DEPARTMENT OF CIVIL ENGINEERING
ANNA UNIVERSITY, CHENNAI

OUR VISION:

Department of Civil Engineering, Anna University, shall strive hard to develop and impart technical knowledge and professional skills required for Civil Engineering practice through excellence in teaching, research and consultancy to address sustainable infrastructure development needs at local, national and International levels.

OUR MISSION:

Department of Civil Engineering, Anna University shall contribute to technological and social development by

1. Providing a firm scientific and technological base in Civil Engineering to achieve self-reliance.
2. Providing quality education through innovation in teaching practices at par with global standards.
3. Nurturing leadership and entrepreneurship qualities with ethical values.
4. Developing and disseminating latest knowledge and technologies in emerging areas of Civil Engineering.
5. Sharing intellectual resources and infrastructure facilities through collaborative partnership.
6. Ensuring supporting conditions for enhancing the employability skills.

ANNA UNIVERSITY, CHENNAI
UNIVERSITY DEPARTMENTS
REGULATIONS - 2019
CHOICE BASED CREDIT SYSTEM
M.E. STRUCTURAL ENGINEERING

1. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the Programme M E Structural Engineering will

PEO1	Gain knowledge and skills in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations
PEO2	Become consultants in Structural Engineering and solve complex real life issues related to analysis, design and maintenance of structures under various environmental conditions.
PEO3	Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or in Research organizations or Academia.
PEO4	Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.
PEO5	Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation

2. PROGRAMME OUTCOMES (POs):

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

PO#	Graduate Attribute	Programme Outcome
PO1	Engineering knowledge	Apply the knowledge of mathematics, science and engineering fundamentals to the formulation and conceptualization of Structural Engineering theory and model.
PO2	Problem analysis	Identify, formulate and solve engineering problems.
PO3	Design/development of solutions	Design structures, structural elements or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal and environmental
PO4	Conduct investigations of complex problems	Conduct experiments and collect, analyze and interpret the data.
PO5	Modern tool usage	Create, select and apply appropriate techniques and modern engineering tools including analysis, modeling and design software, with due understanding of the limitations.
PO6	The Engineer and society	Conduct themselves to uphold the professional and social obligations.
PO7	Environment and sustainability	Design the structure with environment consciousness and sustainable development.
PO8	Ethics	Understand and commit to professional ethics and responsibilities of Structural Engineers and to contribute to the society for sustainable development.
PO9	Individual and team work	Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings and demonstrating a capacity for self-management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis.

PO10	Communication	Communicate effectively with the engineering community and with society at large, and write reports and make effective presentations.
PO11	Project management and finance	Demonstrate a knowledge and understanding of management and business practices, such as risk and change management, and understand their limitations
PO12	Life-long learning	Develop ability to engage in independent and life-long learning to improve competence by critical examination of the outcomes of one's actions and learning from corrective and preventive measures.

3. PROGRAMME SPECIFIC OUTCOMES (PSOs):

Graduates of the program M.E. Structural Engineering will be able to

PSO1	Knowledge of Structural Engineering discipline	In-depth knowledge of Structural Engineering discipline, with an ability to evaluate, analyze and synthesize existing and new knowledge in the structural design.
PSO2	Critical analysis of Structural Engineering issues and innovation	Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	Conceptualize and solve Structural Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio cultural factors

4. PEO / PO Mapping:

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

MAPPING OF COURSE OUTCOME AND PROGRAMME OUTCOME

		COURSE NAME	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
YEAR I	SEMESTER I	Advanced Mathematical Methods															
		Theory of Elasticity and Plasticity	H	H	M	M	M	M	L	M	M	M	L	M	H	M	M
		Structural Dynamics and Earthquake Engineering	H	H	H	H	M	M	-	-	-	-	-	H	H	H	H
		Program Elective I															
		Research Methodology and IPR															
		Audit Course – I															
		Advanced Construction Engineering and Experimental Techniques Laboratory	H	M	H	H	M	M	L	H	L	M	L	H	H	L	M
		Technical Seminar	H	-	M	M	-	H	H	-	-	M	-	M	H	-	H
	SEMESTER II	Advanced Steel Structures	H	H	H	-	M	M	-	-	-	-	-	H	H	-	-
		Advanced Concrete Structures	H	H	H	M	-	-	-	-	-	-	-	-	H	H	-
		Finite Element Analysis in Structural Engineering	M	H	H	M	H	M	L	M	L	L	L	H	H	H	H
		Program Elective II															
		Program Elective III															
		Audit Course –II															
		Numerical and Finite Element Analysis Lab	H	H	H	H	H	H	L	M	L	L	L	H	H	M	H
		Structural Design Studio Lab	H	H	H	H	H	H	H	M	M	M	L	H	H	H	H
YEAR II	SEMESTER III	Program Elective IV															
		Program Elective V															
		Open Elective															
		Practical Training (4 weeks)	M	H	H	M	M	M	M	L	M	L	M	M	H	M	M
		Project Phase I	M	H	H	H	H	L	M	L	L	L	M	H	M	M	H
	SEMESTER IV	Project Phase II	M	H	H	M	H	M	M	M	L	L	M	M	H	H	M

PROGRAM ELECTIVE COURSES [PEC]

S. NO.	COURSE TITLE	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1.	Non-linear Analysis of Structures	H	H	H	H	H	H	L	L	L	L	L	H	H	H	H
2.	Structural Stability	H	H	H										H	H	M
3.	Wind and Cyclone Effect on Structures	H	H	H	-	M	M							H	H	H
4.	Prefabricated Structures	H	H	H	H	H	-	M	M	-	H	M	M	H	H	H
5.	Advanced Concrete Technology	M	H	H	H	H	M	L	H	M	H	L	H	M	L	L
6.	Advanced Prestressed Concrete	M	H	H	M	L	-	-	L	-	-	-	M	H	M	H
7.	Reliability Analysis of Structures	M	M	H	H	H	M	L	M	M	H	L	M	H	H	M
8.	Design of Formwork	H	H	H	M	M	-	-	-	-		-	M	H	H	H
9.	Mechanics of Fiber Reinforced Polymer Composite Materials	H	H	M	-	-	-	-	-	-	-	-	M	H	M	M
10.	Maintenance, Repair and Rehabilitation of Structures	H	H	H	M	M	L	L	L	L	L	L	M	M	H	M
11.	Design of Steel Concrete Composite Structures	H	M	H	L	M	M	L	M	M	M	M	M	M	M	H
12.	Design of Masonry Structures	H	H	M	H	M	L	L	L	L	L	L	M	H	M	H
13.	Design of Industrial Structures	M	H	H	M	L	M	L	H	M	M	-	M	H	H	H
14.	Advanced Design of Foundation Structures	H	H	H	H	M	L	L	L	L	L	L	M	H	M	H
15.	Optimization of Structures	H	M	H	L	H	H	M	M	M	M	L	L	M	M	M
16.	Design of High Rise Structures	H	H	H	M	M	M	M	M	M	M	L	M	H	M	M
17.	Design of Offshore Structures	H	H	H	M	H	M	M	H	L	M	M	M	H	H	H
18.	Performance of Structures with Soil Structure Interaction	M	H	H	M	L	M	L	L	L	M	L	L	H	H	M
19.	Design of Bridge Structures	H	H	H	M	L	M	H	H	L	M	L	H	H	H	H
20.	Design of Shell and Spatial Structures	H	M	H	-	M	M	-	-	-	-	-	-	M	-	-

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CHOICE BASED CREDIT SYSTEM
CURRICULA AND SYLLABI FOR I TO IV SEMESTERS

SEMESTER I

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	MA5152	Advanced Mathematical Methods	FC	3	1	0	4	4
2.	ST5101	Theory of Elasticity and Plasticity	PCC	3	1	0	4	4
3.	ST5102	Structural Dynamics and Earthquake Engineering	PCC	3	1	0	4	4
4.		Program Elective I	PEC	3	0	0	3	3
5.	RM5151	Research Methodology and IPR	RMC	2	0	0	2	2
6.		Audit Course I*	AC	2	0	0	2	0
PRACTICALS								
7.	ST5161	Advanced Construction Engineering and Experimental Techniques Laboratory	PCC	0	0	4	4	2
8.	ST5111	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**16**	**3**	**6**	**25**	**20**

* Audit Course is optional

SEMESTER II

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.	ST5201	Advanced Steel Structures	PCC	3	1	0	4	4
2.	ST5202	Advanced Concrete Structures	PCC	3	1	0	4	4
3.	ST5203	Finite Element Analysis in Structural Engineering	PCC	3	0	0	3	3
4.		Program Elective II	PEC	3	0	0	3	3
5.		Program Elective III	PEC	3	0	0	3	3
6.		Audit Course II*	AC	2	0	0	2	0
PRACTICALS								
7.	ST5211	Numerical and Finite Element Analysis Laboratory	PCC	0	0	4	4	2
8.	ST5212	Structural Design Studio	PCC	0	0	4	4	2
			TOTAL	**17**	**2**	**8**	**27**	**21**

* Audit Course is optional

SEMESTER III

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY								
1.		Program Elective IV	PEC	3	0	0	3	3
2.		Program Elective V	PEC	3	0	0	3	3
3.		Open Elective	OEC	3	0	0	3	3
PRACTICALS								
4.	ST5311	Practical Training (4 weeks)	EEC	0	0	0	0	2
5.	ST5312	Project Phase I	EEC	0	0	12	12	6
			TOTAL	**9**	**0**	**12**	**21**	**17**

SEMESTER IV

S. NO.	COURSE CODE	COURSE TITLE	CATE GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
PRACTICALS								
1.	ST5411	Project Phase II	EEC	0	0	24	24	12
			TOTAL	**0**	**0**	**24**	**24**	**12**

TOTAL CREDITS TO BE EARNED FOR AWARD OF THE DEGREE: 70

FOUNDATION COURSES (FC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	MA5152	Advanced Mathematical Methods	3	1	0	4	1

PROGRAM CORE COURSES (PCC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	ST5101	Theory of Elasticity and Plasticity	3	1	0	4	1
2.	ST5102	Structural Dynamics and Earthquake Engineering	3	1	0	4	1
3.	ST5161	Advanced Construction Engineering and Experimental Techniques Laboratory	0	0	4	2	1
4.	ST5201	Advanced Steel Structures	3	1	0	4	2
5.	ST5202	Advanced Concrete Structures	3	1	0	4	2
6.	ST5203	Finite Element Analysis in Structural Engineering	3	0	0	3	2
7.	ST5211	Numerical and Finite Element Analysis Lab	0	0	4	2	2
8.	ST5212	Structural Design Studio	0	0	4	2	2
					TOTAL CREDITS	**25**	

PROGRAM ELECTIVE COURSES [PEC]

PROGRAM ELECTIVE [PEC] – Group I (SEMESTER I)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	ST5001	Non-linear Analysis of Structures	3	0	0	3	1
2.	ST5002	Structural Stability	3	0	0	3	1
3.	ST5003	Wind and Cyclone Effect on Structures	3	0	0	3	1
4.	ST5004	Prefabricated Structures	3	0	0	3	1

PROGRAM ELECTIVE [PEC] – Group II (SEMESTER II)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	CN5071	Advanced Concrete Technology	3	0	0	3	2
2.	ST5005	Advanced Prestressed Concrete	3	0	0	3	2
3.	ST5006	Reliability Analysis of Structures	3	0	0	3	2
4.	ST5007	Design of Formwork	3	0	0	3	2

PROGRAM ELECTIVE [PEC] – Group III (SEMESTER II)

S. NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	ST5071	Maintenance, Repair and Rehabilitation of Structures	3	0	0	3	3
2.	ST5008	Mechanics of Fiber Reinforced Polymer Composite Materials	3	0	0	3	3
3.	ST5009	Design of Steel Concrete Composite Structures	3	0	0	3	3
4.	ST5010	Design of Masonry Structures	3	0	0	3	3

PROGRAM ELECTIVE [PEC] – Group IV (SEMESTER III)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	ST5011	Design of Industrial Structures	3	0	0	3	4
2.	ST5012	Advanced Design of Foundation Structures	3	0	0	3	4
3.	ST5013	Optimization of Structures	3	0	0	3	4
4.	ST5014	Design of High Rise Structures	3	0	0	3	4

PROGRAM ELECTIVE [PEC] – Group V (SEMESTER III)

S NO.	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	GROUP
			L	T	P		
1.	ST5015	Design of Offshore Structures	3	0	0	3	5
2.	ST5016	Performance of Structures with Soil Structure Interaction	3	0	0	3	5
3.	ST5017	Design of Bridge Structures	3	0	0	3	5
4.	ST5018	Design of Shell and Spatial Structures	3	0	0	3	5

RESEARCH METHODOLOGY AND IPR COURSES (RMC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	RM5151	Research Methodology and IPR	2	0	0	2	1
					TOTAL CREDITS	**2**	

OPEN ELECTIVE COURSES [OEC]

*(Out of 6 Courses one Course must be selected)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	OE5091	Business Data Analytics	3	0	0	3	3
2.	OE5092	Industrial Safety	3	0	0	3	3
3.	OE5093	Operations Research	3	0	0	3	3
4.	OE5094	Cost Management of Engineering Projects	3	0	0	3	3
5.	OE5095	Composite Materials	3	0	0	3	3
6.	OE5096	Waste to Energy	3	0	0	3	3

AUDIT COURSES (AC)

Registration for any of these courses is optional to students

SL. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lectur	Tutorial	Practical		
1.	AX5091	English for Research Paper Writing	2	0	0	0	1/2
2.	AX5092	Disaster Management	2	0	0	0	
3.	AX5093	Sanskrit for Technical Knowledge	2	0	0	0	
4.	AX5094	Value Education	2	0	0	0	
5.	AX5095	Constitution of India	2	0	0	0	
6.	AX5096	Pedagogy Studies	2	0	0	0	
7.	AX5097	Stress Management by Yoga	2	0	0	0	
8.	AX5098	Personality Development Through Life Enlightenment Skills	2	0	0	0	
9.	AX5099	Unnat Bharat Abhiyan	2	0	0	0	
					TOTAL CREDITS	**0**	

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S. NO	COURSE CODE	COURSE TITLE	PERIODS PER WEEK			CREDITS	SEMESTER
			Lecture	Tutorial	Practical		
1.	ST5111	Technical Seminar	0	0	2	1	1
2.	ST5311	Practical Training (4 Weeks)	0	0	0	2	3
3.	ST5312	Project Phase I	0	0	12	6	3
4.	ST5411	Project Phase II	0	0	24	12	4
					TOTAL CREDITS	**21**	

SUMMARY

	Name of the Programme: M.E STRUCTURAL ENGINEERING					
	SUBJECT AREA	**CREDITS PER SEMESTER**				**CREDITS TOTAL**
		I	**II**	**III**	**IV**	
1.	FC	04	00	00	00	04
2.	PCC	10	15	00	00	25
3.	PEC	03	06	06	00	15
4.	RMC	02	00	00	00	02
5.	OEC	00	00	03	00	03
6.	EEC	01	00	08	12	21
7.	Non Credit/Audit Course	✓	✓	00	00	
8.	**TOTAL CREDIT**	**20**	**21**	**17**	**12**	**70**

MA5152 ADVANCED MATHEMATICAL METHODS L T P C
3 1 0 4

OBJECTIVE:

- To familiarize the students in the field of differential equations.
- To enable them to solve boundary value problems associated with engineering applications using transform methods.
- To expose the students to the concepts of calculus of variations.
- To introduce conformal mappings and their applications to fluid flows and heat flows.
- To give the students a complete picture of tensor analysis.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

Laplace transform: Definitions, properties -Transform of error function, Bessel's function, Dirac Delta function, Unit Step functions – Convolution theorem – Inverse Laplace Transform: Complex inversion formula – Solutions to partial differential equations: Heat equation, Wave equation

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 12

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

UNIT III CALCULUS OF VARIATIONS 12

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

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 12

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

UNIT V TENSOR ANALYSIS 12

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

TOTAL: 60 PERIODS

OUTCOMES:

On successful completion of the course, the students will be able to

- develop the mathematical methods of applied mathematics and mathematical physics
- solve boundary value problems using integral transform methods
- apply the concepts of calculus of variations in solving various boundary value problems
- apply conformal mappings in fluid flows and heat flow problems
- familiarize with the concepts of tensor analysis.

REFERENCES:

1. Andrew L.C. and Shivamoggi B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.
2. Elsgolts L., "Differential Equations and the Calculus of Variations", MIR Publishers, Moscow, 2003.
3. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, New Delhi, 2017.
4. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2004.
5. James G., "Advanced Modern Engineering Mathematics", Pearson Education, 4th Edition, Horlow, 2016.

6. Mathews J.H. and Howell R.W., "Complex Analysis for Mathematics and Engineering", Narosa Publishing House, 6th Edition, New Delhi, 2012.
7. O'Neil P.V., "Advanced Engineering Mathematics", Thomson Asia Pvt. Ltd., 8th Edition, Singapore, 2017.
8. Ramanaiah, G.T., "Tensor Analysis", S. Viswanathan Pvt. Ltd., Chennai, 1990.
9. Sankara Rao K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., 3rd Edition, New Delhi, 2010.
10. Spiegel M.R., "Theory and Problems of Complex Variables and its Application" (Schaum's Outline Series), McGraw Hill Book Co., Singapore, 2000.

ST5101 THEORY OF ELASTICITY AND PLASTICITY L T P C
3 1 0 4

OBJECTIVE:

- To develop the ability to use the principles of theory of elasticity in engineering problems and to introduce theoretical fundamentals of theory of plasticity

UNIT I ELASTICITY 12

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

UNIT II 2D STRESS STRAIN PROBLEMS 12

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Coordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION 12

St.Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled- Open and Closed sections-Design approach to open web section subjected to torsion - Finite Difference Method

UNIT IV BEAMS ON ELASTIC FOUNDATIONS 12

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible – Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT V PLASTICITY 12

Physical Assumptions – Yield Criteria – Failure Theories –Thick Cylinder – Plastic Stress Strain Relationship - Bending and Torsion in Elasto-Plastic Materials -Strain hardening Materials

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1	Derive and write the fundamental equations of elasticity describing the linear behavior of element and develop constitutive models based on material behavior
CO2	Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems
CO3	Solve torsion problems in circular and non-circular cross-sections
CO4	Analyse beams resting on elastic foundations
CO5	Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

REFERENCES:

1. Ansel. C. Ugural and Saul.K.Fenster, “Advanced Strength and Applied Elasticity,” Fourth Edition, Prentice Hall Professional technical Reference, New Jersey, 2003.
2. Chakrabarty.J, “Theory of Plasticity”, Third Edition, Elsevier Butterworth - Heinmann – UK, 2007.
3. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
4. Slater R.A.C, “Engineering Plasticity”, John Wiley and Son, New York, 1977.
5. Timoshenko, S. and Goodier J.N."Theory of Elasticity", Third Edition, McGraw Hill Book Co., New York, 2017.

CO – PO Mapping - THEORY OF ELASTICITY AND PLASTICITY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	M	H	H	H	M	H
PO3	Design / development of solutions			M	M		M
PO4	Conduct investigations of complex problems			M			M
PO5	Modern Tool Usage			M	M		M
PO6	Individual and Team work		M			M	M
PO7	Communication		L	L		L	L
PO8	Engineer and Society			M	M		M
PO9	Ethics			M			M
PO10	Environment and Sustainability		M	M	M		M
PO11	Project Management and Finance					L	L
PO12	Life Long Learning	H		M	M		M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	M	M	H
PSO2	Critical analysis of Structural Engineering issues and innovation			H	M		M
PSO3	Conceptualization and evaluation of Design solutions			M	M		M

ST5102 STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING L T P C
3 1 0 4

OBJECTIVE:

- To make the students understand the basics of structural dynamics and earthquake engineering and to develop the ability to design a earthquake resistant structure ,

UNIT I PRINCIPLES OF VIBRATION ANALYSIS 12

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

UNIT II DYNAMIC RESPONSE OF MULTI-DEGREE OF FREEDOM SYSTEMS 12

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

UNIT III DYNAMIC RESPONSE OF CONTINUOUS SYSTEMS 12

Mathematical models of continuous systems, Free and forced vibration of continuous systems, Rayleigh – Ritz method – Formulation using Conservation of Energy – Formulation using Virtual Work, Applications. Damping in MDOF systems, Nonlinear MDOF systems, and step-by-step numerical integration algorithms.

UNIT IV EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES 12

Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures - Lessons Learnt From Past Earthquakes -Evaluation of Earthquake Forces as per codal provisions - Response Spectra, Design Spectra

UNIT V EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES 12

Structural Systems - Types of Buildings - Causes of damage - Planning Considerations – effect of material of construction on performance of structures - Philosophy and Principle of Earthquake Resistant Design - Guidelines for Earthquake Resistant Design - Earthquake Resistant Design of Masonry Buildings and R.C.C. Buildings. Design consideration - Rigid Frames – Shear walls - Lateral load analysis of structures- – Capacity based Design and detailing

TOTAL : 60 PERIODS

OUTCOMES:

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

CO1	Do vibration analysis of system/structures with single degree of freedom and can explain the method of damping the systems
CO2	Do dynamic analysis of system/structures with Multi degrees of freedom under free and forced vibration
CO3	Derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration
CO4	Explain the causes and effect of earthquake
CO5	Design masonry and RC structures to the earthquake forces as per the recommendations of IS codes of practice

REFERENCES:

1. Anil K.Chopra, Dynamics of Structures, Fifth edition, Pearson Education, 2017.
2. Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3. Mario Paz, Structural Dynamics -Theory and Computation, Kluwer Academic Publishers, Fifth Edition, 2006.
4. Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.
5. Bruce A Bolt, “Earthquakes” W H Freeman and Company, New York, 2003.
6. Brebbia C. A., ”Earthquake Resistant Engineering Structures VIII”,WIT Press, 2011
7. Mohiuddin Ali Khan “Earthquake-Resistant Structures: Design, Build and Retrofit”, Elsevier Science & Technology, 2012
8. Pankaj Agarwal and Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, 2009.
9. Paulay.T and Priestley M.J.N., “Seismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley and Sons, 1992.
10. Duggal S K, “Earthquake Resistant Design of Structures”, Oxford University Press, 2007.

CO – PO Mapping - STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	M	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	M	H	H
PO4	Conduct investigations of complex problems	H	H	H	M	H	H
PO5	Modern Tool Usage	M	M	M	L	M	M
PO6	Individual and Team work	M	M	M	M	M	M
PO7	Communication	-	-	-	-	-	-
PO8	Engineer and Society	-	-	-	-	-	-
PO9	Ethics	-	-	-	-	-	-
PO10	Environment and Sustainability	-	-	-	-	-	-
PO11	Project Management and Finance	-	-	-	-	-	-
PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions	H	H	H	H	H	H

RM5151 RESEARCH METHODOLOGY AND IPR LT P C
2 0 0 2

OBJECTIVES:

To impart knowledge and skills required for research and IPR:

- Problem formulation, analysis and solutions.
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents.

UNIT I RESEARCH PROBLEM FORMULATION 6

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW 6

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION 6

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) 6

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc.
Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

1. Ability to formulate research problem
2. Ability to carry out research analysis
3. Ability to follow research ethics
4. Ability to understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity
5. Ability to understand about IPR and filing patents in R & D.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓										
CO2	✓											
CO3	✓							✓				
CO4	✓				✓							
CO5	✓					✓						✓

REFERENCES:

1. Asimov, "Introduction to Design", Prentice Hall, 1962.
2. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.
3. Mayall, "Industrial Design", McGraw Hill, 1992.
4. Niebel, "Product Design", McGraw Hill, 1974.
5. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010

ST5161 ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY

L T P C
0 0 4 2

A) ADVANCED CONSTRUCTION ENGINEERING LABORATORY

OBJECTIVE:

- To provides a thorough knowledge of material selection through the material testing based on specification

LIST OF EXPERIMENTS

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self Compacting concrete.
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability tests on hardened concrete – Demonstration

TOTAL : 30 PERIODS

OUTCOMES:

On completion of the course the student will be able to

CO1	Do the mix proportion using IS and ACI codal provisions.
CO2	Prepare the self-compacting concrete and study the flow characteristics of SCC
CO3	Identify the proper portion of mineral and chemical admixture for concrete.
CO4	Test the concrete in a non-destructive manner using rebound hammer.
CO5	Know the permeability characteristics of concrete.

B) EXPERIMENTAL TECHNIQUES LABORATORY

OBJECTIVE:

- To provide a detailed account of modern experimental techniques in construction Engineering research.
- To introduce the basic working principles, the operational know how, and the strength and limitations of the techniques.

LIST OF EXPERIMENTS

1. Determination of elastic constants – Hyperbolic fringes
2. Determination of elastic constants – Elliptical fringes
3. Strain gauge meter – Determination of Young's modulus of a metallic wire
4. Ultrasonic interferometer – ultrasonic velocity in liquids
5. Electrical conductivity of metals and alloys with temperature-four probe method
6. Resistivity measurements
7. NDT – Ultrasonic flaw detector
8. Calibration of Proving Ring and LVDT

TOTAL : 30 PERIODS

OUTCOMES:

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

CO1	Gain practical knowledge by applying the experimental methods to correlate with the theory.
CO2	Learn the usage of electrical and optical systems for various measurements.
CO3	Describe and explain the working principles of the various measurement techniques
CO4	Identify the strength and limitation of each technique, and thereby choose the right technique
CO5	Apply the analytical techniques and graphical analysis to interpret the experimental data

CO – PO Mapping - ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H		H
PO2	Problem analysis			M			M
PO3	Design / development of solutions	H					H
PO4	Conduct investigations of complex problems				H		H
PO5	Modern Tool Usage	M					M
PO6	Individual and Team work	M		M			M
PO7	Communication		L			L	L
PO8	Engineer and Society	H		H			H
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability			M			M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H					H
PSO1	Knowledge of Structural Engineering discipline	H	H	H			H
PSO2	Critical analysis of Structural Engineering problems and innovation					L	L
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues	M	M				M

ST5111 **TECHNICAL SEMINAR** **L T P C**
0 0 2 1

OBJECTIVE:

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

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

TOTAL: 30 PERIODS

OUTCOME:

- On completion of the course, the student is expected to be able to acquire the skills of oral presentation and to acquire technical writing abilities for seminars and conferences.

CO – PO Mapping - TECHNICAL SEMINAR

PO/PSO		Course Outcome	Overall Correlation of COs to POs
		CO1	
PO1	Knowledge of Engineering Sciences	H	H
PO2	Problem analysis	-	-
PO3	Design / development of solutions	M	M
PO4	Investigation	M	M
PO5	Modern Tool Usage	-	-
PO6	Individual and Team work	H	H
PO7	Communication	H	H
PO8	Engineer and Society	-	-
PO9	Ethics	-	-
PO10	Environment and Sustainability	M	M
PO11	Project Management and Finance	-	-
PO12	Life Long Learning	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H
PSO2	Critical analysis of Structural Engineering problems and innovation	-	-
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues	H	H

ST5201 **ADVANCED STEEL STRUCTURES** **L T P C**
3 1 0 4

OBJECTIVE:

- To study the behaviour of members and connections, analysis and design of Industrial buildings and to study the design of with cold formed steel and plastic analysis of structures.

UNIT I GENERAL **12**

Design of members subjected to combined forces – Design of Purlins, Louver rails, Gable column and Gable wind girder – Design of simple bases, Gusseted bases and Moment Resisting Base Plates.

UNIT II DESIGN OF CONNECTIONS 12

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections– Clip angle Connections – Split beam Connections – Framed Connections.

UNIT III ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 12

Structural Configurations - Functional and Serviceability Requirements- Analysis and design of different types of trusses – Analysis and design of industrial buildings – Sway and non-sway frames – Crane Gantry Girders - Aseismic design of steel buildings.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 12

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames, Effect of axial force - Effect of shear force on plastic moment, Connections - Requirement– Moment resisting connections. Design of Straight Corner Connections – Haunched Connections– Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES 12

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

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1	Design the steel members such as purlins, gable wind girders, base plates subjected to combined forces
CO2	Explain and design the different types of steel connections such as welded, bolted and moment resisting connections
CO3	Analyse and design the industrial structures such as trusses, portal frames subjected to seismic forces
CO4	Explain the effect of axial force and shear force on steel structures and analyse the continuous beams, frames using plastic theory
CO5	Evaluate the behaviour and design of compression and flexural members

REFERENCES:

1. Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1990.
2. Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing, 2000.
3. Subramanian.N, Design of Steel Structures, Oxford University Press, 2016.
4. Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company, 1996
5. S.K. Duggal ,Limit State Design of Steel Structures, McGraw Hill Book Company, 2017

CO – PO Mapping - ADVANCED STEEL STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H	M	H	H	H	H
PO3	Design / development of solutions	H	M	H	M	H	H
PO4	Conduct investigations of complex problems						
PO5	Modern Tool Usage		M				M
PO6	Individual and Team work		M				M
PO7	Communication						
PO8	Engineer and Society						

PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning	H	H	M	H	M	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation						
PSO3	Conceptualization and evaluation of Design solutions						

ST5202 ADVANCED CONCRETE STRUCTURES L T P C
3 1 0 4

OBJECTIVE:

- To make the students be familiar with behaviour of RCC beams and columns and to design special structural members with proper detailing

UNIT I BEHAVIOUR AND DESIGN OF R.C. BEAMS 12

Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT II BEHAVIOUR AND DESIGN OF R.C. COLUMNS 12

Behaviour of short and long columns - behaviour of short column under axial load with uniaxial and bi-axial moments - construction of P_u - M_u interaction curves - Design of slender columns -

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 12

Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

UNIT IV FLAT SLABS AND YIELD LINE BASED DESIGN 12

Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and design of slabs - virtual work method - equilibrium method.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 12

Inelastic behaviour of concrete beams - Moment-curvature curves - moment redistribution - Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1	Explain structural behaviour of flexural members and columns
CO2	Design compression members and construct interaction diagrams
CO3	Design the special elements like corbels, deep beams and grid floors
CO4	Design flat slab and spandrel beams
CO5	Predict the moment curvature behavior and design and detail concrete elements based on ductility

REFERENCES:

1. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2012.
2. Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis and Design”, Tata McGraw Hill, 1986

3. Unnikrishna Pillai and Devdas Menon “Reinforced Concrete Design’, Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2017.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2005.
5. Sinha.S.N., Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd.2014

CO – PO Mapping - ADVANCED CONCRETE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H				H	H
PO3	Design / development of solutions		H	H	H		H
PO4	Conduct investigations of complex problems	M				M	M
PO5	Modern Tool Usage						
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning						
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H				H	H
PSO3	Conceptualization and evaluation of Design solutions		H	H	H		

ST5203 FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

- To make the students understand the basics of the Finite Element Technique, and to cover the analysis methodologies for 1-D, 2-D and 3-D Structural Engineering problems.

UNIT I INTRODUCTION 9

Introduction - Basic Concepts of Finite Element Analysis - Introduction to Elasticity - Steps in Finite Element Analysis - Finite Element Formulation Techniques - Virtual Work and Variational Principle - Galerkin Method - Finite Element Method: Displacement Approach - Stiffness Matrix and Boundary Conditions

UNIT II ELEMENT PROPERTIES 9

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

UNIT III ANALYSIS OF FRAME STRUCTURES 9

Stiffness of Truss Members-Analysis of Truss-Stiffness of Beam Members-Finite Element Analysis of Continuous Beam-Plane Frame Analysis-Analysis of Grid and Space Frame

UNIT IV FEM FOR TWO AND THREE DIMENSIONAL SOLIDS 9

Constant Strain Triangle - Linear Strain Triangle - Rectangular Elements- Numerical Evaluation of Element Stiffness - Computation of Stresses, Geometric Nonlinearity and Static Condensation - Axisymmetric Element - Finite Element Formulation of Axisymmetric Element - Finite Element Formulation for 3 Dimensional Elements- Problems

UNIT V FEM FOR PLATES AND SHELL & APPLICATIONS OF FEM 9

Introduction to Plate Bending Problems - Finite Element Analysis of Thin Plate - Finite Element Analysis of Thick Plate - Finite Element Analysis of Skew Plate -Introduction to Finite Strip Method - Finite Element Analysis of Shell -Finite Elements for Elastic Stability - Dynamic Analysis

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1	Formulate a finite element problem using basic mathematical principles
CO2	Explain the various types of elements and Select the appropriate element for modelling
CO3	Analyse a frame using truss element
CO4	Formulate and analyse two and three dimensional solid finite element problems
CO5	Analyse a shells, thick and thin plate and explain dynamic analysis in FEM

REFERENCES:

1. David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
2. Logan D. L.,A First Course in the Finite Element Method, Thomson- Engineering, 3rd edition, 2001.
3. Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Seventh Edition, McGraw – Hill, 2013.
4. Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in Engineering”, Fourth Edition, Prentice Hall of India, 2015.
5. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 1999.

CO – PO Mapping - FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	M	H	H	M	M
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Conduct investigations of complex problems	H	M	H	M	M	M
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	M	M	M	M	M	M
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Structural Engineering discipline	M	H	M	H	M	M
PSO2	Critical analysis of Structural Engineering issues and innovation	L	L	H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions	M	M	M	M	M	M

ST5211 NUMERICAL AND FINITE ELEMENT ANALYSIS LABORATORY L T P C
0 0 4 2

OBJECTIVE:

- To introduce the solving of mathematical equations and finite element analysis with computational like MATLAB and Finite element software like ANSYS, ABAQUS etc

EXPERIMENTS/ EXERCISES

1. Dynamic analysis of frame using mathematical computational software
2. Finite Element Analysis of 2D truss and 3D space trusses
3. Modelling and Finite Element Analysis of RC beams and slabs
4. Finite Element Analysis of thin and thick plates
5. Stability analysis using FEM

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course the student will be able to carry out

1. Dynamic analysis of frames
2. Analysis of 2D truss and 3D space trusses
3. Analysis of RC beams and slabs
4. Analysis of thin and thick plates
5. Stability Analysis

CO – PO Mapping - NUMERICAL AND FINITE ELEMENT ANALYSIS LABORATORY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	H	M	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Conduct investigations of complex problems	H	H	H	H	H	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	M	M	M	M	M	M
PSO3	Conceptualization and evaluation of Design solutions	H	H	H	H	H	H

ST5212 STRUCTURAL DESIGN STUDIO L T P C
0 0 4 2

OBJECTIVE:

- To design a structure using modern software tools available like ETABS, STAAD, STRAP etc. and present it in the form of complete detail drawing

Students have to work individually with standard codes, computational tools and software packages for analyzing, designing and detailing a structure. A detailed report on the work done shall be submitted by individual student in the form of a report and presentation.

TOTAL: 60 PERIODS

OUTCOMES:

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

CO1	Plan a layout of a structure
CO2	Calculate loads using IS codes and various computational tools
CO3	Analyze the structure for various loads and load combination according to the relevant IS codes
CO4	Design and detail structures using computer software/tools and check the correctness using manual approximate methods
CO5	Prepare the complete structural drawings using computer software

CO – PO Mapping - STRUCTURAL DESIGN STUDIO

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	M	H	H	M	H
PO2	Problem analysis	H	M	H	H	M	H
PO3	Design / development of solutions	H	M	M	H	M	H
PO4	Conduct investigations of complex problems	H	H	H	H	M	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	H	H	H	H	H	H
PO8	Engineer and Society	M	M	M	M	M	M
PO9	Ethics	H	M	M	H	M	M
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	M	M	H	H	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	M	H	M	H
PSO3	Conceptualization and evaluation of Design solutions	H	H	H	H	H	H

ST5311 **PRACTICAL TRAINING (4 Weeks)** **L T P C**
0 0 0 2

OBJECTIVE:

- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.

SYLLABUS: The students individually undertake training in reputed engineering companies doing Structural Engineering during the summer vacation for a specified duration of four weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:

- On completion of the course, the student is expected to be able to develop skills in facing and solving the problems experiencing in the Structural Engineering field.

CO – PO Mapping - PRACTICAL TRAINING

PO/PSO		Course Outcome	Overall Correlation of COs to POs
		CO1	
PO1	Knowledge of Engineering Sciences	M	M
PO2	Problem analysis	H	H
PO3	Design / development of solutions	H	H
PO4	Investigation	M	M
PO5	Modern Tool Usage	M	M
PO6	Individual and Team work	M	M
PO7	Communication	M	M
PO8	Engineer and Society	L	L
PO9	Ethics	M	M
PO10	Environment and Sustainability	L	L
PO11	Project Management and Finance	M	M
PO12	Life Long Learning	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H
PSO2	Critical analysis of Structural Engineering problems and innovation	M	M
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues	M	M

ST5312 **PROJECT PHASE I** **L T P C**
0 0 12 6

OBJECTIVE:

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

SYLLABUS:

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

TOTAL: 180 PERIODS

OUTCOME:

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

CO – PO Mapping - PROJECT PHASE I

PO/PSO		Overall Correlation of COs to POs
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	H
PO5	Modern Tool Usage	H
PO6	Individual and Team work	H
PO7	Communication	H
PO8	Engineer and Society	H
PO9	Ethics	L
PO10	Environment and Sustainability	H
PO11	Project Management and Finance	M
PO12	Life Long Learning	H
PSO1	Knowledge of Structural Engineering discipline	M
PSO2	Critical analysis of Structural Engineering issues and innovation	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H

ST5411 **PROJECT PHASE II** **L T P C**
0 0 24 12

OBJECTIVES:

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

SYLLABUS:

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

TOTAL: 360 PERIODS

OUTCOME:

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

CO – PO Mapping - PROJECT PHASE II

PO/PSO		Overall Correlation of COs to POs
PO1	Knowledge of Engineering Sciences	H
PO2	Problem analysis	H
PO3	Design / development of solutions	H
PO4	Investigation	M
PO5	Modern Tool Usage	H
PO6	Individual and Team work	M
PO7	Communication	L
PO8	Engineer and Society	H
PO9	Ethics	L
PO10	Environment and Sustainability	H
PO11	Project Management and Finance	H
PO12	Life Long Learning	H
PSO1	Knowledge of Structural Engineering discipline	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H

ST5001 NON-LINEAR ANALYSIS OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the concept of nonlinear behaviour and analysis of elements and simple structures.

UNIT I INTRODUCTION TO NONLINEAR ANALYSIS 9

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

UNIT II INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

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

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

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

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Elastic and inelastic analysis of uniform and variable thickness plates

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Analyze bar system considering material and geometric nonlinearity
CO2	Perform inelastic analysis flexural members
CO3	Perform vibration analysis of flexural members
CO4	Perform elastic and inelastic analysis of Plates
CO5	Perform nonlinear and instability analysis of elastically supported beams

REFERENCES:

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

CO – PO Mapping - NONLINEAR ANALYSIS OF STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Conduct investigations of complex problems	H	H	H	H	H	H
PO5	Modern Tool Usage	H	H	H	H	H	H
PO6	Individual and Team work	H	H	H	H	H	H
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	L	L	L	L	L	L
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L

PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions	H	H	H	H	H	H

ST5002 STRUCTURAL STABILITY L T P C
3 0 0 3

OBJECTIVE:

- To study the concept of buckling and analysis of structural elements

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis. Governing equation for column buckling - critical load using Equilibrium, Energy methods - Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method.

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 – Combined Torsional and flexural buckling - Local buckling - Buckling of Open Sections - Lateral buckling of beams - simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9

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

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.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	explain the phenomenon of buckling of columns and calculate the buckling load on column by various approaches
CO2	estimate the buckling load of beam – columns and frames
CO3	explore the concepts of torsional and lateral buckling of thin walled members
CO4	explain the phenomenon of buckling of plates
CO5	analyze the inelastic buckling of columns and plates

REFERENCES:

1. Ashwini Kumar, “Stability Theory of Structures”, Allied publishers Ltd., New Delhi, 2003.
2. Chajes, A. “Principles of Structures Stability Theory”, Prentice Hall, 1974.
3. Gambhir.M.L, “Stability Analysis and Design of Structures”, springer, New York, 2013.
4. Simitser. G.J and Hodges D.H, ”Fundamentals of Structural Stability”, Elsevier Ltd., 2006.
5. Timoshenko. S. P, and Gere. J.M, “Theory of Elastic Stability”, McGraw Hill Book Company,1963

CO – PO Mapping - STRUCTURAL STABILITY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H	H			H	H
PO3	Design / development of solutions	H	H				H
PO4	Conduct investigations of complex problems						
PO5	Modern Tool Usage						
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning						
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H			H	H
PSO3	Conceptualization and evaluation of Design solutions	M	M	H	H	M	M

ST5003 WIND AND CYCLONE EFFECTS ON STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the concept of wind and cyclone effects for the analysis and design of structures.

UNIT I INTRODUCTION 9

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

UNIT II EFFECT OF WIND ON STRUCTURES 9

Classification of structures – Rigid and Flexible – Effect of wind on structures –Vortex shedding, translational vibration of structures - Static and dynamic effects on Tall buildings – Chimneys.

UNIT III DESIGN OF SPECIAL STRUCTURES 9

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

UNIT IV 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.

UNIT V WIND TUNNEL STUDIES 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Explain the characteristics of wind
CO2	Evaluate the intensity of wind on structures
CO3	Design some special structures subjected to wind loading
CO4	Design of structures for cyclone
CO5	Model and analyse a structure in a wind tunnel

REFERENCES:

1. Cook.N.J., “The Designer’s Guide to Wind Loading of Building Structures”, Butterworths, 1989.
2. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J, “Wind Effects on Civil Engineering Structures”, Elsevier Publications, 1984
3. Lawson T.V., “Wind Effects on Building Vol. I and II”, Applied Science Publishers, London,1980.
4. Peter Sachs, “Wind Forces in Engineering”, Pergamon Press, New York, 1978.

CO – PO Mapping - WIND AND CYCLONE EFFECTS ON STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	H	H	H	H	H
PO2	Problem analysis	M	H	H	H	H	H
PO3	Design / development of solutions	M	M	H	H	H	H
PO4	Conduct investigations of complex problems	M	H	H	H	H	H
PO5	Modern Tool Usage	L	M	M	M	M	M
PO6	Individual and Team work	L	L	L	L	L	L
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	L	L	L	L	L	L
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	M	M	M	H	M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	M	H	H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions	L	H	H	H	H	H

ST5004 PREFABRICATED STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To Study the design principles, analysis and design of elements**.**

UNIT I DESIGN PRINCIPLES 9

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

UNIT II REINFORCED CONCRETE 9

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

UNIT III FLOORS, STAIRS AND ROOFS 9

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

UNIT IV WALLS 9

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

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS 9

Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing. Cylindrical, Folded plate and paraboloid shells, Erection and jointing of components in industrial buildings.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Explain the design principles involved in prefabrication
CO2	Detail the different types of connection
CO3	Design for stripping forces during manufacture
CO4	Determine the forces in shear walls
CO5	Identify the different roof trusses used in industrial buildings

REFERENCES:

1. Hubert Bachmann and Alfred Steinle , Precast Concrete Structures, 2012.
2. Koncz.T. Manual of Precast Concrete Construction, Vol.I II and III & IV Bauverlag, GMBH, 1971.
3. Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures, Akademiai Kiado, Budapest, 2007.
4. Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, 1988.
5. Structural Design manual, Precast concrete connection details, Society for studies in the use of Precast concrete, Netherland Betor Verlag, 2009.

CO – PO Mapping - PREFABRICATED STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	M	H	H	H	H
PO2	Problem analysis		H	H	H		H
PO3	Design / development of solutions	M	H	H	H	H	H
PO4	Conduct investigations of complex problems					H	H
PO5	Modern Tool Usage		M	H	H	M	H
PO6	Individual and Team work						
PO7	Communication				M	M	M
PO8	Engineer and Society		L	M	M		M
PO9	Ethics						
PO10	Environment and Sustainability			H			H
PO11	Project Management and Finance	M	M	M	M	M	M
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline			H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation			H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions			H	H	H	H

CN5071 ADVANCED CONCRETE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:

- To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

UNIT I CONCRETE MAKING MATERIALS 9

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

UNIT II MIX DESIGN 9

Principles of concrete mix design, Methods of concrete mix design, IS Method, ACI Method, DOE Method – Mix design for special concretes- changes in Mix design for special materials.

UNIT III CONCRETING METHODS 9

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

UNIT IV SPECIAL CONCRETES 9

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

UNIT V TESTS ON CONCRETE 9

Properties of fresh concrete, Hardened concrete, Strength, Elastic properties, Creep and shrinkage – Durability of concrete. Non-destructive Testing Techniques microstructure of concrete

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Develop knowledge on various materials needed for concrete manufacture
CO2	Apply the rules to do mix designs for concrete by various methods
CO3	Develop the methods of manufacturing of concrete.
CO4	Explain about various special concrete
CO5	Explain various tests on fresh and hardened concrete

REFERENCES:

1. Gambhir.M.L. Concrete Technology, Fifth Edition, McGraw Hill Education, 2017.
2. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Shetty M.S., Concrete Technology, Revised Edition, S.Chand and Company Ltd. Delhi, 2006.
5. Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

CO – PO Mapping - ADVANCED CONCRETE TECHNOLOGY

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H		M	M	M	M
PO2	Problem analysis		H				H
PO3	Design / development of solutions		H				H
PO4	Investigation	M				H	H
PO5	Modern Tool Usage			H	H	M	H
PO6	Individual and Team work		M	H		M	M
PO7	Communication					L	L
PO8	Engineer and Society			H	H		H
PO9	Ethics			M			M
PO10	Environment and Sustainability			H	H	M	H
PO11	Project Management and Finance		L				L
PO12	Life Long Learning		H	H	L	M	H
PSO1	Knowledge of Structural Engineering discipline	M		H	M	M	M
PSO2	Critical analysis of Structural Engineering problems and innovation			L			L
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues				L		L

ST5005 ADVANCED PRESTRESSED CONCRETE L T P C

3 0 0 3

OBJECTIVE:

- Principle of prestressing, analysis and design of prestressed concrete structures**.**

UNIT I PRINCIPLES OF PRESTRESSING 9

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

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behaviour of flexural members, determination of ultimate flexural strength – Various Codal provisions - Design of flexural members, Design for shear, bond and torsion. Transfer of prestress – Box girders.

UNIT III DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

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

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

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

UNIT V DESIGN OF COMPOSITE MEMBERS 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Identify the various methods of prestressing
CO2	Design the beams for shear, bond and torsion
CO3	Design the continuous beams
CO4	Design the water tank, piles and masts
CO5	Analyze and design the composite beams

REFERENCES:

1. Arthur H. Nilson, “Design of Prestressed Concrete”, John Wiley and Sons Inc, New York, 2004.
2. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co., New Delhi, 6th Edition, 2018.
3. Lin.T.Y.and Burns.H “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc, 3rd Edition, 2010.
4. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2014.
5. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”, S.Chand and Co., 1998.

CO – PO Mapping – ADVANCED PRESTRESSED CONCRETE

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M					M
PO2	Problem analysis	M	H	H	H	H	H
PO3	Design / development of solutions	L	M	H	H	H	H
PO4	Conduct investigations of complex problems					M	M
PO5	Modern Tool Usage			L	M	L	L
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society				L	L	L
PO9	Ethics						

PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning	L	M	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation		M	M	M	M	M
PSO3	Conceptualization and evaluation of Design solutions	M	H	H	H	H	H

ST5006 RELIABILITY ANALYSIS OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To develop knowledge to solve structural analysis problems using reliability concepts.

UNIT I DATA ANALYSIS 9

Graphical representation Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$, and parabola, Coefficient of correlation

UNIT II PROBABILITY CONCEPTS 9

Random events-Sample space and events, Venn diagram and event space, Measures of probability-interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem

UNIT III RANDOM VARIABLES 9

Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions

UNIT IV RELIABILITY ANALYSIS 9

Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).

UNIT V SYSTEM RELIABILITY 9

Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Achieve Knowledge of design and development of problem solving skills.
CO2	Understand the principles of reliability.
CO3	Design and develop analytical skills.
CO4	Summarize the Probability distributions
CO5	Understands the concept of System reliability.

REFERENCES:

1. A Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, New York, 1993.
2. R E Melchers, Structural Reliability Analysis and Prediction, Third Edition, John Wiley & Sons Ltd, Chichester, England,2018.
3. O. Ditlevsen, H. O. Madsen, Structural Reliability Methods, Wiley, 1st Edition, 1996.
4. Srinivasan Chandrasekaran, Offshore Structural Engineering: Reliability and Risk Assessment, CRC Press, Florida, 2016.
5. Jack R Benjamin ,C. Allin Cornell, Probability, Statistics, and Decision for Civil Engineers , Dover Publications, Newyork, 2014.

CO – PO Mapping - RELIABILITY ANALYSIS OF STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	M	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Conduct investigations of complex problems	M	M	M	M	M	M
PO5	Modern Tool Usage	M	M	M	M	M	M
PO6	Individual and Team work	L	L	L	L	L	L
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	L	L	L	L	L	L
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	H	H	H	H
PSO3	Conceptualization and evaluation of Design solutions	M	M	M	M	M	M

ST5007 DESIGN OF FORMWORK L T P C
3 0 0 3

OBJECTIVE:

- To study and understand the detailed planning of formwork , Design of forms for various elements such as foundation, slabs, beams, columns and walls.

UNIT I INTRODUCTION 9

General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork.

UNIT II FORMWORK MATERIALS AND TYPES 9

Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete,

UNIT III FORMWORK DESIGN 9

Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT IV FORMWORK DESIGN FOR SPECIAL STRUCTURES 9

Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT V FORMWORK FAILURES 9

Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Select proper formwork, accessories and material
CO2	Design the form work for Beams, Slabs, columns, Walls and Foundations
CO3	Design the form work for Special Structures
CO4	Describe the working of flying formwork.
CO5	Judge the formwork failures through case studies

REFERENCES:

1. Formwork for Concrete Structures, R. L. Peurifoy, McGraw Hill India, 2010.
2. Formwork for Concrete Structures, Kumar Neeraj Jha, Tata McGraw Hill Education, 2012.
3. IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4. Hurd, M.K., Formwork for Concrete, Special Publication No.4, American Concrete Institute, Detroit, 1996
5. Michael P. Hurst, Construction Press, London and New York, 2003.

CO – PO Mapping - DESIGN OF FORMWORK

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	M	M	L	M	M
PO2	Problem analysis	L	H	H		H	H
PO3	Design / development of solutions	H	H	H	M	M	H
PO4	Conduct investigations of complex problems	L	M	M	M	M	M
PO5	Modern Tool Usage	L	L	L	M	M	L
PO6	Individual and Team work	M	M	M	M	M	M
PO7	Communication		L	L	L	L	L
PO8	Engineer and Society	L				L	L
PO9	Ethics	L				L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance					L	L
PO12	Life Long Learning		L	L	L	L	L
PSO1	Knowledge of Structural Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	L	H	H	H	H	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	L	H	H	H	H	H

ST5071 MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the damages, repair and rehabilitation of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance, Repair and Rehabilitation, retrofit and strengthening, need for rehabilitation of structures Facets of Maintenance, importance of Maintenance, routine and preventive maintenance, causes of deterioration. Non-destructive Testing Techniques

UNIT II STRENGTH AND DURABILITY OF CONCRETE 9

Quality assurance for concrete based on Strength and Durability - Thermal properties, microstructure of concrete – packing density- Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion

UNIT III REPAIR MATERIALS AND SPECIAL CONCRETES 9

Repair materials-Various repair materials, Criteria for material selection, Methodology of selection, Health and safety precautions for handling and applications of repair materials, Special mortars and concretes- Polymer Concrete and Mortar, Quick setting compounds, Grouting materials-Gas forming grouts, Sulfoalumate grouts, Polymer grouts, Acrylate and Urethane grouts, Bonding agents-Latex emulsions, Epoxy bonding agents, Protective coatings-Protective coatings for Concrete and Steel, FRP sheets

UNIT IV PROTECTION METHODS AND STRUCTURAL HEALTH MONITORING 9

Concrete protection methods – reinforcement protection methods- Corrosion protection techniques – Corrosion inhibitors, concrete coatings-Corrosion resistant steels, Coatings to reinforcement, cathodic protection, Structural health monitoring.

UNIT V REPAIR, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Various methods of crack repair, Grouting, Routing and sealing, Stitching, Dry packing, Autogenous healing, Overlays, Repair to active cracks, Repair to dormant cracks. Corrosion of embedded steel in concrete, Mechanism, Stages of corrosion damage, Repair of various corrosion damaged of structural elements (slab, beam and columns) Jacketing, Column jacketing, Beam jacketing, Beam Column joint jacketing, Reinforced concrete jacketing, Steel jacketing, FRP jacketing, Strengthening, Beam shear strengthening, Flexural strengthening

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1	Explain the importance of maintenance assessment of distressed structures
CO2	Apply the knowledge on Quality assurance for concrete based on Strength and Durability
CO3	Identify various repair materials and advancements in concrete
CO4	Explain the knowledge on Concrete protection methods Structural health monitoring
CO5	Select Various strengthening and repair methods for different cases

REFERENCES:

1. Dodge Woodson, Concrete Structures, Protection, Repair and Rehabilitation, Butterworth-Heinemann, Elsevier,New Delhi 2012
2. DovKominetzky.M.S., - Design and Construction Failures, Galgotia Publications Pvt.Ltd., 2001
3. Ravishankar.K., Krishnamoorthy.T.S, Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures, Allied Publishers, 2004.
4. Hand book on Seismic Retrofit of Buildings, CPWD and Indian Buildings Congress, Narosa Publishers, 2008.
5. Hand Book on “Repair and Rehabilitation of RCC Buildings” – Director General works CPWD ,Govt of India , New Delhi – 2002

CO – PO Mapping - MAINTENANCE, REPAIR AND REHABILITATION OF STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	M			M	M
PO2	Problem analysis	M	M				M
PO3	Design / development of solutions			H	M	H	H
PO4	Conduct investigations of complex problems	H	H				H
PO5	Modern Tool Usage			H	H	M	H
PO6	Individual and Team work	M	M				M
PO7	Communication		L				L
PO8	Engineer and Society			M	H	M	M
PO9	Ethics		M	M	M		M
PO10	Environment and Sustainability		H		H	M	H
PO11	Project Management and Finance	L					L
PO12	Life Long Learning			M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	M	M				M
PSO2	Critical analysis of Structural Engineering problems and innovation			H	H	M	H
PSO3	Conceptualization and evaluation of engineering solutions to Structural Engineering Issues			M	H	M	M

ST5008 MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE MATERIALS **L T P C 3 0 0 3**

OBJECTIVE:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics.

UNIT I INTRODUCTION **9**

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

UNIT II STRESS STRAIN RELATIONS **9**

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses

UNIT III ANALYSIS OF LAMINATED COMPOSITES **9**

Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates – Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses.

UNIT IV FAILURE AND FRACTURE OF COMPOSITES **9**

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction.

UNIT V APPLICATIONS AND DESIGN **9**

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

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Explain the various types of composites and its constituents
CO2	Derive the constitutive relationship and determine the stresses and strains in a composite material
CO3	Analyze a laminated plate
CO4	Explain the various failure criteria and fracture mechanics of composites
CO5	Design simple composite elements

REFERENCES

1. Agarwal.B.D. Broutman.L.J. and Chandrashekara.K. “Analysis and Performance of Fiber Composites”, Fourth Edition, John-Wiley and Sons, 2017
2. Daniel.I.M, and Ishai.O, “Engineering Mechanics of Composite Materials”, Second Edition, Oxford University Press, 2005.
3. Hyer M.W., and White S.R., “Stress Analysis of Fiber-Reinforced Composite Materials”, D.Estech Publications Inc., 2009
4. Jones R.M., “Mechanics of Composite Materials”, Taylor and Francis Group 1999.
5. Mukhopadhyay.M, “Mechanics of Composite Materials and Structures”, Universities Press, India, 2005.

CO – PO Mapping - MECHANICS OF FIBER REINFORCED POLYMER COMPOSITE MATERIALS

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	H	H	M	H	H
PO2	Problem analysis	L	M	H	M	H	H
PO3	Design / development of solutions	L	M	M	M	H	M
PO4	Conduct investigations of complex problems	L					
PO5	Modern Tool Usage						
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability	L	L	L	L	H	L
PO11	Project Management and Finance						
PO12	Life Long Learning	M				M	M
PSO1	Knowledge of Structural Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	L	M	M	M	H	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	M	M	M	H	H	M

ST5009 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I INTRODUCTION 9

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

UNIT II DESIGN OF COMPOSITE MEMBERS 9

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

UNIT III DESIGN OF CONNECTIONS 9

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

UNIT IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction - behaviour of box girder bridges - design concepts.

UNIT V CASE STUDIES 9

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

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Explain composite action
CO2	Design composite elements
CO3	Design connections
CO4	Explain the concept of design of composite box girder bridges
CO5	Study and evaluate case studies

REFERENCES:

1. Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Fourth Edition, Blackwell Scientific Publications, 2018
2. Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Revised Edition, Pergamon press, Oxford, 2000.
3. Owens.G.W and Knowles.P, ”Steel Designers Manual”, Seventh Edition, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 2011.
4. Narayanan R, “Composite steel structures – Advances, design and construction”, Elsevier, Applied science, UK, 1987
5. Teaching resource for, “Structural Steel Design,” Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.

CO – PO Mapping - DESIGN OF STEEL - CONCRETE COMPOSITE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	-	H
PO2	Problem analysis	H	H	H	M	M	H
PO3	Design / development of solutions	H	H	H	L	-	H
PO4	Conduct investigations of complex problems	L	L	M	-	M	M
PO5	Modern Tool Usage	-	M	-	-	-	M
PO6	Individual and Team work	-	-	-	-	M	M
PO7	Communication	L	L	-	M	H	M
PO8	Engineer and Society	M	M	L	M	M	M

PO9	Ethics	H	H	M	M	M	M
PO10	Environment and Sustainability	M	M	L	-	M	M
PO11	Project Management and Finance	-	-	M	-	L	L
PO12	Life Long Learning	M	M	M	-	M	M
PSO1	Knowledge of Structural Engineering discipline	M	M	M	M	-	M
PSO2	Critical analysis of Structural Engineering issues and innovation	M	M	M	M	H	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H	H	M	M	L	H

ST5010 DESIGN OF MASONRY STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To design, detail and retrofit a masonry structure

UNIT I INTRODUCTION 9

Introduction - Masonry construction - National and International perspective - Historical development, Modern masonry, Material Properties - Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

UNIT II DESIGN OF COMPRESSION MEMBER 9

Principles of masonry design, Masonry standards: IS 1905 and others.- Masonry in Compression - Prism strength, Eccentric loading -Kern distance. Structural Wall, Columns and Plasters, Retaining Wall, Pier and Foundation – Prestressed masonry

UNIT III DESIGN OF MASONRY UNDER LATERAL LOADS 9

Masonry under Lateral loads - In-plane and out-of-plane loads, Ductility of Reinforced Masonry Members Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms. Behaviour of Masonry - Shear and flexure - Combined bending and axial loads - Reinforced and unreinforced masonry -- Infill masonry

UNIT IV ASEISMIC DESIGN OF MASONRY STRUCTURES 9

Structural design of Masonry - Consideration of seismic loads - Cyclic loading and ductility of shear walls for seismic design -Code provisions- Working and Ultimate strength design - In-plane and out-of-plane design criteria for load-bearing and infills, connecting elements and ties. Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra – use of Software.

UNIT V RETROFITTING OF MASONRY 9

Seismic evaluation and Retrofit of Masonry - In-situ and non-destructive tests for masonry - properties - Repair and strengthening of techniques.

TOTAL : 45 PERIODS

OUTCOMES:

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

CO1	Explain the properties of a masonry unit and the various components
CO2	Design a masonry structure for compression
CO3	Design a masonry structure for lateral loads
CO4	Design a earthquake resistant masonry wall
CO5	Suggest retrofitting techniques for existing masonry walls

REFERENCES:

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R, “Masonry Structures: Behaviour & Design”, Prentice Hall Hendry, 1994.
2. A.W. Hendry, B.P. Sinha and Davis, S. R, “Design of Masonry Structures”, E & FN Spon, UK, 1997.
3. R.S. Schneider and W.L. Dickey, “Reinforced Masonry Design”, Prentice Hall, 3rd edition, 1994.
4. Paulay, T. and Priestley, M. J. N., “Seismic Design of Reinforced Concrete and Masonry Buildings”, John Wiley, 1992.
5. A.W. Hendry, “Structural Masonry”, 2nd Edition, Palgrave McMillan Press, 1998.

CO – PO Mapping - DESIGN OF MASONRY STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	M	H	H	H	H	H
PO2	Problem analysis	L	H	H	H	H	H
PO3	Design / development of solutions	L	H	H	H	H	H
PO4	Conduct investigations of complex problems					H	M
PO5	Modern Tool Usage				H		M
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	M	H	H	H	M	H
PSO2	Critical analysis of Structural Engineering issues and innovation	M	M	M	H	H	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	M	H	H	H	H	H

ST5011 DESIGN OF INDUSTRIAL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To disseminate knowledge about planning and design of RCC and STEEL Industrial structures**.**

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

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

UNIT II INDUSTRIAL BUILDINGS 9

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

UNIT III POWER PLANT STRUCTURES 9

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

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles, transmission line towers – Sag and Tension calculations, Methods of tower testing – Design of self supporting and guyed chimney, Design of Chimney bases.

UNIT V FOUNDATION 9

Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Develop the concept of planning & functional requirement of industrial standards.
CO2	Analyse and design of Steel Gantry girders & Crane girders and RCC design of corbels, nibs and staircase.
CO3	Analyse & design of cooling towers, bunker, silos and pipe supporting structures.
CO4	Analyse and design of Steel transmission line towers and chimneys.
CO5	Design foundations for cooling tower, chimneys and turbo generator.

REFERENCES:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.
3. Swami saran, Analysis & Design of substructures, Limit state Design second Edition.
4. D, N. Subramaniyan, Design of Steel Structures 2016
5. N. Krishna Raju, Advanced Reinforced concrete Design, 3rd edition 2016,

CO – PO Mapping - DESIGN OF INDUSTRIAL STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H		M			M
PO2	Problem analysis		H	H	H	M	H
PO3	Design / development of solutions		H	H	H	H	H
PO4	Conduct investigations of complex problems	M	M	M	M	M	M
PO5	Modern Tool Usage		L	L	L	L	L
PO6	Individual and Team work		M	M	M	M	M
PO7	Communication	M	L	L	L	L	L
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	M					M
PO10	Environment and Sustainability		M	M	M	M	M
PO11	Project Management and Finance						
PO12	Life Long Learning	M	M	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation		H	H	H	H	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H	H	H	H	H	H

ST5012 ADVANCED DESIGN OF FOUNDATION STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To design various types of foundations to fulfill the required criteria.

UNIT I SHALLOW FOUNDATIONS 9

soil investigation - Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates – structural design of isolated, strip, rectangular and trapezoidal and combined footings – strap – raft foundation.

UNIT II PILE FOUNDATIONS 9

Types of Pile foundations and their applications - Load Carrying capacity - pile load test - Settlements - Group action - pile cap - structural design of piles and pile caps - undreamed pile foundation.

UNIT III WELL FOUNDATION 9

Types of well foundations - grip length - load carrying capacity - construction of wells - failure and remedies - structural design of well foundation - lateral stability.

UNIT IV MACHINE FOUNDATIONS 9

Types - General requirements and design criteria - General analysis of machine foundations-soil system - Stiffness and damping parameters - Tests for design parameters - design of foundation for reciprocating engines, impact type machines and rotary type machines.

UNIT V SPECIAL FOUNDATIONS 9

Foundations for towers, Chimneys and Silos - design of anchors - reinforced earth retaining walls - Advantages of earth retaining walls - Behaviour and field applications of earth retaining walls

TOTAL: 45 PERIODS

OUTCOME:

On completion of this course student will be able

CO1	Design shallow and deep foundations for various types of structures
CO2	Design piles and pile caps
CO3	Design well foundation for bridge piers and related structures
CO4	Gain knowledge on design and construction of machine foundation
CO5	Design foundations for bridges, towers and chimneys

REFERENCES:

1. Tomlinson, M.J. and Boorman. R., Foundation Design and Construction, ELBS Longman, Seventh Edition, 2001.
2. Nayak, N.V., Foundation Design manual for Practicing Engineers, Dhanpat Rai and Sons, 2012.
3. Brain J. Bell and M.J. Smith, Reinforced Concrete Foundations, George Godwin Ltd., 1981.
4. Braja M. Das, Principles of Foundations Engineering, Eighth Edition, Thomson Asia (P) Ltd., 2015.
5. Bowels J.E., Foundation Analysis and Design, Fifth Edition, McGraw-Hill International Book Co., 2017.

CO – PO Mapping - ADVANCED DESIGN OF FOUNDATION STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	M	M	M	M	L	M
PO3	Design / development of solutions	H	H	H	H	H	H

PO4	Conduct investigations of complex problems						
PO5	Modern Tool Usage						
PO6	Individual and Team work						
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning						
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	M	M	M	M	M	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H	H	H	H	H	H

ST5013 OPTIMIZATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the optimization methodologies applied to structural engineering

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, Dual Simplex method. 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 multistory buildings, water tanks and bridges.

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1	Apply the knowledge of engineering fundamentals to formulate and solve the engineering problems by classical optimization techniques.
CO2	Identify, formulate and solve engineering problems by linear and non-linear programming.
CO3	Analyse the problem and reducing G.P.P to a set of simultaneous equations.
CO4	Apply the Engineering knowledge to understand the concept of dynamic programming.
CO5	Design various structural elements with minimum weight.

REFERENCES:

1. Iyengar.N.G.R and Gupta.S.K, "Structural Design Optimization", Affiliated East West Press Ltd, New Delhi, 1997
2. Rao,S.S. "Engineering Optimization: Theory and Practice", Fourth Edition, Wiley Eastern (P) Ltd., 2013.
3. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971.
4. Uri Kirsch, "Optimum Structural Design", McGraw Hill Book Co. 1981.
5. Haftka, R. T. and Gurdal, Z., Elements of Structural Optimization, Springer, 3 rd Edition, 1992

CO – PO Mapping - OPTIMIZATION OF STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H			H		H
PO2	Problem analysis	M	M	H	M	M	M
PO3	Design / development of solutions					H	H
PO4	Conduct investigations of complex problems					L	L
PO5	Modern Tool Usage					M	M
PO6	Individual and Team work		M	M	M		M
PO7	Communication					L	L
PO8	Engineer and Society	M				M	M
PO9	Ethics					M	M
PO10	Environment and Sustainability					M	M
PO11	Project Management and Finance					M	M
PO12	Life Long Learning					M	M
PSO1	Knowledge of Structural Engineering discipline		M	M	M	H	M
PSO2	Critical analysis of Structural Engineering issues and innovation		M	M	M	H	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues		M	M	M	H	M

ST5014 DESIGN OF HIGH RISE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the behaviour, analysis and design of high rise structures.

UNIT I DESIGN CRITERIA 9

High rise buildings – Structural systems and concepts, configurations - Design philosophy, Introduction to Performance based seismic design, Effect of openings. Large panel construction. Foundation - superstructure interaction.

UNIT II LOADING 9

Gravity loading: Dead and live load, methods of live load reduction, Impact loads, Construction loads. Wind loading: static and dynamic approach, Analytical and wind tunnel experimentation method. Earthquake loading: Equivalent lateral force, modal analysis - Combinations of loading.

UNIT III DESIGN OF CHIMNEYS 9

Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – Cooling Towers - Tall Chimneys – Foundation design for varied soil strata.

UNIT IV ANALYSIS AND DESIGN OF TRANSMISSION TOWER 9

Mast and trestles: Configuration, bracing system, analysis and design of Transmission towers – TV towers and steel monopoles.

UNIT V APPLICATION OF MODERN SOFTWARE 9

Computerized three dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis, Modelling and analysis using recent softwares viz SAP 2000, ETABS and STAAD Pro.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Apply the knowledge of engineering fundamentals to understand the design criteria and structural forms of tall buildings.
CO2	Identify the effects of loading in high rise structures.
CO3	Design the special structures such as chimneys and cooling towers.
CO4	Analyze and design the transmission tower and TV towers.
CO5	Select the modern sophisticated software to analyze the engineering problems.

REFERENCES:

1. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, CRC Press, 2011.
2. Beedle.L.S., “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1986.
3. Smith B.S and Coull A, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 2011.
4. Holmes, “Wind Loading of Structures, Third Edition, Spon Press, London, 2017
5. Schuller W. G, “High rise building structures”- John Wiley,1977.

CO – PO Mapping – DESIGN OF HIGH RISE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H				H	H
PO2	Problem analysis		M	M	H	H	M
PO3	Design / development of solutions			H			H
PO4	Conduct investigations of complex problems					L	L
PO5	Modern Tool Usage			M	H	H	H
PO6	Individual and Team work			M	H	H	H
PO7	Communication					M	M
PO8	Engineer and Society	M				H	M
PO9	Ethics					M	M
PO10	Environment and Sustainability	M	L	M			M
PO11	Project Management and Finance					L	L

PO12	Life Long Learning					L	L
PSO1	Knowledge of Structural Engineering discipline	M	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation		M	H	H	M	M
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues		M	H	M		M

ST5015 DESIGN OF OFFSHORE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To impart knowledge about the concept of wave theories, forces, offshore foundation, analysis and design of jacket towers, pipes and cables**.**

UNIT I WAVE THEORIES 9

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

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces, wave forces on small bodies and large bodies - current forces - 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, analysis and design of mooring cables and pipelines.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Develop the concept of wave theories
CO2	Apply the knowledge of wave forces and offshore structures
CO3	Explain the modeling for offshore structure and its foundation
CO4	Analyse offshore structures by means of static and dynamic methods
CO5	Design of jacket towers, mooring cables and pipelines

REFERENCES:

1. Chakrabarti, S.K., Handbook of Offshore Engineering by, Elsevier, 2005.
2. Chakrabarti, S.K., Hydrodynamics of Offshore Structures, Springer – verlag, 2003.
3. Chakrabarti, S.K. 1994, Offshore Structure Modelling: World Scientific
4. Chandrasekaran, S. 2017. Dynamic analysis and design of ocean structures.
5. B. Gou, S.Song, J Chacko and A. Ghalambar, offshore pipelines, GPP publishers, 2006.

CO – PO Mapping – DESIGN OF OFFSHORE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	M	M	H
PO2	Problem analysis			M	H	H	H
PO3	Design / development of solutions				H	H	H
PO4	Conduct investigations of complex problems	M	M	M	M	M	M
PO5	Modern Tool Usage			H	H	H	H
PO6	Individual and Team work		M	H	M	M	M
PO7	Communication	M	M	M	M	M	M
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	L	L				L
PO10	Environment and Sustainability			M	M	M	M
PO11	Project Management and Finance			M			M
PO12	Life Long Learning	L	L	M	M	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	L	L	H	H	H	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H	H	H	H	H	H

ST5016 PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION **L T P C 3 0 0 3**

OBJECTIVE:

- To study the concept of soil-structure – interaction in the analysis and design of structures.

UNIT I INTRODUCTION **9**

Introduction to Soil-structure interaction(SSI) problems, history - Static SSI - Dynamic SSI - liquefaction Problems associated with SSI, Case studies

UNIT II STATIC SSI PROBLEMS **9**

Contact pressure and its estimation - Estimation of the settlement from the constitutive laws

UNIT III DYNAMIC SSI PROBLEMS **9**

Free-field response - Kinetic interaction - Inertial interaction

UNIT IV SSI MODELS **9**

Winkler model - Elastic continuum-Multi parameter models -Codal provisions of India and others

UNIT V STRUCTURAL ANALYSIS WITH SSI **9**

Shallow foundation & Raft foundation problems - Analysis of high rise building with fixed base and flexible base - SSI consideration in pile foundation - Laterally loaded piles

TOTAL: 45 PERIODS

OUTCOMES:

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

CO1	Explain the concept of soil structure interaction.
CO2	Do a static analysis of soil structure interaction and estimate the contact pressure and settlement
CO3	Do a dynamic analysis of soil structure interaction problems
CO4	Explain the various SSI models
CO5	Analyze structural elements like shallow, Raft and pile foundation and analyze high rise building bases

REFERENCES:

1. John P. Wolf, (1985) Soil-structure interaction, Prentice Hall, 1987.
2. Bowels, J.E., "Analytical and Computer methods in Foundation" McGraw Hill Book Co., New York., 1974
3. Desai C.S. and Christian J.T., "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York.
4. Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.
5. A.P.S. Selvadurai, Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co., 1979.
6. Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice."John Wiley & Sons, New York, 1990.

CO – PO Mapping - Performance of Structures with Soil Structure Interaction

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	M	M	M	M	H	M
PO4	Conduct investigations of complex problems	H	H	H	H	H	H
PO5	Modern Tool Usage	M	M	M	M	M	M
PO6	Individual and Team work	L	L	L	L	L	L
PO7	Communication	L	L	L	L	L	L
PO8	Engineer and Society	L	L	L	L	L	L
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	L	L	L	L	L	L
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	M	M	H	M	M
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	H	H	H	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	M	M	M	M	M	M

ST5017 DESIGN OF BRIDGE STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- To study the loads, forces on bridges and design of several types of bridges.

UNIT I INTRODUCTION 9

Introduction- Selection of Site and Initial Decision Process - Classification of Bridges- General Features of Design- Standard Loading for Bridge Design as per different codes - Road Bridges – Railway Bridges - Design Codes - Working Stress Method- Limit State Method of Design as per IS456:2000- Limit State Method of Design as per IRC 112:2011

UNIT II SUPERSTRUCTURES – Part - I 9

Selection of main bridge parameters, design methodologies -Choices of superstructure types - Orthotropic plate theory, load distribution techniques - Grillage analysis - Finite element analysis Different types of superstructure (RCC and PSC); Longitudinal Analysis of Bridge. - Transverse Analysis of Bridge - Analysis and Design of RCC solid slab culverts and bridges

UNIT III SUPERSTRUCTURES – Part - II 9

Design of RCC Tee beam and slab bridges - Design principles of continuous girder bridges, box girder bridges, balanced cantilever bridges – Arch bridges – Box culverts – Segmental bridges.

UNIT IV SUBSTRUCTURE, BEARINGS AND DECK JOINTS 9

Pier - Abutment - Wing walls - Importance of Soil-Structure Interaction - Types of foundations - Open foundation - Pile foundation - Well foundation Different types of bridge bearings and expansion joints; Design of bearings and joints.

UNIT V PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES 9

Introduction to Design of PSC bridges – PSC girders – Introduction to design of steel bridges - Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners.

TOTAL: 45 PERIODS

OUTCOME:

- On completion of this course student will be able

CO1	Explain the different types of bridges and design philosophies
CO2	Design a RC solid slab culvert bridge
CO3	Design a RC Tee Beam and Slab bridge
CO4	Design the bridge bearings and substructure
CO5	Explain the design of PSC bridges, box girder bridges, truss bridges

REFERENCES:

1. Jagadeesh. T.R. and Jayaram. M. A., “Design of Bridge Structures”, Second Edition, Prentice Hall of India Pvt. Ltd. 2009.
2. Johnson Victor, D. “Essentials of Bridge Engineering”, Sixth Edition, Oxford and IBH Publishing Co. New Delhi, 2018.
3. Ponnuswamy, S., “Bridge Engineering”, Third Edition, Tata McGraw Hill, 2017.
4. Raina V.K.” Concrete Bridge Practice” Tata McGraw Hill Publishing Company, New Delhi,1991.
5. Design of Highway Bridges, Richard M. Barker & Jay A. Puckett, John Wiley & Sons, Inc., 2007

CO – PO Mapping - DESIGN OF BRIDGE STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Knowledge of Engineering Sciences	H	H	H	H	H	H
PO2	Problem analysis	H	H	H	H	H	H
PO3	Design / development of solutions	H	H	H	H	H	H
PO4	Investigation	H	M	M	M	H	M
PO5	Modern Tool Usage	L	L	L	L	L	L
PO6	Individual and Team work	M	M	M	M	M	M

PO7	Communication	H	H	H	H	H	H
PO8	Engineer and Society	H	H	H	H	H	H
PO9	Ethics	L	L	L	L	L	L
PO10	Environment and Sustainability	M	M	M	M	M	M
PO11	Project Management and Finance	L	L	L	L	L	L
PO12	Life Long Learning	H	H	H	H	H	H
PSO1	Knowledge of Structural Engineering discipline	H	H	H	H	H	H
PSO2	Critical analysis of Structural Engineering issues and innovation	H	H	H	H	H	H
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues	H	H	H	H	H	H

ST5018 DESIGN OF SHELL AND SPATIAL STRUCTURES L T P C
3 0 0 3

OBJECTIVE:

- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.

UNIT I CLASSIFICATION OF SHELLS 9

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31.

UNIT II FOLDED PLATES 9

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

UNIT III INTRODUCTION TO SPACE FRAME 9

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

UNIT IV ANALYSIS AND DESIGN 9

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

UNIT V SPECIAL METHODS 9

Application of Formex Algebra, FORMIAN for generation of configuration.

TOTAL: 45 PERIODS

OUTCOME:

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

CO1	Explain the different forms of shells and design the domes and shells
CO2	Evaluate the structural behaviour and design of folded plate structures
CO3	Explain the various functional configurations of space frames
CO4	Design of space frames and apply the knowledge of CAD for the analysis of space structures
CO5	Analyse the configurations of space structures using FORMIAN software

REFERENCES

1. Billington. D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, 1982. ASCE Manual No.31, Design of Cylindrical Shells.
2. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.

3. Subramanian.N ,"Space Structures: Principles and Practice", Multi-Science Publishing Co. Ltd. 2008.
4. Ramasamy, G.S., "Analysis, Design and Construction of Steel Space Frames", Thomas Telford Publishing, 2002.
5. Wilby.C "Concrete Folded Plate Roofs", Elsevier, 1998.

CO – PO Mapping - DESIGN OF SHELL AND SPATIAL STRUCTURES

PO/PSO		Course Outcome					Overall Correlation of COs to POs
		CO1	CO2	CO3	CO4	CO5	
PO1	Engineering knowledge	H	H	H	H	H	H
PO2	Problem analysis	H	H		M		H
PO3	Design / development of solutions	H	H		M		H
PO4	Conduct investigations of complex problems						
PO5	Modern Tool Usage					M	M
PO6	Individual and Team work					M	M
PO7	Communication						
PO8	Engineer and Society						
PO9	Ethics						
PO10	Environment and Sustainability						
PO11	Project Management and Finance						
PO12	Life Long Learning						
PSO1	Knowledge of Structural Engineering discipline	H	M		M		M
PSO2	Critical analysis of Structural Engineering issues and innovation						
PSO3	Conceptualization and evaluation of Engineering solutions to Structural Design issues						

OPEN ELECTIVE COURSES (OEC)

OE5091 BUSINESS DATA ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To understand the basics of business analytics and its life cycle.
- To gain knowledge about fundamental business analytics.
- To learn modeling for uncertainty and statistical inference.
- To understand analytics using Hadoop and Map Reduce frameworks.
- To acquire insight on other analytical frameworks.

UNIT I OVERVIEW OF BUSINESS ANALYTICS 9

Introduction – Drivers for Business Analytics – Applications of Business Analytics: Marketing and Sales, Human Resource, Healthcare, Product Design, Service Design, Customer Service and Support – Skills Required for a Business Analyst – Framework for Business Analytics Life Cycle for Business Analytics Process.

Suggested Activities:

- Case studies on applications involving business analytics.
- Converting real time decision making problems into hypothesis.
- Group discussion on entrepreneurial opportunities in Business Analytics.

Suggested Evaluation Methods:

- Assignment on business scenario and business analytical life cycle process.
- Group presentation on big data applications with societal need.
- Quiz on case studies.

UNIT II ESSENTIALS OF BUSINESS ANALYTICS 9

Descriptive Statistics – Using Data – Types of Data – Data Distribution Metrics: Frequency, Mean, Median, Mode, Range, Variance, Standard Deviation, Percentile, Quartile, z-Score, Covariance, Correlation – Data Visualization: Tables, Charts, Line Charts, Bar and Column Chart, Bubble Chart, Heat Map – Data Dashboards.

Suggested Activities:

- Solve numerical problems on basic statistics.
- Explore chart wizard in MS Excel Case using sample real time data for data visualization.
- Use R tool for data visualization.

Suggested Evaluation Methods:

- Assignment on descriptive analytics using benchmark data.
- Quiz on data visualization for univariate, bivariate data.

UNIT III MODELING UNCERTAINTY AND STATISTICAL INFERENCE 9

Modeling Uncertainty: Events and Probabilities – Conditional Probability – Random Variables – Discrete Probability Distributions – Continuous Probability Distribution – Statistical Inference: Data Sampling – Selecting a Sample – Point Estimation – Sampling Distributions – Interval Estimation – Hypothesis Testing.

Suggested Activities:

- Solving numerical problems in sampling, probability, probability distributions and hypothesis testing.
- Converting real time decision making problems into hypothesis.

Suggested Evaluation Methods:

- Assignments on hypothesis testing.
- Group presentation on real time applications involving data sampling and hypothesis testing.
- Quizzes on topics like sampling and probability.

UNIT IV ANALYTICS USING HADOOP AND MAPREDUCE FRAMEWORK 9

Introducing Hadoop – RDBMS versus Hadoop – Hadoop Overview – HDFS (Hadoop Distributed File System) – Processing Data with Hadoop – Introduction to MapReduce – Features of MapReduce – Algorithms Using Map-Reduce: Matrix-Vector Multiplication, Relational Algebra Operations, Grouping and Aggregation – Extensions to MapReduce.

Suggested Activities:

- Practical – Install and configure Hadoop.
- Practical – Use web based tools to monitor Hadoop setup.
- Practical – Design and develop MapReduce tasks for word count, searching involving text corpus etc.

Suggested Evaluation Methods:

- Evaluation of the practical implementations.
- Quizzes on topics like HDFS and extensions to MapReduce.

UNIT V OTHER DATA ANALYTICAL FRAMEWORKS 9

Overview of Application development Languages for Hadoop – PigLatin – Hive – Hive Query Language (HQL) – Introduction to Pentaho, JAQL – Introduction to Apache: Sqoop, Drill and Spark, Cloudera Impala – Introduction to NoSQL Databases – Hbase and MongoDB.

Suggested Activities:

- Practical – Installation of NoSQL database like MongoDB.
- Practical – Demonstration on Sharding in MongoDB.
- Practical – Install and run Pig
- Practical – Write PigLatin scripts to sort, group, join, project, and filter data.
- Design and develop algorithms to be executed in MapReduce involving numerical methods for analytics.

Suggested Evaluation Methods:

- Mini Project (Group) – Real time data collection, saving in NoSQL, implement analytical techniques using Map-Reduce Tasks and Result Projection.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, the student will be able to:

- Identify the real world business problems and model with analytical solutions.
- Solve analytical problem with relevant mathematics background knowledge.
- Convert any real world decision making problem to hypothesis and apply suitable statistical testing.
- Write and Demonstrate simple applications involving analytics using Hadoop and MapReduce
- Use open source frameworks for modeling and storing data.
- Apply suitable visualization technique using R for visualizing voluminous data.

REFERENCES:

1. Vignesh Prajapati, “Big Data Analytics with R and Hadoop”, Packt Publishing, 2013.
2. Umesh R Hodeghatta, Umesha Nayak, “Business Analytics Using R – A Practical Approach”, Apress, 2017.
3. Anand Rajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Jeffrey D. Camm, James J. Cochran, Michael J. Fry, Jeffrey W. Ohlmann, David R. Anderson, “Essentials of Business Analytics”, Cengage Learning, second Edition, 2016.
5. U. Dinesh Kumar, “Business Analytics: The Science of Data-Driven Decision Making”, Wiley, 2017.
6. A. Ohri, “R for Business Analytics”, Springer, 2012
7. Rui Miguel Forte, “Mastering Predictive Analytics with R”, Packt Publication, 2015.

Business Data Analytics

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	3	1
CO2	2	1	1	2	1	1
CO3	1	1	2	3	3	1
CO4	2	2	1	2	1	1
CO5	1	1	2	2	1	1
CO6	1	1	1	3	2	1

OE5092 INDUSTRIAL SAFETY LT P C
3 0 0 3

OBJECTIVES:

- Summarize basics of industrial safety
- Describe fundamentals of maintenance engineering
- Explain wear and corrosion
- Illustrate fault tracing
- Identify preventive and periodic maintenance

UNIT I INTRODUCTION 9

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING 9

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION 9

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING 9

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TOTAL: 45 PERIODS

OUTCOMES:

CO1: Ability to summarize basics of industrial safety
CO2: Ability to describe fundamentals of maintenance engineering
CO3: Ability to explain wear and corrosion
CO4: Ability to illustrate fault tracing
CO5: Ability to identify preventive and periodic maintenance

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Audels, Pump-hydraulic Compressors, Mcgrew Hill Publication, 1978.
2. Garg H P,Maintenance Engineering, S. Chand and Company,1987.
3. Hans F. Winterkorn ,Foundation Engineering Handbook, Chapman & Hall London,2013.
4. Higgins & Morrow , Maintenance Engineering Handbook, Eighth Edition,2008

OE5093 OPERATIONS RESEARCH LT P C
3 0 0 3

OBJECTIVES:

- Solve linear programming problem and solve using graphical method.
- Solve LPP using simplex method
- Solve transportation , assignment problems
- Solve project management problems
- Solve scheduling problems

UNIT I LINEAR PROGRAMMING 9

Introduction to Operations Research – assumptions of linear programming problems - Formulations of linear programming problem – Graphical method

UNIT II ADVANCES IN LINEAR PROGRAMMING 9

Solutions to LPP using simplex algorithm- Revised simplex method - primal dual relationships – Dual simplex algorithm - Sensitivity analysis

UNIT III NETWORK ANALYSIS – I 9

Transportation problems - Northwest corner rule, least cost method,Voges's approximation method - Assignment problem -Hungarian algorithm

UNIT IV NETWORK ANALYSIS – II 9

Shortest path problem: Dijkstra's algorithms, Floyds algorithm, systematic method -CPM/PERT

UNIT V NETWORK ANALYSIS – III 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models

TOTAL: 45 PERIODS

OUTCOMES:

CO1: To formulate linear programming problem and solve using graphical method.
CO2: To solve LPP using simplex method
CO3: To formulate and solve transportation, assignment problems
CO4: To solve project management problems
CO5: To solve scheduling problems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES:

1. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010
2. Hitler Libermann, Operations Research: McGraw Hill Pub. 2009
3. Pant J C, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Pannerselvam, Operations Research: Prentice Hall of India 2010
5. Taha H A, Operations Research, An Introduction, PHI, 2008

OE5094 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the costing concepts and their role in decision making
- Infer the project management concepts and their various aspects in selection
- Interpret costing concepts with project execution
- Develop knowledge of costing techniques in service sector and various budgetary control techniques
- Illustrate with quantitative techniques in cost management

UNIT I INTRODUCTION TO COSTING *CONCEPTS* 9

Objectives of a Costing System; Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II INTRODUCTION TO PROJECT MANAGEMENT 9

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents, Project team: Role of each member,Importance Project site: Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPTS 9

Project execution Project cost control, Bar charts and Network diagram, Project commissioning: mechanical and process, Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems, Pricing strategies: Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis, Budgetary Control: Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Learning Curve Theory.

TOTAL: 45 PERIODS

OUTCOMES

CO1 – Understand the costing concepts and their role in decision making
CO2–Understand the project management concepts and their various aspects in selection
CO3–Interpret costing concepts with project execution
CO4–Gain knowledge of costing techniques in service sector and various budgetary control techniques
CO5 - Become familiar with quantitative techniques in cost management

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓		✓			✓	✓		✓	✓
CO2	✓	✓	✓		✓				✓		✓	✓
CO3	✓	✓	✓		✓	✓					✓	✓
CO4	✓	✓	✓		✓		✓				✓	✓
CO5	✓	✓	✓		✓	✓	✓				✓	✓

REFERENCES:

1. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher, 1991
2. Charles T. Horngren and George Foster, Advanced Management Accounting, 1988
3. Charles T. Horngren et al Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2011
4. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, 2003
5. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007

OE5095 COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES:

- Summarize the characteristics of composite materials and effect of reinforcement in composite materials.
- Identify the various reinforcements used in composite materials.
- Compare the manufacturing process of metal matrix composites.
- Understand the manufacturing processes of polymer matrix composites.
- Analyze the strength of composite materials.

UNIT I INTRODUCTION 9

Definition – Classification and characteristics of Composite materials - Advantages and application of composites - Functional requirements of reinforcement and matrix - Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS 9

Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers - Properties and applications of whiskers, particle reinforcements - Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures - Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES 9

Casting – Solid State diffusion technique - Cladding – Hot isostatic pressing - Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving - Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES 9

Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding - Properties and applications.

UNIT V STRENGTH 9

Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

OUTCOMES:

- CO1 - Know the characteristics of composite materials and effect of reinforcement in composite materials.
- CO2 – Know the various reinforcements used in composite materials.
- CO3 – Understand the manufacturing processes of metal matrix composites.
- CO4 – Understand the manufacturing processes of polymer matrix composites.
- CO5 – Analyze the strength of composite materials.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		✓	✓	✓								
CO2		✓	✓	✓	✓						✓	
CO3			✓	✓	✓		✓				✓	
CO4			✓	✓	✓		✓				✓	
CO5				✓	✓		✓					

REFERENCES:

1. Cahn R.W. - Material Science and Technology – Vol 13 – Composites, VCH, West Germany.
2. Callister, W.D Jr., Adapted by Balasubramaniam R, Materials Science and Engineering, An introduction, John Wiley & Sons, NY, Indian edition, 2007.
3. Chawla K.K., Composite Materials, 2013.
4. Lubin.G, Hand Book of Composite Materials, 2013.

OE5096 WASTE TO ENERGY L T P C
3 0 0 3

OBJECTIVES:

- Interpret the various types of wastes from which energy can be generated
- Develop knowledge on biomass pyrolysis process and its applications
- Develop knowledge on various types of biomass gasifiers and their operations
- Invent knowledge on biomass combustors and its applications on generating energy
- Summarize the principles of bio-energy systems and their features

UNITI INTRODUCTION TO EXTRACTION OF ENERGY FROM WASTE 9

Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

UNIT II BIOMASS PYROLYSIS 9

Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT III BIOMASS GASIFICATION 9

Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS COMBUSTION 9

Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNITV BIO ENERGY 9

Properties of biogas (Calorific value and composition), Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production -Urban waste to energy conversion - Biomass energy programme in India.

TOTAL: 45 PERIODS

OUTCOMES:

CO1 – Understand the various types of wastes from which energy can be generated
CO2 – Gain knowledge on biomass pyrolysis process and its applications
CO3 – Develop knowledge on various types of biomass gasifiers and their operations
CO4 – Gain knowledge on biomass combustors and its applications on generating energy
CO5 – Understand the principles of bio-energy systems and their features

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓		✓									✓
CO2	✓		✓									✓
CO3	✓	✓	✓		✓							✓
CO4	✓	✓	✓		✓		✓					✓
CO5	✓	✓	✓		✓							✓

REFERENCES:

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

AUDIT COURSES (AC)

AX5091 ENGLISH FOR RESEARCH PAPER WRITING L T P C
2 0 0 0

OBJECTIVES

- Teach how to improve writing skills and level of readability
- Tell about what to write in each section
- Summarize the skills needed when writing a Title
- Infer the skills needed when writing the Conclusion
- Ensure the quality of paper at very first-time submission

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING 6

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

UNIT II PRESENTATION SKILLS 6

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction

UNIT III TITLE WRITING SKILLS 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, Methods, Results, Discussion, Conclusions, The Final Check

UNIT IV RESULT WRITING SKILLS 6

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions

UNIT V VERIFICATION SKILLS 6

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

TOTAL: 30 PERIODS

OUTCOMES

CO1 –Understand that how to improve your writing skills and level of readability
CO2 – Learn about what to write in each section
CO3 – Understand the skills needed when writing a Title
CO4 – Understand the skills needed when writing the Conclusion
CO5 – Ensure the good quality of paper at very first-time submission

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3										✓		✓
CO4										✓		✓
CO5										✓		✓

REFERENCES

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

AX5092 **DISASTER MANAGEMENT** **L T P C**
2 0 0 0

OBJECTIVES

- Summarize basics of disaster
- Explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches

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 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 for Survival

TOTAL : 30 PERIODS

OUTCOMES

CO1: Ability to summarize basics of disaster
CO2: Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3: Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4: Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5: Ability to develop the strengths and weaknesses of disaster management approaches

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓											
CO2	✓											
CO3	✓	✓	✓									
CO4	✓	✓	✓									
CO5	✓	✓	✓									

REFERENCES

1. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" NewRoyal book Company,2007.
3. Sahni, PardeepEt.Al. ," Disaster Mitigation Experiences And Reflections", Prentice Hall OfIndia, New Delhi,2001.

AX5093 SANSKRIT FOR TECHNICAL KNOWLEDGE L T P C
2 0 0 0

OBJECTIVES

- Illustrate the basic sanskrit language.
- Recognize sanskrit, the scientific language in the world.
- Appraise learning of sanskrit to improve brain functioning.
- Relate sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power.
- Extract huge knowledge from ancient literature.

UNIT I ALPHABETS 6

Alphabets in Sanskrit

UNIT II TENSES AND SENTENCES 6

Past/Present/Future Tense - Simple Sentences

UNIT III ORDER AND ROOTS 6

Order - Introduction of roots

UNIT IV SANSKRIT LITERATURE 6

Technical information about Sanskrit Literature

UNIT V TECHNICAL CONCEPTS OF ENGINEERING 6

Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics

TOTAL: 30 PERIODS

OUTCOMES

- CO1 - Understanding basic Sanskrit language.
- CO2 - Write sentences.
- CO3 - Know the order and roots of Sanskrit.
- CO4 - Know about technical information about Sanskrit literature.
- CO5 - Understand the technical concepts of Engineering.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1										✓		✓
CO2										✓		✓
CO3												✓
CO4												✓
CO5												✓

REFERENCES

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

AX5094 **VALUE EDUCATION** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to
- Understand value of education and self-development
- Imbibe good values in students
- Let the should know about the importance of character

UNIT I
Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements

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

UNIT III
Personality and Behavior Development-Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour.
Universal brother hood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature

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

TOTAL: 30 PERIODS

OUTCOMES
Students will be able to
- Knowledge of self-development.
- Learn the importance of Human values.
- Developing the overall personality.

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

AX5095 **CONSTITUTION OF INDIA** **L T P C**
2 0 0 0

OBJECTIVES
Students will be able to:
- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION
History, Drafting Committee, (Composition & Working)

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION
Preamble, Salient Features

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES

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

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

District's Administration head: Role and Importance, • Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Pachayati raj: Introduction, PRI: Zila Pachayat. Elected officials and their roles, CEO Zila 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

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

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to:

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization
- of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party[CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of 1956.

Suggested reading

1. The Constitution of India,1950(Bare Act),Government Publication.
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.

AX5096 PEDAGOGY STUDIES L T P C
2 0 0 0

OBJECTIVES

Students will be able to:

- Review existing evidence on there view topic to inform programme design and policy
- Making under taken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

UNIT I INTRODUCTION AND METHODOLOGY

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 INTRODUCTION AND METHODOLOGY

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 III

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

SUGGESTED READING

1. 'Yogic Asanas for Group Tarining-Part-I":Janardan Swami Yoga bhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata

AX5098	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L T P C 2 0 0 0

OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

UNIT I

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses-29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses-71,73,75,78 (do's)

UNIT II

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.

UNIT III

Statements of basic knowledge - Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 - Personality of role model - shrimad bhagwad geeta - Chapter2-Verses 17, Chapter 3-Verses 36,37,42 - Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63

TOTAL: 30 PERIODS

OUTCOMES

Students will be able to

- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neet is hatakam will help in developing versatile personality of students.

Suggested reading

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar-vairagya, New Delhi,2010
2. Swami Swarupananda , Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.