of the composites.*	*Students will be demonstrated with the practical requirements of the methodologies for laminate composite manufacturing.*	*Students will learn about laminate engineering constants.*	*They will be able to solve problems using layer wise theory.*	*Students will be introduced to eigen value problems of laminated beams.*
	SLO-2	*They will be able to select particular composite as per the requirement.*	*Students will be capable of using typical method as per resources and requirements.*	*Students will be able to use those constants to solve problems in laminates.*	*Students will be address practical problems using layer wise theory.*	*Students will be able to apply the concepts for solving eigen value problems of laminated beams.*
S-12	SLO-1 SLO-**2**	*Tutorial – Composite materials*	*Tutorial – Moulding procedures*	*Tutorial – Coupling effects*	*Tutorial – Shear deformation cases*	*Tutorial – Laminated beams*

Learning Resources	*1. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universities Press.* *2. Jones. R.M, "Mechanics of Composite Materials", Taylor and Francis.*	*3. Kaw, Autar. K, "Mechanics of Composite Materials Taylor and Francis.* *4. Gibson. R.F, "Principles of Composite Material Mechanics", CRC Press.*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-

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

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. *Mr. A. Sivaraman, Design Manager, Utracon, sivaram@utracon.in*	2. *Prof. Yogesh desai, Professor, IITB, desai@civil.iitb.ac.in*	2. *Dr. K.S. Satyanarayanan, SRMIST*

Course Code	20CEE505T	Course Name	Concrete Technology and Special Concretes	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know about concrete characteristics*
CLR-2:	*Know about chemical and mineral admixtures used in concrete. Also understand about concrete mix design*
CLR-3:	*Know about the properties of lightweight, high strength, high performance concrete and ferrocement*
CLR-4:	*Know about the self-compacting concrete and ready mixed concrete*
CLR-5:	*Know about other special concretes: Fibre reinforced concrete, polymer concrete and blended cement concrete*
CLR-6:	*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:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the concrete characteristics*	3	3	-
CO-2:	*Evaluate the chemical and mineral admixtures used in concrete and concrete mix design without and with admixtures*	3	3	-
CO-3:	*Apply the properties of lightweight, high strength, high performance concrete and ferrocement*	3	3	2
CO-4:	*Apply the self-compacting concrete and ready mixed concrete*	3	3	2
CO-5:	*Apply the special concretes: Fibre reinforced concrete, polymer concrete and blended cement concrete*	3	3	2
CO-6:	*Understand the SIFCON, bacterial concrete, geopolymer concrete, roller compacted, recycled aggregate and reactive powder concrete.*	3	3	2

Duration (hour)		12	12	12	12	12
S-1	SLO-1	*CONCRETE CHARACTERISTICS Fresh concrete – workability – workable concrete – affecting factors – workability tests.*	*ADMIXTURES & CONCRETE MIX DESIGN Overview –Chemical and mineral admixtures – additive – plasticizers – definition – situation need high workability – effects of plasticizer in concrete.*	*LIGHTWEIGHT AND HIGH STRENGTH CONCRETE Lightweight concrete – definition – advantages.*	*SELF-COMPACTING CONCRETE Definition – Material –Example of mixes.*	*OTHER SPECIAL CONCRETES Fibre reinforced concrete - definition - basic requirements - properties of FRC - factors affecting FRC.*
	SLO-2	*Segregation – types – favourable conditions – remedies. Bleeding – effects – test.*	*Super plasticizers – effects in – fresh and hardened concrete.*	*Classifications of lightweight concrete*	*Requirements for self-compacting concrete.*	*Effects of fibre in concrete - Types of FRC - Application of FRC.*
S-2	SLO-1	*Hardened concrete. Density. Compressive strength –*	*Accelerators – accelerating plasticizer.*	*Methods for making concrete in lightweight*	*Workability requirement for fresh self-compacting concrete*	*Polymer impregnated concrete*

Duration (hour)		12	12	12	12	12
		affecting factors – test procedure.				
	SLO-2	*Flexural strength – Central point load – two-point load tests. Splitting tensile test. Stress-strain curve for concrete.*	*Retarders – use – materials. Water proofers.*	*Lightweight aggregates used in concrete*		
S-3	SLO-1	*Stress - Strain curve for cement paste, aggregate and concrete.*	*Fly ash – characteristics – use – classification –effects in fresh concrete.*	*Natural aggregates as lightweight aggregate*	*Production and placing.*	*Polymer cement concrete*
	SLO-2	*Modulus of elasticity of concrete - Different elastic moduli - Test procedure.*	*Fly ash –effects in hardened concrete.*	*Artificial aggregates as lightweight aggregate*		
S-4	SLO-1	*Shrinkage of concrete - situation leads to shrinkage - Factors affecting shrinkage*	*Silica fume – characteristics – effects in fresh concrete.*	*Industry – domestic – wastes – used in concrete*	*Mix design*	*Polymer concrete*
	SLO-2	*Causes for shrinking - Types of Shrinkage in Concrete*	*Silica fume – effects in hardened concrete.*	*Agricultural waste as aggregate in concrete*		
S-5	SLO-1	*Concrete creep - definition - Factors Affecting Creep.*	*GGBS - effects in fresh concrete*	*Use of Oil palm shell in concrete*	*Test methods*	*Partially impregnated surface coated polymer concrete Properties - Advantages - Applications.*
	SLO-2	*Effects of Creep on Concrete.*	*GGBS - effects in hardened concrete – uses.*	*Coconut shell concrete - Application of lightweight concrete.*	*Slump flow test*	
S-6	SLO-1	*Variability of concrete strength - three component sources - distribution of results - normal distribution curve - mean and standard deviation.*	*Metakaolin – application.*	*Design of lightweight concrete mix.*	*T_{50} Slump flow test.*	*Blended cement concrete - Definition - Characteristics – Types.*
	SLO-2	*Concrete quality control - Importance of quality control - Quality control application in concrete construction*	*Advantages – uses.*	*Mixing procedure for lightweight concrete production*	*J-ring test*	*Technical - Environmental - General advantages - uses.*
S-7	SLO-1	*Process of manufacturing of concrete - various stages - Batching methods - Mixing methods*	*Definition – Principle of mix design – Factors choice of mix proportion – Properties of concrete related to mix design.*	*High Strength Concrete - Definition*	*V-funnel test*	*Slurry infiltrated fibrous reinforced concrete (SIFCON) - Composition - Process - Design principles.*

Duration (hour)		12	12	12	12	12
	SLO-2	*Methods of transportation.*	*Physical properties of materials required for mix design.*	*Making of high strength concrete in general*		*Factors affecting the efficiency of SIFCON - Advantages - Disadvantages - Application.*
S-8	SLO-1	*Methods of transportation.*	*Nominal and design mix – variables in mix design.*	*Materials used for high strength concrete– Properties*	*L-box test*	*Briefly about Bacterial concrete*
	SLO-2	*Compacting - Curing - Finishing.*	*Objective of mix design – List of methods of mix design.*	*Advantages - Disadvantage – Applications of high strength concrete*	*U-box test*	
S-9	SLO-1	*Special Concreting Methods*	*Basic steps –– Information required for mix design.*	*High performance concrete – Definition.*	*Fill box test*	*Geopolymer concrete*
	SLO-2	*Cold and hot weather concreting.*	*Indian standard method of mix design- step by step mix design procedure.*	*Properties - Classification – uses of high-performance concrete.*	*GTM screen stability test*	
S-10	SLO-1	*Effects of Cold Weather on Concrete - Different conditions aspect of cold weather concreting - Precautions to be taken.*	*Mix design example : Without admixture*	*High density concrete – preparation – mixing – placing – application – advantages – disadvantages.*	*Ready mixed concrete – definition - types*	*Roller compacted concrete*
	SLO-2	*Hot Weather Concreting - Definition- Special problems - Precautions Taken*			*Information to be supplied by the purchaser*	*Smart concrete*
S-11	SLO-1	*Vacuum dewatered concrete*	*Mix design example: With chemical admixture.*	*High performance concrete - Definition - Properties - Classification - uses.*	*Information to be supplied by the producer*	*Recycled aggregate concrete*
	SLO-2	*Rate of Extraction of Water.*			*Advantages - Properties*	
S-12	SLO-1	*Under water concreting – bottom bucket method*	*Mix design example: With mineral admixture.*	*Ferrocement - Differs from conventional concrete - Definition - Materials - Mixing*	*Ready mixed concrete versus site mixed concrete*	*Reactive powder concrete*
	SLO-2	*Tremie pipe method*		*Casting Techniques - Applications and Advantages of ferrocement.*	*Limitations*	

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 (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Analyze								
Level 3	Evaluate	*50%*	-	*50%*	-	*50%*	-	*50%*	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. R. Santhakumar, Professor, Centre for Rulal Department, NITTTR, shanthakumar@nitttrc.ac.in*	*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. K.S. Satyanarayanan, SRMIST*

Course Code	20CEE506T	Course Name	Maintenance and Rehabilitation of Structures	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Provide a comprehensive knowledge on the diagnosis, assessment and material application relating to maintenance and rehabilitation of structures.*
CLR-2:	*Assess the diagnosis and extent of distress*
CLR-3:	*Arrive at the repair techniques*
CLR-4:	*Choose the appropriate material and its application*
CLR-5:	*Study strengthening and demolition of structural components*
CLR-6:	*Know about maintenance of structures*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Apply material application relating to maintenance and rehabilitation of structures.*	3	3	2
CO-2:	*Analyse the extent of distress*	3	3	2
CO-3:	*Understanding the repair techniques and fi methods*	3	3	2
CO-4:	*Evaluate the appropriate material and its application*	3	3	2
CO-5:	*Create, strengthen and demolish structural components*	3	3	2
CO-6:	*Evaluate maintenance of structures*	3	3	2

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Performance of construction materials*	*Maintenance and Diagnosis of Failure*	*Damages and their remedies*	*Materials and techniques of repair*	*Strengthening and demolition aspect*
	SLO-2	*components in actual structure*	*Failure analysis*	*Corrosion damage*	*Repairing conditions*	*General criteria*
S-2	SLO-1	*components in actual structure for strength*	*Definitions: Maintenance*	*Corrosion damage of reinforced concrete*	*Special concrete and mortar*	*Strengthening of existing structures*
	SLO-2	*components in actual structure for permeability*	*Definitions: Repair and Rehabilitation*	*methods of corrosion protection*	*Importance of materials*	*General principle of strengthening*
S-3	SLO-1	*components in actual structure for durability*	*Facets of Maintenance*	*Corrosion inhibitors*	*Importance of durability in concrete*	*Strengthening super structures*
	SLO-2	*components in actual structure for thermal properties*	*importance of Maintenance*	*corrosion resistant steels*	*Importance of water-cement ratio in concrete*	*Plating methods*
S-4	SLO-1	*Types of maintenance*	*Assessment procedure for evaluating a damaged structure*	*cathodic protection*	*concrete chemicals*	*Conversation tocomposite construction*
	SLO-2	*General Maintenance*	*causes of deterioration*	*rust eliminators*	*expansive cement*	*Post stressing*

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-5	SLO-1	*cracking effects*	*Quality assurance for concrete*	*Coatings to reinforcement*	*Polymerconcrete*	*Jacketing of existing structures*
	SLO-2	*cracking effects due to climate*	*Concrete testing*	*Case study on rust elimination*	*Polymerconcrete: characterization*	*Reinforcement addition*
S-6	SLO-1	*cracking effects due to temperature*	*Various aspects of inspection*	*Causes ofdeterioration of concrete*	*sulphur infiltrated concrete*	*Strengthening substructures*
	SLO-2	*cracking effects due to chemicals*	*Assessment procedure for evaluating a damaged structure*	*Causes ofdeterioration of steel*	*sulphur infiltrated concrete: characterization*	*Enhancing the load capacity of footing*
S-7	SLO-1	*cracking effects due to wear and tear*	*Causes of deterioration*	*Causes ofdeterioration of masonry*	*Ferro cement*	*Engineered demolition methods: Mechanical methods*
	SLO-2	*cracking effects due to erosion*	*distress diagnostictechniques*	*Causes ofdeterioration of timber*	*Ferro cement: Material characterization*	*Wrecking Ball Method*
S-8	SLO-1	*Design and construction errors*	*Structural appraisal*	*surface deterioration*	*Fiber reinforced concrete*	*Pusher Arm technique*
	SLO-2	*Major mistakes in construction*	*Economic appraisal*	*Case study on deterioration*	*Fiber reinforced concrete: Material characterization*	*Thermic Lance Technique*
S-9	SLO-1	*Effects of cover thickness*	*Diagnosis of construction failures*	*Efflorescence introduction and impacts*	*Methods of repair in concrete structures*	*Non – Explosive Demolition*
	SLO-2	*Factors determining cover thickness*	*Reasons for failure*	*Causes of Efflorescence*	*Methods of repair in steel structures*	*Concrete Sawing Method*
S-10	SLO-1	*Sustained elevated temperature*	*Failure analysis*	*preventive measures*	*Methods of repair in masonry structures*	*Deliberate Collapse Method*
	SLO-2	*IS code on elevated temperatures*	*Case studies on failures of structures*	*Case study on efflorescence*	*Methods of repair in timber structures*	*Pressure Jetting*
S-11	SLO-1	*Causes of distress in structures*	*Structure failure due to extreme loads*	*Damage remedial measures from corrosion*	*Gunite andshotcrete*	*Implosion techniques*
	SLO-2	*Construction and design failures*	*Structure failure due to elevated temperature*	*Damage remedial measures from deterioration*	*Advantages of Gunite andshotcrete*	*Non Engineering Demolition - Manual Demolition*
S-12	SLO-1	*Condition assessment and distress-diagnostic techniques*	*Failure assessment*	*Concrete and steel maintenance assessment*	*Epoxy injection*	*Safety measures during demolition operation*
	SLO-2	*Inspection and evaluating damaged structure*	*Failure forensics*	*Masonry and timber maintenance assessment*	*Materials for epoxy injection and bonding*	*Dismantling of buildings and reuse of materials/fittings fromenvironmental and financial point of view*

Learning Resources

1. *Shetty .M.S, "Concrete, Technology", Theory and Practice, S.Chand andCompany, New Delhi 2010.*
2. *Raiker .R.N, "Learning from Failures, Deficiencies in Design, Construction and Service", - R&D Centre (SDCPL), Raikar Bhavan, Bombay 1987.*
5. *Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987*
6. *Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, 1997.*

	3. *"Repair & Rehabilitation" "Compilation from The Indian Concrete Journal", - ACC- RCD Publication 2001.* 4. *"Health Monitoring of Structures" - A Proactive strategy - proceedings of theISTE sponsored short course, organized by the Department of Civil Engineering,S.R.M. Engineering College, S.R.M. Nagar, January 2003.*	7. *Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.* 8. *Dodge Woodson.R,"Concrete Structures – protection, repair and rehabilitation", Elsevier Butterworth – Heinmann, UK, 2009*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (20%)		CLA – 3 (10%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20%	-	20%	-	20%	-	20%	-
Level 2	Apply Analyze	30 %	-	30 %	-	30 %	-	30 %	-
Level 3	Evaluate Create	50%	-	50%	-	50%	-	50%	-
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. Lavina D'souza, Head, RMC, Ultratech, lavina.dsouza@adityabirla.com*	1. *Dr. J. Karthikeyan, Associate Professor, NITT, jk@nitt.edu*	1. *Dr. K.S. Satyanarayanan, SRMIST*
2. *Mr. R. Eswaran, Chief Engineering Manager, L&T, eswaran@lntecc.com*	2. *Dr.Manu Santhanam, Professor, IITM, manus@iitm.ac.in*	2. *Dr. S. Senthilselvan, SRMIST*

Course Code	20CEE507T	Course Name	Prestressed Concrete Structures	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Civil engineering		Data Book / Codes/Standards	IS 1343-2012, IS 3370 Part IV	

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Know the utilize and concepts of prestress concrete*
CLR-2:	*Understand about the tension member*
CLR-3:	*Carry out the complete design of compression members and piles*
CLR-4:	*Study analysis and design of composite beam member a*
CLR-5:	*Understand to analyze folded plates and shell*
CLR-6:	*Study analysis and design of indeterminate structures*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Analyze behavior of PSC member flexure and deflection*	3	3	-
CO-2:	*Analyze behavior of PSC member shear and tension*	3	3	-
CO-3:	*Understand the effect of compression member*	3	3	2
CO-4:	*Evaluate the concepts in performing design of composite design*	3	3	2
CO-5:	*Evaluate design of folded plates and shell*	3	3	2
CO-6:	*Evaluate moments on continuous beam and identify the concordant cable and partial prestressing*	3	3	2

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Analysis of rrestress Introduction to basic concepts of prestressed concrete*	*Design of shear, moment and torsionDesign for shear*	*Compression members Design of compression members with and without flexure*	*Composite construction Introduction of composite action , advantages and types of composite construction*	*Continuous beams: psc continuous member , advantages*
	SLO-2	*Type of psc system*				*Analysis of continuous member using theorem of three moments*
S-2	SLO-1	*Pre tensioned and post tensioned system*	*Design problem:1ultimate shear resistance of the section*	*Design:1 design a member with flexure*	*Construction methods – propped and unpropped construction.*	*Design problem:1 two span continuous member*
	SLO-2	*Analysis of psc*	*Design problem:2 design of shear reinforcement*		*Analysis of stresses in propped and unpropped construction*	
S-3	SLO-1	*Concentric and eccentric tendons*	*Design of torsion*	*Design:2 design a member without flexure*	*Design:1 design of propped section*	*Design problem:2 two span continuous member*
	SLO-2	*Stresses at transfer and service loads, analysis of stress for rectangular section*	*Design problem: design of torsion member*			
S-4	SLO-1					

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Tutorial: analysis of stress for rectangular section*	*Tutorial : design of combined bending moment, shear and torsion*	*Tutorial : design of flexure member as per is-1343*	*Tutorial : design:2 design of unpropped section*	*Tutorial : design and concept of linear transformation*
S-5	SLO-1	*Design problem: analysis of stress for symmetrical i- section*	*Design procedure, behaviours*	*Design:1 design a rectangular section*	*Design a composite section with differential in shrinkage*	*Concordant tendon profile*
	SLO-2			*Design :2 design of t section*	*Design :1 design of cast in situ slab with shrinkage*	
S-6	SLO-1	*Deflection Deflection of PSC member(is)*	*Design problem:1 combination of moment, shear and torsion*	*Design:3 design a unbonded section Example: retanagular and t-section*	*Deflection of composite member - design*	*Design: analysis of concordant cable for continuous beam*
	SLO-2	*Short term deflection: uncracked member*				
S-7	SLO-1	*Design problem 1:*	*Water tanks: design of prestressed concrete water tanks*	*Piles, PSC piles, advantages, types, application of PSC piles*	*Design of composite section*	*Cap cables*
	SLO-2					*Introduction of moment re distribution*
S-8	SLO-1	*Tutorial : long term deflection: cracked member*	*Tutorial : design procedure for water tank*	*Tutorial : design of PSC piles*	*Tutorial : design:1analysis of eccentricity and prestressing force*	*Tutorial : design of moment re distribution*
	SLO-2					
S-9	SLO-1	*Design problem 1: deflection due to creep, shrinkage*	*Design of water tank: cylindrical water tank type1*	*Pile reinforcement detail*	*Folded plates Introduction, types of folded plates, slab action, plate action*	*Design : beam member 1*
	SLO-2					
S-10	SLO-1	*Design problem 2: deflection due to creep, shrinkage and temperature*	*Design of water tank: cylindrical water tank type 2*	*Design:1 design of pile*	*Design: folded plate design*	*Design : beam member 2*
	SLO-2					
S-11	SLO-1	*Design of end blocks, stress distribution in end block*	*Pipes: design of PSC pipes*	*Design:2 design of pile*	*Shell: introduction, advantages, types of shells*	*Partial prestressing Introduction of partial prestressing*
	SLO-2			*Crack and crack width of PSC*		
S-12	SLO-1	*Tutorial : Anchorage zone stress- is method*	*Tutorial : Design of cylinder and non cylinder pipes*	*Tutorial : Design of crack width*	*Tutorial : Circular cylindrical shell*	*Tutorial : Design of partial PSC member*
	SLO-2					

Learning Resources	1. *Krishna Raju.N "Prestressed Concrete", 6th Edition, Tata McGraw Hill Publishing Co. chennai 2018* 2. *Sinha .N.C & S.K. Roy, "Fundamentals of Prestressed Concrete S.Chand & Co., 1985* 3. *Lin .T.Y. "Design of Prestressed Concrete Structures", John Wiley and Sons - Inc –2010.* 4. *Rajagopalan.N. "Prestressed Concrete", 2th Edition, Alpha Science International, Limited, 2005* 5. *IS: 1343-2012 "IS Code of Practice for Prestressed Concrete", BIS, New Delhi, 2012.*	6. *Leonhardt.F. "Prestressed Concrete Design and Construction" Edition Wilhelm Ernst & Sohn, Berlin, 1964* 7. *Guyon .V. "Limit State Design of Prestressed Concrete", Applied Science Publishers, London 1995* 8. *Dayaratnam.P., "Prestressed Concrete", Tata McGraw Hill Publishing .* 9. *https://nptel.ac.in/courses/105106117/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3# (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	20 %	-	20 %	-	20 %	-	20 %	-
Level 2	Apply Analyze	40 %	-	40 %	-	40 %	-	40 %	-
Level 3	Evaluate Create	40 %	-	40 %	-	40 %	-	40 %	-
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. A. Sivaraman, Design Manager, Utracon, sivaram@utracon.com*	1. *Dr. Amlan Kumar Sengupta, Professor, IITM, amlan@iitm.ac.in*	1. Dr. K.S. Satyanarayanan,SRMIST
2. *Mr. V.N.Ramakkrishnan, Head, Business development, CCCL, bd@ccclindia.in*	2. *Mr. R. Jayasankar, Associate Professor, NITT, rj@nitt.edu*	2. Ms C. Sudha, SRMIST

Course Code	20CEE601T	Course Name	Design of Steel-Concrete Composite Structures	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	20CEC502T/20CEC504J	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING		Data Book / Codes/Standards	IS 456 :2000, IS 800: 2007, IS 11384, Steel Tables	

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know the concept of steel-concrete composite member design and to get introduced to the relevant IS codes*
CLR-2:	*Create insights to the concepts of Limit state method of design*
CLR-3:	*Utilize the concepts in performing design of steel-concrete composite beams,slabs and columns*
CLR-4:	*Utilize the concepts in performing design of steel-concrete composite connections*
CLR-5:	*Understand the behavior of composite girder bridges*
CLR-6:	*Create insights to the seismic behaviour of composite structures*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the effect of external loads on steel-concrete composite members and the factors influencing their behaviour and to get familiarity with the relevant IS codes*	3	3	2
CO-2:	*Analyze the behavior of steel-concrete composite sections under flexure, shear and compression*	3	3	2
CO-3:	*Evaluate Limit state method of design to steel-concrete composite beams,slabs and columns*	3	3	2
CO-4:	*Evaluate Limit state method of design to steel-concrete composite connections*	3	3	2
CO-5:	*Analyze the behavior of steel-concrete composite girder bridges*	3	2	-
CO-6:	*Analyze the seismic behaviour of composite structures*	3	2	-

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction Introduction to Steel - Concrete Composite Construction-Advantages-Limitations*	*Design Of Steel-Concrete Composite Members Design of Composite beams and slabs*	*Design Of Steel-Concrete Composite Connections Introduction*	*Design Of Steel-Concrete Composite Girder Bridges Introduction*	*Seismic Behaviour Of Steel-Concrete Composite Structures Introduction*
	SLO-2	*Materials to be used-Structural advantages-Factors deciding selection of materials*	*Design Procedure*	*Types of Connections*	*Types-Comparison with conventional bridge types*	*Basic concepts*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-2	SLO-1	*Introduction to steel - concrete composite codes/standards*	*Relevant BIS code provisions*	*Types of Connections*	*Materials to be used*	*General design criteria*
	SLO-2	*Limitations of using BIS codes-Introduction to Eurocode 4*	*Choice of cross-sections*	*Choice of Connections in Composite structures*	*Types of cross-sections*	*General design criteria*
S-3	SLO-1	*Theory of composite structures*	*Design of Composite Trusses*	*Behaviour of Connections in Composite structures*	*Basic Design concepts*	*Relevant BIS Code provisions*
	SLO-2	*Behaviour of composite beams and slabs*	*Design Procedure*	*Basic concepts*	*Basic Design concepts*	*Seismic behavior of composite beams*
S-4	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
S-5	SLO-1	*Behavior of composite beams and slabs*	*Relevant BIS code provisions*	*Relevant BIS Code provisions*	*Configurations*	*Seismic behavior of composite beams*
	SLO-2	*Behavior of composite columns*	*Choice of cross-sections*	*Design procedure*	*Examples*	*Seismic behavior of composite slabs*
S-6	SLO-1	*Behavior of composite columns*	*Design of Composite Columns*	*Design Example 1*	*Behavior of girder bridges*	*Seismicbehavior of composite slabs*
	SLO-2	*Limit state method of design of steel-concrete composite sections under flexure-code provisions*	*Design Procedure*	*Design Example 1*	*Behavior of girder bridges*	*Seismic behavior of composite columns*
S-7	SLO-1	*Limit state method of design of steel-concrete composite sections under shear- code provisions*	*Relevant BIS code provisions*	*Design Example 2*	*Basic design considerations*	*Seismic behavior of composite columns*
	SLO-2	*Limit state method of design of steel-concrete composite sections under compression- code provisions*	*Choice of cross-sections*	*Design Example 2*	*Basic design considerations*	*Seismic behavior of composite connections*
S-8	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
S-9	SLO-1	*Example 1*	*Design Example 1*	*Design of Shear Connections*	*Failure types*	*Seismic behavior of composite trusses*
	SLO-2	*Example 1*	*Design Example 1*	*Basic concepts*	*Failure types*	*Seismic behavior of composite trusses*
S-10	SLO-1	*Example 2*	*Design Example 2*	*Relevant BIS Code provisions*	*Relevant code provisions*	*Design methods*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Example 2*	*Design Example 2*	*Design procedure*	*Mandatory checks*	*Case Studies*
S-11	SLO-1	*Example 3*	*Design Example 3*	*Design Example 1*	*Case Studies*	*Strengthening measures*
	SLO-2	*Example 3*	*Design Example 3*	*Design Example 2*	*Case Studies*	*Introduction to Sandwich Construction*
S-12	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*

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

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr.G.V.Ramarao, Sr. Scientist, CSIR-SERC, ramarao@serc.res.in	*1. Prof.S.ArulJayachandran, IITM, Chennai, aruls@iitm.ac.in*	*1. Prof.G.AugustineManirajPandian, SRMIST*
2. Mr. S. Parthiban, Engineering Manager, spb@Intecc.om	*2. Prof. S. R.Satish Kumar, IITM,Chennai, kim@iitm.ac.in*	*2. Prof. N.Umamaheswari, SRMIST*

Course Code	20CEE602T	Course Name	Offshore Structures	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING			Data Book / Codes/Standards	API RP 2A

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Develop intermediate level knowledge about offshore structures and design principles*
CLR-2:	*Address concepts related to wave generation process*
CLR-3:	*Create insights to different types of offshore structures foundation and structural modelling*
CLR-4:	*Address concepts related to foundation analysis and dynamics of offshore structures*
CLR-5:	*Address concepts of offshore elements, piping and failure issues*
CLR-6:	*Acquaint the students with case studies on failure issues*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Understanding the development of the knowledge of wave generalized process and wave theories*	3	3	-
CO-2:	*Understanding the forces acting on offshore structure*	3	3	-
CO-3:	*Creating an idea about foundation and structural modeling*	3	3	2
CO-4:	*Familiarize with the evaluation of foundation analysis and dynamics of offshore structures*	3	3	2
CO-5:	*Design of evaluation offshore structures with failure probability*	3	3	2
CO-6:	*Assess the knowledge of basic environmental legislations*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Review of basic fluid mechanics*	*Physical properties of seawater, types of ocean waves and their importance*	*Classification of marine soils and relative distribution*	*Fundamentals of Newtonian Mechanics: Newton's laws, impulse and momentum*	*Types of offshore structures and conceptual development*
	SLO-2	*Fluid kinematics*	*Ocean currents, circulation and basin oscillation*	*Characteristics of marine deposits in the Indian sub-continent*	*Fundamentals of Newtonian Mechanics: angular momentum, work and energy, systems of particles.*	*Analytical models for jacket structures*
S-2	SLO-1	*Introduction to wave mechanics*	*Geomorphology and structures of ocean floor*	*Engineering behavior of marine soils*	*Fundamentals of Analytical Mechanics: Degrees of freedom, generalised coordinates*	*Materials and their behaviour under static loads*
	SLO-2	*Wave generation by wind*	*Marine sediments and formation, types, distribution*	*Strength and deformation behavior under static and cyclic loading*	*Stationary value of a definite integral, principle of virtual work*	*Materials and their behaviour under dynamicloads*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-3	SLO-1	*Small amplitude wave theory: formulation and solution*	*Wave forces*	*Offshore soil investigation*	*Truss Element: Mathematical model*	*Various design methods and Code Provisions*
	SLO-2	*Small amplitude wave theory: wave celerity, length and period, classification based on relative depth*	*Morison Equation*	*General characteristics of offshore soil exploration*	*Truss Element: Discrete model*	*Statutoryregulations*
S-4	SLO-1	*Small amplitude wave theory: orbital motions and pressure*	*Wave force on a Circular cylinder*	*In-situ determination of strength of submarine soils*	*Structural matrix analysis for truss structures in 2D*	*Operational loads*
	SLO-2	*Standing waves, wave trains and energy*	*Wave force on a Vertical Cylinder*	*Penetrometer, piezocone, vane and pressure meter techniques*	*Basic concepts of the Finite Element Method*	*Environmental loads due to wind, wave, current and buoyancy*
S-5	SLO-1	*Wave reflection, refraction and diffraction*	*Wave force on an inclined and oscillating cylinder*	*General reconnaissance procedure for installation of fixed structures (gravity and piled type)*	*Beam Element: Mathematical model*	*Principles of Static and dynamic analyses of fixed platforms*
	SLO-2	*Breaking of waves*	*Application of wave forces*	*General reconnaissance procedure for installation offloating structures, sea bed anchors and submarine pipelines.*	*Beam Element: Discrete model*	*Use ofapproximate methods*
S-6	SLO-1	*Finite amplitude waves and theory*	*Wave forces on submarine pipelines*	*Foundations for Gravity Structures: Types of gravity structures*	*Equilibrium and energy method for buckling and post-buckling analysis of single degree-of-freedom rigid systems*	*Design issues and rectifications*
	SLO-2	*Higher order wave theories*	*Pipelines in proximity to seabed*	*Foundations for Gravity Structures:Installation techniques, Movement of gravity structures*	*Applications and problems on SDOF*	*Design of structural elements, mooring cables and pipelines*
S-7	SLO-1	*Stokes wave theory*	*Pipelines near the shore*	*Stressdistribution beneath gravity structures*	*Equilibrium and energy method for buckling and post-buckling analysis of Multi degree-of-freedom rigid systems*	*Design of platforms*
	SLO-2	*Cnoidal wave theory, Solitary wave theory*	*Pipelines within the zone of wave influence*	*Stability of gravity structures under static andcyclic loads*	*Applications and problems on MDOF*	*Problems on platform design*
S-8	SLO-1	*Wave interaction with currents*	*Froude krylov theory*	*Foundations for jack up platforms: Types of jack up platforms*	*Equilibrium approach for buckling of continuous systems*	*Design of helipad*
	SLO-2	*Wave pressure and interaction with land*	*Problems on Froude krylov theory*	*Piles and mat supported*	*Equilibrium approach for buckling of continuous Beam systems*	*Problems on helipad design*
S-9	SLO-1	*Wave slamming*	*Diffraction theory*	*Axial and lateral load capacity of piles*	*Equilibrium approach for buckling of continuous Frame systems*	*Introduction to tubular joints and possible modes of failure*
	SLO-2	*Wave slapping*	*Close form solutions of cylinder*	*Lateral load deformationbehaviour of piles*	*Problems on frame buckling systems*	*Eccentric connections and offset connections*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-10	SLO-1	*Sea general structure and geological feature*	*Close form solutions of large fixed vertical cylinder*	*Design considerations of pile foundations*	*Equilibrium approach for buckling of continuous Truss systems*	*Fatigue of tubular joints*
	SLO-2	*Sea as a stationary random process*	*Wave forces on sea walls*	*Calculation of bearing capacity of piles with API RP 2A guidelines*	*Problems on truss buckling systems*	*Fatigue behaviour*
S-11	SLO-1	*Wave Spectral Density*	*Wave forces on breakwaters*	*Modelling of offshore structures*	*Buckling analysis via stiffness matrix method*	*Corrosion - Corrosion mechanism - Types of corrosion*
	SLO-2	*Mathematical spectrum models*	*Applications of wave force regimes*	*Response of offshore structures*	*The geometric stiffness matrix*	*Offshore structure corrosion zones – Biological corrosion - Preventive measures of Corrosion*
S-12	SLO-1	*Short term wave statistics*	*Different types of loads acting on offshore structures*	*Single and Multiple Degrees of Freedom*	*Offshore analytical problems*	*Principles of cathodeprotection systems*
	SLO-2	*Applications of wave spectrum*	*Load visualization*	*Dynamic characteristics and amplification factor*	*Offshore analysis and techniques*	*Sacrificial anode method and impressed current method*

Learning Resources	*1. Ocean Structures and Materials: Video Course – NPTEL* *2. Dean, R.G., and Darlymple, R.A., Water Wave Mechanics for Engineers andScientists, Prentice Hall, Inc. 1993.* *3. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer Verlag, 1987.* *4. Reddy. DV, and Arockiasamy M, "Offshore Structures", Vol.1, Krieger Publication Company, Malabar, Florida, 1991.*	*5. Dawson, T. H., Offshore Structural Engineering, Prentice Hall, 1983.* *6. API RP 2A., Planning, Designing and Constructing Fixed Offshore Platforms, API.* *7. Graff, W. J., Introduction to Offshore Structures, Gulf Publ. Co.1981.* *8. Wilson, J. F., Dynamics of Offshore Structures, John Wiley, 2002.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	-	*20%*	-	*20%*	-	*20%*	-
Level 2	Apply Analyze	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 3	Evaluate Create	*50%*	-	*50%*	-	*50%*	-	*50%*	-
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. Vijayanandan, Head, Technical, Taamaesek Engineering Consortium, vijayanandan@taamaesek.com*	1. *Dr. S. Nallayarasu, Professor, DOE, IITM - nallay@iitm.ac.in*	1. *Dr. S. Senthilselvan, SRMIST*
2. *Mr. G. Jayaramalingam, Head, Civil & Structural, Reliance Retail Limited, jaya.ramalingam@ril.com*	2. *Dr.Santosh G Thampi , Professor (HAG), NIT Calicut - santosh@nitc.ac.in*	2. *Mr. A. Vijay, SRMIST*

Course Code	20CEE603T	Course Name	Experimental Techniques and Instrumentation	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Give students an understanding about the experimental techniques and instrumentation in engineering fields*
CLR-2:	*Understand force and strain measuring instruments*
CLR-3:	Introduce various devices that are used for vibrating systems
CLR-4:	Familiarize with sound and wind flow measurement
CLR-5:	*Apply the concept of nondestructive testing*
CLR-6:	*Understand modern experimental techniques*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*To familiarize with force and strain measurement devices*	3	3	-
CO-2:	*Understand the concept of instruments used for vibration measurement and stress*	3	3	-
CO-3:	*Understand model analysis, data acquisition systems and wind tunnel studies*	3	3	2
CO-4:	*Able to evaluate distress in a structure and NDT methods*	3	3	2
CO-5:	*Able apply nondestructive testing according to requirement*	3	3	2
CO-6:	*Able to apply use of modern experimental techniques*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	FORCE AND STRAIN MEASUREMENTS Introduction to force measuring instruments	STRESS AND VIBRATION MESUREMENT Photoelasticity effect Wave theory of light White and monochromatic light polarised light	RECORDING ACOUSTICS AND WIND FLOW EASUREMENT Cathode ray oscilloscope (CRO) components	DISTRESS MEASUREMENTDistress – types - causes	SPECIAL MEASUREMENT TECHNIQUESMoire fringes – principle purpose- example
	SLO-2					
S-2	SLO-1	Jacks - types	Plane and circular polariscopes isoclinics and isochromatics	X-Y plotter-Chart plotterSound level meter	Defects – concrete –steel Cracks classification	Holography -HologramsRecording set up Single and double exposure
	SLO-2	Load cells types				
S-3	SLO-1	Proving ringsCalibration of instruments Resultanalysis.	Stress optic law result analysis	Data acquisition system principle and applications	Crack measurement—crack meter-monitor	Use of laser for structural testing
	SLO-2					
S-4	SLO-1	Tutorial on Load cells types	Tutorial on stress optics	Tutorial on CRO	.Tutorial on crack measurement	Tutorialon structural
	SLO-2					
S-5	SLO-1					Prototype testing - necessity

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	Strain gauges-characteristics Introduction to types of strain gaugesSelection criteria-applications	Vibration-effects-types characteristics of structural vibration -Vibration meter,analyser and exciter	Wind tunnel principle need – working of wind tunnel	Cracking due to corrosion-mechanism of cracking	Structural element testing
S-6	SLO-1	Electrical strain gaugesResistance gauges	Seismic waves-seismograph	Applications and uses of wind tunnel	Half-cell – principle – equipment – test procedure	Transmission tower testing Station arrangement-technical specification Assembling
	SLO-2					
S-7	SLO-1	Gauge factor-strain gauge tructure	Linear variable differential transducer (LVDT) principle-construction-operation	Model-Prototype Objective of model studies	NDT Rebound hammer –principle test procedure -application -	Damage assessment procedure – Flow chart
	SLO-2					
S-8	SLO-1	Tutorial on strain gauge	Tutorial on LVDT	Tutorial on model studies	Tutorial on NDT	Tutorial on damage assessment
	SLO-2					
S-9	SLO-1	Strain gauge circuitsWheatstone bridge circuit Potentiometer circuit	LVDT advantages-disadvantages and applications .	Similitude	Ultrasonic pulse velocity (UPV) test principle equipment- application	Demolition reason steps before demolition
	SLO-2					
S-10	SLO-1	Strain gauge configuration	Transducers-classification Velocity transducer-types	Classification of model studies Necessity	Brittle coating - Coating stress - crack detection	Principle of dismantling –methods – demolition techniques
	SLO-2	Advantages of electrical resistance strain gauges				
S-11	SLO-1	Strain gauge data analysis	Accelorometer-transducer-principlePressure transducer	Necessity - difficulties in model studies	Advantages and disadvantages of brittle coating	Controlled blasting for demolition advantages and disadvantages
	SLO-2					
S-12	SLO-1	Tutorial on strain gauge	Tutorial Pressure on accelerometer	Tutorial on similitude	Tutorial on coating stress	Tutorial on demolition techniques
	SLO-2					

Learning Resources	1. *Model analysis of structures –Dr.T.P.Ganesan- University press* 2. *Experimental stress analysis –Sadhu singh- Khanna publishers* 3. *Non-Destructive evaluation –Bray and Stanely-McGraw Hill Publishing company*	4. *Experimental stress analysis –Lecture Notes-Dr.M.Lakshmipathy ,A.U.1985* 5. *5.Experimental stress analysis - L.S. Srinath et al-Tata McGraw Hill company*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20 %*	-	*20%*	-	*20%*	-	*20%*	-

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

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. D. Manoj Kumar, Managing Partner, Mukesh Associates, manojkumar@mukeshassociates.com, salemmanoj@gmail.com*	1. *Dr. Rupen Goswami, Associate Professor, IITM, rg@iitm.ac.in*	1. *Dr. K. Gunasekaran,SRMIST*
2. *Dr. G.V. Ramarao, Sr. Scientist, CSIR-SERC, ramarao@serc.res.in*	2. *Dr. S. R. Satishkumar, Professor, IITM, kim@iitm.ac.in*	2. *Mr. G. Vimalanandan, SRMIST*

Course Code	20CEE604T	Course Name	Design of Reinforced Concrete Foundations	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING			Data Book / Codes/Standards	IS 456-2000,SP-16 Charts, IS 2950 Part – I, Transmission Line Tower Charts

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Know the structural aspects of footings and raft foundations*
CLR-2:	*Familiarize in the design of strap footings*
CLR-3:	*Improving the knowledge on design of pile and well foundations and understand the methodologies to solve different type of pile caps*
CLR-4:	*Analyse the behavior of annular footings*
CLR-5:	*Familiarize in understanding the fundamentals of machine foundations and design the various types of machine foundations*
CLR-6:	*Improve the knowledge in the design of foundation for towers.*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Solve the foundation for structures based on the different soil conditions and evaluation*	3	3	-
CO-2:	*Evaluate and interpret the advantages of using four pile cap over three pile cap*	3	3	-
CO-3:	*Evaluate the design of under reamed pile foundation*	3	3	2
CO-4:	*Understanding the computational analysis of beams on flexible foundations*	3	3	2
CO-5:	*Analyze and design the foundation for machines*	3	3	2
CO-6:	*Apply Limit state method of design to tower foundations*	3	3	2

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Review of limit state design of reinforced concrete*	*Introduction to pile foundation*	*Principles of Structural Design of flat slab rafts*	*Introduction to well foundations*	*Introduction to machine foundations*
	SLO-2	*Comparison between LSM and WSM*	*Introduction to different types of pile foundation*	*Determination of thickness of raft slab*	*Applications of well foundation*	*Classification of machine foundation*
S-2	SLO-1	*Principles of Structural design of isolated footings*	*Design of underreamed pile foundations*	*Principles Structural Design of flat slab rafts*	*Different types of well foundation*	*Design of Rotary type of machine foundation*
	SLO-2	*Principles of Structural design of isolated square footings without pedestal*	*Design of compound wall using underreamed pile foundation*	*Design of raft slab for bending*	*Physical characteristics – shape and size of well foundation*	*Design for amplitude*
S-3	SLO-1	*Principles of Structural design of isolated footings – square with pedestal*	*Design of pile foundation*	*Design of raft slab for shear*	*Components of well foundation*	*Design for natural frequency*

	SLO-2	*Design of footings for shear and bending*	*Determining the uplift capacity of pile*	*Detailing of reinforcement for raft slab*	*Principle use of steining, intermediate plug etc., in well foundation*	*Detailing ofreinforcement*
S-4	SLO-1	*Principles of Structural design of isolated rectangular footings*	*Principles of design of pile foundation on clayey soil*	*Principles of Structural Design of mat foundation with beam and slabs*	*Shifts and tilt in well foundation*	*Design of multiple machines on single foundation block*
	SLO-2	*Design of isolated rectangular footings without pedestal*	*Structural Design of Pile foundation*	*Proportioning of raft slab and beam*	*Remedial measures for the tilt and shift in well foundation*	*Proportioning of foundation block*
S-5	SLO-1	*Principles of Structural design of isolated rectangular footings with pedestal*	*Structural Design of two pile cap*	*Design of raft slab for shear*	*Stability check for well foundation*	*Design for natural frequency and amplitude*
	SLO-2	*Design of isolated rectangular footings for shear and bending*	*Structural Design of two pile cap for bending and shear*	*Design of raft slab for bending*	*Check for buoyancy*	*Detailing of reinforcement*
S-6	SLO-1	*Principles of Structural design of isolated footings with biaxial moment*	*Structural Design of three pile cap*	*Design of mat foundation for bending in raft beams*	*Design of well curb in well foundation*	*Design of Impact Machine foundation*
	SLO-2	*Computation of soil pressure at the corners of the footings*	*Structural Design of three pile cap for bending*	*Design of mat foundation for shear foundation in raft beams*	*Design of cutting edge in well foundation*	*Design for amplitude*
S-7	SLO-1	*Principles of Structural design of Combined foundation- Proportioning*	*Design of three pile cap for shear*	*Structural Design of raft combined with pile foundation in basement floors*	*Design of well cap in well foundation*	*Design for natural frequency*
	SLO-2	*Structural design of Combined foundation for resultant of loads*	*Detailing of reinforcements for pile cap*	*Design of mat slab for shear foundation in raft slabs*	*Design of bottom plug in well foundation*	*Detailing of reinforcement*
S-8	SLO-1	*Structural design of Combined foundation for bending*	*Structural Design of four pile cap*	*Design of mat slab for bending in raft slabs*	*Design of intermediate plug in well foundation*	*Introduction to steel tower*
	SLO-2	*Structural design of Combined foundation for shear and detailing*	*Structural Design of four pile cap for bending and shear*	*Check for uplift force due to water pressure in the design of mat slab*	*Design of steining in well foundation*	*Various forces on steel tower*
S-9	SLO-1	*Principles of Structural design of Strip footing- Proportioning*	*Design of four pile cap based on strut and tie method*	*Design of mat foundation for transfer of force in the footing*	*Analysis of flexible beams on elastic foundations*	*Introduction to different types of tower foundations*

	SLO-2	*Structural design of Strip footing for resultant of loads*	*Detailing of the four pile cap*	*Detailing of reinforcement for mat foundation*	*Different methods to analyse the well foundation*	*General design criteria for tower foundations*
S-10	SLO-1	*Structural design of Strip footing for bending*	*Design of in filled virendeel frame foundations*	*Design of foundation for Chimneys*	*ACI Method of analysis of flexible beams on elastic foundations*	*Structural design of tower foundations*
	SLO-2	*Structural design of Strip footing for shear and detailing*	*Continued*	*Design for wind pressure on chimneys*	*Continued*	*Design for uplift*
S-11	SLO-1	*Principles of Structural design of Strap footing-Proportioning*	*Principles in design of base plate, pedestal and anchor bolts for columns subjected to large eccentricity*	*Proportioning of foundation to avoid eccentricity*	*Analysis of flexible plates on elastic foundations*	*Design for downward load*
	SLO-2	*Structural design of Strap footing for resultant of loads*	*Design of base anchor bolts for columns*	*Design of foundations for shear*	*Continued*	*Design for shear*
S-12	SLO-1	*Structural design of Strap footing for bending*	*Design of pedestal subjected to large eccentricity*	*Design for bending in foundation for chimneys*	*Analysis of flexible plates on elastic foundations*	*Design for biaxial moments*
	SLO-2	*Structural design of Strap footing for shear and detailing*	*Design of foundation for the pedestals*	*Detailing of reinforcement of chimney foundation*	*Continued*	*Detailing of reinforcements*

Learning Resources	1. Varghese.P.C, "Design of Reinforced Concrete Foundations", Prentice Hall of India Pvt. Ltd, 2009. 2. UnnikrishnaPillai.S and DevadasMenon, "Reinforced Concrete Design," Tata MacGraw Hill Publishing Company Limited, Third, New Delhi, 2012. 3. Vazirani.V.N and Ratwani.M.M, "Design of Reinforced concrete Structures", 16th Edition, Khanna Publishers, New Delhi.	4. Kurien .N.P, "Design of foundation systems-Principles and Practices", 3rd Edition, Alpha Science International, 2005. 5. Subramanian.N, "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi, 2013. 6. Punmia.B.C, Ashok Kumar Jain,A run Kumar Jain, Limit State Design of Reinforced Concrete,1st edition, Laxmi Publications Pvt. Ltd., 2007

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20 %*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								

Level 3	Evaluate Create	*40 %*	-	*40%*	-	*40 %*	-	*40 %*	-
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Course Code	20CEE605T	Course Name	Design of Bridges	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Civil Engineering*		**Data Book / Codes/Standards:**	*IRC 6-2014, IRC21-2000, IRC 83-1999(PART-I), IRC 83-2015(PART-II), IRC 112-2011, IS 456:2000, PIGEAURDS CHART, IRC 22-2000, IS 1342-2012, IS 800:2007*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Get exposed to the design aspects of various types of Bridges.*
CLR-2:	*Study the various types of loads*
CLR-3:	*Design the slabs and T beam Bridges*
CLR-4:	*Design the balanced cantilever, Arch bridge, Prestressed and Composite bridges*
CLR-5:	*Study the various types of bearings and expansion joins*
CLR-6:	*Design the bearings and Substructure*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the various types of bridges and calculate the design discharges*	3	3	2
CO-2:	*Understand the various types of Loads*	3	3	2
CO-3:	*Evaluate the knowledge on design of slab Bridges with various methods*	3	3	2
CO-4:	*Able to evaluate the design the long span bridges*	3	3	2
CO-5:	*Apply knowledge and basis of Bearings, Expansion joints and Sub structures*	3	3	2
		3	3	-

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction And Investigation For Bridges*	*Loads on Bridges*	*Slab and T - Beam Bridges*	*Long Span Bridges*	*Bearings and Substructure*
	SLO-2	*Introduction And Investigation For Bridges*	*Indian Road Congress (IRC) bridge codes*	*Introduction*	*Hollow girder bridges*	*Design of bearings for slab*
S-2	SLO-1	*Classification - Need for investigation*	*Indian Road Congress (IRC) bridge codes*	*Design of slab bridges- Introduction*	*balanced cantilever bridge*	*Problems in Bearings*
	SLO-2	*-Bridge site - Data collection*	*dimensions - dead and live loads*	*Problems in design of slab bridge*	*Problems in Balanced Cantilever bridge*	*Design of bearings for slab*
S-3	SLO-1	*design discharge*	*impact effect*	*Problems in design of slab bridge*	*Problems in Balanced Cantilever bridge*	*Design of bearings for slab*
	SLO-2	*Problems in Design Discharge*	*wind and seismic forces*	*skew slab culverts - box culverts- Introduction*	*continuous girder bridges -*	*Design of bearings for slab*

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Tutorial for Design Discharges*	*Tutorial for Loads*	*Tutorial for Slab Bridges*	*rigid frame bridges*	*Tutorial for Bearings*
	SLO-2	*Tutorial for Design Discharges*	*Tutorial for Loads*	*Tutorial for Slab Bridges*	*rigid frame bridges*	*Tutorial for Bearings*
S-5	SLO-1	*Problems in Design Discharge*	*longitudinal and centrifugal forces*	*Design Procedure for skew slab culvert and box culvert slab*	*Tutorial for Balanced Cantilever Bridge*	*Design of bearings for slab*
	SLO-2	*Problems in Design Discharge*	*hydraulic forces*	*T - beam bridges - Pigeaud curves- Introduction*	*Tutorial for Arch Bridge*	*girder, skew bridges*
S-6	SLO-1	*linear waterway*	*earth pressure*	*Problems using Pigeaud curve*	*arch bridges*	*girder, skew bridges*
	SLO-2	*Problems in Linear Water way*	*temperature effect and secondary stresses*	*T - beam bridges - Pigeaud curves- Introduction*	*Problem in Arch Bridge*	*Design of piers*
S-7	SLO-1	*Tutorial for Linear Water way*	*Tutorial for Live load Calculations*	*Tutorial for T Beam Bridges*	*bow string girder bridges. - Theory*	*Tutorial for Piers*
	SLO-2	*Tutorial for Linear Water way*	*Tutorial for temperature and secondary stresses*	*Tutorial for T Beam Bridges*	*Prestressed concrete bridges*	*Tutorial for Skew Bridges*
S-8	SLO-1	*economical span*	*Shrinkage of Concrete, Creep of Concrete*	*Problems using Pigeaud curve*	*Tutorial for Prestressed concrete Bridge*	*Problems in Pier*
	SLO-2	*Problem and Derivation in Economical Span*	*Steel reinforcement-Strength of Steel Reinforcement-Size of Steel Reinforcement*	*Problems using Pigeaud curve*	*Tutorial for Prestressed concrete Bridge*	*Problems in Pier*
S-9	SLO-1	*Problem and Derivation in Economical Span*	*Prestressing Reinforcement- Pre-tensioned vs Post-Tensioned Systems*	*Courbon's theory- Introduction*	*Problems in Prestressed concrete Bridge*	*Problems in Pier*
	SLO-2	*Problems in Scour Depth*	*Commonly Used Tendons-Strength of Tendons*	*Problems using Courbon's Theory*	*Problems in Prestressed concrete Bridge*	*abutments - trestles*
S-10	SLO-1	*Tutorial for Scour Depth*	*Tutorial for Prestress Basics*	*Tutorial for Courbon's Theory*	*Problems in Prestressed concrete Bridge*	*Tutorial for Pier and Trestles*
	SLO-2	*Tutorial for Scour Depth*	*Tutorial for Prestress Basics*	*Tutorial for Courbon's Theory*	*Composite Bridge*	*Tutorial for Pier and Trestles*
S-11	SLO-1	*Case Study 1*	*Case Study 1*	*Case Study 1*	*Composite Bridge*	*Case Study 1*
	SLO-2	*Example Problem 1*	*Example Problem 1*	*Example Problem 1*	*Composite Bridge*	*Example Problem 1*
S-12	SLO-1	*Case Study 2*	*Case Study 2*	*Case Study 2*	*Tutorial for Prestressed Concrete Bridge*	*Case Study 2*
	SLO-2	*Example Problem 2*	*Example Problem 2*	*Example Problem 2*	*Tutorial for Prestressed Concrete Bridge*	*Example Problem 2*

Learning Resources	1. *Johnson Victor. D, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2006.* 2. *Krishna Raju .N, "Design of Bridges", fourth edition Oxford & IBM Publishing Co, Bombay,2009.* 3. *Raina .V.K. "Concrete Bridge Practice", Tata McGraw Hill Publishing Co., New Delhi - 1991*	4. *. Taylor. F.W, Thomson S.E, and Smulski .E. "Reinforced Concrete Bridges", John Wiley & Sons, New York 1955.* 5. *Conference Proceedings, 'Advances and Innovations in Bridge Engineering', IIT, Madras and Indian Institute of Bridge Engineers, Tamilnadu, Allied Publisher, New Delhi, 1999.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20 %*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40 %*	-	*40%*	-	*40 %*	-	*40 %*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Er. G.Hariharanath, GA Consultants, Chennai, gac1996@hotmail.com	*1. Dr. G. AppaRao, Professor, IIT Madras, garao@iitm.ac.in*	*Dr. K.S. Satyanarayanan, SRMIST*
2. Er. UP. Vijay, Senior Engineering Manager, L&T Construction, Buildings and Factories, Chennai,upvijay@Intecc.com	*2. Dr. R. Senthil, Professor, Anna University, senthil@annauniv.edu*	Mr. M. Prakash, *SRMIST*

Course Code	20CEE606T	Course Name	Design of Tall Buildings	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	Civil engineering		Data Book / Codes/Standards	*IS 456-2002, IS1893- 2016(part 1)-2016, IS 875 PART III*	

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Introduce various systems and materials of tall buildings*
CLR-2:	*Know about different types of loads and analysis*
CLR-3:	*Impart knowledge about static, dynamic and stability analysis of various systems*
CLR-4:	*Introduce design of various structural systems*
CLR-5:	*Know about the secondary effect stability of structures*
CLR-6:	*Know about wind effect in tall buildings*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding utilization of material to the engineering application*	3	3	-
CO-2:	*Analyze behavior of Static and dynamic system*	3	3	-
CO-3:	*Analyze structural behavior in framed system*	3	3	2
CO-4:	*Evaluate design with various loads framed structure*	3	3	2
CO-5:	*Evaluate design the gravity load with that effect*	3	3	2
CO-6:	*Create advanced development of tall structures*	3	3	2

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*INTRODUCTION Design Philosophy, History of tall structures*	*ANALYSIS OF FRAME Gravity load, live load , Impact and construction load calculation*	*DESIGN OF STRUCTURAL SYSTEMS Behavior of structural system in High Rise structures*	*ANALYSIS AND DESIGN PRINCIPLES Shear wall , types of shear wall and behavior of shear wall under lateral force*	*STABILITY OF TALL STRUCTURES Analysis for various secondary effects -Creep, shrinkage and temperature.*
	SLO-2	*Advantage and disadvantages of tall structures*		*Various system in steel and concrete*		
S-2	SLO-1	*Scope and feature of tall structures*	*Design example: Gravity load calculation for frame. Live load reduction*	*Different system for load distribution in steel and concrete*	*Coupled shear wall system*	*Case study:1*
	SLO-2					
S-3	SLO-1	*Factors affecting height, growth and form of Human comfort criteria, Vertical city concepts*	*Earthquake loading, load combination as per IS 1893 Equivalent lateral force*	*Vertical and horizontal load resistant systems, Rigid frames various behavior of frame*	*Design example: RC shear wall*	*Second order effects of gravity loading, P-Δ effect, P-Δ effect and various methods of analysis*
	SLO-2					
S-4	SLO-1		*Tutorial : Frame analysis*	*Tutorial :*		*Tutorial :*

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Tutorial : World tallest structure and history*			*Tutorial : wall frames systems, behavior of symmetric wall frame*	
S-5	SLO-1	*Essential amenities system*	*Modal analysis*	*Computation of lateral stiffness considering beam and columns*	*Design example: 1 Analysis wall frame using chart*	*P-Δ effect influence of foundation instability, out of plumb effects*
	SLO-2					
S-6	SLO-1	*Fire safety, Water supply*	*Design example: Frame analysis*	*Computation of lateral deflection for the given horizontal load*	*Design example: 2 Analysis wall frame using chart*	*Design example :1*
	SLO-2					
S-7	SLO-1	*Drainage and Garbage disposal*	*Wind loading - Static and dynamic approach*	*Braced frames, types of bracing system in steel and concrete*	*Tubular systems, behavior of tubular structures*	*Blast load résistance of tall structures*
	SLO-2	*Structural and foundation systems*				
S-8	SLO-1	*Tutorial : Foundation settlement and soil structure interaction*	*Tutorial : Computation of wind load in tall building using static system*	*Tutorial : Behavior of braced frames*	*Tutorial : Analysis wall frame using chart*	*Tutorial : Case study*
	SLO-2					
S-9	SLO-1	*Advanced materials for tall buildings*	*Computation of wind load in tall building using dynamic system*	*Analysis of wall frame with various methods*	*In filled frame system and behavior in high rise structure*	*Structural systems for future generation buildings*
	SLO-2					
S-10	SLO-1	*High strength concrete*	*Design example: 1 Wind load analysis static*	*Design example: Portal frame method*	*Outrigger braced systems, methods of analysis, assumption for analysis*	*Fire safety, Water supply*
	SLO-2	*Light weight concrete*				
S-11	SLO-1	*Fibres and fibre reinforced concrete*	*Design example: 2 Wind load analysis dynamic*	*Design example: Cantilever method*	*Outrigger braced systems, analysis for horizontal deflection*	*Drainage and Garbage disposal*
	SLO-2					*Structural and foundation systems*
S-12	SLO-1	*Tutorial : Composite Materials*	*Tutorial : Analytical and wind tunnel experimental method*	*Tutorial : Comparison with two methods*	*Tutorial : Core structures, behavior and analysis*	*Tutorial : Foundation settlement and soil structure interaction*
	SLO-2					

Learning Resources	1. *Schuller .W.G, "High Rise Building Structures", John Wiley & sons, 1977.* 2. *Lin T.Y, and Burry. D, Stotes, "Structural Concepts and Systems for Architects and Engineers ", John Wiley, 1994..* 3. *Gupta.Y.P,(Editor), "Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities", New Age International Limited, New Delhi,1995*	4. *Lecture Notes on "Tall Buildings"- Short Term Course organized by Civil Engineering Department, SRM Engg college, Kattankulathur. June 2002.* 5. *Smith .B.S, and Coull .A, "Tall Building Structure", 'Analysis and Design', John Wiley & Sons, Inc.,* 6. *Taranath .B.S, "Structural Analysis and Design of Tall Buildings", Mc Graw Hill Co. 1988.*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	-	*20%*	-	*20%*	-	*20%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. *Mr. Nithin Khandelwal, Scientist, CSIR-SERC, nitin@serc.res.in*	2. *Dr. Beulah Gnana Ananthi, Associate Professor, Anna University, beulah28@annauniv.edu, beulahceg@gmail.com*	2. Ms. C. Sudha, SRMIST

Course Code	20CEE607T	Course Name	Analysis and Design of Structural Sandwich Panels	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Introduce the basic principles related to the structural sandwich panels.*
CLR-2:	*Learn about methods of analysis of sandwich panels*
CLR-3:	*Know about design methodologies of sandwich panels*
CLR-4:	*Learn about various standards for testing and procedures*
CLR-5:	*Know buckling loads of sandwich panels*
CLR-6:	*Know the application of sandwich panels*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	***2***	***3***
CO-1:	*Understandingthe basic difference between the sandwich and other types of composites.*	3	3	-
CO-2:	*Able to learn about methods of analysis of sandwich panels*	3	3	-
CO-3:	*Evaluate knowledge on design methodologies of sandwich panels*	3	3	2
CO-4:	*Able to understand about various standards for testing and procedures*	3	3	2
CO-5:	*Evaluation knowledge on buckling loads of sandwich panels*	3	3	2
CO-6:	*Create knowledge of application of sandwich panels*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Studentswillbeintroducedwiththe basic concepts of sandwich panels.*	*Studentswillbeintroduced to the basic concepts of buckling of sandwich struts.*	*Students will learn about the basic assumptions in bending and buckling of an isotropic sandwich panel.*	*They will be introduced with the basic theory of sandwich panels.*	*Students were introduced with the importance of testing of materials used in sandwich panels.*
	SLO-2	*Students will be able to distinguish between the sandwich and other types of composites.*	*Students gain basic knowledge on the concepts of buckling of sandwich struts.*	*Students will be familiar with the basic assumptions in bending and buckling of an isotropic sandwich panel.*	*Students will be able to gain knowledge on basic theories of sandwich panels.*	*They will be able to gain knowledge on the importance of testingofmaterials used in sandwich panels.*
S-2	SLO-1	*They will have the concept of antiplane core.*	*Students will gain knowledge on sandwich struts.*	*They will acquire basic knowledge on bending and buckling analysis of isotropic sandwich panel.*	*Students will acquire knowledge on the theory of sandwich panel and with various boundary conditions.*	*Students will learn the various methods used in testing of materials.*
	SLO-2	*They will be able to understand the use of anti-plane core*	*Students will be able to demonstrate sandwich struts.*	*They will be familiar with the basics of bending and buckling analysis of isotropic sandwich panel.*	*Students will be familiar with the theory of sandwich panel and with various boundary conditions.*	*They will be familiar with the various methods used in testing of materials.*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
		concept in analysis of sandwich beams.				
S-3	SLO-1	*Students will learn the method of analysis of sandwich beams with antiplane core and thin faces.*	*They will learn about the buckling of a sandwich panel*	*They will learn about the differential equations of bending and buckling of a sandwich panel.*	*They will learn about the simply supported edge condition for the design of sandwich panel.*	*Students will learn about the testing method suitable for various types of sandwich construction materials.*
	SLO-2	*Students will be able to perform the analysis of sandwich panels with antiplane core and thin faces.*	*Students will be able to demonstrate about the buckling of a sandwich panel.*	*They will be familiar with the differential equations of bending and buckling of a sandwich panel.*	*They will be able to demonstrate the simply supported edge condition for the design of sandwich panel.*	*They will be able to adopt the method suitable for testing of the required material used in sandwich construction.*
S-4	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
S-5	SLO-1	*Students will learn about the analysis of antiplane core and with faces of unequal thickness.*	*Students will learn the key idea on strain energy method.*	*Students will be introduced to wrinkling and other terms of local instability.*	*Students will be introduced to the large deflection of sandwich beams.*	*Students will be introduced to phase material and core material.*
	SLO-2	*Students will be able to perform the analysis of antiplane core and with faces of unequal thickness.*	*Students will be familiar with the strain energy method.*	*Students will be able to demonstrate of wrinkling and other terms of local instability.*	*Students will be able to demonstrate the large deflection of sandwich beams.*	*They will be able to demonstrate about the phase material and core material.*
S-6	SLO-1	*Students will gain knowledge on analysis of sandwich beams with core of considerable modulus of elasticity.*	*They will acquire knowledge on sandwich beam and strut.*	*Students will learn about the definitions of wrinkling and other terms of local instability.*	*Students will be introduced to the various boundary conditions in design of sandwich beams.*	*Students will learn in depth about the phase material.*
	SLO-2	*Students will be familiar with analysis of sandwich beams with core of considerable modulus of elasticity.*	*They will be able to apply the knowledge acquired in sandwich beam an*	*Students will be able to demonstrate the definitions of wrinkling and other terms of local instability.*	*They will gain knowledge on various boundary conditions in design of sandwich beams.*	*They will be able to demonstrate about the phase material.*
S-7	SLO-1	*Students will gain idea on deflection of a sandwich panels.*	*They will gain knowledge on analysis of sandwich beam and strut by strain energy method.*	*Students will learn about the principle types of wrinkling and other terms of local instability.*	*Students will be introduced to the initial deformation of sandwich beams.*	*Students will gain knowledge about the core material and various types of core materials.*
	SLO-2	*Students will be in a state to demonstrate about the deflection of a sandwich panels.*	*They will be able to perform analysis of sandwich beam and strut by using strain energy method.*	*Students will be able to differentiate the various types of wrinkling and other terms of local instability.*	*They will gain knowledge on initial deformation of sandwich beams.*	*Students will be able to select the suitable core material based on their requirement.*
S-8	SLO-1	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial
	SLO-2	Tutorial	Tutorial	Tutorial	Tutorial	Tutorial

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-9	SLO-1	*Students will learn the concept of analysis of sandwich beams with symmetrical loading and unsymmetrical loading.*	*They will gain knowledge on isotropic and orthotropic sandwich strut.*	*Students will be introduced to formulae for analysis.*	*Students will be introduced to the basic concepts of design of sandwich beams, struts and panels.*	*Students were introduced with the importance of testing of sandwich constructions.*
	SLO-2	*Students will differentiate between the performance of analysis of sandwich beams with symmetrical loading and unsymmetrical loading.*	*They will be familiar with isotropic and orthotropic sandwich strut.*	*Students will be able to demonstrate the formulae for analysis.*	*Students will be able to introduce the basic concepts of design of sandwich beams, struts and panels.*	*They will be able to gain knowledge on the importance of testing of sandwich constructions.*
S-10	SLO-1	*Students will learn about the analysis of sandwich beams with symmetrical loading.*	*They will learn the basic differences between isotropic and orthotropic sandwich strut.*	*Students will learn about the definitions of formulae for analysis.*	*Students will learn about the steps followed in design of sandwich beams, struts and panels.*	*They will learn about the various methods of testing in sandwich constructions.*
	SLO-2	*Students will be able to perform the analysis of sandwich beams with symmetrical loading.*	*They will be familiar in differentiating isotropic and orthotropic sandwich strut.*	*Students will be able to demonstrate the definitions of formulae for analysis.*	*Students will be confident enough to follow the steps in design of sandwich beams, struts and panels.*	*Studentswillbe able to adopt the suitabletestingmethodbased on the type of sandwich construction.*
S-11	SLO-1	*Students will learn about the analysis of sandwich beams with unsymmetrical loads including point load and udl.*	*They learn about performing the analysis of isotropic and orthotropic sandwich strut by Ritz method.*	*Students will learn about the formulae for analysis of sandwich beams.*	*Students will learn to design a sandwich beam, struts and panels.*	*Students will gain knowledge on various properties of materials used in sandwich construction.*
	SLO-2	*Students will be able to perform the analysis of sandwich beams with unsymmetrical loads including point load and udl.*	*Students will be able to carry out performing the analysis of isotropic and orthotropic sandwich strut by Ritz method.*	*Students will be able to demonstrate the formulae for analysis of sandwich beams.*	*They will be able to carry out the design of a sandwich beam, struts and panels.*	*They will be able to demonstrate the various properties of the materials used in sandwich construction.*
S-12	SLO-1	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*
	SLO-2	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*	*Tutorial*

Learning Resources	1. *HOWARD G.ALLEN, "Analysis and design of structural sandwich panels" – Firstedition 1969, PERGAMON PRESS.*	2. *DAVID RANDAL AND STEVE LEE, "The Polyurathanes Book"-November, 2002,JOHN WILEY, LTD.*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice

Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. S.R. Balasubramainan, Sr. Scientist, CSIR-SERC, srbala@serc.res.in*	1. *Dr. R. Santhakumar, NITTTR, rsk65@nitttrc.ac.in*	1. *Dr. Alok Kumar Patra, SRMIST*
2. *Mr. S. Parthiban, Engineering Manager, L&T, spb@lntecc.com*	2. *Dr. Jane Helena, Professor, Anna University, jane@annauniv.edu*	2. *Dr. K.S. Satyanarayanan, SRMIST*

Course Code	20CEE608T	Course Name	Advanced Analysis and Design for Wind Earthquake and Other Dynamic Loads	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	CIVIL ENGINEERING		Data Book / Codes/Standards	IS 875,Part 1,2,3,IS1893,part 1 2002: IS13920: 1993	

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Study the behavior of reinforced cement concrete under the action of impact and cyclic loads*
CLR-2:	*Study the interaction of soil and structure*
CLR-3:	*Study the effect of wind loads, response of the structure*
CLR-4:	*Analyze and design the structure subjected to wind loads*
CLR-5:	*Characteristics of seismic loading and to design structures subjected to seismic loads*
CLR-6:	*Study the design of structures against impact loading*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the various sources of loading conditions*	3	3	-
CO-2:	*Able to evaluate and identify the response of soil and structure*	3	3	-
CO-3:	*Apply knowledge on calculation of wind loads*	3	3	2
CO-4:	*Able to recognize the evaluating effect of wind loads and failure modes*	3	3	2
CO-5:	*Apply the concept of seismic loading*	3	3	2
CO-6:	*Evaluate knowledge of basic and heavy impact loading*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction about structures, élément, idéalisation, and load*	*Introduction about wind loading*	*Wind load acting on structures*	*Detail discussion of Theory of plate tectonics,*	*Blast load definition, basic terminology*
	SLO-2	*Behavior of concrete, various advance technique's used in concrete –under impact load.*	*Spectral studies,construction of response spectra*	*Discuss in detail the various classification of structures under wind load*	*Basic elements of engineering seismology*	*Various types of blast loading, characteristics,*
S-2	SLO-1	*Behavior of steel,varioustypes,manufacturingprocess,basic parameters- under impact load.*	*Gust factor, definition, merits,demerits, Applications*	*Discuss the static and dynamic effects of structures*	*Earth quake size and intensity,various earth quake measurement equipment's*	*Blast wave profile,Friedlander's equation*
	SLO-2	*Components and types of masonry structures,*	*Analysis of building frames using approximate lateral load method*	*Tall buildings-definitions, basicterminology*	*Various category of structures according to earthquake print of view*	*Scaling law,stand off distance*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-3	SLO-1	*Interaction between soil structure under impact loading*	*Estimation of lateral loads on a building frame*	*Various Structural systems --- based on the storey height of building*	*Various classification of damage to buildings subjected to earth quake*	*Various types of explosives,basic classification of explosion*
	SLO-2	*Basic definition about Structural dynamics and its terminology*	*Various step by step procedure followed inapproximate lateral load method*	*Various advantages and disadvantages of tall buildings*	*Construction of response spectra*	*Various types of ignition,sources*
S-4	SLO-1	*Tutorial: Definition of degree of freedom, support conditions ,*	*Tutorial :Structural design requirement' for approximate lateral load method*	*Tutorial :Bundled tube structural system-Detail*	*Tutorial :Response spectrum for support excitation*	*Tutorial :Pressure distribution on building above the ground due to external blast.*
	SLO-2	*Types—single degree of freedom (SDOF), Response of SDOF with various lading*	*Response of two hinged symmetric portal frame to lateral loads*		*Response spectrum for elastic design*	*Pressure distribution on building above the ground due to internal blast.*
S-5	SLO-1	*Multi degree of freedom (MDOF) Response of MDOF with various lading*	*Response of symmetric portal frame with rigid base and rigid beam to lateral load.*	*Tube in tube structural system-Detail*	*Seismic response of regular and irregular building*	*Impact and impulse loads*
	SLO-2	*Various damping system, methods to evaluate damping*	*Response of symmetric portal frame with rigid base and rigid base to lateral load.*	*Framed tube structural system detail*	*Influence of local soil condition case study*	*Various types of field blast test-merits,demerits,application.*
S-6	SLO-1	*Methods to evaluate the force transmitted to foundation- merits and demerits*	*Symmetric and anti-symmetric components of lateral loading in a symmetric simple bay two storied frame .*	*Various methods used to analyze the chimney.*	*Modern concepts used in earth quake resistant design*	*Various types of equipment's used field blast test-merits,demerits,application.*
	SLO-2	*Seismic instruments used to measure important parameter*	*Calculation of basic wind speed from Indian standards*	*Rigid frame-Types-discuss in detail*	*Base isolation technique- Types-Functions*	*Types of steel sections used to resist blast loading*
S-7	SLO-1	*Material properties, strain rate , importance of ductility, Factors influencing and affecting ductility during dynamic loading.*	*Methods of measurements of wind speed*	*Infilled frames- Types-discuss in detail*	*Limitations ofBase isolation technique-*	*Basic Sectional requirements of rcc structure subjected to blast*
	SLO-2	*Definition of ductility ratio, and other basic parameters*	*Variation of speed with respect to height*	*Outrigger –braced and hybrid mega system*	*Case studies performance of regular building under earthquake*	*Basic Sectional requirements of masonry Structure subjected to blast.*
S-8	SLO-1	*Tutorial: Static resistance function*	*Tutorial :Wind tunnel studies ,merits and demerits ,Applications*	*.Tutorial :Chimney—Various types-Detail*	*Tutorial :Case studies performance of irregular building under earthquake*	*Tutorial :Undergroundexplosion,--characteristic study*
	SLO-2	*Various types of sections used in steel subjected to other loading condition*	*Various types of tunnel*		*Various methods used for seismic analysis of a four storied RC building as IS1893 (Part 1): 2002*	*Blast wave design paramètres*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-9	SLO-1	*Various Methods to analyze the structure under various loading*	*Material Modeling, various software' used in market.*	*Case study on infilled frames*	*Step by step procedure for seismic analysis of a four storied RC building as IS1893 (Part 1): 2002*	*Air blast loading phenomena*
	SLO-2	*Merits and demerits of the methods to analyze the structure under various loading*	*Basic Modeling requirements, Inputs and outputs*	*Case study on types of outrigger*	*Mathematical modeling of multi storied RC building*	*Near field shock wave load amplification*
S-10	SLO-1	*Basic design philosophy*	*Methods for interpretation of results*	*Case study on types of chimney*	*Ductility factors*	*Compound shock wave load amplifications*
	SLO-2	*Various design methods used to design structures under earthquake, wind, and other loads*	*Validation of results using Indian standards provision*	*Various methods used to analyse the chimney*	*Discuss the factors affecting ductility*	*Shock wave reflection and diffraction*
S-11	SLO-1	*Introduction about the various field test to determine the behavior of structure under other loads*	*Aero elastic models-definition, Basic terminology*	*Merits and demerits of different frames*	*Ductile Detailing consideration shear wall*	*The underground shock wave-*
	SLO-2	*Mostly used method used to design structures under earthquake, wind, and other loads*	*Parametric consideration for aero elastic model.*	*Case studies on different framed structures in structures*	*Ductile Detailing consideration as per IS13920: 1993- flexural members*	*Various methods used for design of buildings for blast and impact loads*
S-12	SLO-1	*Tutorial:Various Indian standards used to analyze design the structure under wind and other loads*	*Tutorial:Merits, demerits of Aero elastic models*	*Problem 1 – Framed load calculation*	*Tutorial :Relationship between member ductility and system ductility*	*Tutorial :Codal provisions used in design of buildings for blast and impact loads.*
	SLO-2	*Various software's used to analyze and design the structure under wind ,earthquake loads*	*Application of Aero elastic models*	*Problem 2 – Application of loads*	*3D computer analysis of building system –study of analysis results.*	*Finite element software used for analysis of structures under blast*

Learning Resources	1. *EarthQuake Engineering – NPTEL* 2. *BungaleS.Taranath,"Structural Analysis And Design of Tall Buildings:,CRC Press,2010.* 3. *Peter Sachas,"Wind Forces in Engineering", Vol I and VolII,Applied Science Publishers, London 1980.* 4. *BelaGoschy,"Design of Buildings to withstand abnormal loading",Butterworths,1990.*	*5. Kolousek.Et.al "Wind effects on Civil Engineering structures",Elsevier Publications,1984* *6 .Cook,N..,"The designers guide to Wind Loading of Building Structures ",1990.* *7.Course Notes " SeismicDesign of Reinforced Concrete Structures",,IIT Madras*

Learning Assessment					
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)			Final Examination (40% weightage)
		CLA – 1 (20%)	CLA – 2 (25%)	CLA – 3 (15%)	

		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. G. Venkataramarao, Sr. Scientist, CSIR-SERC, ramarao@serc.res.in*	1. *Prof. Jangid R S, Professor, IITB, rsjangid@civil.iitb.ac.in*	1. *Mr. S.A. Vengadesh Subramanian. SRMIST*
2. *Mr. A. Sivaraman, Deign Manager, Utracon, sivaram@utracon.com*	2. *Dr. S. T. G. Raghukanth, Professor, IITM, raghukanth@iitm.ac.in*	2. *Mr. S. Pradeep, SRMIST*

Course Code	20CEE609T	Course Name	Design of Shell and Folded Plate Structures	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*CIVIL ENGINEERING*			Data Book / Codes/Standards	*ASCE Manual for shells, IS 2210-1988.*

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know the structural aspects of shell structures*
CLR-2:	*Know Importance of membrane theory and its limitation*
CLR-3:	*Know the Strains in a circular cylindrical shell*
CLR-4:	*Study the Principles of the design of cylindrical shell*
CLR-5:	*Know the Principles of Structural Design of Intze type tanks*
CLR-6:	Know the Structural Design of a north light folded plates

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand and distinguish between the shell structures and folded plate structures*	3	3	2
CO-2:	*Evaluate the design a single short cylindrical shell*	3	3	2
CO-3:	*Analyze the various types of shells using surface generation.*	3	3	2
CO-4:	*Analyze and design aspects of shells-developable and non developable shells*	3	3	2
CO-5:	*Evaluate structurally a intze type tank, foundations and design*	3	3	2
CO-6:	*Create and perform design of folded plate roofs*	3	3	2

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction to shell structures*	*Theory of circular cylindrical shells with combined action of membrane and bending stress resultants*	*Principles of the design of cylindrical shell*	*Principles of structural design of intze type tanks*	*Principles of structural design of folded plates*
	SLO-2	*Classification of shell structures*	*Need for the bending theory in cylindrical shells*	*Single shell without edge beams*	*Structural elements of intze type tanks*	*History of used of folded plates*
S-2	SLO-1	*Principles of Singly curved shells*	*Stress Analysis of Cylindrical shells*	*Single shell with edge beams*	*Structural Design of intze type tanks*	*Applications of folded plates*
	SLO-2	*Principles of Doubly curved shells*	*Expressions for strain and change in curvature*	*Inner shell of a multiple group of shells with feather edge beams*	*Dimensions of tank based on the capacity of water*	*Scope and Assumptions*
S-3	SLO-1	*Shells of translation and rotation*	*State of Plane stress*	*Inner shell with small edge members*	*Design of top spherical dome*	*Plate and Slab action of folded plates*
	SLO-2	*Synclastic and anticlastic shells*	*Strains in a circular cylindrical shell*	*Inner shell with edge beams*	*Design of top ring beam*	*Stress Distribution in folded plates*

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Stress resultants in a plate element*	*Rotation of the tangent*	*Single shell with nominal edge members supported on walls or an closely spaced rows of flexible columns*	*Design of side walls of tank*	*Effect of joint moments in folded plates*
	SLO-2	*Stress resultants in a shell element*	*Change in circumferential curvature*	*The end shell*	*Design of bottom ring beam*	*The whitney method of analysis*
S-5	SLO-1	*Applications to a simply supported cylindrical shell*	*Bending theories of cylindrical shells*	*Selection of shell parameters*	*Design of conical dome*	*Structural Design of a northlight folded plates*
	SLO-2	*Limitations to membrane theory*	*Finsterwalder theory*	*Selection of type, radius, semi central angle, width of edge beam*	*Design for meridional thrust and meridional stress in conical dome*	*Calculation of ridge loads*
S-6	SLO-1	*methods of generating the surface of different shells like hyperboloid*	*D-K-J Theory*	*Design of single short cylindrical shell without edge beams*	*Design of bottom spherical dome*	*Plate loads due to normal loads*
	SLO-2	*methods of generating the surface of different shells like elliptic paraboloid*	*Moment curvature relations*	*Geometry of shell, parameters used*	*Design of bottom circular girder*	*Ridge loads due to transverse moments*
S-7	SLO-1	*methods of generating the surface of different shells like conical*	*Schorer theory*	*Matrix for stress resultants*	*Design of girder for hoop stress*	*Plate deflections*
	SLO-2	*Reinforcement detailing of shells*	*Schorer Differential equation*	*Boundary Conditions*	*Reinforcement detailing of domes and girders*	*Reinforcement pattern in folded plate roofs*
S-8	SLO-1	*Equilibrium equations for membrane stress resultants*	*The Dischinger theory*	*Solution of the equations*	*Analysis of wind loads on the intze type tank*	*Structural Design of a northlight folded plates using Simpsons's rule*
	SLO-2	*Properties of Curves*	*Aas-Jakobsen's theory*	*Check for statics*	*Analysis of seismic loads on the intze type tank*	*Calculation of ridge loads*
S-9	SLO-1	*Plane curves used as directrix*	*The Flugge theory*	*Design of reinforcement*	*Design of columns for intze type tank*	*Plate loads due to normal loads*
	SLO-2	*Radius of curvature*	*Lundgren's theory*	*Reinforcement for Principal tension*	*Design of wind forces on the top columns*	*Ridge loads due to transverse moments*
S-10	SLO-1	*Stresses in a simply supported shell*	*Exact and Approximate Theories*	*Design of single short cylindrical shell without edge beams*	*Design of moments*	*Plate deflections*
	SLO-2	*Components of cylindrical shell*	*Ivar Holand's method*	*Bending moment based on ASCE Manual no 31.*	*Design of bracings for columns of water tank*	*Reinforcement pattern in folded plate roofs*
S-11	SLO-1	*Stresses in shells with a semi elliptic directrix*	*Analysis of long shells*	*Check for buckling*	*Design of foundations for the intze type tank*	*Iteration method of analysis of folded plates*
	SLO-2	*Cylindrical shell with Circular directrix*	*Analysis of long shells without edge beams*	*Boundary conditions*	*Design of raft slab based on shear*	*Comments on the iteration of method*

Duration (Hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-12	SLO-1	*Cylindrical shell with cycloidaldirectrix*	*Analysis of short shells*	*Detailing of the reinforcement in shells*	*Design of raft slab based on bending moments*	*Principles of continuous folded plates*
	SLO-2	*Cylindrical shell with catenary directrix*	*Analysis of short shells without edge beams*	*Scheme for de-shuttering of shells*	*Reinforcement detailing for foundations*	*Reinforcement pattern for continuous folded plates*

Learning Resources	1. Ramaswamy. G.S, - "Design and Constructions of Concrete Shell Roofs" - CBS Publishers and Distributors - New Delhi – 1986. 2. Chatterjee,B.K, - "Theory and Design of Concrete Shell", - Chapman & Hall, Newyork-third edition, 1988. 3. Bandhopadhyay. J.N, "Thin shell Structures" - Classical and Modern Analysis" New Age International Publishers - New Delhi. 1986.	4. Varghese.P.C, "Design of reinforced concrete shells and folded plates", Prentice Hall of India, New Delhi, 2010. 5. ASCE Manual of Engineering practice No. 31, Design of cylindrical concrete shell roofs ASC, New York. 6. Stephen P Timoshenko and S Woinowsky – Krieger, "Theory of Plates and Shells", Tata McGraw Hill Edition, second edition.

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Analyze								
Level 3	Evaluate	*40%*	-	*40%*	-	*40%*	-	*40%*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. *Er. AGV. Desigan, Design Group Engineering Consultancy Pvt Ltd. Chennai,desigan.agv@gmail.com*	2. *Dr. R. Senthil, Professor, Anna University, senthil@annauniv.edu*	2. *Dr. P.R.KannanRajkumar, SRMIST*

Course Code	20CEE610T	Course Name	Computer Aided Design and Programming	Course Category	E	Professional Elective	L	T	P	C
							3	1	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Develop intermediate level of knowledge about CAD and applications in structural engineering*
CLR-2:	*Address concepts related to structural analysis in cad*
CLR-3:	*Create insights to different programming concepts and basics for structural analysis and design*
CLR-4:	*Address concepts related to Linear programming and statistical methods for optimization*
CLR-5:	*Address concepts of Artificial methods and related applications in civil engineering*
CLR-6:	*Acquaint the students with case studies on analysis and design scenarios using beam and truss element*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding the basics of drafting and computer graphic processing*	3	3	-
CO-2:	*Understanding of different methods of matrix Structural Analysis and finite element method*	3	3	-
CO-3:	*Evaluate use of software for design and detailing and its applications on various packages*	3	3	2
CO-4:	*Application of optimal design principles*	3	3	2
CO-5:	*Evaluate Fundamentals of AI and expert system*	3	3	2
CO-6:	*Knowledge of basic search conditions using AI concept*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Applications of CAD*	*Methods of Structural Analysis*	*Structural design methods of RCC*	*System Approach*	*Introduction to Artificial Intelligence (AI)*
	SLO-2	*Benefits of CAD*	*Comparison on analytical methods*	*Structural design methods of Steel*	*Techniques of operation research*	*Applications and advantages of AI*
S-2	SLO-1	*Processor and controller*	*Structural classical methods and principles*	*Codal provision in RCC structural elements*	*Decision making*	*Heuristic search*
	SLO-2	*Graphic Primitives*	*Structural computer methods and principles*	*Codal provisions in Steel structural elements*	*Researchmodels*	*Concepts of AI with Heuristic search*
S-3	SLO-1	*Geometric transformations*	*Analytical methods for beams*	*Framing RCC beam design flow chart*	*Basic concepts of minimum weight, minimum cost design, variables and constraints*	*Introduction to Data Science*
	SLO-2	*Geometric 2D transformation concepts*	*Analytical methods for trusses*	*Feeding of RCC beam design in computer program*	*Model and model building, objective function*	*Scientific method and modelling concepts*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Tutorial in AutoCAD with single unit commands*	*Tutorial in MS-Excel for beams*	*Tutorial in MS-Excel for RCC beam design*	*Tutorial: Statistical tool*	*Tutorial in R essentials – Commands and Syntax*
	SLO-2	*Tutorial in AutoCAD with building plan*	*Tutorial in MS-Excel for continuous span beams*	*Tutorial in MS-Excel for RCC beam design based on equations*	*Tutorial: Statistical Analysis*	*Tutorials in R – packages and libraries*
S-5	SLO-1	*Types of coordinate systems*	*Finite element basics*	*Principles of Steel design*	*Concept of liner programming*	*Knowledge based expert systems (KBES)*
	SLO-2	*Various applications of the coordinate systems*	*Finite element principles*	*Steel joints and fasteners characteristics*	*Integer programming, Quadratic programming*	*Concept of super intelligence*
S-6	SLO-1	*Homogeneous Coordinate systems*	*Advantages of FEM*	*Framing Steel beam design flow chart*	*Dynamicprogramming and geometric programming methods for optimal design of structuralelements*	*Architecture structure of KBES*
	SLO-2	*Cartesian coordinate systems*	*Applications of FEM*	*Feeding of Steel beam design in computer program*	*Standard form of linear programming problem*	*Applications of KBES*
S-7	SLO-1	*Modelling of curves*	*Workflow of FEM methods*	*Framing Steel beam and joints design flow chart*	*Solution of system of linear simultaneous equations*	*Expert Systems (ES)*
	SLO-2	*Modelling of surfaces*	*Discretization techniques*	*Feeding of Steel beam design and joints in computer program*	*Application of linear programming methods*	*Characteristics of Expert Systems*
S-8	SLO-1	*Tutorial in AutoCAD with curves*	*Tutorial in MS-Excel for Matrix basic operations*	*Tutorial in MS-Excel for Steel beam design*	*Tutorial in Plastic design of frames using linear programming*	*Tutorial in R – statistical analysis*
	SLO-2	*Tutorial in AutoCAD with surfaces*	*Tutorial in MS-Excel for Matrix Stiffness methods*	*Tutorial in MS-Excel for Steel beam design based on equations*	*Tutorial in Computer searchmethods of univarite and multivariate minimsation*	*Tutorial in R – Analytical validation*
S-9	SLO-1	*Solid Modelling Concepts*	*Concepts of Meshing*	*Validating the design components of RCC and Steel structures*	*Simplex method*	*Capabilities of Expert Systems*
	SLO-2	*Solid modelling characteristics*	*Meshing types and applications*	*Importance of design and detailing at site*	*Revised simplex method*	*Components of Expert Systems*
S-10	SLO-1	*Graphic standards*	*Analysis of beam element with FEM*	*Framing of detailed drawing*	*Duality of linear programming sensitivity or post optimality analysis*	*Convolution Neural Networks (NN)*
	SLO-2	*Differences among various available graphic standards and importance of ISO standards*	*Importance of verification and validation*	*Extracting reinforcement detailing*	*Optimization by structural theorems*	*Emerging NN architectures*
S-11	SLO-1	*Drafting Software Packages*	*Analysis through application packages*	*Estimation of bill of materials*	*CPM and PERT*	*Recurrent Neural Networks*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Software package uses*	*Different FEM packages*	*Quantity surveying basic understanding*	*CPM and PERT application genetic algorithm and applications.*	*Long Short-Term Memory and Time Series Forecasting using Recurrent method*
S-12	SLO-1	*Tutorial in AutoCAD with transformations*	*Tutorial in ANSYS - Beam formation*	*Tutorial in MS-Excel in estimation of materials*	*Tutorial in CPM method*	*Tutorial in AI and KBES using google*
	SLO-2	*Tutorial in AutoCAD with ISO graphic standard*	*Tutorial in ANSYS – Meshing of beam elements*	*Tutorial in MS-Excel in valuation*	*Tutorial in PERT method*	*Tutorial in NN using piped project*

Learning Resources	1. *Harrison .H.B, "Structural Analysis and Design" Vol. I & II, Pergamon Press, 1991. Hinton. E and* 2. *Owen .D.R.J, Finite Element Programming, Academic Press 1977.* 3. *Billy. E, Gillet, "Introduction to Operation Research", A Computer OrientedAlgorithmic Approach,* 4. *Tata McGraw 1982.* 5. *Krishnamoorthy .C.S and Rajeev .S., "Computer Aided Design", NarosaPublishing House New* 6. *Delhi , 1991.*	7. *Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.* 8. *Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.* 9. *Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.* 10. *Stuart Russell & Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice-Hall, Third Edition (2009)*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	-	*20%*	-	*20%*	-	*20%*	-
Level 2	Apply Analyze	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Level 3	Evaluate Create	*40%*	-	*40%*	-	*40%*	-	*40%*	-
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. K. Lakshmi, Sr. Scientist, CSIR-SERC, lakshmik@ser.res.in*	1. *Dr. Mausam, Professor, CSE, IITD–Mausam@cse.iitd.ac.in*	1. *Dr. S. Senthilselvan, SRMIST*
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Course Code	20CEE611T	Course Name	Ancient Building Materials and Additives in The Conservation Of Heritage Structures	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know about the various construction materials used in the heritage structures*
CLR-2:	*Outline the status of conservation practice in the country and the various guidelines for the preservation, conservation and restoration of buildings.*
CLR-3:	*Know about the role of additives in the ancient construction*
CLR-4:	*Understand the behavior, repair and strengthening solutions of structural system of historic structures.*
CLR-5:	*Understand the salient features of ancients' monuments with case studies*
CLR-6:	

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding various construction materials used in the heritage structures*	3	3	-
CO-2:	*Analyze knowledge of conservation, preservation, and restoration of heritage structures.*	3	3	-
CO-3:	*Evaluate the role of additives in the ancient construction.*	3	3	2
CO-4:	*Analyze the stability of the historic structure*	3	3	2
CO-5:	*Understanding the ancient temple architecture in India*	3	3	2
CO-6:		3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction of Ancient Building Materials*	*Introduction of Conservation In India*	*Introduction ofAdditives In Ancient Construction*	*Introduction ofStability Of Historic Structures*	*Introduction to temple architecture*
	SLO-2	*Ancient Building Materials-Stones*	*Ethics of conservation*	*Need for additives*	*Introduction to structural components in a historic structure*	*Elements of temple architecture*
S-2	SLO-1	*Ancient Building Materials - Bricks*	*Ethics of conservation*	*Usesof additives*	*Introduction to structural components in a historic structure*	*Elements of temple architecture*
	SLO-2	*AncientBinders*	*Preservation of ancient structures*	*Various natural additives used in ancient construction*	*Components in historic structure*	*Using various natural admixtures*
S-3	SLO-1	*AncientBindersMud*	*Preservationof ancient structures*	*Various natural additives used in ancient construction*	*Components in historic structure*	*Rock cut productions under Pallavas*
	SLO-2	*AncientBindersLime*	*Principles of conservation*	*Study on the role of organics on ancient mortars*	*Types of seismic analysis*	*Rock cut productions under Pallavas*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Types of lime and mud*	*Listing and documentation of historic structures*	*Study on the role of organics on ancient mortars*	*Conditions of stability analysis*	*Chola Architecture*
	SLO-2	*Classification of lime and Mud*	*Listing and documentation of historic structures*	*plasters of ancient construction*	*Load conditions of stability analysis*	*Chola Architecture*
S-5	SLO-1	*Manufacturing process of lime*	*UNESCOWorld Heritage Centre guidelines for preservation*	*plasters of ancient construction*	*structural systems*	*Examples for Chola Architecture*
	SLO-2	*Manufacturing process of lime*	*UNESCOWorld Heritage Centre guidelines for preservation*	*Bio-processing of organics*	*various types of historic structural systems*	*Examples for Chola Architecture*
S-6	SLO-1	*Process of Slaking*	*rehabilitation of historic structures*	*Bio-processing of organics*	*various types of historic structural systems*	*Temple architectures of kerala*
	SLO-2	*Hardening of ancient building materials*	*rehabilitation of historic structures*	*Organic analysis*	*Structural analysis*	*Temple architectures of kerala*
S-7	SLO-1	*Testing and Storage*	*adaptive re-use of historic structures*	*Organic analysis*	*Historic structural analysis*	*Northern india-Temple architecture of Gujarat*
	SLO-2	*Lime putty*	*adaptive re-use of historic structures*	*Fourier Transform Infra RedSpectroscopy(FT-IR)*	*Historic structural analysis*	*Northern india-Temple architecture of Gujarat*
S-8	SLO-1	*Lime putty*	*Monument conservation and the role of Archeological Survey of India*	*Fourier Transform Infra RedSpectroscopy(FT-IR)*	*Understanding the failure of historic structures*	*Northernindia-Temple architecture of Orissa*
	SLO-2	*Precautions in handling*	*Monument conservation and the role of Archeological Survey of India*	*Self healing characteristics of ancient mortars*	*Understanding the failure of historic structures*	*NorthernIndia-Temple architecture of Orissa*
S-9	SLO-1	*Uses of lime*	*INTACH Heritage academy*	*Self healing characteristics of ancient mortars*	*Distress in historic structures*	*Northern India-Temple architecture of Madhyapradesh*
	SLO-2	*Uses of lime*	*INTACHHeritage academy*	*Bacterial precipitation*	*Distress in historic structures*	*Northern India-Temple architecture of, Madhyapradesh*
S-10	SLO-1	*carbonations*	*Central and state government policies and legislations*	*Bacterial precipitation*	*various methods of strengthening*	*Northern India-Temple architecture of Rajasthan*
	SLO-2	*carbonations*	*Central and state government policies and legislations*	*Mechanism of Bacterial precipitation*	*various methods of strengthening*	*Northern India-Temple architecture of Rajasthan*
S-11	SLO-1	*Hydraulic Index*	*Case studies on restoration of temples*	*Mechanism of Bacterial precipitation*	*Check for safety*	*Mughal architecture*
	SLO-2	*Hydraulic Index*	*Case studies on restoration of forts*	*Culturing of bacteria*	*Check for safety*	*Mughal architecture*
S-12	SLO-1	*Natural additive*	*Case studies on restoration of Palaces*	*Tests on bacterial growth*	*Advanced techniques*	*Examples of Mughal architecture*
	SLO-2	*Natural additive*	*Case studies on restoration of Chettinad houses*	*Tests on bacterial growth*	*Advanced techniques*	*Examples of Mughal architecture*

Learning Resources	1. *Percy Brown, Indian Architecture (Buddhist and Hindu Period),,Taraporevala and Sons,Bombay, 1983.* 2. *Satish Grover, The Architecture of India (Buddhist and Hindu Period) Vikas Publishing Housing Pvt. Ltd., New Delhi, 2003.*	3. *Beckmann, Poul 'Structural Aspects of Building Conservation', McGraw Hill, 1995.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Analyze								
Level 3	Evaluate	*50%*	-	*50%*	-	*50%*	-	*50%*	-
	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Mr. S. Kavin Kumar, Director, EPMCR, kavinkumar@epmcr.co.in*	1. *Dr Arun Menon, Associate Professor, IITM, arunmenon@iitm.ac.in*	1. *Dr. R. Ravi, SRMIST*
2. *Mr. Vinayak Dave, Sr. Manager, Business Development, Metecno, Vinayak.dave@metecno.in*	2. *Dr. Radhakrishna G. Pillai, Associate Professor, IITM, pillai@iitm.ac.in*	2. *Mr. A. Vijay, SRMIST*

Course Code	20CEE612T	Course Name	Seismic Retrofit of Buildings	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Know the basic concepts of earthquake resistant design*
CLR-2:	*Create insights to condition assessment of existing buildings*
CLR-3:	*Know the materials and techniques of repair*
CLR-4:	*Understand the local and global deficiencies and retrofitting techniques*
CLR-5:	*Create insights to retrofitting of heritage structures*
CLR-6:	*Know about archeological reconstruction*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the concepts of retrofitting of buildings due to earthquake*	3	3	2
CO-2:	*Apply the methods of seismic evaluation of buildings*	3	3	2
CO-3:	*Apply the local retrofitting techniques*	3	3	2
CO-4:	*Analyze the global retrofitting techniques*	3	3	2
CO-5:	*Understand strengthening techniques of special structures*	3	3	2
CO-6:	*Evaluate retrofitting methods of building*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*To know the basic concepts of earthquakes seismic design and retrofit of buildings*	*Causes and effects of EQ*	*Introduction-*	*Introduction*	*Introduction*
	SLO-2	*seismic vulnerability assessment*	*Characterization of EQ*	*Basic terms and definitions*	*Basic terms and definitions*	*recommendation of the international council on monuments and sites (ICOMOS)*
S-2	SLO-1	*retrofit strategies for different types of buildings*	*Response spectrum*	*Uses and applications*	*Uses and applications*	*Uses and applications*
	SLO-2	*BASIC CONCEPTS Making buildings safe against earthquakes*	*Basics of seismic analysis*	*Limitations*	*Limitations& codes*	*Limitations*
S-3	SLO-1	*Introduction to earthquakes*	*layout and configuration for seismic design*	*Codes used*	*seismic analysis*	*Codes used*
	SLO-2	*factors affecting the response of a building*	*lateral load resisting systems*	*Difference between retrofitting and repair*	*building deficiencies to retrofit*	*cultural heritage*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-4	SLO-1	*Importance of lateral strength*	*capacity based design*	*Systematic approach to diagonsis*	*strengthening of roofs and*	*Natural heritage*
	SLO-2	*importance of ductility*	*performance based design*	*Process of retrofit*	*Strengthening of upstairs floors*	*Difference between natural & cultural heritage*
S-5	SLO-1	*importance of integrity*	*Rapid visual screening, data collection and preliminary evaluation - Overview*	*Lintel belt*	*strengthening of pillars*	*Historical monuments in india*
	SLO-2	*essentials of seismic design of masonry buildings*	*rapid visual screening of Masonry Buildings and as per FEMcontentlink54*	*Corner strengthening*	*stress relieving techniques*	*Historical monuments in world*
S-6	SLO-1	*essentials of seismic design of RC buildings*	*Data Collection*	*Gable bracing*	*global retrofitting techniques*	*Protection of biodiversity*
	SLO-2	*how EQ-safe is our building*	*rapid visual screening of R.C Buildings and as per FEMcontentlink54*	*In- plan roof bracing*	*retrofit strategies-Global*	*Protection of historical places*
S-7	SLO-1	*To retrofit or not-retrofit of non-engineered*	*Data Collection*	*Plinth protection*	*retrofit strategies-local*	*Preserve our nature*
	SLO-2	*To retrofit or not-retrofit of Masonry Buildings*	*rapid visual screening of steel Buildings and as per FEMcontentlink54*	*Crack sealing*	*importance of seismic evaluation*	*condition assessment*
S-8	SLO-1	*To retrofit or not-retrofit of RC Buildings*	*Data Collection*	*Vulnerability of buildings*	*selection of retrofit strategy.*	*strengthening of Masonry walls*
	SLO-2	*Need for seismic evaluation of existing buildings*	*preliminary evaluation*	*seismic resistance features*	*Deficiencies of single storeyed buildings*	*strengthening of arches*
S-9	SLO-1	*attributes to seismic design*	*Condition Assessment of Existing Buildings: Overview*	*repair materials*	*Deficiencies of multi storeyed buildings*	*strengthening of vaults*
	SLO-2	*lateral strength*	*Condition Assessment of Existing Buildings: Introduction*	*repair techniques*	*retrofit strategies for single storey buildings*	*strengthening of domes*
S-10	SLO-1	*lateral stiffness*	*property of materials w.r.t the materials in existing buildings*	*strengthening of roofs*	*retrofit strategies for multi storeyed buildings*	*strengthening of towers*
	SLO-2	*Ductility,stability*	*its deterioration*	*strengthening of up stair floors*	*retrofit of foundations.*	*strengthening of spires*
S-11	SLO-1	*integral action of retrofit, repair and rehabilitation*	*Visual inspection*	*strengthening of walls*	*Deficiencies in foundations*	*reduction of seismic effect on structure*
	SLO-2	*Retrofit goals*	*Detailed investigation*	*strengthening of pillars*	*condition assessment*	*Strengthening of soil*
S-12	SLO-1	*retrofit objectives*	*NDT*	*Various instruments to be used*	*methods of analysis*	*Strengthening of foundation*
	SLO-2	*steps in seismic retrofit*	*intrusive rests.*	*techniques of global strengthening*	*Types of interventions.*	*archeological reconstruction.*

Learning Resources	1. *Naeim, F. (1989). The seismic design handbook. Springer Science & Business Media.* 2. *Jaiswal, O. R., Rai, D. C., & Jain, S. K. (2004). Review of code provisions on seismic analysis of liquid storage tanks. Document No. IITK-GSDMA-EQ04-V1. 0.* 3. *Fintel, M. (Ed.). (1974). Handbook of concrete engineering (p. 801). New York: Van NostrandReinhold* 4. *Hendry, A. W. (1990). Structural masonry. Scholium International.* 5. *Drysdale, R. G., Hamid, A. A., & Baker, L. R. (1994). Masonry structures: behavior and design, Prentice Hall*	6. *Bozorgnia, Y., &Bertero, V. V. (Eds.). (2004). Earthquake engineering: from engineering* 7. *seismology to performance-based engineering. CRC press.* 8. *Gupta, A. K. (1992). Response spectrum method in seismic analysis and design of structures (Vol. 1) CRC press.* 9. *Beskos, D. E., &Anagnostopoulos, S. A. (1997). Computer analysis and design of earthquake resistant structures: a handbook. WIT Press.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	-	*20%*	-	*20%*	-	*20%*	-
Level 2	Apply Analyze	*30%*	-	*30%*	-	*30%*	-	*30%*	-
Level 3	Evaluate Create	*50%*	-	*50%*	-	*50%*	-	*50%*	-
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. *Dr. Smitha Gopinath, Principal Scientist, CSIR-SERC, smithag@serc.res.in*	1. *Dr. U. Saravanan, Professor, IITM, saran@iitm.ac.in*	1. *Mr. H. Thiagu, SRMIST*
2. *Dr. Amar Parakash, Principal Scientist, CSIR-SERC, amar@serc.res.in*	2. *Dr. G.Beulah Gnana Ananthi, Associate Professor, Anna University, beulah28@annauniv.edu, beulahceg@gmail.com*	2. *Mr. S. Pradeep, SRMIST*

Course Code	20CEE613T	Course Name	Disaster Resistant Structures	Course Category	E	Professional Elective	L	T	P	C
							4	0	0	4

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

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Understand the design philosophy for loads, earthquake and wind*
CLR-2:	*Study the materials to be used, and design to be made for disaster resistant structures*
CLR-3:	*Study damage assessment and retrofitting*
CLR-4:	*Understand materials design and detailing for lifeline structures*
CLR-5:	*Know techniques of damage assessment*
CLR-6:	*Acquaint the students with case studies on different extreme cases affecting structures*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understanding design criteria for extreme loads*	3	3	2
CO-2:	*Evaluate materials to be used, and design to be made for disaster resistant structures*	3	3	2
CO-3:	*Evaluation of Knowledge assimilation of damage assessment and retrofitting*	3	3	2
CO-4:	*Application of materials used in disaster prevention*	3	3	1
CO-5:	*Techniques of damage assessment and analyse*	3	3	2
CO-6:	*Evaluate the knowledge of structures behavior against disaster and inclusion of different strategies*	3	3	2

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-1	SLO-1	*Introduction to Life line structures*	*Introduction to Community structures*	*Introduction to rehabilitation*	*Modern Materials for disasters reduction*	*Introduction to damage assessment*
	SLO-2	*Design philosophy of lifeline structures*	*Design philosophy of community structures*	*Introduction to retrofitting*	*Different tests on repair materials*	*Techniques of damage assessment*
S-2	SLO-1	*Design philosophy of flood resistant structures*	*Safety Analysis*	*Various repair materials*	*Test of different Fiber, Mix design with admixtures*	*Damage surveys*
	SLO-2	*Flood resistant structure models across globe*	*Safety rating*	*Repair material properties*	*Test of different Fiber, Mix design without admixtures*	*Maintenance and modification to improve hazard resistance*
S-3	SLO-1	*Design philosophy of cyclone resistant structures*	*Reliability assessment methods*	*Criteria for material selection*	*Artificial fibre reinforced polymers*	*Effects due to climate, temperature, chemicals, wear and erosion*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
	SLO-2	*Cyclone resistant structure models across globe*	*Virtual assessment*	*service/exposure properties*	*Natural fiber like Sisal and Jute*	*Design and construction errors*
S-4	SLO-1	*Design philosophy of earthquake resistant structures*	*Repair methodology*	*Testing and evaluation*	*Adhesive like, Epoxy Resin*	*Purpose of damage assessment*
	SLO-2	*Earthquake resistant structure models across globe*	*Repair techniques*	*Different Non-destructive and partial destructive methods of investigation for concrete structures*	*Special concretes and mortars*	*Rapid assessment techniques*
S-5	SLO-1	*Design philosophy of fire-resistant structures*	*Retrofitting of structures*	*Different Non-destructive and partial destructive methods of investigation for masonry structures*	*Concrete chemicals*	*Investigation of damage*
	SLO-2	*Fire- resistant structure models across globe*	*Case studies on retrofitting*	*Different Non-destructive and partial destructive methods of investigation for timber structures*	*Special elements for accelerated strength gain*	*Evaluation of surface cracks*
S-6	SLO-1	*National code of practice on lifeline structures*	*Retrofitting procedures and practices*	*Schmidt hammer test*	*Techniques for Repair: Rust eliminators*	*Evaluation of structural cracks*
	SLO-2	*International code of practice on lifeline structures*	*Retrofitting of community structures*	*Concrete core drilling*	*Vacuum concrete*	*Crack initiation mechanism*
S-7	SLO-1	*Bylaws of urban areas*	*Nuclear Structures construction practice*	*Petrography testing techniques*	*Gunite and Shot Crete Epoxy injection*	*Damage assessment procedure*
	SLO-2	*Bylaws of urban areas closer to coastal zone*	*Importance of Nuclear structures*	*Ultrasonic pulse velocity test, Rebar locators, Half cell potentiometers*	*Detailing aspects of structures subject to probable disasters*	*NDT Techniques*
S-8	SLO-1	*Bylaws of semi-urban areas*	*Protection of nuclear structures*	*Classification according to safety level*	*Importance of ductile detailing*	*Coastal regulation zones*
	SLO-2	*Bylaws of semi-urban areas closer to coastal zone*	*International structural recommendations on nuclear structures*	*Methods and materials for strengthening for different disasters*	*Codal provisions on ductile detailing*	*Techniques in protecting coastal zones*
S-9	SLO-1	*Past history of floods*	*Dam Structures construction practice*	*Regulations and provisions for various types of disasters*	*Construction techniques*	*Creation of buffer zones in coastal areas*
	SLO-2	*Past history of cyclones*	*Importance of Dam structures*	*International laws on protecting structures against various disasters*	*Analysis methodology for retrofitting*	*Creation of natural methods in preventing storm surges*
S-10	SLO-1	*Past history of earthquake*	*Protection of Dam structures*	*Qualification tests*	*Techniques for optimal performance*	*Case study on mangroves in preventing storm surge*
	SLO-2	*Past history of fire accidents on structure in India*	*International structural recommendations on Dam structures*	*Holistic approach for multi-faced disaster mitigation*	*Structural health monitoring*	*Damages estimation due to explosion*

Duration (hour)		Module 1 (12)	Module 2 (12)	Module 3 (12)	Module 4 (12)	Module 5 (12)
S-11	SLO-1	*Past lessons learnt*	*Bridge Structures construction practice*	*Design issues*	*Active and passive health monitoring techniques*	*Foundation improvement techniques*
	SLO-2	*Approach to traditional and Modern Structures*	*Importance of Bridge structures*	*Seismic retrofitting*	*Load testing of structures*	*Foundation improvement techniques – Cont'd*
S-12	SLO-1	*Concept of life period-based Design*	*Protection of Bridge structures*	*Cyclone shelter and Flood control*	*Introduction to maintenance management*	*Application GIS in disaster management*
	SLO-2	*Live cases of life period-based Design*	*International structural recommendations on Bridge structures*	*Mitigation approaches on structures*	*Introduction to life estimation of structures*	*Case study on GIS in assessment*

Learning Resources	*1. Raiker .R.N, "Learning from failures, Deficiencies in Design, Construction and Service", R&D Center, Raiker Bhavan, 1987.* *2. Allen .R.T, and Edwards .S.C., "Repairs of Concrete Structure", # Ie and Sons, U.K.1987.*	*3. Moskvin .V "Concrete and Reinforced Concrete" - Deterioration and protection - MIR Publishers - Moscow 1983.* *4. Lecture notes on the course "Disasters Management" - conducted by Anna University, 2000.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3 (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	-	*20%*	-	*20%*	-	*20%*	-
	Understand								
Level 2	Apply	*30%*	-	*30%*	-	*30%*	-	*30%*	-
	Analyze								
Level 3	Evaluate	*50%*	-	*50%*	-	*50%*	-	*50%*	-
	Create								
Total		100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers

Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. Kishore Balasubramanian, Head, Structures, info@fsa-se.com	*1. Dr. P. A. Krishnan, Professor, NITT, pak@nitt.edu*	*1. Dr. S. Senthilselvan*
2. Mr. G. Ramesh, Director-Technical, Kriyaacon, info@kriyaacon.com	*2. Dr. S. T. G. Raghukanth, Professor, IITM, raghukanth@iitm.ac.in*	*2. Mr. A. Vijay*

Course Code	20GNS501J	Course Name	RESEARCH PUBLISHING AND PRESENTING SKILLS	Course Category	S	Skill Enhancement	L	T	P	C
							1	0	2	2

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Practice different oral presentation material preparations*
CLR-2:	*Practice presenting techniques suitable for different audiences*
CLR-3:	*Prepare and typeset scientific documents for disseminating research findings*
CLR-4:	*Analyze different disseminating techniques available*
CLR-5:	*Utilize different intellectual property sharing mechanisms*
CLR-6:	*Evaluate amongst different options available to present, publish research findings*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Identify different oral presentation elements, materials and technologies*	1	3	2
CO-2:	*Practice high impact presentation skills*	1	3	2
CO-3:	*Identify ways to present technical / scientific content structure and elements*	1	3	2
CO-4:	*Practice the different disseminating techniques used in scientific research findings*	1	3	2
CO-5:	*Identify intellectual property and its components, ways to protect, share intellectual information*	1	3	2
CO-6:	*Analyze the different oral and written publishing techniques to disseminate research findings*	1	3	2

Duration (hour)		Oral Content Preparation	Presenting Methods	Written Content Preparation	Publishing Methods	Intellectual Property & Plagiarism
		9	9	9	9	9
S-1	SLO-1	*Oral Presentation Structure: Manuscript, Impromptu, Memory, Extempore*	*Describe Audience; knowledge, Experience, Needs, Goals*	*Writing Preface, Prelude, Prologue, foreword, Introduction, Abstract,*	*Typesetting: LaTex, Word, XML etc.,*	*Public License, Creative Commons, Share-alike, Reciprocal License,*
	SLO-2	*context, need, agenda ,task, and object of the presentation document*	*Plan, Prepare, Practice, Present Creating a Positive First Impression,*	*Writing Dedication, Acknowledgement, Forward, Background*	*Indexing: ISI, SCI, SCIE, SCOPUS, SCIMAGO, ESCI, WoS,*	*Copyleft, Patentleft, Open patent, Public Domain*

Duration (hour)		Oral Content Preparation	Presenting Methods	Written Content Preparation	Publishing Methods	Intellectual Property & Plagiarism
		9	9	9	9	9
S 2-3	SLO-1	*Practice-1: Create Structure of a Presentation*	*Practice-4: Building rapport with Audience*	*Practice-7: Writing Preface, Prelude, Prologue, foreword, Introduction, Abstract*	*Practice-12: LaTex Editor, Word Editor*	*Practice-13: GNU-GPL, Public License Creative Commons License, Unlicense*
	SLO-2					
S-4	SLO-1	*Gather data, evidence to present, visual-auditory balance, engagement techniques*	*Increasing Credibility, Presenting Complex Material, Communicating with Impact*	*Literature Review: Narrative, Systematic, Argumentative, Integrative, Theoretical*	*Disseminating Research Findings: Public Domain, Open Information, Wikipedia*	*Intellectual Property Rights, Copyrights, Patents, Trademarks, and Trade secrets*
	SLO-2	*Introduction, body, closure, question-answer*	*Motivating Others, Responding to Pressure Situations, Inspiring People*	*Writing Problem Statement, Limitations, Method Adapted, Tools & Technology used*	*Media, Press Release, Flyers, Brochure, Research Summary, Posters, Websites*	*Industrial design rights, Plant variety rights, trade dress, geographical indications*
S 5-6	SLO-1	*Practice-2: Create a structured oral presentation module*	*Practice-5: Communicating with Greater Impact, Rehersals and Retrials*	*Practice-8: Writing Literature Review*	*Practice-11: Study of Various Open Publishing Methods*	*Practice-14: IPR Law, Private Domain*
	SLO-2					
S-7	SLO-1	*Tools: Presentation Slides, Whiteboard Animators, Immersive Technologies*	*Delivery Styles: Visual, Freeform, Lessig Instructor, Coach, Storytelling, Connector*	*Main Body: Analysis, Design, Development Steps, Implementation Steps, Evaluations*	*Patents, Journals, Conferences, Reports, RFCs etc.,*	*Infringements: Copylefts, Copyrights, Patentlefts, Patentrights,*
	SLO-2	*Handouts, Visual Aids, Demonstrative Aids, Thought Provoking Questions*	*Persuasive, Interactive, Decision Making, Educational, Takahasi Arousing*	*Referencing: Documentary, Parenthetical, Numbered, Vancouver, IEEE, Harvard etc.,*	*Journal Index, Impact Factor, Quality Standards*	*Plagiarism: Paraphrasing, Verbatim, Mosaic, Global, Self, Accidental etc.,*
S 8-9	SLO-1	*Practice-3: Demonstrating a multi technology oral presentation*	*Practice-6: Presenting same content using different delivery styles*	*Practice-9: Writing Main Body*	*Practice-12:Study of h-index, i10-index, g-index, r-index, π - index*	*Practice-15: Plagiarism checking and correcting techniques*
	SLO-2					

Learning Resources	
	1. Dale Carnegie, "Develop Self-Confidence, Improve Public Speaking", Amazing Reads, 2018
	2. Dale Carnegie, "The Art of Public Speaking", Amazing Reads, 2018
	3. Joseph Mugah, "Essentials of Scientific Writing: How to Write Effective Titles and Abstracts for Research Papers and Proposals", Authorhouse, 2016
	4. Rajesh Singh, Sanjeev Kumar Sinha, Samir Kumar, "Unfolding Intellectual Property Rights : A Practical Patent Guide for Researchers, Academicians and start-ups", Notion Press, 2019
	5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (20%)		CLA – 2 (25%)		CLA – 3# (15%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*
	Understand								
Level 2	Apply	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*
	Analyze								
Level 3	Evaluate	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	*15%*	*15%*

	Create								
	Total	100 %		100 %		100 %		100 %	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, Conf. Paper etc.,

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Dr. Sainarayanan Gopalakrishnan, HCL Technologies, sai.jgk@gmail.com	*1. Dr. Venkat Adhikari, Technology Licensing Manager, IISC, venkatadhikari@iisc.ac.in*	*1. Dr. Rajeev Sukumaran SRMIST*
2. Dr. Sricharan Srinivasan, Wipro Technologies, sricharanms@gmail.com	*2. Mr. Ateet Palmurkar, Senior Manager IP Licensing, IITM, ipmarketing@iitm.ac.in*	*2. Dr. V. Nithyananthan SRMIST*

Course Code	20GNS502J	Course Name	RESEARCH METHODOLOGY (SCIENCE and TECHNOLOGY)	Course Category	S	Skill Enhancement	L	T	P	C
							2	1	2	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Get overall picture of research methodology*
CLR-2:	*Search and find research resources and to review it*
CLR-3:	*Get expertise in academic writing and presentation skills*
CLR-4:	*Learn the importance of modern statistical tools for research*
CLR-5:	*Learn optimization tools, modelling tools and case studies in the domain of study*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Demonstrate ability to identify research topic and draft research proposal using the scientific methods of enquiry.*	3	3	-
CO-2:	*Carry out literature survey / review in research domains using online, library resources and modern tools.*	3	3	-
CO-3:	*Write project proposals, research reports and publish the work with ethical and moral responsibilities.*	3	3	2
CO-4:	*Apply statistical principles in data collection, analysis, inference and prediction.*	3	2	2
CO-5:	*Apply basic principles and modern tools to model and simulate engineering systems*	3	-	3

Duration (hour)		Research Preparation and Planning (9+2 Tutorial)	Research Resources (9+2 tutorial)	Academic Writing & Presentation (6+5 Tutorial)	Data Collection, Analysis and Inference (12)	Modelling and Case Studies 12(practice)
S-1	SLO-1	*Introduction to research methodology, Need*	*Sources of information – types, ICT enabled tools*	*Preparation of project proposal for funding – Identification of funding agencies - format - elements of Style*	*Basic probability distributions – types – applications in Engineering – statistics – types*	***Optimization studies and modern tools usage** in the field of study – case studies, use cases, exercises*
	SLO-2	*Research – objectives, definitions – knowledge economy*	*Databases, repositories, public and private sources, indexes*	*Organization of proposals – current status in national & global scenario*	*Normal distribution – exercises – problem solving using software tools*	

S-2	SLO-1	*Perspectives of stakeholders*	*Literature search – Keyword, backward and forward search*	*Research report writing: Identification of line of argument – article type*	*Binominal and Poisson distributions – exercises using software*	
	SLO-2	*Types of research - examples*	*Area of research – background knowledge – new approach*	*Communication model – audience analysis – tailoring for audience*	*Weibull and exponential distributions*	
S-3	SLO-1	*Understanding research goals – examples*	*Quality measurement tools: citation index, impact factor, h-index, g-index, i10 index, JCR*	*Identification of suitable journal – format – instructions to authors – structure - major headings*	*Sampling: types – size of sample – sample designs*	
	SLO-2	*Critical thinking Vs Creative thinking*		*Writing discussion & conclusions*		
S-4	SLO-1	*Templates for design problem definition*	*Reading research article – meta analysis*	*Conference presentation types: Oral, poster – difference in audience interaction*	*Sampling tests: Student t-test – applications in engineering / research – exercises using software tools*	*Modelling and Simulation in the field of study – case studies, use cases, exercises (to improve analyzing and evaluating skills of scholars)*
	SLO-2	*Research proposal – rational techniques to find research ideas*	*Literature review: Grouping, analyzing & comparison of articles*	*Synopsis – Thesis - extended abstract – graphical and video abstract - short communications*		
S-5	SLO-1	*Techniques for generating research topic – attributes, justification*	*Reporting literature review*	*Contributions of the work – Novelty – Innovation - Examples*	*F-test and its application in research studies – exercises using software*	
	SLO-2	*Identifying broad research question and objectives.*	*Literature gap, refining research question and objectives – case studies*	*Referencing – style – tools for referencing, Appendix – Manual for preparation of Synopsis*	*$\chi 2$ test and its application in research studies – exercises using software*	
S-6	SLO-1	*Methods of scientific enquiry – Theoretical, Experimental and Emperical - Examples*	*Identification of research methods – Experiments – results – Examples*	*Thesis Writing: Structure – Preliminary pages, Main body, References – contents - Manual*	*Correlation and regression Analysis- Time series analysis*	
	SLO-2			*Evaluation of Thesis – examiner reports – example - Oral defense*	*Forecasting methods*	
S-7	SLO-1	*Innovation, Tools for scientific enquiry - Questionnaire*	*Intellectual Property Rights – Motivation – WIPO and WTO – IPR laws – TRIPS*	*Tutorial on writing an abstract from a manuscript*	*Factor analysis, Cluster Analysis and Discriminant Analysis*	1. *Recent inventions and innovations in the field of study – Case studies.* 2. *Adoption of Artificial Intelligence and Machine Learning tools in the field of study – case studies.*
	SLO-2	*Techniques in designing questionnaire – case studies*	*Copyright – patent – invention – trademark – trade secret – Geographical indication – industrial designs – Technology transfer*			
S-8	SLO-1	*Hypothesis - Formulation*	*Patenting procedures; Patent search – case studies*	*Tutorial on writing materials and methods and methodology / experiments*	*Design of experiments - basic experimental designs:*	
	SLO-2	*Hypothesis testing – examples / case studies*			*Completely Randomized Design*	
S-9	SLO-1	*Procedural guidelines in research*	*Exercise on literature review*			

	SLO-2	*process – example / use case*		*Tutorial on presenting experimental results using charts and graphs*	*Randomized Block Design, Latin Square Design - Exercises*	
S-10	SLO-1 SLO-2	*Tutorial on questionnaire preparation*	*Tutorial on reading a research article*	*Tutorial on writing discussion section from experimental results and literature review.*	*Full factorial design - 2^2, 2^3 and 2^4 only - exercises*	*Analysis of thesis from library / UGC/ other University web portals, etc*
S-11	SLO-1 SLO-2	*Tutorial on hypothesis formulation and testing*	*Tutorial on writing literature review report from literature search*	*Tutorial on thesis preparation*	*Fractional factorial designs - exercises*	
S-12	SLO-1 SLO-2				*Accuracy, Precision and error analysis*	

Learning Resources	*1. Mukerjee, S.P., (2020), A Guide to Research Methodology: An Overview of Research Problems, Tasks and Methods, CRC Press, Taylor & Francis Group, New York* *2. Bairagi, V., and Munot. M.V., (2019), Research Methodology: A practical and scientific approach, CRC Press, Taylor & Francis Group, New York.* *3. Locharoenrat, K., (2017), Research Methodology for beginners, CRC Press, Taylor & Francis Group, New York* *4. Alvi, M.H., (2016), A Manual for Referencing styles in Research, University of Karachi, Karachi, Pakistan.* *5. IEEE Reference Guide (2018), IEEE Periodicals, Transactions / Journal Department, Piscataway , New Jersey, USA* *6. Ganesan R, Research Methodology for Engineers, MJP Publishers, Chennai. 2011* *7. Walpole R.A., Myers R.H., Myers S.L. and Ye, King: Probability & Statistics for Engineers and Scientists, Pearson Prentice Hall, Pearson Education, Inc. 2007.* 8. *Dawson, C., (2002), Practical Research Methods, How to Books, Oxford OX4.1E, United Kingdom.*	*9. Adams, K.A., and Lawrence, E.K., (2019), Research Methods, Statistics and applications, Sage Publication, Thousand ORKS, California, USA* *10. Gastel, B., and Day, R.A., (2016), How to Write and Publish a Scientific paper, 8th Edition, Greenwood, California* *11. Kornuta, H.M., and Germaine, R.W., (2006), A concise guide to writing a Thesis or Dissertation, 2nd Edition, Taylor & Francis Group, New York* *12. Greenfield, T., and Greener, S., John Wiley & Son (2016), Research Methods for Post Graduates, West Sussex, United Kingdom.* *13. Turabian, T.L., (2007), A Manual for Writers of Research Papers, Thesis and Dissertation, 7th Edition, The University of Chicago Press, Chicago, USA* *14. Theil, D.V., (2014), Research Methods for Engineers, Cambridge University Press, Cambridge, UK.* *15. **Web resources:** Suitable web resources shall be referred by learners.*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (60% weightage)						Final Examination (40% weightage)	
		CLA – 1 (15%)		CLA – 2 (20%)		CLA – 3 #(25%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*30 %*	-	*30 %*	-	-	-	*30 %*	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	-	*80%*	*40 %*	-
Level 3	Evaluate Create	*30 %*	-	*30 %*	-	-	*20%*	*30 %*	-

	Total	100 %	100 %	100 %	100 %

CLA – 3 shall be from Modelling and case studies unit.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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2. Mr. Hariharasudhan - Johnson Controls, Pune, hariharasudhan.v@jci.com	*2. Dr. Venkatesan, Sr. Scientist, NIOT, Chennai, venkat@niot.res.in*	*2. Prof. D. Kingsly Jeba Singh, SRMIST*

Course Code	20CEP601L	Course Name	INTERNSHIP	Course Category	P	Internship In Industry	L	T	P	C
							0	0	0	4

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Provide an exposure to an industrial environment or research laboratory / institution*
CLR-2:	*Acquire practical knowledge of theoretical concepts*
CLR-3:	*Understand the organization structure, functions and protocols*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Appreciate the functioning of an organization*	3	3	2
CO-2:	*Apply the theoretical concepts to solve engineering problems*	3	3	2
CO-3:	*Take up different roles in a career with confidence*	2	2	2

It is mandatory for every student to undergo this course.

Every student is expected to spend a minimum of 4 to 6 weeks in an Industry/ Company/ Organization, during the summer vacation between II and III semester

The type of industry must be NOT below the Medium Scale category in his / her domain of the degree programme.

The student must submit the “Training Completion Certificate” issued by the industry / company / Organisation as well as a technical report not exceeding 15 pages, within the stipulated time to be eligible for making a presentation before the committee constituted by the department.

The committee will then assess the student based on the report submitted and the presentation made.

Marks will be awarded out of maximum 100.

Appropriate grades will be assigned as per the regulations.

Only if a student gets a minimum of pass grade, appropriate credit will be transferred towards the degree requirements, as per the regulations.

It is solely the responsibility of the individual student to fulfill the above conditions to earn the credits.

The attendance for this course, for the purpose of awarding attendance grade, will be considered 100%, if the credits are transferred, after satisfying the above (1) to (8) norms; else if the credits are not transferred or transferable, the attendance will be considered as ZERO.

The committee must recommend redoing the course, if it collectively concludes, based on the assessment made from the report and presentations submitted by the student, that either the level of training received or the skill and / or knowledge gained is NOT satisfactory.

Assessment for Semester Internship		
	Final Evaluation (100% weightage)	
	Report along with completion certificate from company	Viva-Voce
Semester Internship	50 %	50 %

Course Code	20CEP603L	Course Name	PROJECT WORK PHASE - I	Course Category	P	Project Work / Internship in Industry	L	T	P	C
							0	0	12	6

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Provide students with the opportunity to explore a problem or issue of particular personal or professional interest*
CLR-2:	*Address the problem or issue through focused study and applied research*
CLR-3:	*Prepare a technical report and present in a professional manner*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Identify issues/problems pertaining related to structural elements based on individual or societal interest*	3	3	2
CO-2:	*Apply and analyse the structural engineering knowledge for finding suitable solutions for the individual/ set of problems*	3	3	2
CO-3:	*Compile the outcomes scientifically and communicate in the expert forum*	3	3	2

The project work (Phase – I) is the preparatory phase for the major project to be taken up during the final semester of the programme.
Each student is expected to identify an engineering problem in his / her specialization of study.
Each student must study in-depth the issues / causes & effects underlying the problem and define the objective of the subsequent work.
A faculty supervisor / mentor will be assigned to each project.
A report of the work done during Phase – I must be submitted at the end of the semester, for evaluation.
Assessment will be made as per the table below:

	Continuous Learning Assessment (70% weightage)			Final Evaluation (30% weightage)	
	Review - 1	Review - 2	Review – 3	Project Report	Viva-Voce
Project Work (Phase I)	*15 %*	*25 %*	*30 %*	*15 %*	*15 %*

Course Code	20CEP604L	Course Name	PROJECT WORK PHASE - II	Course Category	P	Project Work / Internship in Industry	L	T	P	C
							0	0	32	16

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Provide students with the opportunity to explore a problem or issue of particular personal or professional interest*
CLR-2:	*Address the problem or issue through focused study and applied research*
CLR-3:	*Demonstrate the student's ability to synthesize and apply the knowledge and skills acquired in his/her academic program to real-world issues and problems*
CLR-4:	*Affirm students' ability to think critically and creatively, to solve practical problems, to make reasoned and ethical decisions, and to communicate effectively*
CLR-5:	*Prepare a technical report and present in a professional manner*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand problem pertaining to various social relevant issues based on individual or Community base*	3	3	3
CO-2:	*Apply their expertise to provide a suitable long-term solution to research problems*	3	3	3
CO-3:	*Impart his/her specialization knowledge in addressing issues pertaining to the society*	3	3	3
CO-4:	*Recommend with suitable justification, by comparing with various standards and regulations*	3	3	3
CO-5:	*Compile the output in a scientific way and present it to scientific community*	3	3	3

The project work Phase - II is to extend their academic experience into areas of personal interest, working with new ideas, issues, organizations, and individuals.
The project shall be driven by realistic constraints like that related to economic, environmental, social, political, ethical, health & safety, manufacturability and sustainability.
A report of the work done during Phase – II must be submitted at the end of the semester, for evaluation.

Assessment will be made as per the table below:

	Continuous Learning Assessment (70% weightage)			Final Evaluation (30% weightage)	
	Review - 1	Review - 2	Review - 3	Project Report	Viva-Voce
Project Work (Phase I)	15 %	25 %	30 %	15 %	15 %

Course Code	20CEA531J	Course Name	DISASTER MANAGEMENT	Course Category	A	Audit	L	T	P	C
							1	0	1	0

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Introduce various types of disasters and role of various stakeholders in disaster management*
CLR-2:	*Understand various phases of disaster management and risk reduction measures*
CLR-3:	*Acquire knowledge on hazard management systems*
CLR-4:	*Manage the pre and post disaster scenario*
CLR-5:	*Understand the role of disaster management and development*
CLR-6:	*Understand various disaster management acts*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Understand the role of various stakeholders in risk reduction measures*	3	3	2
CO-2:	*Develop management measures by considering preparedness, response and recovery and mitigation techniques*	3	3	2
CO-3:	*Evaluate the key concepts of hazard management systems*	3	3	1
CO-4:	*Distinguish various approaches of pre and post disaster scenarios*	3	3	2
CO-5:	*Integrate the management principles in disaster management*	3	3	2
CO-6:	*Apply various rules and regulation employed in disaster management*	3	3	2

Duration (hour)		5	5	5	5	5
S-1	SLO-1	*Disaster management; Global Issues; History of Disaster management*	*Hazards- Geological*	*Vulnerability and Risk- Quantitative and qualitative approach of risk evaluation*	*Pre-Disaster Management ; Post Disaster Management*	*Role of Technology in Disaster Management in India; Emergency Management Systems (EMS)*
	SLO-2	*Case Study*	*Case Study*	*Example of risk evaluation*	*Discussion- With Case Study*	*Discussion- NDMP Manual*
S-2	SLO-1	*Global Scenario (1970's- 80's)- Yokohoma and UN Strategy for Disaster Reduction, Hygo Framework for Action*	*Hazards- Hydrologic, Meteorological*	*Risk Perception; Vulnerability*	*Integrated Developmental Planning for Disaster Management; Role of Government agencies and NGO's in Mitigation & Management*	*Role of Remote sensing, GIS and GPS in Disaster Management*
	SLO-2	*Discussion on various strategies*	*Case Study*	*Example of Risk assessment*	*Discussion- With Case Study*	*Discussion- NDMP Manual*

Duration (hour)		5	5	5	5	5
S-3	SLO-1	*Disaster Management- Phases*	*Hazards- Biological/ health related, Infrastructure*	*Principles of mitigation measures; Preparedness*	*Vulnerable Groups in Disasters Management ; Essential Supplies; Site Management, Medical Trauma and Stress Management*	*Disaster Management in India- NDRF*
	SLO-2	*Discussion- NDMP- Manual*	*Case Study*	*Discussion- Need for Preparedness, Role of team work*	*Discussion- With Case Study*	*Discussion- NDMP Manual*
S-4	SLO-1	*Disaster Trends, Relation between Poverty Development*	*Hazards- Transportation, Infrastructure*	*Agencies involved; Mitigation- Types*	*Physical and Socio-economic Impacts of Disasters; Emotional Impacts of Disasters*	*Disaster Management Act (2005), Disaster Management Policy (2009)*
	SLO-2	*Discussion- NDMP- Manual*	*Case Study*	*Discussion on various types of mitigation and their importance*	*Discussion- With Case Study*	*Discussion- NDMP Manual*
S-5	SLO-1	*Disaster Management- Indian Scenario*	*Hazards- Industrial, Intentional*	*Obstacles in Mitigation Process; Role of Insurance*	*Rehabilitation and Reconstruction; Education and Public awareness; Capacity building*	*Major Disasters in India*
	SLO-2	*Case Study*	*Case Study*	*Case Study*	*Discussion- With Case Study*	*Case Studies*

Learning Resources	1. *D. Alexander, Natural Disasters, ULC Press, 1999* 2. *W.N. Carter, Disaster Management: A Disaster Management Handbook, Asian Development Bank, 2008* 3. *Damon P. Coppola, Introduction to International Disaster Management, 3rd edition, Elsevier, 2015* 4. *C.J. Barrow, Developing the Environment: Problems and Management, Harlow: Longman, 1995*	5. *Disaster Management Act "2005", Ministry of Home Affairs, Govt. of India, 2005* 6. *Reports of "National Disaster Management Authority", Govt. of India, 2013* 7. https://nptel.ac.in/courses/105104183/# 8. *https://nptel.ac.in/courses/124107010/*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	10%	10%	-	-
Level 2	Apply Analyze	*20%*	*20%*	*15%*	*15%*	20%	20%	-	-
Level 3	Evaluate Create	*10%*	*10%*	*20%*	*20%*	20%	20%	-	-
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
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Dr. Rajkumar, Director, HECS, Chennai. rajkumar@hecs.in	*Dr. E.S.M Suresh, Professor & Head, NITTTR, Chennai, esmsuresh@gmail.com*	*Dr. P. Purushothaman, SRMIST*

Course Code	20GNA511T	Course Name	CONSTITUTION OF INDIA	Course Category	A	Audit	L	T	P	C
							1	0	0	0

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

Course Learning Rationale (CLR):	*The purpose of learning this course is to:*
CLR-1:	*Identify the basic provisions in the Indian constitution*
CLR-2:	*List the fundamental rights, rights to equality, freedom, religion, culture, education and the right against exploitation*
CLR-3:	*Identify the fundamental duties of the Union of India, President, Vice-President, Union Ministers and Parliament functions*
CLR-4:	*Identify the power of states, its legislature, Governors role and the state judiciary*
CLR-5:	*List the special provisions and functionality of election commission, public service commission, individual tax and GST*
CLR-6:	*Build knowledge on the various aspects in the Indian Constitution, its provisions and right of a citizen and the society*

Course Outcomes (CO):	*At the end of this course, learners will be able to:*	*Programme Outcomes (PO)*		
		1	*2*	*3*
CO-1:	*Define the meaning and nature of constitution of India, its fundamental rights and duties*	3	3	2
CO-2:	*Analyse the power of state legislature and personal library*	3	3	2
CO-3:	*Define the meaning and nature of fundamental rights and its scope*	3	3	2
CO-4:	*Demonstrate the powers of Governor, Chief ministers and Judicial system*	3	3	2
CO-5:	*Incorporate the system of union territories and panchayats*	3	3	2
CO-6:	*Demonstrate the powers of president rule, election commission and UPSC*	3	3	2

Duration (hour)		3	3	3	3	3
S-1	SLO-1	*Meaning of the constitution law and constitutionalism*	*The Directive Principles of State Policy*	*President of India (with Powers and Functions)*	*Governor of the State (with Powers and Functions)*	*Local Self Government – Constitutional Scheme in India*
	SLO-2	*Historical perspective of the Constitution of India*	*Scheme of the Fundamental Right to Equality*	*Prime Minister of India (with Powers and Functions)*	*The Chief Minister of the State (with Powers and Functions)*	*Emergency Provisions : National, President Rule, Financial Emergency*
S-2	SLO-1	*Salient features and characteristics of the Constitution of India*	*Scheme of the Fundamental Right to certain Freedom under Article 19*	*Union Judiciary (Supreme Court) Jurisdiction of the Supreme Court*	*State Judiciary (High Courts)*	*Election Commission of India (with Powers and Functions)*
	SLO-2	*Citizenship*	*Scope of the Right to Life and Personal Liberty under Article 21*	*State Government*	*Union Territories, Panchayats,*	*The Union Public Service Commission (with Powers and*

Duration (hour)		3	3	3	3	3
						Functions)
S-3	SLO-1	*Scheme of the fundamental rights*	*Union Government, Union Legislature (Parliament)*	*State Legislature, Legislative Assembly, Legislative Council*	*Municipalities, Scheduled and Tribal Areas*	*Amendment of the Constitutional Powers and Procedure*
	SLO-2	*The scheme of the Fundamental Duties and its legal status*	*Lok Sabha and Rajya Sabha (with Powers and Functions), Union Executive*	*Powers and Functions of the State Legislature, State Executive*	*Co-operative Societies*	*Income Tax, Goods and Services Tax*

Learning Resources	1. *Durgadas Basu, Introduction to the Constitution of India, Lexis- Nexis, 2015* 2. *Subash C Kashyap, Our Parliament, National Books Trust, 2011*	3. *Kaushal Kumar Agarwal, India's No 1 book on Tax : Simple Language Advanced Problems: Income Tax, Kindle, 2017* 4. *Vivek K R Agarwal, GST Guide for students: Making GST – Good and Simple Tax, Neelam Book House, 2017*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	*40%*	-	*30%*	-	*30%*	-	-	-
	Understand								
Level 2	Apply	*40%*	-	*40%*	-	*40%*	-	-	-
	Analyze								
Level 3	Evaluate	*20%*	-	*30%*	-	*30%*	-	-	-
	Create								
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers			
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts	
1. Dr. Usha Kodandaraman, ABK AOTS, Chenna . drushak@gmail.com	1 .Dr. S. P.Dhanavel, IITM, Chennai, dhanavelsp@iitm@ac.in	1. Dr. K. Anbazhagan, SRMIST	3. Dr. Sukanya Saha, SRMIST
2. Mr. Durga Prasad Bokka, TCS Chennai, durgaprasad@tcs.com	2. Ms. Subashree, VIT, Chennai, subashree@vit.ac.in	2. Ms. Cauveri B, SRMIST	4. Dr. M. M.Umamaheswari, SRMIST 5.. S. Ramya, SRMIST

Course Code	20GNA513J	Course Name	VALUE EDUCATION	Course Category	A	Audit	L	T	P	C
							1	0	1	0

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

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Connect the learners to their potential, identify their potential to create a new positive world*
CLR-2:	*Analyze the merits and demerits of different educational systems. Identify the different systems of education*
CLR-3:	*Draw attention towards the weaknesses they are susceptible to and inspire them through positive models*
CLR-4:	*Instill a sense of professional ethics which help them develop a safe comfortable and prosperous society*
CLR-5:	*Cultivate a spirit of willing accommodation in an increasingly diverse world*
CLR-6:	*Strengthen, enhance the spirit of positivity and facilitate positive contribution in various spheres of life*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Equipped with an awareness of their positive energy and power*	3	3	-
CO-2:	*Identify the meaning of 'education'; have a clearer and better understanding in taking education to the masses*	3	3	-
CO-3:	*Assess their weaknesses; understand risks involved and rectify them through learning from positive and negative instances*	3	3	2
CO-4:	*Realize their professional responsibilities*	3	3	2
CO-5:	*Acquire the required values in an expanding pluralistic world not be swept off their feet due to the rapid changes*	3	3	2
CO-6:	*Equip with better understanding of themselves, society they live. Identify responsibilities in creating a peaceful world*	3	3	2

Duration (hour)		***Visions for Youth***	***Youth and Education***	***Youth and Society***	***Youth as Professionals***	***Youth in Pluralistic Society***
		6	**6**	**6**	**6**	**6**
S-1	SLO-1	*Introduction*	*Meaning and the significance of education*	*Need for social values in the present context*	*Introduction to professional values*	*Introduction to pluralistic society, forces of globalization*
	SLO-2	*Quiz*	*Brainstorming*	*Poem – "Where the mind is without fear" Write up on various instances from real life*	*Brainstorming through visual cues*	*Group Discussion*
S-2	SLO-1	*Two speeches by great personalities*	*Overview of different (traditional,*	*Individual and group behavior,*	*Engineering societies in India*	*Science and technology intercultural*

			modern)educational systems	*respect for others*		*proximity*
	SLO-2	*Oral presentations*	*Debate*	*Case study on recent happenings*	*Quiz*	*Narration of stories from various religions to illustrate the oneness of humanity*
S-3	SLO-1	*Quotes, proverbs relating to the power and potential of youth, Excerpts: Wings of Fire*	*Overview of different (traditional, modern) educational systems*	*Civic sense, bullying-substance abuse, uses of expletives*	*Challenges to be addressed by Engineers in India*	*Positive, Negative impact: religion, politics, gender, economic status, aesthetics*
	SLO-2	*Collecting proverbs highlighting the potential of youth*	*Debate*	*Case study on recent happenings*	*Case Study*	*Discussion on "To Kill a Mocking Bird"*
S-4	SLO-1	*Two news articles highlighting the initiatives for social causes by youth*	*Role of youth in education, Urban and Rural set up, dissemination*	*Hero worship, gender insensitivity, moral policing*	*Challenges in different sectors: agriculture*	*Values required to live in a global society*
	SLO-2	*Role play in a similar context*	*Student presentations*	*Case study on recent happenings*	*Case Study*	*Poster presentation on festivals of various religions*
S-5	SLO-1	*Two news articles highlighting the initiatives for social causes by youth*	*Designing and framing educational curriculum and materials*	*Positive contribution by youth in promoting social welfare*	*Challenges in different sectors: urban development, environment*	*Learning the etiquettes of various societies*
	SLO-2	*Role play in a similar context*	*Students' Presentation based on write ups*	*Short videos followed by discussions*	*Group activity (oral and written)*	*Poster presentation on festivals of various religions*
S-6	SLO-1	*One song exhibiting the positive energy of youth*	*The pressing challenges in current educational system*	*Positive contribution by youth in promoting social welfare*	*Challenges in different sectors: sustainable development, cyber security*	*Success of pluralistic society, enliven the society, religious harmony through literary*
	SLO-2	*Discussion on the song*	*Collage Design*	*Short videos followed by discussions*	*Case Study – from Newspapers*	*Writing the aspects of pluralistic society based on the text*

Learning Resources	1. *Kalam, APJ Abdul. Wings of Fire: AN Autobiography of APJ Abdul Kalam. Ed. Sangam Books Ltd., 1999* 2. *"Banaras Hindu University Speech" and "To Students". The Voice of Truth. General Editor Shriman Narayan. Navajivan Publishing House. pp. 3-13 and pp. 425-30. www.mkgandhi.org* 3. *Piroda, Sam. "Challenges in Science and Technology". www.nfdindia.org/loc19.htm*	4. *Thomas A Address to VTU Students by Narayana Murthy. https://www.karnataka.com/personalities/narayana-murthy/vtu-address-2006/* 5. *World Economic forum. "India's top 7 challenged from skills to water scarcity*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*20%*	*20%*	*15%*	*15%*	*15%*	*15%*	-	-
Level 2	Apply Analyze	*20%*	*20%*	*20%*	*20%*	*20%*	*20%*	-	-
Level 3	Evaluate Create	*10%*	*10%*	*15%*	*15%*	*15%*	*15%*	-	-
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers				
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts		
1. Dr. Usha Kodandaraman, ABK AOTS, drushsk@gmail.com	*1. Dr. S. P.Dhanavel, IIT Madras, dhanavelsp@iitmac.in*	*1. Dr .K.Anbazhagan, SRMIST*	*2. Dr. B. Cauveri, SRMIST*	
2. Mr. Durga Prasad Bokka, TCS, durgaprasad@tcs.com	*2. Ms. Subashree, VIT, Chennai, subashree@vit.ac.in*	*3. Dr. M. M.Umamaheswari, SRMIST*	*4. Dr. Sukanya Saha, SRMIST*	*5. Ms .S. Ramya, SRMIST*

Course Code	20GNA512L	Course Name	PHYSICAL AND MENTAL HEALTH USING YOGA	Course Category	A	Audit	L	T	P	C
							0	0	2	0

Pre-requisite Courses	Nil	Co-requisite Courses	Nil	Progressive Courses	Nil
Course Offering Department	Centre for Applied Research in Education	Data Book / Codes/ Standards	Nil		

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Utilize rich Indian heritage and knowledge for self-healing and self-protection from diseases
CLR-2:	Apply meditation for attaining happiness and balancing emotions and state of mind and body
CLR-3:	Intellectually develop oneself by identifying oneness with divine state and transform towards absolute oneness in space
CLR-4:	Socially transform into a meaningful and purposeful individual to both self and society
CLR-5:	Spiritually enlighten oneself by purifying the body, soul and have a blissful existence
CLR-6:	Achieve personal benefits of whole health and wellbeing by practicing yoga for physical, emotional and mental fitness

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	Identify Indian heritage, culture. Identify key anatomical structures in the human body and basic exercises for the same	3	3	-
CO-2:	Apply yoga meditation practices for emotional development and wellbeing	3	3	-
CO-3:	Identify educational and intellectual development methods using five sense realization and transformation	3	3	2
CO-4:	Demonstrate human values and emotions through thorough understanding about life, naturopathy and food habits	3	3	2
CO-5:	Impact self and society by peaceful coexistence with self-introspection and balanced diet charts	3	3	2
CO-6:	Demonstrate yoga exercises and postures to stretch and strengthen the body and mind	3	3	2

Duration (hour)		Physical Development	Emotional Development	Intellectual Development	Social Development	Spiritual Development
		6	6	6	6	6
S-1	SLO-1	Indian Heritage & Culture, Concept of Yoga, Objectives, Science & Art of Yoga	Brain Functions, Bio-Magnetism, Cognitive Mind	Education & Intelligence Development using Yoga. Improving Intelligence	Introduction: Social Intelligence	Spiritual Connect & Yoga: Self-Realization, Self-Awareness, Self-Actualization
	SLO-2	Women and Yoga Practice – Classification, Modern Age, Philosophy of Life	Emotional Intelligences, Managing Stress and Emotions	Learnability through Concentration, Intelligence through learning sense organs	Human values, Ethics & Morality	Cause and Effect Realization (Karma Yoga), Harmony in Life
S-2	SLO-1	Practice1: Standing exercise, Surya	Practice4: Surya Namaskar,	Practice7: Yoga for Youthfulness	Practice10: Kayakalpha,	Practice13: Management of

		Namaskar	*Standing asanas*	*(Kayakalpah Yoga)*	*Bhandas, Meditation (Crown)*	*Physical problems (Yoga therapy)*
	SLO-2	*Meditation (Self Realization), Relaxation*	*Meditation (Five Sense Realization), Relaxation*	*Meditation (Five Sense Realization), Relaxation*	*Self-introspection Practice (Moralization of Desire) & Relaxation*	*Meditation (Nine centre) & Relaxation*
S-3	SLO-1	*Physical Health: Body Structure, Diseases and Causes, Science of Human Body*	*Meditation for Emotional development: Eyebrow Center (Agna) Meditation*	*Theory of Intellectual Transformation: Divine state origin, absolute space,*	*Exercises for Self-Introspection: Analysis of thoughts, Moralization of desires*	*Spiritual Enlightenment*
	SLO-2	*Yoga &Youthfulness. Benefits, Comparison between other exercises and Yoga*	*Genetic Centre (Santhi) Meditation. Stress Relaxation Exercises*	*Transformation of universe, living beings, Intelligence, Knowledge, Wisdom & Peace*	*Anger Management, Eradicating worries, concerns & challenges*	*Purifying the Body (Genetic center)*
S-4	SLO-1	*Practice2: Surya Namaskar, Sitting Exercises*	*Practice5: Surya Namaskar, Sitting asanas,*	*Practice8: Kayakalpha Yoga, Pranayama*	*Practice11: Kayakalpha Yoga, Krisya Yoga*	*Practice14: Project Submission*
	SLO-2	*Meditation (Self Realization) – Relaxation*	*Meditation (Agna) & Relaxation*	*Meditation (Agna) - Relaxation*	*Yoga Mudhras, Meditation (Santhi) & Relaxation*	*Meditation, Introspection, Sublimination*
S-5	SLO-1	*Exercises: Hands, Legs, Neuro-Muscular breathing, Eye, Ears, Nostrils, kidney, brain*	*Asanas (Postures) for Body Structure: Full Body Structure Maintenance*	*Exercises: Intellectual development Brain Crown Centre (Thuriyam) Meditation*	*Therapy for Social Development: Gestures Yoga (Mudhras) – Body locks (Bhandhas)*	*Spirituality for Stress Management*
	SLO-2	*digestive tract, stomach, lungs, spine, hip, neck. Pressure points in our body*	*Standing, Sitting, Prone & Supine Posture, Benefits of asanas*	*Five Senses (Panchendriya) Meditation, Consciousness and Law of nature*	*Indian Medical System: Naturopathy, Food, Nutrition, Diet Chart for Youthfulness*	*Yoga Practices for blissful existence*
S-6	SLO-1	*Practice3: Prone & Supine posture Exercises*	*Practice6: Surya Namaskar, Prone & Supine posture Asanas*	*Practice9: Kayakalpha, Mudhras, Self- introspection Practice (Thought Analysis)*	*Practice12: Balancing Asanas,*	*Practice15: Practical Exam*
	SLO-2	*Meditation (Self Realization) – Relaxation*	*Meditation (Shanthi) & Relaxation*	*Meditation (Santhi), & Relaxation*	*Meditation (Crown) & Relaxation*	*Meditation & Relaxation*

Learning Resources	1. *Sadhguru Jaggi Vasudev, Inner Engineering – A yogi's guide to joy, 2016* 2. *Shri Shri Ravi Shankar, The Art of stress-free Living, 2011* 3. *Swami Ramdev Ji Yog Its Philosophy and Practice, 2008* 4. *Yogiraj Vethathiri Maharishi, Yoga for Modern Age, Tenth edition, Vethathiri Publications, 2007* 5. *Yogiraj Vethathiri Maharishi, Simplified Physical Exercises, Forty Second edition, Jan-2014*	6. *Vivekananda Kenthria Prkasan Trust, Yogam, 2006* 7. *Swami Chetanananda, Meditation and Its Methods According to Swami Vivekananda, Jan 2001* 8. *Dr. Lakshminarain Sharma, Yoga for the cure of Common Diseases, Mar 2016* 9. *Swami Satyananda Saraswati, Asana Pranayama Mudra Bandha, Bihar School of Yoga, 1993* 10. *Dr. Asana Andiappan, Thirumoolar's Astanga Yoga, International Yoga Academy, 2017*

Learning Assessment									
	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember	-	*40%*	-	*30%*	-	*30%*	-	-
	Understand								
Level 2	Apply	-	*40%*	-	*40%*	-	*40%*	-	-
	Analyze								
Level 3	Evaluate	-	*20%*	-	*30%*	-	*30%*	-	-
	Create								
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	Experts from Higher Technical Institutions	Internal Experts
1. Mr. K. Sivakumar, LIC of India, ksivalic1970@gmail.com	*1. Dr. R. Elangovan, Tamilnadu Physical Education and Sports University, relangovantnpesu@yahoo.co.in*	*1. Dr. V. Nithyananthan, SRMIST*
2. Mrs. R. Piramukutty, World Community Service Centre, iramukutty.gdvmvkm@gmail.com	*2.Dr. N. Perumal, Vethathiri Maharishi Institute for Spiritual and Intuitional Education, visionacademy@vethathiri.edu.in*	*2. Dr. S. Jahira Parveen SRMIST*

Course Code	20PDM501T	Course Name	CAREER ADVANCEMENT COURSE FOR ENGINEERS - I	Course Category	M	Mandatory	L	T	P	C
							1	0	1	0

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Development Centre*	Data Book / Codes/ Standards	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Become an expert in communication and problem solving skills*
CLR-2:	*Recapitulate fundamental mathematical concepts and skills*
CLR-3:	*Strengthen writing skills professionally and understand commercial mathematical applications*
CLR-4:	*Identification of relationships between words based on their function, usage and characteristics*
CLR-5:	*Sharpen logical and critical reasoning through skillful conceptualization*
CLR-6:	*Acquire the right knowledge, skill and aptitude to face any competitive examination*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Acquire communication and problem solving skills*	3	-	2
CO-2:	*Build a strong base in the fundamental mathematical concepts*	2	-	2
CO-3:	*Acquire writing skill to communicate with clarity*	-	3	-
CO-4:	*Use apt vocabulary to embellish language*	-	2	-
CO-5:	*Gain appropriate skills to succeed in preliminary selection process for recruitment*	2	-	2
CO-6:	*Enhance aptitude skills though systematic application of knowledge*	3	-	3

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Types of numbers, Divisibility tests*	*Fractions and Decimals, Surds*	*Percentage - Introduction*	*Sentence Correction*	*Number and Alphabet Series*
	SLO-2	*Solving Problems*	*Solving Problems*	*Solving Problems*	*Practice*	*Direction Test*
S-2	SLO-1	*LCM and GCD*	*Square roots, Cube roots, Remainder*	*Percentage Problems*	*Reading Comprehension*	*Blood Relations*
	SLO-2	*Solving Problems*	*Solving Problems*	*Solving Problems*	*Practice*	*Arrangements Linear, Circular*
S-3	SLO-1	*Unit digit, Number of zeroes, Factorial notation*	*Identities*	*Profit and Loss*	*Reading Comprehension*	*Ranking*
	SLO-2	*Solving Problems*	*Solving Problems*	*Solving Problems*	*Practice*	*Practice*

Duration (hour)		6	6	6	6	6
S-4	SLO-1	*Verbal Reasoning-Vocabulary*	*Spotting Errors*	*Discount*	*Reading Comprehension*	*Critical Reasoning-Strengthening*
	SLO-2	*Practice*	*Practice*	*Solving Problems*	*Practice*	*Practice*
S-5	SLO-1	*Verbal Reasoning-Vocabulary*	*Spotting Errors*	*Sentence Correction*	*Linear Equations*	*Critical Reasoning-Weakening*
	SLO-2	*Practice*	*Practice*	*Practice*	*Solving Problems*	*Practice*
S-6	SLO-1	*Verbal Reasoning-Vocabulary*	*Spotting Errors*	*Sentence Correction*	*Logical Reasoning-Intro*	*Critical Reasoning-Assumption*
	SLO-2	*Practice*	*Practice*	*Practice*	*Coding and Decoding*	*Practice*

Learning Resources	*1. Khattar D. "Quantitative Aptitude", Pearson's Publications, Third Edition (2015).* *2. Praveen R.V. "Quantitative Aptitude and Reasoning", EEE Publications, Third Edition (2016)* *3. Guha A. "Quantitative Aptitude", TATA McGraw Hill Publications, Sixth Edition (2017).* *4. P.A. Anand, "Quantitative Aptitude for Competitive Examination", WILEY Publications (2019)*	*5. Arihant. "IBPS PO - CWE Success Master", Arihant Publications(I) Pvt.Ltd – Meerut, First Edition (2018)* *6. Nishit Sinha. "Verbal Ability for CAT", Pearson India, First Edition (2018).* *7. Archana Ram, "Placementor", Oxford University Press, (2018)* *8.Bharadwaj A.P. " General English for Competitive Examination", Pearson Education, First Edition (2013)* *9. Thorpe S. "English for Competitive Examination", Pearson Education, Sixth Edition (2012).*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	-	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	-	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	-	-
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
Experts from Industry	Internal Experts	
1. Mr. Ajay Zener, Career Launcher, ajay.z@careerlauncher.com	*Dr. P. Madhusoodhanan, Head CDC, SRMIST*	*Dr. M. Snehalatha,, SRMIST*
	Mr. J.Jayapragash , Assistant Professor, SRMIST	*Dr.A.Clement, SRMIST*

Course Code	20PDM502T	Course Name	CAREER ADVANCEMENT COURSE FOR ENGINEERS - II	Course Category	*M*	Mandatory	L	T	P	C
							1	0	1	0

Pre-requisite Courses	*Nil*	Co-requisite Courses	*Nil*	Progressive Courses	*Nil*
Course Offering Department	*Career Development Centre*	Data Book / Codes/ Standards	*Nil*		

Course Learning Rationale (CLR):	***The purpose of learning this course is to:***
CLR-1:	*Recapitulate fundamental mathematical concepts and building the resume*
CLR-2:	*Become an expert in communication and problem solving skills*
CLR-3:	*Sharpen interpretational skills through skillful conceptualization,*
CLR-4:	*Sharpen analytical reasoning skills and professional skills*
CLR-5:	*Utilize professionalism with idealistic, practical and moral values that govern the behavior*
CLR-6:	*Acquire the right knowledge, skill and aptitude to face any competitive examination*

Course Outcomes (CO):	***At the end of this course, learners will be able to:***	***Programme Outcomes (PO)***		
		1	***2***	***3***
CO-1:	*Build a strong base in the fundamental mathematical concepts and resume*	2	-	2
CO-2:	*Acquire communication and problem solving skills.*	3	-	2
CO-3:	*Gain appropriate skills to succeed in preliminary selection process for recruitment*	2	-	2
CO-4:	*Acquire interpretational skills and professional skills*	2	2	2
CO-5:	*Develop professionalism with idealistic, practical and moral values*	2	-	2
CO-6:	*Enhance lexical skills through systematic application of concepts and careful analysis of style, syntax, semantics and logic*	2	3	-

Duration (hour)		6	6	6	6	6
S-1	SLO-1	*Ratio and Proportion-Intro*	*Sets-Rules*	*Group Discussion-3*	*Data Sufficiency-Intro*	*Personal Interview*
	SLO-2	*Solving Problems*	*Solving Problems*	*Practice*	*Solving Problems*	*Practice*
S-2	SLO-1	*Ratio and Proportion*	*Sets-Identities, Venn Diagram*	*Group Discussion-4*	*Data Sufficiency*	*Personal Interview*
	SLO-2	*Solving Problems*	*Solving Problems*	*Practice*	*Solving Problems*	*Practice*
S-3	SLO-1	*Mixture and Solutions-Intro*	*Functions-Intro*	*Group Discussion-5*	*Analytical Reasoning-Intro*	*Mock Interview*
	SLO-2	*Solving Problems*	*Solving Problems*	*Practice*	*Solving Problems*	*Mock Interview*
S-4	SLO-1	*Mixture and Solutions*	*Group Discussion- Do's and Don'ts*	*Data Interpretation-Intro*	*Analytical Reasoning*	*Mock Interview*
	SLO-2	*Solving Problems*	*Practice*	*Solving Problems*	*Solving Problems*	*Mock Interview*

Duration (hour)		6	6	6	6	6
S-5	SLO-1	*Profile Building*	*Group Discussion-1*	*Data Interpretation-Tables, Pie Chart*	*Personal Interview-Do's and Don'ts*	*Mock Interview*
	SLO-2	*Profile Building*	*Practice*	*Solving Problems*	*Practice*	*Mock Interview*
S-6	SLO-1	*Resume Building*	*Group Discussion-2*	*Data Interpretation-Lines, Bar Graphs*	*Personal Interview*	*Quantitative Reasoning Revision*
	SLO-2	*Resume Building*	*Practice*	*Solving Problems*	*Practice*	*Solving Problems*

Learning Resources	*1. Khattar D. "Quantitative Aptitude", Pearson's Publications, Third Edition (2015).* *2. Guha A. "Quantitative Aptitude", TATA McGraw Hill Publications, Sixth Edition (2017).* *3. Butterfield J. "Soft Skills for Everyone", Cengage Learning India Private Ltd, First Edition, (2011).*	*4. Bono E.D. "Six Thinking Hats is a book" , Little Brown and Company, First Edition (1981)* *5. P.A. Anand, "Quantitative Aptitude for Competitive Examination", WILEY Publications (2019)* *6. Archana Ram, "Placementor", Oxford University Press, (2018)*

Learning Assessment

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		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	-	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	-	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	-	-
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

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Experts from Industry	Internal Experts	
Mr. Ajay Zener, Career Launcher, ajay.z@careerlauncher.com	*Dr. P. Madhusoodhanan, Head CDC, SRMIST*	*Dr. M. Snehalatha,, Assistant Professor, SRMIST*
	Mr.P.Priyanand , Assistant Professor, SRMIST	*Mrs.Kaviatha Srisarann, Assistant Professor, SRMIST*

Course Code	20PDM601T	Course Name	CAREER ADVANCEMENT COURSE FOR ENGINEERS - III	Course Category	M	Mandatory	L	T	P	C
							1	0	1	0

Course Learning Rationale (CLR):	The purpose of learning this course is to:
CLR-1:	Acquire knowledge on planning, preparing and designing a learning program
CLR-2:	Prepare effective learning resources for active practice sessions
CLR-3:	Facilitate active learning with new methodologies and approaches
CLR-4:	Create balanced assessment tools
CLR-5:	Hone teaching skills for further enrichment
CLR-6:	Define standards, goals and objectives

Course Outcomes (CO):	At the end of this course, learners will be able to:	Programme Outcomes (PO)		
		1	2	3
CO-1:	Build a strong foundation in designing a lesson plan	2	-	3
CO-2:	Acquire knowledge of learning resources for effective delivery	1	-	2
CO-3:	Sharpen teaching skills with the latest methodologies and techniques	3	2	3
CO-4:	Develop practical assessment tools to ensure validity and flexibility	2	-	2
CO-5:	Enhance effective presentation and teaching methods	2	3	-
CO-6:	Reinforce Bloom's Taxonomy of educational goals and objectives	1	-	2

Duration (hour)		6	6	6	6	6
S-1	SLO-1	Lower and Higher order learning	Definition and purpose of assessment	Peer Teaching practice	Live Teaching Sessions	Live Teaching Sessions
	SLO-2	Outcomes from lower order learning	Practice	Discussion and feedback	Live Teaching Sessions	Live Teaching Sessions
S-2	SLO-1	Planning and preparing a learning programme and session	Distinction between formative and summative assessment	Peer Teaching practice	Live Teaching Sessions	Live Teaching Sessions
	SLO-2	Practice	Examples and discussions	Discussion and feedback	Live Teaching Sessions	Live Teaching Sessions
S-3	SLO-1	Teacher and Student-Centered class room	Instructional materials	Cooperative learning procedure	Live Teaching Sessions	Live Teaching Sessions
	SLO-2	Discussion	Examples and discussion	Different models of cooperative learning	Live Teaching Sessions	Live Teaching Sessions
S-4	SLO-1	Roles of teachers and students	Instructional design	Limitations of cooperative learning	Live Teaching Sessions	Live Teaching Sessions

Duration (hour)		6	6	6	6	6
	SLO-2	*Discussion*	*Practice*	*Discussion*	*Live Teaching Sessions*	*Live Teaching Sessions*
S-5	SLO-1	*Discussion Strategies*	*Presentation of lesson plans*	*Structure of a lecture*	*Live Teaching Sessions*	*Live Teaching Sessions*
	SLO-2	*Practice*	*Discussion*	*Practice*	*Live Teaching Sessions*	*Live Teaching Sessions*
S-6	SLO-1	*Bloom's Taxonomy of educational goal*	*Group Work in learning*	*Live Teaching Sessions*	*Live Teaching Sessions*	*Live Teaching Sessions*
	SLO-2	*Practice*	*Discussion*	*Live Teaching Sessions*	*Live Teaching Sessions*	*Live Teaching Sessions*

Learning Resources	*1. Barker I. "Cambridge International Diploma for Teachers and Trainers", Cambridge University Press, 2006.* *2. Whitehead Jack, Creating a Living Educational Theory from Questions of the kind: How do I improve my Practice? Cambridge Journal of Education, 2006*	*3. Vicki Phillips and Lynn Olson, "Ensuring Effective Instruction: How do I improve teaching using multiple measures?" Bill & Melinda Gates Foundation, 2013* *4. Dr G M Chaudhary, "Teaching Methodology: Effective Teaching Strategies", Independently Published , 2019*

Learning Assessment

	Bloom's Level of Thinking	Continuous Learning Assessment (100% weightage)						Final Examination (0% weightage)	
		CLA – 1 (30%)		CLA – 2 (50%)		CLA – 3#(20%)			
		Theory	Practice	Theory	Practice	Theory	Practice	Theory	Practice
Level 1	Remember Understand	*40 %*	-	*30 %*	-	*30 %*	-	-	-
Level 2	Apply Analyze	*40 %*	-	*40 %*	-	*40 %*	-	-	-
Level 3	Evaluate Create	*20 %*	-	*30 %*	-	*30 %*	-	-	-
	Total	100 %		100 %		100 %		-	

CLA – 3 can be from any combination of these: Assignments, Seminars, Tech Talks, Mini-Projects, Case-Studies, Self-Study, MOOCs, Certifications, and Conf. Paper etc.

Course Designers		
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