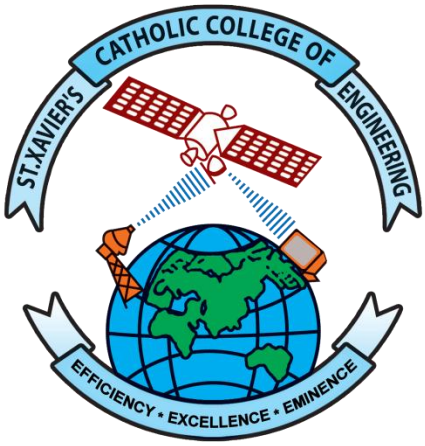
M.E. Degree

in

STRUCTURAL ENGINEERING

CURRICULUM & SYLLABUS (CBCS)

(For students admitted from the Academic Year 2022-2023)



DEPARTMENT OF CIVIL ENGINEERING

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

CHUNKANKADAI, NAGERCOIL – 629 003.

KANYAKUMARI DISTRICT, TAMIL NADU, INDIA

St. XAVIER'S CATHOLIC COLLEGE OF ENGINEERING

Chunkankadai, Nagercoil – 629 003.

AUTONOMOUS COLLEGE AFFILIATED TO ANNA UNIVERSITY

ACADEMIC REGULATIONS 2022

M. E. STRUCTURAL ENGINEERING CURRICULAM

CHOICE BASED CREDIT SYSTEM

INTRODUCTION

Inconsonance to the vision of our College,

An engineering graduate we form would be a person with optimal human development, i.e. physical, mental, emotional, social and spiritual spheres of personality.

He/she would be also a person mature in relationships, especially knowing how to treat everyone with respect, including persons of complementary gender with equality and gender sensitivity guided by clear and pro-social values.

He would be patriotic and would hold the Indian Constitution and all the precepts it outlays close to his heart and would have a secular spirit committed to safeguard and cherish the multi-cultural, multi-religious and multi-linguistic ethos of Indian Society.

Academically, he/she would be a graduate with a strong engineering foundation with proficient technical knowledge and skills. He would have enough exposure and experience into the ethos of relevant industry and be industry ready to construct a successful career for himself and for the benefit of the society.

He would have been well trained in research methodology and would have established himself as a researcher having taken up many research projects, with sound ethical standards and social relevance. He would be a person with a passion for technical innovations committed to lifelong learning and research.

He would be well prepared and confident to develop ingenuous solutions to the problems people face as an individual and as a team and work for the emancipation of our society with leadership and courage.

Structural engineering is a sub-discipline of civil engineering in which structural engineers are trained to design and construct the structural elements. The curriculum provides the students to gain knowledge and skills using modern engineering equipment and software tools by applying appropriate techniques. Graduates can identify, formulate and solve engineering problems in the domain of structural engineering.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

I.	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.
II.	Become consultants in Structural Engineering and solve complex real life issues related to analysis, design and maintenance of structures under various environmental conditions.
III.	Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or in Research organizations or Academia.
IV.	Practice their profession with good communication, leadership, ethics and social responsibility and formulate solutions that are technically sound, economically feasible, and socially acceptable.
V.	Graduates will function in multi-disciplinary teams and adapt to evolving technologies through life-long learning and innovation.

PROGRAMME OUTCOMES (POs)

PO#	Graduate Attribute
1	Independently carry out research/investigation and development work to solve practical problems.
2	Write and present substantial technical report/document.
3	Demonstrate a degree of mastery over the techniques in the area of Structural Engineering.
4	Analyze, design and create novel products and solutions for the real life problems in Structural Engineering.
5	Solve problems in Structural design using modern Engineering equipments and software tools by applying appropriate techniques.
6	Function effectively as a professional with ethical attitude, effective communication skills, team work skills, leadership skills and multi-disciplinary approach to solve Structural Engineering issues to broader social context.

PEO's – PO's MAPPING:

PEO	PO					
	1	**2**	**3**	**4**	**5**	**6**
I	2	-	3	1	-	2
II	3	3	3	3	3	3
III	3	3	3	3	2	2
IV	1	2	2	1	1	3
V	3	2	3	3	3	3

PROGRAMME ARTICULATION MATRIX:

Year	Semester	Course Name	PO					
			1	2	3	4	5	6
I	I	MA22108	1	-	2	2	-	-
		SE22102	2	-	2	2	-	2
		SE22101	2	-	3	2	2	2
		SE22103	2	2	2	2	2	2
		RM22101	-	2	3	-	-	2
		SE22104	3	3	2	-	-	3
I	II	SE22201	2	2	2	2	2	2
		SE22203	3	2	2	3	2	3
		SE22204	2	-	3	3	-	-
		SE22202	1	3	3	2	2	2
		SE22205	2	2	2	3	2	2
		RM22201	2	2	-	-	2	2

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	MA22108	Advanced Mathematical Methods for Structural Engineers	FC	3	1	0	4	4
2	SE22102	Theory of Elasticity and Plasticity	PCC	3	1	0	4	4
3		Professional Elective I	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
4	SE22101	Structural Dynamics and Earthquake Engineering	PCC	3	0	2	5	4
PRACTICAL COURSES								
5	SE22103	Advanced Structural	PCC	0	0	4	4	2

		Engineering Laboratory						
EMPLOYABILITY ENHANCEMENT COURSES								
6	RM22101	Research Methodology	RMC	2	0	0	2	2
7	SE22104	Technical Seminar	EEC	0	0	2	2	1
MANDATORY COURSES								
8		Audit Course I	AC	2	0	0	2	0
TOTAL				16	2	8	26	20

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATE-GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1	SE22201	Advanced Steel Structures	PCC	3	1	0	4	4
2	SE22203	Stability of Structures	PCC	3	0	0	3	3
3	SE22204	Advanced Concrete Structures	PCC	3	0	0	3	3
4		Professional Elective II	PEC	3	0	0	3	3
5		Professional Elective III	PEC	3	0	0	3	3
THEORY COURSES WITH PRACTICAL COMPONENT								
6	SE22202	Finite Element Analysis of Structures	PCC	3	0	2	5	4
PRACTICAL COURSES								
7	SE22205	Structural Design Laboratory	PCC	0	0	4	4	2
EMPLOYABILITY ENHANCEMENT COURSES								
8	RM22201	Research Tool Laboratory	RMC	0	0	4	4	2
MANDATORY COURSES								

9		Audit Course II	AC	2	0	0	2	0
TOTAL				20	1	10	31	24

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
THEORY COURSES								
1		Professional Elective IV	PEC	3	0	0	3	3
2		Professional Elective V	PEC	3	0	0	3	3
3		Open Elective	OEC	3	0	0	3	3
EMPLOYABILITY ENHANCEMENT COURSES								
4	SE22301	Practical Training (4 weeks during summer vacation)	EEC	-	-	-	-	2
5	SE22302	Project Phase I	EEC	0	0	6	6	3
TOTAL				9	0	6	15	14

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	CATE - GORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
EMPLOYABILITY ENHANCEMENT COURSES								
	SE22401	Project Phase II	EEC	-	-	24	24	12
TOTAL								12

Total Credit= 70

SUMMARY

Name of the Programme						
S.No	Subject Area	Credits per Semester				Total Credits
		I	II	III	IV	
1	FC	4	-	-	-	4
2	PCC	10	16	-	-	26
3	PEC	3	6	6	-	15
4	OEC	-	-	3	-	3
5	EEC	1	2	5	12	20
6	RMC	2	-	-	-	2
7	Non-Credit AC	0	0	-	-	0
Total		20	24	14	12	70

AUDIT COURSES (AC)

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**AC22101**	English for Research Paper Writing	AC	2	0	0	2	0
2	**AC22102**	Constitution of India	AC	2	0	0	2	0
3	**AC22201**	Disaster Management	AC	2	0	0	2	0
4	**AC22202**	நற்றமிழ் இலக்கியம்	AC	2	0	0	2	0

PROFESSIONAL ELECTIVE I – SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**SE22111**	Advanced Concrete Technology	PEC	3	0	0	3	3
2	**SE22112**	Prefabricated	PEC	3	0	0	3	3

		Structures						
3	**SE22113**	Prestressed Concrete Structures	PEC	3	0	0	3	3
4	**SE22114**	Mechanics of Composite Materials	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVES II– SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**SE22221**	Maintenance and Rehabilitation of Structures	PEC	3	0	0	3	3
2	**SE22222**	Design of Form Works	PEC	3	0	0	3	3
3	**SE22223**	Design of Steel Concrete Composite Structures	PEC	3	0	0	3	3
4	**SE22224**	Offshore Structures	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVES III – SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**SE22231**	Industrial Structures	PEC	3	0	0	3	3
2	**SE22232**	Wind and Cyclone Effects on Structures	PEC	3	0	0	3	3
3	**SE22233**	Nonlinear Analysis of	PEC	3	0	0	3	3

		Structures						
4	**SE22234**	Optimization of Structures	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVES IV– SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	T	P		
1	**SE22341**	Smart Materials and Smart Structures	PEC	3	0	0	3	3
2	**SE22342**	Design of Masonry Structures	PEC	3	0	0	3	3
3	**SE22343**	Design of Plates and Shells	PEC	3	0	0	3	3
4	**SE22344**	Digital Construction	PEC	3	0	0	3	3

PROFESSIONAL ELECTIVES V – SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	CATEGORY	PERIODS PER WEEK			TOTAL CONTACT PERIODS	CREDITS
				L	**T**	**P**		
1	**SE22351**	Structural Health Monitoring	PEC	3	0	0	3	3
2	**SE22352**	Performance of Structures with Soil Structure Interaction	PEC	3	0	0	3	3
3	**SE22353**	Design of Sub Structures	PEC	3	0	0	3	3
4	**SE22354**	Design of Bridges	PEC	3	0	0	3	3

MA22108	ADVANCED MATHEMATICAL METHODS FOR STRUCTURAL ENGINEERS	L	T	P	C
		3	1	0	4

COURSEOBJECTIVES:

- To familiarize the students with basic concepts of statistical tests, experimental designs and solution of equations
- To make the students with the techniques of statistical tests and design of experiments
- To familiarize the students with the techniques of Laplace transform and the application of solving partial differential equation
- To familiarize the students with the concept and the application of Fourier Transform techniques
- To acquaint the student with the basic concept of Tensor analysis and its applications

UNIT I	TESTING OF HYPOTHESIS	12

Statistical hypothesis - Type I and Type II errors - Large sample tests based on Normal distribution for single mean and difference of means -Tests based on t distribution for single mean and equality of means - Test based on F distribution for equality of variances - Chi square test for single variance and goodness of fit - Independence of attributes - Contingency table: Analysis of r c tables.

UNIT II	DESIGN OF EXPERIMENTS	12

General principles –Analysis of variances-Different designs of Blocks: One way classification: Completely Randomized Block Design (CBD)-two-way classifications: Randomized Block Design (RBD) –Three-way classification: Latin square design (LSD)-2-square factorial design – Taguchi – Concept of the loss function – Experiment design strategy.

UNIT III	LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS	12

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

UNIT IV	FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIALEQUATIONS	12

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

UNIT 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

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Define the basic concept of statistical tests, experimental designs, tensors,

	Laplace and Fourier transforms
CO2:	Discuss the techniques of statistical tests, design of experiments and tensor analysis
CO3:	Interpret Laplace and Fourier transform techniques inpartial differential equations
CO4:	Utilize the hypothesis test, design of experiments and tensor analysis in engineering disciplines
CO5:	Solve the boundary value problems using Laplace and Fourier transform techniques in engineering applications
REFERENCES:	
1.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 9th Edition, 2016.
2.	SankaraRao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt.Ltd, New Delhi, 1997.
3.	Andrews L.C. and Shivamoggi, B., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2009.
4.	Kay, D. C., "Tensor Calculus", Schaum's Outline Series, Tata McGraw Hill Edition, 2014.
5.	Ranjit K Raj, "A primer on the Taguchi method", Society of Manufacturing Engineers, Second edition, 2010.

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	2	2	-	-
CO2	1	-	2	2	-	-
CO3	1	-	2	2	-	-
CO4	1	-	2	2	-	-
CO5	1	-	2	2	-	-
Average	**1**	**-**	**2**	**2**	**-**	**-**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Testing of Hypothesis	2	1 either or	1(2)-CO1	1(2)-CO2	1either or (16)-CO4	-
Unit-II: Design of Experiments	2	1 either or	2(2)-CO1	-	1either or (16)-CO4	-
Unit-III: Laplace Transform Techniques for Partial Differential Equations	2	1 either or	1(2)-CO1	1(2)-CO3	1either or (16)-CO5	-
Unit-IV: Fourier Transform Techniques For Partial Differential equations	2	1 either or	1(2)-CO1	1(2)-CO3	1either or (16)-CO5	-

Unit-V: Tensor Analysis	2	1 either or	1(2)-CO1	1(2)-CO2	1either or (16)-CO4	1 either or (16) — CO5
Total Qns. Advanced Mathematical Methods for Structural Engineers	10	5 either or	6(2)	4(2)	5 either or (16)	-
Total Marks	20	80	12	8	80	16
Weightage	20%	80%	12%	8%	80%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	12	4	4	48	32
Weightage	12%	4%	4%	48%	32%

SE22102	THEORY OF ELASTICITY AND PLASTICITY	L	T	P	C
		3	1	0	4

COURSEOBJECTIVES:

- To understand the concept of 3D stress, strain analysis and its applications

UNIT I	ELASTICITY	12

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law, Beltrami Michell Equation - Navier's Equation.

UNIT II	2D STRESS STRAIN PROBLEMS	12

Plane stress and plane strain - Simple two dimensional problems in Cartesian and Polar Co-ordinates, Airy's Stress function, Introduction to photo elasticity.

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, Torsion of circular and non-circular sections (Ellipse, triangle and rectangle).

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 –Solution by Finite Differences, Boundary conditions - Applications to elasticity problems.

UNIT V	PLASTICITY	12

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

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Define Strain tensor, plane stress and strain, torsion, beams on elastic foundation and plasticity
CO2:	Describe the fundamentals of stress and strain, torsional behavior, beams on elastic foundation and plastic stress strain relationship

CO3:	Solve real life problems on plane stress and plane strain conditions, Circular and non-circular sections, bending of beams and elastic foundations.
CO4:	Analyse stress, strain, torsional behavior of sections, beams resting on elastic foundations and simple boundary value problems with elasto-plastic bending and torsion.
CO5:	Compare various theories of failure, torsional behavior of sections and methods of analysis of beam resting on elastic foundation.
REFERENCES:	
1.	Ansel.C.Ugural and Saul.K.Fenster, ”Advanced Strength and Applied Elasticity,” Fourth Edition, Prentice Hall Professional technical Reference, New Jersy, 2003.
2.	Chakrabarty.J, “Theory of Plasticity”, Third Edition, Elsevier Butterworth - Heinmann – UK, 2011.
3.	Jane Helena H, “Theory of Elasticity and Plasticity”, PHI Learning Pvt. Ltd., 2017.
4.	Slater R.A.C, “Engineering Plasticity”, John Wiley and Son, New York, 1977.
5.	Timoshenko, S. and GoodierJ.N."Theory of Elasticity", McGraw Hill Book Co., New York, 2017.

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	-	1	-	-
CO2	1	-	-	1	-	-
CO3	2	-	-	3	-	2
CO4	2	-	-	3	-	-
CO5	-	-	2	2	-	-
Average	**2**	**-**	**2**	**2**	**-**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Elasticity	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: 2d Stress Strain Problems	2	1 either or	1(2) - CO2	1(2) –CO2 1 either or (16) — CO2	-	-
Unit -III: Torsion of Non-Circular Section	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Beams on Elastic Foundations	2	1 either or	1(2) - CO4	1(2) — CO4	-	1 either or (16) — CO4
Unit-V: Plasticity	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5

Total Qns. Theory of Elasticity And Plasticity	10	5 either or	6(2)	4(2) 2 either or (16)	1 either or (16)	-
Total Marks	20	80	12	40	16	32
Weightage	20%	80%	12%	40%	16%	32%

Weightage for COs

	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22101	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	L	T	P	C
		3	0	2	4

COURSEOBJECTIVES:

- To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads

UNIT I	PRINCIPLES OF VIBRATION ANALYSIS	9

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	9

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	9

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, Generalized single degree of freedom system. Step-by-step numerical integration algorithms, Applications, Case studies in calculating the seismic response quantities of a SDOF as well as MDOF system for any Indian earthquake.

UNIT IV	INTRODUCTION TO EARTHQUAKE ENGINEERING	9

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 LearntFrom Past Earthquakes -Evaluation of Earthquake Forces as per codal provisions – ResponseSpectra, Design Spectra.

UNIT V	EARTHQUAKE RESISTANT DESIGN OF MASONRY AND RC STRUCTURES	9

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: 45 PERIODS	
LIST OF EXPERIMENTS	
•	Calculation of linear and non-linear seismic response quantities of an SDOF system based on any one of the numerical method algorithm in excel sheet
•	Construction of elastic as well as inelastic response spectrum for Indian earthquakes using Prism software.
•	MATLAB software application in calculating natural frequencies and mode shape of MDOF system and eventually its base shear and base moment
•	Earthquake response spectrum analysis of systems with distributed mass and elasticity
•	Dynamic analysis of system continua using finite element analysis.
TOTAL :30 PERIODS	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Gain knowledge on vibration analysis of system/structures with single degree of freedom as well as Multi degrees of freedom under free and forced vibration
CO2:	Derive a mathematical model of continuous system and do a dynamic analysis under free and forced vibration
CO3:	Explain the causes and effect of earthquake
CO4:	Design of masonry and RC structures as earthquake resistant
CO5:	Calculate Earthquake Forces as per codal provisions
REFERENCES:	
1.	Anil K.Chopra, Dynamics of Structures, Pearson Education, 2020.
2.	Leonard Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1986, IOS Press, 2006.
3.	Mario Pazv and William Leigh, Structural Dynamics: Theory and Computation, Springer; 5th Corrected ed. 2004. Corr. 2nd printing 2006 edition (3 June 2006) 2004.
4.	Roy R.Craig, Jr, Andrew J. Kurdila, Fundamentals of Structural Dynamics, John Wiley & Sons, 2011.
5.	Brebbia C. A.," Earthquake Resistant Engineering Structures VIII", WIT Press, 2015

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	-	3	2	3	1

CO2	1	-	3	2	1	1
CO3	2	-	3	2	3	2
CO4	3	-	3	3	-	2
CO5	2	-	3	2	3	2
Average	**2**	**-**	**3**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Principles of Vibration Analysis	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Dynamic Response of Multi-Degree of Freedom Systems	2	1 either or	2(2) - CO2	1 either or	(16) — CO2	-
Unit-III: Dynamic Response of Continuous Systems	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Introduction to Earthquake Engineering	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Earthquake Resistant Design of Masonry and Rc Structures	2	1 either or	2(2) – CO5		-	1 either or (16) — CO5
Total Qns. Structural Dynamics And Earthquake Engineering	10	5 either or	8(2)	2(2) 1 either or (18)	3 either or (16)	-
Total Marks	20	80	16	20	48	16
Weightage	20%	80%	16%	20%	48%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20 %

SE22103	**ADVANCED STRUCTURAL ENGINEERING LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSEOBJECTIVES:

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

LIST OF EXPERIMENTS

- Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
- Flow Characteristics of Self Compacting concrete.

- Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
- NDT on hardened concrete - UPV, Rebound hammer and core test.
- Permeability test on hardened concrete– Demonstration.
- Ultrasonic interferometer – ultrasonic velocity in liquids.
- Electrical conductivity of metals and alloys with temperature-four probe method.
- Deflection test on Beam.
- Compression test on column.

LIST OF EQUIPMENTS

- Strong Floor
- Loading Frame
- Hydraulic Jack
- Load Cell
- Proving Ring
- Demec Gauge
- Rebound Hammer
- Ultrasonic Pulse Velocity Tester
- Dial Gauges
- Four probe apparatus
- Compression testing machine
- L box apparatus
- J box apparatus
- LVDT

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Recall the basis of the design concrete mix which will satisfy the fresh and hardened concrete properties
CO2:	Explain the experimental methods to find the material properties.
CO3:	Apply suitable non-destructive testing for checking the strength of concrete.
CO4:	Apply the analytical techniques and graphical analysis to interpret the experimental data
CO5:	Analyze the effect of mineral admixtures in fresh and hardened concrete property

REFERENCES

1.	Dally J W, and Riley W F, “Experimental Stress Analysis”, McGraw-Hill Inc. New York,2000.
2.	Gambhir, M.L; ‘Concrete Technology”, 3 Edition, Tata McGraw Hill Publishing Co Ltd, New Delhi, 2013.
3.	1S10262-2009 Recommended Guidelines for Concrete Mix Design, Bureau of Indian Standards, New Delhi, 1998
4.	ACI 211.1: Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
5.	Shetty M.S., Concrete Technology, Revised Edition, S.Chand and Company Ltd. Delhi, 2018.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	2	1	-	2
CO2	3	-	2	-	2	2
CO3	1	2	2	2	3	2
CO4	3	3	2	2	-	2
CO5	2	1	2	2	2	2
Average	2	2	2	2	2	2

RM22101	RESEARCH METHODOLOGY	L	T	P	C
		2	0	0	2

COURSEOBJECTIVES:

- To give an overview of the research methodology and IPR, and explain the techniques of data collection and analysis

UNIT I	RESEARCH DESIGN	6

Overview of research process and design, Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys.

UNIT II	DATA COLLECTION AND SOURCES	6

Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.

UNIT III	DATA ANALYSIS AND REPORTING	6

Overview of Multivariate analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation.

UNIT IV	INTELLECTUAL PROPERTY RIGHTS	6

Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.

UNIT V	PATENTS	6

Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licenses, Licensing of related patents, patent agents, Registration of patent agents.

TOTAL: 30 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Outline the methodology of research
CO2:	Explain the research problem, data collection methods, IPR and patent
CO3:	Prepare a well-structured research paper, scientific presentations and patent

	applications
CO4:	Develop awareness on IPR, patent law and procedural mechanism in obtaining a patent
CO5:	Compare the methods of measurement scale, questionnaire, sampling and data analysis
REFERENCES:	
1.	Cooper Donald R, Schindler Pamela S and Sharma JK, "Business Research Methods", Tata McGraw Hill Education, 2012.
2.	Kothari C R, Gaurav Garg, "Research Methodology- Methods and Techniques" New Age International Publishers, 2019.
3.	Catherine J. Holland, "Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets", Entrepreneur Press, 2007.
4.	David Hunt, Long Nguyen, Matthew Rodgers, "Patent searching: tools & techniques", Wiley, 2007.
5.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, "Professional Programme Intellectual Property Rights, Law and practice", September 2013.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	-	3	-	-	-
CO2	-	-	3	-	-	-
CO3	-	2	3	-	-	-
CO4	-	-	3	-	-	-
CO5	-	-	3	-	-	2
Average	**-**	**2**	**3**	**-**	**-**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Research Design	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Data Collection and Sources	2	1 either or	2(2) - CO2		1 either or (16) — CO2	-
Unit-III: Data Analysis and Reporting	2	1 either or	1(2) — CO3	1(2) — CO3		1 either or (16) — CO3
Unit-IV: Intellectual Property Rights	2	1 either or	2(2) - CO4		1 either or (16) — CO4	-
Unit -V: Patents	2	1 either or	1(2) – CO5	1(2) — CO5 1 either or	-	

				(16) — CO5		
Total Qns. Research Methodology	10	5 either or	8(2)	2(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	16	36	32	16
Weightage	20%	80%	16%	36%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22104	TECHNICAL SEMINAR	L	T	P	C
		0	0	2	1

COURSEOBJECTIVES:

- 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

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Identify latest developments in the field of Structural Engineering
CO2:	Develop technical writing abilities for seminars, conferences and journal publications
CO3:	Make use of modern tools to present the technical details

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	3	-	-	3
CO2	-	3	1	-	-	3
CO3	-	-	1	-	-	3
Average	3	3	2	-	-	3

SE22201	ADVANCED STEEL STRUCTURES	L	T	P	C
		3	1	0	4

COURSEOBJECTIVES:

- To study the behaviour of members and connections, analysis and design of Industrial buildings and roofs, chimneys. 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. Design of Side rails.

UNIT II	**DESIGN OF CONNECTIONS**	**12**

Types of connections – Welded and Bolted – Throat and Root Stresses in Fillet Welds – Column splices-Tension Splices -- Seated Connections – Unstiffened and Stiffened seated Connections – Moment Resistant Connections – Clip angle Connections – Split beam Connections – Framed Connections HSFG bolted connections.

UNIT III	**ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS**	**12**

Analysis and design of different types of trusses – Wind load analysis - Calculation of wind load and its combination - Analysis and design of industrial buildings – Sway and non sway frames – Aseismic design of steel buildings - Design of plate Girder.

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 – Hunched Connections- Design of continuous beams.

UNIT V	**DESIGN OF LIGHT GAUGE STEEL STRUCTURE**	**12**

Introduction to Direct Strength Method - Cold formed light gauge section - Type of cross sections - stiffened - multiple stiffened and unstiffened element. - 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

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Knowledge in the behaviour of structural elements in the industrial structures subjected to different forces
CO2:	Interpret the basic concepts in the design of structural members subjected to combined forces
CO3:	Choose an appropriate method to design the structural elements and joints of steel structures
CO4:	Analyze the plastic behavior of industrial structures, light gauge steel structures and design the structural elements subjected to different loading conditions
CO5:	Evaluate the plastic moment, design strength and failure stress in the structural elements

REFERENCES:

1.	Subramanian.N, Design of Steel Structures, Oxford University Press, 2014.
2.	Duggal, “Design of Steel Structures”, Tata McGraw-Hill Education, 2019.
3.	Lynn S. Beedle, Plastic Design of Steel Frames, John Wiley and Sons, 1997.
4.	Narayanan.R.et.al., Teaching Resource on Structural steel Design, INSDAG, Ministry of Steel Publishing,2000.

5.	Wie Wen Yu, Design of Cold Formed Steel Structures, McGraw Hill Book Company,1996

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	2	-	1
CO2	1	2	1	2	-	1
CO3	3	2	3	3	2	2
CO4	2	2	3	3	2	2
CO5	2	2	2	2	-	2
Average	2	2	2	2	2	2

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: General	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Design of Connections	2	1 either or	1(2) - CO2	1(2) - CO2 1 either or (16) — CO2	-	-
Unit-III: Analysis and Design of Industrial Buildings	2	1 either or	1(2) — CO3	1(2) — CO3	-	1 either or (16) — CO3
Unit-IV: Plastic Analysis of Structures	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit -V: Design of Light Gauge Steel Structure	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Advanced Steel Structures	10	5 either or	6(2)	4(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	12	40	16	32
Weightage	20%	80%	12%	40%	16%	32%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22203	STABILITY OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

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

UNIT I	BUCKLING OF COLUMNS	9

States of equilibrium - Classification of buckling problems - concept of equilibrium,

energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - Effect of shear on buckling.		
UNIT II	**BUCKLING OF BEAM-COLUMNS AND FRAMES**	**9**
Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway – Use of stability function to determine the critical load.		
UNIT III	**TORSIONAL AND LATERAL BUCKLING**	**9**
Torsional buckling – Combined Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported and cantilever beams. St Venant torsion and non-uniform torsion, Rayleigh-Ritz method for torsional flexural buckling of column.		
UNIT IV	**BUCKLING OF PLATES**	**9**
Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach – Finite difference method. Shell buckling: Solution of Donnell's equation, Shell buckling by using finite deflection theory, Post buckling of axially compressed cylindrical shell panel.		
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, Linear and non Linear Eigen Value problems-Buckling problem orthogonality relation –Ritz method-Timoshenko method, Galerkin method.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
Upon completion of the course, the students will.../ will be able to...		
CO1:	State the buckling effect of structural elements by various approaches	
CO2:	Describe the mathematical problems in structural elements	
CO3:	Apply differential equation and different methods in structural elements	
CO4:	Analysis the buckling effect of beam, column, and plate	
CO5:	Create to communicate inelastic behavior of different methods	
REFERENCES:		
1.	Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003.	
2.	Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.	
3.	Gambhir, "Stability Analysis and Design of Structures", springer, New York, 2004.	
4.	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.	

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6

CO1	3	1	1	3	-	-
CO2	3	2	3	3	1	-
CO3	3	3	3	3	1	-
CO4	3	1	3	3	2	-
CO5	3	1	1	3	3	3
Average	**3**	**2**	**2**	**3**	**2**	**3**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Buckling of Columns	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Buckling of Beam-Columns And Frames	2	1 either or	1(2) - CO2	1(2) - CO2 1 either or (16) — CO2	-	-
Unit-III: Torsional and Lateral Buckling	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Buckling of Plates	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Inelastic Buckling	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Stability Of Structures	10	5 either or	6(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	12	40	32	16
Weightage	20%	80%	12%	40%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22204	**ADVANCED CONCRETE STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

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

UNIT I	**DESIGN PHILOSOPHY**	**9**

Limit state design - Review of limit state design - Serviceability limit states - beams, slabs and columns according to IS Codes. Calculation of deflection and crack width according to IS Code. Interaction curve generation for axial force and bending.

UNIT II	**DESIGN OF SPECIAL RC ELEMENTS**	**9**

Design of slender columns - Design of plain concrete walls- Design of RC walls. Strut and

tie method of analysis for corbels and deep beams, Design of corbels, Deep-beams and grid floors.		
UNIT III	**FLAT SLABS AND YIELD LINE BASED DESIGN**	**9**
Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and Hillerborg's strip method of design of slabs. Direct design method - Equivalent frame method - Shear in Column.		
UNIT IV	**INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS**	**9**
Inelastic behaviour of concrete beams and Baker's method, moment - rotation curves, ductility definitions, evaluation.		
UNIT V	**DUCTILE DETAILING**	**9**
Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames. Flexural yielding in frames and walls- Quality control of concrete.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	State the properties and behaviour of concrete elements
CO2:	Describe the structural and inelastic behaviour of beams, columns, corbels, RC walls, deep beams, grid floors and Flat slab
CO3:	Design Flexural, compression and special RC elements
CO4:	Analyse the concrete elements to provide a safe construction
CO5:	Estimate the deflection, crack width, moment, shear and ductility of the concrete elements

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.	UnnikrishnaPillai and DevdasMenon "Reinforced Concrete Design', Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2007.
4.	Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2005.
5.	Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2007.

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**

CO1	1	-	2	2	-	-
CO2	2	-	3	2	-	-
CO3	2	-	-	3	-	-
CO4	2	-	3	3	-	-
CO5	2	-	3	3	-	-
Average	**2**	**-**	**3**	**3**	**-**	**-**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Design Philosophy	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Design of Special RC Elements	2	1 either or	1(2) - CO2	1(2) - CO2	1 either or (16) — CO2	-
Unit-III: Flat Slabs and Yield Line Based Design	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Inelastic Behaviour of Concrete Beams and Columns	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Ductile Detailing	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Advanced Concrete Structures	10	5 either or	6(2)	4(2) 1 either or (16)	3 either or (16)	-
Total Marks	20	80	12	24	48	16
Weightage	20%	80%	12%	24%	48%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22202	**FINITE ELEMENT ANALYSIS OF STRUCTURES**	**L**	**T**	**P**	**C**
		3	**0**	**2**	**4**

COURSEOBJECTIVES:

- 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	**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	**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

LIST OF EXPERIMENTS	
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 of structure using FEM.
	TOTAL: 30 PERIODS

COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	State the basics of finite element analysis, its approximation, tackling errors induced and the step by step procedure involved in analysing various structures
CO2:	Describe the pioneer methods to finite element analysis and their comparison
CO3:	Apply the finite element analysis procedure on various structures in order to calculate the internal forces
CO4:	Analyze the results by varying the various parameters
CO5:	Evaluate the static as well as dynamics performances of various structures using any finite element analysis software

REFERENCES:	
1.	David Hutton, “Fundamentals of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
2.	C. Krishnamoorthy, “Finite Element Analysis: Theory and Programming”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2017.
3.	Logan D. L.,A First Course in the Finite Element Method, Thomson-Engineering, 3rd edition, 2001.
4.	Zienkiewicz, O.C. and Taylor, R.L., “The Finite Element Method”, Seventh Edition, McGraw – Hill, 2013.
5.	Chandrupatla, R.T. and Belegundu, A.D., “Introduction to Finite Elements in

	Engineering", Fourth Edition, Prentice Hall of India, 2015.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	-	3	1	-	1
CO2	1	-	3	1	-	1
CO3	1	3	3	2	1	3
CO4	1	3	3	2	1	3
CO5	3	3	3	3	3	3
Average	1	3	3	2	2	2

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Element Properties	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Analysis of Frame Structures	2	1 either or	1(2) — CO3	1(2) — CO3	-	1 either or (16) — CO3
Unit-IV: Two and Three Dimensional Solids	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Applications Of Fem	2	1 either or	1(2) – CO5	1(2) — CO5	1 either or (16) — CO5	-
Total Qns. Finite Element Analysis of Structures	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22205	STRUCTURAL DESIGN LABORATORY	L	T	P	C
		0	0	4	2

COURSEOBJECTIVES:

- The students individually design a structure using modern software tools available like ETABS, STAAD, etc. and present it in the form of a complete detailed drawing

SYLLABUS

Students have to work individually with standard codes, computational tools and software packages for analysing, designing and detailing a structure. A detailed report on the work

done shall be submitted by individual students in the form of a report and presentation.	
TOTAL: 60 PERIODS	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Knowledge in the design of framed structure subjected to loads and load combination, basic concepts in the design of structural members subjected to combined forces
CO2:	Choose an appropriate method to design the structural elements and framed structures
CO3:	Design and detail structures using computer software/tools and check the correctness using manual approximate methods
CO4:	Analyze the structure for various loads and load combination according to the relevant IS Codes
CO5:	Evaluate the forces acting, design strength and failure stress in the structural elements

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	-	-	1
CO2	2	2	3	3	3	2
CO3	2	2	3	3	3	2
CO4	2	2	3	3	2	2
CO5	2	3	1	2	2	2
Average	**2**	**2**	**2**	**3**	**2**	**2**

RM22201	**RESEARCH TOOL LABORATORY**	**L**	**T**	**P**	**C**
		0	**0**	**4**	**2**

COURSEOBJECTIVES:

- To familiarize the fundamental concepts/techniques for Project Management
- To familiarize the journal paper formatting using suitable Software
- To familiarize the software for literature review and Bibliography
- To find the plagiarism percentage of article contents
- To prepare a quality research report and the presentation

LIST OF EXPERIMENTS

- Use of tools / Techniques for Research - Project management -Microsoft Project / Microsoft OneNote / Asana
- Hands on Training related to Software for Paper Formatting like LaTeX / MS Office
- Design a Layout of a Research Paper - Guidelines for Submitting the Research Paper - Review Process -Addressing Reviewer Comments.
- Introduction to Data Analysis Software - Origin SPSS, ANOVA etc.,
- Introduction to Software for detection of Plagiarism – Urkund, Turniton
- Preparing Bibliography / Different Reference Formats. – EndNote, Mently

- Format of Project Report - Use of Quotations - Method of Transcription- Elements: Title Page - Abstract - Table of Contents - Headings and Sub-Headings - Footnotes - Tables and Figures
- Introduction to Microsoft Excel –for Research Analysis
- Presentation using PPTs.
- Data analysis using Matlab

TOTAL: 60 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	List the various stages in research and develop systematic planning of project stages
CO2:	Write a journal paper and formulate as per the standard journal format
CO3:	Develop a literature review and relevant references for a research problem using suitable software
CO4:	Determine the plagiarism of the article / report content by using the Software
CO5:	Compile a research report and the presentation

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	-	2	-
CO2	2	3	-	-	-	-
CO3	-	2	-	-	-	-
CO4	-	2	-	-	-	-
CO5	-	3	-	-	-	2
Average	**2**	**2**	**-**	**-**	**2**	**2**

SE22301	**PRACTICAL TRAINING**	**L**	**T**	**P**	**C**
		0	**0**	**0**	**2**

COURSEOBJECTIVES:

- To train the students in the field work so as to have first-hand 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.

TOTAL: 120 PERIODS

COURSE OUTCOMES:

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

CO1:	Describe the Structural Engineering organization.
CO2:	Realize the various functions of construction activities.
CO3:	Apply the theoretical concepts in carrying out engineering tasks.

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	2	3	3	3	2	3
CO2	2	3	3	3	2	3
CO3	2	3	3	3	2	3
CO	2	3	3	3	2	3

SE22302	**PROJECT PHASE I**	**L**	**T**	**P**	**C**
		0	**0**	**6**	**3**

COURSE OBJECTIVES:

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

SYLLABUS

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

TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

CO1	Develop the ability to solve a specific problem right from its identification and literature review till the successful solution and prepare project reports.

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	3	3	3	-
CO	3	3	3	3	3	-

SE22401	PROJECT PHASE II	L	T	P	C
		0	0	24	12

COURSEOBJECTIVES:

- 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 / Undergo internship. 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 based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 360 PERIODS

COURSE OUTCOMES:

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

CO1	Discover potential research areas in the field of Structural Engineering about the knowledge gained from theoretical and practical courses to be creative, well planned, organized and coordinated, and present the findings of the work conducted by report.

Mapping of Course Outcomes to Programme Outcomes

Course outcomes	PO					
	1	2	3	4	5	6
CO1	3	3	3	3	3	3
CO	3	3	3	3	3	3

PROFESSIONAL ELECTIVE COURSES

SE22111	ADVANCED CONCRETE TECHNOLOGY	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

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

UNIT I	PROPERTIES OF FRESH AND HARDENED CONCRETE	9

Workability-Factors affecting workability- tests to measure workability, Compressive strength, spilt tensile strength, flexural strength, modulus of elasticity-Test procedures-effect of w/c ratio.

UNIT II	CREEP AND SHRINKAGE OF CONCRETE	9

Factors affecting creep – effects of concrete, Factors affecting shrinkage – Plastic

shrinkage, drying shrinkage, autogenous shrinkage, carbonation shrinkage –effects		
UNIT III	**DURABILITY OF CONCRETE**	**9**
Permeability-Correction-Carbonation-Chloride Penetration-Sulphate attack–acid attack– Fire resistance – Frost damage – alkali silica reaction – Penetration test – Rebound hammer test – Ultra pulse velocity method, Pull out test.		
UNIT IV	**STATISTICAL QUILITY CONTROL OF CONCRETE**	**9**
Mean strength-standard deviation- coefficient of variation- Sampling-testing-acceptance criteria		
UNIT V	**SPECIAL TOPIC IN CONCRETE TECHNOLOGY**	**9**
Special concrete: Self Compaction concrete-Fibre reinforced concrete-Ready mix concrete-Geo polymer concrete-Green concrete-lightweight concrete. Special Process: Under water concreting-cold weather concrete-hot weather concreting-mass concrete.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Define the materials used in construction, test on concrete, special types of concrete and various concreting methods
CO2:	Describe the materials used in construction, test on concrete and special types of concrete
CO3:	Apply the rules in the mix proportion of concrete
CO4:	Identify the special types of concrete and their applications
CO5:	Examine the properties of concrete, concreting methods
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, London, 2012.
4.	Shetty M.S., Concrete Technology, Revised Edition, S.Chand and Company Ltd. Delhi, 2018.
5.	Job Thomas., Concrete Technology, Cencage learning India Private Ltd, New Delhi, 2015.

Mapping of Course Outcomes to Programme Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	3	-	-
CO2	3	2	3	3	1	-
CO3	3	-	-	3	-	-
CO4	3	-	-	3	-	-
CO5	3	3	1	3	-	3
Average	**3**	**3**	**2**	**3**	**1**	**3**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Properties of Fresh and Hardened Concrete	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Creep and Shrinkage of Concrete	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Durability of Concrete	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Statistical Quality Control of Concrete	2	1 either or	1(2) - CO4	1(2) — CO4		1 either or (16) — CO4
Unit-V: Special Topic in Concrete Technology	2	1 either or	1(2) – CO5	1(2) — CO5	1 either or (16) — CO5	
Total Qns. Advanced Concrete Technology	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22112	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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, Lateral load resistance, Location and types of shear walls.

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, staircase slab design, types of roof slabs and insulation requirements, Description of joints, their behaviour and reinforcement requirements, Deflection control for short term and long term loads, Ultimate strength calculations in shear and flexure.

UNIT IV	WALLS	9
Types of wall panels, Blocks and large panels, Curtain, Partition and load bearing walls, load transfer from floor to wall panels, vertical loads, Eccentricity and stability of wall panels, Design Curves, types of wall joints, their behaviour and design, Leak prevention, joint sealants, sandwich wall panels, approximate design of shear walls.		
UNIT V	**INDUSTRIAL BUILDINGS AND SHELL ROOFS**	**9**
Components of single-storey industrial sheds with crane gantry systems, R.C. Roof Trusses, Roof Panels, corbels and columns, wind bracing design. Cylindrical, Folded plate and hyper- prefabricated shells, Erection and jointing, joint design, hand book based design.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
Upon completion of the course, the students will.../ will be able to...		
CO1:	State the standardization, structural components, joints and tolerance system of prefabrication	
CO2:	Demonstrate the production, construction of structural members, detailing and codal provisions	
CO3:	Summarize the effects of abnormal loads and codal provisions	
CO4:	Differentiate the erection processes, large panel construction and joint flexibility in prefabrication	
CO5:	Interpret the Design principles of the structural members, expansion joints, connections and abnormal loads	
REFERENCES:		
1.	Koncz.T., Manual of Precast Concrete Construction, Vol. I II and III & IV Bauverlag, GMBH, 1976.	
2.	Laszlo Mokk, Prefabricated Concrete for Industrial and Public Structures,Akademiai Kiado, Budapest,2007.	
3.	Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York, 1998.	
4.	Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precast Concrete, Netherland BetorVerlag, 2009.	
5.	Warszawski, A., Industrialization and Robotics in Building - A managerial approach, Harper and Row, 1990.	

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	1	-	-	1
CO2	1	-	-	2	2	1
CO3	2	2	1	1	2	2
CO4	2	2	2	3	2	2
CO5	2	2	2	3	2	3
Average	**1**	**1**	**1**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Design Principles	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Reinforced Concrete	2	1 either or	1(2) - CO2	1(2) - CO2	1 either or (16) — CO2	-
Unit-III: Floors, Stairs and roofs	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Walls	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Industrial Buildings and Shell Roofs	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Prefabricated Structures	10	5 either or	6(2)	4(2) 1 either or (16)	3 either or (16)	-
Total Marks	20	80	12	24	48	16
Weightage	20%	80%	12%	24%	48%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22113	PRESTRESSED CONCRETE STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To study the 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 – Constituent materials and their properties, Analysis methods, losses of prestress – Short and Long term deflections – Cable layouts – Camber

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 – Design of end blocks

UNIT III	DESIGN OF CONTINUOUS BEAMS	9

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

UNIT 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	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	State the basic concepts of prestressing, methods of achieving continuity and partial prestressing
CO2:	Understand the fundamentals of prestressing, deflection and losses in prestressed concrete members
CO3:	Design the flexural members, tension and compression embers and continuous beams
CO4:	Analyse the tension and compression members and composite members
CO5:	Evaluate the stresses in prestressed concrete members
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.andBurns.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.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	-	-	-	-
CO2	2	-	-	-	-	-
CO3	2	-	3	3	-	-
CO4	2	-	3	3	2	-
CO5	2	-	3	3	2	-
Average	**2**	**-**	**3**	**3**	**2**	**-**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Principles of Prestressing	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Design of Flexural Members	2	1 either or	1(2) - CO2	1(2) - CO2 1 either or (16) — CO2	-	-

Unit-III: Design of Continuous Beams	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Design of Tension and Compression Members	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Design of Composite Members	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Prestressed Concrete Structures	10	5 either or	6(2)	4(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	12	40	32	16
Weightage	20%	80%	12%	40%	32%	16%

Weightage for COs

	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22114	MECHANICS OF COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To impart knowledge on the characteristics of composite materials and effect of reinforcement in composite materials, its manufacturing process and strength analysis

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. Classification – mechanical behavior – basic terminology – manufacture – advantages

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	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Define the characteristics of composite materials and effect of reinforcement in composite materials
CO2:	Classify the different types of various reinforcements used in composite materials and the manufacturing processes of metal matrix composites
CO3:	Choose a reinforcement material for making destined composite strength
CO4:	Solve a repair work by using composites materials
CO5:	Motivate research on composites and suggest such materials for current practice
REFERENCES:	
1.	Gibson, R.F., "Principles of Composite Material Mechanics", McGraw-Hill Inc, 4th edition, 2016.
2.	Hyer, M.W., "Stress Analysis of Fiber – Reinforced Composite Materials", McGraw Hill, 2008.
3.	Issac M. Daniel and OriIshai, "Engineering Mechanics of Composite Materials", Oxford University Press-2006, First Indian Edition – 2007
4.	Mallick, P.K., Fiber, "Reinforced Composites: Materials, Manufacturing and Design", Maneel Dekker Inc, 1993.
5.	Daniel. I.M, and Ishai. O, "Engineering Mechanics of Composite Materials", Second Edition, Oxford University Press, 2005.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	-	-	-	-
CO2	1	-	-	-	-	-
CO3	2	2	2	2	1	2
CO4	2	1	2	2	1	2
CO5	3	2	2	2	1	2
Average	**2**	**1**	**2**	**2**	**1**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Reinforcements	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Manufacturing of Metal Matrix	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-

Composites						
Unit-IV: Manufacturing of Polymer Matrix Composites	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Strength	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Mechanics of Composite Materials	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs

	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22221	MAINTENANCE AND REHABILITATION OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To study the damages, repair and rehabilitation of structures

UNIT I	INTRODUCTION	9

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal- Assessment procedure for evaluating a damaged structure. Building cracks- Causes – diagnosis – Thermal and Shrinkage cracks – unequal loading – Vegetation and trees – Chemical action – Foundation movements – Remedial measures - Techniques for repair – Epoxy injection- grouting, shoring and underpinning.

UNIT II	MOISTURE PENETRATION	9

Sources of dampness – Moisture movement from ground – Reasons for ineffective DPC – Roof leakage – Pitched roofs – Madras Terrace roofs – Membrane treated roofs - Leakage of Concrete slabs – Dampness in solid walls – condensation – hygroscopic salts – remedial treatments – Ferro cement overlay – Chemical coatings – Flexible and rigid coatings. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection.

UNIT III	DISTRESSES AND REMEDIES	9

Concrete Structures: Introduction – Causes of deterioration – Diagnosis of causes – Flow charts for diagnosis – Materials and methods of repair – repairing, spalling and disintegration – Repairing of concrete floors and pavements.

Steel Structures : Types and causes for deterioration – preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Design of protect against corrosion – Design and fabrication errors – Distress during erection.

UNIT IV	MASONRY STRUCTURES AND RETROFITTING	9

Masonry Structures: Discoloration and weakening of stones – Biotical treatments

Preservation – Chemical preservatives – Brick masonry structures – Distresses and remedial measures. Repair of structures distressed due to earthquake – Strengthening using FRP - Strengthening and stabilization techniques for repair - Types of demolition techniques - Engineered demolition techniques for structures.		
UNIT V	**STRENGTHENING OF EXISTINGSTRUCTURES**	**9**
General principle – relieving loads – Strengthening super structures – plating Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening substructures – under pinning – Enhancing the load capacity of footing – Design for rehabilitation.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
Upon completion of the course, the students will.../ will be able to...		
CO1:	List the importance of maintenance, effects in structures due to climate and temperature variations, techniques for repair and their protection methods	
CO2:	Demonstrate the causes for deterioration and the repairing techniques to improve the service life of the structures elements	
CO3:	Identify the damaged structure and maintain the engineering structures safely and effectively	
CO4:	Discriminate suitable type of strengthening techniques to the structures and the modern techniques for the demolition of large and hazardous structure in safe manner	
CO5:	Survey the quality and durability of concrete and adopt suitable repair techniques and protection methods	
REFERENCES:		
1.	Allen R.T and Edwards S.C, "Repair of Concrete Structures", CRC Press, 2019.	
2.	Dayaratnam.P and Rao.R, "Maintenance and Durability of Concrete Structures", Universities Press, India, 1997.	
3.	Dodge Woodson.R, "Concrete Structures – protection, repair and rehabilitation", Elsevier Butterworth – Heinmann, UK, 2011.	
4.	Hand book on seismic retrofit of Building by CPWD and IIT Madras, 2003.	
5.	Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications Pvt. Ltd., 2002.	

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	-	-	1
CO2	2	2	2	-	-	1
CO3	3	2	2	2	2	2
CO4	3	2	2	2	1	2
CO5	3	2	2	2	1	3
Average	**2**	**2**	**2**	**2**	**1**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Moisture Penetration	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Distresses and Remedies	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Masonry Structures And Retrofitting	2	1 either or	1(2) - CO4	1(2) — CO4	-	1 either or (16) — CO4
Unit-V: Strengthening Of existing structures	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Maintenance And Rehabilitation of Structures	10	5 either or	7(2)	3(2) 2 either or (16)	1 either or (16)	2 either or (16)
Total Marks	20	80	14	38	16	32
Weightage	20%	80%	14%	38%	16%	32%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22222	DESIGN OF FORM WORKS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Recognize the importance of proper formwork, accessories design and its failure.
CO2:	Summarize different forms of form work for Beams, Slabs, columns, Walls and Foundations.
CO3:	Design the form work for Foundations, Walls, Columns, Slab and Beams.
CO4:	Design the form work for Special Structures.
CO5:	Determine the selection, design and failure of formwork through case studies.
REFERENCES:	
1.	R. L. Peurifoy and Garold D. Oberlender., "Formwork for Concrete Structures", , McGraw Hill India, 2011.
2.	Kumar Neerajha, "Formwork for Concrete Structures", 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.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	-	2	3	3	2	2
CO2	1	-	1	2	2	3
CO3	1	1	-	3	2	3
CO4	-	2	1	2	3	1
CO5	1	-	2	2	1	3
Average	**1**	**2**	**2**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Formwork Materials and Types	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Formwork Design	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-

Unit-IV: Formwork Design for Special Structures	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Formwork Failures	2	1 either or	1(2) – CO5	1(2) — CO5		1 either or (16) — CO5
Total Qns. Design of Form Works	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	1 either or (16)
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%%	16%

Weightage for COs

	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22223	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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, theory of composite structures

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. Deck slab – encased columns – in filled columns subjected to Uni-axial & Bi-axial.

UNIT IV	COMPOSITE BOX GIRDER BRIDGES	9

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

UNIT V	CASE STUDIES	9

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

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	State the design concrete composite elements and structures
CO2:	Explain the behavior of concrete composite elements and structures
CO3:	Design the connections of composite structures
CO4:	Apply the concept in design of composite beams, columns, trusses and box girder bridges
CO5:	Analysis the position to design composite beams, columns, trusses and box -

	girder bridges including the related connections
REFERENCES:	
1.	Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2019.
2.	Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behaviour", Pergamon press, Oxford, 2013.
3.	Owens.G.W and Knowles.P, "Steel Designers Manual", Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.
4.	HarshadBhandari, " Analysis and Design of Steel and Composite Structures" Scitus Academics LLC (Publisher), 2016.
5.	Teaching resource for, "Structural Steel Design," Volume 2 of 3, Institute for Steel Development and Growth (INSDAG), 2002.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	3	-	-
CO2	3	2	3	3	-	-
CO3	3	3	2	3	-	-
CO4	3	3	1	3	3	2
CO5	3	3	3	3	3	2
Average	**3**	**3**	**2**	**3**	**3**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Design of Composite Members	2	1 either or	2(2) – CO1		-	1 either or (16) — CO4
Unit-III: Design of Connections	2	1 either or	1(2) — CO2	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Composite Box Girder Bridges	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Case Studies	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Design of Steel Concrete Composite Structures	10	5 either or	7(2)	3(2) 1 either or (16)	2 either or (16)	2 either or (16)
Total Marks	20	80	14	32	32	32
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	8	18	18	38	20
Weightage	8%	20%	18%	38%	20%

SE22224	OFFSHORE STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To study the concept of wave theories, forces and design of jacket towers, pipes and cables

UNIT I	WAVE THEORIES	9

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

UNIT II	FORCES OF OFFSHORE STRUCTURES	9

Wind forces, wave forces on Vertical, Inclined cylinders, structures- small bodies and large bodies - current forces - Morison equation.

UNIT III	OFFSHORE SOIL AND STRUCTURE MODELLING	9

Introduction – Offshore soil -Different types of offshore structures, foundation modeling, fixed jacket platform structural modelling.

UNIT IV	ANALYSIS OF OFFSHORE STRUCTURES	9

Introduction – Procedure & concept of Static method of analysis, foundation analysis and dynamics of offshore structures.

UNIT V	DESIGN OF OFFSHORE STRUCTURES	9

Introduction – offshore structure Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.

TOTAL:45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Illustrate the wave interaction and design of offshore structure.
CO2:	Explain the basic theoretical concepts in offshore engineering and apply them to actual problems
CO3:	Execute the calculation of wave forces on fixed and floating structures and calculate the dynamic response
CO4:	Describe the use of design codes to check the capacity of structural members
CO5:	Perform computer simulations, thus being prepared for the practical needs of the industry

REFERENCES:

1.	James F. Wilson, Dynamics of Offshore Structures, John Wiley & Sons, Inc, 2003.
2.	Reddy.D.V and Swamidas A.S.J.,Essential of offshore structures. CRC Press.2013.
3.	TurgutSarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.

4.	Mohamed Abdallah El-Reedy "Off Shore Structures" Gulf Professional Publication, 2012.
5.	Chandrasekaran, S. 2017. Dynamic Analysis and Design of Ocean Structures.

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	-	2	2
CO2	2	2	1	1	2	3
CO3	2	2	1	2	2	3
CO4	1	1	-	2	-	2
CO5	2	3	3	3	2	3
Average	2	2	1	2	2	3

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Wave Theories	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Forces Of offshore Structures	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Offshore Soil and Structure Modelling	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Analysis Of offshore Structures	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Design Of offshore Structures	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Offshore Structures	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	1 either or (16)
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22231	INDUSTRIAL STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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, Roofs for Industrial Buildings - Machine foundations		
UNIT III	**POWER PLANT STRUCTURES**	**9**
Types of power plants – Containment structures - Cooling Towers - Bunkers and Silos - Pipe supporting structures – Design of Turbo generator foundation		
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. Introduction – Transmission Line Towers - Substation Structures - Tower Foundations – Testing Towers		
UNIT V	**FOUNDATION**	**9**
Design of foundation for Towers, Chimneys and Cooling Towers - Machine Foundation - Design of Turbo Generator Foundation.		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	State the properties and behaviour of industrial structures
CO2:	Describe the structural behaviour of Industrial structures
CO3:	Design the structural component of Industrial structure both steel and concrete
CO4:	Analyse the structural component of Industrial structure both steel and concrete
CO5:	Check the deflection, crack width, bending moment for industrial structures

REFERENCES:

1.	Jurgen Axel Adam, KatharriaHausmann, 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

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	1	2	-	-
CO2	2	-	1	3	-	-
CO3	2	-	1	-	-	-
CO4	2	-	-	3	-	-
CO5	2	-	3	3	-	-
Average	**2**	**-**	**1**	**3**	**-**	**-**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Planning and Functional Requirements	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Industrial Buildings	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Power Plant Structures	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Transmission Line Structures and Chimneys	2	1 either or	1(2) - CO4	1(2) — CO4	-	1 either or (16) — CO4
Unit-V: Foundation	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Industrial Structures	10	5 either or	7(2)	3(2) 2 either or (16)	1 either or (16)	2 either or (16)
Total Marks	20	80	14	38	16	32
Weightage	20%	80%	14%	38%	16%	32%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22232	WIND AND CYCLONE EFFECTS ON STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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 Application to design, IS 875 code method, Roofs, Shelters & Plates

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, Window glass design and procedure.		
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

COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Summarize the characteristics of wind and effects of wind on structures
CO2:	Describe the behaviour of wind and cyclone effects on various types of structures and wind tunnel studies
CO3:	Design high rise structures subjected wind load, even structures exposed to cyclone
CO4:	Analyse the effects of wind and cyclone on low rise and tall buildings
CO5:	Examine the static and dynamic effects on flexible and rigid structures through wind tunnel studies
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.
5.	Emil Simiu , DongHun Yeo "Wind Effects on Structures: Modern Structural Design for Wind", Wiley-Blackwell; 4th edition (1 March 2019).

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	3	1	3	-	-
CO2	3	2	3	3	-	-
CO3	3	3	2	3	-	-
CO4	3	3	1	3	3	2
CO5	3	2	3	3	3	2
Average	**3**	**3**	**2**	**3**	**3**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			

Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Effect of Wind on Structures	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Design of Special Structures	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Cyclone Effects	2	1 either or	1(2) - CO4	1(2) — CO4		1 either or (16) — CO4
Unit-V: Wind Tunnel Studies	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Wind and Cyclone Effects on Structures	10	5 either or	7(2)	3(2) 2 either or (16)	1 either or (16)	2 either or (16)
Total Marks	20	80	14	38	16	32
Weightage	20%	80%	14%	38%	16%	32%

Weightage for COs

	CO 1	CO 2	CO 3	CO 4	CO 5
Total Marks	20	20	20	20	20
Weightage	20 %	20%	20%	20%	20 %

SE22233	NONLINEAR ANALYSIS OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To study the concept of non-linear behaviour and analysis of elements and simple structures

UNIT I	INTRODUCTION TO NON-LINEAR ANALYSIS	9

Material non-linearity, geometric non-linearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness. Nonlinear governing Equation for beams: moment-Curvature nonlinearity, geometric nonlinearity due to stretching, material nonlinearity - geometrically nonlinear beam problems - Cantilever beam: Moment-curvature nonlinearity - Centrally loaded beam with two supports - Cantilever beam subjected to tip load.

UNIT II	INELASTIC ANALYSIS OF FLEXURAL MEMBERS	9

Inelastic analysis of uniform and variable thickness members subjected to geometric and material non-linearity; 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	NON-LINEAR VIBRATION AND INSTABILITY	9

Nonlinear vibration and Instabilities of elastically supported beams.

	TOTAL: 45 PERIODS
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
CO1:	Illustrate material and geometric nonlinearity in bars and beams
CO2:	Explain the uniform and variable stiffness members under cyclic loading
CO3:	Understand the elastic as well as inelastic analysis of flexural members including beams and plates
CO4:	Apply the vibration theory for analyzing flexural members
CO5:	Analyze Instabilities of elastically supported beams for the nonlinear vibration
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.
4.	Chuen-Yuan Chia," Nonlinear Analysis of Plates", McGraw-Hill International Book Company, 1980.
5.	Arthur W. Leissa," Vibration of Shells" Acoustical Society of America"1993

Mapping of Course Outcomes to Programme Outcomes

CO	PO					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	3	-	-	1
CO2	1	-	3	1	2	1
CO3	2	-	3	1	2	1
CO4	2	-	3	2	2	1
CO5	2	-	3	3	2	1
Average	**2**	**-**	**3**	**2**	**2**	**1**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Introduction to Non-Linear Analysis	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Inelastic Analysis of Flexural Members	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Vibration Theory and Analysis of Flexural Members	2	1 either or	1(2) — CO3	1(2) — CO3	1 either or (16) — CO3	-
Unit-IV: Elastic And Inelastic Analysis of Plates	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Non-Linear Vibration and Instability	2	1 either or	1(2) – CO5	1(2) — CO5	-	1 either or (16) — CO5
Total Qns. Nonlinear Analysis of Structures	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	1 either or (16) — CO5

Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22234	OPTIMIZATION OF STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- 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 multi-storey buildings, water tanks and bridges.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will 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**.**

Mapping of Course Outcomes to Programming Outcomes

CO	**PO**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	3	-	-	1
CO2	1	-	3	1	2	1
CO3	2	-	3	1	2	1
CO4	2	-	3	2	2	1
CO5	2	-	3	3	2	1
Average	**2**	**-**	**3**	**2**	**2**	**1**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An) Evaluate (Ev)
			No. of Qns. (marks) and CO			
Unit-I: Basic Principles and Classical Optimization Techniques	2	1 either or	2(2) – CO1	1 either or (16) – CO1	-	-
Unit-II: Linear and Non-Linear Programming	2	1 either or	2(2) - CO2	1 either or (16) — CO2	-	-
Unit-III: Geometric Programming	2	1 either or	1(2) — CO3	1(2) — CO3	-	1 either or (16) — CO3
Unit-IV: Dynamic Programming	2	1 either or	1(2) - CO4	1(2) — CO4	1 either or (16) — CO4	-
Unit-V: Structural Applications	2	1 either or	1(2) – CO5	1(2) — CO5	1 either or (16) — CO5	

Total Qns. Optimization of Structures	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	1 either or (16)
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	20	20	20	20	20
Weightage	20%	20%	20%	20%	20%

SE22341	SMART MATERIALS AND SMART STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To give an in-depth knowledge on properties of smart materials and their use in structures.

UNIT I	PROPERTIES OF MATERIALS AND ER AND MR FLUIDS	9

Piezoelectric Materials and properties - Actuation of structural components - Shape Memory Alloys - Constitutive modeling of the shape memory effect, vibration control - Embedded actuators – Electro rheological and magneto rheological fluids - Mechanisms and Properties - Fiber Optics - Fiber characteristics - Fiber optic strain sensors.

UNIT II	VIBRATION ABSORBERS	9

Parallel damped vibration absorber - Gyroscopic vibration absorber - Active vibration, absorber - Applications - Vibration Characteristics of mistuned systems - Analytical approach.

UNIT III	MEASURING TECHNIQUES	9

Strain Measuring Techniques using Electrical strain gauges - Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT IV	CONTROL OF STRUCTURES	9

Control modeling of structures - Control strategies and limitations - Classification of control systems: Classical control, Modern control, Optimal control and Digital control - Active structures in practice.

UNIT V	APPLICATIONS IN CIVIL ENGINEERING	9

Application of Shape Memory - Alloys in Bridges – Concept of Smart Bridges – Application of ER Fluids - Application of MR Dampers in Different Structures – Application of MR Dampers in Bridges and High Rise Structures – Structural Health Monitoring - Application of Optical Fibres - Concept of Smart Concrete.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:	
CO1:	State the importance of various material, its properties and application.
CO2:	Summarize different forms of processing technics of smart materials**.**
CO3:	Design the smart materials and their structural applications.
CO4:	Make use of smart materials in various applications of Civil Engineering.
CO5:	Analyze the performance of smart materials in its application.

REFERENCES:

1.	Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996. 2. Gandhi, M.V and Thompson, B.S., "Smart Materials and Structures", Chapman and Hall, 1992.
2.	Srinivasan, A.V., and Michael McFarland. D., "Smart Structures – Analysis and Design", Cambridge University Press, 2001.
3.	M V Gandhi, "Smart Materials and Structures", Chapman and Hall, 1992-05-31.
4.	Vijay K. Varadan; K. J. Vinoy; S. Gopalakrishnan," Smart Material Systems And Mems", Wiley Professional; Reference & Trade,2006.
5.	A.V. Srinivasan, D. Michael McFarland," Smart Structures", South Asian Edition, 2010.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	3	1	3
CO2	2	2	1	1	-	2
CO3	3	2	1	3	2	1
CO4	2	1	1	3	1	1
CO5	1	-	-	2	3	3
CO	**2**	**2**	**1**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Properties of Materials and ER and MR Fluids	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Vibration Absorbers	2	1 either or	2(2) – CO1	1 either or (16) — CO2	-	-
Unit-III: Measuring Techniques	2	1 either or	1(2) - CO1	1(2) - CO2	1 either or (16) — CO3	-

Unit-IV: Control of Structures	2	1 either or	2(2) – CO1		1 either or (16) — CO4	-
Unit-V: Applications in Civil Engineering	2	1 either or	1(2) - CO1	1(2) - CO2	-	1 either or (16) — CO5
Total Qns. Smart Materials and Smart Structures	10	5 either or	8(2)	2(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	16	36	32	16
Weightage	20%	80%	16%	36%	32%	16%

Weightage for COs

	CO1	CO2	CO3	CO4	CO5
Total Marks	16	36	16	16	16
Weightage	16%	36%	16%	16%	16%

SE22342	DESIGN OF MASONRY STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To design, detail and retrofit a masonry structure.

UNITI	**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	**EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES**	**9**

Structural design of Masonry – Consideration of seismic loads –concepts of confined masonry – 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.

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	
COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	State the properties of a masonry unit and the various components.
CO2:	Describe the different form loads in masonry units.
CO3:	Design a masonry structure for compression and lateral loads.
CO4:	Make use of retrofitting techniques for repair and strengthening of masonry structures.
CO5:	Analyse the effect of earthquake resistant in masonry wall.
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.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	3	1	3
CO2	3	2	1	1	-	2
CO3	3	2	1	3	2	1
CO4	2	3	1	3	1	1
CO5	3	-	-	2	3	3
Average	3	2	1	2	2	2

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Design of Compression Member	2	1 either or	2(2) – CO1	1 either or (16) — CO2	-	-
Unit-III: Design of Masonry Under Lateral Loads	2	1 either or	1(2) — CO1	1(2) — CO2	1 either or (16) — CO3	-
Unit-IV: Earthquake Resistant Design of Masonry Structures	2	I either or	1(2) – CO1	1(2) — CO2		1 either or (16) — CO5
Unit-V: Retrofitting of Masonry	2	1 either or	1(2) – CO1	I(2) — CO2	1 either or (16) — CO4	-
Total Qns. Design of Masonry Structures	10	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	14	38	16	16	16
Weightage	14%	38%	16%	16%	16%

SE22343	THEORY OF PLATES AND SHELLS	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To study the behaviour and design of plates, shell, folded plates

UNIT I	INTRODUCTION TO PLATES	9

Plate equation in Cartesian and polar co-ordinates for isotropic rectangular and circular plates - Analysis of rectangular and circular plates with different boundary conditions and loadings - Analysis of circular plates with opening.

UNIT II	ADVANCED TOPICS IN PLATES	9

Cylindrical bending of long rectangular plates with different boundary conditions and loadings - Analysis of orthotropic plates, Design of plates.

UNIT III	PLATES ON ELASTIC FOUNDATION	9

Differential equation - Rectangular and continuous plates on elastic foundation.

UNIT IV	INTRODUCTION TO SHELLS	9

Classification of shells - Properties of curves - Membrane and bending theory for singly curved and doubly curved shells - Beam theory of cylindrical shells - Lundgren's method. Design of cylindrical shells.		
UNIT V	**FOLDED PLATES**	**9**
Folded Plate structures, Various types, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof- Prismoidal roof. Analysis and principles of design		
		TOTAL: 45 PERIODS

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	Have fundamental knowledge in the analysis of plates, folded plates and shells.
CO2:	Explain the various loads acting of plates, shell, and floded plates and their structural behavior.
CO3:	Analyse the plates, folded plates and concrete shells
CO4:	Design the plates, folded plates and concrete shells
CO5:	Evaluate the performance of the plates resting on elastic foundation
REFERENCES:	
1.	Timoshenko, S.P. Theory of Plates and Shells, Mc Graw Hill Book Company, New York, USA (1987).
2.	Ramaswamy, G.S. Design and Construction of Concrete Shell Roofs, CBS Publishers, India (2005).
3.	Rudolph Szilard. Theories and Application of Plate Analysis, John Wiley & Sons, USA (2004).
4.	Billington.D.P, “Thin Shell Concrete Structures”, McGraw Hill Book Co., New York, ASCE Manual No.31, Design of Cylindrical Shells, 1986.
5.	Varghese P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	1	3	-	-
CO2	3	2	2	3	1	-
CO3	3	-	2	3	-	-

CO4	3	3	3	3	3	-
CO5	3	3	3	3	3	-
CO	**3**	**3**	**2**	**3**	**2**	-

Table of specification for end semester question paper

Unit No. and Title	Total2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Introduction to Plates	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Advanced Topics in Plates	2	1 either or	2(2) – CO1	1 either or (16) — CO3	-	-
Unit-III: Plates on Elastic Foundation	2	1 either or	1(2) — CO1	1(2) — CO2	1 either or (16) —CO4	-
Unit-IV: Introduction to Shells	2	1 either or	1(2) – CO1	1(2) — CO2	1 eitheror (16) — CO4	-
Unit-V: Folded Plates	2	1 either or	1(2) – CO1	1(2) — CO2	-	1 either or (16) — CO5
Total Qns. Design of Plates and Shells	1 0	5 either or	7(2)	3(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	14	38	32	16
Weightage	20%	80%	14%	38%	32%	16%

Weightage for COs

	CO1	CO 2	CO 3	CO 4	CO 5
Total Marks	14	22	16	32	16
Weightage	14%	22%	16%	32%	16 %

SE22344	DIGITAL CONSTRUCTION	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To learn basic concepts of BIM for construction.
- To learn and acquire knowledge in the BIM-based construction design process.
- To understand the challenges in BIM implementation.
- To learn and acquire knowledge in BIM-based construction automation technologies.
- To learn and acquire knowledge in Modern Digital Technologies in Construction.

UNITI	INTRODUCTION TO BIM FOR CONSTRUCTION	9

Fundamentals of BIM – terminology, CAD & BIM. IFCs, schemas, interoperability, parametric modeling.		
UNIT II	**DEVELOPMENT OF DESIGN PROCESS**	**9**
BIM-based design process and analysis - design coordination. BIM-based construction process – 4D, 5D, nD BIM.		
UNIT III	**CHALLENGES IN BIM IMPLEMENTATION**	**9**
BIM-based operation issues – facility management. Drivers and barriers in BIM adoption, BIM global practices.		
UNIT IV	**CONSTRUCTION AUTOMATION**	**9**
Automation in design and construction, virtual experiments – augmented reality, virtual reality, use of sensors in construction.		
UNIT V	**MODERN DIGITAL TECHNOLOGIES IN CONSTRUCTION**	**9**
Robots in construction, autonomous robots, and 3D printing technology in construction. Drones for Construction monitoring, Internet of Things, Smart Manufacturing, etc.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:

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

CO1:	State the Fundamentals of BIM, its global practices, use of sensors and modern digital technologies in construction.
CO2:	Explain the construction design process using BIM.
CO3:	Develop the challenges in BIM implementation.
CO4:	Identify the automation techniques in construction.
CO5:	Examine the modern digital technologies in construction.

REFERENCES:

1.	Daniotti, Bruno, Gianinetto, Marco, Della Torre, Stefano (Eds.), Digital Transformation of the Design, Construction and Management Processes of the Built Environment, Research for Development, Springer Open, 2020.
2.	Dominik Holzer, The BIM Manager's Handbook: Guidance for Professionals in Architecture, Engineering, and Construction, Wiley, 2016.
3.	Erica Epstein, Implementing Successful Building Information Modeling, Artech House, 2012.
4.	Javad Majrouhi Sardroud, Automation in Construction Management, Scholars' Press, 2014.
5.	Thomas R. Kurfess, Robotics and Automation Handbook, CRC Press, 2018.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	PO					
	1	2	3	4	5	6
CO1	3	2	2	3	1	3
CO2	3	2	1	1	-	2
CO3	3	2	1	3	2	1
CO4	2	3	1	3	1	1
CO5	3	-	-	2	3	3
CO	3	2	1	2	2	2

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Introduction to BIM for Construction	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Development of Design Process	2	1 either or	2(2) – CO1	1 either or (16) — CO2	-	-
Unit-III: Challenges in BIM Implementation	2	1 either or	1(2) — CO1	1(2) — CO2	I either or (16) — CO3	-
Unit-IV: Construction Automation	2	1 either or	2(2) – CO1	-	I either or (16) — CO4	-
Unit-V: Modern Digital Technologies in Construction	2	1 either or	2(2) – CO1	-	-	I either or (16) — CO5
Total Qns. Digital Design and Construction	10	5 either or	9(2)	1(2) 2 either or (16)	2 either or (16)	-
Total Marks	20	80	18	34	32	16
Weightage	20%	80%	18%	34%	32%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	18	34	16	16	16
Weightage	18%	34%	16%	16%	16%

SE22351	STRUCTURAL HEALTH MONITORING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES:

- To make the students familiar with various structural health monitoring tools and

techniques.

UNIT I	INTRODUCTION TO STRUCTURAL HEALTH MONITORING	9

Need for SHM, Structural Health Monitoring versus Non-Destructive Evaluation, Methods of SHM Local & Global Techniques for SHM, Short & Long-Term Monitoring, Active & Passive Monitoring, Remote Structural Health Monitoring- Advantages of SHM - Challenges in SHM.

UNIT II	SENSORS AND INSTRUMENTATION FOR SHM	9

Sensors for measurements: Electrical Resistance Strain Gages, Vibrating Wire Strain Gauges, Fiber Optic Sensors, Temperature Sensors, Accelerometers, Displacement Transducers, Load Cells, Humidity Sensors, Crack Propagation Measuring Sensors, Corrosion Monitoring Sensors, Pressure Sensors, Data Acquisition – Data Transmission - Data Processing – Storage of processed data - Knowledgeable information processing.

UNIT III	STATIC AND DYNAMIC MEASUREMENT TECHNIQUES FOR SHM	9

Static measurement - Load test, Concrete core trepanning, Flat jack techniques, Static response measurement, Dynamic measurement -Vibration based testing- Ambient Excitation methods, Measured forced Vibration-Impact excitation, step relaxation test, shaker excitation method.

UNIT IV	DAMAGE DETECTION	9

Damage Diagnostic methods based on vibrational response- Method based on modal frequency/shape/damping, Curvature and flexibility method, Modal strain energy method, Sensitivity method, Baseline-free method, Cross-correlation method, Damage Diagnostic methods based on wave propagation Methods-Bulk waves/Lamb waves, Reflection and transmission, Wave tuning/mode selectivity, Migration imaging, Phased array imaging, Focusing array/SAFT imaging.

UNIT V	DATA PROCESSING AND CASE STUDIES	9

Advanced signal processing methods -Wavelet, Hilbert-Huang transform, Neural networks, Support Vector Machine Principal component analysis, Outlier analysis. Applications of SHM on bridges and buildings, case studies of SHM in Civil/ Structural engineering.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

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

CO1:	State the different types of structural health inspection.
CO2:	Explain the need, importance and instrumentation of structural health monitoring.
CO3:	Identify the health of the Structure using the advanced techniques.
CO4:	Apply the process and methods of health monitoring techniques.

CO5:	Analyse the accuracy of various health monitoring techniques.
REFERENCES:	
1.	Douglas E Adams, Health Monitoring of Structural Materials and Components Methods with Applications, Wiley Publishers, 2007
2.	Hua-Peng Chen,Structural Health Monitoring of Large Civil Engineering Structures, Wiley Publishers, 2018
3.	Ansari, F Karbhari, Structural health monitoring of civil infrastructure systems, V.M,Woodhead Publishing, 2009
4.	J. P. Ou, H. Li and Z. D, "Duan Structural Health Monitoring and Intelligent Infrastructure", Vol1, Taylor and Francis Group, London, UK, 2006.
5.	Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 2007.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	1	1	1	1	1
CO2	1	-	-	-	1	-
CO3	2	2	2	2	1	1
CO4	2	3	2	2	1	1
CO5	2	3	3	2	1	1
CO	1	2	2	1	1	1

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (AP)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Introduction to Structural Health Monitoring	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Sensors and Instrumentation For SHM	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-III: Static and Dynamic Measurement Techniques for SHM	2	1 either or	1(2) – CO1	1(2) – CO2	-	1 either or (16) – CO5
Unit-IV: Damage Detection	2	I either or	1(2) – CO1	1(2) – CO2	-	1 either or (16) – CO4
Unit-V: Data Processing and Case Studies	2	1 either or	1(2) – CO1	1(2) – CO2	1 either or (16) – CO3	

Total Qns. Structural Health Monitoring	10	5 either or	7(2)	3(2) 2 either or (16)	1 either or (16)	2 either or (16)
Total Marks	20	80	14	38	16	32
Weightage	20%	80%	14%	38%	16%	32%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	10	20	22	32	16
Weightage	14%	38%	16%	16%	16%

SE22352	**PERFORMANCE OF STRUCTURES WITH SOIL STRUCTURE INTERACTION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

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

UNITI	**SOIL-FOUNDATION INTERACTION**	**9**

Introduction to soil-foundation interaction problems – Soil behaviour – Foundation behaviour Interface behaviour- Scope of soil foundation interaction analysis- soil response models–Elastic continuum- Two parameter elastic models- Elastic-plastic behaviour- Time dependent behaviour.

UNIT II	**BEAM ON ELASTIC FOUNDATION- SOIL MODELS**	**9**

Infinite beam – Two-parameters models – Isotropic elastic half space model – Analysis of beams of finite length – combined footings.

UNIT III	**PLATES ON ELASTIC CONTINUUM**	**9**

Thin and thick rafts – Analysis of finite plates- Numerical analysis of finite plates.

UNIT IV	**ANALYSIS OF AXIALLY AND LATERALLY LOADED PILES AND PILE GROUPS**	**9**

Elastic analysis of single pile – Theoretical solutions for settlement and load distributions – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap – Load deflection prediction for laterally loaded piles – Subgrade reaction and elastic analysis – Interaction analysis – Pile-raft system.

UNIT V	**GROUND-FOUNDATION-STRUCTURE INTERACTION**	**9**

Effect of structure on ground-foundation interaction – Static and dynamic loads- Contact pressure and its estimation – Estimation of the settlement from the constitutive laws – Free-field response – Kinetic interaction – Inertial interaction – Ground improvement techniques – Application of Plaxis software.

TOTAL: 45 PERIODS

COURSE OUTCOMES:

At the end of the course, the students will be able to:	
CO1:	State the concept of soil structure interaction, soil models, plates on elastic Continuum, laterally loaded piles and pile groups.
CO2:	Explain the static analysis of infinite and finite beams resting on elastic foundation
CO3:	Select suitable models based on the performances of structures with soil structure Interaction.
CO4:	Analyze the beams on elastic foundation, finite plates, axially loaded piles and pile groups
CO5:	Examine the settlement from the constitutive laws problems.
REFERENCES:	
1.	John P. Wolf, (1985) Soil-structure interaction, Prentice Hall, 198.
2.	Soil Structure Interaction, the real behaviour of structures, Institution of Structural Engineers, 1989.
3.	A.P.S. Selvadurai, Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co., 1979.
4.	Prakash, S., and Sharma, H. D., "Pile Foundations in Engineering Practice" John Wiley & Sons, New York, 1990.
5.	Rolando P. Orense, Nawawi Chouw & Michael J. Pender – Soil-Foundation-Structure Interaction, CRC Press, Taylor & Francis Group, London, UK, 2010.

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	2	2	3	1	3
CO2	3	2	1	1	-	2
CO3	3	2	1	3	2	1
CO4	2	3	1	3	1	1
CO5	3	-	-	2	3	3
CO	**3**	**2**	**1**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Soil-Foundation Interaction	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Beam On Elastic Foundation- Soil Models	2	I either or	2(2) – CO1		-	1 either or (16) — CO4
Unit-III: Plates on Elastic Continuum	2	1 either or	1(2) — CO1	1(2) — CO2	I either or (16) — CO3	-
Unit-IV: Analysis of Axially and Laterally Loaded Piles and Pile Groups	2	I either or	1(2) – CO1	1(2) — CO2	1 either or (16) — CO3	-
Unit-V: Ground-Foundation-Structure Interaction	2	1 either or	1(2) – CO1	1(2) — CO2	-	I either or (16) — CO5
Total Qns. Performance of Structures With Soil Structure Interaction	10	5 either or	7(2)	3(2) 1 either or (16)	2 either or (16)	-
Total Marks	20	80	14	22	32	32
Weightage	20%	80%	14%	22%	32%	32%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	14	22	32	16	16
Weightage	14%	22%	32%	16%	16%

SE22353	DESIGN OF SUB STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To gain familiarity with different types of foundation and understand the concepts of design of shallow foundations, deep foundations, designing well, machine and special foundations.

UNITI	SHALLOW FOUNDATIONS	9

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

UNIT II	PILE FOUNDATIONS	9

Introduction – Types of pile foundations – load carrying capacity – pile load test – structural design of straight piles –configuration of piles- different shapes of piles cap – structural design of pile cap.

UNIT III	WELL FOUNDATIONS	9
Types of well foundation – Grip length – load carrying capacity – construction of wells – Failures and Remedies – Design of well foundation – Lateral stability.		
UNIT IV	**MACHINE FOUNDATIONS**	**9**
Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation.		
UNIT V	**SPECIAL FOUNDATIONS**	**9**
Foundation on expansive soils – choice of foundation – under-reamed pile foundation. Foundation for concrete Towers, chimneys – Design of anchors- Reinforced earth retaining walls.		
TOTAL: 45 PERIODS		

COURSE OUTCOMES:	
At the end of the course, the students will be able to:	
CO1:	List different types of foundation and its importance.
CO2:	Explain the concepts of design of shallow foundations, deep foundations, designing well, machine and special foundations.
CO3:	Identify suitable foundation based on soil condition.
CO4:	Design reinforced concrete shallow foundations, pile foundations, well foundations, and machine foundations.
CO5:	Analyse the load carrying capacity of each type of foundation.

REFERENCES:	
1.	Bowles. J.E., "Foundation Analysis and Design", McGraw Hill Publishing co., New York, 1997.
2.	Swamy Saran, Analysis and Design of substructures, Oxford and IBH Publishing Co. Pvt. Ltd., 2006.
3.	Tomlinson.M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995.
4.	Varghese.P.C, "Design of Reinforced Concrete Foundations" – PHI learning private limited, New Delhi – 2009.
5.	Swami Saran, "Analysis And Design Of Substructures", Limit State Design, Second Edition, 2018.

Mapping of Course Outcomes to Programming Outcomes

Course Outcomes	PO					
	1	**2**	**3**	**4**	**5**	**6**
CO1	1	2	2	-	3	3
CO2	2	2	1	3	2	1
CO3	2	1	1	-	3	2
CO4	2	3	-	2	2	3
CO5	1	1	-	2	2	3
CO	**2**	**2**	**1**	**2**	**2**	**2**

Table of specification for end semester question paper

Unit No. and Title	Total 2 MarksQns.	Total 16 MarksQns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Shallow Foundations	2	1 either or	2(2) – CO1	1 either or (16) – CO2	1 either or (16) — CO3	-
Unit-II: Pile Foundations	2	1 either or	2(2) – CO1	1 either or (16) — CO2	-	-
Unit-III: Well Foundations	2	1 either or	1(2) — CO1	1(2) — CO2	1 either or (16) — CO3	-
Unit-IV: Machine Foundations	2	1 either or	1(2) – CO1	1(2) — CO2	1 either or (16) — CO4	-
Unit-V: Special Foundations	2	1 either or	1(2) – CO1	1(2) — CO2	-	1 either or (16) — CO5
Total Qns. Design of Sub Structures	10	5 either or	7(2)	3(2) 1 either or (16)	3 either or (16)	-
Total Marks	20	80	14	22	48	16
Weightage	20%	80%	14%	22%	48%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	14	22	32	16	16
Weightage	14%	22%	32%	16%	16%

SE22354	**DESIGN OF BRIDGES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSEOBJECTIVES:

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

UNITI	**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 - Standard live loads, other forces acting on bridges & general design considerations.		
UNIT II	**SUPERSTRUCTURES**	**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		
UNIT III	**BRIDGE DESIGN PRINCIPLES**	**9**
Analysis and Design of RCC solid slab culverts -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–Design principles only.		
UNIT IV	**SUBSTRUCTURE, BEARINGS AND DECK JOINTS**	**9**
Design of bridge bearings and substructure-Substructure design: piers and abutments of different types - Foundations: Shallow foundations, deep foundations, piles, wells and pneumatic caissons.		
UNIT V	**PRESTRESSED CONCRETE BRIDGES & STEEL BRIDGES**	**9**
Design principles of PSC bridges – PSC girders –Design principles of steel bridges – Plate girder bridges – Box girder bridges – Truss bridges – Vertical and Horizontal stiffeners – Launching of girder in steel truss bridge. Prestressed concrete bridges: simple spans, continuous decks, anchorage of tendons and grouting of tendons – Critical studies of failure of major bridges.		
		TOTAL: 45 PERIODS
COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
CO1:	State the basics, components, and the concepts of moving loads on the various types of bridges.	
CO2:	Describe the types of load acting including heavy moving vehicle loadings and the different load combinations.	
CO3:	Identify the maximum shear force and bending moment and other important internal forces for the types of bridges.	
CO4:	Design bridge bearings, substructure, prestressed concrete bridges and steel bridges.	
CO5:	Analyze the critical elements and check for stability requirements in structures as well as substructures.	
REFERENCES:		

1.	Jagadeesh.T.R. and Jayaram.M.A., "Design of Bridge Structures", Second Edition, Prentice Hall of IndiaPvt. 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

Mapping of Course Outcomes to Programming Outcomes

Course outcomes	**PO**					
	1	**2**	**3**	**4**	**5**	**6**
CO1	3	3	1	3	-	-
CO2	3	2	2	3	1	-
CO3	3	-	2	3	-	-
CO4	3	3	3	3	3	-
CO5	3	3	3	3	3	-
CO	**3**	**3**	**2**	**3**	**2**	**-**

Table of specification for end semester question paper

Unit No. and Title	Total 2 Marks Qns.	Total 16 Marks Qns.	Cognitive Level			
			Remember (Kn)	Understand (Un)	Apply (Ap)	Analyse (An)
			No. of Qns. (marks) and CO			
Unit-I: Introduction	2	1 either or	2(2) – CO1	1 either or (16) – CO2	-	-
Unit-II: Superstructures	2	1 either or	2(2) – CO1		1 either or (16) — CO3	-
Unit-III: Bridge Design Principles	2	1 either or	1(2) — CO1	1(2) — CO2	1 either or (16) — CO3	-
Unit-IV: Substructure, Bearings and Deck Joints	2	1 either or	1(2) – CO1	-	-	1 either or (16) — CO5
Unit-V: Prestressed Concrete Bridges & Steel Bridges	2	1 either or	2(2) – CO1	1(2) — CO2	1 either or (16) — CO4	-
Total Qns. Design of Bridges	10	5 either or	8(2)	2(2) 1either or (16)	3 either or (16)	-
Total Marks	20	80	16	20	48	16
Weightage	20%	80%	16%	20%	48%	16%

Weightage for COs					
	CO1	CO2	CO3	CO4	CO5
Total Marks	16	20	32	16	16
Weightage	16%	20%	32%	16%	16%

AUDIT COURSES

AC22101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

COURSEOBJECTIVES:

- 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, and 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

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

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

REFERENCES:

1.	Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.

2.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006.
3.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.

AC22102	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSEOBJECTIVES:

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**	**5**
History, Drafting Committee, (Composition & Working)		
UNIT II	**PHILOSOPHY OF THE INDIAN CONSTITUTION**	**5**
Preamble, Salient Features		
UNIT III	**CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES**	**5**
Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.		
UNIT IV	**ORGANS OF GOVERNANCE**	**5**
Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions		
UNIT V	**LOCAL ADMINISTRATION**	**5**
District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected 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**	**5**
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

COURSE OUTCOMES:

Upon completion of the course, the students will.../ will be able to...

CO1:	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics
CO2:	Discuss the intellectual origins of the framework of argument that informed the

	conceptualization of social reforms leading to revolution in India.
CO3:	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
CO4:	Discuss the passage of the Hindu Code Bill of 1956
REFERENCES:	
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.

AC22201	**DISASTER MANAGEMENT**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSEOBJECTIVES:

- 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	
COURSE OUTCOMES:	
Upon completion of the course, the students will.../ will be able to...	
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
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.

AX4094	**நற்றமிழ் இலக்கியம்**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**
UNIT I	**சங்க இலக்கியம்**				**6**
1. தமிழின் துவக்க நூல் தொல்காப்பியம் - எழுத்து, சொல், பொருள் 2. அகநானூறு (82) - இயற்கை இன்னிசை அரங்கம் 3. குறிஞ்சிப் பாட்டின் மலர்க்காட்சி 4. புறநானூறு (95,195) - போரை நிறுத்திய ஔவையார்					
UNIT II	**அறநெறித் தமிழ்**				**6**
1. அறநெறி வகுத்த திருவள்ளுவர் - அறம் வலியுறுத்தல், அன்புடமை, ஒப்பறவு அறிதல், ஈகை, புகழ் 2. பிற அறநூல்கள் - இலக்கிய மருந்து - ஏலாதி, சிறுபஞ்சமூலம், திரிகடுகம், ஆசாரக்கோவை (தூய்மையை வலியுறுத்தும் நூல்)					
UNIT III	**இரட்டைக் காப்பியங்கள்**				**6**
1. கண்ணகி புரட்சி - சிலப்பதிகார வழக்குரை காதை 2. சமூக சேவை இலக்கியம் மணிமேகலை - சிறைக்கோட்டம் அறக்கோட்டமாகிய காதை					
UNIT IV	**அருள்நெறித் தமிழ்**				**6**
1. சிறுபாணாற்றுப் படை - பாரி முல்லைக்குத் தேர் கொடுத்தது, பேகன் மயிலுக்குப் போர்வை கொடுத்தது, அதியமான் ஔவைக்கு நெல்லிக்கனி கொடுத்தது, அரசர் பண்புகள்.					

2. நற்றிணை
   - அன்னைக்குரிய புன்னை சிறப்பு
3. திருமந்திரம் (617, 618)
   - இயமம் நியமம் விதிகள்
4. தர்மச்சாலையை நிறுவிய வள்ளலார்
5. புறநானூறு
   - சிறுவனே வள்ளலானான்
6. அகநானூறு (4) - வண்டு
   நற்றிணை (11) - நண்டு
   கலித்தொகை (11) - யானை, புறா
   ஐந்திணை 50 (27) - மான்
   ஆகியவை பற்றிய செய்திகள்

UNIT V	**நவீன தமிழ் இலக்கியம்**	**6**

1. உரைநடைத் தமிழ்
   - தமிழின் முதல் புதினம்
   - தமிழின் முதல் சிறுகதை
   - கட்டுரை இலக்கியம்
   - பயண இலக்கியம்
   - நாடகம்
2. நாட்டு விடுதலை போராட்டமும், தமிழ் இலக்கியமும்
3. சமுதாய விடுதலையும், தமிழ் இலக்கியமும்
4. பெண் விடுதலையும், விளிம்பு நிலையினரின் மேம்பாட்டில் தமிழ் இலக்கியமும்,
5. அறிவியல் தமிழ்
6. இணையத்தில் தமிழ்
7. சுற்றுச்சூழல் மேம்பாட்டில் தமிழ் இலக்கியம்

TOTAL: 30 PERIODS

தமிழ் இலக்கிய வெளியீடுகள்.்.புத்தகங்கள்

1.	தமிழ் இணைய கல்விக்கழகம் (Tamil Virtual University) - www.tamilvu.org
2.	தமிழ் விக்கிப்பீடியா (Tamil Wikipedia)- https://ta.wikipedia.org
3.	தர்மபுர ஆதீன வெளியீடு
4.	வாழ்வியல் களஞ்சியம்- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்
5.	தமிழ்கலைக் களஞ்சியம்- தமிழ் வளர்ச்சித் துறை (thamilvalarchithurai.com)
6.	அறிவியல் களஞ்சியம்- தமிழ்ப் பல்கலைக்கழகம், தஞ்சாவூர்

HOD **DEAN ACADEMICS** **PRINCIPAL**