M.TECH
STRUCTURAL ENGINEERING

SCHEME OF INSTRUCTION AND SYLLABUS

M.Tech-19
(w.e.f 2019– 2020)

Department of Civil Engineering

VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE

(An Autonomous Institution affiliated to Jawaharlal Nehru Technological University Kakinada, Kakinada
NBA Accredited & ISO 9001:2015 Certified)
(Sponsored by Siddhartha Academy of General & Technical Education)
Kanuru, Vijayawada-520007, A.P. India
www.vrsiddhartha.ac.in

INSTITUTE VISION

To nurture excellence in various fields of engineering by imparting timeless core values to the learners and to mould the institution into a centre of academic excellence and advanced research.

INSTITUTE MISSION

To impart high quality technical education in order to mould the learners into globally competitive technocrats who are professionally deft, intellectually adept and socially responsible. The institution strives to make the learners inculcate and imbibe pragmatic perception and pro-active nature so as to enable them to acquire a vision for exploration and an insight for advanced enquiry.

DEPARTMENT VISION

To impart teaching, research and develop consultancy that serves the society and to strive continuously for excellence in education.

DEPARTMENT MISSION

To provide quality education for successful career and higher studies in Civil Engineering that emphasizes academic and technical excellence in profession and research, effective communication, team work and leadership to meet the challenges of the society.

PROGRAM OUTCOMES

PO1: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PO3: Use different software tools to analyse and design of various structural components

PO4: An ability to write and present a substantial technical report/document

PO5: Function as a member in a team effectively with sense of ethics, integrity and social responsibility.

VELAGAPUDI RAMAKRISHNA

SIDDHARTHA ENGINEERING COLLEGE

SCHEME OF INSTRUCTION FOR TWO YEAR PG PROGRAMME [M.TECH 19]

M.TECH IN (Structural Engineering)

SCHEME OF INSTRUCTIONS

SEMESTER I **Contact Hours: 23**

S.No	Course Type	Course Code	Title of the Course	L	T	P	Credits
1.	Programme Core - I	19CESE1001	Advanced Structural Analysis	3	0	0	3
2.	Programme Core - II	19CESE1002	Theory of Plates & Shells	3	0	0	3
3.	Programme Core - III	19CESE1003	Advanced Steel Design	3	0	0	3
4.	Programme Elective - I	19CESE1014	• Structural Health Monitoring • Sub-Structure Design • Analytical and Numerical Methods for Structural Engineering • Industry Oriented Subject	3	0	0	3
5.	Programme Elective - II	19CESE1015	• Prefabricated Structures • Fracture Mechanics of Concrete Structures • Structural Optimization • Design of Prestressed Concrete Structures	3	0	0	3
6.	Mandatory Learning Course	19MTMC1026	Research Methodology and IPR	2	0	0	0
7.	Laboratory - I	19CESE1051	Advanced Concrete Lab	0	0	3	1.5
8.	Laboratory - II	19CESE1052	Numerical Analysis Lab	0	0	3	1.5
			Total	**17**	**0**	**6**	**18**

L – Lecture, T – Tutorial, P – Practical, C – Credits

SEMESTER II **Contact Hours: 25**

S.No	Course Type	Course Code	Title of the Course	L	T	P	Credits
1.	Programme Core – IV	19CESE2001	FEM in Structural Engineering	3	0	0	3
2.	Programme Core – V	19CESE2002	Stability of Structures	3	0	0	3
3.	Programme Core – VI	19CESE2003	Structural Dynamics	3	0	0	3
4.	Programme Elective – III	19CESE2014	• Design of High-Rise Structures • Soil Structure Interaction • Advanced Bridge Engineering • Industry Oriented Subject	3	0	0	3
5.	Programme Elective – IV	19CESE2015	• Repair and Rehabilitation of Structures • Design of Steel-Concrete Composite Structures • Design of Formwork • Earthquake Resistant Design of Structures	3	0	0	3
6.	Audit Course	19CESE2036	Technical Report Writing	2	0	0	-
7.	Term Paper	19CESE2063	Term Paper seminar – Literature Review for the proposed problem	2	0	0	1
8.	Laboratory - I	19CESE2051	Structural Dynamics lab	0	0	3	1.5
9.	Laboratory - II	19CESE2052	Structural Design Lab/Industry Oriented lab	0	0	3	1.5
			Total	**19**	**0**	**6**	**19**

L – Lecture, T – Tutorial, P – Practical, C – Credits

***Students to be encouraged to go industrial training for at least Six weeks during semester break**

#Students should conduct the Literature Survey for the proposed research topic and they need to develop a prototype or simulation based (must be outcome oriented) – the same to be presented in any conference (national or international)

Semester III **Contact Hours:21**

S.No	Course Type	Course Code	Title of the Course	L	T	P	Credits
1.	Programme Elective - V	19CESE3011	Choice for students to complete course in any MOOCS Platform	3	0	0	3
2.	Project (Part-A)	19CESE3061	Dissertation*/ Project/ Research Organization	0	0	18	10
3.	Internship	19CESE3052	Internship/Summer Training in Research Organizations/ Institutions of Higher Learning (After II Sem)	0	0	0	2
			Total	**3**	**0**	**18**	**15**

L – Lecture, T – Tutorial, P – Practical, C – Credits

***To be continued in the IV Semester**

Program Elective V may be completed in semester I or II by satisfying the pre-requisites those who are going for industrial project

Semester IV **Contact Hours:32**

S.No	Course Type	Course Code	Title of the Course	L	T	P	Credits
1.	Project (Part-B)	19CESE4061	Dissertation/ Industrial Project	0	0	32	16
			Total	**0**	**0**	**32**	**16**

L – Lecture, T – Tutorial, P – Practical, C – Credits

Total Credits:68

Semester	Credits
1	**18**
2	**19**
3	**15**
4	**16**

SEMESTER I

19CESE1001	ADVANCED STRUCTURAL ANALYSIS

Course Category:	Programme Core-1	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Apply energy principles for the analysis of determinate and indeterminate structures.				
	CO2	Analyze structures comprising axial elements, Beams, Grids, Plane and space frames using matrix methods.				
	CO3	Analyse continuous beams and grids by flexibility and stiffness matrix methods.				
	CO4	Apply matrix methods for elastic instability and second order effects including plane frames and space frames.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	3	3			
	CO3	3	3			
	CO4	3	3			

Course Content

UNIT-I

REVIEW OF BASIC CONCEPTS IN STRUCTURAL ANALYSIS:
Analysis of statically determinate structures(Trusses, Beams, Frames)Applications of principle of virtual work and displacement based and force -based energy principles, deriving stiffness and flexibility coefficients

REVIEW OF ANALYSIS OF INDETERMINATE STRUCTURES
Force methods - Statically indeterminate Structures,
Displacement Methods - Kinematically indeterminate Structures; Matrix concepts and matrix analysis of structures.

UNIT-II

MATRIX ANALYSIS OF STRUCTURES WITH AXIAL ELEMENTS:
Introduction; One dimensional axial Structures; Plane trusses; Space trusses.

	UNIT-III **MATRIX ANALYSIS OF BEAMS AND GRIDS:** Conventional Stiffness method for beams, Reduced stiffness method for beams, Flexibility method for fixed and continuous beams, Stiffness method for grids.
	UNIT-IV **MATRIX ANALYSIS OF PLANE AND SPACE FRAMES:** Conventional Stiffness method for plane frames, Reduced Stiffness method for plane frames, Flexibility method for plane frames, Stiffness method for Space Frames. **ANALYSIS OF ELASTIC INSTABILITY AND SECOND ORDER EFFECTS:** Effects of axial force on flexural stiffness, Solution by slope deflection method, Solution by matrix method.
Text Books	[T1] Devdas Menon, "Advanced Structural Analysis ", Narosa Publishing House,2009 [T2]Devdas Menon," Structural Analysis", Narosa Publishing House, 2008
Reference Books	[R1] Asslam Kassimali, "Matrix Analysis of Structures", Brooks/ Cole Publishing Co., USA ,1999 [R2] Amin Ghali, Adam M Neville and Tom G Brown," Structural Analysis: A Unified Classical and matrix Approach", Sixth Edition, 2007, Chapman &Hall.
E-resources and other digital material	https://nptel.ac.in/courses/105106050/

19CESE 1002	THEORY OF PLATES AND SHELLS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify the concept of thin plates using various approaches				
	CO2	Analyze the thin plates subjected to different loading and boundary conditions.				
	CO3	Analyse the stress-strain relationship of shells.				
	CO4	Investigate the behaviour of shells subjected to different loading criterion and boundary conditions				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	3			
	CO2	3	3			
	CO3	2	3			
	CO4	2	3			
Course Content		**UNIT- I** Introduction to thin plates, small deflection theory, plate equation. Isotropic and orthotropic plates, bending and twisting of plates, Navier's solution, Levy's solution and energy method.				
		UNIT-II Rectangular, circular plates with variable rigidity in Cartesian and polar co-ordinates, Numerical solutions. Plastic analysis of plates, yeild-line theory, Introducing to stability of plates.				
		UNIT-III Shell behavior, shell surfaces and characteristics, classification of shells, equilibrium equations in curvilinear co-ordinates. Stress-strain & force displacement relations. Membrane analysis of shells of revolution.				

	UNIT-IV Cylindrical shells under different loads. Shallow shells, membrane solution of elliptic paraboloids and hyperboloids. Solution of some typical problems. Introducing to stability of shells
Text Books	[T1]Theory of plates and shells by S.P.Timoshenko and S.Woinowsky-Krieger, McGraw-Hill, 1959. [T2] N. K. Bairagi, "Shell Analysis" ,Khanna Publishers.
Reference Books	[R1]R. Szilard, "Theory & Analysis of Plate - Classical & Numerical Methods" , John Wiley & Sons Publishing Company. [R2]Ramaswamy, G. S., "Design & Construction of Concrete Shell Roofs", McGraw-Hill Publishing Company.
E-resources and other digital material	http://nptel.ac.in/video.php?subjectId=112101095

19CESE1003	ADVANCED STEEL DESIGN

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Analyse wind loads on buildings and pitched roof trusses				
	CO2	Analyze and design tower structures.				
	CO3	Analyze and design various connections				
	CO4	Analyze and design truss bridges				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	3		2	2
	CO2	2	3		2	2
	CO3	2	3		2	2
	CO4	2	3		2	2

Course Content

UNIT-I

WIND LOADS ON BUILDINGS

Introduction to wind load; Design wind speed and pressure; Wind pressure on roofs; Wind effect on cladding and louvers; Design of purlins for roofs and rails for cladding; Open sheds – Pitched roofs.

UNIT-II

TOWERS

Basic structural configurations - free standing and guyed towers - wind loads - foundation design - design criteria for different configurations and transmission line towers.

UNIT-III

CONNECTIONS

Bearing type joints - unstiffened and stiffened seat connections (bolted & welded); bracket connections type I & II (bolted and welded)-semi-rigid connections.

	UNIT-IV **DESIGN OF STEEL TRUSS GIRDER BRIDGES:** Types of truss bridges, component parts of a truss bridge, economic proportions of trusses, self weight of truss girders, design of bridge compression members, tension members, stringer breams, cross beams; wind load on truss girder bridges; wind effect on top lateral bracing; bottom lateral bracing; portal bracing; sway bracing
Text Books	[T1]Design of steel structures by N Subramanian, oxford university press, 2018 [T2]Limit state design of steel structures by S K Duggal, McGraw Hill Education (India) Pvt Ltd., 2017
Reference Books	[R1]Design of Steel Structures by A S Arya and J L Ajmani, Nam Chand Brothers Publication, 2011 [R2]Steel structures: Design and behaviour by C G Salmon and J E Johnson, Prentice-Hall, 1997.
E-resources and other digital material	https://nptel.ac.in/courses/105106113/ https://nptel.ac.in/courses/105106112/

19CESE1014/A	STRUCTURAL HEALTH MONITORING

Course Category:	Programme Elective	Credits:	3
Course Type:	Theory	Lecture - Tutorial -Practice:	3 hrs/week
Prerequisites:		Continuous Evaluation: Semester end Evaluation: Total Marks:	40 60 100

Course Outcomes	On successful completion of the course, the student will be able to:	
	CO1	Acquire fundamentals of structural health monitoring
	CO2	Assess the health of structure by using Vibration techniques
	CO3	Design considerations for structural health monitoring of bridges.
	CO4	Apply repairs and rehabilitation measures of the structure

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	1	2			
	CO2	2	2			
	CO3	2	3		2	2
	CO4	2	3		1	1

Course Content

UNIT-I

INTRODUCTION TO STRUCTURAL HEALTH MONITORING:

Definition of Structural Health Monitoring, Motivation for Structural Health Monitoring, Structural Health Monitoring as a way of making materials and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM,SHM as a part of system management, Passive and active SHM,NDE, SHM and NDECS, Variety and multidisciplinary the most remarkable characters of SHM

UNIT-II

VIBRATION-BASED TECHNIQUES FOR STRUCTURAL HEALTH MONITORING:

Introduction, Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage Structural Health Monitoring, General dynamic behavior

	UNIT-III **APPLICATIONS OF STRUCTURAL HEALTH MONITORING IN CIVIL INFRASTRUCTURE SYSTEMS:** Structural health monitoring of bridges: general issues and applications, Introduction: bridges, Integrated structural health monitoring systems, Designing and implementing a structural health monitoring system, Bridge monitoring, Application examples.
	UNIT-IV **INTRODUCTION TO REPAIRS AND REHABILITATIONS OF STRUCTURES:** Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.
Text Books	[T1]Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006. [T2]Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
Reference Books	[R1]Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006. [R2]Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.
E-resources and other digital material	https://nptel.ac.in/courses/112104160/3

19CESE1014/B	SUB-STRUCTURE DESIGN

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Plan soil investigation and calculate the stresses on soil due to applied loads				
	CO2	Calculate bearing capacity of soil to design shallow foundations & calculate the settlements in soils				
	CO3	Design pile foundations for structures				
	CO4	Design well foundations				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	3			
	CO2	2	3			
	CO3	2	3	1	2	2
	CO4	2	3	1	2	2
Course Content		**UNIT - I** **SUB SOIL INVESTIGATION AND SAMPLING** Introduction; Planning of sub-surface exploration Program; Stages in sub-surface exploration; Methods of exploration; Soil sampling and samplers; Water table location; Depth and number of borings; Bore hole logging; In-situ tests – Standard penetration test, Static cone penetration test, Dynamic cone penetration test and Vane shear tests. **STRESSES DUE TO APPLIED LOADS** Stress-strain parameters; Vertical and horizontal stresses due to concentrated loads; Boussinesq and Westergarrd solutions; Isobars; Influence diagram; Newmark's influence charts; Contact pressure distribution				
		UNIT - II **SHALLOW FOUNDATIONS** Different bearing capacity equations; Types of shear failures; Effect of inclined load, eccentric load and water table on bearing capacity; Bearing capacity from in-situ tests; Methods of improving bearing capacity; Plate load test				

	SETTLEMENT ANALYSIS Settlement of foundations; Immediate and consolidation settlements; Allowable settlement; Proportioning of a foundation for a given settlement.
	UNIT - III **PILE FOUNDATIONS** Necessity of pile foundation; Classification of piles; Construction of piles; Load carrying capacity of single pile from static, dynamic and in-situ test methods; Pile load tests; Pile group and its efficiency; Settlement of pile foundation; Negative skin friction; Under-reamed pile foundation in swelling soils.
	UNIT - IV **WELL FOUNDATIONS** Forces acting on well foundation; Types, different shapes of wells; Analysis of well foundation; Individual components of well; Sinking of wells; Measures for rectification of tilts and shifts.
Text Books	[T1]Basic and Applied Soil Mechanics, GopalRanjan and A.S.R.Rao, New Age International (P) Limited Publishers, 2nd Edition, 2006 [T2]Soil Mechanics and Foundation Engineering K.R.Arora; Standard Publishers and Distributors, 2009
Reference Books	[R1]Advanced Foundation Engineering, V.N.S.Murthy, CBS Publishers and Distributors, New Delhi, 2007 [R2]Foundation Analysis and Design, Joseph E. Bowles,McGraw – Hill International Editions, 4th Edition, 1988
E-resources and other digital material	http://nptel.ac.in/courses/105101083

19CESE1014/C	ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Solve one dimensional wave equation and one dimensional heat conduction problems				
	CO2	Explain functional dependency and solve Laplace and Euler's equations.				
	CO3	Apply separable kernel iterative method to solve integral equations of second kind				
	CO4	Estimate functional relationship between variables and parameters.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	1			
	CO2	3	2	2		
	CO3	3	2	2		
	CO4	3	1			

Course Content

UNIT-I

TRANSFORM METHODS

Laplace transform methods for one-dimensional wave equation - Displacements in a long string - Longitudinal vibration of an elastic bar - Fourier transforms methods for one-dimensional heat conduction problems in infinite and semi-infinite rod.

UNIT-II

ELLIPTIC EQUATIONS

Laplace equation - Properties of harmonic functions - Fourier transform methods for Laplace equation

CALCULUS OF VARIATIONS

Variation and its properties - Euler's equation - Functionals dependent on first and higher order derivatives - Functionals dependent on functions of several independent variables - Some applications - Direct methods - Ritz and Kantorovich methods

	UNIT-III **INTEGRAL EQUATIONS** Fredholm and Volterra integral equations - Relation between differential and integral equations - Green's function -Fredholm equation with separable kernel - Iterative method for solving equations of second kind.
	UNIT-IV **RANDOM VARIABLES AND ESTIMATION THEORY** Probability - Probability distributions - moments, M.G.F-Two dimensional random variables correlation, regression multiple and partial correlation and regression - Curve fitting - Principle of least squares - Fitting of straight line and parabola. Estimation theory basic concepts (Review) - Estimation of parameters - Maximum likelihood estimates - method of moments
Text Books	[T1] Sankara Rao. K, "Introduction to Partial Differential Equations", PHI, New Delhi, 1995. [T2] Sneddon. I.N, "Elements of Partial Differential Equations", McGraw Hill, 1986
Reference Books	[R1]Elsgolts. L, "Differential Equations and Calculus of Variations", Mir Publishers, Moscow, 1966. [R2] Gupta. S.C,&Kapoor. V.K, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Reprint 1999. [R3] Venkataraman. M.K, "Higher Engineering Maths for Engg. And Sciences", National Publishing Company, Chennai
E-resources and other digital material	https://nptel.ac.in/courses/105105043/

19CESE1014/D	PRE ENGINEERED BUILDINGS

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify different materials used for pre-engineered buildings				
	CO2	Classify pre-engineered building components				
	CO3	Analyse pre-engineered building elements for various design loads				
	CO4	Design pre-engineered building components				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2			
	CO3	2	2			2
	CO4	3	3		2	2

Course Content

UNIT-I

INTRODUCTION TO PRE-ENGINEERED BUILDINGS

Introduction – History - Advantages of PEB - Applications of PEB – Materials used for manufacturing of PEB. Difference between Conventional Steel Buildings and Pre-Engineered buildings.

UNIT-II:

PRE-ENGINEERED BUILDING COMPONENTS

Primary System: Main frames, Gable End Frame - Secondary frame system: Sizes and Properties of Purlins & Girts – Bracing System: Rod, angle, Portal, Pipe bracing – Sheeting and Cladding: Roof Sheeting and Wall sheeting – Accessories: Turbo Ventilators, Ridge vents, Sky Lights, Louvers, Insulation, Stair cases.

UNIT-III

DESIGN LOADS ON PRE-ENGINEERED BUILDINGS.

Design of PEB frame under the influence of Dead, Live, Collateral, Wind, Seismic and Other applicable Loads. Serviceability Limits as per code.

	UNIT-IV **PEB DESIGN METHODOLOGY** Design Parameters of PEB Frames - Depth of the section, Depth to Flange width ratios, Thickness of Flange to thickness of Web ratio. d/tw, bf/tf ratios of sections as per IS code. Section Sizes as per Manufacturing Limitations. Analysis and Design of Rigid Frames. Rigid Frame Moment Connection, Shear Connection- Anchor bolt and base plate design (Pinned and Fixed)
Text Books	[T1]Alexander Newman, Metal Building Systems Design and Specifications, 2nd Edition
Reference Books	[R1] K.S.Vivek&P.Vaishavi – Pre Engineered Steel Buildings, Lambert Academic Publishing
E-resources and other digital material	Open Web

19CESE1015/A	PREFABRICATED STRUCTURES

Course Category:	Programme Elective - II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify design principles and IS code specifications				
	CO2	Analyze and design shear walls				
	CO3	Analyze and design different types of floors and roof slabs				
	CO4	Design industrial buildings				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	1	2			1
	CO2	2	3		2	2
	CO3	2	3		2	2
	CO4		2		3	2

Course Content

UNIT-I

INTRODUCTION:
General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications
.

DESIGN PRINCIPLES:
Modular coordination, standardization, Disuniting, of Prefabricates, production, transportation, erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT-II

WALLS: Prefabricated structures, Long wall and cross wall large panel buildings, framed buildings with partial and curtain walls, single storey. Types of wall panels, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

	UNIT-III **FLOORS, STAIRS AND ROOFS:** Types of floor slabs, analysis and design example of cored and panel types and two way systems, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, deflection control for short term and long term loads, ultimate strength calculations in shear and flexure.
	UNIT-IV **DESIGN OF INDUSTRIAL BUILDINGS:** Components of single storey industrial sheds with crane gantry systems, design of R.C. Roof Trusses, roof panels, design of R.C. crane gantry girders, corbels and columns, wind bracing design, Design of shell roofs for Industrial sheds.
Text Books	[T1] S.R.Damodaraswamy & S.Kavitha, Basics of Dynamics and Aseismic Design, PHI Learning ,2009. [T2] PankajAgarwal&shrikhande , Earth quake resistant Design of Structures, PHI Learning ,2009. Chopra A.K., "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Second Edition, Pearson Education, 2007
Reference Books	[R1] V.Soundararajan,R.Jagadeesh kumar, S Kalpana Devi Pre fabricated structures ars publications
E-resources and other digital material	https://www.youtube.com/watch?v=wXNlCrqbOwg

19CESE1015/B	FRACTURE MECHANICS OF CONCRETE STRUCTURES

Course Category:	Programme Elective - II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Apply the principles of linear elastic fracture mechanics				
	CO2	Illustrate the principles of non-linear fracture mechanics				
	CO3	Evaluate the fracture process of concrete				
	CO4	Implement the fracture mechanics to concrete structures				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	1	3			
	CO3	2	3			
	CO4	1	3		2	

Course Content	**UNIT-I** **INTRODUCTION TO FRACTURE MECHANICS OF CONCRETE** Structural failure based on material performance; Concepts of linear elastic fracture mechanics; Fracture mechanics of concrete. **PRINCIPLES OF LINEAR ELASTIC FRACTURE MECHANICS** Airy stress functions for problems in elasticity; Complex stress function; Elastic stress and displacement fields at crack tip; Stress intensity factors and crack opening displacements for useful geometries; Superposition of stress intensity factors; Plastic zone at crack tip; Griffith's fracture theory; Strain energy release rate for crack propagation; Relationship between stress intensity factor and strain energy release rate.
	UNIT-II **PRINCIPLES OF NON-LINEAR FRACTURE MECHANICS** Energy principles for crack propagation in non – linear materials; J-integral for non-linear elastic materials; Fracture resistance (R curve); Crack tip opening displacement

	UNIT-III **STRUCTURE AND FRACTURE PROCESS OF CONCRETE** Constituents and microstructure of concrete; Fracture behavior and strain localization of concrete; fracture process zone and toughening mechanisms; Influence of fracture process zone on fracture behavior of concrete.
	UNIT-IV **APPLICATIONS OF FRACTURE MECHANICS TO CONCRETE STRUCTURES** Behavior of concrete structures and fracture mechanics; Size effect on nominal strength of plain concrete specimen; Tension of reinforced concrete members; Bending of reinforced concrete beams; Minimum reinforced ratios of concrete members.
Text Books	[T1] Fracture mechanics of concrete: Applications of fracture mechanics to concrete, rock, and other quasi-brittle materials by Surendra P. Shah, Stuart E. Swartz &Chengsheng Ouyang, John Wiley & Sons, 1995. [T2] Elements of fracture mechanics by Prashant Kumar, Tata-McGraw-Hill, 2009.
Reference Books	[R1] Fracture Mechanics of Concrete Structures edited by ZDENEK P. BAZANT Walter P. Murphy Professor of Civil Engineering, Northwestern University, Evanston, Illinois, USA
E-resources and other digital material	nptel.ac.in/courses/105106053/18

19CESE1015/C	STRUCTURAL OPTIMIZATION

Course Category:	Programme Elective - II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Classify optimization and various techniques				
	CO2	Solve various linear and Non-linear problems				
	CO3	Evaluate a problem by geometric programming and dynamic programming				
	CO4	Apply optimization to various structural elements.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	1	2			
	CO2	1	2			
	CO3	1	2			
	CO4			2		

Course Content

UNIT-I

INTRODUCTION TO OPTIMIZATION

Statement of an Optimization problem, Classification Applications, Optimization literature

CLASSICAL OPTIMIZATION TECHNIQUES

Single Variable Optimization, Multivariable Optimization with and without constraints, Kuhn-Tucker Conditions

UNIT-II

LINEAR PROGRAMMING

Graphical Method, Analytical Method, Two Phase Simplex Method, Z_j-C_j Method, Primal Dual Algorithm, Big M Method.

NON LINEAR PROGRAMMING (NUMERICAL METHODS)

Unimodal Function, Elimination Methods, Interpolation Methods, Direct Search Methods, Indirect Search Methods.

UNIT-III

GEOMETRIC PROGRAMMING

Unconstrained Minimization Problem, Constrained Minimization,

	Primal Dual Relationships **DYNAMIC PROGRAMMING** Bellman's principle of optimality, multistage decisions processes, concept of sub optimization, conversion of final value problem to initial value problem.
	UNIT-IV **NON TRADITIONAL OPTIMIZATION TECHNIQUES** Multi-objective Optimization, Genetic Algorithms, Simulated Annealing, Neural Network Based Optimization, Optimization of Fuzzy Systems **STRUCTURAL OPTIMIZATION** Methods of Optimum Structural elements, minimum weight design of truss members, optimum reinforced design of RCC slabs and beams, principles of optimization of design of multistorey structures, shell roofs, folded plates, water tanks
Text Books	[T1] Singiresu S. Rao (2011). "Engineering Optimization: Theory and Practice" New Age International Publishers, ISBN 978-81-224-2723-3 [T2] G. Hadley,"Linear programming", Narosa Publishing House, New Delhi, 1990.
Reference Books	[R1] Deb K, (1995), "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall, New Delhi. [R2] RGallagher R.H. and O.C. Zienkiewicz, "Optimum Structural Design: Theory and Applications", John Wiley and Sons, ISBN 0-471-29050-5.
E-resources and other digital material	http://www.nptel.ac.in/courses/105108127/

19CESE1015/D	DESIGN OF PRESTRESSED CONCRETE STRUCTURES

Course Category:	Programme Elective - II	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Distinguish statically determinate and indeterminate members				
	CO2	Design of pre-stressed concrete pipes and tanks				
	CO3	Analyze the pre-stressed concrete slabs				
	CO4	Design the pre-stressed concrete ,piles, sleepers, and shell roofs				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	3			
	CO2	2	3		2	2
	CO3	3	3		2	2
	CO4	3	3		2	2

Course Content

UNIT-I

DESIGN OF PRE-TENSIONED AND POST-TENSIONED FLEXURAL MEMBERS

Difference between reinforced and pre-stressed concrete, Principles of pre-stressing – Classification of prestressed concrete structures – Materials – High strength concrete and High strength steel- Losses in pre-stress. Analysis of prestressed concrete (Pressure line ,load balancing concepts)Design of post-tensioned beams.

STATICALLY INDETERMINATE PRE-STRESSED CONCRETE STRUCTURES

Design of continuous beams; Cable profile – Concordant cable and linear transformation .Sketching of pressure lines for continuous beams.

UNIT-II

PRESTRESSED CONCRETE PIPES

Circular prestressing; Types of prestressed concrete pipes; Advantages of prestressed concrete pipes, Design of prestressed concrete pipes(cylinder,Non cylinder);

	PRESTRESSED CONCRETE TANKS General features of prestressed concrete tanks; Analysis of prestressed concrete tanks; Design of circular pre-stressed concrete tanks.
	UNIT-III **PRE-STRESSED CONCRETE SLABS** Types of pre-stressed concrete floor slabs; Design of pre-stressed concrete one-way slabs; Design of pre-stressed concrete two-way slabs; Design of pre-stressed concrete simple flat slabs
	UNIT-IV **PRE-STRESSED CONCRETE PILES AND PRE-STRESSED SLEEPERS** Advantages of prestressed concrete piles ,Types of prestressed concrete piles, Design considerations of prestressed concrete piles, Types of prestressed concrete sleepers; Design considerations for prestressed sleepers. **PRE-STRESSED CONCRETE SHELLS** Advantages of pre-stressing long span shell structures; Methods of pre-stressing shell structures; Design procedure of pre-stressed concrete shell structures.
Text Books	[T1] Pre-stressed concrete by N.KrishnaRaju, Tata-McGraw-Hill, 1995. [T2] Pre-stressed concrete by N.Rajagopalan, NarosaPublishing House, 2005.
Reference Books	[R1] Pre-stressed concrete by T.Y.Lin&N.H.Burns, John Wiley & Sons,198 [R2] Design of Prestressed Concrete Book by Neil C. ickleborough and R. I. Gilbert, published by Unwin Hyman Ltd,
E-resources and other digital material	https://nptel.ac.in/syllabus/105106118

19MTMC1026	RESEARCH METHODOLOGY AND IPR

Course Category:	MLC	**Credits:**	0
Course Type:	Theory	**Lecture - Tutorial -Practice:**	2 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Acquire an overview of the research methodology and techniques to define research problem				
	CO2	Review the literature and identify the problem				
	CO3	Analyze the optimum sampling techniques for collected data				
	CO4	Apply various forms of the intellectual properties for research work				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	1				
	CO2	1	3		1	1
	CO3	1			2	1
	CO4	1			1	2
Course Content		**UNIT-I** **RESEARCH METHODOLOGY**: Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Research Approaches, Significance of Research, Research and Scientific Methods, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. **RESEARCH PROBLEM:** Defining the Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an Illustration				
		UNIT-II **REVIEWING THE LITERATURE**: Place of the literature review in research, improving research methodology, broadening knowledge base in research area, enabling contextual findings.				

	RESEARCH DESIGN: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Basic Principles of experimental Designs, Important Experimental Designs.
	UNIT-III **DESIGN OF SAMPLING**: Introduction, Sample Design, Sampling and Non-sampling Errors, SampleSurveyversusCensusSurvey,MeasurementandScaling:QualitativeandQuantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, sources of error in measurement tools. **DATA COLLECTION**: Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method **TESTING OF HYPOTHESES:** Hypothesis, Basic Concepts, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing.
	UNIT-IV **Interpretation and Report Writing**: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, and Significance of Report Writing **INTELLECTUAL PROPERTY:** The Concept, Intellectual Property System in India, Development of TRIPSCompliedRegimeinIndia,PatentsAct,1970,TradeMarkAct,1999,TheDesignsAct, 2000, The Geographical Indications of Goods (Registration and Protection)Act1999, Copyright Act,1957, Trade Secrets, Utility Models WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered.
Text Books	[T1] Research methodology: Methods and Techniques, **C.R. Kothari, GauravGarg,** New Age International, 4th Edition,2018. [T2]Research Methodology a step-by-step guide for beginners.

	Ranjit Kumar, SAGE Publications Ltd.,3rd Edition,2011 [T3] Study Material, Professional Programme Intellectual Property Rights, Law and Practice, **The Institute of Company Secretaries of India**, Statutory Body under an Act of Parliament, September2013.
Reference Books	[R1]An introduction to Research Methodology, Garg B.L et al ,RBSA Publishers2002 [R2]An Introduction to Multivariate Statistical Analysis Anderson T.W, Wiley 3rdEdition, [R3]Research Methodology, Sinha, S.C, Dhiman, EssEssPublications2002 [R4]Research Methods: the concise knowledge base ,Trochim ,Atomic Dog Publishing,2005 [R5]How to Write and Publish a Scientific Paper, Day R.A, Cambridge University Press1992 [R6]Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009 [R7]Proposal Writing, Coley S.M. Scheinberg, C.A, Sage Publications,1990 Intellectual Property Rights in the Global Economy, Keith Eugene Maskus, Institute for International Economics
E-resources and other digital material	Open web

19CESE1051	ADVANCED CONCRETE LAB

Course Category:	Laboratory	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial -Practice:**	3
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Investigate the effect of water cement ratio, aggregate cement ratio and chemical admixtures on properties of Concrete				
	CO2	Design the concrete mix using IS and ACI codes with study of material properties				
	CO3	Examine the properties of fresh and hardened concrete.				
	CO4	Analyze the concrete with Non destructive methods and behavior of structural concrete				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	2		3	3
	CO2	3	2		3	3
	CO3	3	2		3	3
	CO4	3	2	1	3	3
Course Content		1. Study the effect of water cement ratio on workability and strength of Concrete. 2. Study the effect of aggregate cement ratio on Workability and strength of concrete. 3. Influence of Different Chemical Admixtures on concrete 4. Study on properties of cement and aggregate for Mix design 5. Mix Design methods using a. I.S. Code method (Design of high strength and high performance concrete) b. ACI Code method 6.Rheological behaviour of fresh Concrete and strength and elastic properties of hardened concrete 7.Study on correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture based on IS Method. 8.A study on the effect of span to depth ratio on the failure pattern ofRC beams. 9.Study of Non-Destructive Testing Methods on Concrete 10.A study on behavior of under reinforced and over reinforcedbeams.				

19CESE1052	NUMERICAL ANALYSIS LAB

Course Category:	Laboratory	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial -Practice:**	3
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Determine root of algebraic and transcendental equations				
	CO2	Develop a curve for given data				
	CO3	Solve system of linear equations numerically				
	CO4	Evaluate numerical solution to ordinary differential equation				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	2	2		3
	CO2	3	2	2		3
	CO3	3	2	2		3
	CO4	3	2	2	2	3
Course Content		1. Find the Roots of Non-Linear Equation Using Bisection Method. 2. Find the Roots of Non-Linear Equation Using Newton's Method. 3. Curve Fitting by Least Square Approximations. 4. Solve the System of Linear Equations Using Gauss - Elimination Method. 5. Solve the System of Linear Equations Using Gauss - Seidal Iteration Method. 6. Solve the System of Linear Equations Using Gauss - Jordan Method. 7. Integrate numerically using Trapezoidal Rule. 8. Integrate numerically using Simpson's Rules. 9. Numerical Solution of Ordinary Differential Equations By Euler's Method. 10. Numerical Solution of Ordinary Differential Equations By Runge- Kutta Method.				

SEMESTER II

19CESE2001	FEM IN STRUCTURAL ENGINEERING

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Interpret the concepts behind formulation methods in FEM				
	CO2	Explain the characteristics and application of different types of elements				
	CO3	Develop element characteristic equation and generation of global equation				
	CO4	Apply boundary conditions to a global equation and evaluate the displacements, stress and strains for structural components				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2			
	CO3	3	3			
	CO4	3	3			

Course Content

UNIT-I

Approximate solution of boundary value problems-Methods of weighted residuals, Approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments.

Basic finite element concepts-Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method, Application: Axial deformation of bars, Axial spring element.

UNIT-II

Analysis of trusses-Two dimensional truss element, Three dimensional space truss element, Stresses due to lack of fit and temperature changes.

Beam bending-Governing differential equation for beam bending, Two node beam element, and Exact solution for uniform beams

	subjected to distributed loads using superposition, Calculation of stresses in beams, Thermal stresses in beams.
	UNIT-III Higher order elements for one dimensional problems-Shape functions for second order problems, Isoparametric mapping concept, Quadratic isoparametric element for general one dimensional boundary value problem, One dimensional numerical integration, Application: Heat conduction through a thin film. Two dimensional boundary value problems using triangular elements, Equivalent functional for general 2D BVP,A triangular element for general 2D BVP, Numerical examples. Isoparametric quadrilateral elements-Shape functions for rectangular elements, Isoparametric mapping for quadrilateral elements, Numerical integration for quadrilateral elements, Four node quadrilateral element for 2D BVP, Eight node serendipity element for 2D BVP. Isoparametric triangular elements-Natural (or Area) coordinates for triangles, Shape functions for triangular elements, Natural coordinate mapping for triangles, Numerical integration for triangles, Six node triangular element for general 2D BVP.
	UNIT-IV Numerical integration-Newton-Cotes rules, Trapezium rule, Simpson's rule, Error term, Gauss-Legendre rules, Changing limits of integration, Gauss-Leguerre rule, Multiple integrals, Numerical integration for quadrilateral elements, Numerical integration for triangular elements. Two dimensional elasticity-Governing differential equations, Constant strain triangular element, Four node quadrilateral element, and Eight node isoparametricelement. Axisymmetric elasticity problems-Governing equations for axisymmetric elasticity, Axisymmetric linear triangular element, Axisymmetric four node isoparametric element.
Text Books	[T1] Bhatti, M.A., Fundamental Finite ElementAnalysis and Applications: with Mathematica and Matlab Computations, Wiley, 2005 [T2] Reddy, J. N.,An Introduction to the Finite Element Method, 3rd Edition, McGraw-Hill Science/Engineering/Math, 2005.
Reference Books	[R1] Logan D. L.,A First Course in the Finite Element Method, Thomson Engineering, 3rd edition, 2001. [R2] Cook, R. D., Malkus, D.S.,Plesha, M.E., and Witt, R.J., Conce and applications of Finite Element Analysis, 4th Edition, Wile India, 2007
E-resources and other digital material	nptel.ac.in/courses/105106053/18

19CESE 2002	STABILITY OF STRUCTURES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Explain the buckling theories of columns and beam-columns				
	CO2	Analyze the lateral buckling of beams				
	CO3	Determine the buckling of rectangular plates				
	CO4	Analyze the buckling of axially loaded cylindrical shells				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3			
	CO2	3	3			
	CO3	3	3			
	CO4	3	3			

Course Content

UNIT-I

BUCKLING OF COLUMNS

Introduction; Methods of finding critical loads; Critical loads for straight columns with different end conditions and loading; Inelastic buckling of axially loaded columns; Energy methods; Prismatic and non-prismatic columns under discrete and distributed loading.

BEAM COLUMNS

Theory of Beam column – Stability analysis of beam column with different types of loads.

UNIT-II

LATERAL BUCKLING OF BEAMS

Beams under pure bending; Cantilever and simply supported beams of rectangular and I sections; Beams under transverse loading; Energy methods; Solution of simple problems.

UNIT-III

BUCKLING OF RECTANGULAR PLATES

Plates simply supported on all edges and subjected to constant

	compression in one or two directions; Plates simply supported along two opposite sides perpendicular to the direction of compression and having various edge conditions along the other two sides
	UNIT-IV **BUCKLING OF SHELLS** Introduction to buckling of axially compressed cylindrical shells, Linear theory of cylindrical shells-donnell equations, critical load of an axially loaded cylinder, failure of axially compressed cylindrical shells
Text Books	[T1] Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961. [T2] Background to buckling by Allen and Bulson, McGraw-Hill, 1980.
Reference Books	[R1] Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007. [R2] Principles of Structural stability theory by AlexandarChajes
E-resources and other digital material	https://nptel.ac.in/courses/105/105/105105108/

19CESE 2003	STRCUTURAL DYNAMICS

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Distinguish the principles of structural dynamics.				
	CO2	Apply the suitable technique for dynamics of MDOF systems.				
	CO3	Analyze natural frequencies and mode shapes				
	CO4	Analyse for lateral loads and apply the design concepts to structures				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	3	3			
	CO3	2	3			
	CO4	3	3		2	1
Course Content		**UNIT-I** **INTRODUCTION TO STRUCTURAL DYNAMICS:** Fundamental objectives of dynamic analysis- types of prescribed loading- Formulation of equations of motion by different methods- direct equilibration using Newton's Law of motion/ D'Alembert's principle, principle of virtual work and Hamilton principle. **SINGLE DEGREE OF FREEDOM SYSTEMS:** Formulation and solution of the equation of motion-Free vibration of SDOF systems- Undamped and damped vibrations, critical damping, logarithmic decrement, Forced vibration of SDOF systems – response to harmonic, periodic, impulsive and general dynamic loadings, Duhamel's integral; Numerical evaluation of dynamic response Newmark's method				
		UNIT-II **MULTI DEGREE OF FREEDOM SYSTEMS:** Selection of single degree of Freedom- Evaluation of structural property matrices- Formulation of the MDOF equations of				

	motions- Undamped Free vibrations- Solutions of Eigen value problem for natural frequencies and mode shapes, Stodola-Vainello method - Analysis of dynamic response-Normal co-ordinates – Uncoupled equations of motion- orthogonal properties of normal modes- Mode superposition procedure- Review of time history and spectrum methods of analysis
	UNIT-III **CONTINUOUS SYSTEMS** Introduction – Flexural and Axial Vibrations of beams- Elementary case- derivation of governing differential equation of motion- analysis of undamped free vibrations of beams in flexure- Natural frequencies and mode shapes of simple beams with different end conditions. Response of continuous systems to dynamic loads
	UNIT-IV **INTRODUCTION TO EARTHQUAKE RESPONSE OF STRUCTURES** Introduction- response of single degree of freedom system to earthquake excitation- Response spectra; Response of MDOF systems to Earthquake excitations; Discussions on IS 1893-2016Codal provisions for building structures- I.S.Code methods of analysis for obtaining response of multi storied buildings.
Text Books	[T1] Dynamics of Structures: Theory and application to Earthquake Engineering by A.K.Chopra , Prentice-Hall of India, 2001. [T2] Dynamics of Structures by R.W. Clough and P.E. Penzien , McGraw-Hill, 1993. [T3] Structural Dynamics: Theory and Computation by Mario Paz, Kluwer Academic Publishers , 2003.
Reference Books	[R1] Theory of Vibration An Introduction by A.A.Shabana, Springer International Edition, 2010 [R2] Dynamics of Structures by J L Humar, Prentice-Hall Structural Dynamics An Introduction to Computer Methods by Roy R. Craig.Jr., JOHN WILEY & SONS, Inc., [R3] Earthquake resistance design of building structures vinodhosur WILEY [R4] Vibrations structural dynamics by m mukhopadhaya oxford
E-resources and other digital material	http://nptel.ac.in/courses/105101006/

19CESE2014 /A	DESIGN OF HIGH-RISE STRUCTURES

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify the different systems and various loads in Tall structures				
	CO2	Distinguish various structural systems and their behaviour				
	CO3	Analyse various structural systems for static and dynamic loads				
	CO4	Classify various Flooring systems and need of various materials for design of tall structures				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2			
	CO3	3	3			
	CO4	1	1			

Course Content

UNIT-I

INTRODUCTION:

History: advantages and disadvantages; essential amenities; fire safety; water supply; drainage and garbage disposal; service systems; structural and foundation systems; factors affecting height; growth and form ; human comfort criteria; Development of high-rise architecture; structural concepts.

LOADS:

Gravity loading – Dead and Live load calculation; Impact and construction loads; Wind loading- static and dynamic approach-Analytical and wind tunnel experimental method; Earthquake loading-Equivalent lateral force; Modal analysis- combination of loading in various design philosophies.

UNIT – II

STRUCTURAL SYSTEMS:

Behavior of High Rise structures- Different systems for load distribution in steel and concrete; Vertical and horizontal load resistant systems; Rigid frames; braced frames; in- filled frames;

	shear walls- wall frames; tubular systems; outrigger braced systems; mega systems.
	UNIT – III **ANALYSIS AND DESIGN:** Analysis and design principles of various horizontal load transfer systems; approximate methods; modeling for accurate analysis- 3D analysis; member forces; displacements. Stability analysis- overall buckling analysis of frames; wall frames; approximate methods. Dynamic analysis- principles of design of tall braced frames for earthquake and blast resistant design. Detailing as per IS codes.
	UNIT – IV **FLOORING SYSTEMS & ADVANCED TOPICS:** Introduction to various flooring systems in concrete and steel. Structural systems for future generation buildings; economics; need of new materials for design of tall buildings.
Text Books	[T1] Tall Building Structures by B.S.Smith and A.Coull, John Wiley & sons, 1991. [T2] Structural Analysis and Design of Tall Buildings by B.S.Taranath, McGraw Hill Co 1988.
Reference Books	[R1] Structural Concepts and Systems for Architects and Engineers" by Lyn T.Y. and Burry D.Stotes, John Wiley, 1994. [R2] High Rise Building Structures" by Sehuller .W.G, John Wiley & sons, 1977
E-resources and other digital material	https://www.youtube.com/watch?v=EIDXE28_8eQ

19CESE2014/B	SOIL STRUCTURE INTERACTION

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Explain the concept of soil structure interaction				
	CO2	Evaluate different types of structures under various loading conditions and subsoil characteristics				
	CO3	Analyse the pile and pile groups for gravity loads				
	CO4	Evaluate action of group of piles under lateral loading considering stress-strain characteristics of real soils				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2			
	CO3	3	3			
	CO4	2	2			
Course Content		**UNIT – I** **SOIL-FOUNDATION INTERACTION:** Introduction to soil-foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behavior, Time dependent behavior				
		UNIT – II **BEAM ON ELASTIC FOUNDATION-SOIL MODELS:** Infinite beam, Two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness. **PLATE ON ELASTIC MEDIUM:** Thin and thick plates, Analysis of finite plates, Numerical analysis of finite plates, simple solutions				

	UNIT – III **ELASTIC ANALYSIS OF PILE:** Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap
	UNIT – IV **LATERALLY LOADED PILE:** Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Interaction analysis, Pile-raft system, Solutions through influence charts.
Text Books	[T1] Foundation analysis and design - J E Bowles, McGraw Hill, NY [T2] Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing
Reference Books	[R1] Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd. [R2] Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
E-resources and other digital material	https://www.youtube.com/watch?v=Ng2tH7CX-WU

19CESE 2014/C	ADVANCED BRIDGE ENGINEERING

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Explain hydrological and geological details including flood discharge estimation for major bridge proposals				
	CO2	Design beam and slab bridge decks				
	CO3	Design various components of a bridge sub structure				
	CO4	Design box girder concrete bridges and bearings				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	3			
	CO2	2	3		2	2
	CO3	2	3		2	2
	CO4	2	3		2	2
Course Content		**UNIT-I** **INVESTIGATION FOR MAJOR BRIDGES** Coverage; Topographical details; Catchment area map; Hydrological particulars; Geotechnical details; Seismology of the area; Navigational requirements; Construction resources; Particulars of nearest bridges; Traffic forecast. **DESIGN OF FLOOD DISCHARGE** Introduction; Contribution factors; Methods of determination of design flood; Unit hydrograph method; Choice of method; Foundation design discharge				
		UNIT-II **DESIGN OF BEAM AND SLAB BRIDGE DECKS** Classification of bridges; Loads on bridges I.R.C. loading standards – Bridge slabs – Effective width method as per I.R.C. – Pigeaud's method – Bridge girders – Courbon's method – Assumptions and analysis and design of reinforced concrete Tbeam bridge for Class AA tracked loading				

	BRIDGE DECKS AND STRUCTURAL FORMS Slab decks; Voided slab deck; Pseudoslab; Maunshell top Hat beam; Beam and slab; Box girders; Curved and skew deck
	UNIT-III **PIERS AND ABUTMENTS** Types of piers and abutments; Materials of construction; Design of piers and abutments. **FOUNDATIONS FOR BRIDGES** Types of bridge foundations; Design of well foundations.
	UNIT-IV **BEARINGS** Classification and types of bearings ; Guidelines for selection of Bearings ; Design considerations ; Basis for metallic bearings ; Ferrous bearings of traditional type ; Design of elastometric Bearings **BOX GIRDER BRIDGE DECKS** Box culvert (Single vent only) – Single span rigid frame bridges (Barrel of solid slab type only)
Text Books	[T1]Bridge engineering by S.Ponnuswamy, TataMcGraw -Hill, 1986. [T2] Bridge superstructure by N.Rajagopalan, Narosa Publishing House, 2006. [T3] Essentials of bridge engineering by D. John Victor, Oxford & IBH, 2001.
Reference Books	[R1] Swami Saran, "Analysis and Design of Substructures", Oxford & IBH Publishing Co., 1996. [R2] R.E. Rowe, "Concrete Bridge Design", 1 st Edition, Elsevier Science and Technology [R3] L.G. Hendry and A.W. Jaeger, "The Analysis of Grid Frameworks and Related Structures", Chatto&Windus
E-resources and other digital material	https://nptel.ac.in/courses/105/105/105105165/

19CESE 2014/D	ADVANCED PRE-ENGINEERED BUILDINGS

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Classify structural stability system of pre-engineered buildings				
	CO2	Design pre-engineered buildings with crane systems				
	CO3	Design pre-engineered buildings with mezzanine floor systems				
	CO4	Design pre-engineered buildings with optimization				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3			
	CO2	3	3	2	2	2
	CO3	3	3		2	2
	CO4	3	3	2	2	2
Course Content		**UNIT-I** **STRUCTURAL STABILITY SYSTEM OF PEB** Shear buckling effect (d/t ratio exceeding 67ε), Effective Cross-sectional area concept for Compression Members d/t ratio exceeding 42ε ; Effect of d/t ratio for flexural members according to section classifications, Lateral Torsional Restraint system : Flange Bracing and design considerations. Global and Local behavior of Frame system depending on Slenderness ratio, d/t and b/t ratio. Bracing system : Rod Bracing, Angle Bracing, Portal Bracing.				
		UNIT-II **CRANE SYSTEM** Different types of Cranes – EOT Cranes, Monorail Cranes, Underslung and Wall mounted - Design of Crane beams with and Without Top Channels (Surge Beam), Design of Crane Brackets – Frame design with different types of Cranes using software.				

	UNIT-III **MEZZANINE FLOOR SYSTEMS** Design of Mezzanine Beams, Columns and joists – Mezzanine decking, Different types of Mezzanine Floor systems – Grating, Chequered plate and Rigid floor System.
	UNIT-IV **ANALYSIS AND DESIGN OF PRE-ENGINEERED BUILDINGS** 2D and 3D Modelling of Portal Frames, Optimization Techniques, Comparison of software output with manual calculations. Design of Cold Formed Sections i.e., Purlins and Girts, Design of Roof Sheeting , trapezoidal , Standing seam sheeting , Erection Procedures. Welding Technology and process for the PEB Sections
Text Books	[T1]Alexander Newman, Metal Building Systems Design and Specifications, 2nd Edition
Reference Books	Nil
E-resources and other digital material	Open Web

19CESE2015/A	REPAIR AND REHABILITATION OF STRUCTURES

Course Category:	Programme Elective- IV	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify the causes for deterioration of structures and remedies through damage assessment.				
	CO2	Explain various methods of diagnosis for the damage by Semi destructive and non-destructive tests				
	CO3	Demonstrate the effect of earthquake on structures and repairs in chemical environment and fire damage assessment through case studies				
	CO4	Recommend appropriate retrofitting techniques and repair procedures.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2			
	CO3	2	2		2	2
	CO4	2	2			
Course Content		**UNIT – I** **AGE AND PERFORMANCE RESPONSE IN STRUCTURES AND CAUSES FOR FAILURE OF STRUCTURES:** Introduction, service life and syndrome year, Repair, maintenance, rehabilitation; Causes of distress in structural members and mechanism, symptoms, prevention for Accidental loadings, chemical attack, construction errors, corrosion, design errors, erosion, freezing and thawing, settlement and movement, shrinkage, temperature changes, fire, weathering. **TRAINED DAMAGE ASSESSMENT FOR SOURCE** visual examination, Action plan, common observations damage assessment procedure pre and post repair evaluation				

	UNIT – II **DIAGNOSIS AND ASSESSMENT OF DISTRESS BY VARIOUS TESTS:** **SEMI DESTRUCTIVE TESTS:** purpose, methods ,Core test, LOK Test, CAPO Test, North American pull-out test, pull off test, Figg's Air and water – permeability test **NON DESTRUCTIVE TESTS : PURPOSE, METHODS** Compressive strength of concrete -rebound hammer test, Windsor probe test Cracks, voids, changes in condition of concrete tests – ultra pulse velocity test, acoustic method, pulse echo method, radiography. Surface absorption test on concrete, Deterioration of concrete -radar technique, infra red thermograph test Chloride test-quntab test, corbonation test, Corrosion test –open circuit and surface potential measuring techniques, electro chemical noise analysis, resititivity of concrete test Strain guages –vibrating type and contact type strain guages
	UNIT – III **REPAIRS IN CHEMICAL ENVIRONMENT** Investigations and recommendations for repairs . **DAMAGE DUE TO EARTHQUAKE: VARIOUS DAMAGES TO STRUCTURES,** Strengthening of buildings – provisions of BIS 1893 and 4326. FIRE DAMAGE ASSESSMENT AND RESTORATION: Case studies of Large auditorium structure and Tower podium of Five star hotel
	UNIT– IV **MODERN TECHNIQUES OF SEISMIC RETROFITTING:** Introduction, Global level and local level and Local level retrofitting techniques **REPAIR MATERIALS AND REPIR METHODS** Epoxy resins, epoxy mortor, quick-setting cement, gypsum cement mortar. Mechanical anchors, Crack repair techniques, stitching, blanketing, jacketing and types, shotcrete, guniting, grouting, pressure injection of epoxy.
Text Books	[T1] R.N.Raikar ,Diagnosis and Treatment of Structures in Distress, R&D Centre, SDCPL,New Bombay,1994. [T2] Repair of concrete structures R.T.Allen and S.C.Edwards, Blakie and Son UK 1987

Reference Books	[R1]CPWD Hand book on Repair and Rehabilitation of RCC Buildings. [R2]Pankaj agarwal & Manish shikhakonde Earth quake resistant design of structures, Prentica-Hall of India, new delhi,2006 [R3]Raikar, R., Learning from failures- deficiencies in design, construction and service- R&D Centre(SDCPL) , Raikar Bhavan, Bombay 1987. [R4]A.R.Santhakumar ,Concrete technology ,S..chand, second edition ,2018.
E-resources and other digital material	Open web

19CESE2015/B	DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES

Course Category:	Programme Elective - IV	Credits:	3
Course Type:	Theory	Lecture - Tutorial -Practice:	3 hrs/week
Prerequisites:		Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:	
	CO1	Identify the behaviour of composite beams and columns
	CO2	Design composite beams, columns and trusses
	CO3	Design connections in composite structures
	CO4	Analyse the behaviour of composite girder bridges

Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	3		2	2
	CO3	2	3		2	2
	CO4	2	3			

Course Content

UNIT I

INTRODUCTION

Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures -Introduction to Steel - Concrete - Steel - Sandwich Construction - Behaviour of composite beams and columns .

UNIT II

DESIGN OF COMPOSITE MEMBERS

Design of Composite beams – Design of Composite Columns - Design of Composite Trusses.

UNIT III

DESIGN OF CONNECTIONS

Types of Connections - Design of Connections in Composite structures - Shear Connections - Design of Connections in composite trusses.

UNIT IV

COMPOSITE GIRDER BRIDGES & CASE STUDIES

Behaviour of girder bridges - Design concepts. Case Studies on steel - concrete composite construction structures in buildings - Seismic behaviour of composite structures and design methods

Text Books	[T1]Teaching Resource Material for Structural Steel Design", Volume 2/3 jointly prepared by 1. I.I.T., MS 2. Anna University [T2]SERC, MS 4. "Institute for Steel Development and growth", Calcutta. [T3]Owens .G.W, &Knowels.P. "Steel Designs Manual", (sixth Edition) Steel Concrete
Reference Books	[R1]Composite structures of steel and concrete Johnson R.P Blackwell Scientific Publications(Second Edition), UK 2001 [R2]Steel Designers manual (Fifth edition) Owens, G.W. and Knowels.P Oxford Blackwell Scientific Publications 200
E-resources and other digital material	https://www.youtube.com/watch?v=h-rQCvxH61c http://www.steel-insdag.org/TM_Contents.asp

19CESE2015/C	DESIGN OF FORMWORK

Course Category:	Programme Elective - IV	**Credits:**	2
Course Type:	Theory	**Lecture - Tutorial -Practice:**	2 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify an appropriate material for false work and form work				
	CO2	Evaluate the pressure of concrete on form work				
	CO3	Design decking, form work and false work				
	CO4	Explain the sequence of construction and safety steps involved in form work and false work.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2		1	
	CO3	2	2		3	1
	CO4	1	1			2
Course Content		**UNIT-I** Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms.				
		UNIT-II Formwork – Design: Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork.				
		UNIT-III Design of Decks and False works: Types of beam, decking and column formwork, Design of decking, False work design, Effects of wind load, Foundation and soil on false work design.				
		UNIT-IV Special Forms: The use and applications of special forms.Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and false work.				
Text Books		[T1]Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996. [T2]Tudor Dinescu and ConstantinRadulescu, Slip Form				

	Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.
Reference Books	[R1] Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996 [R2]Michael P. Hurst, Construction Press, London and New York., 2003
E-resources and other digital material	Open web

19CESE2015/D	EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Course Category:	Programme Elective - IV	**Credits:**	4
Course Type:	Theory	**Lecture - Tutorial -Practice:**	4 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify a good structural configuration for seismic resistance				
	CO2	Estimate the earthquake design forces using appropriate methods				
	CO3	Apply the concept of Base isolation in designing earthquake resistant structures				
	CO4	Design of earthquake resistant structures by applying the concepts of ductility				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3			
	CO2	3	3			
	CO3	2	2		1	1
	CO4	3	3		2	2
Course Content		**UNIT-I** **SEISMO-RESISTANT BUILDING ARCHITECTURE** Introduction; Lateral load resisting systems- moment resisting frame, Building with shear wall or bearing wall system, building with dual system; Building configuration – Problems and solutions; Building characteristics – Mode shape and fundamental period, building frequency and ground period, damping, ductility, seismic weight, hyperstaticity /redundancy, non-structural elements, foundation soil/liquefaction. Foundations; Quality of construction and materials – quality of concrete, construction joints, general detailing requirements.				
		UNIT-II **DESIGN FORCES FOR BUILDINGS** Introduction; Equivalent static method; Mode superposition technique; Dynamic inelastic-time history analysis; Advantages and disadvantages of these methods; Determination of lateral forces as per IS1893(Part 1) – Equivalent static method, Model analysis using response spectrum, Estimate of deflection and drift, P-Δ Effects in frame structures, Torsional effects.				

	UNIT-III **DUCTILITY** Ductility relationships; Ductility considerations in earthquake resistant design of RCC buildings Introduction; Impact of ductility; Requirements for ductility; Assessment of ductility– Member/element ductility, Structural ductility; Factor affecting ductility; Ductility factors; Ductility considerations as per IS13920::2016-Aspects of detailing- Detailing of columns for ductility-Transverse reinforcement for confinement, spacing of column vertical reinforcement; Bond and anchorage-Development of bar strength, lapped splices, Additional considerations for anchorages. Design and detailing of typical flexural member, typical column, footing and detailing of a exterior joint as per IS13920:2016.
	UNIT-IV **BASE ISOLATION OF STRUCTURES** Introduction; Isolation from seismic motion, Considerations for seismic isolation-Seismic isolation using flexible bearings-Seismic isolation using flexible piles and energy dissipators; Basic elements of seismic isolation; seismic- isolation design principle; Feasibility of seismic isolation; Seismic isolation configurations ;codal provisions for seismic isolation. **SEISMIC EVALUATION AND RETROFITTING OF STRUCTURES** Seismic evaluation of structures or condition appraisal; Seismic Retrofitting.
Text Books	[T1]Earthquake resistant design of structures by PankajAgarwal and Manish Shrikhande, Prentice-Hall of India, 2006. [T2]Seismic design of reinforced concrete and masonry buildings by T.Paulay and M.J.N.Priestley, John Wiley & Sons, 1991. [T3]Earthquake-Resistant Design of Building Structures by Dr. VinodHosur, WILEY, 2013.
Reference Books	[R1]Earthquake Resistant Design and Risk Reduction by David Dowrick, WILEY Student Edition, 2012. [R2]Earthquake Resistant Design of Structures by S.K.Duggal, OXFORD Higher Education. [R3]Elements of Earthquake Engineering by Jai Krishna &Brijesh Chandra, South Asian Publishers Private Limited, 2000.
E-resources and other digital material	http://nptel.ac.in/courses/105102016/

19CESE2036	TECHNICAL REPORT WRITING

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Describe the significance of Technical Report Writing				
	CO2	Develop proficiency in writing technical reports				
	CO3	Apply the basic principles to prepare documentation using LATEX				
	CO4	Understanding the need of Bibliography and Reference Books for quality report writing				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1		1		2	1
	CO2		1	1	3	1
	CO3		1	2	3	1
	CO4				3	1

Course Content	**UNIT - I** **WRITING SCIENTIFIC AND ENGINEERING PAPERS** Title, Abstract, Introduction, Materials And Methods, Result, Discussion, Conclusion, Reference Books, Acknowledgements, Appendices, Hedging and Criticizing, Paraphrasing and Plagiarism.
	UNIT – II **EFFECTIVE USE OF CHARTS, GRAPHS AND TABLES, WRITING TECHNICAL REPORTS** Bar Chart, Line Chart, Pie Chart, Area Chart, Cylindrical Chart, Column Bars, Bubble Chart, Flow Diagram, Screen Capture, Tables, Objectives Of Technical Report, Types Of Reports, Steps In Writing A Technical Report, Guidelines For Writing ATechnical Report.
	UNIT – III **LATEX** Introduction, Document Structure –Creatinga Title, Sections , Labeling ,Table of Contents , Font Effects , Colored Text , FontSizes , Lists , Comments & Spacing , Special Characters
	UNIT - IV **TABLES, FIGURES , EQUATIONS , INSERTING REFERENCE BOOKS** Inserting Equations, Mathematical Symbols, Practical,introduction, The BibTeX file , Inserting the bibliography , Citing Reference Books, Styles, Practical.

Text Books	[T1]BarunKMitra, Effective Technical Communication - A Guide for Scientists and Engineers , Oxford University Press,ISBN:978019568291. [T2]LATEX for Beginners, Workbook Edition 5, Document Reference: 3722-2014.
Reference Books	[R1]GoldbortR, Writing for Science, Yale University Press(available on Google Books) [R2]DayR, How to Write and Publish a Scientific Paper,Cambridge University Press
E-resources and otherdigital material	https://www.overleaf.com/learn/latex/sections_and_chapters https://libguides.cu-portland.edu/citationstyles

19CESE2063	TERM PAPER

Course Category:	Term paper	**Credits:**	1
Course Type:	Term paper	**Lecture - Tutorial -Practice:**	0-0-2
Prerequisites:	NIL	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify real world problems related to Structural Engineering				
	CO2	Analyse the problems from its state of the art for arriving at feasible solutions				
	CO3	Prepare an organized report employing elements of technical writing & critical thinking				
	CO4	Summarize and communicate the content to audience in an effective manner				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			1
	CO2	2	2			1
	CO3			2	3	1
	CO4			2	2	1
Course Content		Student shall collect the literature on the advanced topic in relevant fields and critically review the literature and submit it to the department in a form of report and shall make an oral presentation before the Academic Committee				

19CESE2051	STRUCTURAL DYNAMICS LABORATORY

Course Category:	Laboratory	**Credits:**	1.5
Course Type:	Practical	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Determine the unknown resistance and static strain using accepted principles				
	CO2	Determine the principal stresses for various loadings				
	CO3	Examine the response of three storeyed building under harmonic and non-harmonic base motions				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2		3	
	CO2	2	2		3	
	CO3	2	2		3	2
Course Content		1. Measurement of unknown resistance using Wheatstone bridge. 2. Measurement of static strain by electrical resistance strain gauge. 3. Determination of the material fringe value of a given photo elastic material. 4. Determination of principal stress difference in a circular disc subjected to diametrical compression. 5. Determination of principal stresses in a bar subjected to axial tension. 6. Determination of stress concentration factor. 7. Dynamics of a three storey building frame subjected to harmonic base motion.				

19CESE2052	STRUCTURAL DESIGN LAB

Course Category:	Laboratory	**Credits:**	1.5
Course Type:	Practical	**Lecture - Tutorial -Practice:**	3 hrs/week
Prerequisites:		**Continuous Evaluation:**	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Analyze the various structural components for gravity and lateral loads.				
	CO2	Design of structural components and framed buildings				
	CO3	Prepare detailed drawings for structural buildings				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3	3	3	
	CO2	3	3	3	3	2
	CO3	2	3	3	3	1
Course Content		Design and Drawing the reinforcement details of the following RCC Structural elements 1. Concrete beam (singly/doubly) 2. Concrete column subjected to uniaxial/biaxial bending. 3. Concrete slab (One-way/Two-way) 4. Design of G+5 concrete frame building for gravity, seismic and wind loads. 5. Design of G+5 steel frame building for gravity, seismic and wind loads including connections. 6. Steel frame building as per relevant is codes including connections. 7. Building Information Modeling through CYPE CAD. Note: The above problems are to be solved using Computer programs/Application software's like Staad.Pro/CYPE CAD/ETABS (any two)				

SEMESTER III

19CESE3011	SELF LEARNING (MOOCS COURSE)

Course Category:	Program Elective-V	**Credits:**	3
Course Type:	Theory	**Lecture - Tutorial -Practice:**	3-0-0
Prerequisites:	Basic concepts of civil engineering	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	- - 100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Understand the fundamental scientific and engineering concepts in Flexibility of time, place, topic and university				
	CO2	Acquire knowledge in the domain of Civil Engineering from Professors of Premier Institutes				
	CO3	Describe software tools and methods to related to structural engineering by themselves				
	CO4	Interaction through peer review and group collaboration helps social network building				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			1
	CO2	1	2			1
	CO3		1	2		
	CO4				1	2

The department will recommend the self-learning courses from the available open courseware. The self- learning courses shall be taken from the list of approved MOOCs providers (SWAYAM/NPTEL/EDX/Others). They must be approved/ratified in the respective Board of Studies

19CESE3061	PROJECT PART-A

Course Category:	Project Part-A	**Credits:**	10
Course Type:	Project	**Lecture - Tutorial -Practice:**	0-0-20
Prerequisites:	Term paper	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify a topic in relevant are as of Structural Engineering				
	CO2	Review literature to identify gaps and define objectives & scope of the project				
	CO3	Apply appropriate research methodology to provide a solution to the chosen problem				
	CO4	Prepare a technical report effectively, organizing the data by using modern tools.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3			
	CO2	3	3		2	2
	CO3	2	2	2	2	1
	CO4			2	3	3
Course Content		The project shall be carried out in the major areas pertaining to the program approved by Project Review Committee and may address the societal problems/issues related to the program.				

19CESE3052	INTERNSHIP

Course Category:	Internship	**Credits:**	2
Course Type:	Practical	**Lecture - Tutorial -Practice:**	0-0-0
Prerequisites:		**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	- 100 100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Apply theoretical and practical knowledge in accomplishing the tasks assigned in the industry.				
	CO2	Evaluate civil engineering structures by following required Specifications				
	CO3	Apply various soft skills such as time management, positive attitude and communication skills during performance of the task assigned in the internship.				
B Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	2	2			
	CO2	2	2	2	2	
	CO3	1				3
Course Content		The students shall undergo Internship for a period of six weeks in Industry/Research organizations/ institute of higher learning approved by the Head of the Department during any time after the second semester.				

SEMESTER IV

19CESE4061	PROJECT PART-B

Course Category:	Project Part-B	**Credits:**	16
Course Type:	Project	**Lecture - Tutorial -Practice:**	0-0-32
Prerequisites:	Project Part-A	**Continuous Evaluation:** **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Outcomes	On successful completion of the course, the student will be able to:					
	CO1	Identify methods and resources To carry out analysis and experiments				
	CO2	Apply the procedures with a concern for society, environment and Ethics				
	CO3	Generate possible alternative solutions to chosen problem, compare, analyze and interpret the result				
	CO4	Prepare a comprehensive report of the project work and also explore possibility of publishing the work.				
Contribution of Course Outcomes towards achievement of Program Outcomes (1 – Low, 2 –Medium, 3 – High)		PO1	PO2	PO3	PO4	PO5
	CO1	3	3	2		
	CO2	3	3	2		3
	CO3	3	3	2	3	3
	CO4			2	3	2
Course Content		Project Part B shall be the extension of project Part A.				