SCHEME & SYLLABUS

FOR

M.TECH.

STRUCTURAL ENGINEERING

2025-26

Department of Civil Engineering
Siddaganga Institute of Technology
Tumakuru-572 103.

SIDDAGANGA INSTITUTE OF TECHNOLOGY, TUMAKURU

(An autonomous institution affiliated to VTU, Belagavi, Approved by AICTE, New Delhi, Accredited by NAAC with 'A' grade & ISO 9001:2015 Certified)

M.Tech in Structural Engineering

SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

Applicable for students admitted from the Academic Year 2025-26 and onwards

I Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory L	Practical / Seminar P	Tutorial / Skill Development T/SDA	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
1.	IPCC	S1CSE01	Advanced Design of RC Structures (I)	3	2	0	3	50	50	100	4
2.	PCC	S1CSE02	Structural Dynamics	3	0	0	3	50	50	100	3
3.	PCC	S1CSE03	Computational Structural Mechanics	2	0	2	3	50	50	100	3
4.	PCC	S1CSE04	Mechanics of Deformable Bodies	2	0	2	3	50	50	100	3
5.	PEC	S1CSEE1x	Professional Elective – 1	2	-	2	3	50	50	100	3
6.	PEC	S1CSEE2x	Professional Elective – 2	2	0	2	3	50	50	100	3
7.	NCMC	S1PGRM	Research Methodology and IPR	1	0	0	-	50	-	50	PP
8.	PCCL	S1CSEL1	Structural Design Laboratory	1	2	0	3	50	50	100	2
9.	AEC	PGARAS	Aptitude Related Analytical Skills	36 Hrs. for the entire				100	-	100	1
	Total			**16**	**4**	**8**		**500**	**350**	**850**	**22**

Professional Elective 1		Professional Elective 2	
S1CSEE11	Design of Substructures	S1CSEE21	Advanced Pre-Stressed Concrete Structures
S1CSEE12	Advanced Concrete Technology	S1CSEE22	Repair, Rehabilitation and Health Monitoring of Structures
S1CSEE13	Analysis and Design of Plates and Shells	S1CSEE23	Design of Storage and Stack-like Structures
S1CSEE14	Introduction to AI and its applications	S1CSEE24	Advanced Design of Steel Structures

Note: **BSC**-Basic Science Courses, **PCC**: Professional core. **IPCC**-Integrated Professional Core Courses, **PCC(PB):** Professional Core Courses (Project Based), **PCCL-** Professional Core Course lab , **NCMC**- None Credit Mandatory Course, **L**-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities(Hours are for Interaction between faculty and students) **N1PGRM**- Research Methodology and IPR (Offline) for the students who have not studied this course in the Undergraduate level. This course is not counted for vertical progression, Students have to qualify for the award of the master's degree

BSC: **Basic Science Courses**: Courses like Mathematics/ Science are the prerequisite courses that the concerned engineering stream board of Studies will decide. **PCC: Professional Core Course:** Courses related to the stream of engineering, which will have both CIE and SEE components, students have to qualify in the course for the award of the degree. **Integrated Professional Core Course (IPCC):** Refers to a Professional Theory Core Course Integrated with practicals of the same course. The IPCC's theory part shall be evaluated by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. **Project Based Learning Course (PCC(PB):** Project Based Learning course is a professional core Course only Students have to complete a project out of learning from the course and SEE will be viva voce on project work**. PCCL: Professional Core Course Laboratory**: Practical courses whose CIE will be evaluated by the class teacher and SEE will be evaluated by the two examiners.

Skill development activities: Under Skill development activities in a concerning course, the students should 1. Interact with industry (small, medium, and large). 2. Involve in research/testing/projects to understand their problems and help creative and innovative methods to solve the problem. 3. Involve in case studies and field visits/ fieldwork. 4. Accustom to the use of standards/codes etc., to narrow the gap between academia and industry. 5. Handle advanced instruments to enhance technical talent. Gain confidence in the modelling of systems and algorithms for transient and steady-state operations, thermal study, etc. 7. Work on different software/s (tools) to simulate, analyze and authenticate the output to interpret and conclude.

All activities should enhance student's abilities to employment and/or self-employment opportunities, management skills, Statistical analysis, fiscal expertise, etc.Students and the course instructor/s are to be involved either individually or in groups to interact together to enhance the learning and application skills of the study they have undertaken. The students with the help of the course teacher can take up relevant technical –activities that will enhance their skills. The prepared report shall be evaluated for CIE marks

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II Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	IPCC	S2CSE01	Finite Element Method and Analysis (I)	3	2	0	3	50	50	100	4
2.	PCC	S2CSE02	Design of Earthquake-Resistant Structures	3	0	0	3	50	50	100	3
3.	PCC	S2CSE03	Design of Industrial Structures	2	0	2	3	50	50	100	3
4.	PEC	S2CSEE3x	Professional Elective – 3	2	0	2	3	50	50	100	3
5.	MPS	S2CSEMPS	Mini Project with Seminar	0	4	2	--	100	--	100	3
6.	PCCL	S2CSEL1	Structural Dynamics Laboratory	1	2	0	3	50	50	100	2
7.	NCMC	PGSHS07	Soft Skills	36 hrs. during the entire semester				100	-	100	PP
	Total			**11**	**8**	**6**		**400**	**300**	**700**	**18**

Note: PCC: Professional core. IPCC-Integrated Professional Core Courses, PCCL-Professional Core Course lab, PEC- Professional Elective Courses, MDC- Multi-Disciplinary Courses , L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students) L-Lecture, P-Practical, T/SDA-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Professional Elective 3

S2CSEE31	Design of Bridge Structures
S2CSEE32	Design of Tall Structures
S2CSEE33	Construction Project Management
S2CSEE34	Stability Analysis of Structures

1. **Mini Project with Seminar:** This may be hands-on practice, survey report, data collection and analysis, coding, mobile app development, field visit and report preparation, modelling of system, simulation, analysing and authenticating, case studies, etc.
CIE marks shall be awarded by a committee comprising of HoD as Chairman, Guide/co-guide, if any, and a senior faculty of the department. Students can present the seminar based on the completed mini-project. Participation in the seminar by all postgraduate students of the program shall be mandatory.
The CIE marks awarded for Mini-Project work and Seminar, shall be based on the evaluation of Mini Project work and Report, Presentation skill and performance in Question and Answer session in the ratio 50:25:25. Mini-Project with Seminar shall be considered as a head of passing and shall be considered for vertical progression as well as for the award of degree. Those, who do not take-up/complete the Mini Project and Seminar shall be declared as fail in that course and have to complete the same during the subsequent semester. **There is no SEE for this course.**

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III Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Seminar	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PEC	S3CSEE4x	NPTEL Online Course - 1 (12 weeks duration)					100	-	100	3
2.	PEC	S3CSEE5x	NPTEL Online Course - 2 (12 weeks duration)					100	-	100	3
3.	PEC	S3CSEE6x	NPTEL Online Course - 3 (12 weeks duration)					100	-	100	3
4.	INT	S3CSEINT	Internship	One semester Duration			3	100	100	200	11
	Total							**400**	**100**	**500**	**20**

Note: **PROJ**-Project Work Phase-1, **SP** –Societal Project, **INT**-Internship
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Industry Internship: The main objective of the industry internship is to ensure that the intern is exposed to a real-world environment and gains practical experience. Often, it may be a practical exposure to the theory that has been learned during the academic period. The industry internship helps students understand of analytical concepts and tools, hone their skills in real-life situations, and build confidence in applying the skills learned. The students who take up a one-semester Internship in the Industry have to appear SEE at the institute at the end of the semester as per the examination calendar

The online courses selected should not be the same as those studied in the first and second semesters of the program. The student will not be eligible to get their degree if they unintentionally select online courses that match previously finished courses. These courses are not considered for the vertical progression; however, qualifying for these courses and earning the credits is a must for the award of the degree. It is permitted to complete these online MOOC courses either in 3rd semester or in 4th semester.

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SCHEME OF TEACHING AND EXAMINATION (80 Credits Scheme)

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IV Semester

Sl. No.	Course Type and Course Code		Course Title	Teaching Hours per Week			Examination				Credits
				Theory	Practical / Field work	Tutorial / Skill Development Activities	Duration in hrs.	CIE Marks	SEE Marks	Total Marks	
				L	P	T/SDA					
1.	PROJ	S4CSEPR	Project Work	0	8	0	3	100	100	200	20
	Total			**0**	**8**	**0**		**100**	**100**	**200**	**20**

Note: **PROJ**-Project Work
L-Lecture, **P**-Practical, **T/SDA**-Tutorial / Skill Development Activities (Hours are for Interaction between faculty and students)

Project Work: Students in consultation with the guide shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare a synopsis, and narrate the methodology to carry out the project work. Each student, under the guidance of a Faculty, is required to ▪ Present the seminar on the selected project orally and/or through Power Point slides. ▪ Answer the queries and be involved in debate/discussion. ▪ Submit two copies of the typed report with a list of references. ▪ The participants shall take part in discussions to foster a friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident CIE marks for the project report (20 marks), seminar (20 marks) and question and answer (10 marks) shall be awarded (based on the quality of report and presentation skill, participation in the question and answer session by the student) by the committee constituted for the purpose by the Principal. The committee shall consist of internal guide and a faculty from the department with the senior most acting as the Chairperson. Semester End Examination SEE marks for the project report (30 marks), seminar (10 marks) and question and answer session (10 marks) shall be awarded (based on the quality of the report and presentation skill, participation in the question and answer session) by the examiners appointed by the University.

Advanced Design of RC Structures (I)

Contact Hours/ week: (L-T-P-S)	3-0-2-3	**Credits:**	4
Total Lecture Hours:	120 = 42 (L)+0(T)+28(P)+50(S)	**CIE Marks:**	50
Sub. Code:	S1CSE01	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1 Analyze and design RC structural members such as continuous beams, ribbed slabs/grid floors, flat slabs and flat plates, deep beams, corbels and retaining walls, isolated and combined footings and understand various aspects of RC buildings using IS 456-2000 and other relevant codes.

NOTES:

UNIT I

9 Hours

Brief review of limit state design of RC member subjected to axial load, bending, shear & torsion. Analysis and design of continuous beams using IS coefficients method and moment redistribution methods to design the sections including for flexure, and shear. Check for serviceability limit state- deflection. •

UNIT II

9 Hours

Introduction, assumption, yield line patterns, moment capacity across yield line, analysis by virtual work method, yield line analysis by equilibrium method, Design of slabs using yield line theory. Design of ribbed slabs/grid floors by approximate methods. Design for limit state collapse and serviceability. •

UNIT III

8 Hours

Application of IS code method of analysis and design of flat slabs and flat plates for bending and shear. one way and two-way shear check, flexural and shear reinforcement design and detailing. •

UNIT IV

8 Hours

Introduction, minimum thickness, design by IS 456 method determination of reinforcement and detailing of deep beams. Design of corbels. Design and detailing of cantilever type of retaining wall. •

UNIT V

8 Hours

Introduction to foundation such as isolated, combined, Raft, strap, and pile. Design of isolated and combined foundation subjected to axial load and moment. •

LAB COMPONENT

28 Hours

Design of continuous beam using spreadsheets • Design of grid floors using spreadsheets • Design of flat slab using spreadsheets • Design of cantilever RC retaining wall using spreadsheets • Design of isolated footing using spreadsheets • Study of drawing on reinforcement details related to the above structures and/or elements •

TEXT BOOKS:		
1	Varghese, P. C.	Advanced reinforced concrete design, PHI Learning Pvt. Ltd., Technology & Engineering Series, New Delhi, 2nd edition, 2010.
2	Pillai, S. U. and Menon, D.	Reinforced Concrete Design, Tata McGraw Hill, New Delhi, 4th Edition, 2021.
3	Bhavikatti, S. S.	Advanced RCC design, New Age International Publishers, vol 2, Third edition, 2016.

REFERENCES:		
1	Krishna Raju	Advanced Reinforced Concrete Design, (IS: 456-2000), CBS Publishers & Distributors, 4th edition, 2016.
2	Taranath, B.S.	Reinforced Concrete design of tall buildings, CRC Press, Taylor and Francis Group, 1st Edition, 2010.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Design of continuous beams using IS coefficients method and moment redistribution method
CO2	Design of slabs using yield line method and grid floors.
CO3	Design of flat slabs and plates.
CO4	Design of deep beam, corbels and retaining wall.
CO5	Design of isolated and combined footing.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			2		1		
CO2			2		1		
CO3			2		1		
CO4			2		1		
CO5			2		1		

Structural Dynamics

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	S1CSE02	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Introduce the students to the basic formulations governing the dynamic response of structural systems
2	Solving the governing equations (analytically or numerically) to obtain the dynamic response to given excitations.
3	Analyse the response of SDOF and MDOF systems

NOTES:

UNIT I

9 Hours

Dynamics of single-degree-of-freedom systems: • Concept of degrees of freedom, Vector representation of simple harmonic motion, equations of motion for SDOF, mathematical model of SDOF system, free vibration response of undamped system, viscous damping, free vibration of damped systems (overdamped, underdamped and critically damped systems), logarithmic decrement. •

UNIT II

9 Hours

Harmonic loading and seismic instruments • Response to harmonic loading of undamped and damped systems, half power method for determination of damping, energy dissipation, response to support motion, vibration transmissibility and isolation, principle of vibration measuring instruments – seismometer and accelerometer •

UNIT III

8 Hours

Response to arbitrary loading: • Response to periodic forces, Duhamel's integral and direct integration methods, response of SDOF for various loading cases (constant force, rectangular pulse, triangular, linearly varying load), numerical methods applied to dynamic analysis of SDOF. Concept of response spectrum for ground excitations. •

UNIT IV

8 Hours

Free vibration of multi-degree freedom systems: • Stiffness of MDOF systems, Lumped and consistent masses for MDOF, natural frequencies and normal modes of MDOF, orthogonality of normal modes, modal superposition-method, Free vibration of MDOFs with special reference to shear buildings. •

UNIT V

8 Hours

Forced vibration of MDOF systems and dynamics of continuous systems: • Forced vibration analysis of MDOF systems- modal transformation method, fourier transformation method and direct integration methods-problems of 2DOF systems , Introduction to free longitudinal vibration of bars, flexural vibration of beams with different end conditions. •

TEXT BOOKS:		
1	Mario Paz and William Leigh	Structural dynamics–Theory and Computation, Elsevier Publications, 5th Ed., 2004. ISBN: 0-7506-7618-3.
2	Humar, J. L.	Dynamics of Structures, CRC Press, 3rd Edition, 2012. ISBN 9780415620864.

REFERENCES:		
1	Biggs	Introduction to Structural Dynamics, McGraw-Hill Companies, First Edition, 1964.
2	Chopra, A. K.	Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India, 3 edition, 2007.
3	Roy R. Craig and Andre Curdilla	Fundamentals of Structural Dynamics, John Wiley & Sons, 2nd edition, 2006.
4	Franklin Y Cheng	Matrix Analysis of Structural Dynamics- Applications and Earthquake Engineering, CRC Press, First Edition, 2000.
5	Madhujit Mukyopadhyaya	Structural Dynamics- Vibrations and Systems, ANE Books, First edition, 2008.
6	Patric Paultre	Dynamics of Structures, Wiley, First edition, 2011, ISBN 978-8126533138
7	P Srinivasalu, C Vaidyanathan	Handbook of machine foundations, McGraw Hill Education, First Edition, 2017

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Formulate and solve the dynamic equilibrium equation for free vibration response of SDOF systems.
CO2	Solve the dynamic equilibrium equation for response of SDOF systems to harmonic excitations
CO3	Solve the dynamic equilibrium equation for response of SDOF systems to arbitrary excitations by analytical and numerical methods
CO4	Determine and use natural frequency and mode shapes of MDOF system
CO5	Analyze continuous systems and MDOFs subjected to dynamic loads

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			3	1	2		
CO2			3	1	2		
CO3			3	1	2		
CO4			3	1	2		
CO5			3	1	2		

Computational Structural Mechanics

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSE03	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Classify various structural systems and determine their stability, degrees of freedom and develop the force displacement relations.
2	Analyze the continuous beams, frames, trusses using stiffness matrix method by system approach as well as element approach.
3	Analyze the continuous beams, frames, trusses using flexibility matrix method by system approach.
4	Analyze the continuous beams, frames, trusses using flexibility matrix method by element approach.
5	Analyze the continuous beams, frames, trusses using direct stiffness matrix method

NOTES:

UNIT I

8 Hours

Introduction to structural mechanics: • Classical Vs matrix methods of Structural analysis, Classification and idealization of structural systems, Actions and Reactions, support conditions, Stability Conditions, static and Kinematic Indeterminacies, Degrees of freedom, Force-displacement relationship, Concepts of stiffness and flexibility. •

UNIT II

12 Hours

Introduction to stiffness methods (System approach): • Development of element stiffness coefficients for standard cases of truss, beam, and frames. Application to analysis of trusses, continuous beams, frames utilizing stiffness concept (having not more than 3 unknowns). •

UNIT III

12 Hours

Introduction to flexibility (System approach): • Development of flexibility and element stiffness coefficients for standard cases of truss, beam, and frames. Application to analysis of trusses, continuous beams, frames utilizing flexibility concepts (having not more than 3 unknowns). •

UNIT IV

12 Hours

Stiffness Method (Element approach): • Element Stiffness matrix continuous beams, plane trusses, Application to analysis of continuous beams, plane trusses, Rigid plane frames (having not more than 3 unknowns). •

UNIT V

12 Hours

Direct stiffness method: • Element stiffness Matrix in global coordinates for Beams, trusses and frames, Assemblage of Global stiffness matrix and force vector, Analysis of continuous beams, trusses and frames using direct stiffness method (not more than three unknowns). •

TEXT BOOKS:

1	Rajasekaran. S	"Computational Structural Mechanics", PHI, New Delhi, 2001.

REFERENCES:

1	Pandit C.S and Gupta.A.P.	"Structural Analysis – A Matrix approach", Tata McGraw Hill, New Delhi, 2nd Edition, 2008.
2	Meghre A. S. and Deshmukh S. K.	"Matrix methods of structural Analysis", Charotar Publishing House Pvt. Ltd., 2nd edition (2015).

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Check the stability and evaluate the different types of indeterminacies of various structural configurations and evaluate their DOFs.
CO2	Develop the stiffness matrices for various structures and analyze trusses, continuous beams, frames utilizing stiffness concept by system approach.
CO3	Develop the flexibility matrices for various structures and analyze trusses, continuous beams, frames utilizing flexibility matrix method by system approach.
CO4	Analyze trusses, continuous beams, frames utilizing stiffness matrix method by element approach.
CO5	Analyze trusses, continuous beams, frames utilizing direct stiffness matrix method.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				2			
CO2				2			
CO3				2			
CO4				2			
CO5				2			

Mechanics of Deformable Bodies

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	0
Sub. Code:	S1CSE04	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	impart the basic concepts of stresses, stresses on inclined planes & principal stresses, in rectangular and polar coordinates for 2D and 3D problems.
2	understand Stress-strain relationship, compatibility equations for plane stress and plane strain problems.
3	determine Stress functions for plane stress, plane strain conditions, and failure theories.

NOTES:

UNIT I

12 Hours

Analysis of Stresses • Introduction, definition of stress, components of stress at a point in Cartesian co-ordinates (2D and 3D), equilibrium equations, stresses on an inclined plane, principal stresses, maximum shear stress, stress invariants, hydrostatic and deviatoric stresses, octahedral stresses, stress boundary conditions, plane stress and plane strain problems, stress components in polar & cylindrical co-ordinates (2D and 3D), differential equations of equilibrium. •

UNIT II

12 Hours

Analysis of strains • Definition of Strain, components of strain at a point in Cartesian co-ordinate system, plane strain problems, strain transformation, principal and octahedral strain, analysis of strain rosettes and their application. •

UNIT III

12 Hours

Stress strain relation and compatibility equations • Generalized Hooke's law, constitutive equations, Lame's constants, compliance matrix, Saint Venant's principle, principle of superposition, compatibility equations for 3 dimensional elements in Cartesian co-ordinates, compatibility equations for plane stress and plane strain problems in terms of stress components. •

UNIT IV

10 Hours

Two dimensional problems in Cartesian co-ordinates • Biharmonic equation in Cartesian co-ordinates, Airy's stress functions, polynomials as stress functions, stress functions for plane stress and plane strain problems bending of cantilever and simply supported beams. •

UNIT V

10 Hours

Plasticity • Plasticity: Assumptions in plasticity, strain hardening, idealized stress strain curves, yield criteria, Von-mises yield criterion, Tresca's yield criterion, Mohr coulomb failure criterion. Drucker-Prager yield criterion, Flow rule, Principle of normality, plastic potential, Isotripic and Kinematic hardeing, elasto-plastic stress-strain relations (Prandtl-Reuss relations) •

TEXT BOOKS:		
1	L.S. Srinath	Advanced Mechanics of solids, 3rd Edition, Tata McGraw-Hill Publishing Co. Ltd, New Delhi, 2009.
2	T.G. Sitharam & L. Govindaraju	Elasticity for Engineers, I K International Publishing House Pvt. Ltd; 1st Ed. (2016).

REFERENCES:		
1	S.P. Timoshenko and J.N. Goodier	Theory of Elasticity, 3rd Edition, TMH, 2010.
2	Sadhu Singh	Theory of Elasticity (A Textbook for Engineering Students) Khanna Publisher, 1988.
3	Martin H. Sadd	Elasticity, Theory, Applications and Numeric, Academic Press, Elsevier, 2014.
4	A K Singh	Mechanics of Solids, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2007.
5	John DeWolf, David Mazurek, Ferdinand Beer, Jr. Johnston, E. Russell	Mechanics of Materials, 7th Edition, McGraw-Hill Education, 2014.
6	Ansel C. Ugural, Saul K. Fenster	Advanced Mechanics of Materials and Applied Elasticity, 5th Edition, Prentice Hall, 2012.
7	Valliappan C	“Continuum Mechanics Fundamentals”, Oxford IBH Publishing Co. Ltd.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Formulate the expression for differential equations of equilibrium (in Cartesian, polar and cylindrical coordinates), analyze and compute principal stresses, hydrostatic and deviator stresses, octahedral stresses and evaluate stresses on any inclined plane of structural elements using transformation principles.
CO2	Discriminate between plane stress and plane strain problems, analyze and evaluate principal strains, octahedral strains, evaluate strains on arbitrary planes and solve problems on strain rosettes.
CO3	Establish the need for stress-strain and compatibility equations, stress boundary conditions, formulate the generalized Hooke’s law, derive compatibility equations in terms of stresses and strains for different coordinate systems express.
CO4	Formulate bi-harmonic equations in different coordinate systems analyze complex problems using Airy’s stress functions to evaluate stresses, strains and displacements in structural elements and critically compare the stress distribution with simplified solutions based on SOM.
CO5	Apply various failure theories for structural problems.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				2			
CO2				2			
CO3				2			
CO4				2			
CO5				2			

Design of substructures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE11	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	introduced to different types of raft and deep foundation
2	Design the foundations by different methods, considering gravity and lateral loads for different types of soil conditions
3	Design of earth-retaining structures, well and tower foundations under different conditions

NOTES:

UNIT I

12 Hours

Site investigation and general principles of foundation design • Introduction, Site investigation, In-situ testing of soils, Subsoil exploration, Classification of foundations systems, General requirement of foundations, Selection of foundations, Computation of Loads, Design concepts. • Shallow foundations: • Bearing capacity failures, Bearing capacity formulae & factors, Factor of safety, Selection of soil shear strength parameters, Settlement analysis of footings, shallow foundation in clay, shallow foundation in sand and c-ϕ soils, footings on layered soils and sloping ground, Design for Eccentric or moment loads •

UNIT II

12 Hours

.Raft foundations • Types of rafts, bearing capacity & settlements of raft foundation, Rigid methods, Flexible methods (sub-grade reaction method, Winkler method, finite difference method), Combined footings (rectangular & trapezoidal), strap footings & wall footings, Raft – superstructure interaction effects & general concepts of structural design, Basement slabs •

UNIT III

12 Hours

Deep foundations • Load Transfer in Deep Foundations, Types of Deep Foundations, Ultimate bearing capacity of different types of piles in different soil conditions, laterally loaded piles, tension piles & batter piles, Pile groups: Bearing capacity, settlement, uplift capacity, load distribution between piles, Proportioning and design concepts of piles. •

UNIT IV

10 Hours

Earth retaining structures • Types of retaining structures, Theory of lateral earth pressure, Stability of RCC concrete cantilever retaining walls, Drainage requirements, Basement walls, counterfort retaining walls, General considerations in concrete retaining wall design. •

UNIT V

10 Hours

Well Foundations and Foundations for Tower structures • Types of caissons, Analysis of well foundations, Design principles, well construction and sinking • Foundations for tower structures: • Introduction, Forces on tower foundations, Selection of foundation type, Stability and design consideration. •

TEXT BOOKS:		
1	Swami Saran	"Analysis & Design of Substructures- Limit state design", Oxford & IBH Pub. Co. Pvt. Ltd., 2nd edition revised, 2019
2	Nainan P Kurian	"Design of Foundation Systems, Narosa Publishing House, 3rd Edition, 2006

REFERENCES:		
1	Lymon C Reese, William M Isenhover, & Shin Tower Wang	"Analysis & Design of Shallow and Deep Foundations", John Wiley Publication, First Edition, 2006
2	Verghese, P. C.	"Design of Reinforced Concrete Foundations", Prentice Hall of India, First Edition, 2009
3	M S V Kameswara Rao	"Foundation Design- Theory and Practice", Wiley, 1st edition, 2010.
4	Bureau of Indian Standards	IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS2950, IS-11089, IS-11233, IS-2911 and all other relevant codes.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Integrate the basic knowledge of foundation engineering and advanced knowledge of foundations to analyze the geotechnical data for the estimation of bearing capacity and settlement of soil under different field conditions
CO2	Apply original judgment to analyze and design of combined footings subjected to different types of loads and determine the bearing capacity of raft with varying soil profiles, apply lateral thinking to predict uplift, settlement and to evaluate load distribution over the raft.
CO3	Apply original judgment to analyze and determine the bearing capacity of pile with varying soil profiles, apply lateral thinking to predict uplift and settlement, evaluate load distribution in pile, and design of pile and pile groups.
CO4	Analyze the safety and stability of different types of earth retaining structures such as cantilever and counter-fort type RC retaining walls and proportion and design them for various types of loads
CO5	Apply the design principles of different types of well foundations, tower foundation for stability and design considerations.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			2	3			
CO2			2	3			
CO3			2	3			
CO4			2	3			
CO5			2	3			

Advanced Concrete Technology

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE12	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand the influence of microstructure of concrete, the hydration mechanisms of cement with or without admixtures, the rheological characteristics of concrete
2	Understand the failure mechanism of concrete, factors affecting the strength, and behavior of Concrete Under Various Stress States, modulus of elasticity of concrete and factors affecting them, shrinkage of concrete
3	Understand the importance of durability of concrete and how to make durable concrete
4	Design self-compacting concrete and its application, fabrication of FRC and its application.
5	Understand the application of Cement-polymer composites and Special Concreting Practices

NOTES:

UNIT I

12 Hours

Admixtures: • Mineral Admixtures: Physical and chemical properties of different types of mineral admixtures – fly ash, silica fume, GGBS and metakaolin and their interaction with hydrating cement, effects on fresh concrete, mechanical and durability properties of hardened concrete. • Chemical Admixtures: Classification and applications, mechanisms of action, effect on properties of fresh concrete and hardened concrete of plasticizers, super plasticizers, retarders, set accelerators, shrinkage reducers, and corrosion inhibitors, rheology of concrete and its assessment – Bingham model, rheometers, concept of yield stress and plastic viscosity. •

UNIT II

12 Hours

Properties of Hardened Concrete: • Strength: Mechanisms of Failure, Strength - Porosity Relationship, Factors Affecting Strength, Micro cracking, Relationship between Compressive and Tensile Strength - Other Types of Strength - Behavior of Concrete Under Various Stress States. • Deformation: Stress - Strain Relationship - Types of Elastic Moduli - Factors Affecting Modulus of Elasticity and its evaluation • Shrinkage: Types, Factors Affecting Shrinkage, Mechanism of Shrinkage •

UNIT III

12 Hours

Transport and durability properties of concrete: • Transport properties: Capillary absorption, permeability, and diffusion. • Durability: Physical and Chemical deterioration, causes and progression, Effect of exposure to sulphates, acids and gases, chloride and CO_2, Sea Water, fire, frost, freeze thaw, resistance to abrasion and erosion. •

UNIT IV

10 Hours

High Performance Concrete and Special Concretes: • High Performance Concrete: High strength and high-Performance concrete, Self-Compacting Concrete - principles, production, properties, mix-design and applications • Special Concretes: Fiber reinforced concretes: Definitions, Fiber-Matrix Bond, Mechanics of Fiber Reinforcement, Fabrication of FRC, Properties & Application of FRC, Ferro-Cement •

UNIT V
10 Hours
Cement-polymer composites and Special Concreting Practices: • RMC, roller compacted concrete, shotcrete, underwater placement, high and cold weather concrete, Concrete for pavements. • Ferro-cement and its applications •

TEXT BOOKS:

1	Neville A.M.	“Properties of Concrete”, Pearson Education India, 5th edition, 2012.
2	Shetty M.S.	Concrete Technology - Theory and Practice, Chand and Co., New Delhi, 2006.

REFERENCES:

1	Edward G Nawy (es)	Concrete Construction Engineering Handbook, CRC Press, Taylor and Francis Group, 2008 Concrete”, Prentice Hall, 2nd Edition, 2002.
2	John Newman, Cho B.S	Advanced Concrete Technology- Vol. 1Consttuent Materials, Vol. 2 Concrete Properties, Vol.3 Processes, Vol.4 Testing and Quality, Butterworth Henemann, Elsevier, 2003.

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Select the appropriate mineral and chemical admixtures for concrete mixes.
CO2	Distinguish between different mechanisms of failure and discuss the behavior of concrete under various loading conditions and explain the factors affecting modulus of elasticity of concrete, and classify the different types of shrinkage cracks in concrete.
CO3	Explain transport properties and durability properties of concrete.
CO4	Distinguish between different types of modern concretes and explain their principles, production, properties and applications.
CO5	Explain different types of advanced concretes and concreting practices

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1						
CO2			1				
CO3			1				
CO4			1				
CO5			1				

Analysis and design of Plates and Shells

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE13	**SEE Marks:**	20

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Apply the theory of small deflection to laterally loaded thin circular and rectangular plates for analysis of plates for various loading and boundary conditions using Navier's and Levy's methods
2	Understand geometric features of shells and their classification, membrane theory and its application to analysis of spherical, cylindrical shells and hyperbolic paraboloids, axially symmetric bending of shells
3	Perform design and detailing of different types of shells and folded plates

NOTES:

UNIT I

12 Hours

Application of thin plate theory to analysis of rectangular plates • Introduction to plate theory, Definition of flat plates, thin and thick plates, plates with small and large deflection, governing differential equation for small deflection of laterally loaded thin rectangular plates, Bending of rectangular plates under pure bending, symmetrical and cylindrical bending, Navier's and Levy's solution for simply supported rectangular plates under UDL (wit derivation). •

UNIT II

12 Hours

Application of thin plate theory to analysis of circular plates • Symmetrically loaded circular plates-governing deferential equation, solution for axi-symmetrically loaded circular plates under UDL for different boundary conditions(with derivation), Use of energy methods for rectangular and circular plates with different boundary conditions subjected to symmetric loading, Numerical problems. •

UNIT III

12 Hours

Simplified analysis of folded plates and membrane analysis of shells • Principles of Whitney's and Simpson's methods of Analysis, Design and detailing of simple numerical examples of folded plates. Introduction to curved surfaces and classification of shells, Membrane theory of spherical shells, and cylindrical shells. •

UNIT IV

10 Hours

Membrane and bending theories for analysis of shells of revolution • Axially symmetric bending of shells o f revolution Closed cylindrical shells, water tanks, Principles of bending theory of spherical shells •

UNIT V

10 Hours

Design and detailing of simple shell problems • – cylindrical roofs, spherical domes, elements of water tanks, barrel vaults and hyperbolic paraboloid roofs •

TEXT BOOKS:		
1	Timosheko, S. P. and Woinowsky Krieger S	Theory of Plates and Shells, Tata McGraw-Hill Co., 2nd Edition, 2017.
2	Chandrashekhara, K.	Theory of plates, Universities Press, First edition, 2001.
3	Bhavikatti S S	Theory of Plates and Shells, New Age International, Fourth Edition, 2019.

REFERENCES:		
1	Ramaswamy G.S.	Design and Constructions of Concrete Shell Roofs, CBS Publishers and Distributors, First Edition, 1986.
2	Ugural, A. C.	Stresses in Plates and Shells, McGraw-Hill, 2nd edition, 1999
3	R. Szilard	Theory and analysis of plates – classical and numerical methods, Prentice Hall, First Edition, 1994.
4	Chatterjee B. K.	Theory and Design of Concrete Shell, Chapman & Hall, 3rd edition, 1988.
5	Eduard Ventsel, Theodor Krauthammer.	Thin Plates and Shells: Theory, Analysis, and Applications, CRC Press, First Edition, 2001
6	Reddy J. N.	Theory and Analysis of Elastic Plates and Shells, 2nd edition, CRC Press, 2006
7	Maan H Jawad	Theory and Design of Plate and Shell Structures, Springer-Verlag New York Inc, First Edition, 2012.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Formulate and solve the differential equation for various loadings and boundary conditions of rectangular plates
CO2	Formulate and solve the differential equations for various loadings and boundary conditions of circular plates
CO3	Apply simplified analysis methods for analysing folded plates and cylindrical shells
CO4	Apply membrane and bending theories for analysis of shells of revolution
CO5	Design and sketch detailing of simple shell structures for given loads and boundary conditions

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			3	1			
CO2			3	1			
CO3			3	1			
CO4			3	1			
CO5			3	1			

Introduction to AI & Its Applications

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE14	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand the concepts of computational intelligence algorithms and programming.
2	Acquiring advanced technologies like ANN, ML, Deep learning
3	Acquire advanced skills to develop genetic algorithms and programming

NOTES:

UNIT I

12 Hours

Introduction to AI: • Introduction to AI, definition of AI, Historical evolution of AI, AI types, brief introduction to the branches of AI, Machine learning, Natural Language processing, computer vision, robotics, expert systems, Artificial neural networks and deep learning, evolutionary computation, cognitive computing, and swarm intelligence. Applications in civil engineering in each branch of AI. •

UNIT II

12 Hours

Machine Learning: • Introduction to ML, Machine learning process model, Conceptlearning,general-to-specificordering,versionspaces,inductivebias, general to specific ordering, introduction to different kinds of machine learning, supervised, unsupervised, semi supervised, reinforcement, transfer learning and federated learning. The related algorithms under each type of ML, Applications of different ML techniques in Civil Engineering. Well posed learning problem, designing a learning system, examples. •

UNIT III

12 Hours

Artificial neural networks (ANN): • Introduction, biological motivation, appropriate problems in ANN learning, perceptron's, the representational power of perceptions, multilayer networks, back propagation. Introduction to recurrent neural networks, and deep learning. Illustrative real-world examples on applications of neural networks in highway/ infrastructure construction management and other civil engineering domains. •

UNIT IV

10 Hours

Learning under uncertainty and ambiguity • Learning under uncertainty and ambiguity, fuzzy logic, linguistic variables, fuzzy sets, membership functions, fuzzy set operations, fuzzy expert systems, fuzzification, defuzzification, fuzzy rules, fuzzy inferences. Fuzzy inference system, Illustrative examples of engineering applications of fuzzy logic with specific reference to civil engineering. •

UNIT V

10 Hours

Introduction to Computer Vision: • Definition and scope, history and evolution, Image acquis ion, image representation (grey scale and color), basic operations like filtering, thresholding. Primitives of image processing, geometric primitives, 2d Transforms, 3D transforms, photometric image formation, lighting, reflectance and shading, the digital camera, sampling and aliasing. Applications of computer vision in Civil engineering. •

TEXT BOOKS:

1	Stuart Russell and Peter Norvig	Artificial Intelligence a Modern Approach, Pearson Education, Third edition, 2010
2	Ben Coppin	Artificial Intelligence Illuminated, Narosa Publications, First Edition, 2014
3	Margaret A Boden,	Artificial Intelligence, Academic Press London, First Edition, 1996
4	Kothari Dwarkadas Pralhaddas, Samui Pijush	Artificial Intelligence in Civil Engineering, Lambert Academic Publishing, First Edition, 2012

REFERENCES:

1	David. L.Poole , Alan K. Mackworth	Artificial Intelligence – Foundations of Computational Agents, Cambridge University Press, 2nd Edition, 2010
2	Kevin Warwick	Artificial Intelligence-The Basics, Routledge Publications, USA,2012
3	Nikos D. Lagaros and Vagelis Plevris	Artificial Intelligence Applied in Civil Engineering, MDPI, 2022
4	Paul D.Harrison	Artificial Intelligence Applications in Material Science and Engineering, Kindle Edition, 2023

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Gain insights into the role of AI in modern civil engineering practices and how it can enhance decision-making and efficiency.
CO2	Acquire knowledge of basic Machine Learning algorithms and techniques and develop the ability to implement and evaluate ML models for solving complex civil engineering problems
CO3	Comprehend the structure and functioning of Artificial Neural Networks, including various architectures and learning algorithms, and apply ANN techniques to model and solve real-world civil engineering problems
CO4	Learn the principles of Fuzzy Logic and its application in handling uncertainty and imprecision in Civil engineering problems
CO5	Understand the basics of computer vision and image processing techniques, and their relevance in civil engineering will be able to implement computer vision methods for automated inspection, monitoring, and analysis of civil infrastructure

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1		2		
CO2			1		2		
CO3			1		2		
CO4			1		2		
CO5			1		2		

Advanced pre-stressed concrete structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE21	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Design of Pre-stressed concrete members for shear and torsional Resistance
2	Determine the Transfer of Pre-stress, Transmission Length, Bond Stresses, and End-zone Reinforcement in PSC members
3	Design of anchorage zone Stresses in post-tensioned members by different methods.
4	Design of pre-tensioned and post-tensioned member sections for flexure, shear and torsion.
5	Design of composite PSC members

NOTES:

UNIT I

12 Hours

Shear and Tortional Resistance of Pre-stressed concrete members. Shear and Principal Stresses, shear Resistance of cracked and uncracked PSC members. Design of Shear and torsion including detailing. •

UNIT II

12 Hours

Transfer of Pre-stress in Pre-tensioned Members. Transmission of Pre-stressing force by bond. Transmission Length. Distribution of Bond Stresses, Transverse Tensile Stresses, End-zone Reinforcement, Flexural Bond Stresses and Code Provisions for bond and Transmission length •

UNIT III

12 Hours

Anchorage Zone Stresses in Post-Tensioned Members. Stress Distribution in End Block, Computation of Anchorage Zone Stresses by Magnel's Method and Guyon's Method. Indian Code Provisions, Determination and detailing of Anchorage Zone Reinforcement.. •

UNIT IV

10 Hours

Philosophy of limit-state Design, design criteria for different Limit State for Prestressed concrete Members - Design Loads, Strength and serviceability limit states, Type -1, 2 and 3 Design, Principles of dimensioning pre-stressed concrete members. Design of pre-tensioned and post-tensioned member sections for flexure, shear and torsion. Determination of kern zones and cable layout •

UNIT V

10 Hours

Design of composite sections with pre-cast pre-stressed and cast-insitu elements, analysis for flexure, transverse shear and interfacial shear, propped and unpropped construction, problem of differential shrinkage •

TEXT BOOKS:		
1	N. Krishnaraju	Prestressed Concrete, McGraw Hill Education, Sixth edition, 2018.
2	James R.	Modern Prestressed concrete, Springer Publishers, First Edition, 1990.
3	Lin, T.Y. & Burns, N.H.	Design of Pre-stressed Concrete Structures, John Willey & Sons, 3rd Ed., 1981.
REFERENCES:		
1	Y.C. Loo and Cornfreig	Reinforced and prestressed concrete, University Press, 2nd Ed., 2012.
2	Collins, M. and Mitchell, D.	Prestressed Concrete Structures, Prentice Hall, First Edition, 1991.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Design and detail PSC member for combined action of shear, torsion and bending
CO2	Evaluate the transmission length of pre-tensioned wires and evaluate the conformity with code provisions.
CO3	Analyze the anchorage zone of post-tensioned concrete members and evaluate the stresses and reinforcement
CO4	Design pre-tensioned and post-tensioned members
CO5	Design of pre-cast composite sections

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				4			
CO2				4			
CO3				4			
CO4				4			
CO5				4			

Repair, rehabilitation and health monitoring of structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE22	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Identify causes of deterioration of concrete structures and use appropriate diagnostics methods.
2	Classify the physical and chemical deterioration of concrete structures.
3	Perform various Non-destructive tests on concrete members and apply suitable SHM techniques for damage identification and quantification.
4	Understand the importance of repair/rehabilitation materials for damaged concrete structures
5	Explain the various techniques of Repair, strengthening and retrofitting of structures

NOTES:

UNIT I

10 Hours

Introduction: • Review of Basic terminology: Distress, deterioration, damage, repair, maintenance, reconstruction, rehabilitation, retrofit, strengthening, hazard, risk, vulnerability, durability, serviceability, performance, forensic analysis – definition, distinction between various terms with examples • Philosophical overview: Repair process- distress identification and location, testing and quantification, condition survey and condition assessment-repair strategies and management- Structural health monitoring and management. •

UNIT II

10 Hours

Deterioration/damage of concrete: • Mechanisms: Physical mechanisms- Cyclic Freezing and Thawing, thermal shock, abrasion and erosion, effects of creep, shrinkage and relaxation; Chemical attack-sulphates, chlorides, alkali-aggregate reaction; reinforcement corrosion– Cl or CO2 induced, Damage due to construction defects- Effects of cover thickness, cracking, w/c, reinforcement placement and spacing; structural overloads natural and man-made calamities-fire, earthquake, floods, cyclone. • Deterioration Tests: RCPT and RMT tests. •

UNIT III

12 Hours

Testing and health monitoring: Utility of various destructive techniques and non-destructive tests planning and interpretation of in-situ tests, principles, methodology and application of UPV and rebound hammer techniques Pull off, penetration techniques, and concrete core tests. • Structural Health Monitoring: Need, local and global damage, vibration-based techniques-need, advantages and limitations, methodology-sensors used- electrical resistance and capacitance-based sensors, smart sensors- fiber optic and piezoelectric sensors, active and passive control application to bridges, buildings, model-based damage assessment, damage localization and quantification. •

UNIT IV
12 Hours
Repair/rehabilitation materials: • Portland cement mortar/concrete with chemical admixtures, polymers-polyester, epoxy, polymer modifiers, acrylics and mineral additions-FA, micro silica and GGBS, High alumina cement, GI, SS, non-ferrous metals and FRP reinforcement, Dry pack, sealants-insitu and preformed, reactive resins-epoxy, polyurethane, silicone, preplaced aggregate concrete, Shotcrete, bonding coats, coatings and toppings, Silica Fume Concrete, honeycombed concrete-grouting. •
UNIT V
12 Hours
Repair, strengthening and retrofitting techniques: • Structural Repair: Repair of structural cracks by injection, blanketing, stitching, patch repairs, repair of carbonation and chloride induced corrosion, repair of concrete damaged by sulphate attack, repair of old and new RC slabs with spalling of concrete at bottom face, repair of RC beams and columns damaged by reinforcement corrosion. • Strengthening and Retrofitting: of foundations of walls and column footings by underpinning, soil stabilization, section enlargement, strengthening of RC slabs and beams - jacketing, shotcreting, plate bonding, FRP wrapping or sheet bonding, external prestressing. •

TEXT BOOKS:		
1	Verghese P.C	"Maintenance, Repair, rehabilitation and minor works of Buildings", PHI Learning Pvt. Ltd, New Delhi (2014).

REFERENCES:		
1	Poonam I Modi and Chirag N Patel	"Repair and rehabilitation of concrete structures", PHI Learning Pvt. Ltd, New Delhi (2016).
2	Bhattacharjee. J	"Concrete Structures Repair, Rehabilitation and Retrofitting", Kindle Edition, CBS Publishers and Distributors PVT Ltd, 2017.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	describe the terminologies and concepts associated with deterioration of concrete structures.
CO2	explain different types of physical and chemical deterioration in concrete members.
CO3	estimate the extent of damage level in concrete structures using Non-Destructive Tests on concrete members and implement suitable SHM techniques for damage identification and quantification.
CO4	Suggest appropriate repair/rehabilitation materials for damaged concrete structures.
CO5	Implement various rehabilitation and retrofitting techniques using various innovative techniques in structures

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1				
CO2			1				
CO3			1				
CO4			1				
CO5			1				

Design of storage and stack-like structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE23	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1. The objective of this course is to introduce the students to design principles of storage structures for different types of materials including silos, bunkers and water tanks as well as stack structures like reinforced concrete, steel chimneys.

NOTES:

UNIT I

12 Hours

Structures for storage of solids- flow properties of solids, functional design of silos and bins. Design of Bunkers and silos- Introduction, Janssen's theory, Airy's theory. • Design of chimneys– Concrete and steel chimneys, Resistance to DL, IL, WL and seismic loads, design of walls and foundations, guyed stacks–design principles •

UNIT II

12 Hours

Design of water tanks resting on ground-Design of circular and rectangular tanks with different kinds of bases •

UNIT III

12 Hours

Design of underground water tanks- Introduction, Earth pressure on tank walls, uplift pressure on the floor of the tank, design of rectangular tanks with different L/B as per IS:3370-2009. •

UNIT IV

10 Hours

Design of cylindrical Overhead tanks with flat and spherical bases and top, design of Intze tanks. •

UNIT V

10 Hours

Design of staging – Circular, hexagonal and other shapes, effect of wind load and seismic load, design of foundation – independent footings, complete raft and annular raf •

TEXT BOOKS:

1	Varghese, P. C.	Advanced reinforced concrete design, Prentice Hall India, Learning Private Limited, 2 edition, 2005.
2	Krishna Raju	Advanced Reinforced Concrete Design (IS : 456-2000), CBS Publishers & Distributors, 3rd edition, 2008.

REFERENCES:

1	Pillai, S. U. and Menon, D.	Reinforced Concrete Design, Tate McGraw Hill, 3rd Edition, 2009.
2	Vazirani and Ratwani	Reinforced Cement Concrete, Khanna Publishers, 16th edition, 2008.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Design bunkers and silos considering flow properties of solids and using Janssen's and Airy's theory, and design reinforced concrete circular chimneys under the action of dead load, imposed load, wind load, and seismic loads
CO2	Design water tanks resting on grounds with different types of bases
CO3	Design Underground water tanks considering earth pressure, uplift the pressure of the flow and different geometry as per IS3370
CO4	Design different elements of overhead tanks with flat and spherical bases and design of Intze tanks
CO5	Design of staging – Circular, hexagonal and other shapes, effect of wind load and seismic load, design of foundation – independent footings, complete raft and annular raft

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1	2			
CO2			1	2			
CO3			1	2			
CO4			1	2			
CO5			1	2			

Advanced Design of Steel Structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S1CSEE24	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand the background to the design provisions for hot-rolled and coldformed steel structures, including the main differences between them
2	Proficiency in applying the provisions for design of columns, beams, beam-columns
3	Design structural sections for adequate fire resistance

NOTES:

UNIT I

12 Hours

Laterally unrestrained beams • Lateral Buckling of Beams, Factors affecting lateral stability, IS 800 code provisions, Design Approach. Lateral buckling strength of Cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, Monosymmetric and non- uniform beams – Design Examples. Concepts of -Shear Center, Warping, Uniform and Non-Uniform torsion. •

UNIT II

12 Hours

Beam-column frames • Behaviour of Short and Long Beam - Columns, Effects of Slenderness Ratio and Axial Force on Modes of Failure, Biaxial bending, Strength of Beam Columns, Sway and Non-Sway Frames, Strength and Stability of rigid jointed frames, Effective Length of Columns-, Methods in IS 800 - Examples •

UNIT III

12 Hours

Steel beams with Web Openings • Shape of the web openings, practical guide lines, and Force distribution and failure patterns, Analysis of beams with perforated thin and thick webs, Design of laterally restrained castellated beams for given sectional properties, Vierendeel girders (design for given analysis results) •

UNIT IV

10 Hours

Cold formed steel sections • Techniques and properties, Advantages, Typical profiles, Stiffened and unstiffened elements, Local buckling effects, effective section properties, IS 801& 811 code provisions-numerical examples, beam design, column design •

UNIT V

10 Hours

Fire resistance • Fire resistance level, period of structural adequacy, properties of steel with temperature, Limiting Steel temperature, Protected and unprotected members, Methods of fire protection, Fire resistance ratings- Numerical Examples. •

TEXT BOOKS:

1	N. Subramanian	Design of Steel Structures- Limit State, Oxford University Press, First Edition, 2017
2	Duggal, S. K.	Limit State Design of Steel Structures, McGraw Hill, 3rd (Kindle) Edition

REFERENCES:		
1	Wei-Wen Yu, Roger A LaBoube, Helen Chen	Cold-Formed Steel Design, Wiley, 5 ed., 2019

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Apply the principles of stability to analyze and design continuous beams and other kinds subjected to lateral loading
CO2	Use the knowledge of beam-column joint mechanisms and be able to assess the strength and stability of rigid jointed frames
CO3	Analyze the mechanisms of force distribution and failure patterns, and be able to design web openings, perforated thin and thick webs, and castellated beams
CO4	Design and analyze formed steel sections complying with IS 801 & IS 811 code provisions
CO5	Disseminate the knowledge of fire resistance, fire protection, and fire resistance ratings of steel structures

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1	2			
CO2			1	2			
CO3			1	2			
CO4			1	2			
CO5			2	1			

Research Methodology and IPR

Contact Hours/ week: (L-T-P-S)	2-0-0--2	**Credits:**	0
Total Lecture Hours:	0 = 28 (L)+0(T)+0(P)+-28(S)	**CIE Marks:**	50
Sub. Code:	S1PGRM	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Identify the area of research and set the Objectives
2	Define the research problem and carryout literature
3	Develop Research design and framework for experimentation
4	Interpret Sampling design, Measurement and scaling techniques in RM
5	Develop data collection and hypothesis testing procedure
6	Interpret and write research and technical report.

NOTES:

UNIT I

6 Hours

Meaning, Objectives and Characteristics of research - Research methods Vs Methodology -Types of research - Descriptive Vs. Analytical, Applied Vs. Fundamental, Quantitative Vs. Qualitative, Conceptual Vs. Empirical - Research process - Criteria of good research -Developing a research plan. •

UNIT II

6 Hours

Defining the research problem - Selecting the problem - Necessity of defining the problem -Techniques involved in defining the problem - Importance of literature review in defining a problem- Survey of literature - Primary and secondary sources Identifying gap areas from literature review. •

UNIT III

6 Hours

Research design and methods – Research design – Basic Principles- Need of research design — Features of good design – Important concepts relating to research design –- Developing a research plan - Exploration, Description, • Diagnosis, and Experimentation - Determining experimental and sample designs. •

UNIT IV

5 Hours

Sampling design - Steps in sampling design - Characteristics of a good sample design - Types of sample designs - Measurement and scaling techniques - Measurement in Research, Measurement Scales, Sources Of Error In Measurement, Tests Of Sound Measurement, Technique Of Developing Measurement Tools • Methods of data collection – Collection of primary data - Data collection instruments Testing of hypotheses - Basic concepts - Procedure for hypotheses testing flow diagram for hypotheses. •

UNIT V

5 Hours

Interpretation and report writing - Different steps in the preparation - Layout, structure and language of the report - Illustrations and tables - Types of report - Technical reports and thesis. • IPRs- Invention and Creativity- Intellectual Property-Importance and Protection of Intellectual Property Rights (IPRs) - A brief summary of Patents, Copyrights, Trademarks, Industrial Designs. •

TEXT BOOKS:

1	Kothari, C.R	Research Methodology: Methods and Techniques. New Age International. 418p

REFERENCES:

1	Garg, B.L., Karadia,R., Agarwal, F. and Agarwal, U.K.	An introduction to Research Methodology, RBSA Publishers, 2002.
2	Subbarau NR	Handbook on Intellectual Property Law and Practice, S Viswanathan Printers and Publishing Private Limited, 1998

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Identify research categories and develop research plan.
CO2	Conduct and investigate the research problem and carryout literature review.
CO3	Investigate and Develop Research design and framework for experimentation.
CO4	Analyse and Develop Measurement and scaling techniques in their research & hypothesis testing procedure
CO5	Develop data collection and hypothesis testing procedure
CO6	Plan and develop systematically the research and technical report.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2							
CO3							
CO4							

Structural Design Laboratory

Contact Hours/ week: (L-T-P-S)	1-0-2-1	**Credits:**	2
Total Lecture Hours:	60 = 14 (L)+0(T)+28(P)+18(S)	**CIE Marks:**	0
Sub. Code:	S1CSEL1	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Introduction to modeling of structures, Overview of STAAD Pro., Analysis and design of continuous beams and trusses.
2	Understand: 3-dimensional modeling, Loads on buildings, Modeling, analysis and design of single-storied structures.
3	Understand Wind load and seismic forces, Computation of Wind load and seismic forces, Modeling, analysis and design of RC and steel multi-storied structures for wind loads and seismic forces.
4	Knowing Foundation design considerations, Analysis and design of Isolated and combined footings
5	Understand the Analysis and design of bridge decks

NOTES:

UNIT I

6 Hours

Introduction to modeling of structures, Overview of STAAD Pro., Analysis and design of continuous beams and trusses. •

UNIT II

9 Hours

-dimensional modeling, Loads on buildings, Modeling, analysis and design of single-storied structures •

UNIT III

6 Hours

Introduction to Wind load and seismic forces, Computation of Wind load and seismic forces, Modeling, analysis and design of RC and steel multi-storied structures for wind loads and seismic forces. •

UNIT IV

6 Hours

Foundation design considerations, Analysis and design of Isolated and combined footings. •

UNIT V

6 Hours

Analysis and design of bridge decks. •

TEXT BOOKS:

1	S. Unnikrishna Pillai and Devdas Menon	Reinforced Concrete Design, TMH, New Delhi, 3rd Edition 2009.
2	N. Subramanian	Design of steel structures-Limit state design, Oxford University Press, India, 2008.

REFERENCES:		
1	A.K.Jain	Advanced Structural Analysis with Computer Application, Nem chand and Brothers, 3rd Edition, 2015 Roorkee, India.
2	Anil K. Chopra	Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India; 3 edition (2007).
3	Taranath B. S	Structural Analysis and Design of Tall Buildings, McGraw Hill., 1988
4	Bowles, Joseph E.	Foundation analysis and design, 2001

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Model, analysis and design of continuous beams.
CO2	Assess and quantify simple loads on structures and model, analyze & design single-storied structures.
CO3	Understand wind loads and seismic forces on structures and model analyze & design multi-storied RC and steel structures.
CO4	Model, analyze & design isolated and combined footings
CO5	Analyze and design of bridge decks.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				3	3		
CO2				3			
CO3				3	3		
CO4				3	3		
CO5				3	3		

Soft Skills

Contact Hours/ week: (L-T-P-S)	0-0-0-0	**Credits:**	0
Total Lecture Hours:	0 = 0 (L)+0(T)+0(P)+0(S)	**CIE Marks:**	0
Sub. Code:	NHS07	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2							
CO3							
CO4							

Finite Element Method and Analysis (I)

Contact Hours/ week: (L-T-P-S)	3-0-2-3	**Credits:**	4
Total Lecture Hours:	120 = 42 (L)+0(T)+28(P)+50(S)	**CIE Marks:**	50
Sub. Code:	S2CSE01	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Basic procedure of finite element analysis of structural problems
2	Concept of structural discretization and displacement models
3	Relating displacement-strain-stress-forces in discretized form for different types of 1D elements
4	Concept of iso-parametric elements and their stiffness using numerical integration
5	Displacement response of 2D structural problems

NOTES:

UNIT I

15 Hours

Introduction to FEM: (9 hours) • Approximate method of structural analysis, Concept of Rayleigh-Ritz method, Advantages and disadvantages of FEM, Basic procedure of FEM for structural problems- Process of Discretization, finite elements for 1-D, 2-D and 3-D problems, Element aspect ratio, mesh refinement Vs higher order elements, numbering of nodes to minimize band width. Constitutive relationships for plane stress, plane strain and axi-symmetric problems (No derivations). • Lab component: (6 hours) • Introduction to MATLAB - 1) MATLAB windows, creating variables, arrays, array operations, conditional statements, 2) Looping statement, plotting functions, user-defined functions in MATLAB, 3) Developing MATLAB functions to model geometry of a beam using 1D and 2D elements •

UNIT II

15 Hours

Discretization of Structures and Displacement Models (9 hours) • Nodal displacement parameters, Shape functions for one, two and 3-dimensional elements, conditions to be satisfied by displacement functions- invariance, continuity, degree of continuity of displacement functions – C0, C1 and C2 functions, convergence and compatibility, Generalized and natural coordinates, Lagrangian interpolation functions • Lab component (6 hours) • 1) Shape functions as anonymous functions-plotting shape functions, 2) Using shape functions to plot deformed shapes of beams and 2D domains for given nodal displacements •

UNIT III

12 Hours

Displacement response for 1D bar & beam problems (8 Hours) • Strain displacement relationship for bar and beam, derivation of element stiffness matrices for Bar, and Beam elements. Linear static analysis of one-dimensional problem using Linear & Quadratic bar elements and beam elements. Strain displacement matrix and stiffness matrices for triangular elements • Lab component (4 hours) • Generating strain-displacement matrices, stiffness matrices and load vectors for given bar and beam elements •

UNIT IV

14 Hours

Stiffness matric of Iso-parametric elements (8 Hours) • Concept of Iso-parametric elements, sub and super parametric elements, Convergence requirements for Iso-parametric element. Formulation of Jacobian matrix and strain displacement matrix, and element stiffness matrix, Condensation of internal nodes, numerical integration • Lab Component (6 Hours) • Generating strain-displacement matrices, stiffness matrices and load vectors for given iso-parametric elements •

UNIT V
14 Hours
Displacement response for two-dimensional problems (8 hours) • Consistent load vector. Displacement response for Two dimensional problems using constant strain triangular elements and quadrilateral elements. FEM software: Auto mesh generation, Computer Program for FEM – Organization – basic flowcharts, Desired features of Pre and Post Processors • Lab component (6 hours) • Developing MATLAB function for generating consistent load vector, and for solving for displacement of 2D problems, 2) Introduction to commercial FE packages (ANSYS/ABAQUS) for analysing trusses and beams, 3) Use of FE packages (ANSYS/ABAQUS) for analysing frames and 2D continuum models (with triangular and quadrilateral elements) •

TEXT BOOKS:

1	Tirupathi R. Chandrupatla, Ashok D. Belegundu	Introduction to Finite Elements in Engineering, Cambridge University Press, 5th edition, 2021
2	Krishnamoorthy C.S.	Finite Element Analysis – Theory and Programming, Tata McGraw Hill, New Delhi, 2nd Edition, 2011.
3	Khennane, A.	Introduction to finite element analysis using MATLAB® and Abaqus, CRC Press, First Edition, 2013.

REFERENCES:

1	Cook, R.D., Malkus, D.S., and Plesta, M.E. and Robert J Witt	Concepts and Applications of Finite Element Analysis, Wiley India Pvt. Ltd, 4th Edition, 2007.
2	Desai, C.S. and T Kundu	Introductory Finite Element Method, CRC Press, London, First Edition, 2001.
3	Rajasekaran S.	Finite Element Analysis in Engineering Design, S. Chand and Co., First Edition, 2006.
4	Singirsu S. Rao	The finite element method in Engineering, Elsevier Inc., New Delhi, Fourth edition, 2005.
5	Yang T.Y.	Finite Element Structural Analysis, Prentice Hall, New Jersey, 1986.
6	Zienkiewicz, O.C. R L Taylor and J Z Zhu	The Finite Element Method-Its Basis and Fundamentals, Butterworth and Heinemann, Elsevier, 7th Edition, 2013.
7	K J Bathe	Finite Element Procedures, Prentice Hall, Pearson Education Inc., 2nd edition, 2014.

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Apply the basic principles of structural mechanics for solving discretized forms of structural idealizations
CO2	Formulate the interpolation functions in terms of nodal values for various shapes of elements based on the assumption on variation of field variable
CO3	Formulate strain displacement matrix, stiffness matrix and load vector for bar, beam and triangular elements, and thus solve for nodal displacements.
CO4	Formulate strain displacement and stiffness matrices of two-dimensional iso-parametric elements.
CO5	Solving plane stress, plane strain and axi-symmetric problems using isoparametric elements and CST elements.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			3	1	2		
CO2			3	1	2		
CO3			3	1	2		
CO4			3	1	2		
CO5			3	1	2		

Design of Earthquake-Resistant Structures

Contact Hours/ week: (L-T-P-S)	3-0-0-3	**Credits:**	3
Total Lecture Hours:	90 = 42 (L)+0(T)+0(P)+48(S)	**CIE Marks:**	50
Sub. Code:	S2CSE02	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Learn effect of infill's, ductility and energy absorption and capacity-based design, seismic retrofitting
2	Learn design of simple and multistoried frame structures are introduced. The effect of structural configuration and design provisions of IS1893:2016
3	Learn the strong motion characteristics, response history, tripartite response spectrum and its utility for earthquake resistance
4	Learn the requirements of efficient earthquake resistant structural systems, damping devices and base isolation.
5	Learn the elements of seismology and seismic waves, structural response under various load conditions.

NOTES:

UNIT I

9 Hours

Introduction to engineering seismology: Plate tectonics and seismic waves, characteristics of earthquake and its quantification–Magnitude and Intensity scales, ground motion parameters, seismic instruments, Earthquake Hazards, Prediction of PHA, Risk evaluation and Mitigation •

UNIT II

9 Hours

Response history and strong motion characteristics, Response Spectrum – elastic and elastoplastic spectra, tripartite plot, design spectrum, Structural Response under gravity and seismic loads, lateral load resisting structural systems. Structural configuration for earthquake resistant design, concept of plan irregularities and vertical irregularities, soft storey, location of centre of mass and centre of rigidity, torsion in buildings •

UNIT III

8 Hours

Computation of seismic forces: in multistory buildings using equivalent lateral force method and dynamic analysis. Requirements of efficient earthquake resistant structural systems, damping devices and base isolation •

UNIT IV

8 Hours

Design of RC buildings for earthquake resistance: load combinations, ductility and energy absorption in buildings, confinement of concrete for ductility, design of columns and beams for ductility, ductile detailing as per IS:13920, design provisions as per IS:1893 for frames, shear walls and dual systems, structural behavior, design and ductile detailing of shear walls •

UNIT V
8 Hours
Effect of infill masonry walls on frames: modeling concepts of masonry infills, behavior of masonry buildings during earthquakes, failure patterns and strength of masonry infills in shear and flexure, slenderness concepts of masonry walls, concepts of earthquake resistant design of masonry buildings, codal provisions. •

TEXT BOOKS:

1	Agarwal, P. and Shrikhande, M.	Earthquake Resistant Design of Structures, Prentice Hall India Learning Private Limited; 1st Ed. (2011)
2	Chopra, A. K.	Dynamics of Structures-Theory and applications to Earthquake Engineering, Pearson Education India; 4th Edition (2012)
3	Duggal, S. K.	Earthquake Resistant Design of Structures, Oxford University Press, New Delhi 2007.

REFERENCES:

1	Dowrick, D. J.	Earthquake Resistant Design and Risk Reduction, John Wiley and Sons, 2009.
2	Penelis, G. G. and Kappos, A. J.	Earthquake Resistant Concrete Structures, Taylor and Francis Group, London, 2010.
3	Edmund D. Booth, David Key	Earthquake Design Practice for Buildings, Thomas Telford Publishing, London, 2006.

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Explain the causes and effects of Earthquakes.
CO2	Analyse and detail the multi-storeyed structures using I.S Codes by Response Spectrum methods
CO3	Compute the seismic loading on multi-storied structures using I.S Codes by Response Spectrum methods
CO4	Design Earthquake resistant RC Building with ductile detailing as per codal provisions
CO5	Analyze framed structures with infill walls

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			2				
CO2			2	3			
CO3			2	1	1		
CO4				3			
CO5			3				
CO6			1	1	3		

Design of Industrial Structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S2CSE03	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Design industrial structures and their numerous steel building components, such as roof truss members, gantry girders, light gauge steel members, steel connections, plate girders, castellated beams, and virendeel girders Using IS 800-2007 and other relevant Indian codes.

NOTES:

UNIT I

12 Hours

Plastic Analysis and Design: Introduction to plastic hinge, plastic collapse load, conditions of plastic analysis, redistribution of moments, Theorems of plastic collapse, Plastic analysis of continuous beams and portal frames, design of continuous beams. •

UNIT II

12 Hours

Analysis of Industrial buildings and mill bents for gravity and wind loads, design of Industrial buildings components namely roof trusses, rafter bracing, purlins, tie runner, side runner, eave girder. Analysis and design of gantry girders in industrial buildings. •

UNIT III

12 Hours

Forms of light gauge sections based on IS 801, Effective width computation of compressive strength of unstiffened, stiffened, multiple stiffened compression elements of cold formed light gauge sections, concept of local buckling of thin elements, limiting width to thickness ratio, post buckling strength. Flexural strength of light gauge members. •

UNIT IV

10 Hours

Design of Industrial buildings Connections, Rigid and semi rigid connections, Behavior, codal provisions, Design of trusses, design of connections using bolts and welds •

UNIT V

10 Hours

Concept of pre-engineered buildings, Introduction to castellated beams and virendeel girders. Design of plate girder. •

TEXT BOOKS:

1	N.Subramanian	Design of steel structures-Limit state design, Oxford University press, First Edition, 2008
2	Duggal, S. K.	Limit state design of steel structure, Mc Graw Hill, 3rd Edition, 2019

REFERENCES:		
1	Bhavikatti, S. S.	Design of Steel Structures by Limit State Method as Per IS: 800-2007, I K International Publishing House, Second Edition, 2010
2	Ramachandra & Veerendra Gehlot	Limit state Design of steel structures, Scientific Publishers, First Edition, 2018

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Analysis and design of continuous beams and portal frames using plastic theory.
CO2	Design of industrial building structural members including gantry girders.
CO3	Design of light gauge cold formed steel structural members.
CO4	Design of bolted and welded connection.
CO5	Design of plate girder.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			1	2			
CO2			1	2			
CO3			1	2			
CO4			1	2			
CO5			1	2			

Professional Elective – 3

Contact Hours/ week: (L-T-P-S)	0-0-0-0	**Credits:**	0
Total Lecture Hours:	0 = 0 (L)+0(T)+0(P)+0(S)	**CIE Marks:**	0
Sub. Code:	S2CSEE30	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2							
CO3							
CO4							

Design of bridge structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S2CSEE31	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand different types of bridges, their components, design principles, selection of bridge site, loads coming on bridges
2	Design the slab bridges for different IRC loading standards
3	Design reinforced concrete T-beam bridges, PSC bridges and bridge bearings.

NOTES:

UNIT I

12 Hours

Introduction: Components of a bridge, classification of bridges, Historical development, Types of bridge superstructures- Design principles (No problems), selection of bridge site. • Loads on Bridges: Dead loads, Vehicle live load, Impact effect, Wind loading, longitudinal forces, centrifugal forces, Buoyancy, water current forces, Thermal forces, seismic forces. • Culverts: Introduction, analysis and design principles of pipe and box culverts •

UNIT II

12 Hours

Design of Slab Bridges: • Introduction to slab bridges, Effective length of dispersion, effective width of dispersion, Analysis and design of deck slab bridges for different IRC AA (Tracked vehicle), IRC class A vehicle and IRC class 70R loading using limit state method. •

UNIT III

10 Hours

Design of T-beam Reinforced Concrete Bridges • Introduction to T-beam bridges, Analysis using Courbon’s method, Design of T-beam interior panel using pegaud’s method and girders for different IRC AA (Tracked vehicle), IRC class A vehicle and IRC class 70R loading using limit state method •

UNIT IV

10 Hours

Design of Prestressed Concrete Bridges • Introduction to Prestressed concrete bridge decks, principles of prestressing, design on post tensioned prestressed concrete deck slab Bridges. •

UNIT V

12 Hours

Design of Bridge bearings • Introduction to bridge bearing, types of bearings, analysis of load transfer to bearings, Design principles of steel rocker and roller bearings, Design of reinforced concrete rocker bearing, design of elastomeric pad bearing. design of elastomeric pot bearings. •

TEXT BOOKS:

1	T.R.Jagadeesh and M.A.Jayaram	Design of Bridge Structures, 3rd Edition, PHI, 2020

2	N Krishna Raju	Design of Bridges, Oxford & IBH Publishing Co., New Delhi, 1998
3	Johnson Victor	Essentials of Bridge Engineering, Oxford & IBH publishing Co.Pvt.Ltd. New Delhi, 6th edition, 2009

REFERENCES:

1	Ponnuswamy S	Bridge Engineering, 2nd edition, Tata McGraw Hill Publishing Co. Ltd., 2008
2	N. Rajagopalan	Bridge Superstructure, Alpha Science International- Technology & Engineering Series , 2006
3	Conrad P. Heins and Richard A. Lawrie	Design of Modern Concrete Highway Bridges, John Wiley and Sons,1984
4	Narendra Taly	Highway Bridge Superstructure Engineering: LRFD Approaches to Design and Analysis, CRC Press, - Technology & Engineering Series, Taylor and Francis Group, 2014
5	Wai-Fah Chen and Lian Duan	Bridge Engineering Handbook- construction and maintenances CRC Press— Technology & Engineering Series, Taylor and Francis Group, 2014
6	IRC 6 – 2014	Standard Specifications and Code Of Practice For Road Bridges Section II Loads and Stresses, The Indian Road Congress New Delhi
7	IRC 21 – 2000	Standard Specifications and Code Of Practice For Road Bridges Section III Cement Concrete (Plain and reinforced) The Indian Road Congress New Delhi.
8	IRC-18-2000	Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned concrete), Indian Standard specification and code of Practice for PSC Bridges
9	IRC 83	Standard specifications and code of practice for Road bridges Section IX Bearings Part I Metallic Bearings Part II Elastomeric Bearings

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Describe the design principles of critical components (no numerical problems), select ideal bridge site based on requirements, distinguish different types of loadings acting on bridges and explain the principles of load dispersion.
CO2	Design typical slab bridges for different classes of vehicular loads – IRC class AA tracked vehicle and 70 R loading using Pigeuad’s charts.
CO3	Design deck slab and RC T beam bridge girders for IRC-tracked vehicles and class 70R loading.
CO4	Design PSC deck slabs and post tensioned concrete T beam bridge girders.
CO5	Identify different types of bridge bearings, applications of different types of bearings and distinguish their general features, design reinforced concrete rocker bearings, elastomeric pad and pot bearings.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3						
CO2	3		2				
CO3	3		2				
CO4	3		2				
CO5	3		2				

Design of Tall Structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S2CSEE32	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	The objective of the course is to introduce the design philosophy of tall structures, various types of loading and load combinations, factors affecting behavior of various forms of tall structures – rigid frames, braced frames, shear walls, coupled shear walls, wall frames, tubular and core structures, analysis and design of various tall structural systems considering different sectional shapes, deflection, cracking, pre stressing and shear flow, creep temperature, shrinkage and stability.

NOTES:

UNIT I

12 Hours

Design Criteria: • Design philosophy, loading, sequential loading, and materials–high-performance ty, fiber reinforced concrete, lightweight concrete, design mixes. Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads Wind loading: static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, model analysis, combinations of loading, Limit state design. •

UNIT II

12 Hours

Behaviour of various structural systems: • Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Futigger – braced and hybrid mega system. •

UNIT III

12 Hours

Analysis: • Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three-dimensional analysis. Structural elements: sectional shapes, properties and resisting capacities. •

UNIT IV

10 Hours

Design: • Design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire. •

UNIT V

10 Hours

Stability of tall buildings: • Effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Transnational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation. •

TEXT BOOKS:		
1	Taranath B. S.	Structural Analysis and Design of Tall Buildings, McGraw Hill., 1988

REFERENCES:		
1	Wolfgang Schueller	High rise building structures, John Wiley & Sons Inc 1977.
2	Bryan Stafford	Tall building structures, Analysis and Design, Wiley India Pvt Ltd, 2011.
3	Lin T. Y & Stotes Burry D	Structural concepts and system for Architects and Engineers, Wiley; First Edition Edition 1981
4	Lynn S. Beedle	Advances in Tall Buildings, CBS Publishers and Distributors. Van Nostrand Reinhold, 1986.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Explain the design philosophy of tall structures including gravity load, construction load, sequential load, wind loads, impact loads. Students will be able to explain static and analysis, wind tunnel method for the analysis of tall structure including stress, limit state and plastic design methodology. Students will apply concept of special concrete and their design mixes.
CO2	Elaborate on the high raise behavior of structural systems such as rigid frames, frames infill frames, shear walls, tubular and cores etc.
CO3	Explain the analysis of structural system for overall integrity and subsystem interaction, computerized 3D analysis and selection of structural elements.
CO4	Determine deflection, cracking, prestressing shear flow for tall structures, for differential movement creep and shrinkage effects, temperature effects and fire.
CO5	Evaluate the stability of tall buildings using approximate methods second order effects of gravity loading, P-Delta analysis, simultaneous first and P-Delta analysis Transnational, Torsional instability, out of plum effects, stiffness of member in stability, effect of foundation rotation.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				1			
CO2				1			
CO3				1			
CO4				1			
CO5				1			

Design of offshore structures

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S2CSEExx	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand on the types of offshore structures and their conceptual development.
2	Understand the behaviour under static and dynamic load, their design method and codal provisions
3	Understand the tubular member and joint design Objective
4	Understand the behaviour of offshore structure to environment al loads, accidental loads, and corrosion

NOTES:

UNIT I

12 Hours

Introduction to offshore structures, Types of offshore structures and their conceptual development- Fixed, Compliant, Floating-Analytical models for offshore structures- Behaviour under static and dynamic loads-Materials and construction of jacket and gravity platforms- Statutory regulations- Allowable stresses-Design methods and Code Provisions- Design specification as per Classification Societies. •

UNIT II

12 Hours

Introduction to tubular members- Slenderness effect- Principles of WSD and LRFD; Allowable stresses and Partial Safety Factors; Tubular Members, Slenderness effects; Column Buckling, Design for Hydrostatic pressure; Design for combined axial and bending stresses (API RP 2A guidelines). Simple tubular joints, design using allowable loads; stress concentration factors; S-N curves and fatigue damage calculations - Design of tubular joints as per API Code. •

UNIT III

12 Hours

Environmental loads- Wind, wave, current and ice loads- Calculation based on maximum base shear and overturning moments- Design wave height and spectral definition- Morison's Equation-Maximum wave force on offshore structure •

UNIT IV

10 Hours

Design against accidental loads- Fire, Blast and Collision - Behaviour of steel at elevated temperature-Fire rating for Hydrocarbon fire- Design of structures for high temperature- Blast mitigation -Blast walls-Collision of boats and energy absorption. •

UNIT V

10 Hours

Corrosion- Corrosion mechanism- Types of corrosion- Offshore structure corrosion zones- Biological corrosion- Preventive measures of corrosion- Principles of cathode protection systems- Sacrificial anode method and impressed current method- Online corrosion monitoring- Corrosion fatigue. •

TEXT BOOKS:		
1	Srinivasan Chandrasekaran	Dynamic Analysis and Design of Ocean Structures. Springer, First Edition, 2015
2	Chakrabarti, S.K.	Hydrodynamics of Offshore Structures, WIT, First edition, 1987
3	B. Gou, S. Song, J. Chacko and A. Ghalambor,	Offshore pipelines, GPP Publishers, First Edition, 2006
4	W.F. Chen and E.M.Lui	Structural Stability - Theory and Implementation, Prentice Hall, First Edition, 1987
5	Dawson, T. H.	Offshore Structural Engineering, Prentice Hall, First Edition, 1983

REFERENCES:		
1	Joint Industry Research	Interim Guidance Notes for the design of and protection of topside structures against explosion and fire, Joint Industry Research, UK
2	API	API RP 2A- Planning, Designing and Constructing Fixed Offshore Platforms, API, First Edition, 2000.
3	S.K. Chakrabarti	Handbook of Offshore Engineering, Elsevier, First Edition, 2005

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Carry out dimensioning and structural design of offshore structures
CO2	Design jacket platforms, tubular joints, and concrete gravity platforms
CO3	Estimate the maximum forces on an offshore structure due to environmental loads
CO4	Estimate the resistance of offshore platforms against accidental loads, elevated temperature, blast and collision.
CO5	Explain the physics of corrosion and methods to monitor and prevent corrosion

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1			2	1			
CO2			2	1			
CO3			2	1			
CO4			2	1			
CO5			1	1			

Construction Project Management

Contact Hours/ week: (L-T-P-S)	2-2-0-2	**Credits:**	3
Total Lecture Hours:	90 = 28 (L)+28(T)+0(P)+34(S)	**CIE Marks:**	50
Sub. Code:	S2CSEE33	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Understand the Insights of Construction Project Management – Types, Function, Application of Construction Project Management in Construction Projects using structured strategies
2	Comprehend the Project Scheduling - Its tactics and tools and techniques for planning Construction works/activities. Schedule the activities using Network diagrams.
3	Understand the Contract Management- types of Contracts and associated tasks used in Construction Projects.
4	Explore the Construction Safety Engineering and Management and Risk Management in Construction
5	Know about Project Quality Management and Environmental Management concepts and its frame works

NOTES:

UNIT I

12 Hours

Project: • Project Life Cycle Phases Function of Project Management Function of Project Management Project Planning: Scope, Planning process and its objectives, Types of Project Plan Resource Planning Breakdown structures, Duration estimation, Quantity Takeoff, activity-based costing •

UNIT II

12 Hours

Project Scheduling • Introduction, Precedence Network Analysis (A-O-A network and A-O-N network) Logic Diagram, Construction Scheduling Techniques CPM, PERT LOB and Linear Scheduling Float and its implications on Project schedule Resource allocation Resource Smoothening Resource Leveling and related problems •

UNIT III

12 Hours

Contract Management • Classification based on Tendering process Economic Considerations, Tasks involved Main and Sub-contracts, Features, Merits and demerits Applicability of the various types of contracts, FIDIC and KTPP guidelines Breach of Contract Classification, Common Breaches by Principal, Contractor, Damage assessment, Claims for damages Quantum Meruit, Force Majeure or Frustration Dispute resolution: Methods, Negotiation, Mediation, Conciliation Dispute Resolution boards, Arbitration, Litigation/Adjudication by courts •

UNIT IV

10 Hours

Safety Management • Construction safety engineering and Management. Technological aspects, Organizational aspects, Behavioural aspects. Safety rules and Safety remedies for common hazards in construction. Safety in Use of construction Equipment • Risk Management • In construction industry, Key terms and definitions Risk Identification, Risk Analysis and Evaluation Risk Response and monitoring, Risk Management Misconceptions •

UNIT V

10 Hours

Project Quality Management • Introduction, Elements of Quality QA and QC Quality Planning, audit, Quality Checklists TQM tools – Philosophy (Deming, Juran, Crossby, Taguchy) Flow Charts, Histograms, Pareto diagram Scatter diagram, Control Charts Introduction to ISO 9000 Quality Systems ISO 14001 Environmental Management System •

TEXT BOOKS:

1	Jimmie W. Hinze	Construction Planning and Scheduling, 4th Edition (2011)
2	Smith, Curie and Hancok	Common Sense Construction Law, John Wiley & Sons, 4th Edition, 2009
3	Dr. Rajendra Prasad D S	A Simple Practical Approach to Project Management- Concepts, Tools & Techniques, Sapna Book House, Bangalore, 2022
4	Dr. Rajendra Prasad D S	A Simple Practical Approach to ISO 9001:2015Quality Management Systems – Implementation, Sapna Book House, Bangalore, 2016
5	Gary E. MacLean	Documenting Quality for ISO 9000 and other Industry Standards, Tata McGraw Hill Book Company Limited.

REFERENCES:

1	Frank Harris and Ronald Mc Caffer	Modern Construction Management, Wiley-Blackwell, 7th Edition, 2009
2	Denny McGeorge and Patrick Zou	Construction Management and New Directions, Wiley Black Publication, Wiley Blackwell, 3rd Edition, 2012
3	Saurav Kumar Soni	Construction Management and Equipment, S K Kateria & Sons, 1st Edition, 2015
4	John L. Hardesky	Productivity and Quality Improvement, McGraw Hill Book Company
5	Bagchi	ISO 9000 Concepts, Methods, Implementation, Wheeler Publishing
6	Mohamed Zairi	Total Quality Management for Engineers, Aditiya books Private Limited
7	Elwyn E. Seelye	Data Book for Civil Engineers Field Engineers, John Wiley & Sons, Inc
8	A.M. Neville	Properties of concrete, ELBS Publications
9	BIS ISO 9001:2015	Quality Management System- Requirements
10	BIS ISO 14001:2015	Environmental Management System- Requirements
11	BIS ISO 45001:2019	Occupational Health & Safety Management System- Requirements
12	BIS IS: 456:2000	Indian Standard Specifications for Plain and Reinforced Concrete Code of Practice, 4th Revision, Bureau of Indian Standards
13	Web	Excerpts from Internet Downloads

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO1	Describe the elements of a Project and Phases of Project Life cycle and applying Project Management Principles to develop WBS for various Projects (L5)
CO2	Develop Schedules with the help of different scheduling techniques and network diagrams considering uncertainty in a Project (L5)
CO3	Allocate Resources to a Construction Project considering the importance of smoothening and leveling. (L4)
CO4	Select Materials, vendors and participants according to Contractual terms and often set the Project Timeline and also to help develop the Client proposal and identify breaches of Contact. (L6)
CO5	Highlight the Scope of Risk and Safety Management on Site and Analyze the Statistical Quality Control Process of Construction Project. (L6)

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1				3			
CO2						3	
CO3						3	
CO4						3	
CO5						3	

Mini Project with Seminar

Contact Hours/ week: (L-T-P-S)	0-2-4-0	**Credits:**	3
Total Lecture Hours:	90 = 0 (L)+28(T)+56(P)+6(S)	**CIE Marks:**	0
Sub. Code:	S2CSEMPS	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2							
CO3							
CO4							

Structural Dynamics Laboratory

Contact Hours/ week: (L-T-P-S)	1-0-2-1	**Credits:**	2
Total Lecture Hours:	60 = 14 (L)+0(T)+28(P)+18(S)	**CIE Marks:**	50
Sub. Code:	S2CSEL1	**SEE Marks:**	50

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

1	Determine the logarithmic decrement and damping ratio for one-storied and two-storied steel frames subjected to harmonic excitation and induced base motion.
2	Determine the logarithmic decrement and damping ratio for one-span and two-span beams subjected to harmonic excitation.
3	Determine the logarithmic decrement and damping ratio for four storied building frame model with and without an open ground floor subjected to harmonic base motion
4	Extract the natural frequencies and mode shapes for cantilever and fixed beams.
5	Extract the natural frequencies and mode shapes for frames.

NOTES:

UNIT I

7 Hours

Experiments Set 1: • Experimental investigation one and two-span beam model subjected to periodic motion to determine variation of vibration amplitude, logarithmic decrement, and damping. •

UNIT II

8 Hours

Experiments Set 2: • Experimental investigation one-storied building frame model subjected to periodic base motion to determine variation of vibration amplitude, logarithmic decrement and damping. •

UNIT III

8 Hours

Experiments Set 3: • Experimental investigation of two and three storied building frame models subjected to harmonic base motion to determine logarithmic decrement, damping, modal amplitudes. •

UNIT IV

8 Hours

Experiments Set 4: • Experimental investigation of a four storied building frame model with and without an open ground floor subjected to harmonic base motion to determine logarithmic decrement, damping, modal amplitudes. •

UNIT V

8 Hours

Experiments Set 5: • Extract the natural frequencies and mode shapes for cantilever and fixed beams, and frame model in undamaged and damaged conditions. •

TEXT BOOKS:

1	Mario Paz and William Leigh	Structural dynamics–Theory and Computation, 5th Ed. 2004. Elsevier Publications, 2003. ISBN: 0-7506-7618-3

REFERENCES:		
1	Douglas Thorby	"Vibration Testing in Structural Dynamics and Vibration in Practice", An Vibration in Practice, An Engineering Handbook, Butterworth and Heinemann, An Imprint of Elsevier Publications, Oxford, UK, 2008.
2	Paolo Gatti and Vittorio Ferrarri	"Applied structural and mechanical vibrations- Theory, methods and measuring instrumentation", E and FN Spon, Imprint of Taylor and Francis, London, 1999.

COURSE OUTCOMES: Upon completion of this course the student will be able to:	
CO1	Conduct experiments on one and two-span model beams and determine the dynamic responses like amplitude logarithmic decrement and damping.
CO2	Conduct experiments on one-storied building frame model beams and determine the dynamic responses like amplitude logarithmic decrement and damping.
CO3	Conduct experiments on two and three storied building frame models subjected to harmonic base motion to determine logarithmic decrement, damping, modal amplitudes.
CO4	Conduct experiments on four storied building frame models with and without an open ground floor subjected to harmonic base motion to determine logarithmic decrement, damping, modal amplitudes.
CO5	Conduct experiments on damaged and undamaged beams, and frame models to extract natural frequencies and mode shapes.

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1					2		
CO2					2		
CO3					2		
CO4					2		
CO5					2		

Aptitude Related Analytical Skills

Contact Hours/ week: (L-T-P-S)	1-0-0-1	**Credits:**	1
Total Lecture Hours:	30 = 14 (L)+0(T)+0(P)+16(S)	**CIE Marks:**	0
Sub. Code:	ARAS	**SEE Marks:**	0

CIE- Continuous Internal Evaluation, SEE-Semester End Examination

COURSE OBJECTIVES:
This course will enable students to:

NOTES:

TEXT BOOKS:

REFERENCES:

COURSE OUTCOMES: Upon completion of this course the student will be able to:

CO-PO Mapping: 1=> Low, 2=> Medium, 3 => Strong mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1							
CO2							
CO3							
CO4							