SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur-603203.

DEPARTMENT OF CIVIL ENGINEERING

Post Graduate

CURRICULA AND SYLLABI.

(Regulations 2019)

Programme: M.E. Structural Engineering

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University, Chennai,
'A' grade accredited by NAAC, NBA accredited ISO 9001: 2015 certified)
M. E. STRUCTURAL ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA & SYLLABI (I –IV SEMESTERS)

1.PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

1. To produce graduates who can understand their ethical, environmental as well as professional responsibilities so that they appreciate the impact of the engineering solutions which have sustainability over society and the nation.
2. To develop the graduates who will exhibit strong technical ability to create & synthesize data using relevant tools and concepts, for providing sustainable solutions to civil engineering problems and projects.
3. To equip the graduates with suitable skills making them industry ready when they leave the portals of the Institute and to become a competent distinguished Professional Civil Engineer.
4. To produce students who can exhibit attitude, professionalism, ability to communicate with team members and adapt to the latest technology by engaging themselves in life-long learning

2.PROGRAMME OUTCOMES (POs):

After going through the two years of study, our Structural Engineering Graduates will exhibit ability to:

PO#	Graduate Attribute	Programme Outcome
1	Engineering knowledge	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation for the solution of complex engineering problems.
2	Problem analysis	Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3	Design/development of solutions	Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for public health and safety, and cultural, societal, and environmental considerations.
4	Conduct investigations of	Use research-based knowledge and research

	complex problems	methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
5	Modern tool usage	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling to complex engineering activities, with an understanding of the limitations.
6	The engineer and society	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
7	Environment and sustainability	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8	Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
9	Individual and team work	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
10	Communication	Communicate effectively on complex engineering activities with the engineering community and with the society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
11	Project management and finance	Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
12	Life-long learning	Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change

3. PROGRAM SPECIFIC OUTCOMES (PSOs):

By the completion of Structural Engineering program the student will have following Program specific outcomes

1. Establish a Civil Engineering career in industry, government or academic field and achieve professional expertise as appropriate.
2. Execute innovation and excellence in Civil engineering problem solving and design in global and societal contexts.
3. Commit to lifelong learning and professional development in the Civil Engineering field to stay updated in technology, research topics and contemporary issues.

4. Understand the fundamentals of Civil Engineering in commercial contexts and in expediting construction projects.

4. PEO / PO Mapping:

PROGRAMME EDUCATIONAL OBJECTIVES	PROGRAMME OUTCOMES												PROGRAM SPECIFIC OUTCOMES			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
I	3	1	1	1	2	3	3	3	2	3	1	3	3	1	1	1
II	2	3	3	3	3	2	3	2	2	2	3	3	2	3	3	3
III	1	-	-	3	3	3	1	1	3	-	2	1	1	-	-	3
IV	3	-	-	1	3	3	3	-	3	3	2	3	3	-	-	1

Contribution: 1. Reasonable 2. Significant 3. Strong

MAPPING – M.E - STRUCTURAL ENGINEERING

			PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Year I	Sem I	Advanced Mathematical Methods	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
		Advanced Concrete and Steel structures		2	2	-	2	2	-	-	-	1	2	-	-	2	-	2
		Dynamics of Structures	1	2	2	-	1	-	-	-	-	2	1	-	2	-	3	2
		Theory of elasticity and plasticity	-	1	1	-	1	-	1	-	-	2	2	2	-	-	2	-
		Advanced Structural Engineering Laboratory	2	2	2	2	2	2	2	3	-	-	-	3	-	2	-	3
Year I	Sem II	Stability of Structures	1	1	2	2	2	1	-	1	-	-	-	1	1	2	-	2
		Experimental Techniques	-	1	2	-	2	-	2	-	-	-	1	2	-	3	2	-
		Finite Element Analysis of structures	2	1	3	2	2	-	-	2	2	2	-	-	-	2	-	3
		Practical Training I (2 weeks)	2	2	2	2	2	-	-	2	2	1	2	2	3	2	-	3
Year II	Sem III	Earthquake Analysis and Design of Structures	2	2	1	-	2	1	-	-	-	-	-	1	2	1	-	-
		Advanced Concrete Technology	1	1	2	2	2	1	1	1	1	2	-	2	1	1	2	-
		Seminar	2	2	2	2	2	-	-	2	2	1	2	2	3	2	-	3
		Project work -	-	2	2	-	2	-	2	-	3	2	2	3	2	2	2	3

		Phase I																
		Practical Training II	2	2	2	2	2	-	-	2	2	1	2	2	3	2	-	3
Year II	Sem IV	Practical Training III	2	2	2	2	2	-	-	2	2	1	2	2	3	2	-	3
		Project work - Phase II	-	2	2	-	2	-	2	-	3	2	2	3	2	2	2	3
Professional Elective-I & II																		
Year I	Sem I	Maintenance and rehabilitation of structures	1	2	-	-	3	2	-	-	2	-	-	2	-	-	2	2
		Prefabricated structures	1	2	2	-	3	-	2	-	-	-	1	1	-	2	-	-
		Off shore structures	2	2	3	2	2	-	-	-	2	1	-	1	-	-	3	2
		Matrix method for structural analysis	2	2	2	1	3	2	2	-	-	2	-	2	-	-	2	2
Professional Elective-III & IV																		
Year I	Sem II	Theory of Plates	2	1	1	2	1	1	-	1	1	1	-	1	1	1	-	-
		Mechanics of Composite materials	1	2	-	2	2	2	2	-	-	2	2	1	2	1	-	-
		Analysis and design of Tall Buildings	1	2	3	-	2	-	-	1	-	1	-	1	2	2	-	1
		Industrial Structures	1	2	3	1	2	-	1	2	2	3	1	1	2	-	1	-
		Prestressed Concrete	2	2	3	1	2	-	1	1	-	1	1	1	1	1	1	-
		Wind and Cyclone effects of structures	-	2	3	1	2	-	1	1	2	-	2	1	1	1	2	-
Professional Elective-V & VI																		
Year II	Sem III	Nonlinear Analysis of Structures	2	2	3	3	3	-	-	1	-	-	-	2	-	3	2	-

		Design of Sub Structures	-	3	3	2	-	3	-	2	-	3	-	2	-	2	2	2
		Optimization of Structures	-	2	3	2	3	-	-	-	2	-	-	2	-	2	2	-
		Design of Steel Concrete Composite Structures	-	1	3	3	-	1	1	2	-	2	-	1	2	3	1	2
		Design of Bridges	1	2	3	2	-	2	-	2	-	2	2	1	-	2	-	1
		Design of Shell and Spatial Structures	2	-	3	-	3	3	-	3	-	2	-	3	-	2	2	-
		Computer Aided Analysis and Design	1	2	3	2	2	-	-	-	-	2	-	-	2	3	-	-

SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution Affiliated to Anna University, Chennai,
'A' grade accredited by NAAC, NBA accredited ISO 9001: 2015 certified)
M. E. STRUCTURAL ENGINEERING
REGULATIONS – 2019
CHOICE BASED CREDIT SYSTEM
CURRICULA & SYLLABI (I –IV SEMESTERS)

SEMESTER I

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918103	Advanced Mathematical Methods	FC	4	4	0	0	4
2.	1917101	Advanced Concrete and Steel Structures	PC	3	3	0	0	3
3.	1917102	Dynamics of Structures	PC	3	3	0	0	3
4.	1917103	Theory of Elasticity and Plasticity	PC	3	3	0	0	3
5.	191710X	Professional Elective-I	PE	3	3	0	0	3
6.	191710X	Professional Elective-II	PE	3	3	0	0	3
PRACTICALS								
7.	1917108	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
			TOTAL	**23**	**19**	**0**	**4**	**21**

SEMESTER II

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917201	Stability of Structures	PC	3	3	0	0	3
2.	1917202	Experimental Techniques	PC	3	3	0	0	3
3.	1917203	Finite Element Analysis of structures	PC	3	3	0	0	3
4.	191720X	Professional Elective-III	PE	3	3	0	0	3
5.	191720X	Professional Elective-IV	PE	3	3	0	0	3

PRACTICALS								
6.	1917210	Practical Training I	EEC	-	0	0	0	1
			TOTAL	**15**	**15**	**0**	**0**	**16**

SEMESTER III

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917301	Earthquake Analysis and Design of Structures	PC	3	3	0	0	3
2.	1917302	Advanced Concrete Technology	PC	3	3	0	0	3
3.	191730X	Professional Elective-V	PE	3	3	0	0	3
4.	191730X	Professional Elective-VI	PE	3	3	0	0	3
PRACTICALS								
5.	1917311	Seminar	EEC	2	0	0	2	1
6.	1917312	Project Work - Phase I	EEC	12	0	0	12	6
7.	1917313	Practical Training II	EEC	-	0	0	0	1
			TOTAL	**26**	**12**	**0**	**14**	**20**

SEMESTER IV

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	1917401	Practical Training III	EEC	-	0	0	0	1
2.	1917402	Project Work - Phase II	EEC	24	0	0	24	12
			TOTAL	**24**	**0**	**0**	**24**	**13**

SUMMARY

DEPARTMENT OF CIVIL ENGINEERING

M.E. STRUCTURAL ENGINEERING

S.No	Subject Area	Credits as per Semester				Credits Total	%
		I	II	III	IV		
1.	**HS**						
2.	**FC**	4				**4**	5.71
3.	**BS**						
4.	**ES**						
5.	**PC**	11	9	6		**26**	37.14
6.	**PE**	6	6	6		**18**	25.71
7.	**OE**						
8.	**EEC**		1	8	13	**22**	31.43
9.	**PCD**						
	Total	**21**	**16**	**20**	**13**	**70**	**100**

TOTAL CREDITS: 70

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	1917210	Practical Training I	EEC	-	0	0	0	1
2.	1917311	Seminar	EEC	2	0	0	2	1
3.	1917312	Project Work - Phase I	EEC	12	0	0	12	6
4.	1917313	Practical Training II	EEC	-	0	0	0	1
5.	1917401	Practical Training III	EEC	-	0	0	0	1
6.	1917402	Project Work - Phase II	EEC	24	0	0	24	12

FOUNDATION COURSES (FC)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1918103	Advanced Mathematical Methods	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917101	Advanced Concrete and Steel Structures	PC	3	3	0	0	3
2.	1917102	Dynamics of Structures	PC	3	3	0	0	3
3.	1917103	Theory of Elasticity and Plasticity	PC	3	3	0	0	3
4.	1917108	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
5.	1917201	Stability of Structures	PC	3	3	0	0	3
6.	1917202	Experimental Techniques	PC	3	3	0	0	3
7.	1917203	Finite Element Analysis of Structures	PC	3	3	0	0	3
8.	1917301	Earthquake Analysis and Design of Structures	PC	3	3	0	0	3
9.	1917302	Advanced Concrete Technology	PC	3	3	0	0	3

PROFESSIONAL ELECTIVE I & II (PE)

SEMESTER I

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917104	Maintenance and Rehabilitation of Structures	PE	3	3	0	0	3
2.	1917105	Prefabricated Structures	PE	3	3	0	0	3
3.	1917106	Off shore Structures	PE	3	3	0	0	3
4.	1917107	Matrix Method for Structural Analysis	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III & IV

SEMESTER-II

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917204	Theory of Plates	PE	3	3	0	0	3
2.	1917205	Mechanics of Composite Materials	PE	3	3	0	0	3
3.	1917206	Analysis and Design of Tall Buildings	PE	3	3	0	0	3
4.	1917207	Industrial Structures	PE	3	3	0	0	3
5.	1917208	Prestressed Concrete	PE	3	3	0	0	3
6.	1917209	Wind and Cyclone Effects of Structures	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE V & VI

SEMESTER-III

SL NO.	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	1917303	Nonlinear Analysis of Structures	PE	3	3	0	0	3
2.	1917304	Design of Sub Structures	PE	3	3	0	0	3
3.	1917305	Optimization of Structures	PE	3	3	0	0	3
4.	1917306	Design of Steel Concrete Composite Structures	PE	3	3	0	0	3
5.	1917307	Design of Bridges	PE	3	3	0	0	3
6.	1917308	Design of Shell and Spatial Structures	PE	3	3	0	0	3
7.	1917309	Computer Aided Analysis and Design	PE	3	3	0	0	3

1918103 ADVANCED MATHEMATICAL METHODS L T P C

4 0 0 4

OBJECTIVES:

- The main objective of this course is to provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering.
- This course covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of Variations, Conformal Mapping and Tensor Analysis.
- Application of these topics to the solution of problems in physics and engineering is stressed.

UNIT-I: LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATION 12

Laplace transform: Definitions – Properties – Transform error function – Bessel's function – Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace Transform: Complex inversion formula – Solutions to partial differential equations: Heat equation – Wave equation.

UNIT-II: FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Fourier transform: Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation – Wave equation – Laplace and Poisson's equations.

UNIT-III: CALCULUS OF VARIATIONS 12

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

problems – Direct methods – Ritz and Kantorovich methods.

UNIT-IV: CONFORMAL MAPPING AND APPLICATIONS 12

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications : Fluid flow and heat flow problems.

UNIT-V: TENSOR ANALYSIS 12

Summation convention – Contravariant and covariant vectors – Contraction of tensors – Inner product – Quotient law – Metric tensor – Christoffel symbols – Covariant differentiation – Gradient- Divergence and curl.

TOTAL : 60 PERIODS

REFERENCES :

1. Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineersǁ, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolc, L.D., “Calculus of Variations", Dover Publications Inc., New York, 2007.
3. Kay, D. C., "Tensor Calculus”, Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
4. Mathews, J. H., and Howell, R.W., “Complex Analysis for Mathematics and Engineering”, 5th Edition, Jones and Bartlett Publishers, 2006.
5. Naveen Kumar, “An Elementary Course on Variational Problems in Calculus”, Narosa Publishing House, 2005.
6. Saff, E.B and Snider, A.D, “Fundamentals of Complex Analysis with Applications in Engineering, Science and Mathematics”, 3rd Edition, Pearson Education, New Delhi, 2014.
7. Sankara Rao, K., “Introduction to Partial Differential Equations”, Prentice Hall of India Pvt. Ltd., New Delhi, 1997.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
2	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
3	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
4	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-
5	3	2	2	1	-	-	-	-	-	-	-	1	-	-	-	-

1917101 ADVANCED CONCRETE AND STEEL STRUCTURES L T P C
3 0 0 3

OBJECTIVES:

- 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 impart knowledge on the design of RCC beams under combined shear, torsion and bending, limit state of serviceability for structural members.
- To make the students confident 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-I: DESIGN PHILOSOPHY 9

Limit state design - beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Code. Interaction curve generation for axial force and bending. Comparative study with Euro Code & ACI Code.

UNIT-II: SPECIAL RC ELEMENTS 9

Design of slender columns - Design of RC walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors, Pile caps.

UNIT-III: 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. Yield line theory - Equilibrium and Virtual work method - Analysis and design of square slab with different boundary conditions subjected to UDL and concentrated loads - Analysis and design of rectangular slab with different boundary conditions subjected to UDL and concentrated loads.

UNIT-IV: DESIGN OF CONNECTIONS 9

Types of connections – Welded and Bolted – 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 HSFG bolted connections.

UNIT-V: DESIGN OF LIGHT GAUGE STEEL STRUCTURES 9

Introduction to Direct Strength Method - 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

OUTCOMES:

- On completion of this course the students will have the confidence to design various concrete structures.
- Will be able to design structural elements by limit state design and detail the same for ductility as per codal requirements.
- The students will have the confidence to design various special concrete elements.
- The students will have the confidence to design various steel structural

components.

- Will have knowledge in design procedures for Light Gauge Steel Structures.

REFERENCES:

1. N. Krishna Raju, “Advanced Reinforced Concrete Design (IS 456-2000)”, CBS Publishers & Distributors, New Delhi, 2010.
2. Arthur H.Nilson, George Winter, “Design of Concrete Structures”, 11th Edition, McGraw Hill Book Co., New York, 2009.
3. P. Bhatt, T.J. MacGinley, B.S. Choo, Ban Seng Choo and Thomas J. MacGinley, “Reinforced Concrete; Design theory and examples”, Routledge Publisher, 2006.
4. Edward G. Nawy, “Reinforced Concrete – A fundamental Approach”, 6th Edition, Prentice Hall, 2008.
5. P.C. Varghese, “Advanced Reinforced Concrete Design”, 2nd Edition, Prentice Hall of India Pvt., Ltd., New Delhi, 2009.
6. N. Krishna Raju, “Advanced Reinforced Concrete Design (IS 456-2000)”, CBS Publishers & Distributors, New Delhi, 2010.
7. Unnikrishna Pillai and Devdas Menon, “Reinforced Concrete Design”, Tata Mc Graw Hill Publishing Company Ltd., New Delhi, 2007.
8. B.C. Punmia. Ashok K. Jain and Arun K. Jain, “Comprehensive RCC Designs”, Lakshmi Publications (P) Ltd., New Delhi, Ninth Edition, 2009.
9. P. Dayaratnam, “Limit State Design of Reinforced Concrete Structures”, Oxford & IBH Publishing Co. Pvt Ltd, 2008.
10. S.N. Sinha, “Reinforced Concrete Design”, Tata McGraw-Hill, New Delhi, 2002.
11. N.C. Sinha and S.K Roy, “Fundamentals of Reinforced Concrete”, S. Chand & Company Ltd, New Delhi, 2007.
12. Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, 1990.
13. Narayanan.R.et.al., “Teaching Resource on Structural steel Design”, INSDAG, Ministry of Steel Publishing, 2000.
14. Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2014.
15. Wie Wen Yu, “Design of Cold Formed Steel Structures”, McGraw Hill Book Company, 1996

CODE BOOKS:

1. IS 456:2000 Plain and Reinforced Concrete – Code of Practice.
2. IS 875 (1-5):1987 Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures.
3. SP 16:1980 Design Aids for Reinforced Concrete to IS 456:1978.
4. SP 34:1987 Handbook of concrete reinforcement and detailing.
5. IS 13920:1993 Ductile detailing of Reinforce Concrete Structures subjected to Seismic forces-Code of Practice.
6. ACI224R – 80 Control of cracking in concrete structures ACI Committee 224, Concrete International, 1980
7. EN1992 – Euro code 2 (EC2) – European standards for design of concrete structures.
8. ACI318-08 Building Code Requirements for Structural Concrete & Commentary
9. IS 800-2007 Indian Standard General Construction in steel — code of practice
10. IS: 875 (part 3) - 1987 code of practice for design loads for buildings and structures
11. IS801-1975 Indian standard code of practice for use of cold-formed light gauge steel structural members in general building construction

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	-	-	2	-	-	2	-	-	-	-	-	-
2	-	1	2	-	-	-	-	-	-	1	-	-	-	2	-	-
3	-	2	2	-	1	2	-	-	-	-	2	-	-	-	-	2
4	-	-	-	-	-	2	-	-	-	-	2	-	-	-	-	2
5	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-	1

1917102 DYNAMICS OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To expose the students the principles and methods of dynamic analysis of structures.
- To impart knowledge about theory of vibrations and vibration parameters
- To prepare them for designing the structures for wind, earthquake and other dynamic loads.
- To study the behavior of dynamic loading and to analyse the dynamic forces caused by an earthquake.
- To introduce the design of buildings for blast and impact forces as per BIS codes of practice.

UNIT-I: PRINCIPLES OF DYNAMICS 9

Vibration and its importance to structural engineering problems – Elements of vibratory systems and simple harmonic motion – Generalized mass - D'Alembert's principle – Mathematical modelling of dynamic systems - Degree of freedom – Equation of motion for S.D.O.F - Damped and undamped free vibrations – Undamped forced vibration – Critical damping – Response to harmonic excitation – Damped or undamped – Evaluation of damping – resonance – band width method to evaluate damping – Force transmitted to foundation – Vibration isolation - examples related to structural engineering.

UNIT-II: TWO DEGREE OF FREEDOM SYSTEMS 9

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

UNIT-III: DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 9

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, response spectrum method, Applications.

UNIT-IV: DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 9

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

UNIT-V: DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 9

Damping in MDOF systems, Nonlinear MDOF systems, step-by-step numerical integration algorithms, substructure technique, Applications.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course the student will be able to

- Understand the response of structural systems to dynamic loads and displacements.
- Realize the behaviour and response of linear and non-linear SDOF and MDOF structures with various dynamic loading.
- Understand the behaviour and response of MDOF structures with various dynamic loading.
- Find suitable solution for continuous system.
- Understand the behaviour of structures subjected to dynamic loads such as wind, earthquake and blast.

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.
5. Clough, R.W., and Penzien, “Dynamics of Structures” , McGraw Hill Book Co., 1986

6. Madhujit Mukhopadhyay – “Structural Dynamics Vibrations and Systems”, Ane Books India Publishers, 2010.
7. Craig.R.R, -'Structural Dynamics - An Introduction to Computer methods”, John Wiley & Sons, 1989.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	2	-	-	-	-	-	-	-	-	-	2	-	-	-
2	1	2	2	-	1	-	-	-	-	2	1	-	-	-	-	--
3	1	1	2	-	1	-	-	-	-	2	1	-	-	-	2	1
4	-	3	3	-	-	-	-	-	-	1	-	-	1	-	-	-
5	1	-	-	-	-	-	-	-	-	-	-	-	-	-	3	2

1917103 THEORY OF ELASTICITY AND PLASTICITY L T P C

3 0 0 3

OBJECTIVES:

- To study the classical theory of linear elasticity for two and three dimensional state of stress.
- To obtain solutions for elasticity problems in rectangular and polar coordinates as well as torsion of prismatic bars.
- To introduce the energy principles and energy method of solution of solid continuum mechanics.
- To gain knowledge on torsion of non-circular sections and thin walled sections.
- To understand the plastic stress strain relations, criteria of yielding and elasto- plastic problems.

UNIT-I : ELASTICITY 9

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke’s law.

UNIT-II: FORMULATION AND SOLUTION OF ELASTICITY PROBLEMS 9

Methods of formulation of elasticity problems, methods of solution of elasticity problems, Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Co- ordinates.

UNIT-III: TORSION OF NON-CIRCULAR SECTION 9

Introduction, general solution of torsion problems, boundary conditions, stress function method - Torsion of non-circular sections, Prandtl's membrane analogy, Torsion of thin walled open and closed sections - Thin walled multiple cell closed sections.

UNIT-IV: BEAMS ON ELASTIC FOUNDATIONS 9

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.

UNIT-V: PLASTICITY 9

Physical Assumptions – Yield Criteria – Failure Theories – Plastic Stress Strain Relationship. Elasto-Plastic Problems in Bending – Torsion and thick cylinder.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course, the students will be able to analyse the stresses and strains.
- Solve the two dimensional problems in cartesian and polar coordinates.
- Analyse the beams and columns using energy methods.
- Analyse torsion of non-circular sections and thin walled sections.
- Describe the basic concepts on the theory of plasticity

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. Chakrabarthy.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth –

Heinmann UK, 2007.

3. Jane Helena H, “Theory of Elasticity and Plasticity”, PHI Learning Pvt. Ltd., 2016.
4. Slater R.A.C, “Engineering Plasticity”, John Wiley and Son, New York, 1977.
5. Timoshenko, S. and Goodier J.N. "Theory of Elasticity", McGraw Hill Book Co., New York, 2010.
6. Sadhu Singh, “Theory of Elasticity and Metal Forming Processes”, Khanna Publishers, 2005.
7. Sadhu Singh, “Theory of Plasticity”, Khanna Publishers, 2007

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	1	-	-	2	-	-	-	-	2	-	-	-	-	-	-
2	-	1	1	-	-	-	-	-	-	-	-	2	-	-	-	-
3	-	2	2	-	1	-	-	-	-	-	2	-	-	-	2	-
4	-	-	-	-	1	-	-	-	-	-	2	-	-	-	2	-
5	-	-	1	-	-	-	1	-	-	2	-	1	-	-	-	-

1917108 ADVANCED STRUCTURAL ENGINEERING LABORATORY L T P C

3 0 0 3

OBJECTIVES:

- To understand the test procedure and flexural behavior of the RC beams.
- To gain knowledge on various NDT test.
- To study about the structural behaviour of steel sections.
- To understand the test procedure and Compressive behavior of the RC Columns.
- To understand the Fresh properties of Self Compacting Concrete.

LIST OF EXPERIMENTS

1. Concrete Mix Design- I.S. code Method
2. Fresh properties of Self Compacting Concrete using slump flow, L Box and V Funnel Tests
3. Fabrication, casting and testing of simply supported reinforced concrete

beam for strength and deflection behavior.

4. Testing of simply supported steel beam for strength and deflection behavior.
5. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
6. Non-Destructive Test on concrete
    i. Rebound hammer and
    ii. Ultrasonic Pulse Velocity Tester.
7. Determination of Impact Resistance of concrete
8. Determination of Permeability of concrete
9. Measurement of Cracks

LIST OF EQUIPMENTS

1. Strong Floor
2. Loading Frame
3. Hydraulic Jack
4. Load Cell
5. Proving Ring
6. Demec Gauge
7. Electrical Strain Gauge with indicator
8. Rebound Hammer
9. Ultrasonic Pulse Velocity Tester
10. Dial Gauges
11. Clinometers
12. Vibration Exciter
13. Vibration Meter

TOTAL: 60 PERIODS

OUTCOMES:

- On completion of this laboratory course students will be able to cast and test RC beams for strength and deformation behavior.

- They will be able to test dynamic testing on steel beams
- They will be able to static cyclic load testing of RC frames
- They will be able to non-destruction testing on concrete.
- Will have knowledge on various admixtures used in concrete mixes as per IS Code.

REFERENCES:

1. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill Inc. New York,1991

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	2	-	-	-	2	-	2	-	-	-	-	3	-	-	-	-
2	-	2	-	-	-	2	-	1	-	-	-	2	-	1	-	-
3	-	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-
4	1	2	-	2	-	-	-	4	-	-	-	3	-	-	-	3
5	-	-	-	3	-	-	-	-	-	-	-	-	-	2	-	3

1917201 STABILITY OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the concept of buckling and analysis of structural elements.
- To impart students sufficient knowledge about basic concepts of elastic structural stability, analytical approaches to stability and analysis of inelastic buckling of columns.
- To understand the design procedure in Column and plate analysis
- To study the concepts regarding tall buildings.
- To give exposure on the stability analysis of beam columns and frames using FEM and other methods and analysis of buckling of beams and thin plates.

UNIT-I: BUCKLING OF COLUMNS **9**

States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.

UNIT-II: BUCKLING OF BEAM-COLUMNS AND FRAMES **9**

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load-Columns on elastic foundation- Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.

UNIT-III: TORSIONAL AND LATERAL BUCKLING **9**

Tensional buckling – Combined Tensional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported and cantilever beams.

UNIT-IV: BUCKLING OF PLATES **9**

Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach – Finite difference method.

UNIT-V: INELASTIC BUCKLING **9**

Double modulus theory - Tangent modulus theory - Eccentrically loaded inelastic column. Isotropic rectangular plates -Inelastic buckling of plates - Post buckling behaviour of plates.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course student will know the phenomenon of buckling of columns.
- They are in a position to calculate the buckling load on column, beam – column, frames and plates using classical and approximate methods..
- Will have knowledge about the Torsional and lateral buckling of beams.
- Lateral buckling analysis of columns can be performed.
- Will be able to analyze inelastic behavior of structures.

REFERENCES:

1. Ashwini Kumar, “Stability Theory of Structures”, Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. “Principles of Structures Stability Theory”, Prentice Hall, 1974.
3. Gambhir, “Stability Analysis and Design of Structures”, springer, New York, 2004.
4. Iyenger.N.G.R., “Structural stability of columns and plates”, Affiliated East West Press,1986.
5. Timoshenko.S.P, and Gere.J.M, “Theory of Elastic Stability”, McGraw Hill Book Company, 1963.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-
2	-	1	-	2	-	1	-	1	-	-	-	-	-	2	-	-
3	1	1	1	-	-	-	-	-	-	-	-	-	-	2	-	-
4	1	1	-	-	2	1	-	-	-	-	-	-	1	-	-	1
5	1	-	2	-	2	1	-	1	-	-	-	1	1	-	-	2

1917202 EXPERIMENTAL TECHNIQUES L T P C

3 0 0 3

OBJECTIVES:

- To impart knowledge on basic concepts of measurements and related

instruments.

- To offer theoretical knowledge and hands on training in the usage of strain gauge, load cell, LVDT and data acquisition systems.
- To learn the principles of measurements of static and dynamic response of structures and carryout the analysis of results.
- To impart students knowledge on working principle of non-destructive testing techniques and its usage in real time conditions.
- To expose students the theory and principles involved in model analysis.

UNIT-I: FORCES AND STRAIN MEASUREMENT **9**

Choice of Experimental stress analysis methods, Errors in measurements - Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – vibrating wire sensors– Fibre optic sensors.

UNIT-II: MEASUREMENT OF VIBRATION AND WIND FLOW **9**

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – wind tunnels – Flow meters – Venturimeter – Digital data Acquisition systems.

UNIT-III: **DISTRESS MEASUREMENTS AND CONTROL** **9**

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring.

UNIT-IV: NON DESTRUCTIVE TESTING METHODS **9**

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission– ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR ,Ground penetrating radar (GPR).

UNIT-V: **MODEL ANALYSIS** **9**

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study-Direct model study - Limitations of models – investigations – structural problems –Usage of influence lines in model studies.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will know about measurement of strain, vibrations and wind blow.
- They will be able to analyze the structure by non-destructive testing methods and model analysis.
- Employ load cell, sensitive dial gauges and LVDT for different application areas and interpret the results.
- Acquire load-deflection and load-strain behaviour using data acquisition systems.
- Describe the importance of model analysis in predicting structural behaviour of large scale structures.

REFERENCES:

1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi, 2006.
2. Ganesan.T.P, “Model Analysis of Structures”, University Press, India, 2000.
3. Ravisankar.K.and Chelapan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures”, SERC, Chennai, 2007.
4. Sirohi.R.S., Radhakrishna.H.C, “Mechanical Measurements”, New Age

International (P) Ltd. 1997.

5. Dalley .J. W and Riley. W. F, “Experimental Stress Analysis”, McGraw Hill Bok Company,N.Y. 1991.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	2	-	1	-	2	-	-	-	-	-	-	-	-	-
2	-	1	1	-	3	-	-	-	-	-	1	3	-	3	-	-
3	-	1	2	-	1	-	-	-	-	-	-	-	-	-	2	-
4	-	1	-	-	-	-	-	-	-	-	1	1	-	-	2	-
5	-	-	1	-	2	-	-	-	-	-	1	2	-	-	-	-

1917203 FINITE ELEMENT ANALYSIS OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems.
- To introduce the fundamental concepts of finite element method.
- To understand specifically the conception of an idea that involved in the finite element analysis of a structure.
- To incorporate overview of matrix techniques and plane stress and plane strain concepts.
- To expose the finite element software to analyse the structural members.

UNIT-I : **INTRODUCTION** **9**

Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Approximate solutions of boundary value problems - Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments-continuity, compatibility, convergence aspects., Finite element equations using modified Galerkin method.

UNIT-II: **APPLICATION : AXIAL DEFORMATION OF BARS, AXIAL SPRING** **9**

Natural Coordinates - Triangular Elements -Rectangular Elements - Lagrange and Serendipity Elements -Isoparametric Formulation - Stiffness Matrix of Isoparametric Elements - Numerical Integration: One, Two and Three Dimensional - Examples.

UNIT-III: ANALYSIS OF FRAMED STRUCTURES **9**

Stiffness of Truss Member - Analysis of Truss -Stiffness of Beam Member-Finite Element Analysis of Continuous Beam -Plane Frame Analysis -Analysis of Grid and Space Frame – Two Dimensional Solids - Constant Strain Triangle -Linear Strain Triangle -Rectangular Elements - Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Ax symmetric Element -Finite Element Formulation of Ax symmetric Element -Finite Element Formulation for 3 Dimensional Elements – Solution for simple frames.

UNIT-IV: PLATES AND SHELLS **9**

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate -Finite Element Analysis of Thick Plate - Introduction to Finite Strip Method -Finite Element Analysis of Shell.

UNIT-V: APPLICATIONS **9**

Finite Elements for Elastic Stability - Dynamic Analysis - Nonlinear and Vibration-Meshing and Solution Problems - Modeling and analysis using recent soft wares.

TOTAL : 45 PERIODS

OUTCOMES:

- On completion of this course, the students will know the concept of finite element analysis and enable to analyze framed structure, Plate and Shells and modify using recent software.
- Solve the boundary value problems using approximate methods.
- Derive and elemental equations and shape function for one and two dimensional elements.

- Form the isoparametric functions for various elements.
- Perform the mesh refinement and error evaluation for various elements.

REFERENCES:

1. Bhavikatti.S.S, “Finite Element Analysis”, New Age International Publishers, 2007.
2. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Prentice Hall of India, 2007.
3. Rao.S.S, “Finite Element Method in Engineering”, Butterworth – Heinmann, UK, 2008.
4. Logan D. L., “A First Course in the Finite Element Method”, Thomson Learning, 2007.
5. R.D.Cook, “Concepts and Applications of Finite Element Analysis”, John Wiley & Sons.
6. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-
2	-	2	3	2	-	-	-	-	-	2	-	-	-	-	-	2
3	1	1	2	-	-	-	-	-	-	-	-	-	-	2	-	-
4		1	-	-	1	-	-	-	2	-	-	-	-	-	-	3
5	2	-	-	2	-	-	-	2	-	-	-	-	-	1	-	-

1917210 PRACTICAL TRAINING I L T P C

0 0 0 1

OBJECTIVES:

- The students are advised to collect peer reviewed journal papers relevant to their proposed project work and prepare a report in consultation with a faculty having expertise in that field.
- Seminar is an important component of learning where the student gets

acquainted with preparing and presentation of a technical report.

- Presentation schedules will be prepared by the course faculty in line with the academic calendar.
- The students shall be required to present a technical report in PPT and submit a relevant report.
- Each student shall be given at least two opportunities to exhibit his/her presentation skills.

SYLLABUS:

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.

OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- To develop skills in facing and solving the field problems.
- Training is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Will have knowledge in different research works related to structural engineering.
- Students are trained to face the delegates during their project presentation.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	2	-	-	2	-	1	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	2	-	2	-	-	-	-
3	2	2	2	2	-	-	-	-	2	1	-	2	-	-	-	3
4	-	-	-	-	2	-	-	-	2	1	-	-	-	2	-	-
5	1	-	-	-	-	-	-	-	3	1	2	-	3	-	-	-

1917301 EARTHQUAKE ANALYSIS AND DESIGN OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the effect of earthquakes, analysis and design of earthquake resistant Structures.
- To introduce the phenomena of earthquakes and its measurements, factors that affect the design of structures in seismic areas.
- To impart knowledge on the fundamentals of load calculation, various structural systems, design and detailing aspects of structures subject to earthquake loading.
- To provide the basic understanding on the theory of vibrations.
- To provide insight knowledge on the seismic retrofitting techniques of structures.

UNIT-I: EARTHQUAKE GROUND MOTION 9

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon), Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters.

UNIT-II: EFFECTS OF EARTHQUAKE ON STRUCTURES 9

Dynamics of Structures - SDOF's & MDOF's - Response Spectra - Evaluation of Earthquake Forcesas per codal provisions - Effect of Earthquake on Masonry and RCC Structures – Lessons Learnt From Past Earthquakes.

UNIT-III: EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings - Design consideration – Guidelines.

UNIT-IV: EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

Earthquake Resistant Design of R.C.C. Buildings - Material properties - Lateral load analysis – Capacity based Design and detailing – Rigid Frames – Shear walls.

UNIT-V: VIBRATION CONTROL TECHNIQUES 9

Vibration Control - Tuned Mass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems- Case Studies.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course the students will be able to understand the causes and effect of earthquake.
- Develop the equation of motion for single degree of freedom.
- Analyze the dynamic response of multi degree of freedom systems and free and forced vibration of bars and beams
- They will be able to design masonry and RC structures to the earthquake forces as per there commendations of IS codes of practice.
- Find the dynamic response of structures using vibration control methods.

REFERENCES:

1. Brebia C. A., “Earthquake Resistant Engineering Structures VI”,WIT Pres, 2001
2. Bruce A Bolt, ‘Earthquakes” W H Freman and Company, New York, 2004.
3. Dugal S K, “Earthquake Resistant Design of Structures”, Oxford University Pres, 2007.
4. Mohiudin Ali Khan, “Earthquake-Resistant Structures: Design, Build and Retrofit”, ElsevierScience & Technology, 2012
5. PankajAgarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”,Prentice Hal of India, 2009.
6. Paulay,T and Priestley, M.J.N., “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wiley and Sons, 1992.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	-	-	1	-	-	-	-	-	2	2	1	-	-
2	2	2	1	-	1	-	-	-	-	-	-	1	1	1	-	-
3	2	2	1	-	1	1	-	-	-	-	-	1	-	-	-	-
4	-	-	-	-	2	1	-	-	-	-	-	2	-	-	-	-
5	1	1	-	-	2	1	-	-	-	-	-	1	-	-	-	-

1917302 ADVANCED CONCRETE TECHNOLOGY L T P C

3 0 0 3

OBJECTIVES :

- To study the properties of various concrete constituent materials.
- To introduce the fundamentals of concrete mix design.
- To gain knowledge on fresh and hardened properties of concrete.
- To provide knowledge on durability properties of concrete and different types of special concretes.
- To study about the various concreting methods.

UNIT-I: CONCRETE MAKING MATERIALS 9

Aggregates classification, IS Specifications, Properties, Grading, Methods of combining aggregates, specified gradings, 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-II: TESTS ON CONCRETE 9

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

UNIT-III: 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-IV: 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-V: 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

OUTCOMES:

On completion of this course the students will know

- Various tests as per codal provisions to assess the fresh and hardened concrete properties.
- Conduct tests to assess the properties of concrete constituent materials and its validation for the desired application.
- Perform mix design for normal concrete, self-compacting concrete and high performance concrete as per specified standards.
- Special concrete and the methods of manufacturing of concrete.
- Carryout durability studies on different types of concrete and suggest type of concrete based on application and durability requirements.

REFERENCES:

1. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
2. Gupta.B.L., Amit Gupta, “Concrete Technology, Jain Book Agency, 2010.
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.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	3	2	-	1	1	1	-	-	-	1	1	-	-	-
2	2	1	1	1	-	1	1	1	-	-	-	-	-	-	2	-
3	-	-	-	-	2	-	-	-	-	2	-	2	1	-	-	-
4	1	-	-	-	2	-	-	1	1	-	-	-	-	1	-	-
5	-	-	-	-	2	1	-	1	1	-	-	2	1	1	-	-

1917311 **SEMINAR** **L T P C**

0 0 2 1

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.
- Seminar is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- The students shall be required to present a technical report in PPT and submit a relevant report.
- Each student shall be given at least two opportunities to exhibit his/her presentation skills.

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 during the seminar.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be trained to face an audience and to tackle any problem during group discussion in the Interviews.
- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- To develop skills in facing and solving the field problems.
- Training is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Will have knowledge in different research works related to structural engineering.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	-	-	-	-	2	-	-	2	-	1	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	2	-	2	-	-	-	-
3	2	2	2	2	-	-	-	-	2	1	-	2	-	-	-	3
4	-	-	-	-	2	-	-	-	2	1	-	-	-	2	-	-
5	1	-	-	-	-	-	-	-	3	1	2	-	3	-	-	-

1917312 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.
- To prepare the final report of project work in standard format.
- To present the work in International/National conference or reputed journals.

SYLLABUS:

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

TOTAL: 180 PERIODS

OUTCOMES:

- 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.
- Students are trained to face the delegates during their project presentation.
- Students will be trained to conduct research work on various materials used in structures.
- Students will have knowledge in design and analysis using various software.
- Able to handle the work individually.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	2	-	1	-	2	-	-	-	-	-	1	2	-	-
2	-	-	-	-	-	-	-	-	3	1	2	3	3	-	-	-
3	-	-	-	-	3	-	-	-	-	2	2	3	-	2	2	-
4	-	-	-	-	3	-	-	-	-	-	-	2	-	-	-	3
5	-	-	-	-	-	-	-	-	3	-	-	2	-	-	1	-

1917313 **PRACTICAL TRAINING II** **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 shall be required to present a technical report in PPT and submit a relevant report.
- Seminar is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Presentation schedules will be prepared by the course faculty in line with the academic calendar.

SYLLABUS:

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.

OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to Structural Engineering.
- To develop skills in facing and solving the field problems.
- Training is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Will have knowledge in different research works related to structural engineering.
- Students are trained to face the delegates during their project presentation.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	2	-	-	2	-	1	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	2	-	2	-	-	-	-
3	2	2	2	2	-	-	-	-	2	1	-	2	-	-	-	3
4	-	-	-	-	2	-	-	-	2	1	-	-	-	2	-	-
5	1	-	-	-	-	-	-	-	3	1	2	-	3	-	-	-

1917401 **PRACTICAL TRAINING III** **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 shall be required to present a technical report in PPT and submit a relevant report.
- Seminar is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Presentation schedules will be prepared by the course faculty in line with the academic calendar.

SYLLABUS:

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.

OUTCOMES:

- They are trained in tackling a practical field/industry orientated problem related to

Structural Engineering.

- To develop skills in facing and solving the field problems.
- Training is an important component of learning where the student gets acquainted with preparing and presentation of a technical report.
- Will have knowledge in different research works related to structural engineering.
- Students are trained to face the delegates during their project presentation.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	-	-	-	2	-	-	2	-	1	-	-	-	1	-	-
2	2	2	2	2	2	-	-	-	-	2	-	2	-	-	-	-
3	2	2	2	2	-	-	-	-	2	1	-	2	-	-	-	3
4	-	-	-	-	2	-	-	-	2	1	-	-	-	2	-	-
5	1	-	-	-	-	-	-	-	3	1	2	-	3	-	-	-

1917402 **PROJECT WORK - PHASE II** **L T P C**

0 0 24 12

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 skills to analyze and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva-voce examination.
- To prepare the final report of project work in standard format.
- To present the work in International/National conference or reputed journals.

SYLLABUS:

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be

prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

OUTCOMES:

On completion of the project work

- Students will be in a position to take up any challenging practical problem and find better solutions.
- Students are trained to face the delegates during their project presentation.
- Students will be trained to conduct research work on various materials used in structures.
- Students will have knowledge in design and analysis using various software.
- Students will be able to handle the work individually.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	2	-	1	-	2	-	-	-	-	-	1	2	-	-
2	-	-	-	-	-	-	-	-	3	1	2	3	3	-	-	-
3	-	-	-	-	3	-	-	-	-	2	2	3	-	2	2	-
4	-	-	-	-	3	-	-	-	-	-	-	2	-	-	-	3
5	-	-	-	-	-	-	-	-	3	-	-	2	-	-	1	-

1917104 MAINTENANCE AND REHABILITATION OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To assess the various damages in structure and their causes.
- To know about the quality of concrete used for construction works
- To gain knowledge on various causes of failures, detailed assessment procedure for evaluating a distressed structure,.
- To understand about the materials available for effecting repair and techniques

for effective rehabilitation.

- To offer knowledge to students on rehabilitation of real time distressed structures through case studies.

UNIT-I: 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-II: BUILDING CRACKS **9**

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

UNIT-III: MOISTURE PENETRATION **9**

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

UNIT-IV: DISTRESSES AND REMEDIES **9**

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – Materials and 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-V: 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 substructures – under pining – Enhancing the load capacity of footing.

TOTAL: 45 PERIODS

OUTCOMES:

- 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.
- Conduct systematic condition assessment of damaged structures using conventional and non-destructive testing methods.
- Suggest suitable materials for repair based on damage level, deterioration mechanism and durability requirements of the distressed structures.
- Recommend repair techniques for rehabilitation of damaged structural elements based on deterioration level, serviceability and durability requirements.
- Specify rehabilitation procedure for fire affected, corrosion affected and other structurally distressed members and engineered demolition techniques.

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, 191.
4. Dodge Woodson.R, “Concrete Structures – protection, repair and rehabilitation”, Elsevier Butterworth – Heinmann, UK, 2009.
5. Hand book on seismic retrofit of Building by CPWD and IT Madras,2003.
6. Peter H.Emmons, “Concrete Repair and Maintenance Illustrated”, Galgotia Publications Pvt. Ltd., 2001.
7. Raikar, R.N., “Learning from failures - Deficiencies in Design, Construction and Service” – R and D Centre (SDCPL), Raikar Bhavan. Bombay, 1987.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	1	-	-	-	2	-	-	2	-	-	2	-	-	-	-
2	-	-	-	-	3	2	-	-	-	-	-	-	-	-	3	-
3	2	2	-	-	-	3	-	-	-	-	-	-	-	-	-	2
4	-	-	-	-	2	-	-	-	-	-	-	2	-	-	1	2
5	1	-	-	-	-	2	-	-	-	-	-	3	-	-	2	-

1917105 PREFABRICATED STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To Study the design principles, analysis and design of elements.
- To impart the knowledge on prefabricated construction.
- To impart required knowledge about the behavior of prefabricated RC structures.
- To demonstrate the concept and advantages of prefabricated structures.
- To know the problems in joints due to flexibility and Identify different types of joints adopted for structural connections.

UNIT-I: DESIGN PRINCIPLES 9

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

UNIT-II: REINFORCEDCONCRETE 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 , column to column and column to foundation.

UNIT-III: 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-IV: WALLS **9**

Types of wall panels, Blocks and large panels, Curtain, Partion 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 behavior and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.

UNIT-V: 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: 45 PERIODS

OUTCOMES:

- At the end of this course student will have god knowledge about the prefabricated elements and the technologies used in fabrication and erection.
- They will be in a position to design floors, stairs, roofs, walls and industrial buildings, and various joints for the connections.
- Discuss the usage of prefabricated structures in modern construction.
- Create a panel and framed buildings with their connections of prefabricated RC structures.
- Construct a prefabricated structural components for industrial buildings.

REFERENCES:

1. Koncz.T., “Manual of Precast Concrete Construction”, Vol.I I and I & IV Bauverlag, GMBH, 1971.

2. Laszlo Mok, “Prefabricated Concrete for Industrial and Public Structures”, Akademiai Kiado, Budapest, 2007.
3. Lewicki.B, “Building with Large Prefabricates”, Elsevier Publishing Company, Amsterdam/ London/New York, 1998.
4. Structural Design Manual, “Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete”, Netherland Betor Verlag, 2009.
5. Warszawski, A., “Industrialization and Robotics in Building - A managerial approach”, Harper and Row, 1990.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	1	-	-	-	-	2	-	-	-	1	1	-	2	-	-
2	-	-	3	-	3	-	-	-	-	-	2	1	-	-	-	-
3	2	2	-	-	-	-	1	-	-	-	-	1	-	-	-	-
4	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
5	-	-	2	-	-	-	-	-	-	-	1	-	-	1	-	-

1917106 OFFSHORE STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the concept of wave theories, forces and design of jacket towers, pipes and Cables.
- To understand the forces on offshore structure.
- To expand the idea on foundation and structural modeling and analysis on offshore structures.
- To impart knowledge on wave generalized process and wave theories.
- To design of offshore structures with failure probability.

UNIT-I: WAVE THEORIES 9

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT-II: FORCES OF OFFSHORE STRUCTURES **9**

Wind forces, wind forces on vertical, inclined cylinders, structures - current forces and use of Morrison equation.

UNIT-III: OFFSHORE SOIL AND STRUCTURE MODELLING **9**

Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.

UNIT-IV: ANALYSIS OF OFFSHORE STRUCTURES **9**

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

UNIT-V: DESIGN OF OFFSHORE STRUCTURES **9**

Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines. Corrosion and Fatigue Failure.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to determine the forces due to ocean Waves.
- Solve various types of forces due to ocean waves.
- Describe the foundation for offshore structures.
- Perform and analyze the dynamics of offshore structures.
- Design offshore structures like platform, helipads, jackets, towers etc.,

REFERENCES:

1. API RP 2A-WSD, “Planning, Designing and Constructing Fixed Offshore Platforms – Working stress Design” - API Publishing Services, 2005
2. Chakrabarti, S.K., “Handbook of Offshore Engineering” by, Elsevier, 2005.
3. Chakrabarti, S.K., “Hydrodynamics of Offshore Structures”, WIT press, 2001.
4. Dawson.T.H., “Offshore Structural Engineering”, Prentice Hall Inc Englewood Cliffs, N.J. 1983.

5. James F. Wilson, “Dynamics of Offshore Structures”, John Wiley & Sons, Inc, 2003.
6. Reddy, D.V. and Arockiasamy, M., “Offshore Structures”, Vol.1 and Vol.2, Krieger Publishing Company, 1991.
7. Reddy.D.V and Swamidas A.S.J., “Essential of offshore structures”.CRC Press.2013
8. Turgut Sarpkaya, “Wave Forces on Offshore Structures”, Cambridge University Press, 2010.
9. Wiegel .R.L, "Oceanographical Engineering", Prentice Hall Inc. Englewood, Cliffs, N.J. 1964.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	1	2	-	-	-	-	-	-	1	-	-	-	1
2	3	2	-	-	1	-	-	-	1	-	-	-	-	-	-	-
3	1	2	-	2	-	-	-	-	2	-	-	-	-	-	-	-
4	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	3
5	-	-	3	-	3	-	-	-	-	-	-	1	-	-	3	-

1917107 MATRIX METHODS FOR STRUCTURAL ANALYSIS L T P C

3 0 0 3

OBJECTIVES:

- To study the concepts, characteristics and transformation of structures using matrix approach.
- To understand the difference between matrix based flexibility and stiffness approaches in structural analysis.
- To impart knowledge to compute deflections and forces in statically determinate and indeterminate structures using matrix methods.

UNIT-I: 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-II: 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-III: 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 superposition.

UNIT-IV: 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.

UNIT-V: THE STIFFNESS METHOD 9

Introduction-Development of Stiffness Method- Stiffness Matrix for Structures with zero force at some coordinates-Analogy between Flexibility and Stiffness-Analysis due to thermal expansion and Lack of Fit- 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

OUTCOMES:

- On completion of this course students will be able to use matrix approach for solving structural engineering problems.
- Students will have a thorough understanding of both flexibility and stiffness approach of analysis.
- Explain the transformation of forces and displacement through matrix method.
- Apply the matrix flexibility method for planar trusses, beams, and frames.
- Analyse the direct stiffness method for three dimensional framed structure.

REFERENCES:

1. Natarajan C and Revathi P., "Matrix Methods of Structural Analysis", PHI Learning Private Limited, New Delhi, 2014
2. Devdas Menon., "Advanced Structural Analysis", Narosa Publishing House, New Delhi, 2009
3. Pandit G.S. and Gupta S.P., "Structural Analysis-A Matrix Approach", Tata McGraw- Hill Publishing Company Limited, New Delhi, 1997.
4. Wang C.K., "Intermediate Structural Analysis", McGraw Hill International Editions, 1983.
5. Reddy C.S., "Basic Structural Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1997.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	-	3	2	-	-	-	-	-	-	-	1	-	-	-	1
2	2	2	-	1	3	-	-	-	-	2	-	2	-	-	2	-
3	-	2	-	1	-	1	-	-	-	-	-	-	-	-	1	-
4	-	-	1	-	2	-	-	-	-	-	-	-	-	-	2	-
5	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	2

1917204 **THEORY OF PLATES** **L T P C**

3 0 0 3

OBJECTIVES:

- To study the behaviour and analysis of thin plates in cartesian and polar coordinates.
- To understand the behaviour of reinforced concrete plate elements at material level, element level and system level.
- To understand about the various finite element methods for plate analysis.
- To equip the students with analysis and design procedures for folded plate structures.
- To design the structures using various plate theory and codes.

UNIT-I: INTRODUCTION TO PLATES THEORY **9**

Thin Plates with small deflection. Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT-II: RECTANGULAR PLATES **9**

Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's method, Rectangular plates with various edge conditions, plates on elastic foundation. Moody's chart (for analysis of plates with various boundary conditions or loading).

UNIT-III: CIRCULAR PLATES **9**

Symmetrical bending of circular plates.

UNIT-IV: SPECIAL AND APPROXIMATE METHODS **9**

Energy methods, Finite difference and Finite element methods.

UNIT-V: ANISOTROPIC PLATES AND THICK PLATES **9**

Orthotropic plates and grids, moderately thick plates.

TOTAL: 45 PERIODS

OUTCOME:

At the end of this course students will be able

- To analyze different types of plates (Rectangular and circular) under different boundary connections by various classical methods and approximate methods.
- They will also know behavior of orthotropic and thick plates and grids.
- Describe the behaviour of thin and thick circular plates.
- Solve and establish classical solutions for various types of plates.
- Analyse the various types of anisotropic and thick plates under different loading conditions.

REFERENCES:

1. Ansel C.Ugural, “Stresses in plate and shells”, McGraw Hil International Edition, 1999.
2. Bairagi, “Plate Analysis”, Khanna Publishers, 1996.
3. Bulson.P.S., “Stability Of Flat Plates”, American Elsevier Publisher. Co.,1969.
4. Chandrashekahara, K. “Theory of Plates”, University Press (India) Ltd., Hyderabad, 2001.
5. Reddy J N, “Theory and Analysis of Elastic Plates and Shells”, McGraw Hill Book Company, 2006.
6. Szilard, R., “Theory and Analysis of Plates – classical and numerical methods”, Prentice Hall Inc., 2004.
7. Timoshenko.S.P, and Krieger S.W. “Theory of Plates and Shells”, McGraw Hill Book Company, New York, 2003.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	1	1	2	1	1	-	1	1	1	-	1	2	1	-	
2	2	2	1	3	-	1	-	-	-	2	-	-	-	1	-	-
3	2	1	1	2	1	1	-	1	1	1	-	1	1	2	-	-
4	3	2	2	3	-	-	-	-	1	1	-	-	-	-	-	-
5	2	1	2	2	1	1	-	1	2	-	-	1	1	-	-	-

1917205 MECHANICS OF COMPOSITE MATERIALS L T P C

3 0 0 3

OBJECTIVE:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.
- To impart sufficient knowledge about classification and characteristics of composite materials used in structures.
- To understand the analysis of laminated composites, netting analysis, manufacturing and fabrication processes of fibres.
- To familiarise the students with the constituents of composite materials.
- To train the students in designing with composite materials

UNIT-I: INTRODUCTION 9

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constiuents, Composite Construction, Properties of Unidirectional Long Fiber Composites and Short Fiber Composites.

UNIT-II: 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-III: 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.

UNIT-IV: FAILURE AND FRACTURE OF COMPOSITES 9

Neting Analysis, Failure Criterion, Fracture Mechanics of Composites, Sandwich Construction.

UNIT-V: APPLICATIONS AND DESIGN **9**

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course students will have sufficient knowledge

- On behavior of various composite materials and will have an idea of failure and fracture mechanisms.
- To Classify the composite materials and their use in structures.
- Identify the principle material direction and arbitrary axes
- Apply the various theories for analysis of laminated composites and Sandwich Construction
- Perform netting analysis in analyse, manufacture and fabricate the composite materials.

REFERENCES:

1. Agarwal.B.D. Broutman.L.J., and Chandrashekara.K. "Analysis and Performance of Fiber Composites", John-Wiley and Sons, 2006.
2. Daniel.IM., and Ishai.O, " Enginering Mechanics of Composite Materials", Oxford University Pres, 2005.
3. Hyer M.W., and White S.R., "Stres Analysis of Fiber-Reinforced Composite Materials", D.Estech Publications Inc., 2009
4. Jones R.M., "Mechanics of Composite Materials", Taylor and Francis Group 1999.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", Universites Pres,India, 2005.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	1	2	-	2	2	2	-	-	-	-	2	1	2	1	-	-
2	1	3	-	1	3	2	1	-	-	-	-	1	2	1	-	-

3	1	1	-	1	2	2	-	-	-	2	-	1	-	1	-	-
4	1	3	-	2	-	1	-	-	-	-	1	1	1	1	-	-
5	1	-	-	3	1	2	3	-	-	1	-	2	-	-	-	-

1917206 ANALYSIS AND DESIGN OF TALL BUILDING L T P C

3 0 0 3

OBJECTIVES:

- To study the behaviour, analysis and design of tall buildings with respect to different loads.
- To provide the fundamental information pertinent to tall buildings.
- To gain knowledge on the behaviour, analysis and design of various structural systems.
- To impart knowledge on stability of tall buildings and also on dynamic analysis of wind and earthquake loadings.
- To understand the problems associated with large heights of structures with respect to different loads.

UNIT-I: 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. High Rise building – Introduction Structural systems Load resisting systems Codes requirements conforming to Indian Standard Load Calculation(Dead, Live, Wind).

UNIT-II: 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-III: ANALYSIS AND DESIGN **9**

Modeling 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 analysis – Assumptions in 3D analysis – Simplified 2D analysis. Case studies on industrial projects.

UNIT-IV: STRUCTURAL ELEMENTS **9**

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow, Design for differential movement, creep and shrinkage effects, temperature effects and fire resistance. Design of concrete frames Design of Steel frame elements- Modeling and design of shear walls.

UNIT-V: DUCTILE DETAILING **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

OUTCOMES:

On completion of this course students will be able

- To know the behavior of tall buildings due to various types of loads.
- To analyze and design such buildings by approximate, accurate and simplified methods.
- To analyze the response of wind and seismic motions on tall structures.
- To classify and use appropriate types of structural systems in tall structures.
- To Manipulate the second order effects of gravity loading, translational and torsional instability in the analysis of tall structures

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”, John Wiley and Sons, Inc., 2005.
3. Gupta.Y.P.,(Editor), “Proceedings of National Seminar on High Rise Structures - Design and Construction Practices for Middle Level Cities”, New Age International Limited, New Delhi,1995.
4. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.
5. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGraw Hill, 1988.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	2	3	-	2	-	-	2	-	1	-	1	3	2	-	-
2	1	2	2	-	3	-	-	-	-	2	-	2	1	3	-	1
3	1	3	2	-	2	-	-	1	-	1	-	2	1	2	-	1
4	2	2	3	-	2	-	-	-	-	1	-	1	1	-	-	2
5	1	2	3	-	1	-	-	1	-	1	-	1	2	-	-	1

1917207 INDUSTRIAL STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the requirements, planning and design of Industrial structures**.**
- To provide relevant knowledge on functional requirements of industrial buildings and to design various industrial building components.
- To design various special structures and transmission line towers.
- To describe the principles of prefabrication
- To plan and prepare layout of industrial components

UNIT-I: PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration -

Guidelines of Factories Act.

UNIT-II: INDUSTRIAL BUILDINGS **9**

Steel and RCC - Gantry Girder, Crane Girders - Design of Corbels and Nibs – Design of Staircase.

UNIT-III: POWER PLANT STRUCTURES **9**

Types of power plants – Substations - Cooling Towers - Bunkers and Silos - Pipe supporting structures.

UNIT-IV: TRANSMISSION LINE STRUCTURES AND CHIMNEYS **9**

Analysis and design of steel monopoles, transmission line towers – free standing and guyed towers – Design of self-supporting and guyed chimney, Design of Chimney bases.

UNIT-V: FOUNDATION **9**

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Construction techniques for foundation of rotary machines.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course student will be able to plan industrial structures for functional requirements.
- Design an industrial building with bents along with crane girder; describe suitable foundations for the various types of machines/equipment in an industry.
- They will be able to design various structures such as Bunkers and Silos.
- Analyse and design Cooling Towers, Chimneys, and Transmission Towers with required foundations.
- Identify suitable tower configurations for power transmission, analyse and design a lattice tower with suitable foundations.

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Manohar S.N, “Tall Chimneys - Design and Construction”, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., “Transmission Line Structures”, Tata McGraw Hill,1992.
4. Srinivasulu P and Vaidyanathan.C, “Handbook of Machine Foundations”, Tata McGraw Hill, 1976.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	-	2	-	2	-	1	1	2	3	1	2	3	-	2	-
2	2	2	3	1	-	-	-	-	-	-	-	1	1	-	-	-
3	-	-	2	-	-	-	2	-	-	-	-	-	2	-	1	-
4	1	3	3	1	2	-	-	-	1	2	2	1	1	-	1	-
5	-	2	3	2	-	-	1	2	-	-	1	-	-	-	-	-

1917208 **PRESTRESSED CONCRETE** **L T P C**

3 0 0 3

OBJECTIVES:

- To understand the principle of prestressing, analysis and design of prestressed concrete structures.
- To impart knowledge to analyze and design prestressed concrete flexural and shear members.
- To expand knowledge to design of prestressed concrete continuous and cantilever beams.
- To impart knowledge to analyze and design prestressed concrete tension and compression members.
- To describe the concepts of prestressed concrete bridges.

UNIT-I: PRINCIPLES AND BEHAVIOUR OF PRESTRESSING 9

Basic concepts of Prestressing - Types and systems of prestressing - Need for High Strength materials, Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts.

UNIT-II: DESIGN OF FLEXURAL MEMBERS 9

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

UNIT-III: DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

Analysis and design of continuous beams - Methods of achieving continuity - concept of linear transformations- concordant cable profile and gap cables – Analysis and design of cantilever beams.

UNIT-IV: 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-V: DESIGN OF PRESTRESSED CONCRETE BRIDGES 9

Composite beams - analysis and design, Composite sections ultimate strength Application in prestressed concrete bridges - Design of pre- tensioned and post tensioned girder bridges - Partial prestressing - advantages and applications.

TOTAL: 45 PERIODS

OUTCOMES:

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

- To explain the principle, types and systems of prestressing and analyse the deflections.
- Determine the flexural strength and design the flexural members, end blocks

- Analyse the statically indeterminate structures and design the continuous beam.
- Design the tension and compression members and apply it for design of piles.
- Analyse the composite sections ultimate strength and apply it for the design of bridges.

REFERENCES:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004. 29
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.
3. Lin.T.Y.,and Burns.H “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, New York, 2009.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co.,1998.

CODE BOOKS:

1. IS456 - 2000 - IS Code of Practice for Plain and Reinforced Concrete.
2. IS1343 - 1980 - IS Code of Practice for Prestressed Concrete.
3. IS1678-1998-Specification for Prestressed Concrete Pole for overhead Power Traction and Telecommunication lines.
4. IRC:6-2010 Standard Specifications and Code of Practice for Road Bridges, Section II - Loads and Stresses (Fifth Revision).
5. IRC:18-2000 Design Criteria for Prestressed Concrete Road Bridges(Post-Tensioned Concrete) (3rd Revision).
6. IRS - Indian Railway Standard Specifications.
7. BS8110 - 1985 - Code of Practice for Design and Construction.
8. IS784 - 2001 - IS Specification for Prestressed Concrete Pipes.
9. IS3370 - 1999 - Part III - IS Code of Practice for Concrete Structures for the storage of liquids.
10. IS875 - 1987 - Part I - IV - IS Code of Practice for Design load

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	3	-	1	2	-	1	1	-	2	1	1	1	-	1	-
2	-	3	3	1	2	-	2	-	-	-	-	2	-	1	1	-
3	1	2	3	2	2	-	1	1	-	-	-	2	-	1	1	-
4	-	2	2	1	1	-	2	-	-	1	1	1	1	2	1	-
5	2	1	3	1	2	-	1	2	-	1	1	1	1	-	-	-

1917209 WIND AND CYCLONE EFFECTS ON STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the concept of wind effects on design of structures.
- To impart sufficient knowledge on the analysis of wind effects on structures.
- To familiarise on the modeling and designing the structures for wind and cyclone effects as per the codal recommendations.
- To understand the design philosophy of tall buildings, the loading and behaviour of structural systems.
- To study about the cyclone effect on design of structures.

UNIT-I: INTRODUCTION 9

Introduction, Types of wind – Characteristics of wind – Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects - Dynamic nature of wind Pressure and suctions - Spectral studies.

UNIT-II WIND TUNNEL STUDIES 9

Wind Tunnel Studies, Types of tunnels, - Prediction of acceleration – Load combination factors Wind tunnel data analysis – Calculation of Period and damping value for wind design - Modeling Requirements, Aero dynamic and Aero-elastic models-Recent advancements.

UNIT-III EFFECT OF WIND ON STRUCTURES 9

Classification of structures – Rigid and Flexible – Effect of wind on structures - Static and dynamic effects on Tall buildings – Chimneys- Wind effect - case studies.

UNIT-IV: DESIGN OF SPECIAL STRUCTURES 9

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – design of Tall Buildings – Chimneys – Transmission towers and steel monopoles– Industrial sheds.

UNIT-V: CYCLONE EFFECTS 9

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding- Cyclone case studies.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of this course, students will be able

- To design high rise structures subjected wind load, even structures exposed to cyclone.
- Students will be conversant with various code provisions for the design of structures for wind load.
- Describe the concepts on the wind effects on structures.
- Critically describe the behavior of various special structures due to wind loading.
- Describe and perform the design of structures against cyclone.

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. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers,

London, 1980.

4. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1978.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	2	-	2	2	-	1	2	2	-	2	1	1	1	-	-
2	-	3	2	1	1	-	1	-	-	-	-	1	1	-	-	-
3	-	2	3	1	3	-	2	1	1	-	1	2	2	1	1	-
4	-	2	2	-	2	-	1	1	-	-	2	1	1	1	-	-
5	-	2	3	-	3	-	1	1	2	-	1	1	-	1	2	-

1917303 NONLINEAR ANALYSIS OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To introduce the fundamental concepts of nonlinear analysis.
- To study the concept of nonlinear behaviour and analysis of elements and simple structures.
- To understand the inelastic analysis of flexural members.
- To incorporate overview of vibration theory and analysis of flexural members and plates.
- To understand the nonlinear vibration and instability of beams.

UNIT-I: INTRODUCTION TO NONLINEAR ANALYSIS 9

Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.

UNIT-II: INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial Restraints.

UNIT-III: VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

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

UNIT-IV: ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates.

UNIT-V: NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course student will have enough knowledge on inelastic and vibration analysis of Flexural members.
- They will have knowledge about the difference between elastic and inelastic analysis of plates and Instabilities of elastically supported beams.
- On completion of this course, the students will know the concept of finite element analysis and enable to analyze framed structure, Plate and Shells and modify using recent software.
- Solve and establish classical solutions for various types of plates.
- Analyse the various types of nonlinear vibrations and instabilities of elastically supported beams using recent software too.

REFERENCES:

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

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	3	2	-	3	-	-	-	-	-	-	-	2	-	-	-	-

2	1	-	3	2	-	-	-	-	-	-	-	-	-	3	-	-
3	-	-	-	-	3	-	-	1	-	-	-	-	-	-	2	-
4	-	3	3	-	-	-	-	-	-	-	-	2	-	-	2	-
5	1	2	3	3	3	-	-	1	-	-	-	1	-	2	1	-

1917304 DESIGN OF SUB STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To gain familiarity with different types of foundation.
- To expose the students to the design of shallow foundations and deep foundations.
- To familiarize the students for the geotechnical design of pile foundations.
- To understand the concepts in designing well, machine and special foundations.
- To plan and execute a detailed site investigation to select geotechnical design parameters and type of foundation.

UNIT-I: SHALLOW FOUNDATIONS 9

Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation.

UNIT-II: PILE FOUNDATIONS 9

Introduction – Types of pile foundations – load carrying capacity - pile load test –pile driving and construction–configuration of piles- different shapes of piles cap – structural design of pile cap – Under-reamed pile foundation.

UNIT-III: WELL FOUNDATIONS 9

Types of well foundation – Grip length – load carrying capacity – construction of wells – Design aspects – Failures and Remedies – Design principles of well foundation – Lateral stability.

UNIT-IV: MACHINE FOUNDATIONS **9**

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines –Construction aspects–vibration isolation.

UNIT-V: SPECIAL FOUNDATIONS **9**

Foundation on expansive soils – choice of foundation – Foundation for concrete Towers and chimneys – Reinforced earth retaining walls - Marine Foundations.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to select appropriate foundation type based on available soil conditions.
- They will be in a position to determine the load carrying capacity of deep foundation.
- Design the well foundations for construction engineering structures.
- Understand the theory of vibrations and Design the well foundations for construction Engineering structures.
- Analyze the soil foundation on expansive soils and to design foundation for special structures.

REFERENCES:

1. Varghese.P.C, “Design of Reinforced Concrete Foundations” – PHI learning private limited, New Delhi – 2009.
2. Bowles .J.E., “Foundation Analysis and Design”, McGraw Hill Publishing co., New York, 1997.
3. Swamy Saran, “Analysis and Design of substructures” Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
4. Tomlinson.M.J, “Foundation Design and Construction”, Longman, Sixth Edition, New Delhi, 1995.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	-	3	2	1	-	-	-	-	-	-	-	2	-	1	1	2
2	-	-	3	3	-	-	-	-	-	3	-	2	-	-	2	1
3	-	3	3	-	-	3	-	1	-	-	-	-	-	2	-	-
4	-	-	3	-	-	-	-	1	-	-	-	-	-	2	-	-
5	-	3	3	3	-	-	-	3	-	-	-	-	-	3	-	-

1917305 OPTIMIZATION OF STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To study the optimization methodologies applied to structural engineering.
- To impart sufficient knowledge on basic concepts of optimization and classical methods.
- To give detailed overview of queuing theory, exposure to various optimization techniques for design of structural elements.
- Linear and nonlinear programming methods for plastic design.
- To understand the methods for optimal design of structural elements.

UNIT-I: 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-II: 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 - Fibonaci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques.

UNIT-III: 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.

UNIT-IV: DYNAMIC PROGRAMMING **9**

Bellman's principle of optimality –Representation of a multi stage decision problem - Concept of sub -optimization problems – Truss optimization.

UNIT-V: 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 multistory buildings, water tanks and bridges.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will have sufficient knowledge on various optimization techniques like linear programming, non-linear programming, geometric and dynamic programming.
- They will also in a position to design various structural elements for minimum weight.
- Execute different optimization techniques for the design of structural elements.
- Appropriately use the computer search methods for the analysis of structures.

- Describe the various optimization theorems for the analyzing of structures.

REFERENCES:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 197
2. Rao,S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hal, New Jersey 1971.
4. Uri Krish, "Optimum Structural Design", McGraw Hil Bok Co. 1981
5. Belegundu, A.D.and Chandrapatla,T.R., "Optimisation Concepts and Applications in Engineering", Pearson Education, 2011.
6. Deb K., "Optimisation for Engineering Design", Algorithms and examples, Prentice Hall, New Delhi, 2012.
7. Arora J.S., "Introduction to Optimum Design", McGraw –Hill Book Company, 2011.
8. Taha, H.A., "Operations Research – An Introduction", Prentice Hall of India, 2004.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	-	1	-	2	-	-	-	-	-	-	-	2	-	-	2	-
2	-	2	3	2	2	-	-	-	-	-	-	-	-	3	-	-
3	-	2	3	-	-	-	-	-	2	-	-	1	-	2	-	-
4	-	2	-	1	3	-	-	-	-	-	-	-	-	3	-	-
5	-	3	3	1	-	-	-	-	-	-	-	-	-	1	-	-

1917306 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- To develop an understanding of the behaviour and design concrete composite elements and structures.
- To introduce the behaviour of composite beams and columns.

- To study about the different types of connections in composite structures.
- To describe the composite structures using various theories.
- To understand the behaviour and design concepts of composite box girder bridges and composite trusses.

UNIT-I: INTRODUCTION **9**

Introduction to steel - concrete composite construction – theory of composite structures – Codes - Composite action – Serviceability and Construction issues in design.

UNIT-II: DESIGN OF COMPOSITE MEMBERS **9**

Design of composite beams, slabs, columns, beam – columns - Design of composite trusses.

UNIT-III: DESIGN OF CONNECTIONS **9**

Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.

UNIT-IV: COMPOSITE BOX GIRDER BRIDGES **9**

Introduction - behaviour of box girder bridges and its types - Design procedure & concepts.

UNIT-V: CASE STUDIES **9**

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

TOTAL: 45 PERIODS

OUTCOMES:

- At the end of this course students will be in a position to design composite beams, columns, trusses and box-girder bridges including the related connections.
- Will be able to design the composite beams and columns.
- Describe the connection in composite structures using various theories.

- Will have knowledge in design procedure and concepts of box girders.
- They will get exposure on case studies related to steel-concrete constructions of buildings.

REFERENCES:

1. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004.
2. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behavior", Pergamon press, Oxford, 1995.
3. Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.
4. David A.Nethrcot "Composite Construction" Spon Press, UK, 2003.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-	2
2	-	2	3	3	-	-	-	1	-	2	-	-	-	3	1	1
3	-	1	3	2	-	-	-	1	-	2	-	-	-	3	1	-
4	-	1	3	2	-	1	1	1	-	-	-	1	-	-	-	-
5	-	-	-	3	-	-	-	-	-	2	-	1	-	-	1	-

1917307 DESIGN OF BRIDGES LT P C

3 0 0 3

OBJECTIVES:

- Design of bridges is a specialized area in structural engineering practice. In this course, the students are taught the IRC loading standards and analysis and design of different types of bridges.
- To offer knowledge on design of short span bridges, design of T-Beam and slab bridges, prestressed concrete bridges and plate girder bridges.
- To describe the concepts of prestressed concrete bridges.

- To give exposure to design principles of continuous, box girder and balanced cantilever bridges.
- To get knowledge on different types of bearings and design of sub structures.

UNIT-I: GENERAL INTRODUCTION AND SHORT SPAN RC BRIDGES 9

Types of bridges and IRC loading standards - Choice of type - I.R.C. specifications for road bridges – Design of RCC solid slab bridges - analysis and design of slab culverts.

UNIT-II: LONG SPAN RC BRIDGES 9

Tee beam and slab bridges- General features-Pigeaurd's Curve-Courbon's theory – Continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges-Advantages-General features-Design principles only.

UNIT-III: PRESTRESSED CONCRETE BRIDGES 9

Pre-stressed concrete bridges-Preliminary dimensions-Flexural and torsional parameters – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections.

UNIT-IV: STEEL BRIDGES 9

General – Railway loadings – dynamic effect – Railway culvert with steel beams – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

UNIT-V: BEARINGS AND SUBSTRUCTURES 9

Bridge bearings – Plate, Roller and Rocker bearings-Elastomeric bearings – Design of piers and abutments of different types – Types of bridge foundations – Design of foundations.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course students will be able

- To design slab culverts and T-beam bridge superstructure for the IRC loading conditions. To design different types of RCC bridges.
- To Steel bridges and pre-stressed concrete bridges with the bearings and substructures.
- To design post tensioned prestressed T-beam bridge superstructure for the IRC loading.
- To design steel plate girder bridge superstructure based on IRS loading conditions.
- To design steel rocker cum roller bearing and substructure for pile foundation and well foundation as per IRC.

REFERENCES:

1. Jagadesh.T.R. and Jayaram.M.A., “Design of Bridge Structures”, Prentice Hal of India Pvt. Ltd. 2004.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Oxford and IBH Publishing Co. New Delhi, 2001.
3. Ponnuswamy, S., “Bridge Engineering”, Tata McGraw Hill, 2008.
4. Raina V.K. “Concrete Bridge Practice” Tata McGraw Hill Publishing Company, New Delhi, 1911.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	1	-	2	-	2	-	2	-	1	-	2	-	1
2	-	2	3	2	-	2	-	1	-	2	2	1	-	-	-	-
3	-	2	3	2	-	2	-	2	-	-	2	1	-	-	-	-
4	1	2	3	3	-	2	-	2	-	-	2	1	-	2	-	-
5	1	1	3	3	-	-	-	1	-	-	-	1	-	2	-	-

1917308 DESIGN OF SHELL AND SPATIAL STRUCTURES L T P C

3 0 0 3

OBJECTIVES:

- Study the behaviour and design of shells.
- To impart knowledge on the behavior of folded plates.
- To understand the behaviour analysis and design of space frames.
- To provide students with a rational basis for the analysis and design of thin shells.
- To apply the numerical techniques and tools for the complex problems in shells.

UNIT-I: CLASSIFICATION OF SHELLS **9**

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31. Application to design of shell roofs of water tanks (membrane analyses).

UNIT-II: FOLDED PLATES **9**

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof.

UNIT-III: INTRODUCTION TO SPACE FRAME **9**

Space frames - configuration - types of nodes - Design Philosophy - Behaviour.

UNIT-IV: ANALYSIS AND DESIGN **9**

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to Computer Aided Design.

UNIT-V: SPECIAL METHODS **9**

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

OUTCOMES:

- On completion of this course students will be able to analyze and design various types of shells, folded plates and space frames manually and also using computer Aided design and software packages.

- Illustrate the characteristics on different types of shells and develop equilibrium equations and force displacement relations.
- Will have knowledge in configuration and design philosophy of space frames.
- Analyse the various types of shells under different loading conditions using CAD.
- Design the various types of shells structures by special methods.

REFERENCES:

1. ASCE Manual No.31, “Design of Cylindrical Shells”.
2. Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982.
3. Ramasamy, G.S., “Design and Construction of Concrete Shells Roofs”, CBS Publishers, 1986.
4. Subramanian.N , “Principles of Space Structures”, Wheeler Publishing Co. 1999.
5. Varghese.P.C., “Design of Reinforced Concrete Shells and Folded Plates”, PHI Learning Pvt. Ltd., 2010.

CO	PO												PSO			
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4
1	2	-	3	-	3	3	-	-	-	-	-	-	-	-	-	-
2	1	-	3	-	-	-	-	3	-	-	-	-	-	2	--	-
3	3	-	-	-	-	2	-	2	-	-	-	-	-	2	-	-
4	-	-	-	-	2	-	-	-	-	2	-	3	-	-	1	-
5	-	-	2	-	3	-	-	-	-	2	-	-	-	-	2	-

1917309 COMPUTER AIDED ANALYSIS AND DESIGN L T P C

3 0 0 3

OBJECTIVES:

- To impart required knowledge about modeling of curves and surfaces and Solid modeling

- To learn the principles of computer graphics, structural analysis, structural design, Finite Element Analysis, Optimization and Artificial Intelligence supported by software tools.
- To familiarise on the use of typical software packages and computer methods of analysis such as FEM and computer aided design of steel and RC structural elements.
- To provide exposure on computer aided project scheduling such as CPM and PERT applications.
- To understand the concepts on the knowledge based expert systems and principles of neural network.

THEORY

UNIT-I: COMPUTER GRAPHICS **6+6**

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

UNIT-II: STRUCTURAL ANALYSIS **6+6**

Computer method of structural analysis – Simulation and Analysis of steel sections I, channel and Angle –PEB Elements – RCC and Composite members - Nonlinear Analysis through software packages.

UNIT-III: STRUCTURAL DESIGN **6+6**

Computer Aided Design of Steel and RC structural elements – Detailing of reinforcement – Detailed Drawing.

UNIT-IV: OPTIMIZATION **6+6**

Introduction to Optimization – Applications of Linear programming – Simplex Algorithm – Post Optimality Analysis – Project scheduling – CPM and PERT Applications.

UNIT-V: ARTIFICIAL INTELLIGENCE **6+6**

Introduction – Heuristic Research – Knowledge based Expert Systems – Architecture and Applications – Rules and Decision tables – Inference Mechanisms – Simple Applications – Genetic Algorithm and Applications – Principles of Neural Network – Expert system shells.

PRACTICAL

LIST OF EXERCISES

1. 2-D Frame Modelling and Analysis.
2. 3 – D Frame Modelling and Analysis.
3. Non Linear Analysis using Design software.
4. Design and Detailing of Structural Elements.
5. Simulation and Analysis of steel beam using FEA software.
6. Simulation and Analysis of R.C.Beam using FEA software.
7. Simulation and Analysis of Composite element s using FEA software.

TOTAL (L : 30 P :30) : 60 PERIODS

OUTCOMES:

At the end of course, students will be able to

- Apply the drafting techniques with the use of software packages
- Analyse the structural members through FEA software packages.
- Design the steel and RC structural elements using computer aided analysis packages.
- Apply various optimization techniques in project management systems.
- Apply the concept of artificial intelligence in structures.

REFERENCES:

1. Krishnamoorthy C.S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 1991.
2. GrooverM.P.and Zimmers E.W. Jr.," CAD/CAM, “Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 1993.
3. Harrison H.B., “Structural Analysis and Design Vol.I and II”, Pergamon Press,

1991.

4. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009.
5. Richard Forsyth (Ed.), “Expert System Principles and Case Studies”, Chapman and Hall, 1996.
6. Shah V.L. “Computer Aided Design in Reinforced Concrete” Structural Publisher.

CO	PO												PSO			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**	**4**
1	1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
2	1	-	-	-	3	-	-	-	-	2	-	-	-	-	-	-
3	-	3	3	3	2	-	-	-	-	-	-	-	2	3	-	-
4	2	2	3	1	1	-	-	-	-	-	-	-	2	3	-	-
5	1	-	2	3	1	-	-	-	-	1	-	-	2	-	-	-