SCHEME OF INSTRUCTION
AND
SYLLABUS

M.TECH
IN
STRUCTURAL ENGINEERING

w.e.f 2019– 2020 (VR19)

DEPARTMENT OF CIVIL ENGINEERING
VELAGAPUDI RAMAKRISHNA
SIDDHARTHA ENGINEERING COLLEGE
(An Autonomous Institution affiliated to Jawaharlal Nehru Technological University Kakinada, Kakinada
NBA Accredited & ISO 9001:2008 Certified)
(Sponsored by Siddhartha Academy of General & Technical Education)
Kanuru, Vijayawada-520007, A.P. India

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

After completion of the program graduates will be able to

PO (A). Apply the knowledge of science, mathematics, and engineering principles for developing problem solving attitude.

PO (B). Identify, formulate and solve engineering problems in the domain of structural engineering.

PO (C). Use different software tools for Analysis and Design in the domain of structural engineering.

PO (D). Design and conduct experiments, analyze and interpret data, for development of simulation experiments.

PO (E). Function as a member of a multidisciplinary team with sense of ethics, integrity and social responsibility.

PO(F).Apply current techniques and skills in the field of structural engineering

PO(G).Apply Building Information Modeling (BIM) to optimize team collaboration in project management.

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	19CESE1026	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**

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	19CESE2067	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 leastSix weeks during semester break**

#Students should conduct the Literature Survey for the proposed research topic and they need to develop a prototype or simulationbased (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)	19CESE3062	Dissertation*/ Project/ Research Organization	0	0	18	10
3.	Internship	19CESE3051	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**

19CESE1001 ADVANCED STRUCTURAL ANALYSIS

Course Category:	Programme Core-1	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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:apply energy principles for the analysis of determinate/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 (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	H	H	M	L	L		
	CO2	H	H	M	L	L		
	CO3	H	H	M	L	L		
	CO4	H	H	M	L	L		

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

1. DevdasMenon, "Advanced Structural Analysis ", Narosa Publishing House,2009
2. DevdasMenon," Structural Analysis",Narosa Publishing House, 2008

Reference books:	1. AsslamKassimali,"Matrix Analysis of Structures", Brooks/ Cole Publishing Co., USA ,1999 2. 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	**Lectures**	3 hrs/week
		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 the concept of thin plates using various approaches.
	CO2: analyze the thin plates subjected to different loading and boundary conditions.
	CO3: discuss the behavior of shells and their classifications and stress-strain and force-displacement relationship.
	CO4: analyze different types of shells subjected to different loading criterion and boundary conditions

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	H	H	M	L	L		
	CO2	H	H	M	L	L	M	
	CO3	H	H	M	L	L		
	CO4	H	H	M	L	L	M	

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	1. Theory of plates and shells by S.P.Timoshenko and S.Woinowsky-Krieger, McGraw-Hill, 1959. 2. N. K. Bairagi, “Shell Analysis” ,Khanna Publishers.
Reference Books:	1. R. Szilard, “Theory & Analysis of Plate - Classical & Numerical Methods” , John Wiley & Sons Publishing Company. 2. 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	**Lectures**	3 hrs/week
		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: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 (L – Low, M - Medium, H – High)		PO (A)	PO (B)	PO (C)	PO (D)	PO (E)	PO (F)	PO (G)
	CO1	M		L	H		H	M
	CO2	M	H	L	H		H	M
	CO3	M	H	L			H	
	CO4	M	H	L	H		H	

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	1. Design of steel structures by N Subramanian, oxford university press, 2018 2. Limit state design of steel structures by S K Duggal, McGraw Hill Education (India) Pvt Ltd., 2017
Reference Books:	1. Design of Steel Structures by A S Arya and J L Ajmani, Nam Chand Brothers Publication, 2011 2. 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/

19CESE1014/1 ---- Structural Health Monitoring

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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: applyrepairs and rehabilitation measures of the structure

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO (B)	PO (C)	PO (D)	PO (E)	PO (F)	PO (G)
	CO1	L	L				L	
	CO2	L	M				L	
	CO3	L	M				L	
	CO4	M	M			H	M	

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	1. Structural Health Monitoring, Daniel Balageas, Claus Peter Fritzen, Alfredo Güemes, John Wiley and Sons, 2006. 2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
Reference books	1. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006. 2. 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

19CESE1014/2 ---- SUB-STRUCTURE DESIGN

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		Continuous Evaluation: **Semester end Evaluation:** **Total Marks:**	40 60 100

Course outcomes	**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 (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	M			M			
	CO2	H	M					
	CO3	H	M				L	
	CO4	H	M				L	

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	1. Basic and Applied Soil Mechanics, GopalRanjan and A.S.R.Rao, New Age International (P) Limited Publishers, 2nd Edition, 2006 2. Soil Mechanics and Foundation Engineering K.R.Arora; Standard Publishers and Distributors, 2009
Reference books	1. Advanced Foundation Engineering, V.N.S.Murthy, CBS Publishers and Distributors, New Delhi, 2007 2. 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

19CESE1014/3 ---- ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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: 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 (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	H	H					
	CO2	H	H					
	CO3	H	H					
	CO4	H	H					

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	**Text Book:** 1. Sankara Rao. K, "Introduction to Partial Differential Equations", PHI, New Delhi, 1995. 2. Sneddon. I.N, "Elements of Partial Differential Equations", McGraw Hill, 1986
Reference books	1. Elsgolts. L, "Differential Equations and Calculus of Variations", Mir Publishers, Moscow, 1966. 2. Gupta. S.C,&Kapoor. V.K, "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, Reprint 1999. 3. 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/

19CESE1014/4 ---- PRE ENGINEERED BUILDINGS

Course Category:	**Programme Elective**	**Credits:**	3
Course Type:	**Theory**	**Lectures**	3 hrs/week
		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 classify different materials used for pre-engineered buildings
	CO2 classify pre-engineered building components
	CO3 classify different design loads on pre-engineered buildings
	CO4 apply pre-engineered building design methodology

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO (E)	PO(F)	PO(G)
	CO1		H					
	CO2		H					
	CO3		H					
	CO4	H	H				M	M

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	1. Alexander Newman, Metal Building SystemsDesign and Specifications, 2nd Edition
Reference books	1. K.S.Vivek&P.Vaishavi – Pre Engineered Steel Buildings, Lambert Academic Publishing
E-resources and other digital material	Open Web

19CESE1015/1 ---- PREFABRICATED STRUCTURES

Course Category:	**Programme Elective**	**Credits:**	3
Course Type:	**Theory**	**Lectures**	3 hrs/week
		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 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 (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO (D)	PO (E)	PO (F)	PO(G)
	CO1		M					
	CO2	M	M				M	M
	CO3		M		L		M	M
	CO4		M		L		M	M

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	**Text Books:** 1.S.R.Damodaraswamy&S.Kavitha, Basics of Dynamics and Aseismic Design, PHI Learning ,2009. 2.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	1 V.Soundararajan,R.Jagadeeshkumar, S KalpanaDevi Pre fabricated structures ars publications
E-resources and other digital material	https://www.youtube.com/watch?v=wXNlCrqbOwg

19CESE1015/2 FRACTURE MECHANICS OF CONCRETE STRUCTURES

Course Category:	Programme Elective-II	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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 Apply the principles of linear elastic fracture mechanics
	CO2 Apply theprinciples of non-linear fracture mechanics
	CO3 Evaluate the fracture process of concrete
	CO4 Apply the fracture mechanics to concrete structures

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	M			M			
	CO2	M			M			
	CO3	M	H		L			
	CO4	M	H		L			

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	1. Fracture mechanics of concrete: Applications of fracture mechanics to concrete, rock, and other quasi-brittle materials by Surendra P. Shah, Stuart E. Swartz &ChengshengOuyang, John Wiley & Sons, 1995. 2. Elements of fracture mechanics by Prashant Kumar, Tata-McGraw-Hill, 2009.
Reference books	1. 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

19CESE1015/3 STRUCTURAL OPTIMIZATION

Course Category:	Programme Elective-II	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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 classify optimization and various techniques
	CO2 solve various linear and Non-linear problems
	CO3 solve a problem by geometric programming and dynamic programming
	CO4 apply optimization to various structural elements.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	L	L	H				
	CO2	L	L	H				
	CO3	L	L	H				
	CO4	L	L	H				

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 and	1. Singiresu S. Rao (2011). "Engineering Optimization: Theory and Practice" New Age International Publishers, ISBN 978-81-224-2723-3 2. G. Hadley,"Linear programming", Narosa Publishing House, New Delhi, 1990.
Reference books	1. Deb K, (1995), "Optimization for Engineering Design: Algorithms and Examples", Prentice Hall, New Delhi. **2.** 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/

19CESE1015/4 DESIGN OF PRESTRESSED CONCRETE STRUCTURES

Course Category:	Programme Elective-II	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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 Analyse and design statically determinate and statically indeterminate members
	CO2 Analyze and design the cylinder and non cylinder pipes and tanks
	CO3 Analyze and design the prestressed concrete slabs

	CO4 Analyse and design piles, sleepers, and shell roofs

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	L	H				L	M
	CO2	L	H				L	M
	CO3	L	H				L	M
	CO4	L	H				L	M

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

1. Pre-stressed concrete by N.KrishnaRaju, Tata-McGraw-Hill, 1995.
2. Pre-stressed concrete by N.Rajagopalan,

	NarosaPublishing House, 2005.
Reference books	1. Pre-stressed concrete by T.Y.Lin&N.H.Burns, John Wiley & Sons,198 2. 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

19CESE1026RESEARCHMETHODOLOGY AND IPR

Course Category:	MLC	**Credits:**	0
Course Type:	Theory	**Lectures**	2hrs/week
		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 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 (L – Low, M - Medium, H – High)

	PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
CO1		M					
CO2	L	M					
CO3		M	L	M			
CO4	L					M	

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.

ResearchDesign:MeaningofResearchDesign,NeedforResearchDesign,FeaturesofaGood Design, Important Concepts Relating to Research Design, Basic Principles of experimental Designs, Important ExperimentalDesigns.

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 measurementtools.

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, CopyrightAct,1957,TradeSecrets,UtilityModelsWTO,Paris ConventionfortheProtection 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	1. Research methodology: Methods and Techniques, **C.R. Kothari, GauravGarg,** New Age International, 4th Edition,2018. 2. Research Methodology a step-by-step guide for beginners. **Ranjit Kumar, SAGE Publications** Ltd.,3rd Edition,2011 3. 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	1. An introduction to Research Methodology, Garg B.L et al ,RBSA Publishers2002 2. An Introduction to Multivariate Statistical Analysis Anderson T.W, Wiley 3rdEdition, 3. Research Methodology, Sinha, S.C, Dhiman, EssEssPublications2002 4. Research Methods: the concise knowledge base ,Trochim ,Atomic Dog Publishing,2005 5. How to Write and Publish a Scientific Paper, Day R.A, Cambridge University Press1992 6. Conducting Research Literature Reviews: From the Internet to Paper, Fink A, Sage Publications, 2009 7. Proposal Writing, Coley S.M. Scheinberg, C.A, Sage Publications,1990 Intellectual Property Rights in the Global Economy, Keith Eugene Maskus, Institute for InternationalEconomics
E-resources and other digital material	Open web

19CESE1051 ADVANCED CONCRETE LAB

Course Category:	**Laboratory**	**Credits:**	2
Course Type:	**Practical**	**Lectures**	3
		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 effect of water cement ratio on strength of concrete
	CO2 distinguish the effect of aggregate cement ratio
	CO3 determine the properties of fresh and hardened concrete.
	CO4 design the concrete mix for various grades by using Indian and ACI Code

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(
	CO1				H			
	CO2				H			
	CO3				H			
	CO4				H			

Course Content	**PART-A :** 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
	Part-B 1. Rheological behaviour of fresh Concrete and strength and elastic properties of hardened concrete 2. Study on correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture based on IS Method.

	3. A study on the effect of span to depth ratio on the failure pattern of RC beams. 4.Study of Non-Destructive Testing Methods on Concrete 5.A study on behavior of under reinforced and over reinforced beams.
Description and testing based on availability of material	Fibre reinforced Concrete, Polymer Concrete, Epoxy resins and screeds for rehabilitation – properties and application – Emerging trends in replacement of fine and coarse aggregates. Durability tests(ANY TWO)

19CESE1052 – Numerical Analysis Lab

Course Category:	**Laboratory**	**Credits:**	2
Course Type:	**Practical**	**Lectures**	3
		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: find root of algebraic and transcendental equations
	CO2: fit 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 (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	L		M				
	CO2	L	L	M				
	CO3	L	L	M				
	CO4	L	L	M				

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.

19CESE2001 FEM IN STRUCTURAL ENGINEERING

Course Category:	ProgrammeCore	**Credits:**	3

Course Type:	Theory	**Lectures**	3 hrs/week
		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: identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements
	CO3: develop element characteristic equation and generation of global equation
	CO4: apply suitable boundary conditions to a global equation for bars, trusses beam and axisymmetric and elements and solve them displacements, stress and strains induced

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO (B)	PO(C)	PO (D)	PO (E)	PO (F)	PO (G)
	CO1	M	H					
	CO2	M	H					
	CO3	M	H					
	CO4	M	H					

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	1. Bhatti, M.A., Fundamental Finite ElementAnalysis and Applications: with Mathematica and Matlab Computations, Wiley, 2005 2. Reddy, J. N.,An Introduction to the Finite Element Method, 3rd Edition, McGraw-Hill Science/Engineering/Math, 2005.
Reference books	1. Logan D. L.,A First Course in the Finite Element Method, Thomson Engineering, 3rd edition, 2001. 2. Cook, R. D., Malkus, D.S.,Plesha, M.E., and Witt, R.J., Concepts and applications of Fi Element Analysis, 4th Edition, Wiley-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	**Lectures**	3 hrs/week
		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 buckling of columns, beam-columns and find critical loads using energy and non-energy methods
	CO2: analyze the lateral buckling of beams by energy and non-energy methods
	CO3:analyze the buckling of rectangular plates and find critical compressive loads for various boundary conditions
	CO4: analyze the buckling of axially loaded cylindrical shells

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO (A)	PO (B)	PO (C)	PO(D)	PO (E)	PO (F)	PO (G)
CO1	H	M	L	L			
CO2	H	M	L	L			
CO3	H	M	L	L			
CO4	H	H	H				

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	**Text Book:** 1. Theory of elastic stability by Timoshenko & Gere, McGraw Hill, 1961. 2. Background to buckling by Allen and Bulson, McGraw-Hill, 1980.
Reference Books:	1. Elastic stability of structural elements by N.G.R.Iyengar, Macmillan India Ltd., 2007. **2.** Principles of Structural stability theory by AlexandarChajes
E-resources and other digital material	https://nptel.ac.in/courses/105/105/105105108/

19CESE 2003 DYNAMICS OF STRCUTURES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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 classify the principles of structural dynamics.
	CO2 summarize the solution technique for dynamics of MDOF systems.
	CO3 design and develop analytical skills to calculate natural frequencies and mode shape
	CO4 analyze for lateral load on structures

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO(B)	PO(C)	PO(D)	PO (E)	PO (F)	PO (
	CO1							
	CO2	L	M					
	CO3	M	M	H	M			
	CO4	L	L		L			

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	1. Dynamics of Structures: Theory and application to Earthquake Engineering by A.K.Chopra , Prentice-Hall of India, 2001. 2. Dynamics of Structures by R.W. Clough and P.E. Penzien , McGraw-Hill, 1993. **3.** Structural Dynamics: Theory and Computation by Mario Paz, Kluwer Academic Publishers , 2003.
Reference Books:	1. Theory of Vibration An Introduction by A.A.Shabana, Springer International Edition, 2010 2. 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., 3. Earthquake resistance design of building structures vinodhosur WILEY 4. Vibrations structural dynamics by m mukhopadhaya oxford
E-resources and other digital material	http://nptel.ac.in/courses/105101006/

19CESE2014 /1 DESIGN OF TALL STRUCTURES

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

Course Outcome	On Successful Completion of the course, the student will be able to**:**
	CO1: identify about different systems and various loads in Tall structures
	CO2: identify about various structural systems and their behavior
	CO3:interpret static, dynamic and stability analysis of various systems
	CO4: classify various Flooring systems and modern progress of tall structures

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO(A)	PO (B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
CO1							
CO2							
CO3	M	M		L		M	M
CO4	M	M				M	M

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 andconstruction loads; Wind loading- static and dynamic approach-Analytical and wind tunnel experimental method; Earthquakeloading-Equivalent lateral force; Modal analysis- combination ofloading 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:	1. Tall Building Structures by B.S.Smith and A.Coull, John Wiley & sons, 1991. 2. Structural Analysis and Design of Tall Buildings by B.S.Taranath, McGraw Hill Co 1988.
Reference Books:	1. Structural Concepts and Systems for Architects and Engineers" by Lyn T.Y. and Burry D.Stotes, John Wiley, 1994. 2. High Rise Building Structures" by Sehuller .W.G, John Wiley & sons, 1977
E-resources	https://www.youtube.com/watch?v=EIDXE28_8eQ

19CESE2014/2 ---- SOIL STRUCTURE INTERACTION

Course Category:	Programme Core	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		Continuous Evaluation: **Semester end Evaluation:** **Total Marks:**	40 60 100

Course Outcome	On Successful Completion of the course, the student will be able to**:**
	CO1: elucidatesoil structure interaction concept and complexities involved.
	CO2: evaluate soil structure interaction for different types of structures under various conditions of loading and subsoil characteristics
	CO3evaluate interaction analysis of pile and pile groups with rigid cap.
	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 (L – Low, M - Medium, H – High)		PO (A)	PO (B)	PO (C)	PO(D)	PO (E)	PO (F)	PO(G)
	CO1	L	L	M	L			
	CO2	L	L	M	L			
	CO3	L	L	M	L		M	M
	CO4	L	L	M	L			

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	1. Foundation analysis and design - J E Bowles, McGraw Hill, NY 2. Design of Foundation System- Principles & Practices, Kurian N. P., Narosa Publishing
Reference books	1. Analysis & Design of substructures, Swami Saran, Oxford & IBH Publishing Co. Pvt. Ltd. **2.** Selvadurai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier, 1979.
E-resources	https://www.youtube.com/watch?v=Ng2tH7CX-WU

19CESE 2014/3 ADVANCED BRIDGE ENGINEERING

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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: develop a sound knowledge on investigation of 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 (L – Low, M - Medium, H – High)

	PO (A)	PO (B)	PO (C)	PO(D)	PO(E)	PO(F)	PO(G)
CO1	L	L	M	L			
CO2	L	L	M	L		M	M
CO3	L	L	M	L		M	M
CO4	L	L	M	L		M	M

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	1. Bridge engineering by S.Ponnuswamy, TataMcGraw-Hill, 1986. 2. Bridge superstructure by N.Rajagopalan, Narosa Publishing House, 2006. 3. Essentials of bridge engineering by D. John Victor, Oxford & IBH, 2001.
Reference books	1. Swami Saran, "Analysis and Design of Substructures", Oxford & IBH Publishing Co., 1996. 2. R.E. Rowe, "Concrete Bridge Design", 1 st Edition, Elsevier Science and Technology 3. 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 2014/4 ADVANCED PRE-ENGINEERED BUILDINGS

Course Category:	Programme Elective	**Credits:**	3
Course Type:	Theory	**Lectures**	3 hrs/week
		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: analyse and design pre-engineered buildings with optimization.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO (A)	PO (B)	PO(C)	PO (D)	PO(E)	PO(F)	PO(G)
CO1	L	M					
CO2	L	M	H			M	M
CO3	M	M				M	M
CO4	M	M				M	M

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	1. Alexander Newman, Metal Building Systems Design and Specifications, 2nd Edition
Reference books	
E-resources and other digital material	Open Web

19CESE2015/1 REPAIR AND REHABILITATION OF STRUCTURES

Course Category:	Programme Elective-IV	**Credits:**	3
Course Type:	Theory	**Lectures/week**	3
		Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

Course outcomes	Upon 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	learn various methods of diagnosis for the damage by Semi destructive and non-destructive tests						
	CO3	identify the effect of earthquake on structures and repairs in chemical environment and fire damage assessment through case studies						
	CO 4	identify various retrofitting techniques and repair procedures						
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO(B)	PO(C)	PO(D)	PO (E)	PO(F)	PO(G)
	CO1	L	L				L	
	CO2	L	H			H	L	
	CO3	L	M			H	L	
	CO4	M	L			H	L	L
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,designerrors,erosion,freezingand thawing, settlement and movement,shrinkage,temperaturechanges,fire,weathering. **Trained Damage assessmentfor 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-quntabtest,corbonationtest,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** Epoxyresins, epoxymortor, quick-settingcement,gypsumcementmortar.Mechanicalanchors, Crack repair techniques, stitching, blanketing, jacketing and types, shotcrete, guniting, grouting, pressure injection of epoxy.
Text books	1. R.N.Raikar ,Diagnosis and Treatment of Structures in Distress, R&D Centre,SDCPL,New Bombay,1994. 2. Repair of concrete structures R.T.Allen and S.C.Edwards, Blakie and Son UK 1987

Reference books	1. CPWD Hand book on Repair and Rehabilitation of RCC Buildings. 2. PankajagarwalManishshikhakondeEarth quake resistant design of structures,Prentica-Hall of India, new delhi,2006 3. Raikar, R., Learning from failures- deficiencies in design, construction and service- R&D Centre(SDCPL) , RaikarBhavan, Bombay 1987. 4. A.R.Santhakumar ,Concrete technology ,S..chand, second edition ,2018.
E-resources	Open web

19CESE2015/2 DESIGN OF STEEL-CONCRETE COMPOSITE STRUCTURES

Course Category:	Programme Elective-IV	**Credits:**	3
Course Type:	Theory	**Lectures/week**	3
		Continuous Evaluation:	40
		Semester end Evaluation:	60
		Total Marks:	100

Course outcomes	Upon 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						
	CO 4	Identify the behaviour of composite girder bridges.						
Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO(B)	PO (C)	PO (D)	PO (E)	PO(F)	PO(G)
	CO1							
	CO2	M	M	L			M	M
	CO3	M	M	L			M	M
	CO4							

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

19CESE2015/3 FORM WORK DESIGN

Course Category:		**Credits:**	2
Course Type:	**Practical**	**Lectures**	2
		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 select a right material for manufacturing false work and form work suiting specific
	CO2 identify the pressure of concrete on form work
	CO3Design decking, form work and false work.
	CO4classify the sequence of construction of civil engineering structures and safety steps involved in the design of form work and false work.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO (D)	PO(E)	PO(F)	PO(G)
	CO1	M	M	L				
	CO2	L	M					
	CO3	L	M	L			M	M
	CO4		M	M	L		M	M

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	1. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996. 2. Tudor Dinescu and ConstantinRadulescu, Slip Form Techniques, Abacus Press, Turn Bridge Wells, Kent, 2004.

Reference Books	3. Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996 4. Michael P. Hurst, Construction Press, London and New York., 2003
E-References	Open web

19CESE2015/4 EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

Course Category:	Programme Core	**Credits:**	4
Course Type:	Theory	**Lectures**	4 hrs/week
		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: Plan a good structural configuration for seismic resistance.
	CO2: Calculate the earthquake design forces using appropriate methods as per IS 1893-2002(Part-I).
	CO3: Apply the concept of Ductility and Base isolation in designing earthquake resistant structures.
	CO4: Design the structure using IS 13920 code provisions.

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)

	PO (A)	PO(B)	PO (C)	PO(D)	PO(E)	PO(F)	PO(G)
CO1	H		L				
CO2	L		H				
CO3	H		L			L	
CO4	M		H			M	M

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	1. Earthquake resistant design of structures by PankajAgarwal and Manish Shrikhande, Prentice-Hall of India, 2006. 2. Seismic design of reinforced concrete and masonry buildings by T.Paulay and M.J.N.Priestley, John Wiley & Sons, 1991. 3. Earthquake-Resistant Design of Building Structures by Dr. VinodHosur, WILEY, 2013.

Reference books	1. Earthquake Resistant Design and Risk Reduction by David Dowrick, WILEY Student Edition, 2012. 2. Earthquake Resistant Design of Structures by S.K.Duggal, OXFORD Higher Education. 3. 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/

19CESE2051 STRUCTURAL ENGINEERING LABORATORY

Course Category:	Laboratory	**Credits:**	1.5
Course Type:	Practical	**Lectures**	3 hrs/week
		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: Obtain the unknown resistance and static strain using accepted principles
	CO2: Determine the principal stresses for various loadings
	CO3: Determine the response of three storeyed building under harmonic and non-harmonic base motions
	CO4: Understand and apply the concept of Vibration isolation and vibration absorber

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO (A)	PO(B)	PO(C)	PO(D)	PO(E)	PO(F)	PO(G)
	CO1	L			H			
	CO2	L			H			
	CO3	L			H			
	CO4	L			H			

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. 8. Dynamics of three storey building frame subjected to non-harmonic (periodic) base motion. 9. Dynamics of a one-storey building frame with planar asymmetry subjected to harmonic base motion. 10. Vibration Isolation of a secondary system. 11. Dynamics of a vibration absorber.

19CESE2052 STRUCTURAL DESIGN LAB

Course Category:	Laboratory	**Credits:**	1.5
Course Type:	Practical	**Lectures**	3 hrs/week
		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: analyze and design the structural components like beams, slabs &columns.
	CO2:analyze&design framed buildings for earthquake & wind loads
	CO3:prepare detailed drawings for structural elements
	CO4:generate Building Information Model

Contribution of Course Outcomes towards achievement of Program Outcomes (L – Low, M - Medium, H – High)		PO(A)	PO(B)	PO(C)	PO(D)	PO(E)	PO (F)	PO(G)
	CO1	M	M	H	M	M		
	CO2	M	M	H	M	M	M	
	CO3	L		H	L	M	M	
	CO4	L		H	L	M	M	H

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)