SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

Approved by AICTE, Recognized by UGC & Affiliated to Anna University
Accredited by NBA-AICT, NAAC-UGC with 'A+' Grade

SNS Kalvi Nagar, Sathy Main Road (NH 209),
Saravanampatti (Po),
COIMBATORE -641035

M.E – STRUCTURAL ENGINEERING

REGULATION 2019

SNS COLLEGE OF TECHNOLOGY
(An Autonomous Institution)
Coimbatore- 35

DEPARTMENT OF CIVIL ENGINEERING

ABOUT THE DEPARTMENT

The Department of Civil Engineering was established in the year 2009. The department has eighteen highly qualified and dedicated faculty members headed by the Dean with a vast experience. There are three faculty members with doctoral degree and two of them are recognized supervisors under Anna University, Chennai. The Department has also been recognized as a Research Centre by Anna University, Chennai. The faculty members are actively involved in research and consultancy activities. The consultancy focuses on Building Materials Testing, Soil investigations, Concrete Mix Design, Structural Design and Verification.

The Department is provided with good Infrastructural facilities and well equipped Laboratories. The Laboratories include Concrete and Highway, Strength of materials, Hydraulics and Fluid Machinery, Soil Mechanics, Environmental Engineering, Survey and Computer. The department has 70 computers with 20Mbps internet connectivity. The Department offers B.E. Civil Engineering degree programme and M.E. Structural Engineering programme. The Under Graduate programme (B.E.) in Civil Engineering was started in the year 2009-10 with a sanctioned of 72. Based on its expertise, the department was permitted to offer Post Graduate programme (M.E.) in Structural Engineering from 2013-14 onwards with a sanctioned intake of 18 students. Considering the ever growing demand of Civil Engineers and growing emphasis on planning, a new and unique Under Graduate programme, B.E - Civil Engineering and Planning was introduced from the year 2016-17 onwards.

To achieve the vision of producing Internationally Acclaimed Civil Engineers the department adopts best teaching practices. Through the implementation

of these effective teaching-learning methodologies, the Department has produced 10 University ranks in the B.E Civil Engineering Programme under Anna University. The department also focuses on the overall development of the students. Students are motivated to participate in co-curricular and extra-curricular activities. The students have brought laurels to the department by winning prizes in Paper Presentations and other events in Symposiums. They have also presented papers in conferences at National and International levels. One of our students holds dual records in Guiness World Records, Limca Book of Records and India Book of Records. He also holds one Record in Asia Book of Records.

In order to bridge the gap between industry and academics, students are made to attend guest lectures and workshops by industry experts and a platform is arranged to interact with alumni members. The practical knowledge of the students is boosted by encouraging them to go for implant training and internship training. The placement track of the passing out students is very healthy. The students are also motivated to pursue higher students. In order to train students for competitive exams, special coaching classes are conducted by the department faculty members.

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DEPARTMENT OF CIVIL ENGINEERING

VISION

Department of Civil Engineering strives to provide quality education for producing world class Engineers and to become an advanced centre of learning and research.

MISSION

To impart conceptual knowledge in all the domains of Civil Engineering.

To provide practical knowledge and skills in State-of-Technologies in the Civil Engineering field, to meet the challenges of the society and to develop Internationally acclaimed Engineers.

To provide conducive environment for learning and research for students, scholars and faculty members.

To provide modern facilities for strengthening the research centre and to excel in Research & Development and consultancy services.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PEO I	Graduates will acquire through knowledge in analysis, design and execution of sustainable structure with considering global and environmental issues.
PEO II	Graduates will possess an attitude to update themselves in modern tools of structural analysis and design techniques in-line with global work environment
PEO III	Graduates will have the skill to involve themselves in basic and applied research and development activities in core areas by effectively handling complex structural engineering and inter-disciplinary projects
PEO IV	Graduates will improve research and development activities with view of latest innovations and trends
PEO V	Graduates will use their professional leadership skills and team work qualities to excel in the profession

PROGRAMME OUTCOMES (PO)

At the end of this programme, Graduates will be able to:

PO-a	**Engineering Knowledge**	Acquire exhaustive knowledge in the area of applied science and mathematics for the scholarship of knowledge.
PO-b	**Problem Analysis**	Analyze and design the complex engineering problems by critical thinking.
PO-c	**Evaluation of problems/ Development of solutions**	Evaluate the reasons for problems and provide optimal solutions by solving the engineering problems with considering public healthand safety, cultural, societal and environmental factors
PO-d	**Conduct Investigations of complex problems**	Study the problems through literature survey and conducting experiments apply research skills, appropriate research methodologies, techniques and tools give solutions to that problem.
PO-e	**Modern Tool usage**	Create models for complex engineering problems by applying appropriate modern techniques and resources by using modern engineering tools
PO-f	**Multidisciplinary work**	Execute collaborative-multidisciplinary work with self-management and teamwork in order to achieve common goals and further the learning of themselves as well as others
PO-g	**Communication Ability**	Communicate with clients and the engineering community self-confidently and effectively, able to prepare effective reports and design documentation by obeying appropriate standards give and receive clear instructions
PO-h	**Ethics**	Understand and follow the professional ethics,

		responsibilities and code of conduct in Structural engineering practices.
PO-i	**Individual and Team Work**	Function as an individual and as a team member in infrastructure projects encompassing multidisciplinary teams.
PO-j	**Modern software packages**	Use the techniques, skills, advanced modern engineering tools, instrumentation and software packages necessary for structural engineering practice
PO-k	**Project management and finance**	Inculcate Engineering and Management principles and work in multidisciplinary environments as an individual or as a team.
PO-l	**Life-long learning**	Recognize the need for and to engage in continual learning through.

PROGRAM SPECIFIC OUTCOMES (PSO's)

At the end of this programme, Graduates will be able to:

PSO-1: Utilize philosophy, methods, modern software's and instruments and codes of practices to excel in the areas of planning, analysis and designs related to Structural Engineering systems.

PSO-2: Prepare detailed drawings, cost estimates, reports, walk through views, interact with clients, manage workers, work in a team and executes construction works.

PEOs	PO												PSO		
	a	b	c	d	e	f	g	h	i	j	k	l	I	II	III
I	*	*	*	*								*	*	*	
II		*	*	*	*	*	*			*	*	*		*	
III			*		*	*	*	*	*					*	
IV		*	*			*	*	*	*	*			*		
V		*	*	*	*	*	*		*	*	*	*		*	

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DEPARTMENT OF CIVIL ENGINEERING

R 2019 – CURRICULUM
M.E – STRUCTURAL ENGINEERING

S.No.	SUBJECT AREA	CREDITS PER SEMESTER				TOTAL CREDITS
		I	II	III	IV	
1	FC	3	-	-	-	**3**
2	PCC	11	11	3	-	**25**
3	PEC	3	6	6	-	**15**
4	EEC	3	2	8	12	**25**
5	MLC	3	-	-	-	**3**
6	OE	-	-	3	-	**3**
	TOTAL	**23**	**19**	**20**	**12**	**74**

SEMESTER I										
S. No.	**Course Code**	**Course**	**L**	**T**	**P**	**J**	**CH/ W**	**Credit**	**Int/Ext**	**Category**
Theory Courses										
1	19MAT604	Applied Mathematics	3	0	0	0	3	3	50/50	FC
2	19SET601	Advanced Reinforced Concrete Structures	3	0	0	0	3	3	50/50	PCC
3	19SET602	Matrix Methods of Structural Analysis	3	0	0	0	3	3	50/50	PCC
4	19SET603	Theory of Elasticity and Plasticity	3	0	0	0	3	3	50/50	PCC
5		Professional Elective - I	3	0	0	0	3	3	50/50	PEC
6	19SET604	Research Methodology and IPR	3	0	0	0	3	3	50/50	MLC
7	19GEB601	Design Thinking and Innovation	1	0	4	0	5	3	50/50	EEC
8		Audit Course - I	2	0	0	0	2	0	-	EEC
Practical Courses										
9	19SEP605	Computer Application in Structural Engineering Laboratory	0	0	4	0	4	2	60/40	PCC
		Total	**21**	**0**	**8**	**0**	**29**	**23**		

SEMESTER II										
S. No.	**Course Code**	**Course**	**L**	**T**	**P**	**J**	**CH/ W**	**Credit**	**Int/Ext**	**Category**
Theory Courses										
1	19SET606	Advanced Design of Steel Structures	3	0	0	0	3	3	50/50	PCC
2	19SET607	Finite Element Method	3	0	0	0	3	3	50/50	PCC
3	19SET608	Structural Dynamics	3	0	0	0	3	3	50/50	PCC
4		Professional Elective - II	3	0	0	0	3	3	50/50	PEC
5		Professional Elective - III	3	0	0	0	3	3	50/50	PEC
6		Career Course - I	2	0	0	0	2	2	50/50	EEC
7		Audit Course - II	2	0	0	0	2	0	-	EEC
Practical Courses										
8	19SEP609	Structural Engineering Laboratory	0	0	4	0	4	2	60/40	PCC
		Total	**19**	**0**	**4**	**0**	**23**	**19**		

SEMESTER III										
S. No.	**Course Code**	**Course**	**L**	**T**	**P**	**J**	**CH /W**	**Credit**	**Int/Ext**	**Category**
Theory Courses										
1	19SET701	ASeismic Design of Structures	3	0	0	0	3	3	50/50	PCC
2		Professional Elective – IV	3	0	0	0	3	3	50/50	PEC
3		Professional Elective - V	3	0	0	0	3	3	50/50	PEC
4		Open Elective	3	0	0	0	3	3	50/50	OE
5		Career Course - II	2	0	0	0	2	2	50/50	EEC
Practical Courses										
6	19SEP702	Project Work – Phase I	0	0	12	0	12	6	60/40	EEC
		Total	**14**	**0**	**12**	**0**	**26**	**20**		

SEMESTER IV										
S. No.	**Course Code**	**Course**	**L**	**T**	**P**	**J**	**CH /W**	**Credit**	**Int/Ext**	**Category**
Practical Courses										
1	19SEP704	Project Work – Phase II	0	0	24	0	24	12	60/40	EEC
		Total	**0**	**0**	**24**	**0**	**24**	**12**		

PROFESSIONAL CORE COURSES

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits	Semester
1	19SET601	Advanced Reinforced Concrete Structures	3/0/0/0	3	3	I
2	19SET602	Matrix Methods of Structural Analysis	3/0/0/0	3	3	I
3	19SET603	Theory of Elasticity and Plasticity	3/0/0/0	3	3	I
4	19SEP605	Computer Application in Structural Engineering Laboratory	0/0/4/0	4	2	I
5	19SET606	Advanced Design of Steel Structures	3/0/0/0	3	3	II
6	19SET607	Finite Element Method	3/0/0/0	3	3	II
7	19SET608	Structural Dynamics	3/0/0/0	3	3	II
8	19SEP609	Structural Engineering Laboratory	0/0/4/0	4	2	II
9	19SET701	ASeismic Design of Structures	3/0/0/0	3	3	III

PROFESSIONAL ELECTIVE I

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19SEE610	Maintenance and Rehabilitation of Structures	3/0/0/0	3	3
2	19SEE611	Pre-Stressed Concrete Structures	3/0/0/0	3	3
3	19SEE612	Offshore Structures	3/0/0/0	3	3
4	19SEE613	Non-Linear Analysis of Structures	3/0/0/0	3	3

PROFESSIONAL ELECTIVE II

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19SEE614	Design of Substructures	3/0/0/0	3	3
2	19SEE615	Environmental Engineering Structures	3/0/0/0	3	3
3	19SEE616	Theory of Plates and Shells	3/0/0/0	3	3
4	19SEE617	Design of Structures for Dynamic Loads	3/0/0/0	3	3

PROFESSIONAL ELECTIVE III

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits

1	19SEE618	Modern Construction Materials	3/0/0/0	3	3
2	19SEE619	Optimization in Structural Design	3/0/0/0	3	3
3	19SEE620	Wind and Cyclone Effect on Structures	3/0/0/0	3	3
4	19SEE621	Advanced Construction Technology	3/0/0/0	3	3

PROFESSIONAL ELECTIVE IV

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19SEE705	Structural Health Monitoring	3/0/0/0	3	3
2	19SEE706	Prefabricated Structures	3/0/0/0	3	3
3	19SEE707	Stability of Structures	3/0/0/0	3	3
4	19SEE708	Design of Steel Concrete Composite Structures	3/0/0/0	3	3

PROFESSIONAL ELECTIVE V

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19SEE709	Design of Bridges	3/0/0/0	3	3
2	19SEE710	Design of Tall Buildings	3/0/0/0	3	3
3	19SEE711	Industrial Structures	3/0/0/0	3	3
4	19SEE712	Special Concrete	3/0/0/0	3	3

OPEN ELECTIVES COURSES OFFERED TO OTHER PG PROGRAMMES

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19SEO701	Industrial Safety Management	3/0/0/0	3	3
2	19SEO702	Environmental Impact Assessment	3/0/0/0	3	3

CAREER COURSE

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19GET601	Professional Development	2/0/0/0	2	2

2	19GET602	Quality Assurance & Accreditation in Engineering Education	2/0/0/0	2	2
3	19GET603	Wholistic Education	2/0/0/0	2	2

AUDIT COURSE

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19GEA601	English for Research Paper Writing	2/0/0/0	2	0
2	19GEA602	Disaster Management	2/0/0/0	2	0
3	19GEA603	Value Education	2/0/0/0	2	0
4	19GEA604	Constitution of India	2/0/0/0	2	0
5	19GEA605	Pedagogy Studies	2/0/0/0	2	0

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

Sl. No	Course Code	Course	L/T/P/J	CH/W	Credits
1	19GEB601	Design Thinking and Innovation	1/0/4/0	5	3
2		Audit Course - I	2/0/0/0	2	-
3		Audit Course - II	2/0/0/0	2	-
4		Career Course – I	2/0/0/0	2	2
5		Career Course – II	2/0/0/0	2	2
6	19SEP702	Project Work – Phase I	0/0/12/0	12	6
7	19SEP704	Project Work – Phase II	0/0/24/0	24	12

SEMESTER-I

19MAT604	APPLIED MATHEMATICS	L	T	P	C
		3	0	0	3

UNIT I	DIMENSIONAL WAVE AND HEAT EQUATIONS	9
Laplace transform methods for one-dimensional wave equation – Displacements in a long string – longitudinal vibration of an elastic bar – Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rods.		

UNIT II	ELLIPTIC EQUATION	9
Laplace equation – Properties of harmonic functions – Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip – Solution of Poisson equations by Fourier transform method.		

UNIT III	CALCULUS OF VARIATIONS	9
Concept of variation and its properties – Euler's equation – Functional dependant on first and higher order derivatives – Functional dependent on functions of several independent variables – Vibrational problems with moving boundaries –Direct methods – Ritz and Kantorovich methods.		

UNIT IV	EIGEN VALUE PROBLEMS	9
Methods of solutions: Faddeev – Leverrier Method, Power Method with deflation – Approximate Methods: Rayleigh – Ritz Method.		

UNIT V	NUMERICAL INTEGRATION	9
Gaussian Quadrature – One and Two Dimensions – Gauss Hermite Quadrature – Monte Carlo Method – Multiple Integration by using mapping function.		
	L: 45 T:0 P:0 TOTAL : 45 PERIODS	

TEXT BOOKS	
1.	SankaraRao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
2.	Rajasekaran.S, "Numerical Methods in Science and Engineering A Practical Approach", A.H.Wheeler and Company Private Limited, 1986.
REFERENCES	
1.	Erwin Keeyszig, "Advanced Engineering Mathematics", John Wiley, 2007.
2.	Sneddan, Partial Differential Equation, Prentice Hall of India, 2006.
3.	Elsgoth.L"Differential Equation and Calculus of Variations", Mir Publishing Moscow, 2006.

19SET601	ADVANCED REINFORCED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

UNIT I	OVERALL REVIEW	9

Review of limit state design of beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS

UNIT II	DESIGN OF SPECIAL RC ELEMENTS	9
Design of slender columns - Design of RC walls - ordinary and shear walls. Strut and tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors.		

UNIT III	FLAT SLABS AND FLAT PLATES	9
Design of flat slabs and flat plates according to IS methods - Design of shear reinforcement – Design of spandrel beams - Yield line theory and Hillerborgs strip method of design of slabs.		

UNIT IV	INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES	9
Inelastic behaviour of concrete beams, moment - rotation curves, moment redistribution.		

UNIT V	DESIGN LOADS OTHER THAN EARTHQUAKE LOADS	9
Dead Loads – Imposed Loads (IS 875 Part 2) – Loads due to Imposed Deformations – General Theory of Wind Effects on Structures.		

L: 30 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1	Varghese, P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, 2007
2	Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India,
REFERENCES	
1	Unnikrishna Pillai and Devdas Menon “Reinforced concrete Design’, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2006.
2	Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis and Design”, Tata McGraw Hill, 1986
3	Gambhir, “Design of Reinforced Concrete Structures”, PHI Learning Ltd., New Delhi, 2011. (Unit-II, Unit-III)

COURSE OUTCOMES

At the end of the course students should be able to
CO1: Design RC beam slab and column
CO2: Design Special RC elements
CO3: Design Flat slabs and plates
CO4: Analyze inelastic behavior of concrete
CO5: Understand Wind load and its effects.

19SET602	MATRIX METHODS OF STRUCTURAL ANALYSIS	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION	9
Review of fundamental concepts – Introduction – Force and displacement measurements – Superposition of forces and displacements – Betti's law – Stiffness and flexibility matrices of the elements – a review – Energy concepts – Strain energy in terms of stiffness and flexibility matrices — Strain energy in systems and in elements		

UNIT II	TRANSFORMATION OF INFORMATION	9
Transformation of information – Determinate and indeterminate structures – Transformation of system force to element force – Element flexibility to system flexibility – Element displacement to system displacement – Transformation of forces and displacements in general.		

UNIT III	FLEXIBILITY METHOD	9
General formulation of flexibility matrices and application to beams, rigid frames and pin-jointed trusses – Analysis due to thermal expansion, lack of fit, sinking of supports		

UNIT IV	STIFFNESS METHOD	9
Development of stiffness method – application to beams, rigid frames and pin-jointed trusses – Analysis due to thermal expansion, lack of fit and sinking of supports.		

UNIT V	STIFFNESS METHOD – ADVANCED TOPICS	9
Direct Stiffness method and application to 3-D frames and trusses, and grids (with three members only) – Analysis of large structures – use of symmetry and anti symmetry – Procedure for sub structuring and static condensation techniques.		

L: 45 T:0 P:0TOTAL : 45 PERIODS

TEXT BOOKS	
1.	V.K.Manikaselvam– Elements of Matrix Analysis and Stability Analysis of structures, Khanna Publishers, New Delhi Seventh Edition-2012.
2.	C.Nataran, P.Revathi -Matrix Methods of Structural Analysis: Theory and Problems,PHILearning pvt.ltd, New Delhi.
REFERENCES	
1.	P. N. Godbole, R. S. Sonparote, S. U. Dhote, "Matrix Methods of Structural Analysis - ,PHI Learning pvt.ltd, New Delhi- 2014
2.	Rajasekharan S. and Sankarasubramainian G., "Computational Structural Mechanics",Prentice Hall, India, 2001(Unit-I, Unit-II,Unit-III, Unit-IV and Unit-V).
3.	Negi, "Structural Analysis", Tata McGraw Hill Publishing Company 2007.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: explain the fundamental concepts and modern methods of analysis **CO2**: understand the transformations **CO3**: analyze the structures by matrix flexibility method **CO4**: analyze the structures by matrix stiffness method **CO5**: analyze the structures by direct stiffness method and its advanced techniques

19SET603	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
		3	0	0	3

UNIT I	ANALYSIS OF STRESS, STRAIN AND STRESS STRAIN RELATIONS	9
Analysis of stress (two and three dimensions) - Body force, surface forces and stresses, uniform state of stress - principal stresses - stress transformation laws - Differential equations of equilibrium. Analysis of Strain (two and three dimensions) - strain and displacement relation – compatibility equations - state of strain at a point - strain transformations - principle of superposition. - Stress strain relation - Generalised Hooke's law -Lame's constants.		

UNIT II	FORMULATION OF ELASTICITY PROBLEMS AND TWO DIMENSIONAL PROBLEMS IN CARTESIAN COORDINATES	9
Methods of Formulation - Equilibrium equations in terms of displacements - Compatibility equations in terms of stresses - boundary value problems - plane stress - plane strain problems.Introduction to two dimensional problems in Cartesian Co-ordinates - Boundary condition - Plane stress and strain problems - examples - Airy's stress function - polynomials - Direct method of determining Airy's stress functions - solution of Bi-harmonic equation - St.Venant`s principle - Two dimensional problems in Cartesian co-ordinates - bending of a cantilever loaded at end.		

UNIT III	TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES	9
General equations in polar co-ordinates - stress distribution symmetrical about an axis - pure bending of curved bars - strain components in polar co-ordinates - displacements for symmetrical stress distribution - bending of a curved bar - effect of a circular hole on stress distribution – Thick cylinder - Forces on wedges - a circular disk with diametric loading		

UNIT IV	TORSION OF CYLINDRICAL BARS	9
Torsion of prismatic bars - General solution of the problem by displacement (warping function) and force (Prandtl`s stress function) approaches-Torsion of shafts of circular and non circular		

(elliptic, triangular and rectangular) cross sectional shapes only-Torsion of thin rectangular section and hollow thin-walled sections

UNIT V	INTRODUCTION TO PLASTICITY	9
Introduction to stress strain curve - ideal plastic body - criterion of yielding - Rankine`s theory - St.Venant`s theory - Tresca criterion - Beltrami`s theory - Von Mises criterion - Mohr`s theory of yielding - yield surface - Flow rule (plastic stress - strain of relation) – Prandtl-Reuss equations - Plastic work - stress - strain relation based on Tresca - Plastic potential. Solution of elastic - plastic problems-Elastic plastic problems of beams in bending- thick hollow spheres and cylinders subjected to internal pressure - General relation - plastic torsion - perfect plasticity - bar of circular cross sections - Nadai`s sand heap analogy.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Timeshenko.S.P and Goodier.J.N, “Theory of Elasticity”, McGraw Hill International Edition, 2010.
2.	Sadhu Singh, “Theory of Elasticity and Metal Forming Processes”, Khanna Publishers, 2005
REFERENCES	
1.	J. N. Goodier, Jr., P. G. Hodge, “Elasticity and Plasticity: The Mathematical Theory of Elasticity and The Mathematical Theory of Plasticity ”, Dover Publications (17 March 2016)
2.	Sadd, " Elasticity: Theory, Applications, And Numerics”, Elsevier India (2014)
3.	Mendelson, Plasticity: Theory and Application A McMillan and co, NewYork 1983

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: execute the stress state and stresses analysis **CO2**: formulate elasticity problems in two – dimensional cartesian Coordinates **CO3**: formulate elasticity problems in two – dimensional polar Coordinates **CO4**: analyse torsion of cylindrical bars **CO5**: know basic concepts of plasticity

19SET604	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

UNIT I	RESEARCH CONCEPTS	6
Concepts, meaning, objectives, motivation, types of research, approaches, research (Descriptive research, Conceptual, Theoretical, Applied & Experimental). Formulation of Research Task – Literature Review, Importance & Methods, Sources, quantification of Cause Effect Relations, Discussions, Field Study, Critical Analysis of Generated Facts , selection of Research task.		

UNIT II	MATHEMATICAL MODELING AND SIMULATION	6
Concepts of modeling, Classification of Mathematical Models, Modeling with Ordinary differential Equations, Graphs, Simulation, Process of formulation of Model based on Simulation.		

UNIT III	EXPERIMENTAL MODELING	6
Definition of Experimental Design, Examples, Single factor Experiments, Guidelines for designing experiments. Process Optimization and Designed experiments, Taguchi approach to parameter design		

UNIT IV	ANALYSIS OF RESULTS	6
Parametric and Non-parametric, descriptive and Inferential data, types of data, collection of data (normal distribution, calculation of correlation coefficient), processing, analysis, error analysis, different methods, analysis of variance, significance of variance, analysis of covariance		

UNIT V	REPORT WRITING & PATENT RIGHTS	6
Types of reports, layout of research report, interpretation of results, style manual, layout and format, style of writing, typing, References:, tables, figures, conclusion, appendices. Scope of Patent Rights: Licensing and transfer of technology. Patent information and databases. Geographical Indications		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

TEXT BOOKS	
1	Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’
2	T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.
3	S. S. Rao, ‘Optimization Theory and Application’, Wiley Eastern Ltd., New Delhi, 1996
REFERENCES	
1	Willktnsion K. L, Bhandarkar P. L, ‘Formulation of Hypothesis’, Himalaya Publication

2	Schank Fr., 'Theories of Engineering Experiments', Tata Mc Graw Hill Publication. Douglas Montgomary, 'Design of Experiments', Statistical Consulting Services, 1990
3	Douglas H. W. Allan, 'Statistical Quality Control: An Introduction for Management', Reinhold Pub Corp, 1959.
4	Cochran and Cocks, 'Experimental Design', John Willy & Sons.
5	John W. Besr and James V. Kahn, 'Research in Education', PHI Publication.
6	Adler and Granovky, 'Optimization of Engineering Experiments', Meer Publicatio
7	Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
8	Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9	R. Panneerselvam, 2nd Edition, "Research Methodology " PHI Learning
10	C.R.Kothari , "Research Methodology – Methods & Techniques" - New Age International Publishers

COURSE OUTCOMES
At the end of the course students should be able to **CO1:** Demonstrate various methods and techniques related to research process. **CO2:** Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity. **CO3:**Excecute the experimental design **CO4:** Analyze the data from a research **CO5:** Write a research report and Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

19GEB601	**DESIGN THINKING AND INNOVATION**	**L**	**T**	**P**	**J**	**C**	
		1	**0**	**0**	**4**	**3**	

UNIT I	**INTRODUCTION TO DESIGN THINKING**	**3**
A brief insight to Design Thinking and Innovation- People Centered Design & Evoking the 'right problem'- Purpose of Design Thinking- Design Thinking Framework		

UNIT III	**PROCESS IN DESIGN THINKING (EMPATHY, DEFINE)**	**3**
Design Thinking Process – Empathy – Uncovering and Investigating Community Concerns - Define : Examine and Reflect on the problem		

UNIT III	**CONCEPTING AND BUILDING (IDEA, CREATE)**	**3**
Generating Ideas-Identifying top three ideas-Bundling the Ideas and create concepts-Rapid Prototyping		

UNIT IV	**TESTING, REFINING AND PITCHING THE IDEAS**	**3**
Importance & Testing the Design with People-Retest and Redefine Results-Creating a		

Pitch for the design

UNIT V	VALUE PROPOSITION DESIGN	3
Business Vs Startup-Briefing the Problem-Problem Validation and User Discovery-Challenge Brief		

L: 15 T:0 J: 30 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Robert A Curedale, Design Thinking Process & Methods 4th Edition, December 2017, Design Community College Inc.
2.	Andrew Pressman, Design Thinking: A Guide to Creative Problem Solving for Everyone, First Edition, Nov 2018, Routledge.
REFERENCES	
1.	Idris Mootee, Design Thinking for Strategic Innovation - What They Can't Teach You at Business or Design School, First Edition, 2017, Wiley
2.	Yves Pigneur, Greg Bernarda, Alan Smith, Trish Papadakos Alex Osterwalder, Value Proposition Design: How to Create Products and Services Customers Want, 2015, Wiley
3.	Brown, Tim, and Barry Katz. Change by Design: How Design Thinking Transforms Organizations and Inspires Innovation, 2009, Harper Business

COURSE OUTCOMES

At the end of the course students should be able to

CO1:Learn new approach-design thinking—that enhances innovation activities in terms of market impact, value creation, and speed.

CO2:Feel the Empathy and can define their problems based on the Community Concerns

CO3:Strengthen their individual and collaborative capabilities to identify customer needs, create sound concept hypotheses, collect appropriate data, and develop a prototype that allows for meaningful feedback in a real-world environment

CO4:Translate broadly defined opportunities into actionable innovation possibilities and recommendations for client organization

CO5:Become an Entrepreneurs

19SEP605	COMPUTER APPLICATION IN STRUCTURAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

ANALYSIS AND DESIGN OF STRUCTURES USING STAAD PRO

1. Analysis of Beams
2. Analysis of Plane Frames.
3. Analysis of Space Frames.
4. Analysis of Trusses

ANALYSIS OF STRUCTURES USING ANSYS

1. Analysis of Structures using Finite element= Package.
2. Problem Formulation – input parameters – modeling – material properties – boundary conditions.
3. Mesh generation – Solution and post processing.
4. FEM analysis – Truss, Beams, Plates, Shells and Columns

L: 0 T:0 P:45TOTAL : 45 PERIODS

REFERENCES

1.	Krishnamoorthy C.S. Rajeev, S, Rajaraman. A"Computer Aided Design", Alpha Science International Ltd; 2nd revised edition edition, 2003.
2.	Rajasekaran, S., "Finite Element Analysis in Engineering Design", S Chand & Co., 2006.
3.	M. AsgharBhatti., "Fundamental Finite Element Analysis and Applications with mathematical and MATLAB Computations :, Wiley India Pvt Ltd, 2012.

COURSE OUTCOMES

At the end of the course students should be able to
CO1: analysis and design of beam by stadd pro.
CO2: analysis and design of plane and space frames by stadd pro.
CO3: analysis and design of Truss by stadd pro.
CO4: analysis of elements using FEA.
CO5: analysis of Truss, Beams, Plates, Shells and Columns by ANSYS

LIST OF EQUIPMENTS

Sl. No.	Description of Equipments	Quantity
1	Computer Work Station	18
2	SOFTWARE – latest/recent versions of AutoCAD	18 Licenses
3	SOFTWARE – latest/recent versions of ANSYS	18 Licenses
4	SOFTWARE – latest/recent versions of STAAD PRO	18Licenses
5	Laser Printer	01

SEMESTER II

19SET606	ADVANCED DESIGN OF STEEL STRUCTURES	L	T	P	C

		3	**0**	**0**	**3**

UNIT I	**DESIGN CONNECTIONS**	**9**
Connections - Bracket connections –shear connections –fin plate, end plate and cleat connections - moment connections –direct welded, strap plate end plate connections-semi rigid connections		

UNIT II	**DESIGN OF COMPOSITE STRUCTURES**	**9**
Concepts-Design of beams –Shear Connections –Encased columns- Unfilled columns – uniaxial and biaxial eccentric columns-Designs of Deck slab		

UNIT III	**DESIGN OF COLD - FORMED STEEL STRUCTURES**	**9**
Types of cross sections - concepts of local buckling, and effective width - Design of compression and tension members - concepts of lateral buckling – Design of Beams, deflections of beams and design of beam webs - Combined stresses and connections- Empirical design of Z-purlins with lips and wall studs		

UNIT IV	**INDUSTRIAL STRUCTURES**	**9**
Design of chimneys –Self-supporting and guyed chimneys –Design of silos- Design of Bunkers – Designsof frames and towers		

UNIT V	**PLASTIC ANALYSIS OF STRUCTURES**	**9**
Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portalframes, Effect of axial force - Effect of shear force on plastic moment, Connections – Requirement – Moment resisting connections. Design of Straight Corner Connections– Design of continuous beams.		

L: 45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Dr.Jayagopal.L.S, Dr.Tensing.D, “Design of Steel Structures”,Vikas Publishing House Pvt.Ltd, 2016. (Unit I- Unit V)
2.	S.K. Duggal, “Limit State Design of Steel Structures”, McGraw Hill Education, 2014
REFERENCES	
1.	Lynn S. Beedle, “Plastic Design of Steel Frames”, John Wiley and Sons, New York, 1990
2.	Wie Wen Yu, “Design of Cold Formed Steel Structures”, McGraw Hill Book Company,New York, 1996
3.	Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008.(Unit-I, Unit-II, Unit-IV, Unit-V).

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: design various types of connections for steel structural elements. **CO2**: design composite beams, slabs and columns. **CO3**: design cold-formed steel structural components. **CO4**: design special structures like steel chimney, bunkers and silos, frames and towers **CO5**: analyse and design of steel structures in non –linear stage (plastic).

19SET607	FINITE ELEMENT METHOD	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO FINITE ELEMENT ANALYSIS	9
Introduction: Basic concepts of finite element analysis – Element types - Shape functions - Convergence Requirements.-Discretizations-Method of Weighted Residuals: Variational principles -Rayleigh Ritz method - Method of collocation - Sub domain method - Galerkin's method - Method of least squares		

UNIT II	ONE DIMENSIONALPROBLEMS	9
Stiffness matrix for an axial element - Coordinate transformation –formulation of finite element equation and Analysis problems for bar, truss, Beam, plane frames		

UNIT III	TWO AND THREE DIMENSIONAL PROBLEMS	9
Plane Stress and Plane Strain Problems: Finite element modeling –2-D element under plane stress and plane strain condition-Shape function for the Constant Strain Triangular element using natural coordinates and generalized-Strain displacement matrix of CST element – ax symmetric element problems-Three Dimensional Elements: Tetrahedron element family - Hexahedron element family.		

UNIT IV	ISOPARAMETRIC FORMULATION	9
Natural co-ordinate systems-Isoparametric elements-shape functions for a 2-D four noded and eight NodedIsoparametric rectangular elements using natural coordinate system Sub - iso - super parametric elements - Shape functions mapping - Linear isoperimetric quadrilateral - Simple problems– Axisymmetric stress analysis -Higher Order Triangular elements - Comparison of		

different methods – Serendipity elements-Rectangular element - Serendipity family - Lagrangian family – Hermitian family

UNIT V	APPLICATION TO PLATES AND SHELLS	9
Plate Bending Problems: Basic concepts -Effect of shear deformation in plates - Introduction to finite strip method -Shell elements: Concepts of shell elements - Degenerated shell elements - Derivation of stiffness matrix for degenerated shell elements. Use of FEM packages for analysis: Stress analysis of using FEM packages.		

TEXT BOOKS	
1.	Singaresu.S.Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, 2010
2.	Reddy J N, “An Introduction to Finite Element Method”, McGraw Hill International third Edition, New Delhi, 2005
REFERENCES	
1.	Daryl L Logan, A First Course in the Finite Element Method, Cengage Learning, 2010
2.	C. S. Krishnamoorthy, Finite Element Method - Theory and Programming, Tata McGraw Hill Publishing Company, New Delhi, 1994.
3.	K. J. Bathe, Finite Element Procedure, Prentice Hall of India, and New Delhi, 2007.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: Predict the displacement, stress and strain of elements after idealizing by finite element method. **CO2**: Analyze the internal forces for beams, frames and trusses subjected to different boundary conditions by discretizing the members into small elements. **CO3**: Analyze 2-D and 3-D structures for complex geometry problems. **CO4**: Apply the finite element method to form the stiffness matrix for plates and shells. **CO5**: Recommend the appropriate mesh shape and size for reliable results.

19SET608	STRUCTURAL DYNAMICS	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO STRUCTURAL DYNAMICS	9

Formulation of equations of motion by different methods - Single degree of freedom systems - Free vibration - Forced response to harmonic - Periodic and impulsive loads - Response to general dynamic loading - Effect of damping - Methods of evaluation of damping.

UNIT II	MULTI-DEGREE-OF-FREEDOM SYSTEMS	9
Formulation of Structure, property matrices-Eigen value problems-methods-Dunkerlys method-Holzer method- Stodola method-Rayleighs method- Rayleigh-Ritz method-Mode shapes-ortho normality of modes.		

UNIT III	DYNAMIC RESPONSE OF MDOF SYSTEMS	9
Mode superposition Techniques-Problems on two degree of freedom for building frames-Numerical Integration Techniques-New marks method-Linear Acceleration method-Problems-Numerical Evaluation of Duhamel Integral.		

UNIT IV	CONTINUOUS SYSTEMS	9
Modelling- Free and forced vibrations of bars- Flexural vibration of simple beams-Modes and frequencies-Orthogonality properties of normal modes of continuous systems.		

UNIT V	DESIGN OF STRUCTURES SUBJECTED TO DYNAMIC LOADS	9
Idealization of multi-storeyed frames for dynamic analysis-Machine foundations -Earthquake response-elastic rebound theory-deterministic analysis of earthquake response- -Design of earthquake response-Design of earthquake resistant structures-IS code provisions.		

L: 30 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Mario Paz, “Structural Dynamics”, Kluwer Academic Press, 2012
2.	Manickaselvam V.K., “Elementary Structural Dynamics”, Dhanpat Rai& Sons, 2001.
REFERENCES	
1.	Clough R.W. and Penzien J. “Dynamics of structures”, McGraw Hill Book Co.,
2.	Craig Roy R. “Structural Dynamics – An introduction to computer methods”, John Wiley & Sons,2006.
3.	MadhujitMukhopadhyay, “Structural Dynamics Vibrations and Systems”, Ane Books India Publishers, 2010.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: study the response of structures to general dynamic loading **CO2**: formulate mode shapes and natural frequencies of MDOF system **CO3**: evaluate the response of MDOF system **CO4**: study the vibrational characteristics of continuous systems **CO5**: elaborate the dynamics of structural system under earthquake load.

19SEP609	STRUCTURAL ENGINEERING LABORATORY	L	T	P	C
		0	0	4	2

LIST OF EXPERIMENTS
1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour. 2. Testing of simply supported steel beam for strength and deflection behaviour. 3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading. 4. Dynamic Response of cantilever steel beam a. To determine the damping coefficients from free vibrations. b. To evaluate the mode shapes. 5. Static cyclic testing of single bay two storied steel frames and evaluate a. Drift of the frame. b. Stiffness of the frame. c. Energy dissipation capacity of the frame. 6. Non-Destructive Test on concrete i) Rebound hammer and ii) Ultrasonic Pulse Velocity Tester

L: 0 T:0 P: 45 TOTAL : 45 PERIODS

REFERENCES	
1.	Dally J W, and Riley W F, “Experimental Stress Analysis”, McGraw-Hill Inc. New York, 2010
2.	C..S.Krishnamoorthy and S.Rajeev, Computer Aided Design, Narosa Publishing House, New Delhi,2003.
3.	H.B.Harrison, Structural Analysis and Design Vol. I & II, Pergamon Press, 1991

LABORATORY EQUIPMENTS REQUIREMENTS

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. Clinometer
12. Vibration Exciter
13. Vibration Meter
14. FFT Analyser

PROFESSIONAL ELECTIVES

PROFESSIONAL ELECTIVE –I

19SEE610	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

UNIT I	MAINTENANCE AND REPAIR STRATEGIES	9
Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration-surface-defects- colour variation-other surface blemishes.		

UNIT II	SERVICEABILITY AND DURABILITY OF CONCRETE	9
Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking		

UNIT III	MATERIALS AND TECHNIQUES FOR REPAIR	9
Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection-corrosion of embedded steel in concrete.		

UNIT IV	REPAIRS TO STRUCTURES	9
Repair of structures distressed due to earthquake – Strengthening using FRP - Strengthening and stabilization techniques for repair-strengthening of reinforces concrete by external bonding of steel plates-leak sealing-surface coating-underwater repair-repair of concrete floors.		

UNIT V	REHABILITATION AND RETROFITTING	9
Testing and evaluation - Classification of structures for safety point of view – methods of strengthening for different disasters - qualification test.		

L: 45 T:0 P:0TOTAL : 45 PERIODS

TEXT BOOKS	
1.	B Vidivelli, “Rehabilitation Of Concrete Structures”, Standard Publishers Distributors; 1 edition (2009).
2.	Santhakumar A.R., “Concrete Technology” Oxford University Press, Printed in India by Radha Press, New Delhi, 2007 (Unit-II, Unit-IV)
REFERENCES	

1.	Allen R.T and Edwards S.C, "Repair of Concrete Structures", CRC Press, 2011(Unit-III, Unit-V)
2.	Dension, C. Alien and H. Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1993
3.	R. N. Raikar, Learning from failures - Deficiencies in Design, Construction and Service,- R &D Centre (SDCPL), RaikarBhavan, Bombay, 1993.

COURSE OUTCOMES
At the end of the course students should be able to
CO1: demonstrate the various types of distress in concrete structures
CO2: understand the typical and potential applications of these materials
CO3: recommend the best Materials and Techniques for Repair.
CO4: understand the importance of repairs to structures
CO5: know about testing and evaluation of structures

19SEE611	**PRE-STRESSED CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**PRINCIPLES OF PRE-STRESSING**	**9**
Difference between reinforced and prestressed concrete- Types and systems of prestressing- Analysis methods - Losses in Prestress: Loss due to elastic shortening in pretensioned and post tensioned beams. Loss due to creep, shrinkage, relaxation, friction - Approximate percentage of various losses in pretensioned and post tensioned beams		

UNIT II	**DESIGN OF FLEXURAL MEMBERS AND ANCHORAGE ZONE**	**9**
Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress – Design of beams for shear and Torsion at working and ultimate loads. Design of Anchorage Zone by Guyon's method - Concept of Mangel's method - IS 1343 recommendations. Design of end block.		

UNIT III	**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 IV	**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 V	DESIGN OF COMPOSITE MEMBER	9
Statically indeterminate structures - concept of concordant cable and linear transformations - sketching of pressure lines for continuous beams and single span single storey rigid frame. Design principles of partially prestressed concrete structures - circular prestressing - Design of a circular tank for circular and vertical prestressing		

L: 45 T: 0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 2008.
2.	Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 2011
REFERENCES	
1.	Lin T.Y., Ned H. Burns , “Design of Prestressed Concrete Structures, Wiley India Private Limited; Third edition, 2010.
2.	Arthur H. Nilson “Design of Prestressed Concrete”, John Wiley & Sons Inc, New York.,2004
3.	Dayaratnam.P, “Prestressed Concrete Structures”, Oxford and India Book House Ltd., Chennai, 2016.
4.	Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.
5.	Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: knowledge about various method and losses in prestress. **CO2**: Design the prestressed concrete members for flexure and shear **CO3**: Design the prestressed concrete members for tension members and compression members **CO4**: Analyze and design of continuous beams and cantilever beams. **CO5**: Analyze and design of composite beams, circular tank and the concepts of partial pre-stressing..

19SEE612	OFFSHORE STRUCTURES	L	T	P	C

		3	**0**	**0**	**3**

UNIT I	**WAVE THEORIES**	**9**
Wave generation process, small and finite amplitude wave theories.		

UNIT II	**FORCES OF OFFSHORE STRUCTURES**	**9**
Wind forces, wave forces on vertical, inclined cylinders, structures - current forces and use of Morison 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 and mooring cables and pipe lines.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Mohamed A. El-Reedy,"Offshore Structures: Design, Construction and Maintenance", Gulf Professional Publishing ,2012
2.	Chakrabarti, S.K. "Hydrodynamics of Offshore Structures", Computational Mechanics Publications, 1987.

REFERENCES	
1.	Brebia, C.A and Walker, S., "Dynamic Analysis of Offshore Structures", NewButterworths, U.K.
2.	PI, Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms, American Petroleum Institute Publication
3.	Reddy, D.V. and Arockiasamy, M., "Offshore Structures", Vol.1 and Vol.2, Krieger Publishing Company

COURSE OUTCOMES

At the end of the course students should be able to **CO**1: know about wave generation processes **CO2**: study the forces acting on offshore structures **CO3**: model the offshore structure and foundation **CO4:** analyze the offshore structures **CO5**: design the offshore structures

19SEE613	**NON-LINEAR ANALYSIS OF STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**ELASTIC ANALYSIS OF FLEXURAL MEMBERS**	**9**
Introduction to nonlinear mechanics; statically determinate and statically indeterminate flexible barsof 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 flexible bars of uniform and variable stiffness members with and without axial restraints.		

UNIT III	**VIBRATION THEORY AND ANALYSIS OF OF FLEXURALMEMBERS**	**9**
Vibration theory and analysis of flexible members; hysteretic models and analysis of uniform andvariable 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		

L: 45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Ramchandra , "Non-Linear Analysis of Steel Structures", Standard Publications-Delhi(2006)
2.	Sathyamoorthy, M.,"Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida,1997.(Unit-I, Unit-II, Unit-III, Unit-IV, Unit-V)

REFERENCES	
1.	Skullerud “Nonlinear Analysis of Offshore Structures”, Wiley-Blackwell; (2001)
2.	Fertis, D. G.,”Nonlinear Mechanics”, CRC Press, Boca Raton, Florida, 1998..(Unit-I,Unit-II, Unit-III, Unit-IV, Unit-V)
3.	K. I. Majid “Non Linear Structures”, Butterworth Heinemann (2014) K. I. Majid “Non Linear Structures”, Butterworth Heinemann (2014)

COURSE OUTCOMES

At the end of the course students should be able to
CO1: analyze the flexural members by elastic methods of approach.
CO2: analyze the flexural members by inelastic methods.
CO3: acquire knowledge on vibration theory and analysis of flexural members
CO4: analyze the plates by elastic and inelastic methods.
CO5: know about instabilities of elastically supported beams

PROFESSIONAL ELECTIVE –II

19SEE614	DESIGN OF SUBSTRUCTURES	L	T	P	C
		3	0	0	3

UNIT I	SITE INVESTIGATION AND SELECTION OF FOUNDATION	9
Soil investigation – Basic requirements of foundation – Functions of foundation-Types and selection of foundations. Methods of exploration – Geophysical methods- Depth of exploration ––Sampling – Representative and undisturbed sampling–sampling techniques–Split spoon sampler, Thin tube sampler, Stationary piston sampler– Bore log report– Insitu testing of Soils (Penetration tests -SPT and SCPT)–Data interpretation (Strength parameters and Liquefaction potential)–Selection of foundation based on soil condition.		

UNIT II	SHALLOW FOUNDATIONS	9
Introduction to bearing capacity- Types of shear failures-Bearing capacity of shallow foundations by Terzaghi's theory, Meyerhof's theory, and IS codal provisions – Bearing capacity of footing subjected to inclined andeccentric loading – structural design of isolated, combined footing and raft foundation — General principles of foundation design.Settlement of shallow foundation - Plate load test.		

UNIT III	PILE FOUNDATIONS	9
Introduction – Types of pile foundations – load carrying capacity –settlement analysis of pile group-pile load test –Negative skin- friction-structural design of straight piles –configuration of piles- different shapes of piles cap – structural design of pile cap.		

UNIT IV	WELL FOUNDATIONS	9
Types of well foundation – Grip length -Depth of well foundation-Forces acting on well foundation- elements of well foundation- Design of individual components of caisson and well foundation (only forces and design principles) - sinking of well-shifts and tilts-preventive measures		

UNIT V	SPECIAL FOUNDATIONS	9
Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete chimneys – Design of anchors- Reinforced earth retailing walls.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Dr.K.R.Arora, "Soil Mechanics & Foundation Engineering", Standard Publishers &Distributors, 2005.).
2.	B. C.Punmia,Ashok Kumar Jain , A. K. Jain, "Soil Mechanics and Foundations "LaxmiPublications, 2005.

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

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: able to select appropriate foundation type based on available soil conditions. **CO2**: design reinforced concrete shallow foundations **CO3**: design reinforced concrete pile foundations **CO4**: design well foundations **CO5**: design foundation for special structures

19SEE615	ENVIRONMENTAL ENGINEERING STRUCTURES	L	T	P	C
		3	0	0	3

UNIT I	DESIGN OF PIPES	9
Structural Design and detailing of Reinforced concrete, Steel & Cast iron piping mains Anchorage for pipes – Hydro dynamic considerations.		

UNIT II	SEWAGE TREATMENT STRUCTURES	9
Design and detailing of steel structures used in water supply works & Sewage treatment works.		

UNIT III	INDUSTRIAL WASTE WATER STRUCTURES	9
Structural Design of Sedimentation tank – Septic Tank – Trickling Filters – Activated Sludge Plant – Oxidation Ponds.		

UNIT IV	DESIGN OF SPECIAL PURPOSE STRUCTURES	9
Structural design and detailing of Underground Reservoirs – Swimming pools – Water Retaining Structures – Settling tanks, Clari floculators, Aeration tank. Effect of Earth pressure & Uplift considerations – Selection of materials of construction.		

UNIT V	REPAIR & REHABILITATION	9
Diagonising the cause & Damage – Identification of cracks –NDT Test – Repair & rehabilitation methods for masonry, R.C.C, P.S.C & Steel structures used in water supply & Sewage treatment works.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
TEXT BOOKS	
1.	Jai Krishna and Jain.O.P., "Plain and Reinforced concrete" Nem Chand; Eighth Edition (2008)
2.	B Vidivelli, "Rehabilitation Of Concrete Structures",Standard Publishers Distributors; 1 edition (2009).

REFERENCES	
1.	CarioRainieri and Fabbrocino*"* Operational Modal Analysis of Civil Engineering Structures"Springer -2014
2.	Saikia , Mini Das,"Elements of Civil Engineering",Prentice Hall India Learning Private Limited (2010).
3.	Kalliat T. Valsaraj , Elizabeth M. Melvin, "elements of Environmental Engineering:

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: design pipes **CO2**: design sewage treatment structures **CO3**: design industrial waste structures **CO4**: design special structures **CO5**: know the repair and rehabilitation of structures

19SEE616	THEORY OF PLATES AND SHELLS	L	T	P	C
		3	0	0	3

UNIT I	LATERALLY LOADED PLATES	9
Thin Plates with Small Defection. Laterally Loaded Thin Plates, Governing Differential Equation, Boundary Conditions. Rectangular Plates, Simply Supported Rectangular Plates, Navier Solution and Levy's Methods, Plates with Various Edge Conditions-Symmetrical Bending of Circular Plates, Plates on Elastic Foundation.		

UNIT II	NUMERICAL METHODS	9
Finite Difference Method – Isotropic Rectangular plates – Boundary Conditions – All-round simply supported square plate, clamped square plate and fixed square plate subjected to uniformly distributed load.		

UNIT III	ANISOTROPIC PLATES AND THICK PLATES	9
Orthotropic Plates and Grids, Moderately Thick Plates.		

UNIT IV	MEMBRANE THEORY OF SHELLS	9
Classification of Shells - Types of Shells - Structural Action - Membrane Theory - Shells of Revolution and Shells of Translation - Examples - Limitations of Membrane Theory		

UNIT V	FOLDED PLATES	9
Folded Plate structures - structural behavior and analysis - Types - Design by ACI - ASCE Task Committee method.		

L: 45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Timoshenko, S. and Krieger S.W. Theory of Plates and Shells , McGraw Hill Book Company,1990
2.	Ramasamy, G.S., Design and Construction of Concrete Shells Roofs, CBS Publishers,1986
REFERENCES	
1.	Szilard, R., Theory of Analysis of Plates , Prentice Hall Inc. 2004
2.	Woinowsky-Krieger S., Theory of Plates and Shells, Timoshenko and Tata McGraw Hill Edition, 2010.
3	Stephen P, Timoshenko, S. Theory Of Plates And Shells, McGraw Hill Book Company,2010
4	Woinowsky-Krieger S., Theory of Plates and Shells, Timoshenko and Tata McGraw Hill Edition, 2010.
5	Varghese P. C., Design of Reinforced Concrete Shells & Folded Plate, 1st Edition, PHI.

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Analyze the laterally loaded plates, anisotropic plates and thick plates

CO2: Apply various numerical methods for analysis of plates.

CO3: Analyse and design of shells and folded plates.

CO4knowledge on structural behaviour and analysis of different types of shells.

CO5: knowledge on structural behaviour and analysis of different types of plates

19SEE617	DESIGN OF STRUCTURES FOR DYNAMIC LOADS	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION	9
Factors affecting design against dynamic loads – behavior of concrete, steel, masonry and soil under impact and cyclic loads – Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems – Ductility and its importance.		

UNIT II	DESIGN AGAINST EARTHQUAKES	9
Earth quake characterization – response spectra – Seismic coefficient and response spectra method for estimating loads – response of framed, braced frames and shear wall buildings – Design as per BIS Codes of practice ductility based design. (IS 13920-1993).		

UNIT III	DESIGN AGAINST BLAST AND IMPACT	9
Characteristics of internal and external blast – Impact and Impulse loads – Pressure distribution on buildings above ground due to external blast – Underground explosion – Design of buildings for blast and impact as per BIS codes of practice.		

UNIT IV	DESIGN AGAINST WINDS	9
Characteristics of wind – Basic design and wind speeds – effect of permeability of the structure – pressure coefficient – Aero elastic and aerodynamic effects – Design as per BIS code of practice including Gust Factor approach – Tall buildings, Stacks and Chimneys.		

UNIT V	SPECIAL CONSIDERATIONS	9
Energy absorption capacity – Ductility of the material and the structure – Detailing for ductility – Passive and active control of vibrations – New and Favourable materials.		

L: 45 T: 0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Belagoschy, “Design of Buildings to with stand abnormal loading”, Butterworths, 1990
2.	Paulay. T, and Priestly, M.N.J. A. “Seismic Design of Reinforced Concrete and Masonry buildings”, John Wielyand Sons, 2013.(Unit-I, Unit-II, Unit-III, Unit-IV and Unit-V)
REFERENCES	
1.	Kolusek. V. Et al, “Wind effects on Civil Engineering Structures”, Elsevier, 1984.
2.	Aggarwal P Earthquake Resistant Design of Structures, Prentice Hall India Learning Private

COURSE OUTCOMES
At the end of the course students should be able to **CO1:** Explain the behavior of structures under dynamic loads **CO2:** Design structures for earthquake **CO3:** Design structures for blast and impact loads **CO4:** Identify the effects due to Wind on structures **CO5:** Perform ductile detailing

PROFESSIONAL ELECTIVE -III

19SEE618	MODERN CONSTRUCTION MATERIALS	L	T	P	C
		3	0	0	3

UNIT I	SPECIAL CONCRETES	9

Concretes, Behaviour of concretes – Properties and Advantages of High Strength and High Performance Concrete – Properties and Applications of Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete

UNIT II	**METALS**	**9**
Steels –Types, Manufacturing process of steel – Advantages of new alloy steels – Properties and advantages of aluminum and its products – Coatings to reinforcement – Types , Applications of Coatings		

UNIT III	**COMPOSITES**	**9**
Plastics – Types, Properties– FRP – Types, advantages, factors affecting, limitations and applications .		

UNIT IV	**OTHER MATERIALS**	**9**
Water Proofing Compounds -types and properties – Types of Non-weathering Materials and its uses – Types of Flooring and Facade Materials and its application.		

UNIT V	**SMART AND INTELLIGENT MATERIALS**	**9**
Smart and Intelligent Materials - Types and Differences– Special features – Case studies showing the applications of smart & Intelligent Materials.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	M.S. Shetty, “Concrete Technology”, S Chand, 2006 (Unit-I,IV)
2.	Santhakumar A.R., “Concrete Technology” Oxford University Press, Printed in India by Radha Press, New Delhi, 2007 (Unit-II, Unit-IV)
REFERENCES	
1.	1. Allen R.T and Edwards S.C, “Repair of Concrete Structures”, CRC Press, 2011(Unit-III, Unit-V).
2.	Shan Somayaji, Civil Engineering Materials, Prentice Hall Inc., 2001
3.	Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2005.
4.	Mamlouk, M.S. and Zaniewski, J.P., Materials for Civil and Construction Engineers, Prentice Hall Inc., 1999.
5.	ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.

COURSE OUTCOMES
At the end of the course students should be able to CO1: compare the properties of most common and advanced building materials. CO2: understand the properties of modern construction materials. CO3: understand the relationship between material properties and structural form CO4: understand the importance of experimental verification of material properties. CO5: knowledge of modern construction materials to be used in the field.

19SEE619	OPTIMIZATION IN STRUCTURAL DESIGN	L	T	P	C
		3	0	0	3

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 - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques		

UNIT III	GEOMETRIC PROGRAMMING	9
Polynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty		

UNIT IV	DYNAMIC PROGRAMMING	9
Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods		

UNIT 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 multi-storey buildings, water tanks and bridges

L: 30 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi
2.	Rao. S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd.
REFERENCES	
1.	Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey
2.	Uri Krish, "Optimum Structural Design", McGraw Hill Book Co.
3.	Bhavikatti S.S, "Structural Optimisation Using Sequential Linear Programming", Vikas Publishing House Pvt. Ltd., New Delhi.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: formulate simple optimization problems and solve using the relevant techniques **CO2**: know about linear and non-linear programming in optimization **CO3**: know about geometric programming in optimization **CO4**: know about dynamic programming in optimization **CO5**: to design various structural elements for minimum weight.

19SEE620	**WIND AND CYLONE EFFECTS ON STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**INTRODUCTION**	**9**
Introduction, Spectral studies, Gust factor, Wind velocity, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects- Dynamic nature of wind – Pressure and suctions		

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.		

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.		

UNIT IV	DESIGN OF SPECIAL STRUCTURES	9
Design of Structures for wind loading – Application to design, IS 875 code method- Buildings, Chimneys, Roofs and Shelters.		

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.		

L: 45 T: 0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Davenport A.G., and Riera J.D., "Wind Effects on Buildings and Structures ", CRC Press , 1998).
2.	Emil Simiu, and Robert H. Scanlan , "Wind Effects on Structures", Dover Publications,2011.
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, 1972

COURSE OUTCOMES

At the end of the course students should be able to
CO1: understand the dynamic nature of wind.
CO2: know about modeling requirements, period and damping value for wind design.
CO3: understand about the effect of Wind in high rise building.
CO4: able to design high rise structures subjected wind load.
CO5: able to design high rise structures subjected wind load, even structures exposed to cyclone.

19SEE621	ADVANCED CONSTRUCTION TECHNOLOGY	L	T	P	C
		3	0	0	3

UNIT I	SUB-STRUCTURE CONSTRUCTION	9
Box jacking – Pipe jacking – Under water construction of diaphragm walls and basement – Tunneling techniques – driving well and caisson – sinking cofferdam – cable anchoring and grouting – driving diaphragm walls, sheet piles – laying operations for built up offshore system – shoring for deep cutting large reservoir construction with membrane and earth system –well points – dewatering and stand by plant equipment for underground open excavation.		

UNIT II	SUPER STRUCTURE CONSTRUCTION	9
Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections –launching techniques – suspended form work – erection techniques of tall structures, large span structures – launching techniques for heavy decks – in situ prestressing in high rise structures, aerial transporting, handling and erecting light weight components on tall structures – erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, skyscrapers, bow string bridges, cable stayed bridges –launching and pushing of box decks – Advanced construction techniques in offshore construction practice – construction sequence and methods in RCC domes and prestress domes		

UNIT III	REPAIR CONSTRUCTION	9
Mud jacking grout through slab foundation – micro piling for strengthening floor and shallow profile – pipeline laying – protecting sheet piles, screw anchors – sub grade – water proofing – under pinning Advanced techniques – Sequence in demolition and dismantling.		

UNIT IV	ORGANIZING PROJECT MANAGEMENT	9
What is project Management – Trends in Modern Management – Strategic Planning and Project Programming organization of project participants – Traditional Designer – Constructor sequence– Professional Construction Management – owner – Builder Operation – Turnkey operation – Leadership and Motivation for the project team – Interpersonal Behaviour in Project-Organizations – Perception of Owners and Contractors. Innovation and Technological Feasibility– Innovation and Economic Feasibility – Geotechnical Engineering: Investigation Construction Planning – Computer aided planning		

UNIT V	LABOUR, MATERIAL, EQUIPMENT AND FINANCIALMANAGEMENT	9
Factors affecting job-site productivity of labour – Labour relations in construction – Problems in		

collective bargaining – Materials procurement and Delivery – Inventory control – Tradeoffs of costs in Materials Management – Construction equipment – Choice of equipment and standard production rates – Equipments for industrial construction and pre-fabrication. Type of Construction cost estimates – Unit cost method of estimation – Application of cost indices to estimating – Estimate based on Engineers list of quantities allocation of construction costs over time – Estimation of operating costs – Computer Aided Cost Estimation.

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.(Unit-I, Unit-II).
2.	Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003. (Unit-III, Unit-IV, Unit-V).
REFERENCES	
1.	A.R.Santhakumar ;"Concrete Technology",Oxford University Press,2007..(Unit-I, Unit- II, Unit III,Unit-V)
2.	Rudhani G, "Light Weight Concrete", Academic Kiado, Publishing Home of Hungarian Academy of Sciences, 1963.
3.	Seetharaman S, Construction Engineering and Management, Umesh Publications, NaiSarak, Delhi – 2002

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: Know the about the advance Sub-structure construction methods. **CO2**: Know the about the Super -structure construction methods **CO3**: understand the techniques in repairing constructions. **CO4**: understand the importance of Project Management methods. **CO5**: understand the importance of cost control in projects.

SEMESTER II

19SET701	**ASEISMIC DESIGN OF STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**EARTHQUAKES AND GROUND MOTION**	**9**

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

UNIT II	**EFFECTS OF EARTHQUAKE ON STRUCTURES**	**9**
Dynamics of Structures (SDOFS/ MDOFS), Response Spectra - Average Response Spectra - Design Response Spectra, Evaluation of Earthquake Forces as per codal provisions, Effect of Earthquake on Different Types of 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 Earthen Buildings, 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 - Design anddetailing – Rigid Frames – Shear wall – Coupled Shear wall.		

UNIT V	**SPECIAL TOPICS**	**9**
Mathematical modeling of multistoried RC Buildings – Capacity based design. Vibration Control – TunedMass Dampers – Principles and application, Basic Concept of Seismic Base Isolation – various Systems-Case Studies, Important structures.		

TEXT BOOKS	
1.	PankajAgarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2006.(Unit-I, Unit-II, Unit-III, Unit-IV,Unit-V)
2.	S K Duggal, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007. (Unit-I,Unit-III, Unit-IV)
3.	Course Notes "Design of Reinforced Concrete Buildings", IIT Kanpur, June 1999.
4.	Paulay,T and Priestly, M.N.J., “Aseismic Design of Reinforced Concrete and Masonry buildings”,John Wiley and Sons, 1991

REFERENCES	
1.	Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2004
2.	BungaleS.Taranath"Structural Analysis and Design of Tall Buildings – McGraw Hill BookCompany, New York, 1999.
3.	Anil K. Chopra, Dynamics of Structures – Theory and Applications to Earthquake Engineering, Prentice Hall of India Pvt. Ltd., New Delhi, 2007(Unit-II)

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: The students willable to understand the concepts and principles of seismic design **CO2**: The students will master the software which is used for calculation earthquake loads **CO3**: The students able to designing earthquake resistant buildings to ensure the health, safety and security infrastructures. **CO4**: The students will acquire clear idea about the modern concepts used for earthquake resistant Buildings. **CO5**: The students will foresee the potential consequences of strong earthquakes on urban areas and civilinfrastructures.

PROFESSIONAL ELECTIVE -IV

19SEE705	STRUCTURAL HEALTH MONITORING	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION TO HEALTH MONITORING	9
Factors affecting Health of Structures-Causes of Distress-Regular Maintenance-HM scheme-various steps in SHM-challenges in SHM-Concepts- Various Measures, Structural Safety in Alteration. Assessment of Health of Structure-Collapse and Investigation-Investigation Management-SHM Procedures.		

UNIT II	SENSORS FOR HEALTH MONITORING SYSTEMS	9
Review of Signals, Systems and Data Acquisition Systems: Frequency and time domain representation of systems, Fourier/Laplace transforms, modelling from frequency response measurements, D/A and A/D converters, programming methods for data acquisition systems-Electrical Resistance Strain Gages (ERSG)-Vibrating Wire Strain Gages (VWSG)-Fiber Optic Sensors (FOS)-Temperature Sensors-Accelerometers-Displacement Transducers-Load Cells-Humidity Sensors-Crack Propagation Measuring Sensors-Corrosion Monitoring Sensors-Pressure Sensors-		

UNIT III	FIELD TESTS	9
Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardwarerequirements, Static Response Measurement. Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.		

UNIT IV	SYSTEMS AND TECHNIQUES	9
Health Monitoring/Diagnostic Techniques: Vibration signature analysis-modal analysis-neural network-based classification techniques- electro–mechanical impedance (EMI) technique. Integrated Health Monitoring Systems: Intelligent Health Monitoring Techniques-Neural network classification techniques-extraction of features from measurements-training and simulation techniques-connectionist algorithms for anomaly detection- multiple damage detection-and case studies		

UNIT V	INFORMATION TECHNOLOGY FOR HEALTH MONITORING	9
Information gathering, -signal analysis-information storage-archival-retrieval-security; wireless communication-telemetry-real time remote monitoring-network protocols-data analysis and interpretation. Project Based Health Monitoring Techniques: Health monitoring techniques based on case studies-practical aspects of testing large bridges for structural assessment-structural integrity of aging multi-storey buildings-condition monitoring of other types of structures-Application of IoT in Structural Health Monitoring-Case Studies.		

L: 45 T:0 P:0TOTAL:45 PERIODS

TEXT BOOKS

1.	Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, "Structural Health Monitoring", Wileyand sons 2006.
2.	J.P. Ou, H.Li and Z.D. Duan, "Structural Health Monitoring and Intelligent Infrastructure", Vol-1, Taylor and Francis Group, London, U.K, 2006.
3.	Douglas E Adams, "Health Monitoring of Structural Materials and Components-Methods with Applications" John Wiley and Sons, 2007.
REFERENCES	
1.	Philip, W., "Industrial sensors and applications for condition monitoring", MEP, 1994.
2.	Armer, G.S.T (Editor), "Monitoring and assessment of structures", Spon, London, 2001.
3.	Harris, C.M., Shock vibration handbook, McGraw-Hill, 2000.
4.	Fu Ko Chang, "Structural Health Monitoring: Current Status and Perspectives".

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: identify factors affecting health of the structure and perform structural audit. **CO2**: understand systems and sensors for health monitoring of structures **CO3**:assess the health of structure using static & dynamic field methods. **CO4**: carry out different techniques for health monitoring of structures **CO5**: make use of IT concepts for health monitoring of structures

19SEE706	**PREFABRICATED STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**INTRODUCTION**	**9**
Need for prefabrication – Principles – Materials – Modular coordination – Standardization – Systems – Production – Transportation – Erection- Elimination of erection stresses – Beams, columns - Symmetrical frames.		

UNIT II	**PREFABRICATED COMPONENTS**	**9**
Behaviour of structural components – Large panel constructions – Construction of roof and floor slabs – Wall panels – Columns – Shear walls		

UNIT III	**DESIGN PRINCIPLES**	**9**
Disuniting of structures- Design of cross section based on efficiency of material used – Problems in design because of joint flexibility – Allowance for joint deformation.		

UNIT IV	**JOINT IN STRUCTURAL MEMBERS**	**9**
Joints for different structural connections – Dimensions and detailing – Design of		

expansion joints .

UNIT V	DESIGN FOR ABNORMAL LOADS	9
Progressive collapse – Code provisions – Equivalent design loads for considering abnormal effects such as earthquakes, cyclones, etc., - Importance of avoidance of progressive collapse.		

L: 30 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1	Gerostiza C.Z., Hendrikson C. and Rehat D.R., Knowledge based process planning for construction and manufacturing, Academic Press Inc., 1994 (Unit-I,II,IV,V)
2	Koncz T., "Manual of precast concrete construction", Vols. I, II and III, Bauverlag, GMBH, 1971.(Unit-I,II,III)

REFERENCES	
1	John D. Quale., "Sustainable, Affordable, Prefab: The EcoMOD Project", University of Virginia Press, 2012 (Unit-I,II,III, IV,V)
2	CBRI, Building materials and components, India, 1990 (Unit-I,II,IV)
3	Kim S Elliott, Colin Jolly., "Multi-Storey Precast Concrete Framed structures", Wiley, 2013 (Unit-I, IV,V)
4	Colin Davies., "The Prefabricated Home", Reaktion Books, 2005 (Unit-II,III,IV)

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: Adopt the prefabrication technique and methodology of residential structures **CO2**: Adopt the prefabrication technique of various industrial structures **CO3**: Distinguish between the basic types of construction of prefabricated reinforced concrete, timber and steel structures **CO4**: Explain the Basic knowledge of building technology applied in bridge structures using prefabricated technology and construction of underground structures using prefabrication **CO5**: Ability to employ the knowledge to design abnormal loads

19SEE707	STABILITY OF STRUCTURES	L	T	P	C

		3	**0**	**0**	**3**

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 and end couples 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**
Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever beams.		

UNIT IV	**BUCKLING OF PLATES**	**9**
Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques.		

UNIT V	**INELASTIC BUCKLING**	**9**
Double modulus theory - Tangent modulus theory - Shanley's model – Eccentrically loaded Inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates.		

L: 45 T: 0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Timoshenko, S and Gere., "Theory of Elastic Stability", McGraw Hill Book Company, 2012.
2.	Gambhir, "Stability Analysis and Design of Structures", springer, New York , 2004
REFERENCES	
6.	Brush and Almorth, "Buckling of Bars, Plates and Shells", McGraw Hill Publishing Company Ltd, 1990.
7.	Iyenger.N.G.R.,, "Structural stability of columns and plates", Affiliated East West Press,1986

8.	Ashwini Kumar, “Stability of Structures”, Allied Publishers LTD, New Delhi, 2003
9.	Chajes, A. “Principles of Structures Stability Theory”, Prentice Hall, 1974.
10.	Simitser.G.J and Hodges D.H, ”Fundamentals of Structural Stability”, Elsevier Ltd., 2006.

WEB RESOURCES

1. www.slideshare.net/Kx53/stability-of-structures
2. http://freevideolectures.com/Course/92/Mechanics-of-Solids/10

COURSE OUTCOMES

At the end of the course students should be able to

CO1: Know the phenomenon of buckling and they are in a position to calculate the buckling load on column.

CO2 Know the phenomenon of buckling and they are in a position to calculate the buckling load on beam – column, frames

CO3: Know the phenomenon of lateral and Torsional buckling of f simply supported and cantilever beams.

CO4: : Know the phenomenon of buckling and they are in a position to calculate the buckling load on plates

CO5: Know the phenomenon of Inelastic Buckling of inelastic column and Inelastic buckling of plates

19SEE708	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

UNIT I	INTRODUCTION	9
Introduction to steel - concrete composite construction – Codes – Composite action – Serviceability and - Construction issues.		

UNIT II	DESIGN OF CONNECTIONS	9
Shear connectors – Types – Design of connections in composite structures – Degree of shear connection – Partial shear interaction		

UNIT III	DESIGN OF COMPOSITE MEMBERS	9
Design of composite beams, slabs, columns, beam – columns - design of composite trusses.		

UNIT IV	COMPOSITE BOX GIRDER BRIDGES	9
Introduction - behaviour of box girder bridges - design concepts		

UNIT V	CASE STUDIES	9

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

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008
2.	Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India, 2007.

REFERENCES	
1.	Johnson R.P., “Composite Structures of Steel and Concrete”, Blackwell Scientific Publications, UK.
2.	Proceedings of Workshop on “Steel Concrete Composite Structures”, Anna University.
3.	Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: know basics of steel composite construction **CO2**: know about different connections in steel composite construction **CO3**: design composite members **CO4**: design composite box girder bridges

PROFESSIONAL ELECTIVE -V

19SEE709	DESIGN OF BRIDGES	L	T	P	J
		3	0	0	0

UNIT I	INTRODUCTION	9
Classification, investigations and planning, choice of type, I.R.C. Specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.		

UNIT II	SHORT SPAN BRIDGES	9
Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges.- Design Problems.		

UNIT III	LONG SPAN GIRDER BRIDGES	9
Design principles of continuous bridges, box girder bridges, bow string girder bridges,balanced cantilever bridges .		

UNIT IV	DESIGN OF PRESTRESSED CONCRETE BRIDGES	9
Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflections		

UNIT V	BEARINGS, CONSTRUCTION AND MAINTENANCE OF BRIDGES	9
Bearings – Steel rocker and roller bearings – Reinforced concrete rocker and roller bearings – Elastomeric bearings - Expansions joints-Design of abutments and piers – Bridge Construction and Maintenance. Types of bridge foundations – Design of foundations.		

L: 45 T:0 P: 0 TOTAL : 45PERIODS

TEXT BOOKS	
1.	Krishnaraju, N., "Design of Bridges " Oxford and IBH Publishing Co., Bombay, Calcutta, New Delhi, 2010.
2.	Ponnuswamy, S., Bridge Engineering, Tata McGraw Hill, 2008.
REFERENCES	

1.	Raina V.K. "Concrete Bridge Practice" , Tata McGraw Hill Publishing Company, New Delhi, 2010.
2.	Jagadeesh T.R and Jayaram M.A, “Design Of Bridge Structures”, PHI Learning Private Limited, 2009
3.	Bakht, B. and Jaegar, L.G., "Bridge Analysis simplified", McGraw Hill, 1985.
4.	Derrick Beckett, "An introduction to Structural Design of Concrete Bridges", Surrey University Press, Henley Thomes, Oxford Shire, 1973
5.	IRC 21-2000, Standard specifications and code of practice for road bridges
6.	IRC 24-2000,Standard specifications and code of practice for road bridges
7.	IRC 18-2000, Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned Concrete)

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: Explain the different types of bridges and design philosophies. **CO2**: Acquire basic knowledge on the planning and design aspects of bridges **CO3**: Design of short span bridges and long span girder bridges **CO4:**Design of pre stressed concrete bridges. **CO**5: Design various components of bridges.

19SEE710	**DESIGN OF TALL BUILDINGS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**DESIGN PRINCIPLES AND LOADING**	**9**
Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis - combination of loading, - Static and Dynamic approach - Analytical and wind tunnel experimental methods - Design philosophy - working stress method, limit state method and plastic design.		

UNIT 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

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.		

UNIT V	**STABILITY ISSUES**	**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.		

L: 45 T:0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Taranath B.S, "Structural Analysis and Design of Tall Buildings", McGraw Hill, 2011.
2.	Beedle.L.S, "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1986.

REFERENCES	
1.	Bryan Stafford Smith and Alexcoull, "Tall Building Structures - Analysis and Design", John Wiley and Sons, Inc., 2005.
2.	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.
3.	Lin T.Y and Stotes Burry D, "Structural Concepts and systems for Architects and Engineers", John Wiley, 1988.

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: know the different types of loadings **CO2**: know about different structural systems and its behaviour **CO3**: to analyze and design tall buildings **CO4**: know the properties of structural elements and its design

19SEE711	**INDUSTRIAL STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	PLANNING AND FUNCTIONAL REQUIREMENTS	9
Classification of Industries and industrial structures – planning for layout requirements regarding Lightening, Ventilation and Fire safety – Protection against Noise and Vibration – Guidelines from Factories Act.		

UNIT II	INDUSTRIAL BUILDINGS	9
Roofs for Industrial buildings – Steel and RC – Folded plates and Shell roofs – Gantry girder Design of Corbels and Nibs – Machine Foundations		

UNIT III	INDUSTRIAL STORAGE& ENVIRONMENTAL CONTROL STRUCTURES	9
Design of silos, bins and bunkers – Design of supporting system for storage hoppers and bunkers - Design of chimneys – Self-supporting, Guyed and braced.		

UNIT IV	POWER TRANSMISSION STRUCTURES	9
Cables – Transmission Line Towers – Substation structures – Tower foundations – Testing Towers		

UNIT V	MACHINE FOUNDATIONS	9
Types – Design Principles – Foundation for Turbo generators		

L: 45 T:0 P:0 TOTAL : 45 PERIODS

TEXT BOOKS	
1.	Subramanian.N, “Design of Steel Structures”, Oxford University Press, 2008.(Unit-I, Unit-II, Unit-IV, Unit-V)
2.	Dayaratnam.P, “Design of Steel Structures”, A.H.Wheeler, India, 2007.
REFERENCES	
1.	Linton E. Grinter, “Design of Modern Steel Structures”, Eurasia Publishing House, New Delhi, 2000.
2.	Alexander Newman, Metal building system- Design and specifications, Second edition, McGraw Hill, New Delhi , 2004.
3.	P. Srinivasalu and C. V. Vaidiyanathan, “Handbook on foundations”, Tata McGraw Hill 2002. (Unit-V)
4.	IS 800:2007 Code of practice for general construction in steel.
5.	IS 3370(Part 1):2009 Code of practice for concrete structures for storage of liquids: Part 1 General requirements (first revision)

6.	IS 3370(Part 2):2009 Code of practice for concrete structures for storage of liquids: Part 2 Reinforced concrete structures (first revision)
7.	IS 3370(Part 4):1967 Code of practice for concrete structures for the storage of liquids: Part 4 Design tables
8.	IS 875(Part 1):1987 Code of practice for design loads (other than earthquake) for buildings and structures Part 1 Dead loads - Unit weights of building material and stored materials (second revision) (Incorporating IS:1911-1967)
9.	IS 875(Part 2):1987 Code of practice for design loads (other than earthquake) for buildings and structures: Part 2 Imposed loads (second revision)
10.	IS 875(Part 3):1987 Code of practice for design loads (other than earthquake) for buildings and structures: Part 3 Wind loads (second revision)
11.	IS 802(Part 1/Sec Code of practice for use of structural steel in overhead 1):1995 transmission line towers, Part 1 Materials, Loads and permissible stresses Section 1 Materials and Loads (third revision)
12.	IS 802(Part 2):1978 Code of practice for use of structural steel in overhead transmission line towers: Part 2 Fabrication, galvanizing, inspection and packing
13.	IS 802(Part 3):1978 Code of practice for use of structural steel in overhead transmission line towers: Part 3 Testing
14.	IS 803:1976 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tanks (first revision)
15.	IS 6533(Part 1):1989 Code of practice for design and construction of steel chimneys Part 1 Mechanical aspects (first revision)
16.	IS 6533(Part 2):1989 Code of practice for design and construction of steel chimneys Part 2 Structural aspects (first revision)
17.	IS 10987:1992 Code of practice for design, fabrication, testing and installation of underground/above ground horizontal cylindrical storage tanks for petroleum products (first revision)

COURSE OUTCOMES
At the end of the course students should be able **CO1**: to plan industrial structures for functionalrequirements.. **CO2**: design the various types of roof for industrial buildings. **CO3**: design the bunkers, silos, bins, Chimneys and storage hoppers **CO4**: design the power transmission structures. **CO5**:designthe machine foundation.

19SEE712	**SPECIAL CONCRETE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

UNIT I	**CONSTITUENT MATERIALSAND SPECIAL CEMENTS**	**9**
Constituent materials: Role of constituents, Components of modern concrete, Rheology, Mineral		

and Chemical admixtures and their effect on properties of concrete

Special cements: Need, Classifications, Blended cements, modified hydraulic cements, calcium aluminate cements, calcium sulphate based binders, calcium sulfo aluminate cements, shrinkage compensating (or) expansive cements, macro defect-free cements, phosphate cements, fast setting cements, their Performance and prescriptive specifications, Methods of mix proportioning: ISmethod

UNIT II	SPECIAL CONCRETE	9

Light Weight Concrete: Introduction, classification, strength and elastic properties, durability, mix Proportioning.

High Density Concrete: Radiation shielding ability of concrete, materials for high density concrete, mix proportioning, properties in fresh and hardened state, placement methods.

Self-compacting Concrete: General characteristics, Properties, microstructure,methods of mix proportioning and applications.

UNIT III	OTHER CONCRETES FOR SPECIAL PROPERTIES	9

High-volume fly ash concretes, geo-polymer concrete, pervious concrete, Self curing concrete, aerated concrete, Mass concrete, Roller compacted concrete**,** ultrahigh performance concretes, Reactive powder concrete, Bacterial concrete, Heat resistant and refractory concrete. Their significance, materials, general consideration strength and durability aspects.

UNIT IV	FIBRE REINFORCED CONCRETE AND FERRO CEMENT	9

Fibre reinforced concrete: Fibre materials, mix proportioning, distribution and orientation, interfacial bond, properties in fresh state, toughness and impact resistance, elastic modulus, creep, and drying shrinkage, strength and behaviour in tension, compression and flexure, crack arrest and toughening mechanism, durability,applications.

Ferro cement: materials, mechanical properties, cracking of ferrocement, types and methods of construction, strength and behaviour in tension, compression and flexure, D design of ferrocement in tension, durability and applications.

UNIT V	HIGH STRENGTH CONCRETES AND NDT TECHNIQUES	9

Materials and mix proportion, properties in fresh and hardened states, microstructure, stress-strain relation, fracture, drying shrinkage, and creep, applications and limitations. **Different NDT techniques for performance evaluation of structures:** Rebound hammer, Ultrasonic pulse velocity meter, Profometer, Ground Penetrating Radar (GPR), Core test, Carbonation and Corrosion assessment.

L: 45 T: 0 P: 0 TOTAL : 45 PERIODS

TEXT BOOKS

1. Neville A.M, "Properties of Concrete" Pearson EducationAsia,2011
2. A.R.Santhakumar, "Concrete Technology"-Oxford University Press, New

	Delhi,2007
3.	M.S.Shetty, "Concrete Technology - Theory and Practice" S.Chand and Company Pvt. Ltd. New Delhi, 2014
REFERENCES	
1.	P. Kumar Mehta, Concrete: Microstructure, Properties, and Materials (Fourth Edition)Tata McGraw-Hill Education Pvt. Ltd, 2014
2.	Gambhir "Concrete Technology"TMH. New Delhi,2011
3.	Short A and Kinniburgh.W, "Light Weight Concrete"- Asia Publishing House, 2012
4.	Aitcin P.C. "High Performance Concrete"-E and FN, Spon London 1998
5.	Rixom.R. and Mailvaganam.N., "Chemical admixtures in concrete"- E and FN, Spon London 1999
6	http://qcin.org/CAS/RMCPC/http://nptel.ac.in

COURSE OUTCOMES

At the end of the course students should be able to

CO1: identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy.

CO2:acquire and apply fundamental knowledge in the fresh and hardened properties of concrete for specialproperties.

CO3: understand the concepts, mix proportioning and methods of special concretingoperations.

CO4: evaluate the effect of the environment on service life performance, properties and failure of structural concrete.

CO5:apply the techniques of measuring the Non Destructive Testing of concretestructure.

CARRER COURSE

19GET601	PROFESSIONAL DEVELOPMENT	L	T	P	C
		2	0	0	2

UNIT-I	PROFESSIONAL COMMUNICATION	6
Importance of communication- Types of communication- Verbal and Non-verbal Communication -Barriers to communication		

UNIT-II	PERSONALITY DEVELOPMENT	6
Significance of Personality development- Attitude - Motivation-Self Esteem-Body language - Problem-solving- Decision-making skills- Leadership qualities-Character building -Team-work -Work ethics -Good manners and etiquette		

UNIT-III	PUBLIC SPEAKING	6
Introduction to public speaking- Barriers- Speech organization-Understanding audience-Information & Communicative Technologies (ICT)-Effective power point presentation-feedback		

UNIT-IV	NETWORKING	6
Introduction to networking-Types of networking- Business Card- strategies for networking-networking database-Role of social media& internet		

UNIT-V	SOCIALIZATION	6
Importance of socialization-Theories of self-development-Agents of socialization-socialization across the life		

TOTAL-30 Hours

TEXT BOOKS	
1.	Personality development- 1. Hurlock, E.B (2006). Personality Development, 28th Reprint.

	New Delhi: Tata McGraw Hill.
2.	Stephen P. Robbins and Timothy A. Judge(2014), Organizational Behaviour 16th Edition: Prentice Hall
3.	Butterfield, Jeff Soft Skills for Everyone. Cengage Learning: New Delhi, 2015

Web Links	
1.	Public Speaking- https://www.businessballs.com/communication-skills/presentation-skills- and-techniques/
2.	Networking: https://study.com/academy/course/guide-to-business-networking.html
3.	Socialization- https://opentextbc.ca/introductiontosociology/chapter/chapter5-socialization/

19GET602	**QUALITY ASSURANCE & ACCREDITATION IN ENGINEERING EDUCATION**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

UNIT-I	**CENTER FOR LEARNING AND TEACHING (CLT)**	**7**
Learning Resources-Model & Mini project- Industry Specific Assignment - Industrial case study - MOOC-Teachers Manual-Workbook-LMS & Quality Assurance in Academic Performance-GATE.		

UNIT-II	**CENTRE FOR CREATIVITY (CFC)**	**6**
Project-Product Development-Patent-Consultancy-Books/Book chapter- Research/Seminar Grant- Publications - Industry collaborated laboratories - Foreign collaboration & Exchange.		

UNIT-III	**SKILL AND CAREER DEPARTMENT (SCD)**	**5**
Hackathon/Industrial contest- Project Proposal- Certification courses-Placement training-Schemes for student motivation-Clubs-Sports		

UNIT-IV	**SOCIAL RESPONSIBILITY INITIATIVE (SRI)**	**4**
Need for outreach-Types of outreach –Stake holder communication-website-newsletter-magazine- meetings.		

UNIT-V	**INDUSTRY INSTITUTE PARTNERSHIP CELL (IIPC)**	**4**
Industrial networking- MoU-Industrial delivery -workshop- Internship/Training-Partial delivery-Adjunct Professor- Placement- Campus companies-Start-Up.		

UNIT-VI	INTERNAL QUALITY ASSURANCE CELL (IQAC)	4
Importance of IQAC- members- Goal setting-Audit-Feedback system-Governing bodies-Accreditation bodies - process-Ranking.		

TOTAL-30 Hours

REFERENCES	
1.	Quality Assurance in Higher Education Editors: João Rosa, Maria, Amaral, A. (Eds.) Palgrave Macmillan publications
2.	Introduction to Creativity and Innovation for Engineers by Stuart Walesh, E-source
3.	Effective Teaching

19GET603	WHOLISTIC EDUCATION	L	T	P	C
		2	0	0	2

UNIT-I	UNIT 1. TEACHING, LEARNING & RESEARCH	6
Basics of Teaching & Learning- Blooms Taxonomy-Role of facilitator - Instruction planning and delivery methods- Technology Enabled Learning-Evaluation techniques-Meaningful R&D-Institutional management and Administrative procedures.		

UNIT-II	JOB SEARCH & INTERVIEW	6
Job Search- Types of Job search- Channels-Role of Internet- Interview- Modes of Interview-MNC Interview- Industrial contest.		

UNIT-III	WORK FOR LIFE BALANCE.	6
Benefits of a Healthy Balance- Signs of an Imbalance- Employer Resources- Tip in Time Management- Goal Setting- Optional Ways to Work- Stress Management- Home office		

UNIT-IV	STUDENT RELATIONSHIP MANAGEMENT.	6
Introduction-Key Partners- Key Activities- Key Resources- Value Propositions- Customer Relationship- Customer Segments- Channels- Cost Structure- Revenue Streams-Case study.		

UNIT-V	BUSINESS MODEL CANVAS (BMC)	6
Introduction-Key Partners- Key Activities- Key Resources- Value Propositions- Customer Relationship- Customer Segments- Channels- Cost Structure- Revenue Streams-Case study.		

TOTAL-30 Hours

REFERENCES	
1.	Business Model Generation by Alexander Osterwalder, Yves Pigneur, Jon Wiley& sons Inc

WEB LINKS	
1.	BMC- https://www.coursera.org/learn/business-model-canvas
2	Teaching Learning Process https://www.coursera.org/learn/teaching
3	Job search -https://www.udemy.com/course/the-ultimate-job-search-course/
4	Work for Life balance- https://e-courses4you.com/course/work-life-balance-online-short-course/

AUDIT COURSE

19GEA601	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

UNIT I		**6**

Planning and Preparation, Word Order, Breaking up long sentences, StructuringParagraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness		

UNIT II		**6**
Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing,Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction		

UNIT III		**6**
Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.		

UNIT IV		**6**
Key skills are needed when writing a Title; key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.		

UNIT V		**6**
Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed whenwriting the Discussion, skills are needed when writing the Conclusions		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

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

COURSE OUTCOMES

At the end of the course students should be able to
CO1: Understand that how to improve your writing skills and level ofreadability
CO2: Learn about what to write in eachsection
CO3: Understand the skills needed when writing a Title
CO4: Ensure the good quality of paper at very first-time submission

19GEA602	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

UNIT I	INTRODUCTION	6
Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.		

UNIT II	REPERCUSSIONS OF DISASTERS AND HAZARDS	6
Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem.Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.		

UNIT III	DISASTER PRONE AREAS IN INDIA	6
Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics		

UNIT IV	DISASTER PREPAREDNESS AND MANAGEMENT	6
Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.		

UNIT V	RISK ASSESSMENT&DISASTER MITIGATION	6
Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies forSurvival. Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

TEXT BOOKS	
1.	R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies

	"'New Royal book Company.
2.	Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, NewDelhi.
3.	Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., NewDelhi

COURSE OUTCOMES

At the end of the course students should be able to

CO1: learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response

CO2: Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.

CO3: Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

CO4: Critically understand the strengths and weaknesses of disaster management approaches planning and programming in different countries, particularly their home country or the countries they work in

19GEA603	VALUE EDUCATION	L	T	P	C
		2	0	0	0

UNIT I		7
Values and self-development –Social values and individual attitudes. Work ethics, Indian vision ofhumanism-Moral and non- moral valuation. Standards and principles-Valuejudgements		

UNIT II		8
Importance of cultivation ofvalues-Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness-Honesty, Humanity. Power of faith, National Unity-Patriotism-Love for nature,Discipline		

UNIT III		8
Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity anddiscipline-Punctuality, Love andKindness-Avoid faultThinking-Free from anger, Dignity oflabour-Universal brotherhood and religioustolerance-Truefriendship-Happiness Vssuffering, love fortruth-Aware of self-destructivehabits-Association and Cooperation-Doing best for savingnature		

UNIT IV		7
Character and Competence –Holy books vs Blind faith-Self-management and Goodhealth.-Science of reincarnation.• Equality, Nonviolence ,Humility, Role of Women-All religions and same message-Mind your Mind, Self-control-Honesty, Studyingeffectively		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

TEXT BOOKS	
1.	Chakroborty, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, NewDelhi

COURSE OUTCOMES
At the end of the course students should be able to **CO1**: Knowledge of self-development **CO2**:Learn the importance of Human values **CO3**: Developing the overall personality

19GEA604	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

UNIT I	History of Making of the Indian Constitution	7
History -Drafting Committee, (Composition & Working)		

UNIT II	Philosophy of the IndianConstitution	5
Preamble Salient Features		

UNIT III	Contours of Constitutional Rights &Duties	5
Fundamental Rights-Right to Equality-Right to Freedom-Right against Exploitation-Right to Freedom of Religion-Cultural and Educational Rights-Right to Constitutional Remedies-Directive Principles of State Policy-Fundamental Duties.		

UNIT IV	Organs of Governance	4
Parliament-Composition-Qualifications and Disqualifications-Powers and Functions-Executive-President-Governor-Council of Ministers-Judiciary, Appointment and Transfer of Judges,Qualifications, Powers and Functions		

UNIT V	Local Administration	5
District's Administration head: Role and Importance-Municipalities: Introduction, Mayor and role of Elected-Pachayati raj: Introduction, PRI:Zila Pachayat-Elected officials and their roles, CEOZila Pachayat: Position and role-Block level: Organizational Hierarchy (Different departments)-Village level: Role of Elected and Appointed officials-Importance of grass root		

democracy

UNIT VI	**Election Commission**	**5**
Election Commission: Role and Functioning-Chief Election Commissioner and Election Commissioners-State Election Commission: Role and Functioning.-Institute and Bodies for the welfare of SC/ST/OBC and women.		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

TEXT BOOKS	
1.	The Constitution of India, 1950 (Bare Act), GovernmentPublication
2.	Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.
3.	M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4.	D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015

COURSE OUTCOMES

Students will be able to:

CO1: Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indianpolitics.

CO2: Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution inIndia.

CO3: Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the IndianConstitution

CO4: Discuss the passage of the Hindu Code Bill of1956.

19GEA605	**PEDAGOGY STUDIES**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

UNIT I	**INTRODUCTION AND METHODOLOGY**	**7**
Aims and rationale, Policy background, Conceptual framework and terminology -Theories of learning, Curriculum, Teacher education-Conceptual framework, Research questions-Overview of methodology and Searching.		

UNIT II		**5**
Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries-Curriculum, Teacher education.		

UNIT III		5
Evidence on the effectiveness of pedagogical practices-Methodology for the in depth stage: quality assessment of included studies-How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?-Theory of change-Strength and nature of the body of evidence for effective pedagogical practices-Pedagogic theory and pedagogical approaches-Teachers' attitudes and beliefs and Pedagogic strategies.		

UNIT IV		4
Professional development: alignment with classroom practices and follow- upsupport-Peer support-Support from the head teacher and the community-Curriculum and assessment-Barriers to learning: limited resources and large class sizes		

UNIT V	**Research gaps and future directions**	5
Research design-Contexts-Pedagogy-Teacher education-Curriculum and assessment-Dissemination and research impact.		

L: 30 T:0 P: 0 TOTAL : 30 PERIODS

TEXT BOOKS

1.	Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2.	Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3):361-379.
3.	Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London:DFID.
4.	AkyeampongK, LussierK, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3):272–282.
5.	Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston:Blackwell.
6.	Chavan M (2003) Read India: A mass scale, rapid, 'learning to read'campaign.
7.	www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

Students will be able to:

CO1: What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?

CO2: What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3: How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?