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 field.

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	-	-
		SE22101	2	-	3	2	2	2
		SE22102	2	-	2	2	-	2
		RM22101	-	2	3	-	-	2
		SE22103	2	2	2	2	2	2
		SE22104	3	3	2	-	-	3
I	II	SE22201	2	2	2	2	2	2
		SE22202	1	3	3	2	2	2
		SE22203	3	2	2	3	2	3
		SE22204	2	-	3	3	-	-
		SE22205	2	2	2	3	2	2
		RM22201	2	2	-	-	2	2

SEMESTER I

Sl.No.	Course Code	Course Title	Category	Periods per week			Total contact Period	Credits
				L	T	P		
THEORY								
1	MA22108	Advanced Mathematical Methods for Structural Engineers	FC	3	1	0	4	4
2	SE22101	Structural Dynamics and Earthquake Engineering	PCC	3	0	2	5	4
3	SE22102	Theory of Elasticity and Plasticity	PCC	3	1	0	4	4
4		Professional Elective I	PEC	3	0	0	3	3
5	RM22101	Research Methodology	RMC	2	0	0	2	2
6		Audit Course I	AC	2	0	0	2	0
PRACTICAL								
7	SE22103	Advanced Structural Engineering Laboratory	PCC	0	0	4	4	2
8	SE22104	Technical Seminar	EEC	0	0	2	2	1
			TOTAL	**16**	**2**	**8**	**26**	**20**

SEMESTER II

Sl.No.	Course Code	Course Title	Category	Periods per week			Total contact Period	Credits
				L	T	P		
THEORY								
1	SE22201	Advanced Steel Structures	PCC	3	1	0	4	4
2	SE22202	Finite Element Analysis of Structures	PCC	3	0	2	5	4
3	SE22203	Stability of Structures	PCC	3	0	0	3	3
4	SE22204	Advanced Concrete Structures	PCC	3	0	0	3	3
5		Professional Elective II	PEC	3	0	0	3	3
6		Professional Elective III	PEC	3	0	0	3	3
7		Audit Course II	AC	2	0	0	2	0
PRACTICAL								
8	**SE22205**	Structural Design Laboratory	PCC	0	0	4	4	2
9	**RM22201**	Research Tool Laboratory	EEC	0	0	4	4	2
			TOTAL	**20**	**1**	**10**	**31**	**24**

AUDIT COURSES (AC)

Sl. No.	Course Code	Course Title	Cate Gory	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	நற்றமிழ்இலக்கியம்	AC	2	0	0	2	0

PROFESSIONAL ELECTIVE I – SEMESTER I

Sl. No.	Course Code	Course Title	Cate Gory	Periods Per Week			Total Contact Periods	Credits
				L	T	P		
1	SE22111	Advanced Concrete Technology	PEC	3	0	0	3	3
2	SE22112	Prefabricated Structures	PEC	3	0	0	3	3
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	Cate Gory	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	Cate Gory	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 Structures	PEC	3	0	0	3	3
4	SE22234	Optimization of Structures	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	Programme Outcomes					
	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**	**-**	**-**

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**
Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoring and Seismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of Earthquake Parameters, Microzonation. Effect of Earthquake on Different Types of Structures - Lessons Learnt From Past Earthquakes -Evaluation of Earthquake Forces as per codal provisions - Response Spectra, Design Spectra.		
UNIT IV	**EARTHQUAKE GROUND MOTION AND ITS EFFECTS ON STRUCTURES**	**9**
Engineering Seismology Seismotectonics and Seismic Zoning of India, Earthquake Monitoring andSeismic Instrumentation, Characteristics of Strong Earthquake Motion, Estimation of EarthquakeParameters, 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	Programme Outcomes					
	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**

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 foundatio

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	**Programme Outcomes**					
	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**

RM22101	RESEARCH METHODOLOGY	L	T	P	C
		2	0	0	2

COURSEOBJECTIVES:

- To give an overview of the research methodology and IPR, and explainthe 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, Licences, 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	Programme Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	3	-	-	-
CO2	-	-	3	-	-	-
CO3	-	2	3	-	-	-
CO4	-	-	3	-	-	-
CO5	-	-	3	-	-	2
Average	-	2	3	-	-	2

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 IndianStandards, 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	Programme Outcomes					
	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**

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	Programme Outcomes					
	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	DESIGNOF 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 OFINDUSTRIALBUILDINGS	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 ANALYSISOF STRUCTURES	12

Introduction, Shape factor, Moment redistribution, Combined mechanisms, Analysis of portal frames,Effectofaxialforce-Effectofshearforceonplasticmoment,Connections–Requirement-Moment resisting connections. Design of Straight Corner Connections – HunchedConnections-Design of continuous beams.

UNIT V	DESIGN OF LIGHT GAUGESTEELSTRUCTURE	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	Programme Outcomes					
	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**

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:	Understand 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	**Programme Outcomes**					
	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**

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

COURSEOBJECTIVES:

- To study the concept of buckling and analysis of structuralelements

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-COLUMNSAND 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 ANDLATERAL 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	BUCKLINGOFPLATES	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 ofplates, 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:	Understanding the buckling effect of structural elements by various approaches
CO2:	Describing the mathematical problems in structural elements
CO3:	Applying 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	Programme Outcomes					
	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**

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 SPECIALRC 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 LINEBASED 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 BEAMSANDCOLUMNS	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, gridfloors 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	Programme Outcomes					
	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**	**-**	**-**

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	Programme Outcomes					
	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 familiarise 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	**Programme Outcomes**					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	-	2	-
CO2	2	3	-	-	-	-
CO3	-	2	-	-	-	-
CO4	-	2	-	-	-	-
CO5	-	3	-	-	-	2
Average	**2**	**2**	**-**	**-**	**2**	**2**

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	Programme Outcomes					
	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

SE22112	PREFABRICATED STRUCTURES	L	T	P	C
		3	0	0	3

COURSEOBJECTIVES:

- To Study the design principles, analysis and design ofelements

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, STAIRSANDROOFS	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 ANDSHELL 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 codalprovisions
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,AkademiaiKiado, Budapest,2007.
3.	Lewicki.B, Building with Large Prefabricates, Elsevier Publishing Company, Amsterdam/ London/New York,1998.
4.	Structural Design Manual, Precast Concrete Connection Details, Society for the Studies in the use of Precase Concrete, Netherland 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	Programme Outcomes					
	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**

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	**Programme Outcomes**					
	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**	**-**

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	Programme Outcomes					
	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**

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	DISTRESSESAND 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 andpavements.

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 OFEXISTINGSTRUCTURES**	**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	Programme Outcomes					
	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**

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:	Executing the design of form work for Special Structures
CO4:	Describe the working of flying formwork
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 NeerajJha, "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	Programme Outcomes					
	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

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:	Generalize the knowledge in design concrete composite elements and structures
CO2:	Understanding the behavior of concrete composite elements and structures
CO3:	Identify the connection in composite structures
CO4:	Applying knowledge 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	Programme Outcomes					
	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**

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 OFOFFSHORE 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 OFOFFSHORE STRUCTURES**	**9**
Introduction – Procedure & concept of Static method of analysis, foundation analysis and dynamics of offshore structures.		
UNIT V	**DESIGN OFOFFSHORE 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:	Define the wave interaction and design of offshore structure.
CO2:	Understand 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 SwamidasA.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	Programme Outcomes					
	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**

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 structurer both steel and concrete
CO4:	Analyse the structural component of Industrial structurer 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	Programme Outcomes					
	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	-	-

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:	State 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:	Assess 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	Programme Outcomes					
	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**

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:	Gain knowledge on 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	Programme Outcomes					
	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**

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	Programme Outcomes					
	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**

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: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: 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.	