P.S. R. ENGINEERING COLLEGE

(An Autonomous Institution, Affiliated to Anna University, Chennai)
Sevalpatti (P.O), Sivakasi – 626140.

DEPARTMENT OF

CIVIL ENGINEERING

REGULATIONS 2019

CURRICULUM AND SYLLABI

FOR

M.E.STRUCTURAL ENGINEERING

DEPARTMENT OF CIVIL ENGINEERING

VISION

- The vision of the Civil Engineering Department is to produce the Civil Engineers to meet the dynamic problems in the society with human values.

MISSION

- To provide high-class engineering education.
- To join hands with organizations to provide training and internship.
- To facilitate the students for research and development.
- To deliver good Civil Engineering graduates with human values.

PROGRAM OUTCOMES (PO's) OF STRUCTURAL ENGINEERING

a) An ability to independently carry out research/ investigation and development work to solve practical Problems in key areas of Structural Engineering.
b) An ability to write and present a substantial report/document.
c) Able to demonstrate Structural Engineering Problems critically in development project and find suitable solution.
d) Graduate will show the understanding of impact of engineering solutions on the society and also will be aware of contemporary issues.
e) Able to design a system, component or process as per needs and specifications.
f) Able to use modern engineering tools, software and equipment to analyze problems.

PROGRAM SPECIFIC OUTCOMES (PSO's) OF STRUCTURAL ENGINEERING

a) To motivate the graduate students to address the societal needs by interdisciplinary approach through advanced courses such as Finite Element Analysis, Plates & Shell structures, Structural Dynamics, Soil Dynamics, and allied courses.
b) To enrich the graduate students to get hands on training on latest equipment / software to be industry ready / pursue advanced research.
c) Engineers will be able to apply concepts for design/ test/implement /analysis system in the area related to civil engineering industry and society.
d) Excel in the research innovation design and problem solving in structural engineering domain.

REGULATION – 2019

M.E. STRUCTURAL ENGINEERING

CURRICULUM- I TO IV SEMESTER

SEMESTER- I

Sl. No.	Subject Code	Course Title	Category	L	T	P	C
Theory							
1	192SE11	Advanced Structural Analysis	PC	3	0	0	3
2	192SE12	Advanced Concrete Structures	PC	3	0	0	3
3	192SE13	Research Methodology and IPR	MC	3	0	0	3
4	--	Elective-I	PE	3	0	0	3
5	--	Elective-II	PE	3	0	0	3
6	--	Audit Course-I	MC	2	0	0	0
Practical							
7	192SE17	Advanced Concrete Laboratory	PC	0	0	4	2
8	192SE18	Structural Design Laboratory	PC	0	0	4	2
			TOTAL	**17**	**0**	**8**	**19**

SEMESTER – II

Sl. No.	Subject	Course Title	Category	L	T	P	C
Theory							
1	192SE21	Advanced Steel Structures	PC	3	0	0	3
2	192SE22	Advanced Solid Mechanics	PC	3	0	0	3
3	192SE23	Structural Dynamics	PC	3	0	0	3
4	--	Elective-III	PE	3	0	0	3
5	--	Elective-IV	PE	3	0	0	3
6	--	Audit Course-II	MC	2	0	0	0
Practical							
7	192SE27	Mini Project	PROJ	0	0	4	2
8	192SE28	Numerical Analysis Laboratory	PC	0	0	4	2
			TOTAL	**17**	**0**	**8**	**19**

SEMESTER –III

Sl. No.	Subject Code	Course Title	Category	L	T	P	C
Theory							
1	--	Elective-V	PE	3	0	0	3
2	--	Open Elective	OE	3	0	0	3
Practical							
3	192SE31	Project Phase - I	PROJ	0	0	20	10
			TOTAL	**6**	**0**	**20**	**16**

SEMESTER –IV

Sl. No.	Subject Code	Course Title	Category	L	T	P	C
Practical							
1	192SE41	Project Phase - II	PROJ	0	0	32	16
			TOTAL	**0**	**0**	**32**	**16**

TOTAL NO. OF CREDITS = 70

LIST OF ELECTIVES - (Regulations 2019)

PROGRAM ELECTIVE (PE)					
Elective –I					
Code No	**Course Title**	**L**	**T**	**P**	**C**
192SEE01	Design of Plates and Shells	3	0	0	3
192SEE02	Experimental Methods of Stress Analysis	3	0	0	3
192SEE03	Theory and Applications of Cement Composites	3	0	0	3
192SEE04	Theory of Structural Stability	3	0	0	3
Elective –II					
192SEE05	Analytical and Numerical Methods for Structural Engineering	3	0	0	3
192SEE06	Corrosion and Durability Studies	3	0	0	3
192SEE07	Structural Health Monitoring	3	0	0	3
192SEE08	Structural Optimization	3	0	0	3
Elective –III					
192SEE09	Earthquake Analysis and Design of Structures	3	0	0	3
192SEE10	Design of Bridges	3	0	0	3
192SEE11	Design of Formwork	3	0	0	3
192SEE12	Design of High Rise Structures	3	0	0	3
192SEE13	Design of Masonry Structures	3	0	0	3
Elective –IV					
192SEE14	Advanced Design of Foundations	3	0	0	3
192SEE15	Design of Industrial Structures	3	0	0	3
192SEE16	Finite Element Analysis	3	0	0	3
192SEE17	Soil Structure Interaction	3	0	0	3
Elective -V					
192SEE18	Analysis of Laminated Composite Plates	3	0	0	3
192SEE19	Design of Prestressed Concrete Structures	3	0	0	3
192SEE20	Fracture Mechanics of Concrete Structures	3	0	0	3
OPEN ELECTIVE (OE)					
192OE01	Business Analytics	3	0	0	3
192OE02	Industrial Safety	3	0	0	3
192OE03	Operations Research	3	0	0	3
192OE04	Design of Experiments	3	0	0	3
192OE05	Cost Management of Engineering Projects	3	0	0	3
192OE06	Composite Materials	3	0	0	3
192OE07	Waste to Energy	3	0	0	3
192OE08	Nanomaterials and Nanotechnology	3	0	0	3

AUDIT COURSE I & II (AC)					
192AC01	Constitution of India	2	0	0	0
192AC02	Disaster Management	2	0	0	0
192AC03	English for Research Paper Writing	2	0	0	0
192AC04	Sanskrit for Technical Knowledge	2	0	0	0
192AC05	Value Addition	2	0	0	0
192AC06	Pedagogy Studies	2	0	0	0
192AC07	Stress Management by Yoga	2	0	0	0
192AC08	Personality Development through Life Enlightenment Skills	2	0	0	0

PC – Program Core, PE – Program Elective, AC – Audit Course, OE – Open Elective

MC – Mandatory Course, PROJ – Project

192SE11	ADVANCED STRUCTURAL ANALYSIS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**PC**	
Prerequisites:	Nil					
Aim:	To understand the energy concepts, analysis of structures by stiffness and flexibility approaches.					

BASIC CONCEPTS	**9**
Indeterminacy – Static, Kinematic – Generalized measurements – Degrees of freedom – Constrained measurements – Behaviour of Structures – Principle of Superposition – Equilibrium, Compatibility and Force displacement relations.	
STIFFNESS AND FLEXIBILITY	**9**
Stiffness and Flexibility matrices in single, two and n-coordinates; Structures with constrained measurements; stiffness and flexibility coefficients – basic stiffness and flexibility method applied to spring models.	
ENERGY CONCEPTS AND TRANSFORMATION OF INFORMATION	**9**
Strain energy: stiffness and flexibility matrices for strain energy – Betti's law and its applications – Properties of stiffness and flexibility matrices – Contra gradient law – Co-ordinate transformations – Transformation of element matrices to structure matrices – orthogonal transformations.	
STIFFNESS METHOD	**9**
Development of the method – Structure stiffness matrix for beams, frames and trusses using displacement transformation matrix – Internal forces due to thermal expansion and lack of fit – Direct stiffness methods – Static condensation – Transfer matrix method – Symmetry and anti-symmetry of structures – Reanalysis technique – Analysis by substructures using stiffness Method-Develop computer programs for simple problems(beams, frames and trusses).	
FLEXIBILITY METHOD	**9**
Flexibility method applied to statically determinate and indeterminate structures; Choice of redundant; Primary structure – General formulation – Structures flexibility matrix using force transformation matrix –Internal forces due to thermal expansion and lack of fit - Development of computer programs.	
Total Periods	**45**

References:

1. Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, Daryagang, New Delhi,2009.
2. Moshe.F.Rubinstein, "Matrix Computer Analysis of Stuctures", Prentice Hall,1986.
3. Rajasekaran.S, Sankarasubramanian.G, "Computational Structural Mechanics", Prentice Hall of India Pvt Ltd, New Delhi - 110 001, First Edition,2001.
4. Pandit.G.S and Gupta.S.P, "Structural Analysis – a matrix Approach", Tata Mc Grew Hill Publishing Company,2004.
5. Weaver.J.R and Gere.J.M, "Matrix Analysis of Framed Structures", CBS Publishers, New Delhi,1986.
6. Fleming.J.F., "Computer analysis of Structural Systems", Mcgraw Hill Book Co.,1989.

Course Outcomes:

At end of this course, the students will be able to

CO1	Able to identify the degree of freedom, equilibrium compatibility and force displacement relation
CO2	Able to apply fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices
CO3	Impart knowledge about analysis of system through direct and element approach of flexibility method
CO4	Impart Knowledge about Betti's law and its application
CO5	Able to analysis the structures by direct and element approach of stiffness method is to be included
CO6	Understand the energy concepts and transformation

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	3	1			2		2	3
CO2	3	1	2	1			1		2	3
CO3	3	1	2	1		1	1		1	1
CO4	3						1	1	1	
CO5	3		1	2			1		1	1
CO6	2	1	2	1		1	1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE12	ADVANCED CONCRETE STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**PC**	
Prerequisites:	Nil					
Aim:	To study the behaviour, analysis and design of R.C. structures..					

OVERALL REVIEW	**9**
Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS and ACI Codes	
DESIGN OF SPECIAL RC ELEMENTS	**9**
Design of slender columns-Design of RC walls-ordinary and shear walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors.	
FLAT SLABS AND YIELD LINE THEORY	**9**
Design of Column-Supported Slabs (with/without Beams) under Gravity Loads - Direct design method - Equivalent frame method - Shear in Column - Supported two-way slabs - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs	
PLASTIC DESIGN	**9**
Limit analysis - Moment redistribution - Codal recommendations for Moment redistribution - Baker's method of plastic design - Design of cast-in-situ joints in frames.	
DETAILING AND FIELD PRACTICE	**9**
Detailing for ductility - Measures of ductility - Flexural yielding in frames and walls - Flexural members in ductile frames - Columns and frame members subject to bending and axial load - Joints in ductile frames - shear walls - Fire resistance of structural members – Code requirements - Quality control of concrete.	
Total Periods	**45**

References:

1. Unnikrishna Pillai and Devdas Menon "Reinforced concrete Design', Tata McGraw Hill Publishers Company Ltd., New Delhi,2006.
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2007.
3. Varghese,P.C,"AdvancedReinforcedConcreteDesign",PrenticeHallofIndia,2000
4. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill,1986
5. Sinha.N.C. and Roy S.K., "Fundamentals of Reinforced Concrete",S.Chandand Company Limited, New Delhi,2003.

Course Outcomes:

At end of this course, the students will be able to

CO1	Impart Knowledge about review of Limit state design of beams, slabs and columns according to IS codes.
CO2	Calculate deflection and crack width of structural Elements.
CO3	Design the special elements of reinforced structures like shear wall, corbels, and deep beams
CO4	Design flat slabs and flat plates according to ACI and Indian standards.
CO5	Design of slabs by applying, yield line theory and Hillerborg's strip method
CO6	Analyze and design plastic and inelastic frame structures.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	1	3	1	3	1	1	1	3	2
CO2	3	1	2		3		1	1	2	1
CO3	3		3		3	1	2	1	2	1
CO4	3		3		2		1		1	1
CO5	2	1	2	1	2		1	1	1	1
CO6	3	2	2	1	1	1	2		2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE13	RESEARCH METHODOLOGY AND IPR				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**		**MC**
Prerequisites:	Nil					
Aim:	To Initiate the learning for fundamental research and development activities.					

PROBLEM IDENTIFICATION	**9**
Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem.Approaches of investigation of solutions for research problem, data collection, analysis, interpretation,Necessaryinstrumentations	
LITERATURE STUDY	**9**
Effective literature studies approaches, analysis Plagiarism, Research ethics.	
PAPER AND PROPOSAL FORMULATION	**9**
Effective technical writing, how to write report, Paper, Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	
INTRODUCTION TO IPR	**9**
Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development:technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting underPCT.	
PATENT AND ITS DEVELOPMENT	**9**
Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications, New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.	
Total Periods	**45**

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science &engineeringstudents'"
2. Wayne Goddard and Stuart Melville, "Research Methodology: AnIntroduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide forbeginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall , "Industrial Design", McGraw Hill,1992.
6. Niebel , "Product Design", McGraw Hill,1974.
7. Asimov , "Introduction to Design", Prentice Hall,1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age",2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,2008

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand research problem identification.
CO2	Identify the approaches of investigation of solutions for research problem
CO3	Analyze research related information.
CO4	Write effective technical papers, Research Proposals.
CO5	To emphasis the need of information about Intellectual Property Right
CO6	Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	3	2	1		2	2		2	
CO2	3	1	3	2	2		3	2		
CO3	2	2	1				3			2
CO4	3	3	2	2		2		2		2
CO5	2	1		1			2	2		
CO6	2	1				2	2	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE17	ADVANCED CONCRETE LABORATORY				L-T-P	C
					0-0-4	2
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**PC**	
Prerequisites:	Nil					
Aim:	This paper aims at enabling the students to study the behavior of artificial construction material in fresh and hardened state and strength test to be conducted					

LIST OF EXPERIMENTS

1. Concrete mix design by using IS and ACI codemethod
2. Test on self-compacting and Geo polymerconcrete
3. Determination of Impact resistance
4. Study of stress-strain curve of high strength concrete, Correlation between cube strength, cylinder strength, split tensile strength and modulus ofrupture.
5. Effect of cyclic loading onsteel.
6. Non-Destructive testing of existing concretemembers.
7. Behavior of Beams under flexure, Shear andTorsion.

Total Periods **45**

References:

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall,2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co.,2006.

Course Outcomes:

At end of this course, the students will be able to

CO1	Design high grade concrete and study the parameters affecting its performance.
CO2	Conduct Non Destructive Tests on existing concrete structures.
CO3	Apply engineering principles to understand behavior of structural/ elements.
CO4	To prepare the students to solve problems including design elements and related to their course work.
CO5	To prepare the students to effectively link theory with practice and application and to demonstrate background of the theoretical aspects.
CO6	To encourage the students to use computers in analyzing the data.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO 2	PSO 3	PSO 4
CO1	3	2	1	2	1		2	2		
CO2	1	2	2			2	2		3	
CO3	2	2	3	1			2	1		
CO4	3	2	2		1	1	2		3	
CO5	3	2	1					2		2
CO6	2		1	1		2	2	2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE18	STRUCTURAL DESIGN LABORATORY				L-T-P	C
					0-0-4	2
Programme:	M.E. Structural Engineering	**Sem:**	**I**	**Category:**	**PC**	
Prerequisites:	Nil					
Aim:	To integrate the theoretical design concepts with practical approach of design.					

LIST OF EXPERIMENTS

Unit-1

Manual analysis and design of RCC elements

Types of buildings, Loads on a multistoried building, introduction to IS 875 part 1 and part 2, Basic concept of analysis and design, design procedure of slab, beam, column, footing and stair case.

Unit-2

Architectural and structural drawings

Architectural plan, section and elevation, deciding column location, structural framing plan and centerline.

Unit-3

Building modeling using STAAD PRO V8i

Local axis, global axis, coordinates, centerline grids, defining material properties like concrete and steel, defining member properties of slabs, beams, columns and shear wall. Modeling the multistoried building, application of dead load, live load, superimposed dead load. Introduction to IS 1893 and application of seismic loads.

Total Periods	**45**

References:

1.Subramanian N, "Design of Reinforced Concrete Structures",Oxford University Press, New Delhi, 2014.
2.Varghese P. C, "Limit state Design of Reinforced Concrete", PHI Learning, 2013.

Course Outcomes:

At end of this course, the students will be able to

CO1: Choose advanced testing systems of RC elements
CO2: Cast and Testing of reinforced RC Column
CO3: Analyze the static and dynamic load testing of steel and RC beams
CO4: Analyze the ultimate bearing load and deflection of beam
CO5: Analyze flexure behaviors of simply supported reinforced concrete beam
CO6: Analyze the quality of concretestructuresConduct

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	2	1		2	2		
CO2	1	2	2			2	2		3	
CO3	2	2	3	1			2	1		
CO4	3	2	2		1	1	2		3	
CO5	3	2	1					2		2
CO6	2		1	1		2	2	2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE21	ADVANCED STEEL STRUCTURES			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**PC**
Prerequisites:	Nil				
Aim:	To study the behaviourofmembers and connections, analysis and design of steel towers, chimneys.				

INTRODUCTION	**9**
Design of members subjected to lateral loads and axial loads, Analysis and design of Industrial Buildings and bents, Sway and non-sway frames, Design of Purlins, Louver rails, Gable column and Gable wind girder - Design of Moment Resisting Base Plates – Analysis of Gable Frames.	
DESIGN OF CONNECTIONS	**9**
Types of connections – Welded and riveted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections– FramedConnections.	
ANALYSIS AND DESIGN OF STEEL TOWERS	**9**
AnalysisandDesignofMicrowave/TransmissionLineTowers–Typesofbracingpatterns-SagandTension calculations. Design of Self-supporting Chimney – Design of Base Plates, Foundations and Anchor bolts and GuyedSteelChimney-Guyropes-Stressesduetowind.Alongwithloadcalculation-GustFactorMethod.	
PLASTIC ANALYSIS OF STRUCTURES	**9**
Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement – Moment resisting connections. Design of Straight Corner Connections – Haunched Connections – Design of continuous beams.	
DESIGN OF LIGHT GAUGE STEEL STRUCTURES	**9**
Cold formed light gauge section – Type of cross sections – stiffened - multiple stiffened and unstiffened element - flat width ratio - effective design width – Design of light gauge compression member – Effectivewidth for load and deflection determination - Design of tension members – Design of flexural members – Shear lag – Flange curling.	
Total Periods	**45**

References:

1. Subramanian.N, “Design of Steel Structures”, Oxford University Press,2008.
2. Duggal, “Limit state design of Steel structures”, Tata McGrew Hill, New Delhi,2010.
3. Ramachandra, “Design of Steel Structures” Vol.2, Standard Publishing House, New Delhi, 2004.
4. Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India,2007.
5. Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi,1996.
6. John E. Lothers, “Design in Structural Steel”, Prentice Hall of India, New Delhi,1990.
7. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, New York,1990.
8. Wie Wen Yu, “Design of Cold Formed Steel Structures”, McGraw Hill Book Company, New York, 1996.

Course Outcomes:

At end of this course, the students will be able to

CO1	Discuss the basic loads, types and methods of analyzing steel structures.
CO2	Analysis Gable Frames.
CO3	Design the various types of connections with respect to the appropriate place
CO4	Analyze and design steel towers by different kind of method
CO5	Analyse the effect of shear Force on plastic moment and Connections.
CO6	Analyze steel structures by plastic method

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1		2				1	2		2	1
CO2	2	2	1		3		2		2	1
CO3	2	2	1		2		2	1	2	
CO4	1	3			3	1	2		2	2
CO5	1	2			2	3	2	1	2	2
CO6	2	2	1		2		2		2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE22	ADVANCED SOLID MECHANICS	L-T-P	C

				3-0-0	**3**
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**PC**
Prerequisites:	Nil				
Aim:	To understand the concept of 3D stress, strain analysis and its applications to simple problems.				

ELASTICITY	**12**
Analysis of stress and strain, Equilibrium equations - Compatibility equations – stress strain relationship. Generalized Hooke's law.	
ELASTICITY SOLUTION	**12**
Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar co-ordinates.	
TORSION OF NON-CIRCULAR SECTION	**12**
St.venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections.	
ENERGY METHODS	**12**
Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticityproblems.	
PLASTIC DEFORMATION	**12**
Strain Hardening, Idealized Stress- Strain curve, Yield Criteria, von Mises Yield Criterion, Tresca Yield Criterion, Plastic Stress-Strain Relations, Principle of Normality and Plastic Potential, Isotropic Hardening.	
Total Periods	**60**

References:

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi1988.
2. Ernest E.Sechler "Elasticity in Engineering" Dover Publications, New York,1968.
3. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York,1977.
4. Chou P.C. and Pagano, N.J. "Elasticity Tensor, Dyadic and Engineering Approaches", D.VanNostr and Co., Inc., London,1967.
5. Timoshenko, S and GoodierJ.N. "Theory of Elasticity", McGraw Hill BookCo., Newyork,1988.
6. Hearn , E.J. "Mechanics of Materials", Vol.2, Pergamon Press, Oxford,1985
7. Irving H.Shames and James, M.Pitarresi, "Introduction to Solid Mechanics", Prentice Hall of India Pvt. Ltd., New Delhi-2002.

Course Outcomes:

At end of this course, the students will be able to

CO1	Explain the theory of elasticity including strain/displacement and Hooke's law relationships.
CO2	Analysis Stress and Strain
CO3	Solve the two dimensional problems in Cartesian and polar co-ordinates
CO4	Discuss about St.Venant's and Prandtl's approach.
CO5	Derive the torsion of thin walled open and closed sections
CO6	Apply the Principle of Virtual work and energy theorems.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	2				1	2		1	1
CO2	3	2	2	1		1	2		1	1
CO3	3	2			1	1	2	1	1	1
CO4	1	2			1	1	2		1	
CO5	2	2	1				2		1	
CO6				2			1		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE23	STRUCTURAL DYNAMICS			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**PC**
Prerequisites:	Nil				
Aim:	To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads.				

PRINCIPLESOF DYNAMICS	**12**
Vibration and its importance to structural engineering problems – Simple harmonic motion - Mathematical modelling of dynamic systems - Degree of freedom – Equation of motion for S.D.O.F - Damped and undamped free vibrations – Undamped forced vibration – Critical damping – Response to harmonic excitation – Damped or undamped	
TWO DEGREE OF FREEDOMSYSTEMS	**12**
Equations of Motion of two degree of freedom systems - Damped and undamped free vibrations – Undamped forced vibration - Normal modes of vibration – Applications	
DYNAMIC ANALYSISOFMDOF	**12**
Multidegree of freedom system- undamped free vibrations - Orthogonality relationship - Approximate methods - Holzer - Rayleigh - Rayleigh-Ritz - mode superposition technique - Numerical integration procedure- Central Difference – Newmark's method.	
DYNAMIC ANALYSIS OFCONTINUOUSSYSTEMS	**12**
Free and forced vibration of continuous systems- axial vibration of a beam- Flexural vibration of a beam - Rayleigh – Ritz method –Formulation using Conservation of Energy – Formulation using Virtual Work.	
PRACTICALAPPLICATIONS	**12**
Idealization and formulation of mathematical models for wind, earthquake, blast and impact loading, aerodynamics, gust phenomenon - Base isolation techniques – Earthquake Resistant Design.	
Total Periods	**60**

References:

1. Paz, Structural Dynamics: "Theory and Computation", Kluwer Academic Publication,2004.
2. Anil K.Chopra, "Dynamics of Structures", Pearson Education,2001.
3. ManickaSelvam K., "Elementary structural dynamics", Dhanpatraiandsons, Newdelhi, 2001.
4. Clough,R.W.andPenzien.J,"Dynamicsofstructure",McGrawHill,NewYork,1993.
5. Berg.Glen., "Element of structure dynamics", Prentice hall Englewood Cliffs, New jersy, 1989.
6. William Thomson, "Theory ofvibrationand its applications", George Allen Pub.

Course Outcomes:

At end of this course, the students will be able to

CO1	Discuss the various elements of vibration and its importance to structural Engineering problems.
CO2	Calculate undamped forced vibration and critical damping.
CO3	Analyze vibrations in Two Degree of Freedom System.
CO4	Analyze MDOF vibrations and its elements.
CO5	Explain dynamic analysis of continuous system and its application.
CO6	Understand base Isolation techniques.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2		1	1	3	1	2	
CO2		1		1	1	2	1		2	2
CO3	1	2	2		1		1		2	2
CO4		2	1	3		2	1		2	2
CO5	1	2	1		1		2		1	1
CO6				1	1	2	2	1		

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE27	MINI PROJECT				L-T-P	C
					0-0-4	2
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**PROJ**	
Prerequisites:	Nil					
Aim:	To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.					

SYLLABUS CONTENTS

Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End sem will be monitored by the departmentalcommittee.

Total Periods 60

Course Outcomes:

At end of this course, the students will be able to

CO1	Identify structural engineering problems reviewing availableliterature.
CO2	To develop Technical skills in facing and solving the fieldproblems
CO3	Study different techniques used to analyze complex structuralsystems.
CO4	To innovate the project and solve the societyproblems
CO5	Demonstrate the design methodology for the project
CO6	Work on the solutions given and present solution by using his/her technique applying engineering principles.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		2		1	1	3	2		2
CO2		1		1	1	2	3	2	1	1
CO3	1	2	2		1		1	3	3	2
CO4	1		2		2	1		2	3	2
CO5	2	1		1	2	2	1	2	2	3
CO6	3	2	1	1	2	1	2	2	1	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE28	NUMERICAL ANALYSIS LABORATORY			L-T-P	C
				0-0-4	2
Programme:	M.E. Structural Engineering	**Sem:**	**II**	**Category:**	**PC**
Prerequisites:	Nil				
Aim:	To solve each method in this course to find Roots of Non linear equations				

SYLLABUS CONTENTS **9**

1. Find the Roots of Non-Linear Equation Using BisectionMethod.
2. Find the Roots of Non-Linear Equation Using Newton'sMethod.
3. Curve Fitting by Least SquareApproximations.
4. Solve the System of Linear Equations Using Gauss –EliminationMethod.
5. Integrate numerically using Simpson's Rules.
6. Numerical Solution of Ordinary Differential Equations ByRunge- Kutta Method
7. Numerical Solution of Ordinary Differential Equations by Euler's Method

Total Periods **45**

References:

1. Fausett L.V. (2007) Applied Numerical Analysis Using MATLAB, 2nd Ed., Pearson Education.
2. Chapra S.C. and Canale R.P. (2006) Numerical Methods for Engineers, 5th Ed.,

Course Outcomes:

At end of this course, the students will be able to

CO1	Find Roots of non-linear equations by Bisection method
CO2	Find Roots of non-linear equations by Newton's method
CO3	Do curve fitting by least square approximations
CO4	Solve the system of Linear Equations using Gauss - Elimination
CO5	Integrate Numerically Using Simpson's Rules
CO6	Find Numerical Solution of Ordinary Differential Equations by Runge- KuttaMethod

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	3	2		1	2		2	2
CO2	1		1		2		1	3	1	1
CO3	2	2		3	1	3	2		2	2
CO4	1		1		2		2		2	2
CO5		2		1		1	2		2	2
CO6	1		2		2	1	1	2		2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE31	PROJECT PHASE-I				L-T-P	C
					0-0-20	10
Programme:	M.E. Structural Engineering	**Sem:**	**III**	**Category:**		**PROJ**
Prerequisites:	Nil					
Aim:	To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.					

SYLLABUS:

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner

Total Periods **180hrs**

Course Outcomes:

At end of this course, the students will be able to

CO1	Do a literature review independently
CO2	Develop the methodology to solve the identifiedproblem.
CO3	An ability to use various techniques, engineering knowledge and skill, and modern engineering tools
CO4	Analysis and designing of engineering projects like building, roads, geotechnical works/problems
CO5	Identify their weaker areas and helps to improve.
CO6	To train the students in preparing project reports and to face reviews and viva-voceexamination.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1		2		2			2		3	
CO2	2	2	2		2		2	2	2	
CO3	2		2	2	3	2		2		2
CO4		2	2		2	3	2	1		2
CO5	1	1		2		1		2	1	1
CO6	1	2	1	2	2		2		2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SE41	PROJECT PHASE-II			L-T-P	C
				0-0-32	16
Programme:	M.E. Structural Engineering	**Sem:**	**IV**	**Category:**	**PROJ**
Prerequisites:	Nil				
Aim:	Creativity of students applied to solve development problems of our people and State through Science and Technology				

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

Total Periods	**180hrs**

Course Outcomes:

At end of this course, the students will be able to

CO1	An understanding of professional and ethical responsibilities
CO2	Train the students in preparing project reports and to face reviews and viva-voceexamination
CO3	Understand the impact of their solutions in a global, economic, environmental and societal context.
CO4	Recognition of the need for, and ability to engage in life-long learning.
CO5	Acquired enough confidence to enter into an industry
CO6	Develop skills to analyze and discuss the test results, and make conclusions.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		3		2	2	2		2	
CO2	2		2	3				3		2
CO3	2		2	2	3	2	3	2	2	
CO4		2	2	3					2	2
CO5		3		3	2	2		2		3
CO6	2		1		2		2	2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE01	DESIGN OF PLATES AND SHELLS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	Understand the rudimentary principles involved in the analysis and design of plates and shells.					

THIN PLATES WITH SMALL DEFLECTION	**9**
Laterally loaded thin plates – governing differential equations – Simply supported and fixed boundaryconditions	
RECTANGULAR PLATES	**9**
Simply supported rectangular plates – Navier's solution and Levy's method.	
THIN SHELLS	**9**
Classification of shells-structural actions – membrane theory	
ANALYSIS OF SHELLS	**9**
Analysis of spherical dome – cylindrical shells – folded plates ,	
DESIGN OF SHELLS	**9**
Design of spherical dome – cylindrical shells – folded plates	
Total Periods	**45**

References:

1. Szilard R, Theory and analysis of plates, Prentice Hall Inc,1995
2. Timoshenko, S. and Krieger S.W. "Theory of Plates and Shells", McGraw Hill Book Company, New York, 1990.
3. Chatterjee B. K., Theory and Design of Concrete Shells, Oxford & IBH, New Delhi,1998
4. Bairagi, "Plate Analysis", Khanna Publishers,1999.
5. Billington D. P., Thin Shell Concrete Structures, McGraw-Hill,1995
6. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company,2006.
7. Chandrashekahara, K. Theory of Plates, University Press (India) Ltd., Hyderabad,2001.

Course Outcomes:

At end of this course, the students will be able to

CO1	Calculate deflection on Laterally Loaded thin plates.
CO2	Design rectangular plates for various edge conditions
CO3	Explain Narier's solution and Levy's method.
CO4	Knowledge to classify shells.
CO5	Adequate knowledge in design of shell structures
CO6	Analyses the spherical done and cylindrical shell.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		2	2	3		1	2		1
CO2	2		3	2	3	1	1		2	2
CO3	1	1	2	3	2		1		1	1
CO4	1		3	1	2		2		1	
CO5	1		3	3	1	2	2		3	3
CO6	2		2	2	2	2	2		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE02	EXPERIMENTAL METHODS OF STRESS ANALYSIS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**PE**
Aim:	To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.					

FORCES AND STRAIN MEASUREMENT	**9**
Choice of Experimental stress analysis methods, errors in measurements – Strain gauge - principle - types, performance and uses- Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – Vibrating wire sensors– Fibre optic sensors..	
VIBRATION MEASUREMENTS	**9**
Characteristics of structural vibrations – Linear variable differential Transformer (LVDT) – Transducers for velocity and acceleration measurements - Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisitionsystems	
ACOUSTICS AND WIND FLOW MEASURES	**9**
Principles of Pressure and flow measurements – Pressure transducers – sound level meter – Venturimeter and flow meters – Wind tunnel and its use in structural analysis - structural modeling – Direct Model Study and Indirect Model study.	
DISTRESSMEASUREMENTS ANDCONTROL	**9**
Diagnosis of distress in structures – Crack observation and measurements – Corrosion of reinforcement in concrete – Half cell, construction and use – Damage assessment – Controlled blasting for demolition – Techniques for residual stress measurements.	
NON DESTRUCTIVE TESTING METHODS	**9**
Load testing on structures, buildings, bridges and towers – Rebound Hammer – Acoustic emission – Ultrasonic testing principles and application – Holography – Use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR-Ground penetrating radar (GPR).	
Total Periods	**45**

References:

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, NewDelhi,1996
2. Srinath.L.S, Raghavan.M.Ringaiah.K, Gargesha.G, Pant.BandRamachandra.K, "Experimental Stress Analysis", Tata McGraw Hill Company, New Delhi,1984.
3. Dalley.J.WandRiley.W.F, "Experimental Stress Analysis", McGraw Hill BookCompany, N.Y. 1991.
4. Sirohi.R.S.,Radhakrishna.H.C, "Mechanical Measurements", New Age International (P) Ltd. 1997.
5. Ganesan T.P., "Model Analysis of Structures", Universities Press (India) Ltd2005.

Course Outcomes:

At end of this course, the students will be able to

CO1	Discuss about forces and strain measurement in multi stage testing systems.
CO2	Measure the basic elements of vibration using different aids
CO3	Get idea of acoustics and wind flow measuring systems with modeling techniques.
CO4	Compute the value of corrosion of reinforcement and distress measurements.
CO5	Differentiate application of Destructive Testing methods from other Systems.
CO6	Know the uses of Laser for Structural Testing.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		2	1	2		3		2	1
CO2	2		1	2	1	2	2		1	
CO3	2		1	3	1	3	2		1	
CO4	3		2	2	1	3	2		2	
CO5	1		3	1	1	3	2		1	1
CO6	1		1	2	2	2	2	2	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE03	THEORY AND APPLICATIONS OF CEMENT COMPOSITES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To impart knowledge about Formulate constitutive behaviour of composite materials – Ferrocement, SIFCON and Fibre Reinforced Concrete					

INTRODUCTION	**9**
Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Restrictions on Elastic Constants, Plane Stress Problem, Biaxial Strength, Theories for an Orthotropic Lamina.	
MECHANICAL BEHAVIOUR	**9**
Mechanics of Materials Approach to Stiffness- Determination of Relations between Elastic Constants, Elasticity Approach to Stiffness- Bounding Techniques of Elasticity, Exact Solutions - Elasticity Solutions with Continuity, Halpin, Tsai Equations, Comparison of approaches to Stiffness.	
CEMENT COMPOSITES	**9**
TypesofCementComposites–Terminology-ConstituentMaterialsandtheirProperties-Construction Techniques for Fibre Reinforced Concrete – Ferrocement - SIFCON, Polymer Concretes -Preparation of Reinforcement - Casting andCuring.	
MECHANICAL PROPERTIES OF CEMENT COMPOSITES	**9**
Behavior of Ferro cements - Fiber Reinforced Concrete in Tension, Compression, Flexure, Shear, Fatigue and Impact - Durability and Corrosion.	
APPLICATION OF CEMENT COMPOSITES	**9**
FRC and Ferro cement - Housing, Water Storage, Boats and Miscellaneous Structures - Composite Materials- Orthotropic and Anisotropic behavior - Constitutive relationship - Elastic Constants.	
Total Periods	**45**

References:

1. Mechanics of Composite Materials, Jones R. M,,2nd Ed., Taylor and Francis,BSP Books,1998.
2. Ferrocement – Theory and Applications, Pama R. P., IFIC,1980.
3. New Concrete Materials, Swamy R.N., 1st Ed., Blackie, Academic and Professional, Chapman & Hall,1983.

Course Outcomes:

At end of this course, the students will be able to

CO1	Classify and identify the characteristic behavior of composite materials.
CO2	Formulate constitutive behavior of composite materials
CO3	Trained knowledge about construction techniques for Fibre Reinforced Concrete.
CO4	Classify the materials as per orthotropic and anisotropic behaviour.
CO5	Estimate strain constants using theories applicable to composite materials.
CO6	Analyze and design structural elements made of cement composites

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1			2	3	3	1	2	1		
CO2	2		2	3	2		1		1	
CO3	1		3	2	2		2		1	1
CO4			1	2	2	1	2		1	2
CO5			2	2	3	3	2			1
CO6	1		2	1	2	2	2	1	3	3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE04	THEORY OF STRUCTURAL STABILITY				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the concept of buckling and analysis of structural elements.					

BUCKLING OF COLUMNS	**9**
States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear onbuckling	
BUCKLING OF BEAM-COLUMNS AND FRAMES	**9**
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method.	
TORSIONAL AND LATERAL BUCKLING	**9**
Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever.	
BUCKLING OF PLATES	**9**
Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numericaltechniques	
INELASTIC BUCKLING	**9**
Double modulus theory - Tangent modulus theory - Shanley'smodel- Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviourofplates	
Total Periods	**45**

References:

1. Timoshenko, S., and Gere., "Theory of Elastic Stability", McGraw Hill Book Company, 1963.
2. H.G.Allen&P.S.Bulson, "Background to Buckling", Mc Graw Hill Co.,1980.
3. Chajes.A, "Principles of Structural Stability Theory", Prentice Hall, Inc., New Jersey,1974.
4. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall,1974.
5. Ashwini Kumar, "Stability Theory of Structures", Tata Mc Graw Hill Publishing Company Ltd., New Delhi,1995.
6. Iyenger. N.G.R. "Structural stability of columns and plates", Affiliated East West Press, 1986.
7. Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.

Course Outcomes:

At end of this course, the students will be able to

CO1	Achieve Knowledge of analysis for various boundary conditions.
CO2	Solve Eigen value problems.
CO3	Understand the principles of strength and stability
CO4	Design torsional buckling.
CO5	Appraise the Stability analysis by finite element approach.
CO6	Understand the concepts of Lateral buckling of beams.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1		2	2	3		2	1	1	
CO2	1		1	1	3		2		1	
CO3	1		1	2	3		2		1	
CO4	1		1	1	3		2		3	2
CO5	1		2	1	2		2		2	1
CO6	1		2	1	2	1	3		1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE05	ANALYTICAL AND NUMERICAL METHODS FOR STRUCTURAL ENGINEERING				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**PE**
Aim:	To impart knowledge in numerical methods, algebra, interpolation, differentiation and solve the structural engineering field problems					

FUNDAMENTALS OF NUMERICAL METHODS	**9**
Introduction - Error Analysis - Polynomial Approximations and Interpolations - Curve Fitting;Interpolation and extrapolation - Solution of Nonlinear Algebraic and Transcendental Equations	
ELEMENTS OF MATRIX ALGEBRA	**9**
Introduction - Solution of Systems of Linear Equations - Eigen Value Problems.	
NUMERICAL DIFFERENTIATION & INTEGRATION	**9**
Introduction - Solution of Ordinary and Partial Differential Equations	
FINITE DIFFERENCE SCHEME	**9**
Introduction – Implicit scheme - Explicit scheme.	
COMPUTER ALGORITHMS	**9**
Introduction - Numerical Solutions for Different Structural Problems - Fuzzy Logic and Neural Network.	
Total Periods	**45**

References:

1. An Introduction to Numerical Analysis, AtkinsonK.E., J. Wiley and Sons,1989.
2. Theory and Problems of Numerical Analysis, Scheid F, McGraw Hill Book Company, (Shaum Series), 1988.- Analysis, Sastry S. S, Prentice Hall of India,1998.

Course Outcomes:

At end of this course, the students will be able to

CO1	Solve ordinary and partial differential equations in structural mechanics using numerical methods.
CO2	Solve Eigen Value Problems.
CO3	Find out solution for Non Linear Algebraic and Transcendental equations.
CO4	Derive solution of ordinary and PDE
CO5	Know the Implicit and Explicitscheme.
CO6	Find numerical solutions for different problem Structures.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2		1	2		2	2		1	1
CO2	1		2	1	2	1	2		1	1
CO3				2	2		2	1	1	
CO4			1	1	2		2	1		1
CO5			2		2		1	1		
CO6			2	1	1		2	1		1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE06	CORROSION AND DURABILITY STUDIES			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**		**Category:**	**PE**
Aim:	To make the students to have knowledge about corrosion and Durability of concrete structures.				

CORROSION **9**

Introduction of corrosion of steel in concrete – factors responsible for corrosion of steel in concrete –transport mechanisms of ions in concrete – corrosion of reinforced and prestressed concrete – corrosion of blended cement concrete - expressions for corrosion rate, emf and galvanic series , merits and demerits, Pourbaix diagram for iron, magnesium and aluminium - Forms of corrosion, Uniform, pitting, intergranular, stress corrosion – Corrosion fatigue - Dezincification - Erosion corrosion - Crevice corrosion - Cause and remedial measures, Pilling Bed worth ratio, High temperature oxidation.

CORROSION MONITORNG AND TESTING ON R.C.C **9**

Corrosion monitoring in R.C.C. and pre-stressed concrete structures –special steels and concretes – coating to concrete – coatings to steel – repairing of corroded concrete structures – repair materials – residual life estimation– deterioration of concrete. Purpose of corrosion testing, classification, humidity and porosity tests, accelerated weathering tests - Chloride ion test and impedance analysis - ASTM standards for corrosion testing.

POLARIZATION **9**

Polarization - Exchange current density, Activation polarization, Tafel Equation, Passivating metals and non passivating metals, Effect of oxidizing agents. Coating based on cements – catholic protection of concrete structures – sacrificial anodes – impressed current cathode.

DURABILITY OF CONCRETE **9**

Durability of concrete - causes for inadequate durability of concrete chloride diffusion - Carbonation of concrete - Sulphate attack - Acid attack on concrete – Alkali - Silica reaction - Abrasion resistance - Fire resistance - Erosion resistance – Cavitations - Flame resistance - corrosion resistance - Chemical resistance of concrete and other durability tests methods on concrete

CRACKS, CRACK DETECTION AND CONTROL **9**

Classifications of cracks in plain and reinforced concrete - Types of cracks Shear cracking- Moment cracking - Torsional cracking - Settlement cracks - Cracks due to force transfer - Cracking due to earthquake forces and cracking due to other factors. Long term effects of cracking - Material and loading effects- Creep effect – Bond - Slip theory - Straight line theory - Flexural stiffness - Computation of crack width and crack spacing's. Crack detection - Crack measuring techniques - Control of cracking in plain and reinforced concrete beams and columns- Crack control by material selection - Advanced crack control and repair techniques.

Total Periods **45**

References:

1. Fontana and Greene., Corrosion Engineering, McGraw Hill Book Co, New York,1983.
2. Raj Narayan ., An Introduction to Metallic Corrosion and its prevention, Oxford andIBH, New Delhi,1983.
3. Budinski, K.G., Surface Engineering for Wear Resistance, Prentice Hall Inc., Engelwood Cliff, New Jersey, USA,1988.
4. Uhlig, H.H ., Corrosion and Corrosion Control , John Wiley and Sons, New York, USA, 1985

Course Outcomes:

At end of this course, the students will be able to

CO1	Identify the necessity of corrosion studies with respect to places.
CO2	Monitor the rate of corrosion in steel and concrete of RCC and pre stressed structures.
CO3	Explain testing methodology and standards of corrosion at various conditions.
CO4	Illustrate the process of polarization and its techniques.
CO5	Discuss the concepts of electro less plating and anodizing.

CO6	Know the concepts of Chemical resistance of concrete and other durability tests methods on concrete.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		1	2	1		3	2	1	
CO2	1		2	2	2		3		2	1
CO3			2	1	2		2	1	1	
CO4			2	2	3	3	2	1		
CO5	1		1	2	1	2	2	1		
CO6	1		1	1	2		2	2	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE07	STRUCTURAL HEALTH MONITORING				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To learn the principles of measurements of static and dynamic response ofstructures carryout the field test and rehabilitation of the structures					

STRUCTURAL HEALTH	**9**
Introduction - Factors affecting Health of Structures - Causes of Distress, Regular Maintenance - Structural Health Monitoring – introduction – Concepts - Various Measures - Structural Safety in Alteration.	
STRUCTURAL AUDIT	**9**
Introduction - Assessment of Health of Structure - Collapse and Investigation – Investigation Management - SHM Procedures.	
STATIC FIELD TESTING	**9**
Introduction - Types of Static Tests - Simulation and Loading Methods - sensor systems and hardware requirements - Static Response Measurement.	
DYNAMIC FIELD TESTING	**9**
Introduction - Types of Dynamic Field Test - Stress History Data - Dynamic Response Methods - Hardware for Remote Data Acquisition Systems - Remote Structural Health Monitoring.	
REPAIRS AND REHABILITATIONS OF STRUCTURES	**9**
Introduction - Case Studies (Site Visits) - piezo– electric materials and other smart materials - electro–mechanical impedance (EMI) technique - adaptations of EMI technique.	
Total Periods	**45**

References:

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.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK,2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes:

At end of this course, the students will be able to

CO1	Diagnosis the distress in the structure understanding the causes and factors.
CO2	Assess the health of structure using static field methods.
CO3	Assess the health of structure using dynamic field tests
CO4	Suggest repairs and rehabilitation measures of the structure
CO5	Know the various types of static tests, simulation and Louding methods.
CO6	Know the various Sensor systems and hardware for RDAS.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		3	2	1	1	1			1
CO2	3		1	3	1		1	2	1	1
CO3	3		1	3	1		1	2	1	1
CO4	2		2	2	2	2	1	1	1	1
CO5	1		3	2	1	3	1		1	
CO6			2	1	2	3	1	2	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE08	STRUCTURAL OPTIMIZATION				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the optimization methodologies applied to structural engineering approaches.					

BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES	**9**
Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behaviour and other constraints - Design space- Feasible and infeasible – Convex and Concave - Active constraint - Local and global optima. Differential calculus – Optimality criteria Single variable optimization - Multivariable optimization with no constraints - (Lagrange Multiplier method) – with inequality constraints (Khun-Tucker Criteria).	
LINEAR AND NON-LINEAR PROGRAMMING	**9**
LINEAR PROGRAMMING: Formulation of problems - Graphical solution - Analytical methods - Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal –Dualalgorithm. **NON LINEAR PROGRAMMING:** One Dimensional minimization methods: Uni dimensional - Uni modal function – Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimizationTechniques.	
GEOMETRIC PROGRAMMING	**9**
Polynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree ofdifficulty..	
DYNAMIC PROGRAMMING	**9**
Bellman's principle of optimality – Representation of a multistagedecisionproblem concept of sub-optimizationproblemsusingclassicalandtabularmethods.	
STRUCTURAL APPLICATIONS	**9**
Methodsforoptimaldesignofstructural elements, continuousbeamsand singlestoriedframesusingplastic theory – Minimumweightdesignfortrussmembers-Fullystresseddesign- Optimization principles to design of R.C. structures such as multistoreybuildings, water tanks andbridges.	
Total Periods	**45**

References:

1. Rao,S.S. "Optimization theory and applications", Wiley Eastern (P)Ltd.,1984
2. Uri Krish, "Optimum Structural Design", McGraw Hill Book Co.1981
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey1971.
4. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimisation", Affiliated East West Press Ltd, New Delhi,1997.

Course Outcomes:

At end of this course, the students will be able to

CO1	Apply the basic ideas in optimization to make the structures as lightly as possible.
CO2	Apply the linear programming techniques in engineering optimization.
CO3	Apply Non Linear programming techniques in Engineering problem optimization.
CO4	Solve the unconstrained and constrained optimization problems in structural design
CO5	Understand the methods in solving the problems related to geometric and dynamic Programming.
CO6	Have knowledge in advanced techniques of optimization such as genetic algorithm and Artificial Neural Networks.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		3	1	2	1	2		2	1
CO2	1		1	2	2	1	2	1	2	1
CO3	1		3	2	1		2	1	2	1
CO4	2		3	2	2		2	1	2	1
CO5	2		3	3	2		2	1	2	1
CO6	1		3	2	2		1	2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE09	EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the effect of earthquakes, analysis and design of earthquake resistant Structures.					

EARTHQUAKEGROUNDMOTION	**9**
Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seism tectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation.	
EFFECTS OF EARTHQUAKEONSTRUCTURES	**9**
Dynamics of Structures SDOFS MDOFS - Response Spectra - Evaluation of Earthquake Forces as per codal provisions - Effect of Earthquake on Different Types of Structures - Lessons Learnt From Past Earthquakes.	
EARTHQUAKE RESISTANT DESIGN OFMASONRYSTRUCTURES	**9**
Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.	
EARTHQUAKE RESISTANT DESIGN OFRCSTRUCTURES	**9**
Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis – Capacity based Design and detailing – Rigid Frames – Shear walls.	
VIBRATIONCONTROLTECHNIQUES	**9**
Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems- Case Studies, Important structures.	
Total Periods	**45**

References:

1. Brebbia C. A.,"Earthquake Resistant Engineering Structures VIII",WIT Press,2011
2. Bruce A Bolt, "Earthquakes" W H Freeman and Company, New York,2004.
3. Duggal S K , "Earthquake Resistant Design of Structures", Oxford University Press,2007.
4. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2012
5. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India,2009.
6. Paulay,T and Priestley, M.J.N., "Seismic Design of Reinforced Concrete and Masonry buildings", John Wiley and Sons,1992.

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand the causes and effect of earthquake.
CO2	They will be able to design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice.
CO3	Estimate the Earthquake parameters and microzonation.
CO4	Learned Lessons from past Earthquakes
CO5	Know the guidelines for Earthquake resistant Design.
CO6	Design of earthquake resistant Structures.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3		3	2	1		2		1	
CO2	3		3	3	2		2	1	3	2
CO3	2		3	2	2	2	1	1	1	
CO4	2		3	2	1	1	1			1
CO5	2		3	1	2	3	1	1	3	2
CO6	2		1	1	3	2	1	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE10	DESIGN OF BRIDGES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the loads, forces on bridges and design of several types of bridges.					

INTRODUCTION	**9**
Classification, investigations and planning, choice of type, I.R.C.specifications for road bridges, standard live loads, other forces acting on bridges, Theories of Lateral Load distribution, general design considerations.	
SHORT SPAN BRIDGES	**9**
Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.	
LONG SPAN GIRDER BRIDGES	**9**
Design principles of continuous bridges, box girder bridges, and balanced cantilever bridges.	
DESIGN OF PRESTRESSED BRIDGES	**9**
Flexural and torsional parameters – Carbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.	
DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES	**9**
Design of riveted and welded plate girder bridges for highway and railway loading – wind effects – main section, splicing, curtailment, stiffeners – Different types of bearings – Design of bearings – Design of masonry and concrete piers and abutments – Types of bridge foundations – Design of foundations.	
Total Periods	**45**

References:

1. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill,2008.
2. Johnson Victor, D. "Essentials of Bridge Engineering", Oxford & IBH Publishing Co. New Delhi.
3. Jagadeesh.T.R. andJayaram.M.A., "Design of Bridge Structures", PrenticeHall of India Pvt. Ltd. 2004.
4. Raina V.K." Concrete Bridge Practice" Tata McGraw Hill Publishing Company, New Delhi, 1991.
5. Rabinson J.R. (1996), "Piers abutments and form work for bridges", B.I.Publications,Bombay.
6. Krishnaraju N (1998), "Design of bridges", Oxford and IBH Publishing house, NewDelhi.
7. Taylor, F.W., Thomson, S.E., and Smulski E., "Reinforced Concrete Bridges", John Wiley and Sons, New York,1955.

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand the design theories for super structure and substructure of bridges
CO2	Know the Load Distribution theories.
CO3	Analysis and Design of slab culverts, tee beam and slab bridges.
CO4	Understand the behavior of continuous bridges, box girder bridges
CO5	Design prestressed concrete bridges.
CO6	Analyze the short term and Long term deflections.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		1	2	3	1	2	1	3	2
CO2		2	1	2			2	1	1	1
CO3	1		2	1		1	2	2	3	2
CO4	1	3			1		1	1	2	1
CO5	1		3	2		1	1	2	3	2
CO6			1		2	3	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE11	DESIGN OF FORMWORK				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**PE**
Aim:	To impart knowledge on common form work and special form works, and design of form work with different materials for various structural elements					

FORMWORK MATERIALS	**9**
Introduction - Requirements and Selection of Formwork - Formwork Materials- Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports.	
FORMWORK DESIGN	**9**
Introduction - Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams	
FORMWORK DESIGN FOR SPECIAL STRUCTURES	**9**
Introduction - Formwork Design for Special Structures -Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.	
FLYING FORMWORK	**9**
Flying Formwork - Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete, Formwork Management Issues –Pre- and Post-Award.	
FORMWORK FAILURES	**9**
Formwork Failures - Causes and Case studies in Formwork Failure, Formwork Issues in Multi- Story Building Construction.	
Total Periods	**45**

References:

1. Formwork for Concrete Structures, Peurify, Mc Graw Hill India,2015.
2. Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education,2012.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.

Course Outcomes:

At end of this course, the students will be able to

CO1	Select proper formwork, accessories and material.
CO2	Design the form work for Beams, Slabs, columns, Walls and Foundations.
CO3	Design the form work for Special Structures.
CO4	Understand the working of flying formwork.
CO5	Judge the formwork failures through case studies.
CO6	Able to understand Formwork management issues.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1			1	1	1			1
CO2	1		1	2	3	2	1	1	3	2
CO3	1		1	2	3	2	2	2	3	2
CO4	1	3	2	1			2	2	3	2
CO5	2	2	1		1	2	1		1	1
CO6	1	3	2	2			1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE12	DESIGN OF HIGH RISE STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the behaviour, analysis and design of tall structures.					

DESIGN PRINCIPLES AND LOADING	**9**
General - Factors affecting growth, height and structural form - Design philosophy - Loading - Gravity loading - Wind loading - Earthquake loading - Combinations of loading - Strength and Stability - Stiffness and drift limitations - Human comfort criteria- Creep effects - Shrinkage effects - Temperature effects - Fire - Foundation settlement – Soil structure interaction, Material.	
BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS	**9**
Factors affecting growth, Height and Structural form - High rise behaviour, Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid megasystems.	
ANALYSIS OF TALL BUILDINGS	**9**
Modeling for analysis - Assumptions - Modeling for approximate analyses - Modeling for accurate analysis - Reduction techniques - Dynamic analysis - Response to wind loading - Along-wind response - Across- wind response - Estimation of natural frequencies & damping - Types of excitation - Design to minimise dynamic response - Response to earthquake motions - Response to ground accelerations - Response spectrum analysis - Estimation of natural frequencies and damping - Human response to building motions.	
STRUCTURAL ELEMENTS	**9**
Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.	
STABILITY OF TALL BUILDINGS	**9**
Overall buckling analysis of frames, wall-frames, Approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first-order and P- Delta analysis, Translational, Torsional instability, out ofplumbeffects,stiffnessofmemberinstability,effectoffoundationrotation.	
Total Periods	**45**

References:

1. Bryan Stafford Smith and Alexcoull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc.,1991.
2. Taranath B.S., "Structural Analysis and Design of Tall Buildings", Mc Graw Hill,1988.
3. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures- Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,1995.
4. Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley,1988.
5. Beedle.L.S., "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi,1986.

Course Outcomes:

At end of this course, the students will be able to

CO1	Describe the development of high rise building structures.
CO2	Know the shiftness and drift limitation
CO3	Apply the behavior of shear walls under lateral loading.
CO4	Know the factors affecting growths height ans structural form.
CO5	Explain the design of flat slab building structures and tubular system.
CO6	Examine the approximate design of Rigid Frame buildings.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	2	1	1	3			1			1
CO2		2			1		1		1	
CO3	2	2		1		1	1	1	2	1
CO4		3			2		1	1		1
CO5	1	2	2		1	1	2	2	3	2
CO6	2		1	2	3		2	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE13	DESIGN OF MASONRY STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To impart knowledge about the engineering properties and uses of masonry units, defects and crack in masonry and its remedial measures.					

INTRODUCTION	**9**
Historical Perspective, Masonry Materials, Masonry - Design Approaches, Overview of Load Conditions, Compression Behaviour of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces	
FLEXURAL STRENGTH	**9**
Introduction -Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading.	
SHEAR STRENGTH	**9**
Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation. Shear Strength and Ductility of Reinforced Masonry Members.	
PRESTRESSED MASONRY	**9**
Introduction- Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.	
ELASTIC AND INELASTIC ANALYSIS	**9**
Introduction -Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra	
Total Periods	**45**

References:

1. Design of Reinforced Masonry Structures, Narendra Taly, ICC, 2ndEdn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G.,1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo,2014.
4. Earthquake-resistant Design of Masonry Buildings,TomaeviMiha, Imperial College Press,1999.

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand the masonry design approaches.
CO2	Analyze Reinforced Masonry Members.
CO3	Determine interactions between members.
CO4	Determine shear strength and ductility of Reinforced Masonry members.
CO5	Check the stability of walls
CO6	Perform elastic and Inelastic analysis of masonry walls.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	3		2	1		2	1	2	2
CO2			2	2	1	3	2	1	2	2
CO3	1	2			2		1		1	1
CO4	2	1		3			2	1	1	1
CO5	2		1		3	1	1			1
CO6			2		2		1	1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE14	ADVANCED DESIGN OF FOUNDATIONS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To Gain knowledge of about advanced topics of foundation design and analyses, supplementing their comprehensive knowledge acquired in basic foundation engineering course					

SHALLOW FOUNDATION	**9**
Introduction, Planning of Soil Exploration for Different Projects, Methods of Subsurface Exploration, Methods of Borings along with Various Penetration Tests.Shallow Foundations, Requirements for Satisfactory Performance of Foundations, Methods of Estimating Bearing Capacity, Settlements of Footings and Rafts, Proportioning of Foundations using Field Test Data, Pressure - Settlement Characteristics from Constitutive Laws.	
PILE FOUNDATION	**9**
Introduction, Pile Foundations, Methods of Estimating Load Transfer of Piles, Settlements of Pile Foundations, Pile Group Capacity and Settlement, Laterally Loaded Piles, Pile Load Tests, Analytical Estimation of Load- Settlement Behavior of Piles, Proportioning of Pile Foundations, Lateral and UpliftCapacity of Piles.	
WELLFOUNDATION	**9**
Introduction, Well Foundation, IS and IRC Code Provisions, Elastic Theory and Ultimate Resistance MethodsTunnels and Arching in Soils, Pressure Computations around Tunnels	
OPENCUT	**9**
Introduction, Open Cuts, Sheeting and Bracing Systems in Shallow and Deep Open Cuts in Different Soil Types.	
COFFERDAM	**9**
Introduction, Coffer Dams, Various Types, Analysis and Design, Foundations under uplifting loads, Soil-structure interaction	
Total Periods	**45**

References:

1. Design of foundation system, N.P. Kurian, NarosaPublishingHouse
2. Foundation Analysis and Design, J. E. Bowles, Tata McGraw Hill NewYork.
3. Analysis and Design of Substructures, Sawmi Saran, Oxford and IBH Publishing Co. Pvt. Ltd, NewDelhi.

Course Outcomes:

At end of this course, the students will be able to

CO1	Decide the suitability of soil strata for different projects.
CO2	Know method of borings along with various penetration test.
CO3	Know the methods of estimating load transfer of piles.
CO4	Design shallow foundations deciding the bearing capacity of soil.
CO5	Analyze and design the pile foundation.
CO6	Understand analysis methods for well foundation

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1		3	2			2		3	1
CO2			3			2	2		2	1
CO3			2	1		2	1		1	1
CO4	2			2	3		2	1	3	2
CO5			2	1	3	1	2	2	3	2
CO6	1			2	2	3	2	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE15	DESIGN OF INDUSTRIAL STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the requirements, planning and design of Industrial structures.					

PLANNING AND FUNCTIONAL REQUIREMENTS	**9**
Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of FactoriesAct.	
INDUSTRIAL BUILDINGS	**9**
Design of Single & Multi-bay Industrial Structures in Concrete & Steel - Roofs for Industrial Buildings - Gantry Girders - Design of Corbels and Nibs – Machine foundations.	
POWER PLANT STRUCTURES	**9**
Types of power plants – Design of Turbo generator foundation – containment structures.	
POWER TRANSMISSION STRUCTURES	**9**
Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers.	
AUXILLIARY STRUCTURES	**9**
Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures.	
Total Periods	**45**

References:

1. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill,1985.
2. Santhakumar A.R.an d Murthy S.S., “Transmission Line Structures”, Tata Mc Graw Hill, 1992.
3. Srinivasulu P and Vaidyanathan.C, “Handbook of Machine Foundations”, Tata Mc Graw Hill,1976.
4. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, “Industrial Buildings: A Design Manual”, Birkhauser Publishers,2004.
5. Procs. of Advanced course on “Industrial Structures”, Structural Engineering Research Centre, Chennai,1982.

CODE BOOKS:

1. IS 4995 (Part I) -1974 - Criteria for design of reinforced concrete bins for the storage of granular and powdermaterials.
2. IS 4995 (Part II) -1974 - General Requirements and assessment of binLoads.
3. IS 6060 -1971 - Code of practice for Day lighting of factorybuildings.
4. IS 3103 -1975- Code of practice for industrialventilation.
5. IS 3483 -1965 - Code of practice for Noise reduction in industrialbuildings.
6. IS:456-2000 - Code of Practice for Plain and ReinforcedConcrete.
7. IS 6533 (Part 2) -1989 - Code of practice for design and construction of steelchimneys.
8. IS:875 (Part 1 to 5) - Code of Practice for Designloads.
9. IS:802-1977(Part 2) - Code of practice for use of structural steel in Over Head transmission linetowers.
10. IS:3370-1967 – Part 2 to 4 - Code of Practice for Concrete Structures for the storage of liquids – Reinforced ConcreteStructures.
11. IS:4091-1979 - Code of Practice for Design and Construction of Foundations for Transmission Line Towers andPoles.
12. IS:9178-1980 - Criteria for Design of Steel Bins for Storage of BulkMaterials.
13. IS:2974 (Part I to V) - Code of practice for design and construction of machinefoundations

Course Outcomes:

At end of this course, the students will be able to

CO1	Discuss the planning and functional requirements of Industrial structures.
CO2	Know the guidelines of factories act

CO3	Design of single and multi bay Industrial Structures in concrete and steel.
CO4	Discover the need to learn about the design concepts, and constructional aspects of Industrial structures.
CO5	Analyse and evaluate the importance of various construction materials for Industrial constructions.
CO6	Design portal frames, tower cranes and bracing system in Industrial buildings.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		3	2			2	1	1	1
CO2		2	2	3			1		1	2
CO3	2		3		3		2	2	3	2
CO4	1		1		3		2	1	2	2
CO5			2	3		2	2	1	2	2
CO6	1				3		2	1	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE16	FINITE ELEMENT ANALYSIS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the energy principles, finite element concept, stress analysis, meshing, nonlinear problems and applications.					

FUNDAMENTAL CONCEPTS	**9**
Introduction – stresses and equilibrium – boundary conditions (Strain displacement relations) – Stress strain relations (potential energy and equilibrium) – Weighted integral and weak formulation – Variational approach – Rayleigh ritz method.	
ONE DIMENSIONAL PROBLEMS	**9**
Introduction (Finte element modeling, coordinates and shape functions) – The potential energy approach – Assembly of gobal stiffness matrix and load vector – Properties of k, finite element equations and treatment of boundary conditions – One dimentionalprolems – Quadratic shape functions.	
TRUSSES	**9**
Introduction (Plane trusses) – Local and global coordinate systems – Element stiffness matrix – Stress calculations – Problems in finding stresses in truss members – Introduction to three dimensional trusses (space structures).	
TWO DIMENSIONAL PROBLEMS	**9**
Introduction (Finte element modeling of two dimensional problems) – Constant strain triangle (Isoparametric representation) – Potential energy approach (Element stiffness matrix and Force terms) – Stress calculations – Problems in two dimensional stress field - Isoparametric elements – Four node quadrilateral (Shape functions and element stiffness matrix) – Eight and nine node quadrilateral – One and two point formula- Two dimensional integral – Problems in numerical integration using gauss quadrature formula.	
MISCELLANCEOUS TOPICS	**9**
Higher order elements – plate bending and shell elements – FEM for dynamic problems – Error evaluation- Auto Adaptive Mesh Generation Techniques – Introduction to three dimensional problems - FEM software.	
Total Periods	**45**

References:

1. S. S. Bhavikatti, “Finite Element Analysis”, New Age Publishers,2007.
2. C. S. Krishnamoorthy, “Finite Element Analysis: Theory and Programming”, Tata McGraw- Hill, 1995
3. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw HillPublishing Company Limited, New Delhi,2005.
4. Bathe, K.J., “Finite Element Procedures in Engineering Analysis”, PrenticeHall Inc.,1996.
5. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, McGraw – Hill,1987.
6. Tirupathi R. Chandrupatla, and Ashok D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India,1997.
7. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 1999.
8. Rajasekaran.S, “Finite Element Analysis in Engineering Design”, S.Chand and Company Ltd., 2003.

Course Outcomes:

At end of this course, the students will be able to

CO1	Define the theoretical basis of the weighted residual Finite Element Method.
CO2	Implement the Galerkin residual weak formulation into the Finite Element Method for the solution of

	Ordinary and Partial Differential Equations
CO3	Select appropriate elements and formulate the structure accordingly to reproduce the real behavior.
CO4	Compute the stiffness values of an 8-noded element
CO5	Perform finite element analysis using 2-D triangular and rectangular elements.
CO6	Analyze two dimensional problems.

Mapping with Programme Outcomes:

Course Outcomes	**Program Outcomes (POs)**						**Program Specific Outcomes (PSO's)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		3	2			3	2	3	2
CO2	2		3		2		2	3	3	2
CO3	3		2		2		1	2	1	1
CO4	2		3	1	2		2	1	3	2
CO5	2		3		2		2	2	3	2
CO6	2		2		3		2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE17	SOIL STRUCTURE INTERACTION				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To get exposed to the behavioral aspects of structures when it is founded on different soils with different characteristics.					

SOIL-FOUNDATION INTERACTION	**9**
Introduction to soil-Foundation interaction problems, soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, soil response models, Winkler, Elastic continuum, Two parameter elastic models, Elastic plastic behaviour and Time dependent behavior.	
BEAM ON ELASTIC FOUNDATION-SOIL MODELS	**9**
Infinite beam, Two parameters, Isotropic elastic half space, Analysis of breams of finite length, Classification of finite beams in relation to their stiffness.	
PLATE ON ELASTIC MEDIUM	**9**
Infinite plate, Winkler, Two parameters, isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates, simple solutions.	
ELASTIC ANALYSIS OF PILES	**9**
Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, analysis of pile group, Interaction analysis, Load distribution in groups with rigidcap.	
LATERALLY LOADED PILE	**9**
Load deflection prediction for laterally loaded piles, subgrade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions, through influence charts.	
Total Periods	**45**

References:

1. Selvadurai, A.P.S, "Elastic Analysis of Soil Foundation Interaction", Elsevier,1979.
2. Poulos, H.G, and Davis, E. H, "Pile Foundation Analysis and Design", John Wiley,1980.
3. Scott, R.F, "Foundation Analysis", Prentice Hall,1981.
4. "Structure Soil Interaction-State of Art Report", Institution of Structural Engineers. 1978. 336.2R-88: Suggested Analysis and Design Procedures for Combined Footings and Mats (Reapproved2002).

Course Outcomes:

At end of this course, the students will be able to

CO1	To develop an idea about soil-foundation interaction
CO2	Know the soil foundation interaction analysis and soil response models.
CO3	To understand the solid models
CO4	Analyze finite plate's rectangular and circular plates.
CO5	Numerical analysis of finite plates
CO6	To familiarize with elastic analysis of pile

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	2	2			2	1	2	2
CO2	1		2		3	3	1		2	
CO3	1	2	3	1			1	2	3	1
CO4				2	3	3				2
CO5	2		2	1	3	1	2		2	1
CO6		2	2	1		1		2	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE18	ANALYSIS OF LAMINATED COMPOSITE PLATES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	To study the behaviourofcomposite materials and to investigate the failure and fracture characteristics.					

INTRODUCTION	**9**
Introduction to Composites, Classifying composite materials, Commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites.	
STRESS STRAIN RELATIONS	**9**
Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses	
ANALYSIS OF LAMINATED COMPOSITES	**9**
Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates. Static, dynamic and stability analysis for simpler cases of composite plates. Inter laminar stresses.	
FAILURE AND FRACTURE OF COMPOSITES	**9**
Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, SandwichConstruction.	
APPLICATIONS AND DESIGN	**9**
Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues.	
Total Periods	**45**

References:

1. Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press,2005.
2. Jones R.M., "Mechanics of composite materials", McGraw-Hill, Kogakusha Ltd., Tokyo,1975.
3. Agarwal.B.D. and Broutman.L.J., "Analysis and Performance of fiber composites", John-Wiley and Sons, 1980.
4. Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill,1999.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", University Press, India, 2004

CODE BOOKS:

1. BS 5950-1 : 2000 Structural use of steel work in building. Code of practice for design – Rolled and weldedsections.
2. EN 1994 Euro code 4 : Design of composite steel and concrete structures, compositeslabs.
3. IS11384 – 1985 code of practice for composite construction in structural steel andconcrete.

Course Outcomes:

At end of this course, the students will be able to

CO1	Explain the terminology related to concrete composite materials
CO2	Explain about properties of unidirectional Long fiber Composites and short Fiber Composites.
CO3	Understand the Hooke's Law for orthotropic and Anistropic materials.
CO4	Explain Concepts in solid mechanics
CO5	Analysisoflaminatedcompositematerials
CO6	Design failure and fracture of composites and stress strain behavior

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3		2	2		1	2	1	2	2
CO2	3		2	1		2	2	1	2	2
CO3	1	1	3	2	1	1	2	1	2	2
CO4	3		3	1	1	3	1		2	1
CO5	2		2	3		2	3	1	2	2
CO6	3	1	2	2		2	3	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE19	DESIGN OF PRESTRESSED CONCRETE STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**PE**	
Aim:	Principle of prestressing, analysis and design of prestressed concrete structures.					

PRINCIPLES OF PRESTRESSING	**9**
Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cablelayouts	
ANALYSIS AND DESIGN OF MEMBERS FOR FLEXURE	**9**
Analysis and design of members for flexure, shear, bond and bearings. Cable layouts. Design of circular systems, domes and slabs - Design of end blocks.	
DESIGN OF CONTINUOUS BEAMS	**9**
Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations, concordant cable profile and gap cables.	
DESIGN OF PRE-STRESSED BRIDGES	**9**
Design of Pre-stressed Bridges, (Super-structure only).	
DESIGN OF COMPOSITE MEMBERS	**9**
Analysis of stresses – Estimate for deflections – Flextural strength of composite members – Shear strength of composite members.	
Total Periods	**45**

References:

1. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill PublishingCo,2000.
2. Sinha. N.C. and Roy. S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co.,1998.
3. Lin.T.Y., "Design of Prestressed Concrete Structures", John Wiley andSonsInc,1981.
4. Evans, R.H. and Bennett, E.W., "Prestressed Concrete", Champman and Hall, London,1958.
5. Rajagopalan.N, Prestressed Concrete, Narosa Publications, New Delhi,2008.

CODE BOOKS:

1. IS456 – 2000 - IS Code of Practice for Plain and ReinforcedConcrete.
2. IS1343 – 1980 – IS Code of Practice for PrestressedConcrete.
3. IS1678–1998–Specification for Prestressed Concrete Pole for verhead Power Traction and Telecommunicationlines.
4. IRC:6-2010 Standard Specifications and Code of Practice for Road Bridges, Section II – Loads and Stresses (FifthRevision).
5. IRC:18-2000 Design Criteria for Prestressed Concrete Road Bridges(Post-Tensioned Concrete) (3rdRevision).
6. IRS – Indian Railway StandardSpecifications.
7. BS8110 – 1985 – Code of Practice for Design andConstruction.
8. IS784 – 2001 – IS Specification for PrestressedConcretePipes.
9. IS3370 – 1999 - Part III - IS Code of Practice for Concrete Structures for the storage of liquids.
10. IS875 – 1987 – Part I – IV - IS Code of Practice for Designloads.

Course Outcomes:

At end of this course, the students will be able to

CO1	Explain the terminology related to pre-stressing and pre-stressing systems
CO2	Analyze the sections using strength, stress load balancing concept and losses of prestressing.
CO3	Design the flexural member and stress distribution in the end block.

CO4	Design a prestressed concrete pipes and tanks.
CO5	Analyze the stress and estimate the deflection for composite construction.
CO6	Design Prestressed Bridges.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	2	2	1	1	3	2		2	1
CO2	2	1	3	1		2	3	1	3	2
CO3	1	1	3	3	1	3	3	1	2	2
CO4	3		3	2	1	2	3	1	2	2
CO5	3	2	3	2		3	2	2	2	2
CO6	2	2	3	3	1	2	3	2	3	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192SEE20	FRACTURE MECHANICS OF CONCRETE STRUCTURES				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**PE**
Aim:	To impart knowledge in to predict the crack front growth and instability under elastic and elastic plastic conditions and to compute the stress intensity factors and stain energy releaserate.					

INTRODUCTION	**9**
Introduction - Review of Engineering Failure Analysis-Brittle fracture-Ductile fracture Modes of fracture failure, The Griffith energy Balance Approach-Crack tip Plasticity-Fracture toughness.	
LINEAR ELASTIC FRACTURE MECHANICS	**9**
Introduction - Elastic crack tip stress field Stress and displacement fields in isotropic elastic materials-Westergaard's approach (opening mode)- Plane Strain Fracture toughness (KIC) testing-Feddersen approach Determination of R curve, Energy released rate for DCB specimen-Anelastic deformation at crack tip-K1c Testtechniques, Various test specimens-Critical energy release rate.	
ELASTIC PLASTIC FRACTURE MECHANICS	**9**
Limitation of K approach -Approximate shape and size of the plastic zone- Effective crack length-Effect of plate thickness-Elastic plastic fracture concept-Crack tip opening displacement-Dugdale approach-Path independence, Critical J integral-Evaluation of CTOD-Relationship between CTOD, K1 and G1 for small scale yielding.	
FATIGUE CRACK GROWTH	**9**
Fatigue crack growth to sharpen the tip-methods to determine J1cMechanism of Fatigue, Fatigue crack propagation-Paris law-Crack closure mechanism-Residual stresses at crack tip-Retardation effect fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor-Variable amplitude service loading, Interaction effects	
CRACK ARREST & NUMERICAL METHODS	**9**
Principles of crack arrest, crack arrest in practice, K-R Curves, Crack resistance curve, Numerical Methods and Approaches in Fracture Mechanics, Direct methods to determine fracture parameters Indirect methods to determinefractureparameters.	
Total Periods	**45**

References:

1. Barson M. &Stanely T. Rolfe, "Fracture and Fatigue Control in Structure," Prentice Hall Inc, USA,1987.
2. Bhushan L. Karihaloo, "Fracture Mechanics and Structural Concrete," Longman Scientific Publishers, USA, 1972.
3. David Broek, "Elementary Engineering Fracture Mechanics, " MartinusNijhoff Publishers, The Hague, 1982.
4. Gdoutos E. E., " Fracture Mechanics – An introduction," Kluwer Academic publishers, Dordrecht, 1993.
5. Jean Lemative& Jean Louis Chboche, "Mechanics of Solid Materials," Cambridge University Press, Cambridge,1987.
6. Knott J. F., "Fundamentals of Fracture Mechanics," John Wiley & Sons, New York1973.
7. Simha K. R. Y ., "Fracture Mechanics for Modern Engineering Design," University Press (India) Ltd, Hyderabad, 2001.
8. Suresh S., "Fatigue of Materials," Cambridge University Press, Cambridge1991.

Course Outcomes:	
At end of this course, the students will be able to	
CO1	Evaluate the fracture failure parameters
CO2	Evaluate the linear elastic fracture mechanics problems
CO3	Explain the concept of elastic plastic fracture mechanics
CO4	Estimate the residual life of fatigue Crack Growth in structure.
CO5	Suggest suitable crack arrest parameters using various techniques
CO6	Evaluate the fracture parameters using direct and indirect methods

Mapping with Programme Outcomes:

Course Outcomes	**Program Outcomes (POs)**						**Program Specific Outcomes (PSO's)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1	3	1	1		1	1	3	2
CO2	1		2	3			1	1	2	2
CO3	2	1		1		2	1	1	2	1
CO4	1		1		3	1	2	1	1	1
CO5	3	2	3			1	2	1	2	1
CO6		1	3		2	2	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE01	BUSINESS ANALYTICS			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**OE**
Aim:	To Understand the role of business analytics within an organization.				

BUSINESS ANALYTICS	**9**
Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.	
TRENDINESS AND REGRESSION ANALYSIS	**9**
Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.	
ORGANIZATION STRUCTURES	**9**
Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the businessanalytics Process, Prescriptive Modelling, nonlinear Optimization	
FORECASTING TECHNIQUES	**9**
Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression. Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New- Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	
DECISION ANALYSIS AND RECENT TRENDS	**9**
Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees,TheValueofInformation,UtilityandDecisionMaking.RecentTrendsinEmbeddedandcollaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	
Total Periods	**45**

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FTPress.
2. Business Analytics by James Evans, persons Education.

Course Outcomes:

At end of this course, the students will be able to

CO1	Demonstrate knowledge of data analytics.
CO2	Review of probability distribution and data modeling, sampling.
CO3	Visuality and Exploring Data Business analytic technology.
CO4	Demonstrate the ability of think critically in making decisions based on data and deep analytics

CO5	Demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
CO6	Demonstrate the ability to translate data into clear, actionable insights

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2		2	1	1	2	1	2	2	2
CO2	1	1	2	1	2	1	1	2	2	2
CO3		1		1		2	1	1	2	1
CO4	2	1	1	2	1	2	2	3	2	2
CO5	2	1	2	3		1	2	3	2	2
CO6	3	2		1		3	1	3	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE02	INDUSTRIAL SAFETY				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**OE**
Aim:	To understand about fire and explosion, preventive methods, relief and its sizing methods					

INDUSTRIAL SAFETY	**9**
Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	
FUNDAMENTALS OF MAINTENANCE ENGINEERING	**9**
Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	
WEAR AND CORROSION AND THEIR PREVENTION	**9**
Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosionprevention methods.	
FAULT TRACING	**9**
Fault tracing - concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi Electrical motors, Types of faults in machine tools and their general causes.	
PERIODIC AND PREVENTIVE MAINTENANCE	**9**
Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept andimportance	
Total Periods	**45**

References:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da InformationServices.
2. Maintenance Engineering, H. P. Garg, S. Chand andCompany.
3. Pump-hydraulic Compressors, Audels, McgrewHillPublication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman &HallLondon.

Course Outcomes:

At end of this course, the students will be able to

CO1	To provide exposure to the students about safety and health provisions related to hazardous processes

	as laid out in Factories act1948.
CO2	Know the maintenance engineering responsibility.
CO3	Find out the Corrosion prevention methods.
CO4	To make the decision from draw decision tree for problems.
CO5	Desire solution of types of fault in machine tools and causes.
CO6	To know the periodic inspection, cleaning and repairing scheme.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1		3	2		1	1		
CO2	3		1	2		3	2			1
CO3	2	2		1		1	2	1	2	2
CO4		1		2	3	3	1		1	1
CO5	1	2	2			1	1		1	1
CO6	1	1		3			2	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE03	OPERATIONS RESEARCH			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**OE**
Aim:	To identify and develop operational research models from the verbal description of the real system.				

OPTIMIZATION TECHNIQUES	**9**
Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	
LINEAR PROGRAMMING PROBLEM	**9**
Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	
NONLINEAR PROGRAMMING PROBLEM	**9**
Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	
GEOMETRIC PROGRAM	**9**
Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming	
DYNAMIC PROGRAM	**9**
Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	
Total Periods	**45**

References:

1. H.A. Taha, Operations Research, An Introduction, PHI,2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi,1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub.2009
5. Pannerselvam, Operations Research: Prentice Hall of India2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India2010

Course Outcomes:

At end of this course, the students will be able to

CO1	Apply the dynamic programming to solve problems of discreet and continuous variables
CO2	Apply the concept of linear programming
CO3	Apply the concept of non-linear problem.
CO4	Carry out sensitivity analysis.
CO5	Analysis the deterministic probabilities inventory models.
CO6	Model the real world problem and stimulate it.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2	2			3	2	1	2	2
CO2	1		2			3	2	1	2	1
CO3		1	2		3	2	2	1	2	1
CO4		1				2	2		1	1
CO5	3		1		2		2		1	1
CO6	1			2	1	1	1	1	1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE04	DESIGN OF EXPERIMENTS			L-T-P	C
				3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**		**Category:**	**OE**
Aim:	To design the experiments and analyze data collected from experiments				

FUNDAMENTALS OF DESIGN OF EXPERIMENTS	**9**
Basic principles of design of experiment-randomization –replication –interactions -simple comparative experiments -applications of experimental design -barriers in DOE -practical methodology	
ANALYTICAL TOOLS OF DOE	**9**
Main effects plot -Interactions plots -Cube plots -Pareto plot of factor effects -Normal Probability Plot of factor effects -Response surface plots and regression models -Model building –Analysis of variance	
FACTORIAL DESIGNS	**9**
Single factor experiments -Latin square designs and extensions –Introduction to factorial designs, two levels, 2kfactorial designs-Fractional factorial designs , two-level, three-level and mixed-level factorials	
TAGUCHI APPROACH	**9**
Overview of Taguchi approach -common experiments and methods of analysis. Orthogonal array-properties - Degrees of freedom-confidence level and interval –case study exercises.	
PARAMETER OPTIMIZATION	**9**
Regression models -parameter optimization –single and multi-Objectiveoptimization -Response surface methodology –grey relational analysis –complex proportional assessment of alternatives (COPRAS) -case study exercises	
Total Periods	**45**

References:

1.Douglas C. Montgomery, "Designand Analysis of Experiments", 5thedition., Wiley. 2001
2.Jiju Antony, " Design of Experiments for Engineers and Scientists", 2ndEdition, Elsevier, Londan, 2014.
3.Lennart Eriksson, " Design of Experiments: Principles and Applications",Umetrics Academy, Sweedan, 2008
4.Oehlert, GaryW. "First Course in Design and Analysis of Experiments", Freeman Publishers, New York, 2000
5.Ranjit K Roy, Design of Experiments using the Taguchi Approach, John Wiley & sons, Inc., 2001

Course Outcomes:

At end of this course, the students will be able to

CO1	Familiarize the Fundamentals of design of experiments
CO2	Practice the various tools used in DOE
CO3	Conduct experiments based on factorial design
CO4	Impart the concepts of Taguchi technique
CO5	Apply for product/process optimization

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	3						2			
CO2						3		3	3	
CO3	2								3	
CO4					3					2
CO5			3						3	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (H)

192OE05	COST MANAGEMENT OF ENGINEERING PROJECTS				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**OE**
Aim:	To develop the knowledge and skills required to administer and manage projects effectively in a specific discipline of engineering					

INTRODUCTION	**9**
Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.	
PROJECT	**9**
Meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram.Projectcommissioning: mechanical and process	
COST BEHAVIOR AND PROFIT PLANNING	**9**
Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis.	
COSTING	**9**
Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets.Measurementof Divisional profitability pricing decisions including transfer pricing.	
COST MANAGEMENT	**9**
Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	
Total Periods	**45**

References:

2. Cost Accounting A Managerial Emphasis, Prentice Hall of India,NewDelhi
3. Charles T. Horngren and George Foster, Advanced ManagementAccounting
4. Robert S Kaplan Anthony A. Alkinson, Management &CostAccounting

Course Outcomes:

At end of this course, the students will be able to

CO1	Impact Knowledge about cost concepts in decision making.
CO2	Understand the creation of a Database for operation Control.
CO3	Know the project execution as conglomeration of technical and non-technical activities.

CO4	Impact Knowledge about cost behavior and project planning.
CO5	Know the Measurement of divisional profitability costing.
CO6	Know the Budget Planning.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3	2	2	3	2	1	2		1	1
CO2	1	1	1	1	2	1	1		1	
CO3	3		1	2	1	2	2		1	1
CO4	2	2	2		3	1	2	2	2	1
CO5	1		3	1	2	3	2		1	1
CO6	3	3	2	2			1	1	1	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE06	Composite Materials				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**OE**
Aim:	To understand about the design of composite materials.					

Unit I	**9**
INTRODUCTION: Definition –Classification and characteristics of Composite materials. Advantages andapplication of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance	
Unit II	**9**
Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements.Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.	
Unit III	**9**
Manufacturing of Metal Matrix Composites: Casting –Solid State diffusion technique, Cladding –Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic MatrixComposites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon –Carbon composites: Knitting, Braiding, Weaving. Properties and applications.	
Unit IV	**9**
Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs –hand layup method –Autoclave method –Filament winding method –Compression moulding –Reaction injection moulding. Properties and applications.	
UNIT V	**9**
Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength;Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots;stress concentrations.	
Total Periods	**45**

References:

1.Libin G, “Hand Book of Composite Materials”, Van Nostrand Reinhold, New York, 1982.
2.Deborah D.L. Chung,“Composite Materials Science and Applications”.Springer-Verlag London, 2010
3.Danial Gay, SuongV.Hoa, Stephen W. Tasi,“Composite Materials Design and Applications”, CRCPress, 2002

Course Outcomes:

At end of this course, the students will be able to

CO1	Identify the properties of fiber reinforcements, polymer matrix materials.
CO2	Develop competency in one or more common composite manufacturing techniques.
CO3	select the appropriate technique for manufacture of fiber-reinforced composite products
CO4	Analyze the elastic properties and simulate the mechanical performance of composite laminates; and understand and predict the failure behavior of fiber-reinforced composites
CO5	Apply knowledge of composite mechanical performance and manufacturing methods to a composites

	design project
CO6	Critique and synthesize literature and apply the knowledge gained from the course in the design and application of fiber-reinforced composites.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3						3	3		
CO2	2	2	3		2			3		
CO3	3						2			2
CO4		3						2		
CO5	2			2	2		3			
CO6		3	2					2		3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE07	WASTE TO ENERGY				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**OE**
Aim:	To deal with the production of energy from different types of wastes through thermal, biological and chemical routes.					

INTRODUCTION TO ENERGY FROM WASTE	**9**
Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	
BIOMASS PYROLYSIS	**9**
Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.	
BIOMASS GASIFICATION	**9**
Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers–Design,constructionandoperation–Gasifierburnerarrangementforthermalheating–Gasifierengine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.	
BIOMASS COMBUSTION	**9**
Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.	
BIOGAS AND APPLICATION	**9**
Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysisandliquefaction-biochemicalconversion-anaerobicdigestion-TypesofbiogasPlants–Applications– Alcoholproduction from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.	
Total Periods	**45**

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand of the concept of waste to energy.
CO2	Link legal technical and management principles for production of energy from waste.
CO3	Learn about the best available technologies for waste to energy.

CO4	Know the manufacture and method of Biomass pyrolysis.
CO5	Know the equilibrium and kinematic consider in gasified operation.
CO6	Design construction operation of biomass combustion.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	3	2	1			2	2	1	1
CO2		2	2	1		1	2	1	1	1
CO3	2	1	1		1		1	1	1	1
CO4	1	2	1	1	3	2	2			1
CO5	1		3	4		1	2		1	
CO6	1	2	1		3	2	2	1	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192OE08	NANOMATERIALS AND NANOTECHNOLOGY				L-T-P	C
					3-0-0	3
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**OE**
Aim:	To design the experiments and analyze data collected from experiments.					

ZERO –DIMENSIONAL NANOSTRUCTURES	**9**
Nanoparticles through homogenous nucleation, nanoparticles through the h eterogeneous nucleation, kinetically confined synthesis of nanoparticles, epitaxial core –shell nanoparticles. One Dimensional Nanostructure-Nanowires And Nanorods: Spontaneous growth, template based synthesis,electro spinning, and lithography.	
TWO-DIMENSIONAL NANOSTRUCTURES-THIN FILMS	**9**
Fundamentals of film growth, vacuum science, physical vapor deposition (PVD), Chemical Vapor Deposition(CVD), Atomic Layer Deposition (ALD), Electrochemical Deposition,Sol - Gel films.	
NANOSTRUCTURES FABRICAITON	**9**
Lithography, nano manipulation and nanolithography, soft lithography, assembly of nanoparticles and nanowires, other methods of micro fabrication, Scanning Electron Microscope.Nanomechanics: A high speed review of motion: Displacement, velocity, acceleration and force, nanomechanical oscillation, feeling faint forces.	
NANO ELECTRONICS: ELECTRON ENERGY BANDS, ELECTRONS IN SOLIDS	**9**
Conductors, insulation and semi-conductors, fermi energy, the density of states for solids, quantum confinement, tunneling, single electron phenomenon, molecular electronics. Nanophotonics: Photonics properties of nanomaterials, near-field light, optical tweezers, photonic crystals.	
NANO SCALE HEAT TRANSFER	**9**
Nanoscale heat, conduction, convection, radiation. Nanoscale Fluid Mechanics: Fluids at the nanoscale: major concepts, flow fluids flow at the nanoscale, applications of nanofludics.	
Total Periods	**45**

References:

1.Ben Rogers, Pennathur and Adams, “Nanotechnology: Understanding Small System”, CRC Press, 2008.
2.Bhushan, Bharat (Ed.) “Handbook of Nanotechnology”, Springer 2006.
3.Guozhong Cao, “Nanostructures and Nanomaterials”, Imperial College Press, 2006.
4.Lundstrom, Mark, Guo, Jing, “Nanoscale transistors, Device physics, modeling and simulation”,Springer,2006.
5.Yury Gogotsi, “Nanomaterials Handbook”, Drexel University, Philadelphia, Pennsylvania, USA, 2006.

Course Outcomes:

At end of this course, the students will be able to

CO1	Acquire the knowledge of the representatives of Nano particles and Characteristic techniques of nanomaterials.
CO2	Be familiar with new trends in engineering, namely nanotechnology and nanofabrication and with their applications in modern industries.
CO3	Get the knowledge in the field of nanotechnology and nanomaterials.

CO4	Practice the Nano electronics.
CO5	Familiarize Nano heat transfer.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	3						3			
CO2	3							3	2	
CO3	2			2			2			
CO4					3	3			3	2
CO5		3			3	2				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC01	CONSTITUTION OF INDIA				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	To understand, connect up and explain basics of Indian Constitutional Rights modern scientific perspective.					
HISTORY OF MAKING OF THE INDIAN CONSTITUTION						**9**
History, Drafting Committee, (Composition & Working)						
PHILOSOPHY OF THE INDIAN CONSTITUTION						**9**
Preamble Salient Features						
CONTOURS OF CONSTITUTIONAL RIGHTS & DUTIES						**9**
Fundamental Rights- Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.						
ORGANS OF GOVERNANCE						**9**
Parliament – Composition - Qualifications and Disqualifications - Powers and Functions – Executive - President - Governor - Council of Ministers- Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions						
LOCAL ADMINISTRATION						**9**
District's Administration head: Role and Importance, - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. - Pachayati raj: Introduction, PRI: ZilaPachayat. - Elected officials and their roles, CEO ZilaPachayat: Position and role. - Block level: Organizational Hierarchy (Differentdepartments),-Villagelevel:RoleofElectedandAppointedofficials,-Importanceofgrassrootdemocracy						
ELECTION COMMISSION						9
Election Commission: Role and Functioning. - Chief Election Commissioner and Election Commissioners. - State Election Commission: Role and Functioning. -Institute and Bodies for the welfare of SC/ST/OBC and women.						
					Total Periods	**45**
References:						
1. The Constitution of India, 1950 (Bare Act), GovernmentPublication. 2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015. 3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014. 4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.						
Course Outcomes:						
At end of this course, the students will be able to						
CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.					

CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO3	Impact the knowledge about philosophy of the Indian constitution.
CO4	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO5	Discuss the passage of the Hindu Code Bill of 1956.
CO6	Students to know the Role and importance of Districts administration, Municipal Corporation panchayati Raj.

Mapping with Programme Outcomes:

Course Outcomes	**Program Outcomes (POs)**						**Program Specific Outcomes (PSO's)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3		2	2	2	2	1	1	
CO2	1	3		3	1		1		2	1
CO3	1	2		2	2		2		2	
CO4	1	2	1	2	1	2			2	2
CO5		2		3	2		2		1	1
CO6	1	1	2	3		2		2	2	

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC02	DISASTER MANAGEMENT				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	The main aim of this course critical understanding of key concepts in disaster risk reduction and humanitarian response.					

INTRODUCTION	**9**
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	
REPERCUSSIONS OF DISASTERS AND HAZARDS	**9**
Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks ofDisease And Epidemics, War And Conflicts.	
DISASTER PRONE AREAS IN INDIA	**9**
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	
DISASTER PREPAREDNESS AND MANAGEMENT	**9**
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	
RISK ASSESSMENT	**9**
Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co- Operation In Risk Assessment And Warning, People'sParticipation In Risk Assessment. Strategies for Survival.	
DISASTER MITIGATION	
Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. StructuralMitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	
Total Periods	**45**

References:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, NewDelhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., NewDelhi.

Course Outcomes:

At end of this course, the students will be able to	
CO1	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO2	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives
CO3	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations
CO4	Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particulars their home country or the countries they work in.
CO5	Explain the legislation of disaster management system.
CO6	Understanding foundations of hazards disasters and associated natural/ social phenomena.

Mapping with Programme Outcomes:

Course Outcomes	**Program Outcomes (POs)**						**Program Specific Outcomes (PSO's)**			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	1	1	2	3			1	1	3	2
CO2	2	2	1	2	1		2		2	1
CO3	2	1	2	3			1		1	1
CO4	1	2	1	2	1	1	2		1	1
CO5	1	2	2	1	1	1	2	1	1	1
CO6	2	2	3	2	1	1	2			1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC03	ENGLISH FOR RESEARCH PAPER WRITING				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	Understand the skills needed when writing a Title Ensure the good quality of paper at very first-timesubmission					

CHAPTER–I	**4**
Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	
CHAPTER–I I	4
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	
CHAPTER–III	4
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	
CHAPTER–I V	4
key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,	
CHAPTER–V	4
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	
CHAPTER–VI	4
Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	
Total Periods	**24**

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on GoogleBooks)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge UniversityPress
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book.
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

Course Outcomes:

At end of this course, the students will be able to

CO1	Understand that how to improve your writing skills and level of readability.
CO2	Learn about what to write in each section.
CO3	Understand the skills needed when writing a Title Ensure the good quality of paper at very first- time submission.
CO4	Complete research using primary and secondary sources. Share results through documented research papers and presentations.
CO5	Summarize and respond to oral presentation, academic lectures and written texts of a variety of

	rhetorical patterns
CO6	Gain confidence in participating in making presentations.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3	1		2	1	2		1	
CO2	3	3	1			2			2	2
CO3		2		2	2		2		2	1
CO4	2	2	1	3		2	1	1	2	2
CO5	2	3		2	2			2	2	
CO6		2	2	2		2		3	2	2

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC04	SANSKRIT FOR TECHNICAL KNOWLEDGE				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	To get a working knowledge in illustrious Sanskrit, the scientific language in the world					
CHAPTER–I						**8**
Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences						
CHAPTER–II						**8**
Order- Introduction of roots - Technical information about Sanskrit Literature						
CHAPTER–III						**8**
Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.						
					Total Periods	**24**
References:						
1. Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, NewDelhi 2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New DelhiPublication 3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., NewDelhi						
Course Outcomes:						
At end of this course, the students will be able to						
CO1	Understanding basic Sanskrit language.					
CO2	Ancient Sanskrit literature about science & technology can be understood.					
CO3	Being a logical language will help to develop logic in students.					
CO4	Learning of Sanskrit to improve brain functioning.					
CO5	Learning of Sanskrit to develop the logic in mathematics, science & other subjects.					
CO6	The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.					

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	2		1		1	2			1
CO2	1	2		2	1		1		2	
CO3	1	1		1	1		1			
CO4	2	2		2	1				1	
CO5	1	2		2	1	1		2	1	
CO6	2	2		1	2	2		1	2	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC05	VALUE EDUCATION				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	To imbibe good values in students					

VALUES AND SELF-DEVELOPMENT	**4**
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. - Moral and non- moral valuation. Standards and principles. -Value judgements	
IMPORTANCE OF CULTIVATION OF VALUES	**6**
Importance of cultivation of values. - Sense of duty. Devotion, Self-reliance -Confidence, Concentration. Truthfulness, Cleanliness. -Honesty, Humanity. Power of faith, National Unity. -Patriotism. Love for nature ,Discipline	
PERSONALITY AND BEHAVIOUR DEVELOPMENT	**6**
Personality and Behaviour Development - Soul and Scientific - attitude.PositiveThinking.Integrity and discipline. Punctuality, Love and Kindness. -Avoid fault Thinking. -Free from anger, Dignity of labour. - Universal brotherhood and religious tolerance. -True friendship. -Happiness Vs suffering, love for truth.- Aware of self-destructive habits. -Association and Cooperation - Doing best for saving nature	
CHARACTER AND COMPETENCE	**6**
Character and Competence –Holy books vs Blind faith. - Self-management and Good health. - Science of reincarnation. - Equality ,Non violence ,Humility, Role of Women. - All religions and same message. - Mind your Mind ,Self-control. -Honesty, Studying effectively	
Total Periods	**22**

References:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Course Outcomes:

At end of this course, the students will be able to

CO1	Knowledge of self-development
CO2	To Know the work ethics, Indian vision of humanism.
CO3	Learn the importance of cultivation of values.
CO4	To know personality and behavior development.
CO5	To know the aware of self destructive habits.
CO6	To know the self management and good health.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1	1	1		1			2			1
CO2	1	2	1	3	1		2	1		
CO3	1	1		2			1			1
CO4	1	1		2			1			1
CO5	2	1		3			2			
CO6	1	1		2			1			

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC06	PEDAGOGY STUDIES			L-T-P	C
				2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	**MC**

INTRODUCTION AND METHODOLOGY:	**4**
Aims and rationale, Policy background, Conceptual framework and Terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions**.** -Overview of methodology and Searching.	
THEMATIC OVERVIEW	**2**
Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.	
PEDAGOGICAL PRACTICES	**4**
Evidence on the effectiveness of pedagogical practices - Methodology for the in depth stage: quality assessment of included studies. - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change. - Strength and nature of the body of evidence for effective pedagogical -practices. -Pedagogic theory and pedagogical approaches. - Teachers' attitudes and beliefs and Pedagogicstrategies.	
PROFESSIONAL DEVELOPMENT	**4**
Professional development: alignment with classroom practices and follow up Support - Peer support - Support from the head teacher and the community. -Curriculum andassessment - Barriers to learning:limitedresources and large class sizes	
RESEARCH GAPS AND FUTURE DIRECTIONS	**2**
Research design – Contexts –Pedagogy -Teacher education -Curriculum and assessment - Dissemination and research impact.	
Total Periods	**16**

References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2):245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London:DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3):272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read'campaign.

www.pratham.org/images/resource%20working%20paper%202.pdf..	
Course Outcomes:	
At end of this course, the students will be able to	
CO1	What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
CO2	What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
CO3	How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?
CO4	Understand the quality assessment of pedagogical practices and studies.
CO5	To know the effective and practices of pedagogical theory.
CO6	Students to know the professional development.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	3	2		2	1		2		1
CO2	1	2		2	1	1	1	1		2
CO3	2	2	1	1	1	1	1	1		
CO4	2		1	2				1	2	
CO5		2	1		1	2	2			2
CO6	2	2	2	1	1		2		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC07	Stress Management by Yoga			L-T-P	C
				2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**	MC
Aim:	To overcome stress and to maintain good health.				

UNIT I	**8**
Definitions of Eight parts of Yoga. (Ashtanga)	
UNIT II	**8**
Yam and Niyam. •Do`s and Don'ts in life. i.Ahinsa, satya, astheya, bramhacharya and aparigraha ii.Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	
UNIT III	**8**
Asan and Pranayam •Various yog poses and their benefits for mind & body •Regularization of breathing techniques and its effects-Types of Pranayam.	
Total Periods	**24**

References:

1.JanardanSwami Yogabhyasi Mandal "Yogic Asanas for Group Tarining-Part-I" ,Nagpur, 2014.
2."Rajayoga or conquering the Internal Nature" Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

Course Outcomes:

At end of this course, the students will be able to

CO1	Develop healthy mind in a healthy body thus improving social health
CO2	Classify Yoga Ashtanga
CO3	Learn Do`s and Don't's in life
CO4	Differentiate between Yam and Niyam
CO5	Regularize of breathing techniques
CO6	Implement various yog poses and their benefits for mind and body.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3	PSO4
CO1						3				3
CO2						3				3
CO3						2				2
CO4						2				1
CO5						2				3
CO6						1				3

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

192AC08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS				L-T-P	C
					2-0-0	0
Programme:	M.E. Structural Engineering	**Sem:**	-	**Category:**		**MC**
Aim:	To learn to achieve the highest goal happily.					

CHAPTER–I	**8**
Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (dont's) Verses- 71,73,75,78 (do's)	
CHAPTER–II	**8**
Approach to day to day work and duties. Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35, Chapter 18-Verses 45, 46, 48.	
CHAPTER–III	**8**
Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	
Total Periods	**24**

References:

1. Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.

Course Outcomes:

At end of this course, the students will be able to

CO1	Learn to achieve the highest goal happily
CO2	Become a person with stable mind, pleasing personality and determination
CO3	Awaken wisdom in students
CO4	Develop their personality by studying Shrimad-Bhagwad-Geeta
CO5	Develop versatile personality of students by studying Neetishatakam.
CO6	Achieve the highest goal in life by studying Shrimad-Bhagwad-Geeta.

Mapping with Programme Outcomes:

Course Outcomes	Program Outcomes (POs)						Program Specific Outcomes (PSO's)			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	2	1	1	2	1		1		2
CO2	2		2		2	2	1		2	1
CO3	2	1		2			1		1	1
CO4		2	1		2		2		1	
CO5	1		2			2		1	1	
CO6	2	2		1	1		1		1	1

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)