ADHIYAMAAN COLLEGE OF ENGINEERING

(An Autonomous Institution Affiliated to Anna University, Chennai)
[Accredited by NAAC]
Dr.M.G.R NAGAR, HOSUR, KRISHNAGIRI (DT) – 635130, TAMILNADU, INDIA

REGULATIONS 2018

CHOICE BASED CREDIT SYSTEM

M.E-STRUCTURAL ENGINEERING

VISION

Visible Innovation of Scientific Industrial and Organizational Nationalism

MISSION

- To maintain excellence in Education and Research to enable the students to face the challenges in the field of Civil Engineering Practices and Technology.
- To motivate the students to imbibe skills to produce solutions for technical problems with scientific and engineering relevance
- To analyse, design and create innovative products for its real-time Application

The Programme defines Programme Educational Objectives, Programme Outcomes and Programme Specific Outcomes as follows:

I. PROGRAMME EDUCATIONAL OBJECTIVES [PEOs]

PEO 1 Our graduates can conduct experiments, analyze real world problems and deliver 11 comprehensive solutions, design and create novel products by applying mathematical, scientific and engineering fundamentals

PEO 2 Our graduates will exercise professional integrity at work place and attain a successful carrier with effective communication skills, team spirit and professional ethics that meet the diversified needs of industry, academics and research

PEO 3 Our graduates will focus on sustenance Practices and resolving issues of social relevance and significantly contribute to the National development.

PEO 4 Our graduates will aim for excellence; inculcate the philosophy of higher and continuous learning, creative thinking and acquisition of new knowledge.

PEO 5 Our graduates will evolve leadership qualities and management skills for technology innovation and entrepreneurship.

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II. PROGRAMME OUTCOMES [POs]

PO1: An ability to relate the theoretical knowledge of mathematics, science and engineering, to practical real world applications.
PO2: An ability to identify, formulate and solve the engineering problems.
PO3: An ability to produce the efficient system design and components design for various applications.
PO4: An ability to conduct and investigate different experiments for analysis and synthesis purpose.
PO5: Familiar with modern Engineering tools, Software's and other equipments.
PO6: An understanding the Professional responsibility in this techno savvy world.
PO7: An understanding the impact of Professional Engineering Solution in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.
PO8: An understanding of code of conduct and ethical responsibilities.
PO9: An ability to work on multi-disciplinary task and team work.
PO10: Ability to write and communicate effectively in verbal, written and graphical form.
PO11: An ability to develop confidence for self education and for life-long learning.
PO12: An understanding of Engineering Economics and Management principles to manage projects.

III. PROGRAM SPECIFIC OUTCOMES [PSOs]

PSO1 An ability to explicit the knowledge gained from civil engineering course to attain solutions which addresses the changing needs and issues of the society
PSO2 An ablility to adapt the technological advancement in Civil engineering and implement the same on real time basis
PSO3 An ability to prepare and produce plans detailed drawings , rate analysis and specification s including the execution of engineering projects

PEO / PO Mapping

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAMME SPECIFIC OUTCOMES		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
I	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
II	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
III	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IV	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
V	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3
	SEM 1	Applied mathematics and statistics	3									3			1		3
		Advanced Concrete Design				2	3			1					3	1	1
		Structural Dynamics	3	2	2			1				3	2	2	1	1	
		Theory of Elasticity and Plasticity	3	2			1		2		1	3	2		2		2
		Elective – I															
		Elective – II															
	SEM 2	Finite Element Analysis	3	2		3				3			2				
		Experimental Techniques and Instrumentation		2					2				2		1	1	1
		Advanced Structural Steel Design		3		3	2	2		3	2	2	3		2	1	1
		Earthquake Analysis and Design of Structures				3	2			3	2						
		Elective – III															
		Elective – IV													2	2	1
		Advanced Structural Engineering Laboratory	3	2	2		1		2				2			2	2
	SEM 3	Elective-V															
		Elective-VI															
		Elective-VII															
		Practical Training (4 Weeks)		3	2			3	2		1		3			2	
		Seminar									3	1	1		3		
		Project Work (Phase- I)		3			2				2		3		2	1	1
	SEM 4	Project Work (Phase - II)		3									3		3	2	2
												3					

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COURSE CODE DEFINITIONS

Course Code	Definitions
HSMC	Humanities, Social Sciences including Management
BSC	Basic Science Courses
ESC	Engineering Science Course
PCC	Professional Core Courses
PEC	Professional Elective Courses
EEC	Employability Enhancement Course
OEC	Open Elective Course

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M.E - STRUCTURAL ENGINEERING

SEMESTER - I

I SEMESTER			Hours / Week				Marks		
Subject Code	Category	Subject Name	L	T	P	C	IA	EA	TOTAL
THEORY									
118SET01	FC	Applied mathematics and statistics	3	2	0	4	50	50	100
118SET02	PCC	Advanced Concrete Design	3	0	0	3	50	50	100
118SET03	PCC	Structural Dynamics	4	0	0	4	50	50	100
118SET04	PCC	Theory of Elasticity and Plasticity	4	0	0	4	50	50	100
118SEE	PEC	Elective – I	3	0	0	3	50	50	100
118SEE	PEC	Elective – II	3	0	0	3	50	50	100

Total No. of Credits: 21

SEMESTER – II

Subject Code		Subject Name	L	T	P	C	CA	EA	TOTAL
THEORY									
218SET01	PCC	Finite Element Analysis	4	0	0	4	50	50	100
218SET02	PCC	Experimental Techniques and Instrumentation	3	0	0	3	50	50	100
218SET03	PCC	Advanced Structural Steel Design	3	0	0	3	50	50	100
218SET04	PCC	Earthquake Analysis and Design of Structures	3	0	0	3	50	50	100
218SEEXX	PEC	Elective – III	3	0	0	3	50	50	100
218SEEXX	PEC	Elective – IV	3	0	0	3	50	50	100
PRACTICAL									
218SEP01	PCC	Advanced Structural Engineering Laboratory	0	0	3	1	50	50	100

No. of Credits: 20

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SEMESTER – III

III SEMESTER			Hours / Week				Marks		
Subject Code	**Category**	**Subject Name**	**L**	**T**	**P**	**C**	**IA**	**EA**	**TOTAL**
THEORY									
318SEEXX	PEC	Elective-V	3	0	0	3	50	50	100
318SEEXX	PEC	Elective-VI	3	0	0	3	50	50	100
318SEEXX	PEC	Elective-VII	3	0	0	3	50	50	100
PRACTICAL									
318SEP01	EEC	Practical Training (4 Weeks)	-	-	-	-	100	-	100
318SEP02	EEC	Seminar	0	0	4	-	100	-	100
318SEP03	EEC	Project Work (Phase- I)	0	0	12	6	50	50	100

No. of Credits: 15

SEMESTER IV

Subject Code	**Category**	Subject Name	**L**	**T**	**P**	**C**	**IA**	**EA**	**Total**
418SEP01	EEC	Project Work (Phase - II)	0	0	32	16	50	50	100

Total Credits: 16

FOUNDATION COURSES (FC)

Subject Code	Subject Name	**L**	**T**	**P**	**C**	**IA**	**EA**	**Total**
118SET01	Applied mathematics and statistics	3	1	0	4	50	50	100

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PROFESSIONAL CORE COURSES [PCC]

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1.	118SET02	Advanced Concrete Design	3	0	0	**3**	1
2.	118SET03	Structural Dynamics	4	0	0	**4**	1
3.	118SET04	Theory of Elasticity and Plasticity	4	0	0	**4**	1
4.	218SET01	Finite Element Analysis	4	0	0	**4**	3
5.	218SET02	Experimental Techniques and Instrumentation	3	0	0	**3**	2
6.	218SET03	Advanced Structural Steel Design	3	0	0	**3**	2
7.	218SET04	Earthquake Analysis and Design of Structures	3	0	0	**3**	2
8.	218SEP01	Advanced Structural Engineering Laboratory	0	0	4	**1**	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	Course Code	CourseTitle	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1	318SEP01	Practical Training (4 Weeks)	-	-	-	-	3
2	318SEP02	Seminar	0	0	4	-	3
3	318SEP03	Project Work (Phase- I)	0	0	12	6	3
4	418SEP01	Project Work (Phase - II)	0	0	32	16	4

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LIST OF PROFESSIONAL ELECTIVES

ELECTIVE-I (CHOICE-1)

Sl. No	Course Code	CourseTitle	Periods perweek			Credits	Semester
			Lecture	Tutorial	Practical		
1.	118SEE01	Advanced Concrete Technology	3	0	0	3	1
2.	118SEE02	Mechanics of Composite Materials	3	0	0	3	1
3.	118SEE03	Cracks and Crack Control in Concrete Structures	3	0	0	3	1
4.	118SEE04	Optimization of Structures	3	0	0	3	1

ELECTIVE-II (CHOICE-II)

Sl. No	Course Code	Course Title	Periodsperweek			Credits	Semester
			Lecture	Tutorial	Practical		
1.	218SEE01	Design of Bridges	3	0	0	3	2
2.	218SEE02	Design of Shell and Spatial Structures	3	0	0	3	2
3.	218SEE03	Design of Precast Components and Ferro cement	3	0	0	3	2
4.	218SEE04	Computer Aided Analysis and Design	3	0	0	3	2

ELECTIVE-III (CHOICE-III)

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1	218SEE01	Design of Bridges	3	0	0	3	2
2	218SEE02	Design of Shell and Spatial Structures	3	0	0	3	2
3	218SEE03	Design of Precast Components and Ferro cement	3	0	0	3	2
4	218SEE04	Computer Aided Analysis and Design	3	0	0	3	2

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ELECTIVE-IV (CHOICE-IV)

Sl. No	Course Code	Course Title	Periods per week			Credits	Semester
			Lecture	Tutorial	Practical		
1	218SEE05	Stability of Structures	3	0	0	3	2
2	218SEE06	Theory of Plates	3	0	0	3	2
3	218SEE07	Space Structures	3	0	0	3	2
4	218SEE08	Construction Safety and Management	3	0	0	3	2

ELECTIVE-V (CHOICE-V)

S.No	Course Code	Course Title	L	T	P	C
1.	318SEE01	Industrial Structures	3	0	0	3
2.	318SEE02	Offshore Structures	3	0	0	3
3.	318SEE03	Prefabricated Structures	3	0	0	3
4.	318SEE04	Smart Structures and Applications	3	0	0	3

ELECTIVE-VI (CHOICE-VI)

S.No	Course Code	Course Title	L	T	P	C
1.	318SEE05	Wind and Cyclone Effects on Structures	3	0	0	3
2.	318SEE06	Pre-stressed Concrete	3	0	0	3
3.	318SEE07	Power Plant Structures	3	0	0	3
4.	318SEE08	Energy Efficient Structures	3	0	0	3

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ELECTIVE-VII (CHOICE-VII)

S.No	Course Code	Course Title	L	T	P	C
1.	318SEE09	Design of Steel Concrete Composite Structures	3	0	0	3
2.	318SEE10	Structures In Disaster Prone Areas	3	0	0	3
3.	318SEE11	Random Vibrations and Structural Reliability	3	0	0	3
4.	318SEE12	Sub Structure Design	3	0	0	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No.	Course Code	Course Title	Category	L	T	P	C
THEORY							
1	318SEP03	Technical Seminar	EEC	0	0	2	-
2	318SEP04	Practical Training(4 weeks)	EEC	0	0	0	-
3	318SEP05	Project Work- I	EEC	0	0	12	6
3	418SEP01	Project Work – II	EEC	0	0	24	12
TOTAL				**0**	**0**	**38**	**21**

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SUMMARY

Sl. No.	Name of the Programme: M.E STRUCTURAL ENGINEERING					
	SUBJECT AREA	CREDITS PER SEMESTER				CREDITS TOTAL
		I	II	III	IV	
1.	FC	04	00	00	00	04
2.	PCC	11	14	-	-	25
3.	PEC	06	06	09	00	21
4.	EEC	-	-	06	16	22
TOTAL CREDIT		**20**	**21**	**15**	**16**	**72**

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118SET01 APPLIED MATHEMATICS AND STATISTICS

L	P	T	C
4	0	0	4

OBJECTIVES:

- To familiarize the students to use Laplace and Fourier techniques to solve boundary value problems.
- To introduce the mathematical techniques in calculus of variations for functionals.
- To understand the eigenvalue problems.
- To introduce the statistical techniques useful in making rational decisions.
- To study randomized block design and latin square design

UNIT-1 ONE DIMENSIONAL WAVE AND HEAT EQUATIONS **9**

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

UNIT-2 CALCULUS OF VARIATIONS **9**

Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functionals dependant on functions of several independent variables – Variational problems with moving boundaries.

UNIT-3 EIGEN VALUE PROBLEMS **9**

Methods of solutions: Faddeev – Leverrier Method, Power Method with deflation – Approximate Methods: Rayleigh – Ritz Method.

UNIT-4 TESTING OF HYPOTHESIS **9**

Sampling distributions - Tests for single Mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – Chi-square test for goodness of fit – Independence of attributes

UNIT-5 DESIGN OF EXPERIMENTS **9**

ANOVA - Completely randomized design – Randomized block design – Latin square design. Control charts for measurements ($\bar{x}$ and R-charts).

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Solve the boundary value problems using Laplace and Fourier Transform techniques.

CO.2 Compute maxima and minima of a functional that occur in various branches of engineering disciplines.

CO.3 Acquire the knowledge of solving eigen value problems.

CO.4 Draw inference and make decision through hypothesis testing.

CO.5 Apply the concept of analysis of variance.

REFERENCES:

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1. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice Hallof India Pvt. Ltd., New Delhi, 2012.
2. Andrews, L.C. and Shivamoggi, B.K., “Integral Transforms for Engineers”,Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
3. Rajasekaran.S, “Numerical Methods in Science and Engineering A Practical Approach”,
4. A.H.Wheeler and Company Private Limited, 2013.
5. Gupta, A.S., “Calculus of Variations with Applications”, Prentice Hall ofIndia Pvt. Ltd., NewDelhi, 2011.
6. Richard L.Burden, J.Dougles Faires and Annette M. Burden, “Numerical Analysis”, Tenth Edition, Cengage, 2016. www.cengage.com/international
7. Miller and Freund., “Probability and Statistics for Engineers”, Pearson Education, Asia, 7th edition, 2012.

Course Outcomes	**Programme Outcomes (PO’s)**												**(PSO’s)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	2	1	1	-	2	2	1	2	1	1	2	2	3
CO 2	3	2	2	2	1	1	-	2	2	1	1	1	2	2	2
CO 3	2	3	2	1	2	1	1	-	1	1	1	1	2	3	2
CO 4	2	3	2	1	2	1	1	1	-	1	1	1	2	3	2
CO 5	2	3	2	1	2	1	1	1	1	-	1	1	2	3	2

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118SET02 **ADVANCED CONCRETE DESIGN** **L T P C**
3 0 0 3

OBJECTIVES:

- To make the students understand the design philosophy of limit state method
- To make the students be familiar with the limit state design of RCC beams and columns
- To design special structures such as Deep beams, Corbels, Deep beams, and Grid floors
- To design the flat slab as per Indian standard, yield line theory and strip method.
- To design the beams based on limit analysis and detail the beams, columns and joints for ductility.

UNIT-1 Design Philosophy **9**

Limit state design - beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Code - Design of slender columns

UNIT-2 Design of Special Rc Elements **9**

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.

UNIT-3 Flat Slabs and Yield Line Based Design **9**

Design of flat slabs and flat plates according to IS method – Check for shear - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs.

UNIT-4 Inelastic Behaviour of Concrete Structures **9**

Inelastic behaviour of concrete beams and frames, moment - rotation curves, moment redistribution.

UNIT-5 Ductile Detailing **9**

Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames – Fire resistance of Reinforced concrete members.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 To know the philosophy of limit state method limit state method

CO.2 To design various concrete structures and structural elements by limit state design and detail the same for ductility as per codal requirements.

CO.3 The students will have confident to design the flat slab as per Indian standard, yield line theory and strip method.

CO.4 To know the inelastic behaviour of concrete structires

CO.5 To design beams and columns for ductility

REFERENCES:

1. Gambhir.M.L. "Design of Reinforced Concrete Structures", Prentice Hall of India, 2012.
2. Purushothaman, P, "Reinforced Concrete Structural Elements: Behaviour Analysis and Design", Tata McGraw Hill, 2008
3. UnnikrishnaPillai and DevdasMenon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.

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4.Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5.Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007.

Course Outcomes	Programme Outcomes (PO’s)												(PSO’s)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	2	2	2	2	3	3	2	2	2	2	3	2
CO 2	2	3	3	2	2	1	2	1	1	2	2	2	3	3	2
CO 3	3	3	2	2	1	2	1	2	1	2	1	2	3	2	3
CO 4	3	2	3	3	2	1	2	1	2	1	1	1	2	3	3
CO 5	2	3	2	3	2	3	2	1	2	2	1	2	2	2	3

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118SET03 **STRUCTURAL DYNAMICS** **L T P C**
4 0 0 4

OBJECTIVES

- To expose the students the principles and methods of dynamic analysis of structures
- To prepare the students for designing the structures for wind, earthquake and other dynamic loads.
- To analyse dynamic response of multidegree of freedom systems
- To know the direct integration methods for dynmic response

UNIT-1 Principles of Vibration Analysis 12

Mathematical models of single degree of freedom systems - Free and forced vibration of SDOF systems, Response of SDOF to special forms of excitation, Effect of damping, Transmissibility.

UNIT-2 Dynamic Response of Two Degree of Freedom Systems 12

Mathematical models of two degree of freedom systems, free and forced vibrations of two degree of freedom systems, normal modes of vibration, applications.

UNIT-3 Dynamic Response of Multi-Degree of Freedom Systems 12

Mathematical models of Multi-degree of freedom systems, orthogonality of normal modes, free and forced vibrations of multi degree of freedom systems Mode superposition technique, Applications.

UNIT-4 Dynamic Response of Continuous Systems 12

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work, Applications.

UNIT-5 Direct Integration Methods for Dynamic Response 12

Damping in MDOF systems, Nonlinear MDOF systems, Wilson Theta method, Newmark beta method, step-by-step numerical integration techniques.

TOTAL :60 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

On completion of this course, the student is expected to be able to

CO1 Do vibration analysis of system/structures with single degree of freedom and can explain the method of damping the systems

CO2 Do dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration

CO3 Derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration

CO4 know the dynamic response of continuous systems

CO5 Analyse damping in multidegree of freedom systems

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, Pearson Education, 2007.

2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.

3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, 2004.

4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	2	2	1	2	2	2	2	1	1	3	3	2
CO 2	3	2	3	2	3	1	2	2	1	2	2	2	3	2	3
CO 3	3	2	3	2	3	2	2	2	1	2	1	2	3	3	3
CO 4	3	2	3	2	2	1	1	2	1	2	2	2	3	2	2
CO 5	3	2	3	3	1	2	2	2	2	1	1	1	3	3	3

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118SET04 THEORY OF ELASTICITY AND PLASTICITY **L T P C**
4 0 0 4

OBJECTIVES:

- To understand the concept of 3D stress, strain analysis and its applications to simple problems.
- To understand the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems
- To understand torsion problems in circular and non-circular cross-sections
- To analyse beams resting on elastic foundations
- To understand the simple boundary value problems with elasto-plastic and strain hardening properties

UNIT-1 Elasticity **12**

Analysis of stress and strain, Equilibrium equations - Compatibility equations - stress strain relationship. Generalized Hooke's law.

UNIT-2 Elasticity Solution **12**

Plane stress and plane strain - Simple two dimensional problems in Cartesian and polar coordinates.

UNIT-3 Torsion of Non-Circular Section **12**

St.Venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and closed sections

UNIT-4 Beams On Elastic Foundations **12**

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible – Uniform cross section – Point load and udl – Solution by finite differences.

UNIT-5 Plasticity **12**

Physical Assumptions – Yield criteria – Failure theories – Applications of thick cylinder – Plastic stress strain relationship. Elasto-plastic problems in bending and torsion.

TOTAL : 60 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1 Derive and write the fundamental equations of elasticity describing the linear behavior of element and develop constitutive models based on material behavior

CO2 Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems

CO3 Solve torsion problems in circular and non-circular cross-sections

CO4 Analyse beams resting on elastic foundations

CO5 Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

REFERENCES:

1. Ansel.C.Ugural and Saul.K.Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2006.
3. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 1988.
4. Slater R.A.C, "Engineering Plasticity", John Wiley and Son, New York, 1977.
5. Timoshenko, S. and GoodierJ.N."Theory of Elasticity", McGraw Hill Book Co., New York, 1988.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	2	2	1	1	1	2	2	1	1	2	2	3	2
CO 2	3	3	2	1	1	1	1	1	2	2	1	2	3	3	2
CO 3	2	3	2	3	2	1	2	2	2	2	1	2	2	3	3
CO 4	3	3	3	2	3	1	1	1	2	2	2	2	3	2	2
CO 5	2	3	3	3	2	2	2	1	1	2	2	2	3	3	3

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118SEE01 ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the properties of concrete making materials
- To conduct tests on concrete
- To study the mix design of concrete
- To know about special concretes
- To know the various methods for making concrete.

UNIT-1 Concrete Making Materials **9**

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified grading, testing of aggregates. Cement, Grade of cement, Chemical composition, testing of concrete, Hydration of cement, Structure of hydrated cement, special cements. Water Chemical admixtures, Mineral admixture.

UNIT-2 Tests On Concrete **9**

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage – Durability of concrete.

UNIT-3 Mix Design **9**

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Statistical quality control – Sampling and acceptance criteria.

UNIT-4 Special Concrete **9**

Light weight concrete, Fly ash concrete, Fibre reinforced concrete, Sulphur impregnated concrete, Polymer Concrete – High performance concrete. High performance fiber reinforced concrete, Self-Compacting-Concrete, Geo Polymer Concrete, Waste material based concrete – Ready mixed concrete.

UNIT-5 Concreting Methods **9**

Process of manufacturing of concrete, methods of transportation, placing and curing. Extreme weather concreting, special concreting methods. Vacuum dewatering – Underwater Concrete.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To understand concrete making materials
CO2: To conduct tests on fresh, hardened concrete, special concrete concrete
CO3: To carry out the mix design of concrete
CO4: To use special concretes
CO5: To know the various methods of manufacturing of concrete.

REFERENCES:

1. Gambhir.M.L. Concrete Technology, McGraw Hill Education, 2006.
2. Gupta.B.L., Amit Gupta, “Concrete Technology, Jain Book Agency, 2010.18
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Santhakumar.A.R. Concrete Technology”, Oxford University Press, 2007.
5.Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	2	2	1	2	1	2	2	1	1	1	3	2	2
CO 2	3	2	3	2	1	1	2	2	2	1	2	1	3	3	3
CO 3	3	2	3	3	2	1	2	1	2	1	2	2	3	2	2
CO 4	3	2	2	2	3	2	1	1	1	2	2	1	3	2	2
CO 5	2	2	2	3	3	1	1	2	2	1	2	1	3	3	3

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118SEE02 MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the properties of composite materials
- To understand the stress strain relations and properties of composite fiber and matrix constituents
- To analyse laminated composites
- To understand the failure criterion and fracture mechanism of composites and its applications.
- To design with composite materials

UNIT-1 Introduction **9**

Introduction to Composites - Classifying composite materials and their properties - Commonly used fiber and matrix constituents - Composite Construction - Properties of Unidirectional Long Fiber Composites - Short Fiber Composites.

UNIT-2 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.

UNIT-3 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.

UNIT-4 Failure and Fracture of Composites **9**

Netting analysis - Failure criterion - maximum stress - maximum strain, fracture mechanics of composites - Sandwich construction.

UNIT-5 Applications and Design **9**

Metal and ceramic matrix composites - Applications of composites, composite joints - Design with composites- Review, Environmental issues

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 To relate the stress –strain properties, longitudinal and transverse properties of composites lamina

CO.2 To understand the stress strain relations and properties of composite fiber and matrix constituents

CO.3 To analyse the laminated composites

CO.4 To compute the lamina strength and

CO.5 To apply the load deformation relation, residual stresses for the design of composites.

REFERENCES:

1. Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2006.
2. Jones R.M., "Mechanics of composite materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1998.
3. Agarwal.B.D. AndBroutman.L.J., "Analysis and Performance of fiber composites", John-Wiley and Sons, 2006.
4. Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill, 2009.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", University Press, India, 2005.

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	2	1	1	-	1	1	2	1	2	3	3	2
CO 2	3	2	3	3	1	2	2	2	1	1	1	2	3	3	3
CO 3	2	2	2	3	1	2	2	1	1	2	2	1	3	2	2
CO 4	2	2	3	2	2	1	2	1	2	1	2	1	3	2	3
CO 5	3	3	2	2	1	2	1	2	1	1	2	2	2	2	3

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118SEE03 CRACKS AND CRACK CONTROL IN CONCRETE STRUCTURES **L T P C**
3 0 0 3

OBJECTIVES:

- To classify the different types of cracks due to any type of force including earthquake force and other factors.
- To have a knowledge of long term effects of cracking.
- To impinge a knowledge of crack detection and crack measuring techniques.
- To compute crack width, and deflection long and short term values
- To measure cracks and remedy for control of cracks

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UNIT-1 Properties of Concrete **9**

Historical note on Portland Cement Concrete - Basic properties of plain concrete – Microstructure - Shrinkage, creep and strength of concrete - Temperature effect on concrete- Transport properties of concrete – Tensile, shear, bend and torsional strength of plain and reinforced concrete

UNIT-2 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.

UNIT-3 Theory of Cracks **9**

Classifications of cracks in plain and reinforced concrete - Theories of cracking and fundamental mechanics of cracking - Shear cracking- Moment cracking - Torsional cracking - Settlement cracks - Cracks due to force transfer - Cracking due to earthquake forces and cracking due to other factors.

UNIT-4 Properties of Cracks **9**

Long term effects of cracking - Material and loading effects- Creep effect – Bond - Slip theory - Straight line theory - Flexural stiffness - Effective moment of inertia - Computation of deflection due to short term and long term - Computation of crack width and crack spacing's.

UNIT-5 Crack Detection and Control **9**

Crack detection - Crack measuring techniques - Control of cracking in plain and reinforced concrete beams and columns - Crack control by material selection - Crack reduction designs and construction practices - Advanced crack control and repair techniques.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To know the causes and propagation of cracks

CO2: To understand the long term effects of cracking

CO3 To know the various theories of cracks.

CO4: To know the properties of cracks

CO5: To detect various cracks and measuring techniques for the same

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REFERENCES:

1. SandorPopovics, “Concrete Materials: Properties, Specifications, and Testing”, Noyes Publications, 1992.
2. Prashanthkumar, “Elements of Fracture Mechanics”, by Wheeler Publishing Company, New Delhi, 2009.
3. Srinath L.S., “Advanced mechanics of Solids”, Tata McGraw-hill Publishing Company Ltd, New Delhi, 2009.
4. Parton V.N, Movozov E.M., “Elastic-plastic Fracture Mechanics”, Mir publishers Moscow,

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	2	1	2	1	2	1	1	2	3	3	2
CO 2	3	2	3	2	3	2	1	1	1	2	1	2	2	3	2
CO 3	2	2	3	3	2	2	1	2	1	1	2	2	3	3	2
CO 4	3	2	2	2	1	2	1	1	1	2	1	2	3	2	2
CO 5	3	2	3	2	2	1	2	1	1	2	1	1	2	2	3

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118SEE04 OPTIMIZATION OF STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

OBJECTIVES:

- To study the optimization methodologies applied to structural engineering
- To study linear and non linear programming using analytical and graphical methods
- To understand concept of solving GPP
- To understand sub optimization problems
- To study optimum solution for structural application

UNIT-1 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).

UNIT-2 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 - Dual algorithm. Non Linear Programming: One Dimensional minimization methods: Unidimensional - Unimodal function - Exhaustive and unrestricted search – Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT-3 Geometric Programming **9**

Posynomial - 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 of difficulty.16

UNIT-4 Dynamic Programming **9**

Bellman’s principle of optimality - Representation of a multistage decision problem – concept of sub-optimization problems using classical and tabular methods.

UNIT-5 Structural Applications **9**

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multi-storey buildings, water tanks and bridges.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To know the basic principles and classification of optimization techniques

CO2: To know about linear and non-linear programming

CO3: To know about geometric programming

CO4: To know about dynamic programming

CO5: T know the structural applications of optimisation techniques

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REFERENCES:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd
2. Rao, S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics
4. Services, Prentice-Hall, New Jersey 1971.
5. Uri Krish, "Optimum Structural Design", McGraw Hill Book Co. 1981

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	2	1	1	2	1	2	1	2	2	3	3	2
CO 2	2	2	3	1	2	1	1	2	1	1	2	1	2	3	3
CO 3	3	2	2	3	2	3	1	2	2	1	1	1	2	3	3
CO 4	3	2	2	2	1	2	1	1	1	2	1	1	2	3	2
CO 5	2	3	2	2	1	2	1	2	1	1	1	2	3	2	3

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118SEE05 ANALYSIS AND DESIGN OF TALL BUILDINGS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the behaviour, analysis and design of tall structures.
- To study structural system components
- To analyse modelling and structural design
- To understand mechanical properties of sturual components
- To study various features of tall buildings

UNIT-1 Loading and Design Principles **9**

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, – Static and Dynamic approach – Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.

UNIT-2 Behaviour of Various Structural Systems **9**

Factors affecting growth, height and structural form. High rise behaviour, Rigid frames, braced Frames, in filled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, outrigger - braced and hybrid mega systems.

UNIT-3 Analysis and Design **9**

Modelling for approximate analysis, Accurate analysis and reduction techniques, Analysis of Buildings as total structural system considering overall integrity and major subsystem interaction, Analysis for member forces, drift and twist - Computerized three dimensional analyses – Assumptions in 3D analysis – Simplified 2D analysis.

UNIT-4 Structural Elements **9**

Sectional shapes, properties and resisting capacity, design, deflection, cracking, pre stressing, Shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance.

UNIT-5 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 of plumb effects, stiffness of member in stability, effect of foundation rotation.

TOTAL : 45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To know the behaviour, analysis and design of tall structures.
CO2: To know about structural system components
CO3: To analyse modelling and structural design
CO4: To know the mechanical properties of stuctural components
CO5: To know the various features of tall buildings

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REFERENCES:

1.Beedle.L.S. “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.

2.Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, JohnWiley and Sons, Inc., 2005.

3.Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures - Design andConstruction 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.Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

Course Outcomes	**Programme Outcomes (PO’s)**												**(PSO’s)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	2	3	2	2	1	1	2	2	3	2	3	2	3
CO 2	2	2	2	3	2	2	1	1	2	2	3	2	3	2	3
CO 3	3	2	2	3	2	1	2	1	2	1	1	2	3	3	2
CO 4	2	2	3	2	1	2	1	2	1	2	2	1	2	2	3
CO 5	2	3	2	1	2	1	2	1	2	2	1	1	3	3	2

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118SEE06 NONLINEAR ANALYSIS OF STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To study the concept of nonlinear behavior and analysis of elements and simple structures.
- To analyse inelastic bhaviour of uniform and variable thickness members
- To understand vibration of different modes
- To study analysis of plates
- To understand non linear vibration techniques

UNIT-1 Introduction to Nonlinear Analysis **9**

Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate flexible bars of uniform and variable thickness.

UNIT-2 Inelastic Analysis of Flexural Members **9**

Inelastic analysis of uniform and variable thickness members subjected to small deformations; Inelastic analysis of flexible bars of uniform and variable stiffness members with and without axial restraints

UNIT-3 Vibration Theory and Analysis of Flexural Members **9**

Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading.

UNIT-4 Elastic and Inelastic Analysis of Plates **9**

Elastic and inelastic analysis of uniform and variable thickness plates

UNIT-5 Nonlinear Vibration and Instability **9**

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To know on inelastic and vibration analysis of Flexural members..

CO2: To analyse inelastic bhaviour of uniform and variable thickness members

CO3: To know vibration of different modes

CO4: To know the difference between elastic and inelastic analysis of plates and Instabilities of elastically supported beams.

CO5: To know about non linear vibration techniques

REFERENCES:

1. Fertis, D.G, Nonlinear Mechanics, CRC Press, 1999.
2. Reddy.J.N, Nonlinear Finite Element Analysis, Oxford University Press, 2008.
3. Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	2	1	2	1	1	2	2	1	2	3	2	3
CO 2	2	2	3	1	2	3	2	1	3	1	1	2	2	3	3
CO 3	2	2	3	1	2	1	2	2	1	1	2	1	3	3	2
CO 4	3	3	2	2	1	2	1	2	1	1	2	1	3	3	2
CO 5	2	2	3	2	1	2	1	2	1	1	2	1	3	2	3

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118SEE07 MAINTENANCE AND REHABILITATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To study the damages, repair and rehabilitation of structures.
- To study remdial measures of cracks
- To study effect of dampness on structural components
- To understand causes and remidal measures of cracks in steel and concrete structures
- To make understanding of restrengthening of structures

UNIT-1 Introduction **9**

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.

UNIT-2 Building Cracks **9**

Causes – diagnosis – remedial measures – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Techniques for repair – Epoxy injection.

UNIT-3 Moisture Penetration **9**

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay –Chemical coatings – Flexible and rigid coatings.

UNIT-4 Distresses and Remedies **9**

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements. Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against corrosion – Design and fabrication errors – Distress during erection. Masonry Structures: Discoloration and weakening of stones – Biotical treatments – Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures.

UNIT-5 Strengthening Of Existing Structures **9**

General principle – relieving loads – Strengthening super structures – plating – Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening the substructures – under pinning – Increasing the load capacity of footing – Design for rehabilitation.

TOTAL :45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To point out the causes of distress in concrete, masonry and steel structures.
CO2: To suggest the remedial measures of cracks
CO3: To know effect of dampness on structural components
CO4: To know the causes and remidal measures of cracks in steel and concrete structures
CO5: To know about the restrengthening of structures

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At the end of this course students will be in a position to point out the causes of distress in concrete, masonry and steel structures and also they will be able to suggest the remedial measures.

REFERENCES:

1. Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987
2. Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", University Press, India, 1997.
3. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.
4. Dodge Woodson.R, Concrete Structures – protection, repair and rehabilitation", Elsevier Butterworth – Heinmann, UK, 2009.
5. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd., 2001.
6. Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" – Rand D Centre (SDCPL), RaikarBhavan, Bombay, 1987.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	2	2	2	1	1	1	2	2	1	2	2	2	3
CO 2	2	2	2	3	2	2	1	1	2	2	3	2	3	2	3
CO 3	3	2	2	3	2	1	2	1	2	1	1	2	3	3	2
CO 4	2	2	3	2	1	2	1	2	1	2	2	1	2	2	3
CO 5	2	3	2	1	2	1	2	1	2	2	1	1	3	3	2

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118SEE08 MATRIX METHODS FOR STRUCTURAL ANALYSIS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To Study the Energy Concepts in Structures, Characteristics and Transformation of Structures.
- To understand flexibility and stiffeness matrix formulation
- Study of system displacement and element displacement
- To study conept of stiffness matrix development
- To know about development of flexibility matrix in structural components

UNIT-1 Energy Concepts In Structures **9**

Introduction – Strain Energy – Symmetry of The Stiffness And Flexibility Matrices – Strain Energy in Terms of Stiffness And Flexibility Matrices – Stiffness And Flexibility Coefficients in Terms of Strain Energy – Additional properties of [a] and [k] – another Interpretation of coefficients aij and kij– Betti's law – Applications of Betti's law: Forces not at the coordinates – Strain energy in systems and in Elements.

UNIT-2 Characteristics of Structures – Stiffness and Flexibility **9**

Introduction – Structure with Single Coordinate- Two Coordinates-Flexibility and Stiffness Matrices in Coordinates- Examples-Symmetric Nature of Matrices- Stiffness and Flexibility Matrices in Constrained Measurements- Stiffness and Flexibility of Systems and Elements-Computing Displacements and Forces form Virtual Work-Computing Stiffness and Flexibility Coefficients.

UNIT-3 Transformation of Information In Structures **9**

Determinate- Indeterminate Structures-Transformation of System Forces to Element Forces Element Flexibility to System Flexibility - System Displacement to Element Displacement-Element Stiffness to System Stiffness-Transformation of Forces and Displacements in General – Stiffness and Flexibility in General –Normal Coordinates and Orthogonal Transformation-Principle of Contre gradience

UNIT-4 The Flexibility Method **9**

Statically Determinate Structures –Indeterminate Structures-Choice of Redundant Leading to Ill and Well-Conditioned Matrices-Transformation to One Set of Redundant to Another-Internal Forces due to Thermal Expansion and Lack of Fit-Reducing the Size of Flexibility Matrix Application to Pin-Jointed Plane Truss-Continuous Beams-Frames-Grids.17

UNIT-5 The Stiffness Method **9**

Introduction-Development of Stiffness Method- Stiffness Matrix for Structures with zero Force at some Coordinates-Analogy between Flexibility and Stiffness-Lack of Fit-Stiffness Matrix with Rigid Motions-Application of Stiffness Approach to Pin Jointed Plane Trusses-Continuous Beams Frames-Grids-Space Trusses and Frames-Introduction Only-Static Condensation Technique Choice of Method-Stiffness or Flexibility.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To transform the unknown from system coordinates to element coordinates

CO2: To identify the degree of freedom

CO3: To formulate flexibility matrix of components of structure

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CO4: To formulate the stiffness matrix and apply to 2D & 3D structure
CO5: To develop stiffness matrix in structural components

REFERENCES:

1. K. Rubinstein.F.M., "Matrix Computer Methods of Structural Analysis", Prentice Hall
2. Rubinstein.F.M., "Matrix Computer Methods of Structural Analysis", Prentice Hall
3. Dr. DevadasMenon., "Advanced Structural Analysis", Narosa Publishing House, 2009
4. Pandit G.S. and Gupta S.P., "Structural Analysis-A Matrix Approach", Tata McGraw-Hill PublishingCompany Limited, New Delhi, 1997
5. Reddy C.S., "Basic Structural Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	3	2	1	1	2	1	2	1	1	1	2	3	3
CO 2	2	2	3	2	1	2	1	2	1	1	2	1	3	2	3
CO 3	3	2	3	2	1	2	2	1	2	1	1	1	3	3	2
CO 4	2	2	1	3	2	1	2	1	1	2	2	1	2	3	3
CO 5	2	3	1	2	2	1	1	2	2	1	1	1	3	3	2

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M.E - STRUCTURAL ENGINEERING

SEMESTER – II

Subject Code	Subject Name	L	T	P	C	CA	EA	TOTAL
THEORY								
218SET01	Finite Element Analysis	4	0	0	4	50	50	100
218SET02	Experimental Techniques and Instrumentation	3	0	0	3	50	50	100
218SET03	Advanced Structural Steel Design	3	0	0	3	50	50	100
218SET04	Earthquake Analysis and Design of Structures	3	0	0	3	50	50	100
218SEEXX	***Choice - III***	3	0	0	3	50	50	100
218SEEXX	***Elective – I***	3	0	0	3	50	50	100
PRACTICAL								
218SEP01	Advanced Structural Engineering Laboratory	0	0	4	2	50	50	100

No. of Credits: 21

Subjects for Choice – III

1. 218SEE01 - Design of Bridges
2. 218SEE02 - Design of Shell and Spatial Structures
3. 218SEE03 - Design of Precast Components and Ferro cement
4. 218SEE04 - Computer Aided Analysis and Design

Subjects for Elective – I

1. 218SEE05 - Stability of Structures
2. 218SEE06 - Theory of Plates
3. 218SEE07 - Space Structures
4. 218SEE08 - Construction Safety and Management

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218SET01	Finite Element Analysis	L	T	P	C
		4	0	0	4

OBJECTIVES

- To study the finite element concept, stress analysis, meshing, nonlinear problems and applications.
- To equip with the Finite Element Analysis fundamentals.
- To formulate the design problems into FEA.
- To perform engineering simulations using Finite Element Analysis software.
- To understand the ethical issues related to the utilization of FEA in the industry.

UNIT-1 FORMULATION OF BOUNDARY VALUES 12

Boundary Value Problems – Approximate Solutions – Variational and Weighed Residual Methods – Ritz and Galerkin Formulations – Concept of Piecewise Approximation and Finite Element – Displacement and Shape Functions –Weak Formulation – Minimum Potential Energy – Generation of Stiffness Matrix and Load Vector – applications to structural engineering.

UNIT-2 STRESS ANALYSIS 12

Two Dimensional problems – Plane Stress, Plane Strain and Axisymmetric Problems– Triangular and Quadrilateral Elements –Natural Coordinates –Isoparametric Formulation - Numerical Integration – Plate Bending and Shell Elements — Brick Elements –Elements for Fracture Analysis – applications to structural engineering.

UNIT-3 MESHING AND SOLUTION PROBLEMS 12

Higher Order Elements – p and h Methods of Mesh Refinement – ill conditioned Elements – Discretisation Errors – Auto and Adaptive Mesh Generation Techniques -Error Evaluation – applications to structural engineering.

UNIT-4 NONLINEAR, VIBRATION AND THERMAL PROBLEMS 12

Material and Geometric Nonlinearity – Methods of Treatment – Consistent System Matrices – Dynamic Condensation – Eigen Value Extraction - thermal analysis – applications to structural engineering.

UNIT-5 APPLICATIONS 12

Modelling and analysis using latest software – applications to structural engineering.

TOTAL: 60 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Develop finite element formulations of single degree of freedom problems and solve them

CO.2 Use finite element analysis programs based upon either “p-method” or “h-method” finite element mathematical formulations

CO.3 Compute the stiffness values of noded elements.

CO.4 Identify the Eigen values of non-linear vibration problems

CO.5 Perform modal analysis to determine its natural frequencies, and analyze harmonically-forced vibrations.

REFERENCES:

1. **S. S. Bhavikatti**, “*Finite Element Analysis*”, New Age Publishers, 2007.
2. **David Hutton**, “*Fundamentals of Finite Element Analysis*”, Tata McGraw HillPublishing Company Limited, New Delhi, 2005.
3. **Moaveni, S.,** “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 2003.

4. **Chandrupatla, R.T. and Belegundu, A.D.,** "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2011.
5. **C. S. Krishnamoorthy,** "Finite Element Analysis: Theory and Programming", Tata McGraw-Hill, 2012.
6. **S.S.Rao,** "The Finite Element Method in Engineering", Elsevier, 2011.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	1	2	3	2	1	1	2	3	2	2	3	3
CO 2	2	1	2	3	1	2	1	3	1	2	3	2	3	2	1
CO 3	3	2	3	2	3	2	3	1	2	2	2	1	2	3	2
CO 4	2	2	3	2	3	3	2	1	1	2	2	3	3	2	2
CO 5	3	3	2	2	2	1	2	2	1	3	2	3	2	2	3

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218SET03 **Advanced Structural Steel Design** **L P T C**
3 0 0 0

OBJECTIVES

- To enrich the students on analysis and design of industrial buildings
- To study various connections (welded and riveted) , seated connections (Unstiffened and Stiffened connections) and to design them.
- To focus on the study and design of various steel towers and steel chimneys.
- To study the plastic analysis of steel structures.
- To study the design concepts of light gauge steel structures.

UNIT-1 GENERAL **9**

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.

UNIT-2 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 – Framed Connections.

UNIT-3 ANALYSIS AND DESIGN OF STEEL TOWERS AND CHIMNEYS **9**

Analysis and Design of Microwave / Transmission Line Towers - Types of bracing patterns - Sag and Tension calculations. Design of Self-supporting Chimney – Design of Base Plates, Foundations and Anchor bolts and Guyed Steel Chimney - Guy ropes - Stresses due to wind. Along with load calculation - Gust Factor Method.

UNIT-4 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.

UNIT-5 DESIGN OF LIGHT GAUGE STEEL STRUCTURES **9**

Behaviour of Compression Elements - Effective width for load and deflection determination – Behaviour of Unstiffened and Stiffened Elements – Design of webs of beams – Flexural members – Lateral buckling of beams – Shear Lag – Flange Curling – Design of Compression Members – Wall Studs.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Construct industrial buildings for the intended purpose
CO.2 Design different types of steel connections and joints.
CO.3 Have an exposure to design steel tower and chimneys.
CO.4 Design for plasticity.
CO.5 Perform design of light gauge steel structures.

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REFERENCES:

- **Subramanian.N**, "*Design of Steel Structures*", Oxford University Press, 2008.
- **Dayaratnam.P**, "*Design of Steel Structures*", A.H.Wheeler, India, 2007.
- **Wie Wen Yu**, "*Design of Cold Formed Steel Structures*", McGraw Hill Book MCompany, New York, 2010.
- **Linton E. Grinter**, "*Design of Modern Steel Structures*", Eurasia Publishing House, New Delhi, 1996.
- **John E. Lothers**, "*Design in Structural Steel*", Prentice Hall of India, 1990.
- **Lynn S. Beedle**, "*Plastic Design of Steel Frames*", John Wiley and Sons, 1990.

CODE BOOKS :

1. IS:800-2007 - Indian Standard Code of Practice for general construction in steel.
2. IS:875 (Part I to V) - Code of Practice for Design loads.
3. IS:801-1975 - Code of practice for use of cold formed light gauge steel structural members in general building construction.
4. IS:811-1987 - Cold formed light gauge structural steel sections.
5. IS:6533-1989 (Part I & II) - Code of Practice for Design and Construction of Steel Chimney.
6. IS:802-1977 - Code of Practice for use of structural steel in Overhead Transmission Line Towers.
7. SP:6 - Handbook on Structural Steel Section.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	2	2	2	2	1	1	2	2	1	2	2	3
CO 2	3	3	1	3	2	2	2	2	3	3	1	2	3	2	3
CO 3	2	3	3	2	3	2	3	2	2	3	2	1	2	2	2
CO 4	2	2	3	2	2	3	3	2	3	1	1	2	3	2	3
CO 5	3	2	3	2	3	2	2	2	3	3	1	1	2	3	2

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218SEE02 Design of Shell and Spatial Structures

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To classify and analyse the different type of shell structures.
- To design circular domes, conical roofs and circular cylindrical shells.
- To study the behaviour of pyramidal roof
- To be familiar with design philosophy of space frames.
- To study the finite element analysis shell structures.

UNIT-1 SHELL CLASSIFICATION AND ANALYSIS 9

Classification of shells - Structural actions – Membrane theory - Analysis of spherical dome – Cylindrical shells – Folded plates

UNIT-2 DESIGN OF SHELLS 9

Design of circular domes - Conical roofs - Circular cylindrical shells.

UNIT-3 FOLDED PLATES 9

Folded plate structures - Structural behaviour – Types - Design - Pyramidal roof.

UNIT-4 INTRODUCTION TO SPACE FRAME 9

Space frames - Configuration - Types of nodes - General principles of design Philosophy - Behaviour.

UNIT-5 FINITE ELEMENT ANALYSIS 9

Finite element application on cylindrical shells - Introduction to shell elements- Flat elements - Axisymmetric elements- Degenerated elements - General shell element.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Analyse the shells and plates using membrane theory

CO.2 Design various shell and spatial structures

CO.3 Design all types of domes and Understand the behaviour of folded plates.

CO.4 Know the structural behaviour and philosophy of space frames.

CO.5 Proficient with finite element analysis of shell structures.

REFERENCES:

1. **Billington.D.P**, "*Thin Shell Concrete Structures*", McGraw Hill Book Co., New York, 1982.
2. **Santhakumar.A.R and Senthil.R**, "*Proceedings of International Conference onSpace Structures*", Anna University, Chennai, 1997.
3. **Subramanian.N** ,"*Principles of Space Structures*", Wheeler Publishing Co.1999.
4. **Ramasamy, G.S.,** "*Design and Construction of Concrete Shells Roofs*", CBS Publishers, 1986.
5. **ASCE Manual No.31,** "Design of Cylindrical Shells".

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	2	1	3	3	2	2	1	2	1	2	2	2
CO 2	3	2	3	2	3	2	3	2	1	1	1	2	3	2	3
CO 3	3	2	2	3	2	3	2	2	3	2	2	1	2	3	2
CO 4	2	3	2	3	3	2	3	2	1	2	3	2	3	3	3
CO 5	3	2	2	3	3	2	2	3	2	1	2	2	2	2	3

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218SEE03 Design of Precast Components and Ferro-cement

L	T	P	C
3	0	0	3

OBJECTIVES:

- To impart the knowledge on basic concepts of prefabricated structures
- To study the various materials used for precast members.
- To design various prefabricated components.
- To possess knowledge about joints and connections.
- To design of Ferroconcrete Structures.

UNIT-1 INTRODUCTION 9

Advantages and disadvantages of precast concrete construction; different types of units involved in general building construction, including residential, factory and industrial framed structure; their general principles of design; mechanical handling of large projects like stadium, bridges etc.

UNIT-2 MATERIALS 9

Materials viz. Concrete, Self-Compacting Concrete, Grout, Reinforcement and structural welded wire cages. Requirements of industrialized buildings, standardization of precast elements and unification of building design. Influence of manufacture, transport and erection technologies on design solution (Modular and Tilt-Up); expansion and contraction joints.

UNIT-3 PREFABRICATED COMPONENTS AND ITS BEHAVIOUR 9

Design of Precast Concrete Components and Behaviour of structural components, large panel constructions, Construction of roof and floor slabs, Wall panels, Beams, Columns, Shear walls. Design for Flexure: Strength Design (Depth of Stress block, Flanged Elements, Strength reduction factor, Limitations on reinforcement, Critical sections), Service load design. Design for Shear: Horizontal and vertical shear resistance.

UNIT-4 JOINTS AND CONNECTIONS 9

Joints and connections in precast construction; classification and their requirements. Design of Concrete bracket and corbels; Cantilever beam-design method, Strut-and-tie method. Introduction to Hanger Connections. Design of bearing pads, column bases and moment connections. Typical connection designs for lateral load resisting systems.

UNIT-5 DESIGN OF FERROCRETE STRUCTURES 9

Design, analysis and optimization, Special design considerations, Typical features of ferrocrete affecting design, Design criteria, Rational method of design ferrocrete structure. Strength through shape, Shape and form of a structure, various structural forms and their behaviour, Comparative study of various forms.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Handle large projects like stadium, bridges etc.,

CO.2 Understand the design theories of precast components and its behaviour.

CO.3 Understand the joints and connections in precast construction.

CO.4 Design of Ferrocrete Structures.

CO.5 Knowledge about manufacture, transport and erection technologies of precast components.

REFERENCES:

1. **Gerostiza C.Z., Hendrikson C. and Rehat D.R**., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994.
2. Ferrocement- Materials and applications-- **Publication SP 61**, AC Detroit. USA.

3. **A E Naaman,** "Ferrocement and laminated cementitious composites", Techno-press, Ann Arbor, Michigan, USA.
4. **B R Paul and R P Pama,** "Ferrocement" Published by International Ferrocement Information Centre. A.I.T. Bangkok, Thailand.
5. Structural design manual, Precast concrete connection details, Society for the studies in the use of precast concrete, Netherland Betor Verlag, 1978.
6. PCI Design Handbook – Precast and Prestressed Concrete (6th Edition)

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	3	2	3	2	3	1	2	1	2	3	2	3
CO 2	3	3	2	2	3	2	2	2	2	1	2	1	2	2	3
CO 3	3	2	3	2	3	2	2	1	2	1	1	2	2	3	2
CO 4	3	2	2	2	3	2	2	1	1	2	2	1	2	2	3
CO 5	2	3	2	3	2	1	2	1	2	1	1	2	3	2	3

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218SEE04 **Computer Aided Analysis and Design** **L P T C**
3 0 0 3

OBJECTIVES:

- To familiarise with graphic primitives, transformations and 2-D drafting of computer graphics.
- To get practiced with computer methods of structural analysis.
- To understand the structural design concepts.
- To be familiar with linear programming and CPM and PERT.
- To inculcate the students with Artificial Intelligence.

UNIT-1 INTRODUCTION TO COMPUTER AIDED DESIGN 9

Reasons for implementing CAD – Design process – Applications of computers to design – Benefits of computer Aided design.

UNIT-2 COMPUTER GRAPHICS 9

Graphic primitives - Transformations - Basics of 2-D drafting - Modelling of curves and surfaces – Wire frame modelling - Solid modelling - Graphic standards – Drafting software packages and usage.

UNIT-3 STRUCTURAL ANALYSIS 9

Computer methods of structural analysis –Analysis through software packages.

UNIT-4 STRUCTURAL DESIGN 9

Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials

UNIT-5 OPTIMIZATION 9

Application of linear programming - Simplex algorithm - Post-optimality analysis -Project scheduling - CPM and PERT applications

TOTAL: 45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Handle 2 D drafting and can use drafting software.
CO.2 Perform structural analysis using analysis package
CO.3 Design the structures with computer methodologies.
CO.4 Optimize the structural design with various computer packages and graphics.
CO.5 Apply artificial intelligence to real life applications.

REFERENCES:

1. **Krishnamoorthy C.S and Rajeev S.,** "*Computer Aided Design*", Narosa Publishing House, New Delhi, 2005
2. **Groover M. P. and Zimmers E. W. Jr**.," *CAD/CAM, Computer Aided Design and Manufacturing* ", Prentice Hall of India Ltd, New Delhi, 2006
3. **Harrison H.B**., "*Structural Analysis and Design Vol. I and II*", Pergamon Press,1991
4. **Hinton E. and Owen D.R.J**., "*Finite Element Programming*", Academic Press1977.
5. **Rao. S.S**., "Optimisation *Theory and Applications* ", Wiley Eastern Limited, New Delhi, 2009.
6. **Richard Forsyth (Ed.),** "*Expert System Principles and Case Studies*", Chapman and Hall, 1996.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	2	3	2	3	1	2	1	1	2	2	3	2	2
CO 2	3	2	3	3	2	3	2	2	2	1	2	1	3	3	2
CO 3	2	3	2	2	2	3	2	1	2	1	1	2	3	2	3
CO 4	2	2	3	3	3	2	1	1	2	2	1	1	2	2	2
CO 5	2	3	2	3	2	3	1	2	1	2	2	2	3	3	3

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218SEE05 **Stability Of Structures** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the stability of columns using theoretical and numerical methods.
- To understand the approximate methods and numerical methods of inelastic buckling.
- To get accustomed to beam column behaviour and that of frames.
- To enumerate the lateral buckling, lateral torsional buckling and flexural torsional buckling of beams.
- To study various numerical techniques and energy methods for buckling of thin plates.

UNIT-1 STABILITY OF COLUMNS 9

Fundamental concepts - Elastic structural stability - Structural instability - Analytical methods for the stability analysis, equilibrium, imperfections and energy methods - Non-prismatic columns- Built up columns- Buckling modes Effect of shear on buckling load - Large deflection theory.

UNIT-2 METHODS OF ANALYSIS AND IN ELASTIC BUCKLING 9

Approximate methods – Rayleigh and Galerkin methods – numerical methods – Finite difference and finite Element - analysis of columns – Experimental study of column behaviour – South well plot - Column curves - Derivation of Column design formula - Effective length of Columns - Inelastic behaviour- Tangent modulus and Double modulus theory.

UNIT-3 BEAM COLUMNS AND FRAMES 9

Beam column behaviour- standard cases- Continuous columns and beam columns – Columns on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Use of Wood's charts.

UNIT-4 BUCKLING OF BEAMS 9

Lateral buckling of beams – Energy method- Application to Symmetric and single symmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- –Numerical solutions – Torsional buckling – Uniform and non-uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.

UNIT-5 BUCKLING OF THIN PLATES 9

Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods –Numerical Techniques.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Analyse both static and dynamic instabilities, by both theoretical and numerical methods

CO.2 Examine the behaviour of beam columns and frames with and without side sway using classical and stiffness methods.

CO.3 Well versed in the lateral buckling, torsional buckling, Flexural torsional buckling of various beams and non-circular sections.

CO.4 Evaluate buckling of thin plates using energy methods and various numerical techniques.

CO.5 Execute and work out the inelastic buckling using various methodologies.

REFERENCES:

1. **Timoshenko, S., and Gere., "**Theory of Elastic Stability", McGraw Hill Book Company, 2009.
2. **Chajes, A. "**Principles of Structures Stability Theory", Prentice Hall, 1974.

3. **Ashwini Kumar,** Stability of Structures, Allied Publishers LTD, New Delhi, 2003
4. **Iyenger.N.G.R.,,** "Structural stability of columns and plates", Affiliated East West Press,1986.
5. **Gambhir,** "Stability Analysis and Design of Structures", springer, New York , 2004.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	2	3	2	3	2	1	1	2	2	1	2	3	2	3
CO 2	3	3	2	3	3	2	2	2	1	1	2	2	3	2	2
CO 3	2	3	3	2	3	2	3	2	2	1	1	1	2	2	3
CO 4	3	2	2	3	3	2	1	2	1	2	2	2	3	3	2
CO 5	2	3	3	2	3	1	2	2	1	1	2	1	2	3	2

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218SEE06 **THEORY OF PLATES** **L T P C**
3 0 0 3

OBJECTIVES:

- To get introduced to various plate theories, governing equations for bending of plates and various boundary conditions.
- To conceptualize the Navier's solution and Levy's solution and to analyze rectangular plates.
- To study the behavior of bending of circular plates.
- To familiarize with the concepts of finite difference method.
- To use energy methods to analyze the solution of rectangular plates for the given boundary conditions.

UNIT-1 INTRODUCTION TO PLATE THEORY 9

Thin and thick plates, Small and large Deflection Theory of thin plate assumptions, Moment Curvature Relations, Stress Resultants, Governing Differential Equation for Bending of Plates, various boundary conditions.

UNIT-2 RECTANGULAR PLATES 9

Navier's Solution: Simply supported rectangular plates subjected to UDL and varying loads on entire area, Parabolic loads, sinusoidal loads, partly loaded plates, concentrated loads and couples , Distributed Couples, Symmetric and Antisymmetric Loadings.

Levy's Solution :Plates subjected to UDL and varying loads, sinusoidal parabolic loads between the supported edges. Conditions for other two edges – Simply supported, Fixed, Free and Elastically Restrained.

UNIT-3 CIRCULAR PLATES 9

Bending of Circular Plates with Clamped and Simply Supported Edges, Plate with central hole, uniformly distributed and varying loads, conical loads, Distributed Couples, Ring Loads, Semi circular Plates, Asymmetrically loaded plates.

UNIT-4 FINITE DIFFERENCE METHOD 9

Solution of plate problems – Deviation of Delta/Pattern/Stencil for biharmonic form for a rectangular mesh, Two stage solutions, Solutions for various loadings and Boundary Conditions, Use of Symmetry and Anti – symmetry , extrapolation formula, Introduction to Improved Finite Difference Technique.

UNIT-5 ENERGY METHODS 9

Use of potential energy principle, solution of rectangular plates with various boundary conditions and loadings.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Apply the knowledge about various plate theories and Navier's solution, Levy's solution and solve for the rectangular plates.

CO.2 Analyse circular plates for any boundary conditions.

CO.3 Solve plate problems using finite difference method.

CO.4 Understand the potential energy principle

CO.5 Find the solution of rectangular plates for various loadings

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REFERENCES:

1. **Timoshenko, S. and Krieger S.W.** "Theory of Plates and Shells", McGraw Hill Book Company, New York, 1990.
2. **Bairagi,** "Plate Analysis", Khanna Publishers, 1996
3. **Reddy J N,** "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2006.
4. **Szilard, R.,** "Theory and Analysis of Plates", Prentice Hall Inc., 1995.
5. **Chandrashekahara, K.** Theory of Plates, University Press (India) Ltd., Hyderabad, 2001.

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	2	3	3	3	2	1	2	1	2	1	3	3	2
CO 2	2	3	3	3	2	2	1	2	1	1	2	2	3	2	3
CO 3	2	3	2	3	2	2	1	2	2	1	1	2	2	2	2
CO 4	3	3	3	2	3	2	2	1	2	1	1	2	2	3	2
CO 5	2	3	3	3	2	1	2	2	1	2	2	1	3	3	3

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218SEE07 **Space Structures** **L T P C**
3 0 0 3

OBJECTIVES:

- To analyze many types of space structures such as Geodesic dome, cable suspension structures and Tensile Membrane and Tensegrity Structures
- To apply non -traditional optimization methods for structures.
- To enrich the students on different connectors
- To know the design of cable suspension structures
- To impart knowledge on using finite element analysis for spatial structures

UNIT-1 PRINCIPLES 9

Definition – Historical development – Types – Materials – Practical difficulties – Construction – Support conditions – Cladding – Aesthetics Failure of space structures – Formex data generation of space structure – Single and Multi – layer grids and domes – Advantages – Water drainage – Progressive collapse and composite space trusses – Network domes – Geodesic domes – Double dome – Ice dome – erection – Folded plate roofs.

UNIT-2 CONNECTORS 9

Classification – Ball joint systems – Socket joint – Plate joint – Slot joint – Shell joint – Modular systems – Composite system – Prefabricated systems – Patented systems – MERO joints – simple connectors.

UNIT-3 STRESSED SKIN-CABLE SUSPENSION STRUCTURES 9

Stressed skin steel buildings – Stressed skin grids – Cable suspended roofs – Design of cable roofs – Erection of cable roofs – Economy – New trends.

UNIT-4 TENSILE MEMBRANE AND TENSEGRITIC STRUCTURES 9

Pneumatic structures – Materials and coatings – Fans and pressure control – Lighting anchor design – Trends in pneumatic construction – Failures – Tensegritic structures – Maxwell's rules – Stability of tensegritic structures – Cable tenstar dome – Flying mast fabric roof system.

UNIT-5 ANALYSIS 9

Finite element analysis of skeletal structures – Approximate methods – Optimal design of space structures using non – traditional optimization methods such as (Genetic Algorithm) GA, (Evolution Strategies) ES or (Ant colony Optimization) ACO – Space structures with changing geometries.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Understand materials and practical difficulties
CO.2 Analyse and design the space structures
CO.3 Solving using finite difference method.
CO.4 Understand the concepts about various connectors available.
CO.5 Analyse the spatial structures using various method

REFERENCES:

1. **G. S. Ramaswamy, M. Eekhout and G. R. Suresh,** Analysis, design and Constructions of space Structures, Thomas Telford, 2002
2. **N. Subramaniam,** Space Structures: Principles and Practice, Multi Science Publishing Company, 1983.
3. **B. B. Wang,** Free Standing Tension Structures, Taylor & Francis, 2007

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	3	3	3	2	2	2	2	1	1	1	3	2	3
CO 2	2	2	3	3	3	2	1	1	1	2	2	2	3	3	3
CO 3	3	3	2	2	3	2	1	1	2	2	2	1	2	3	2
CO 4	3	2	2	3	2	2	2	1	1	2	2	1	3	3	3
CO 5	2	3	3	3	2	2	1	1	1	2	2	1	2	2	3

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218SEE08 **Construction Safety And Management** **L T P C**
3 0 0 3

OBJECTIVES:

- To provide comprehensive knowledge on the cause of accident and construction industry related laws.
- To know in detail about the safety in various aspects of construction.
- To have a knowledge about the preparation of accident report by analysing the key factors.
- To have a brief knowledge in construction management.
- To have a practical knowledge about the safety implementation by case studies.

UNIT-1 INTRODUCTION **9**

Importance – causes of accident, safety measures- Environmental issues in construction-Construction industry related laws. Occupation Safety and Health Act (OSHA), National Safety Council (NSC) - British Safety Council (BSC) - Council of industrial safety (CIS) - Loss Prevention Association (India)-Construction safety- Elements of an effective safety programmes job-Site assessment.

UNIT-2 PLANNING **9**

Safety aspects of building and plant-layout-Introduction to treatment and disposal on Industrial wastes & effluents-Planning and safe operations- Planning and site operations- Safe systems of storing in construction materials-Excavation-Demolition work-Blasting-Timbering- Scaffolding-Hoisting apparatus and conveyors-Manual handling- Safe use of Ladder-Safety in hand tools-Safety in use of mobile cranes-Trusses, girders and beams.

UNIT-3 ACCIDENT CAUSATION, REPORTING AND INVESTIGATION **9**

Accidents and Hazards control-Cost of accidents- Accident reports-Accident reporting, investigations and statistics-Identification of the key factors-Safety organization-Types-Functions-Safety committees.

UNIT-4 SAFETY MANAGEMENT IN CONSTRUCTION **9**

Safety policy-safety meeting-Planning for safety and productivity-safety management techniques-Safety sampling-Safety Audit-Job safety analysis-Incident recall techniques- Safety and Health provision in the factories act.

UNIT-5 CASE STUDIES **9**

Involvement in safety-Role of Government and voluntary agencies-Safety officers-Fire hazards and preventing methods- case studies - fire accidents.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 Understand the basic mandatory procedures to be followed in the construction industry.

CO.2 Know the fundamental planning and safety practices commonly implemented on construction sites and the key factor for causing accidents.

CO.3 Understand the requirements for compliance and inspection imposed for the safety in construction site

CO.4 Understand the importance of agencies involved in rescue operation by various case studies.

CO.5 Execute a given site with zero percent accident

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REFERENCES:

1. **Jimmie Hinze,** Construction safety, Prentice-Hall,1997
2. **Herbert William Heinrich,** Industrial Accident Prevention, McGraw-Hill, 1950
3. **Richard J. Coble, Jimmie Hinze and Theo C. Haupt,** Construction Safety and Health Management, Prentice Hall Inc., 2001.

Code Books:

1. IS 3696 : 1987 (Part I) 1991 (PART II) –code of safety for Scaffolds and ladder
2. IS 3764 : 1992 - Code of Safety for Excavation work
3. IS 4081 : 1986 – Code of Safety for blasting and related drilling operations
4. IS 7293 : 1974 – Safety Code for Working with Construction Machinery
5. IS 13416 : 1992 (Part I to V)– Preventive measures against Hazards at work places
6. IS 15883 : 2009 (Part I) – Construction Project Management.
7. SP 70, 2001, Hand Book of Construction Safety Practices, Bureau of Indian Standards, New Delhi.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	2	3	3	2	1	2	1	2	1	1	3	2	3
CO 2	2	3	2	3	2	1	2	2	1	1	2	2	2	2	3
CO 3	2	3	2	2	3	2	1	2	2	1	1	1	3	3	2
CO 4	3	2	3	3	2	3	2	1	1	2	2	1	2	2	3
CO 5	2	3	2	3	3	2	1	1	2	2	1	1	3	3	2

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III SEMESTER			Hours / Week				Marks		
Subject Code	**Category**	**Subject Name**	**L**	**T**	**P**	**C**	**IA**	**EA**	**TOTAL**
THEORY									
318SEE	Choice - III	***Elective***	3	0	0	3	50	50	100
318SEE	Choice - IV	***Elective***	3	0	0	3	50	50	100
318SEE	Choice - V	***Elective***	3	0	0	3	50	50	100
PRACTICAL									
318SEP01	Practical	Practical Training (4 Weeks)	-	-	-	1	100	-	100
318SEP02	Practical	Seminar	0	0	4	2	100	-	100
318SEP03	Project	Project Work (Phase- I)	0	0	12	6	50	50	100

No. of Credits: 18

Subjects for Elective – III

1. 318SEE01 - Industrial Structures
2. 318SEE02 - Offshore Structures
3. 318SEE03 - Prefabricated Structures
4. 318SEE04 - Smart Structures and Applications

Subjects for Elective – IV

1. 318SEE05 - Wind and Cyclone Effects on Structures
2. 318SEE06 - Pre-stressed Concrete
3. 318SEE07 - Power Plant Structures
4. 318SEE08 - Energy Efficient Structures

Subjects for Elective – V

1. 318SEE09 - Design of Steel Concrete Composite Structures
2. 318SEE10 - Structures In Disaster Prone Areas
3. 318SEE11 - Random Vibrations and Structural Reliability
4. 318SEE12 - Sub Structure Design

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318SEP01 **PRACTICAL TRAINING (4 WEEKS)** **L T P C**
0 0 0 1

OBJECTIVES:

- 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.
- To develop skills in facing and solving the field problems

The students individually undertake training in reputed industries during the summer vacation for a specified period of two weeks. at the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. the students will be evaluated through a viva-voce examination by a team of internal staff.

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
CO.2 Know the fundamental planning and safety practices commonly implemented on construction sites and the key factor for causing accidents.
CO.3 Understand the requirements for compliance and inspection imposed for the safety in construction site
CO.4 Understand the importance of agencies involved in rescue operation by various case studies.
CO.5 Execute a given site with zero percent accident

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	3	2	3	3	2	1	2	1	2	1	2	3	3	2
CO 2	2	3	3	2	1	1	2	1	2	1	1	1	2	3	3
CO 3	2	2	3	2	1	2	1	2	1	1	2	1	3	2	3
CO 4	3	2	3	2	1	2	2	1	2	1	1	1	3	3	2
CO 5	2	2	1	3	2	1	2	1	1	2	2	1	2	3	3

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318SEP02 **SEMINAR** **L T P C**

0 0 4 2

OBJECTIVES:

- To work on a specific technical topic in Structural Engineering and acquire the skills of written and oral presentation.
- To acquire writing abilities for seminars and conferences.

SYLLABUS:

The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Structural Engineering and to engage in discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown dung the seminar.

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 The students will be trained to face an audience and to tackle any problem during group discussion in the Interviews.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	3	2	1	2	2	1	1	2	2	3	3	2
CO 2	3	2	2	2	1	2	1	1	2	1	1	2	2	3	3
CO 3	2	2	3	3	2	1	2	1	1	2	1	1	3	3	2
CO 4	2	2	3	2	1	1	2	1	2	1	1	2	2	2	3
CO 5	3	2	3	2	2	1	2	1	1	2	1	2	3	3	2

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318SEP03 **PROJECT WORK (PHASE – I)** **L T P C**

0 0 12 6

OBJECTIVES:

- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

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.

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	2	3	2	1	2	2	1	1	2	2	3	3	2
CO 2	3	2	2	2	1	2	1	1	2	1	1	2	2	3	3
CO 3	2	2	3	3	2	1	2	1	1	2	1	1	3	3	2
CO 4	2	2	3	2	1	1	2	1	2	1	1	2	2	2	3
CO 5	3	2	3	2	2	1	2	1	1	2	1	2	3	3	2

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318SEE01 **INDUSTRIAL STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To study planning and functional requirements of industrial structures
- To study the design of roofs, gantry girders and corbels
- To study the design of turbo generator foundation
- To study about power transmission structures
- To study the design of chimneys and cooling towers

UNIT-1 Planning and Functional Requirements **9**

Classification of Industries and Industrial structures - planning for LayoutRequirements regarding Lighting, Ventilation and Fire Safety – Protectionagainst noise and vibration - Guidelines of Factories Act.

UNIT-2 Industrial Buildings **9**

Roofs for Industrial Buildings - Steel and RCC - Gantry Girders - Design of Corbels and Nibs – Machine foundations.

UNIT-3 Power Plant Structures **9**

Types of power plants – Design of Turbo generator foundation – containment structures.

UNIT-4 Power Transmission Structures **9**

Transmission Line Towers - Substation Structures - Tower Foundations – Testing Towers.

UNIT-5 Auxilliary Structures **9**

Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: Able to know the Planning and Functional requirements of various industries.
CO2: Understand about the materials used and design of industry structural elements.
CO3: Realize the basic concepts and design of power plant structures.
CO4: Able to design power transmission structures.
CO5: Able to design Chimneys, cooling towers, bunkers and silos

REFERENCES:

1.**Manohar S.N**, "*Tall Chimneys - Design and Construction*", Tata McGraw Hill, 2010
2.**Santhakumar A.R.an d Murthy S.S**., "*Transmission Line Structures*", TataMcGraw Hill, 2009
3.**Srinivasulu P and Vaidyanathan.C**, "*Handbook of Machine Foundations*", TataMcGraw Hill, 2012.
4.**Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, KlaussDaniel,** "*Industrial Buildings: A Design Manual*", Birkhauser Publishers, 2004.

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5.Procs. Of Advanced course on "*Industrial Structures*", Structural EngineeringResearch Centre, Chennai, 1982.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	2	3	2	2	1	1	2	2	1	3	3	2
CO 2	2	3	2	2	3	1	2	1	2	2	1	1	2	3	2
CO 3	2	2	3	2	3	2	1	1	2	1	2	1	3	3	2
CO 4	3	2	2	3	2	1	1	2	2	1	1	2	2	2	3
CO 5	3	2	1	2	1	2	2	2	1	1	1	2	3	3	2

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318SEE02 **OFFSHORE STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the concept of wave theories
- To study about the forces acting on offshore structures
- To study about offshore soil and structure modelling
- To study the analysis of offshore structures
- To study the design of offshore structures

UNIT-1 Wave Theories **8**

Wave generation process, small and finite amplitude wave theories

UNIT-2 Forces on Offshore Structures **8**

Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison equation.

UNIT-3 Offshore Soil and Structure Modelling **9**

Different types of offshore structures, foundation modelling, and structural modelling
Effect of Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, chimneys.

UNIT-4 Analysis Of Offshore Structures **10**

Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT-5 Design Of Offshore Structures **10**

Design of platforms, helipads, Jacket tower and mooring cables and pipe lines

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To understand the wave generation process and wave theories
CO2: To analyse the forces acting on offshore structures
CO3: To analyse the effect of wind on structures and perform structure modelling
CO4: To do static method of analysis on offshore structures
CO5: To design offshore structures

REFERENCES:

1.**Chakrabarti, S.K.** "*Hydrodynamics of Offshore Structures*", Computational Mechanics Publications, 2007

2. **Dawson.T.H.,** "*Offshore Structural Engineering*", Prentice Hall Inc Englewood Cliffs, N.J. 2003

3. **Brebia, C.A and Walker, S**., "*Dynamic Analysis of Offshore Structures*", NewButterworths, U.K. 2009.

4.API, Recommended Practice for Planning, Designing and Constructing FixedOffshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex, 2000.

5.**Reddy, D.V. and Arockiasamy, M.,** "*Offshore Structures*", Vol.1 and Vol.2, 0Krieger Publishing Company, Florida, 2001.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	2	1	1	2	1	2	1	1	1	2	3	3
CO 2	2	2	3	2	1	2	1	2	1	1	2	1	3	2	3
CO 3	3	2	3	2	1	2	2	1	2	1	1	1	3	3	2
CO 4	2	2	1	3	2	1	2	1	1	2	2	1	2	3	3
CO 5	2	3	1	2	2	1	1	2	2	1	1	1	3	3	2

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318SEE03 PREFABRICATED STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES:

- To understand the principles of prefabrication
- To understand the behaviour of prefabricated structures
- To design prefabricated components and structural connections
- To know about construction of industrialised structures and shall be able to design some of the prefabricated elements
- To gain knowledge in the construction methods using these elements.

UNIT-1 Design Principles **9**

General Civil Engineering requirements, specific requirements for planning and layout of prefabricates plant. IS Code specifications Modular co-ordination, standardization, Disuniting of Prefabricates, production, transportation, and erection, stages of loading and codal provisions, safety factors, material properties, Deflection control, Lateral load resistance, Location and types of shear walls.

UNIT-2 Prefabricated Reinforced Concrete Structural Elements **9**

Prefabricated structures - Long wall and cross-wall large panel buildings, one way and two way prefabricated slabs, Framed buildings with partial and curtain walls, -Connections – Beam to column and column to column.

UNIT-3 Floors, Stairs and Roofs **9**

Types of floor slabs, analysis and design example of cored and panel types and two way systems, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT-4 Walls **9**

Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT-5 Industrial Buildings and Shell Roofs **9**

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper-prefabricated shells, Erection and jointing, joint design, hand book based design.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: Understand the basic concepts of prefabrication and their needs in construction industry.
CO2: Knowing the behaviour of prefabricated structures.
CO3: Design the cross section and joints of prefabricated units
CO4: To know about the joints for different structural connections
CO5: To design for abnormal loads in structures

REFERENCES:

1.**Structural Design Manual**, *Precast Concrete Connection Details*, Society for the Studies in the use of Precase Concrete, Netherland BetorVerlag, 1978.
2.**Hass, A.M**. *Precast Concrete Design and Applications*, Applied Science Publishers, 2003.

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3.**Promislow, V***Design and Erection of Reinforced Concrete Structures*, MIR Publishers, Moscow.
4.**Gerostiza. C.Z., Hendrikson, C. and Rehat D.R.,** *Knowledge Based Process Planning for Construction and Manufacturin*g, Academic Press, Inc., 2009.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	3	2	3	2	2	1	1	2	1	2	3	2	2
CO 2	3	2	3	2	2	1	1	2	2	2	1	1	2	3	2
CO 3	2	3	3	2	3	2	1	2	1	2	1	1	3	3	2
CO 4	2	2	3	2	-	1	1	2	1	1	2	1	2	2	3
CO 5	2	2	3	2	1	1	2	2	1	1	1	1	3	2	2

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318SEE04 SMART STRUCTURES AND APPLICATIONS

L	T	P	C
3	0	0	3

OBJECTIVES:

- To describe the basic principles and mechanisms of smart materials and devices
- To study about the components of smart systems
- To study about the materials used in smart construction
- To know about the control systems and its features
- To study about sensors in smart structures

UNIT-1 Introduction to passive and active systems **9**

Introduction to passive and active systems – need for active systems – smart systems –definitions and implications - active control and adaptive control systems – examples.

UNIT-2 Components of smart systems **9**

Components of smart systems– system features and interpretation of sensor data – proactive and reactive systems – demo example in component level – system level complexity

UNIT-3 Materials used in smart systems **9s**

Smart Materials (Physical Properties) piezoelectric materials, materials, magnetostrictive electrostrictive materials, magneto electric materials. magneto rheological fluids, electrorheological fluids, shape memory materials, fiber-optic sensors.

UNIT-4 Control Systems **9**

Control Systems – features – active systems – adaptive systems – electronic, thermal and hydraulic type actuators – characteristics of control systems – application examples.

UNIT-5 Sensors in smart structures **9**

Smart Sensor, Actuator and Transducer Technologies smart sensors: accelerometers; force sensors; load cells; torque sensors; pressure sensors; microphones; impact hammers; mems sensors; sensor arrays smart actuators: displacement actuators; force actuators; power actuators; vibration dampers; shakers; fluidic pumps; motors smart transducers: ultrasonic transducers; sonic transducers; air transducers.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To understand active and passive systems
CO2: To know the components of smart systems and its features
CO3: To know the materials used in smart system and its physical properties
CO4: To know about the types of actuators and the characteristics of control system
CO5: To know about the sensors used in smart structures

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REFERENCES:

1.Srinivasan, A.V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2000.

2.Yoseph Bar Cohen, Smart Structures and Materials 2003, The International Society for Optical Engineering 2003.

3.Brian Culshaw, Smart Structures and Materials, Artech House, Boston, 2006.

4.M.V.Gandhi and B.S.thompson, Smart Materials and Structures, Chapman and Hall 2002.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	3	3	2	1	1	2	2	1	2	3	2	2
CO 2	2	2	3	2	1	2	1	2	1	1	2	1	3	2	3
CO 3	3	2	3	2	1	2	2	1	2	1	1	1	3	3	2
CO 4	2	2	1	3	2	1	2	1	1	2	2	1	2	3	3
CO 5	2	3	1	2	2	1	1	2	2	1	1	1	3	3	2

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318SEE05 WIND AND CYCLONE EFFECTS ON STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- To study the consequence of wind effects, analysis and design of structures.
- To study the types of wind tunnelsand its modelling
- To study the effect of wind on structures
- To study the design chimneys and roofs using IS codes
- To study the effect of cyclone on structures

UNIT-1 Introduction **10**

Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, and drag effects.

UNIT-2 Wind Tunnel Studies **5**

Wind Tunnel Studies, Types of tunnels, Modelling requirements, Interpretation of results, Aero-elastic models.

UNIT-3 Effect of Wind on Structures **12**

Effect of Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, chimneys.

UNIT-4 IS Codes Applications **12**

Application of IS 875 code to design Buildings, Chimneys and Roofs

UNIT-5 Cyclone Effects **6**

Cyclone effect on structures, cladding design, window glass design.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To know the consequence of wind effects, analysis and design of structures.
CO2: To know the types of wind tunnels and its modelling
CO3: To know the effect of wind on structures
CO4: To design chimneys and roofs using IS codes
CO5: To analyse the effect of cyclone on structures

REFERENCES:

1.**Cook.N.J.,** "The *Designer's Guide to Wind Loading of Building Structures",* Butterworths, 1989.
2. **Kolousek.V**, **Pirner.M, Fischer.O and Naprstek.J,** "*Wind Effects on Civil Engineering Structures"*, Elsevier Publications, 1984
3. **Peter Sachs,** "*Wind Forces in Engineering"*, Pergamon Press, New York, 1972.
4.**Lawson T.V.,** *"Wind Effects on Building Vol. I and II",* Applied Science Publishers, London, 1980.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	3	3	3	2	2	1	1	2	1	2	1	2	2	2
CO 2	3	2	2	2	1	2	1	1	2	1	1	2	2	3	3
CO 3	2	2	3	3	2	1	2	1	1	2	1	1	3	3	2
CO 4	2	2	3	2	1	1	2	1	2	1	1	2	2	2	3
CO 5	3	2	3	2	2	1	2	1	1	2	1	2	3	3	2

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318SEE06 PRE-STRESSED CONCRETE STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES

- To understand the behaviour and performance of prestressed concrete structures
- To know about the different methods of prestressing
- To compare the behaviour of prestressed concrete members with that of the normal reinforced concrete structures
- To understand the performance of composite members
- To learn the design of prestressed concrete structures

UNIT-1 Principles of Pre-stressing **9**

Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts.

UNIT-2 Design of Flexural Members **9**

Behaviour of flexural members, determination of ultimate flexural strength – Codal provisions - Design of flexural members, Design for shear, bond and torsion, Design of end blocks.

UNIT-3 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

UNIT-4 Design of Tension And Compression Members **9**

Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure – its application in the design piles, flag masts and similar structures.

UNIT-5 Design of Composite Members **9**

Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications.

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: Design a prestressed concrete beam accounting for losses.
CO2: Design for flexure and shear.
CO3: Design the anchorage zone for post tensioned members and deflection in beams.
CO4: Design composite members and continuous beams.
CO5: Design water tanks, pipes and poles.

REFERENCES:

1.**Krishna Raju,** "*Prestressed Concrete"*, Tata McGraw Hill PublishingCo, 2000.
2.**Sinha.N.C. andRoy.S.K**, "*Fundamentals of Prestressed Concrete",*S.Chandand Co., 2008
3. **Liyn.T.Y.** *"Design of Prestressed Concrete Structures",* John Wiley and SonsInc, 2001.
4.**Evans, R.H. and Bennett, E.W.,** *"Prestressed Concrete*", Champman and Hall, London, 2008.
5.**Rajagopalan.N,** *PrestressedConcrete, Narosa* Publications, New Delhi, 2008.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	2	2	3	3	2	2	1	1	2	1	1	3	3	2
CO 2	3	3	2	1	1	1	1	1	2	2	1	2	3	3	2
CO 3	2	3	2	3	2	1	2	2	2	2	1	2	2	3	3
CO 4	3	3	3	2	3	1	1	1	2	2	2	2	3	2	2
CO 5	2	3	3	3	2	2	2	1	1	2	2	2	3	3	3

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318SEE07 **POWER PLANT STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES:

- To enable the students familiar with various planning and lay out of power plants
- To study the design of steel and concrete chimneys
- To be familiar with cooling towers
- To make the student to understand the design of machine foundations and turbo generator foundations
- To study the design of silos and bunkers

UNIT-1 Power Plants **9**

Planning and Layout of different types of Power plants.

UNIT-2 Chimneys **9**

Analysis and Design of Chimneys - IS codal provisions.

UNIT-3 Cooling Towers **9**

Design of Induced draught and natural draught cooling towers.

UNIT-4 Foundations **9**

Machine foundations and Turbo generator foundations.

UNIT-5 Material Handling Structures **9**

Silos and Bunkers

TOTAL:45 PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 The student will be able to formulate the planning and layout of different power plants.
CO.2 The student can analyse and design chimneys as per codal provisions
CO.3 The student will be efficient in design of cooling towers.
CO.4 The student may be familiar with all types of machine foundations. The students will be able to design all types of material handling systems.

CODE BOOKS:

1.IS: 456-2000 - Code of Practice for Plain and Reinforced Concrete.
2.IS 6533 (Part 2) -1989 - Code of practice for design and construction of steel chimneys.
3.IS: 875 (Part 1 to 5) - Code of Practice for Design loads.
4.IS:9178-1980 - Criteria for Design of Steel Bins for Storage of Bulk Materials
5.IS: 2974 (Part I toV) - Code of practice for design and construction of machine foundations.
6.IS 4995 (Part II) -1974 - General Requirements and assessment of bin Loads.
7.IS 6060 -1971 - Code of practice for Day lighting of factory buildings.

REFERENCES:

1.Krishna Raju N. “Advanced Reinforced Concrete Design”, CBS Publishers and Distributors, 2nd Edition, 2008.

2. Srinivasulu, P and Vaidyanathan, G.V., “Handbook of Machine Foundations”, Tata McGraw Hill, 2nd Edition, 2009.
3.Vijay K. Puri and ShamsherPrakash, “Foundations for Machines: Analysis and Design (Series in Geotechnical Engineering)”, John Wiley & Sons, 2nd Edition, 2000.
4.Eldey Mc. K., Naxey Brooke K.K. “The Industrial Cooling Tower with special reference to design, construction, operation and maintenance of water cooling tower”, Elsevier Publishing company, 1st Ed., 2000.

Course Outcomes	**Programme Outcomes (PO’s)**												**(PSO’s)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	3	3	2	2	1	1	1	2	2	3	2	2
CO 2	2	3	3	3	2	2	1	1	2	2	1	1	2	3	2
CO 3	3	3	2	2	3	1	1	2	2	1	1	2	2	2	3
CO 4	3	2	2	3	3	2	2	2	1	1	1	2	2	3	2
CO 5	3	2	3	3	3	2	2	1	1	1	2	2	3	2	2

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318SEE08 ENERGY EFFICIENT STRUCTURES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the concepts of energy efficient building
- To study the different climate types and their influence in building design
- To study the thermal environment of structures
- To study the principles of solar heating and cooling systems
- To study the energy survey and energy audit in buildings

UNIT-1 Concepts Of Energy Efficient Building **9**

Need of energy in buildings - assessment - Energy consumption pattern of various types of buildings - Factors influencing the energy use in building - Concepts of energy efficient building.

UNIT-2 Influence of Climate **9**

Study of Climate types - their influence in building design - Environmental factors affecting building design -Analysis of thermal and visual environment.

UNIT-3 Influence of Heat and Light **9**

Heat gain and loss phenomenon in buildings - Thermal performance parameters - Role of building enclosures, openings and materials in thermal environment - Basic principles of light and daylight - Energy efficient light design of buildings - Daylight design of buildings.

UNIT-4 Appliances in Buildings **9**

Major appliances in building and their energy consumptions - Principles of solar heating, cooling and power (PV) systems - Integration of energy efficient appliances with the buildings.

UNIT-5 Energy Audit **9**

Energy survey and energy audit of buildings - Calculation of energy inputs and utilization in buildings – Energy audit reports of buildings - Concepts of Green Buildings - energy rating of buildings.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To understand the concepts of energy efficient building

CO2: To understand te influence of climate and environmental factors affecting building design

CO3: To gain knowledge on design of buildings according to thermal environment

CO4: To acquire the skills of utilisation of appliances and the principles

CO5: To obtain the knowledge of energy audit in buildings.

CODE BOOKS:

1.‘Handbook on functional requirements of buildings’, Parts 1-4, SP: 41 (S&T), Bureau of Indian Standards – 1995.

REFERENCES:

1.Chand, I. and Bhargava, P.K., “The Climatic Data Handbook”, Tata McGraw Hill Publishing Company Limited, New Delhi 1999.

2. Threlkeld, J.L,”Thermal Environmental Engineering”, Printice-Hall, Englewood Cliffs, NJ,

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3.LalJayamaha, “Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance”, McGraw Hill, 2007.
4.Krishnan, A., Baker, N., Yannas, S. and Szokolay, S.V., “Climate Responsive Architecture – A Design Hand Book for Energy Efficient Buildings”, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2001.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	3	3	3	2	2	1	1	1	2	2	3	2	2
CO 2	3	2	3	2	3	2	3	2	1	1	1	2	3	2	3
CO 3	3	2	2	3	2	3	2	2	3	2	2	1	2	3	2
CO 4	2	3	2	3	3	2	3	2	1	2	3	2	3	3	3
CO 5	3	2	2	3	3	2	2	3	2	1	2	2	2	2	3

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318SEE09 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C
3 0 0 3

COURSE OBJECTIVES:

- To study the design of steel concrete sandwiched construction
- To study the design of composite beams, slabs and columns
- To design connections in composite structures
- To study the behaviour of box girder bridges and its design concepts
- .To gain knowledge in concrete composite construction in buildings

UNIT-1 Introduction **9**

Introduction to steel - concrete composite construction - theory of composite structures - construction - Design of steel-concrete steel sandwiched construction.

UNIT-2 Design of Composite Members. **9**

Design of composite beams, slabs, columns, beam – columns

UNIT-3 Design of Connections and composite trusses **9**

Types of connections, Design of connections in the composite structures – shear connections. Degree of shear connection – Partial shear interaction- design of composite trusses.

UNIT-4 Composite Box Girder Bridges **9**

Introduction - behaviour of box girder bridges - design concepts.

UNIT-5 Case Studies **9**

Case studies on steel - concrete composite construction in buildings – seismic behaviour of composite structures.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To possess knowledge of the composite behaviour of structures
CO2: To design various composite structural elements such as beams, columns, floors, slabs and concrete filled steel tubes
CO3: To understand the behaviour of box girder bridges and the design concepts of the same
CO4: The student will have practical knowledge of construction and design of various structural elements
CO5: To understand the concepts through case studies.

REFERENCES:

1.**Johnson R.P.,** "*Composite Structures of Steel and Concrete*", BlackwellScientific Publications, UK, 2004.
2.**Oehlers D.J. and Bradford M.A**., "*Composite Steel and Concrete StructuralMembers, Fundamental behaviour*", Pergamon press, Oxford, 2005.
3.Proceedings of Workshop on "*Steel Concrete Composite Structures*", AnnaUniversity, 2007.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	2	3	3	2	2	2	1	1	1	2	3	3	3
CO 2	3	3	2	1	1	1	1	1	2	2	1	2	3	3	2
CO 3	2	3	2	3	2	1	2	2	2	2	1	2	2	3	3
CO 4	3	3	3	2	3	1	1	1	2	2	2	2	3	2	2
CO 5	2	3	3	3	2	2	2	1	1	2	2	2	3	3	3

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318SEE10 STRUCTURES IN DISASTER PRONE AREAS L T P C
3 0 0 3

OBJECTIVES:

- To understand various types of disasters
- To study the philosophy for design to resist earthquake
- To study the seismic vulnerability of urban areas
- To use modern materials and techniques in disaster reduction
- To study the various stages of disaster management

UNIT-1 Introduction 9

Introduction - Types of disasters - Disaster mitigating agencies and their organization structure at different levels - Overview of disaster situations in India - Vulnerability profile of India and vulnerability mapping including disaster prone areas, communities and places.

UNIT-2 Response of the Structure 9

Philosophy for design to resist Earthquake, Cyclone and flood –Bye-laws of urban and Semi-Urban areas-Traditional and modern structures. Response of dams, bridges, buildings - Testing and evaluation – Classification of structures from safety point of view - Methods of strengthening for different disasters – Qualification test.

UNIT-3 Seismic Vulnerability of Urban Areas 9

Seismic response of R.C frames buildings with soft first storey - Preparedness and planning for an urban earthquake disaster - Tsunami and its impact - Urban settlements.

UNIT-4 Modern Materials and Techniques 9

Use of modern materials their impact on disaster reduction – Use of modern analysis, design and construction techniques - Optimization for performance - Damage surveys – Maintenance and modifications to improve hazard resistance – Different types of foundation and its impact on safety.

UNIT-5 Disaster Management 9

Landslide hazards zonation mapping - Geo-environmental problems associates with the occurrence of landslides - Role of remote sensing, science and technology - Rehabilitation programmes - Management of Relief Camp - information systems and decision making tools, voluntary agencies and community participation - various stages of disaster Management.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 To overview different disaster situations,

CO2: To understand various types of disasters

CO3: To be prepared and planned in earthquake disaster and Tsunami

CO4: To use modern materials for disaster risk reduction

CO5: To know about the geo-environmental problems associated with the occurrence of landslides

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CODE BOOKS:

1.IS 1893: 2002 (Part 1) - Criteria for Earthquake Resistant Design of Structures – General.
2.IS 4326: 1993 - Code of Practice for Earthquake Resistant Design and Construction of Buildings.

REFERENCES:

1.Allen, R.T. and Edwards, S.C., "Repair of Concrete Structures", Blakie and Sons, 2005.
2. Moskvin V, "Concrete and Reinforced Structures – Deterioration and Protection", MirPublishers, Moscow,03
3. Singh R.B, "Disaster Management", Rawat Publications, 2000.
4.Jon Ingleton, Tulor Rose, "Natural Disaster management", 1999.
5.Sachindra Narayan, "Anthropology of Disaster management", Gyan Publishing house.

Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	3	3	3	2	3	2	2	2	2	1	1	1	3	2	2
CO 2	2	3	2	3	2	1	2	2	1	1	2	2	2	2	3
CO 3	2	3	2	2	3	2	1	2	2	1	1	1	3	3	2
CO 4	3	2	3	3	2	3	2	1	1	2	2	1	2	2	3
CO 5	2	3	2	3	3	2	1	1	2	2	1	1	3	3	2

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318SEE11 RANDOM VIBRATIONS AND STRUCTURAL RELIABILITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand concepts of structural safety
- To study the resistance distribution and parameers
- To study statistical analysis of materials, structural reliability analysis
- To know the reliability based design
- To study about decision analysis

UNIT-1 Random Variables **9**

Concepts of structural safety: Design Methods, statistics and probability; data reductions, histograms, sample correlation, random variable, discrete and continuous variables and common probability distribution.

UNIT-2 Resistance distribution and parameters **9**

Statistical analysis of materials, steel, concrete, bricks and mortar; Dimensional variations, characterization of variables and allowable stresses based on specified reliability. Probabilistic analysis for live load, gravity load and wind load.

UNIT-3 Structural Reliability **9**

Computation of basic structural reliability, reliability analysis of simple element such as beam and column. Reliability methods, basic variables, first order second moment methods (FOSM) and concept of reliability index. Reliability of structural systems: Redundant and non-redundant systems, series, parallel and mixed systems.

UNIT-4 Reliability based design **9**

Load and resistance factors of design, safety checking formats and code calibrations, ARE Code provision, Introduction to stochastic process.

UNIT-5 Decision Analysis **9**

Introduction, simple risk decision problems, decision problems, decision models, decision tree, decision criteria, decision based on existing information, prior analysis.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: To design for structural safety
CO2: To perform probabilistic analysis
CO3: To compute the structural reliability analysis of beams and columns
CO4: To determine the load and resistance factors of design
CO5: To solve simple risk decision problems

REFERENCES:

1.R.Ranganatham: Reliability Analysis and Design of Structures, McGraw- Hill

2.Edward Haugen: Probabilistic Approaches to Design, John Wiley and Sons, London

3. R.E. Melchers, Structural Reliability- Analysis and Prediction, Ellis Horwood Ltd., Chichester, UK

4.A Papoulis, 1993, Probability, random variables and stochastic processes, McGraw-Hill, NY.

5.R E Melchers, 1999, Structural reliability analysis and prediction, John Wiley, Chichester.

6.O. Ditlevsen, H. O. Madsen, Structural Reliability Methods, Wiley, 1 edition, 1996.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	3	2	3	2	3	1	1	2	2	1	1	2	3	3	2
CO 2	3	2	3	2	3	2	3	2	1	1	1	2	3	2	3
CO 3	3	2	2	3	2	3	2	2	3	2	2	1	2	3	2
CO 4	2	3	2	3	3	2	3	2	1	2	3	2	3	3	3
CO 5	3	2	2	3	3	2	2	3	2	1	2	2	2	2	3

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318SEE12 **DESIGN OF SUB STRUCTURE** **L T P C**
3 0 0 3

OBJECTIVES:

- To study the selection of foundation and bearing capacity of soil
- To study the design of different type of shallow foundations like isolated, raft and combined footing.
- To familiarise with the design of pile foundation and pile caps.
- To design well and caissons foundations.
- To design various types of tower foundations.

UNIT-1 Site Investigation, Selection of Foundation and Bearing Capacity 9

Objectives – Methods of exploration – Depth of exploration – Sample disturbance – Factors governing location and depth of foundation – In situ testing of Soils – Plate load test – Geophysical methods – Selection of foundation– Bearing capacity of shallow foundations by Terzaghi's theory, Meyerhof's theory, and codal provisions – Bearing capacity of footing subjected to inclined and eccentric loading – Problems – Types of shear failure – General principles of foundation design.

UNIT-2 Design of Shallow Foundations 9

Types of shallow foundations – General principles of design of reinforced concrete shallow foundations – Structural design of isolated and combined footing – Structural design of rafts by conventional method – Principles of design of buoyancy raft and basement (no design problems).

UNIT-3 Pile Foundation 9

Pile foundations – Types – General principles of design – Estimation of load capacity of piles by static and dynamic formulae – Detailing of reinforcement as per IS 2911 - Design of pile caps – Settlement analysis of pile groups – Negative skin friction – Pile load tests.

UNIT-4 Well and Caisson Foundations 9

Well and caisson foundations – Structural elements of Caisson and Well foundations – Elements of well foundation – Forces acting on Caisson and well foundations – Design of individual components of Caisson and well foundation(only forces acting and design principles) – Sinking of well – Shifts and tilts in well foundations – Preventive measures.

UNIT-5 Foundations of Transmission Line Towers 9

Introduction - Necessary information - Forces on tower foundations - General design criteria - Choice and type of foundation - Design of foundation for transmission towers.

TOTAL:45PERIODS

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO1: Attain the perception of site investigation to select suitable type of foundation based on soil category
CO2: To design different types of shallow foundation.
CO3: To design different types of pile and evaluation of pile group capacity.
CO4: To design different types of well foundation
CO5: To design transmission line tower foundation.

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CODE BOOKS:

1.IS 2911: Part 1: Sec 1: 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 1 Driven cast in-situ concrete piles.
2.IS 2911: Part 1: Sec 2: 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 2 Bored cast-in-situ piles.
3.IS 2911: Part 1: Sec 3: 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 3 Driven precast concrete piles.
4.IS 2911: Part 1: Sec 4: 1984 Code of practice for design and construction of pile foundations: Part 1 concrete piles, Section 4 Bored precast concrete piles.
5.IS 2911: Part 2: 1980 Code of practice for designing and construction of pile foundations: Part 2 Timber piles.
6.IS 2911: Part 3: 1980 Code of practice for design and construction of pile foundations: Part 3 Under reamed piles
7.IS 2911: Part 4: 1985 Code of practice for design and construction of pile foundations: Part 4 Load test on piles
8.IS 6403: 1981 Code of practice for determination of bearing capacity of Shallow Foundations

REFERENCES:

1.Tomlinson. M.J. and Boorman, R., "Foundation design and construction", VI edition, ELBS Longman, 2001.
2. Nayak. N.V., "Foundation design manual for practicing engineers", DhanpatRai and Sons.
3. Arora. K.R, "Soil Mechanics & Foundation Engineering", Standard Publishers & Distributors, 2005.

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Course Outcomes	Programme Outcomes (PO's)												(PSO's)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO 1	2	2	3	3	3	2	1	1	2	2	1	1	3	2	3
CO 2	3	3	2	1	1	1	1	1	2	2	1	2	3	3	2
CO 3	2	3	2	3	2	1	2	2	2	2	1	2	2	3	3
CO 4	3	3	3	2	3	1	1	1	2	2	2	2	3	2	2
CO 5	2	3	3	3	2	2	2	1	1	2	2	2	3	3	3

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M.E. - STRUCTURAL ENGINEERING

CURRICULUM

SEMESTER IV

Subject Code	Subject Name	L	T	P	C	IA	EA	Total
418SEP01	Project Work (Phase - II)	0	0	32	16	50	50	100

Total Credits: 16

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418SEP01 **PROJECT WORK (PHASE – II)** **L T P C**

0 0 32 16

OBJECTIVES

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

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.

COURSE OUTCOMES:

After undergoing the course, the students will have ability to

CO.1 On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.
CO2: To design different types of shallow foundation.
CO3: To design different types of pile and evaluation of pile group capacity.
CO4: To design different types of well foundation
CO5: To design transmission line tower foundation.

Course Outcomes	**Programme Outcomes (PO's)**												**(PSO's)**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO 1	2	3	3	3	2	2	2	1	1	2	2	1	3	2	2
CO 2	2	3	2	3	2	1	2	2	1	1	2	2	2	2	3
CO 3	2	3	2	2	3	2	1	2	2	1	1	1	3	3	2
CO 4	3	2	3	3	2	3	2	1	1	2	2	1	2	2	3
CO 5	2	3	2	3	3	2	1	1	2	2	1	1	3	3	2

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G
RANGANATH

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