KSR College of Engineering

AN AUTONOMOUS INSTITUTION

NAAC ACCREDITED A++ | NBA ACCREDITED PROGRAMMES

25 Years KSRCE 2001 – 2026 Celebrating Academic Excellence

M.E - STRUCTURAL ENGINEERING

REGULATIONS 2024

(Academic Year 2024-25 Onwards)

Curriculum & Syllabus

K.S.R. COLLEGE OF ENGINEERING: TIRUCHENGODE - 637 215

(Autonomous)

DEPARTMENT OF CIVIL ENGINEERING

M.E - STRUCTURAL ENGINEERING

(REGULATIONS 2024)

Vision of the Institution

IV	To become a globally renowned institution in Engineering and Management, committed to providing holistic education that fosters research, innovation and sustainable development.

Mission of the Institution

IM 1	Deliver value-based quality education through modern pedagogy and experiential learning.
IM 2	Enrich Engineering and Managerial Skills through cutting-edge laboratories to meet evolving global demands.
IM 3	Empower research and innovation by integrating collaboration, social responsibility, and commitment to sustainable development.

Vision of the Department

DV	To develop premier Civil Engineers through education, fostering innovation and research to create a sustainable environment.

Mission of the Department

DM 1	Provide value-based education using advanced teaching methods and experiential learning.
DM 2	Prepare engineers for global challenges through state-of-the-art labs and advanced skills.
DM 3	Promote research, foster innovation, and strengthen industry collaboration, addressing infrastructure challenges through sustainable solutions.

Programme Educational Objectives (PEOs): M.E. – Structural Engineering

The graduates of the programme will be able to	
PEO 1	**Professional Skill Development:** Provide students to learn the detailed concepts of structural engineering for designing Civil Engineering structures.
PEO 2	**Core Competence:** Have successful career in different sectors of Structural Engineering Industry and technical institutes through life-long learning.
PEO 3	**Interpersonal Skill and teamwork**: Independently analyze socio-industrial problems and provide feasible solutions through critical thinking and research.

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Programme Outcomes (POs) of M.E. - Structural Engineering

Program Outcomes (POs)	
PO1	**Conduct Investigations of complex Problems:** An ability to independently carry out research/ investigation and development work to solve practical problems.
PO2	**Presentation Skill:** An ability to write and present a substantial technical report / document
PO3	**Scholarship of Knowledge:** Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO4	**Research Culture:** Profound knowledge of Structural Engineering discipline, with an ability to evaluate, analyze and synthesize the existing and new knowledge in the field of structural design with wide applications
PO5	**Core Values:** Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.

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	K. S. R COLLEGE OF ENGINEERING (Autonomous) Approved by AICTE and Affiliated to Anna University, Chennai Accredited by NAAC ('A++' Grade) K.S.R. Kalvi Nagar, Tiruchengode - 637 215	CURRICULUM PG R 2024
Department	Civil Engineering	
Programme	M.E. - Structural Engineering	

SEMESTER – I

Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C= T/30	CA	ES	Total
THEORY COURSES												
1	ST24T11	Matrix Methods of Structural Analysis	PCC	45	0	0	45	90	3	40	60	100
2	ST24T12	Advanced Concrete Structures	PCC	45	0	0	45	90	3	40	60	100
3	ST24T13	Structural Dynamics	PCC	45	0	0	45	90	3	40	60	100
4	MA24T12	Applied Mathematics for Structural Engineering	FC	45	0	0	45	90	3	40	60	100
5		Professional Elective – I	PEC	45	0	0	45	90	3	40	60	100
6		Professional Elective – II	PEC	45	0	0	45	90	3	40	60	100
LABORATORY COURSES												
7	ST24P11	Advanced Structural Engineering Laboratory	PCC	0	0	60	0	60	2	60	40	100
EMPLOYABILITY ENHANCEMENT COURSES												
8	ST24P12	Technical Presentation - I	EEC	0	0	30	0	30	1	60	40	100
			Total	**270**	**0**	**90**	**270**	**630**	**21**	**800**		

SEMESTER – II

Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C= T/30	CA	ES	Total
THEORY COURSES												
1.	RM24T09	Research Methodology and IPR	RMC	45	0	0	45	90	3	40	60	100
2.	ST24T21	Theory of Elasticity and Plasticity	PCC	45	0	0	45	90	3	40	60	100
3.	ST24T22	Advanced Steel Structures	PCC	45	0	0	45	90	3	40	60	100
4.	ST24T23	Finite Element Method	PCC	45	0	0	45	90	3	40	60	100
5.	-	Professional Elective – III	PEC	45	0	0	45	90	3	40	60	100
6.	-	Professional Elective – IV	PEC	45	0	0	45	90	3	40	60	100
LABORATORY COURSES												
7.	ST24P21	Advanced Computing Laboratory	PCC	0	0	60	0	60	2	60	40	100
EMPLOYABILITY ENHANCEMENT COURSES												
9.	ST24P22	Technical Presentation - II	EEC	0	0	30	0	30	1	60	40	100
			Total	**270**	**0**	**90**	**270**	**630**	**21**	**800**		

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SEMESTER – III													
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
THEORY COURSES													
1.	ST24T31	Design of Sub Structures	PCC	45	0	0	45	90	3	40	60	100
2.	-	Professional Elective - V	PEC	45	0	0	45	90	3	40	60	100
3.	-	Open Elective	OEC	45	0	0	45	90	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSES													
4.	ST24P31	Project Work Phase - I	EEC	0	0	180	0	180	6	60	40	100
5.	ST24P32	Practical Training*	EEC	0	0	30	0	30	1	60	40	100
AUDIT COURSE													
5.	-	Audit Course - I	AC	30	0	0	30	60	0	100	-	100
Total				**165**	**0**	**210**	**165**	**540**	**16**	**600**		

SEMESTER – IV												
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
EMPLOYABILITY ENHANCEMENT COURSES												
1.	ST24P41	Project Work Phase – II	EEC	0	0	360	0	360	12	60	40	100
Total				**0**	**0**	**360**	**0**	**360**	**12**	**100**		
TOTAL NO. OF CREDITS = 70												
TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 70												

Note: FC – Foundation Courses, AC – Audit Courses, PCC – Professional Core Courses, PEC – Professional Elective Courses, EEC – Employability Enhancement Courses, RMC – Research Methodology and IPR Courses

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FOUNDATION COURSES (FC)													
Sl. No.	Course Code	Course Name	Category	Hours/Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
1.	MA24T12	Applied Mathematics for Structural Engineering	FC	45	0	0	45	90	3	40	60	100
			Total	45	0	0	45	90	3	-		

PROFESSIONAL CORE COURSES (PCC)												
Sl. No.	Course Code	Course Name	Category	Hours/Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
1.	ST24T11	Matrix Methods of Structural Analysis	PCC	45	0	0	45	90	3	40	60	100
2.	ST24T12	Advanced Concrete Structures	PCC	45	0	0	45	90	3	40	60	100
3.	ST24T13	Structural Dynamics	PCC	45	0	0	45	90	3	40	60	100
4.	ST24P11	Advanced Structural Engineering Laboratory	PCC	0	0	60	0	60	2	60	40	100
5.	ST24T21	Theory of Elasticity and Plasticity	PCC	45	0	0	45	90	3	40	60	100
6.	ST24T22	Advanced Steel Structures	PCC	45	0	0	45	90	3	40	60	100
7.	ST24T23	Finite Element Method	PCC	45	0	0	45	90	3	40	60	100
8.	ST24P21	Advanced Computing Laboratory	PCC	0	0	60	0	60	2	60	40	100
9.	ST24T31	Design of Sub Structures	PCC	45	0	0	45	90	3	40	60	100
			Total	315	0	120	315	750	25	1800		

RESEARCH METHODOLOGY AND IPR COURSES (RMC)												
S. No.	Course Code	Course Title	Category	Hours/Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
1.	RM24T09	Research Methodology and IPR	RMC	45	0	0	45	90	3	40	60	100
			Total	45	0	0	45	90	3	100		

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EMPLOYABILITY ENHANCEMENT COURSES (EEC)													
Sl. No.	Course Code	Course Name	Category	Hours/Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Total
1.	ST24P12	Technical Presentation - I	EEC	0	0	30	0	30	1	60	40	100
2.	ST24P22	Technical Presentation - II	EEC	0	0	30	0	30	1	60	40	100
3.	ST24P31	Project Work Phase – I	EEC	0	0	180	0	180	6	60	40	100
4.	ST24P32	Practical Training	EEC	0	0	30	0	30	1	60	40	100
5.	ST24P41	Project Work Phase – II	EEC	0	0	360	0	360	12	60	40	100
Total				0	0	630	0	630	21	500		

PROFESSIONAL ELECTIVE – I & II (SEMESTER – I)												
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C= T/30	CA	ES	Total
THEORY COURSES												
1.	ST24E01	Advanced Concrete Technology	PEC	45	0	0	45	90	3	40	60	100
2.	ST24E02	Maintenance and Rehabilitation of Structures	PEC	45	0	0	45	90	3	40	60	100
3.	ST24E03	Wind Analysis and Design of Structures	PEC	45	0	0	45	90	3	40	60	100
4.	ST24E04	Optimization in Structural Design	PEC	45	0	0	45	90	3	40	60	100
5.	ST24E05	Soil Structure Interaction	PEC	45	0	0	45	90	3	40	60	100
6.	ST24E06	Storage Structures	PEC	45	0	0	45	90	3	40	60	100
7.	ST24E07	Fracture Mechanics of Concrete Structures	PEC	45	0	0	45	90	3	40	60	100
8.	ST24E08	Design and Construction of Ferrocement Structures	PEC	45	0	0	45	90	3	40	60	100
9.	ST24E09	Design of Formwork	PEC	45	0	0	45	90	3	40	60	100
10.	ST24E10	Non Linear Analysis of Structure	PEC	45	0	0	45	90	3	40	60	100
Total				450	0	0	450	900	30	1000		

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AUDIT COURSES (SEMESTER – III)													
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C = T/30	CA	ES	Total
THEORY COURSES													
1.	AX24A01	Disaster Management	AC	30	0	0	30	60	0	100	--	100
2.	AX24A02	Value Education	AC	30	0	0	30	60	0	100	--	100
3.	AX24A03	Constitution of India	AC	30	0	0	30	60	0	100	--	100
4.	AX24A04	Indian Knowledge System	AC	30	0	0	30	60	0	100	--	100

OPEN ELECTIVES OFFERED BY OTHER PG PROGRAMMES												
S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Tot.
1.	PE24O01	Switching Concepts and Power Semiconductor Devices	OEC	45	0	0	45	90	3	40	60	100
2.	PE24O02	Smart Grid Technology	OEC	45	0	0	45	90	3	40	60	100
3.	PE24O03	Renewable Energy Technology	OEC	45	0	0	45	90	3	40	60	100
4.	PE24O04	Energy Management and Conservation	OEC	45	0	0	45	90	3	40	60	100
5.	CN24O01	Energy Efficient Building	OEC	45	0	0	45	90	3	40	60	100
6.	CN24O02	Economics and Finance Management in Construction	OEC	45	0	0	45	90	3	40	60	100
7.	CN24O03	Stress management	OEC	45	0	0	45	90	3	40	60	100
8.	ET24O01	Embedded Systems	OEC	45	0	0	45	90	3	40	60	100
9.	ET24O02	Embedded Control	OEC	45	0	0	45	90	3	40	60	100
10.	ET24O03	Embedded Automation	OEC	45	0	0	45	90	3	40	60	100
11.	CU24O01	Principles of Multimedia	OEC	45	0	0	45	90	3	40	60	100
12.	CU24O02	IoT for Smart Systems	OEC	45	0	0	45	90	3	40	60	100
13.	CU24O03	MEMS and NEMS	OEC	45	0	0	45	90	3	40	60	100
14.	CU24O04	Introduction to Cognitive Radio Network	OEC	45	0	0	45	90	3	40	60	100

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PROFESSIONAL ELECTIVE – III and IV (SEMESTER – II)													
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C= T/30	CA	ES	Total
THEORY COURSES													
1.	ST24E11	Prestressed Concrete Structures	PEC	45	0	0	45	90	3	40	60	100
2.	ST24E12	Special Concrete	PEC	45	0	0	45	90	3	40	60	100
3.	ST24E13	Design of Steel Concrete Composite Structures	PEC	45	0	0	45	90	3	40	60	100
4.	ST24E14	Experimental Techniques and Instrumentation	PEC	45	0	0	45	90	3	40	60	100
5.	ST24E15	Industrial Structures	PEC	45	0	0	45	90	3	40	60	100
6.	ST24E16	Earthquake Resistant Structures	PEC	45	0	0	45	90	3	40	60	100
7.	ST24E17	Design of Tall Buildings	PEC	45	0	0	45	90	3	40	60	100
8.	ST24E18	Design of Offshore Structures	PEC	45	0	0	45	90	3	40	60	100
9.	ST24E19	Chemistry of Cement and Concrete	PEC	45	0	0	45	90	3	40	60	100
10.	ST24E20	Soft Computing in Structural Engineering	PEC	45	0	0	45	90	3	40	60	100
Total				450	0	0	450	900	30	1000		

PROFESSIONAL ELECTIVE – V (SEMESTER – III)													
Sl. No.	Course Code	Course Name	Category	Hours/ Semester					Credit	Maximum Marks		
				L	T	P	SL	Tot	C= T/30	CA	ES	Total
THEORY COURSES													
1.	ST24E21	Stability of Structures	PEC	45	0	0	45	90	3	40	60	100
2.	ST24E22	Corrosion of Steel in Concrete	PEC	45	0	0	45	90	3	40	60	100
3.	ST24E23	Aseismic Design of Structures	PEC	45	0	0	45	90	3	40	60	100
4.	ST24E24	Design of Bridges	PEC	45	0	0	45	90	3	40	60	100
5.	ST24E25	Design of Plate and Shell Structures	PEC	45	0	0	45	90	3	40	60	100
Total				225	0	0	225	450	15	500		

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OPEN ELECTIVES OFFERED TO OTHER PG PROGRAMMES													
S. No.	Course Code	Course Title	Category	Periods / Semester					Credit	Max. Marks		
				L	T	P	SL	Tot.	C= T/30	CA	ES	Tot.
1.	ST24O01	Principles of Sustainable Development	OEC	45	0	0	45	90	3	40	60	100
2.	ST24O02	Failure Analysis of Structures	OEC	45	0	0	45	90	3	40	60	100
3.	ST24O03	Smart materials and Smart Structures	OEC	45	0	0	45	90	3	40	60	100

COURSE COMPONENT SUMMARY

S. No.	Category	Credits Per Semester				Credits Total	Percentage Credits
		I	II	III	IV		
1.	FC	03	-	-	-	03	4.28
2.	RMC	-	03	-	-	03	4.28
3.	PCC	11	11	03	-	25	35.71
4.	PEC	06	06	03	-	15	21.42
5.	EEC	01	01	07	12	21	30
6.	OEC	-	-	03	-	03	4.28
7.	Audit Course	-	-	0	-	-	0
TOTAL		**21**	**21**	**16**	**12**	**70**	**100**

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ST24T11	MATRIX METHODS OF STRUCTURAL ANALYSIS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Knowledge of axial, shear, and bending stresses in structural members. Proficiency in analyzing static and dynamic forces in structures. Knowledge of numerical techniques for solving linear and nonlinear equations.

OBJECTIVES:

- To analyze and apply the principles of strain energy, stiffness, and flexibility matrices; formulate and transform these matrices for structures with varying coordinate systems; and develop the stiffness method to analyze both statically determinate and indeterminate structures at system and element levels.

UNIT - I	ENERGY CONCEPTS IN STRUCTURES	(9)

Introduction - Strain Energy – Symmetry of the Stiffness and Flexibility Matrices - Strain Energy in terms of Stiffness and Flexibility Matrices - Stiffness and Flexibility Coefficients in terms of Strain Energy - Additional properties of [a] and [k] - Another Interpretation of Coefficients aij and kij - Betti's Law - Applications of Betti's Law: Forces not at the coordinates - Strain energy in systems and in Elements.

UNIT - II	CHARACTERSTICS OF STRUCTURES - STIFFNESS AND FLEXIBILITY	(9)

Introduction – Structure with Single Coordinate - Two Coordinates - Flexibility and Stiffness Matrices in Coordinates - Examples - Symmetric Nature of Matrices - Stiffness and Flexibility Matrices in Constrained Measurements - Stiffness and Flexibility of Systems and Elements - Computing Displacements and Forces from Virtual Work - Computing Stiffness and Flexibility Coefficients.

UNIT - III	TRANSFORMATION OF INFORMATION IN STRUTURES	(9)

Determinate- Indeterminate Structures - Transformation of System Forces to Element Forces - Element Flexibility to System Flexibility - System Displacement to Element Displacement - Element Stiffness to System Stiffness - Transformation of Forces and Displacements in General - Stiffness and Flexibility in General - Normal Coordinates and Orthogonal Transformation - Principle of Contra grandniece.

UNIT - IV	FLEXIBILITY METHOD	(9)

Statically Determinate Structures - Indeterminate Structures - Choice of Redundant Leading to ILL and Well-Conditioned Matrices - Transformation to One Set of Redundant to Another - Internal Forces due to Thermal Expansion and Lack of Fit - Reducing the Size of Flexibility Matrix - Application to Pin - Jointed Plane Truss-Continuous Beams – Frames-Grids.

UNIT - V	STIFFNESS METHOD	(9)

Introduction - Development of Stiffness Method - Stiffness Matrix for Structures with zero Force at some Coordinates - Analogy between Flexibility and Stiffness - Lack of Fit - Stiffness Matrix with Rigid Motions-Application of Stiffness Approach to Pin Jointed Plane Trusses-Continuous Beams-Frames - Grids-Space Trusses and Frames-Introduction Only - Static Condensation Technique - Choice of Method - Stiffness or Flexibility

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Illustrate the fundamentals in the analysis of structural members	Understand
CO2	Identify about the characteristics of structures by evaluation of its flexibility and stiffness matrices.	Apply
CO3	Apply the transformation of system forces to element forces and element flexibility to system flexibility.	Apply
CO4	Categorize about analysis of system through direct and element approach of flexibility method.	Analyze
CO5	Examine structures by direct and element approach of stiffness method.	Analyze

REFERENCES:

1. Natarajan C, Revathi P., "Matrix Methods of structural Analysis: Theory and Problems", PHI leaning Pvt. Ltd., 1stEdition, 2014.
2. Bhavikati, S.S., "Matrix Methods of Structural Analysis", Dreamtech Press, 1st Edition, 2019.Frank B. Gross, "Frontiers in Antennas", Mc Graw Hill, First Edition, 2011.
3. Pandit, G.S, and Gupta, S.P., "Structural Analysis Matrix Approach", Tata McGraw-Hill Publishing Company Limited, 2nd Edition, 2008.
4. Bhavikati, S.S., "Structural Analysis Vol.-I & II", Vikas Publishing House Pvt. Ltd., 5th Edition, 2021.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	3	-	3	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	3	3	3
Avg.	3	-	3	3	3

1-Low, 2-Medium, 3-High

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ST24T12	ADVANCED CONCRETE STRUCTURES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Familiarity with the design principles of reinforced concrete structures, including knowledge of design codes (such as ACI, Eurocode, or similar). Proficiency in analyzing structures to determine internal forces and moments. This includes knowledge of statics, dynamics, and methods like the finite element analysis.

OBJECTIVES:

- To reinforce limit state design principles for RC elements such as beams, slabs, and columns as per IS codes. The course focuses on analysing and designing special components like slender columns, walls, deep beams, corbels, grid floors, and flat slabs using IS, ACI methods, and yield line theory.

UNIT - I	INTRODUCTION	(9)

Review of limit state design of beams, slabs and column according to Indian standard (IS) codes - Calculation of deflection and crack width according to IS and American Concrete Institute (ACI) Codes.

UNIT - II	DESIGN OF SPECIAL REINFORCED CONCRETE(RC) ELEMENTS	(9)

Design of slender columns - Design of reinforced concrete walls - Ordinary and shear walls - Strut and tie method of analysis for corbels and deep beams - Design of corbels - Deep Beams - Grid floors.

UNIT - III	FLAT SLABS AND FLATE PLATES	(9)

Design of flat slabs and flat plates according to IS & ACI methods - Design of shear reinforcement - Design of spandrel beams - Yield line theory and Hiller - Borg strip method of design of slabs.

UNIT - IV	INELASTIC BEHAVIOR OF CONCRETE STRUCTURES	(9)

Inelastic behavior of concrete beams and frames, moment - Rotation curves - Moment redistribution Baker's method of plastic design - Design of cast - Insitu joints in frames.

UNIT - V	DETAILING AND FIELD PRACTICE	(9)

Detailing for ductility - Fire resistance of structural members - Quality control of concrete

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the design of beams, column and slabs with codal provisions.	Apply
CO2	Examine the design of special RC elements.	Analyze
CO3	Analyze flat slab and spandrel beams according to IS and ACI methods.	Analyze
CO4	Illustrate the inelastic behaviour of concrete structures.	Understand
CO5	Interpret the quality control of concrete infield practice.	Understand

REFERENCES:

1. Krishna Raju, N., Advanced Reinforced Concrete Design, Vision as Ltd., 3rd Edition, 2024.
2. Varghese, P.C., Advanced Reinforced Concrete Design, Prentice Hall of India Private Limited, 2nd Edition, 2011.
3. Gambhir. M. L., "Design of reinforced Concrete Structures", PHI Learning Pvt. Ltd., 1st Edition, 2014.
4. S.S. Bhavikatti., "Advanced RCC Design - (RCC Vol. - II)", New Age International Pvt. Ltd., 1st Edition, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	2	3
CO2	3	-	2	2	3
CO3	3	-	2	2	3
CO4	3	-	2	2	3
CO5	3	-	2	2	3
Avg.	3	-	2	2	3

1-Low, 2-Medium, 3-High

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ST24T13	STRUCTURAL DYNAMICS	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Structural Dynamics course have a solid background in Mechanics of Materials, which includes an understanding of stress, strain, and deformation in structural elements and proficiency in Dynamics of Structures, including the basic principles of vibration and force analysis.

OBJECTIVES:

- To equip students with theoretical and practical skills for analyzing and designing structures subjected to dynamic forces. The course covers dynamic analysis and modeling techniques, including mode superposition methods and vibration modeling for structural beams.

UNIT - I	PRINCIPLES OF DYNAMICS	(9)

Formulation of Equations of Motion by Different Methods - Single Degree of Freedom Systems - Free and Forced Response - Effect of Damping.

UNIT - II	MULTIDEGREE OF FREEDOM (MDOF) SYSTEMS	(9)

Formulation of Structure - Property Matrices - Eigen Value Problems - Methods - Dunkerly's Method - Holzer Method - Stodola Method - Rayleigh's Method - Rayleigh - Ritz Method - Mode shapes - Ortho normality of Modes.

UNIT - III	DYNAMIC RESPONSE OF MDOF SYSTEMS	(9)

Mode Superposition Techniques - Problems on Two Degree of Freedom for Building Frames - Numerical Integration Techniques - New Marks Method - Linear Acceleration Method - Problems - Numerical Evaluation of Duhamel's Integral.

UNIT - IV	CONTINUOUS SYSTEMS	(9)

Modeling - Free and Forced Vibrations of Bars - Flexural Vibration of Simple Beams - Modes and Frequencies - Orthogonality Properties of Normal Modes of Continuous Systems.

UNIT - V	DESIGN OF STRUCTURES SUBJECTED TO DYNAMIC LOADS	(9)

Idealization of Multi - Storied Frames for Dynamic Loads - Machine Foundations - Analysis for Blast Loading - Earthquake Response - Elastic Rebound Theory - Deterministic Analysis of Earthquake response - Lumped SDOF system - Design of Earthquake Response - Design of Earthquake Resistant Structures - Indian Standard (IS) code Provisions - Wind Analysis - Gust Factor.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Illustrate the fundamental principles of dynamic system and effects of damping.	Understand
CO2	Apply the principles of structural dynamics to formulate structure and property matrices for various structural systems.	Apply
CO3	Analyze the dynamic response of multi degree of freedom by various methods.	Analyze
CO4	Identify the core principles and methods utilized in modelling dynamic systems and structural components.	Apply
CO5	Understand the process of idealizing multi-storied frames for dynamic load analysis	Understand

REFERENCES:

1. Mario Paz William Leigh, "Structural Dynamics", Kluwer Academic Press, Springer, Boston, Sixth Edition, 2019
2. Anil. K. Chopra., Dynamics of Structures – Theory and applications to Earthquake Engineering, Pearson Education India, Sixth Edition, 2023.
3. Roy R. and Craig. Jr., Structural Dynamics - An Introduction to Computer Methods, John Wiley & Sons, New York, Third Edition, 2012.
4. Clough. R.W. and Penzien. J., Dynamics of Structures, CBS Publishers & Distributors, New Delhi, Second Edition, 2015.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	3	-	3	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	3	3	3
Avg.	3	-	3	3	3

1-Low, 2-Medium, 3-High

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MA24T12	APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING	Category	L	T	P	SL	C
		FC	45	0	0	45	3

SEMESTER - I (M.E. : STRUCTURAL ENGINEERING)

PREREQUISITE :
The students must have the knowledge and familiarity on the basic concepts of Calculus, Fourier Transform, Laplace equation and Numerical Integration.

OBJECTIVES :
To develop the concepts of one dimensional wave and heat equations, Laplace and Poisson equations, concepts of Calculus of variations, linear programming models and Gaussian Quadrature and Monte Carlo Method.

UNIT - I **ONE DIMENSIONAL WAVE AND HEAT EQUATIONS** **(9)**

Laplace transform methods for one-dimensional wave equation – Displacements in a long string – longitudinal vibration of an elastic bar – Fourier transform methods for one dimensional heat conduction problems in infinite and semi-infinite rods.

UNIT - II **ELLIPTIC EQUATION** **(9)**

Fourier Transform method for solving Laplace equation transforms in a half plane, in an infinite strip and in a semi-infinite strip – Properties of harmonic functions – Solution of Poisson equation.

UNIT - III **CALCULUS OF VARIATIONS** **(9)**

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

UNIT - IV **LINEAR PROGRAMMING PROBLEMS** **(9)**

Formulation – Graphical Solution – Simplex Method – Big M method – Transportation and Assignment Problems.

UNIT - V **NUMERICAL INTEGRATION** **(9)**

Gaussian Quadrature – One and Two Dimensions – Gauss Hermite Quadrature – Monte Carlo Method – Multiple Integration by using mapping function.

Lecture = 45, Tutorial = 0 , Self Learning = 45 ; Total = 90 Periods

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

COs	Course Outcome	Cognitive Level
CO1	Solve one dimensional wave and heat equations.	Apply
CO2	Extend their knowledge in elliptic and Poisson equations.	Understand
CO3	Developing their skills in calculus of variations.	Apply
CO4	Formulate the LPP and find the optimal solutions.	Apply
CO5	Apply the numerical integration methods to obtain the solution and to interpret the multiple integration.	Apply

TEXT BOOKS :

1. Sankara Rao, K.," Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 2015.

2. Gupta A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2014.

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REFERENCES :

1. P.K.Gupta and Man Mohan , "Operations Research" , Sulthan Chand & Sons ,6th Edition ,2020.
2. Taha, H. A.," Operations Research ", Pearson Education , New Delhi, 9th Edition, 2012.
3. Andrews, L.C. and Shivamoggi, B.K., "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2013.
4. Rajasekaran.S, "Numerical Methods in Science and Engineering A Practical Approach", A.H.Wheeler and Company Private Limited, 2016.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	3
CO2	3	-	2	3	3
CO3	3	-	2	3	3
CO4	3	-	2	3	3
CO5	3	-	2	3	3

1 - Low, 2 - Medium, 3- High .

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637215 Centre for Academic Courses

ST24P11	ADVANCED STRUCTURAL ENGINEERING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

A foundational understanding of structural engineering principles is essential. Knowledge of material properties, Familiarity with both static and dynamic loading conditions, including cyclic and vibrational analysis, is required to assess damping coefficients, mode shapes, and frame behavior.

OBJECTIVES:

- To understand fabrication, casting, and testing methods for reinforced concrete beams and columns under various loading conditions. The course involves analyzing strength, deflection, and dynamic behavior of steel and concrete beams, including damping and mode shapes.

List of Experiments:

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behavior.
2. Testing of simply supported steel beam for strength and deflection behavior.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever steel beam
    a) To determine the damping co-efficient from free vibrations
    b) To evaluate the mode shapes
5. Static cyclic testing of single bay two storied steel frames and evaluate
    a) Drift of the frame
    b) Stiffness of the frame
    c) Energy dissipation capacity of the frame
6. Determination of in-situ strength and quality of concrete using
    a) Rebound hammer and
    b) Ultrasonic pulse velocity tester
7. Flow characteristics of self-compacting concrete.

PRACTICAL: 60, SELF LEARNING: 0, TOTAL: 60 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level	Exp
CO1	Interpret the method of testing of simply supported reinforced concrete beam for strength and deflection behavior.	Understand	1,2,3
CO2	Examine the dynamic testing of steel elements.	Analyze	4
CO3	Identify the method of testing of static cyclic testing of single bay two storied steel frames.	Apply	5
CO4	Categorize the quality of concrete and method of testing of concrete by non-destructive test – rebound hammer & ultra-sonic pulse velocity test.	Analyze	6
CO5	Contrast the flow characteristics of self-compacting concrete.	Analyze	7

REFERENCES:

1. Dally, J.W, and Riley, W. F., Experimental Stress Analysis, Mc Graw-Hill, New Delhi, 3rd Edition, 1991.
2. Rajasekaran, S., and Sankar, A., Structural Analysis: A Unified Classical and Matrix Approach, Prentice Hall of India, New Delhi, 3rd Edition, 2009.
3. Gere, J.M., and Timoshenko, S.P., Mechanics of Materials, CBS Publishers, New Delhi, 5th Edition, 2012.
4. Bhavikatti, S.S., Advanced Structural Analysis, Vikas Publishing House, New Delhi, 3rd Edition, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3
Avg.	3	3	3	2	3

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637215. Centre for Academic Courses

ST24P12	TECHNICAL PRESENTATION - I	Category	L	T	P	SL	C
		EEC	0	0	30	0	1

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

A foundational understanding of the relevant technical subject matter and prior coursework in communication or presentation skills. Students should also be familiar with basic research methodologies to effectively convey their ideas.

OBJECTIVES:

- To develop the ability to effectively search, analyze, and synthesize literature from journals and conference proceedings on selected research topics. The course enhances skills in preparing technical reports with structured abstracts and literature reviews, and delivering engaging presentations using tools like PowerPoint.

1. The students have to refer the journals and conference proceedings and collect the literature.
2. The student can select a course-oriented topic.
3. The students have to collect at least 30 research papers published in the last decades.
4. Using OHP / Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
5. The student has to make five presentations in the semester.
6. The student has to write a technical report for about 30 - 50 pages (Title page, one page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references).
7. The technical report has to be submitted to the course coordinator one week before the final presentation.

PRACTICAL: 30, SELF LEARNING: 0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the area of interest of the student.	Apply
CO2	Identify the thrust areas by referring journals, conference proceedings etc.	Apply
CO3	Illustrate with literature collection.	Understand
CO4	Outline his/her own ideas in the current topic.	Understand
CO5	Evaluate report writing and presentation.	Evaluate

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REFERENCES:

1. Beall, J., and Thomas, G, "Research Presentation: A Guide for Students and Researchers", Academic Press, London, 2015.
2. McCarthy,P., and McCarthy, J., "Effective Communication Skills for Engineers and Scientists", Wiley, Hoboken, 2019.
3. Bertsch, S., and Tschunko, H. "Technical Communication: A Practical Approach," Springer, New York, 2018.
4. Gordon, D. "Presenting Engineering Projects: A Guide to Successful Presentation Skills," CRC Press, Boca Raton, 2020.

Mapping of COs with POs and PSOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	3	3	2	2
CO3	3	3	3	2	2
CO4	3	3	3	2	2
CO5	3	3	3	2	2
Avg.	**3**	**3**	**3**	**2**	**2**

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode, Centre for Academic Courses

RM24T09	RESEARCH METHODOLOGY AND IPR	Category	L	T	P	SL	C
		RMC	45	0	0	45	3

(Common to ALL)

PREREQUISITE:

Basic understanding of research methodology and general awareness of legal and innovation-related frameworks.

OBJECTIVE:

- To equip learners with the knowledge and skills to design and conduct research, analyze data effectively, and understand the fundamentals of intellectual property rights and patent processes.

UNIT - I	RESEARCH DESIGN	(9)

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	(9)

Measurements: Measurement scales – Questionnaires and instruments – Sampling and Methods. Data – Preparing, Exploring, Examining and Displaying.

UNIT - III	DATA ANALYSIS AND REPORTING	(9)

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	(9)

Intellectual Property – The concept of IPR, Evolution and development of the concept of IPR, IPR development process, Trade secrets, Utility models, IPR & Biodiversity, 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	(9)

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.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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K.S.R. College of Engineering, Tiruchengode-637215 Centre for Academic Courses

COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
COs	Course Outcome	Cognitive Level
CO1	Develop a suitable research process to solve real-time problems.	Apply
CO2	Apply appropriate methods to collect qualitative and quantitative data for analysis.	Apply
CO3	Apply appropriate statistical tools to analyze data and solve research problems.	Apply
CO4	Describe the types and features of intellectual property and its role in IPR establishment.	Understand
CO5	Illustrate the patent procedures, E-filling, register of patents, and licensing of patents.	Understand

TEXT BOOKS:	
1	Cooper Donald, R., Schindler Pamela, S., and Sharma, J.K., "Business Research Methods", Tata McGraw Hill Education, Eleventh Edition, 2012.
2	Catherine J. Holland, Intellectual Property: Patents, Trademarks, Copyrights, Trade Secrets, Entrepreneur Press, 2007.
REFERENCES:	
1	David Hunt, Long Nguyen, Matthew Rodgers, Patent Searching: Tools & Techniques, Wiley, 2007.
2	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 COs with POs and PSOs					
COs/ POs	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	3	3	-	-	3
CO2	3	3	-	-	3
CO3	3	3	-	-	3
CO4	3	3	-	-	3
CO5	3	3	-	-	3
1 - Low, 2 - Medium, 3 - High					

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K.S.R College of Engineering, Tiruchengode-637215 Centre for Academic Courses

ST24T21	THEORY OF ELASTICITY AND PLASTICITY	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Theory of Elasticity and Plasticity course should have a foundational understanding of Mechanics of Materials, including concepts of stress, strain, and deformation. A solid grasp of Mathematics for Engineering is also essential for analyzing complex stress-strain relationships. Fundamentals of structural analysis is important, covering the analysis of static and dynamic forces.

OBJECTIVES:

- To understand equilibrium, compatibility, plane stress, and plane strain for solving 2D elasticity problems in different coordinate systems. To apply advanced analysis methods like Saint Venant's principle, membrane analogy, and energy theorems in structural analysis.

UNIT - I	PLANE STRESS AND PLANE STRAIN	(9)

Basic concepts of deformation of bodies - Notations of stress and strain in three dimensional (3D) fields -Transformation of stress and strain in 3D field - Analysis of Stress and Strain - Stress-Strain Relationship - Equilibrium Equations - Compatibility Equations - Generalized Hooke's Law - Plane Stress and Plane strain Problems.

UNIT - II	TWO DIMENSIONAL IN ELASTICITY	(9)

Two Dimensional Problems in Cartesian and Polar Co-ordinates for Simple Problems - Airy's stress function - Bi - Harmonic Equation.

UNIT - III	TORSION OF NON-CIRCULAR SECTION	(9)

Saint Venant's Principle - Methods of Analysis - Membrane Analogy -Torsion of thin Rectangular Section and Hollow thin-walled sections - Thick cylinder - Bending of Curved Bars.

UNIT - IV	ENERGY PRINCIPLE	(9)

Theorem of minimum potential energy and complementary energy - Bending of prismatic bars - Stress function - Beam of rectangular cross section - Beams of circular cross section.

UNIT - V	PLASTICITY	(9)

Physical Assumptions - Yield Criteria - Failure Theories - Plastic Stress Strain Relationship - Elastic Plastic Problems in Bending - Torsion and Thick Cylinder.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637215. Centre for Academic Courses

COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
COs	**Course Outcome**	**Cognitive Level**
CO1	Illustrate the equilibrium and compatibility equations, plane stress & plane strain.	**Understand**
CO2	Recall the fundamental concepts of two-dimensional problems in Cartesian and polar coordinates.	**Remember**
CO3	Identify various methods of analysis used in structural mechanics.	**Apply**
CO4	Summarize the theorem of minimum potential energy and the theorem of complementary energy.	**Understand**
CO5	Interpret elastic-plastic behavior in bending problems, including how materials transition from elastic to plastic deformation.	**Understand**

REFERENCES:

1. Timoshenko, S, and Goodier, J.N., "Theory of Elasticity", McGraw Hill (India) Private Limited, Noida, Third Edition, 2019.
2. Dr. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi, Fourth Edition, 2015.
3. P N Chandramouli, "Theory of Elasticity", Yes Dee Publishing Pvt.Ltd, 2017.
4. Jane Helena, H., "Theory of Elasticity and Plasticity", PHI Learning, New Delhi, First Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	3	3	3
CO2	3	2	3	3	3
CO3	3	2	3	3	3
CO4	3	2	3	3	3
CO5	3	2	3	3	3
Avg.	**3**	**2**	**3**	**3**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering. Tiruchengode-637215. Centre for Academic Courses

ST24T22	ADVANCED STEEL STRUCTURES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Understanding of structural mechanics and analysis is essential, including concepts like stress, strain, and equilibrium. Proficiency in steel design principles, including the behavior of materials under various loads, is essential.

OBJECTIVES:

- To develop the ability to design structural members subjected to lateral and axial loads and gain expertise in designing various types of connections, including stiffened and un-stiffened configurations. The course covers analysis and design of steel towers and self-supporting chimneys with considerations for bracing, sag, tension, and load distribution.

UNIT - I	INTRODUCTION	(9)

Design of members subjected to lateral loads and axial loads - Analysis and design of Industrial Buildings and bents-Sway and non-sway frames - Design of purlins, Louver rails, Gable column and Gable wind girder - Analysis of Gable Frames check for deflection.

UNIT - II	DESIGN OF CONNECTIONS	(9)

Types of connections - Bold and welded connections - Design of Framed Connections - Seated Connections - Unstiffened and Stiffened seated Connections - Moment Resistant Connections

UNIT - III	ANALYSIS AND DESIGN OF STEEL TOWERS	(9)

Analysis and Design of Transmission Line Towers - Types of bracing patterns - Sag and Tension calculations - Design of Self-supporting Chimney (Lined and unlined) - Guyed Steel stacks - Stresses due to wind and earthquake force - Design of foundation along with load calculation - Gust Factor Method.

UNIT - IV	PLASTIC ANALYSIS OF STRUCTURES	(9)

Introduction - Shape factor - Moment redistribution - static, kinematic and uniqueness theorems - Combined mechanism - Analysis of single bay and two bay portal frames - Methods of plastic moment distribution - Effect of axial force and shear force on plastic moments - Connection moments distributing connection - Design of continuous beams.

UNIT - V	DESIGN OF LIGHT GAUGE STEEL STRUCTURES	(9)

Types of cross sections - Local bucking and lateral bucking - Concepts of effective width - Design of compression and tension members, beams, deflection of beams and design of beam web - Combined stresses and connections, wall studs.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Interpret the members subjected to forces as per the standard code.	Understand
CO2	Identify different types of steel connections.	Apply
CO3	Analyze and design transmission line towers and Chimneys.	Analyze
CO4	Examine plastic analysis in continuous beams and portal frame.	Analyze
CO5	Analyze light gauge steel elements.	Analyze

REFERENCES:

1. Subramanian. N., "Design of Steel Structures", Oxford University Press, 4th Edition, 2018.
2. L. S. Negi, "Design of steel Structures", Vision as, 2nd Edition (Paperback), 2023.
3. Gambhir. M.L., "Fundamentals of Structural Steel Design", McGraw Hill Education, 1st Edition, 2017.
4. Wei- Wen Yu., "Design of Cold Formed Steel Structures", McGraw Hill Book Company, 5th Edition, 2019.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

K.S.R. College of Engineering, Tiruchengode-637215, Centre for Academic Courses

Chairman (BoS)

ST24T23	FINITE ELEMENT METHOD	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a solid foundation in engineering mechanics and strength of materials, as well as familiarity with matrix algebra and differential equations. Prior knowledge of structural analysis principles and basic computational methods.

OBJECTIVES:

- To understand the fundamentals and historical evolution of 1D and 2D Finite Element Analysis (FEA) and apply methods like weighted residuals, variational formulation, and the Ritz method for solving boundary value problems.

UNIT - I	1D FINITE ELEMENT ANALYSIS	(9)

Historical background - Weighted residual methods - Basic concepts of FEM - Variation formulation of Boundary value problems - Ritz method - Finite element modeling - Element equations - Linear and quadratic shape functions - Bar, beam elements - Applications to heat transfer.

UNIT - II	FINITE ELEMENT ANALYSIS OF 2D PROBLEMS	(9)

Basic Boundary Value Problems in 2 Dimensions - Triangular, Quadrilateral, higher order elements - Poisson and Laplace's equation - Weak Formulation - Element matrices and vectors.

UNIT - III	ISO - PARAMETRIC FORMULATION	(9)

Natural co-ordinate system - Lagrangian interpolation Polynomials - Iso-parametric - Elements - Formulation – Numerical integration - 1D & 2D triangular elements - Rectangular elements - Illustrative Examples.

UNIT - IV	MESHING AND SOLUTION PROBLEMS	(9)

Higher order elements - P and H Methods of Mesh Refinement - ill conditioned elements - Discretization errors - Auto and Adaptive mesh generation techniques - Error evaluation.

UNIT - V	ANALYSIS OF BEAMS AND RIGID FRAMES	(9)

Introduction - Beam analysis using two nodal elements - Analysis of Rigid Plane Frame using 2 Node Beam Elements - A three-dimensional rigid frame element - Timoshenko beam element

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Illustrate basic concept of Finite Element Method, boundary and initial value problems.	Understand
CO2	Examine about the finite element analysis of two-dimensional problems.	Analyze
CO3	Compare Isoparametric elements and formulation of elements equations in one and two dimensions.	Analyze
CO4	Illustrate field problems in higher order elements and analyze using mesh refinement and error evaluation.	Understand
CO5	Inspect about the analysis of beams and rigid frames using two nodal beam elements.	Analyze

REFERENCES:

1. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, 2017.
2. Logan D. L,A "First Course in the Finite Element Method", Cengage Learning India, 5th edition, 7th Edition, 2012.
3. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", McGraw Hill publications, 2013.
4. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 4th Edition, 2015.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	3	-	3	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	3	3	3
Avg.	3	-	3	3	3

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R College of Engineering, Tiruchengode-637215, Centre for Academic Courses

ST24P21	ADVANCED COMPUTING LABORATORY	Category	L	T	P	SL	C
		PCC	0	0	60	0	2

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

The prerequisites typically include a combination of foundational knowledge and skills necessary for advanced computational work. Proficiency in basic computing concepts, including familiarity with computer architecture, operating systems, and programming languages.

OBJECTIVES:

- To gain practical experience in mesh generation, applying loads and constraints, and selecting suitable solution techniques for FEM analysis. The course involves analyzing structural components like RCC beams, slabs, columns, frames, and complex systems such as bridges and retaining walls.

LIST OF EXPERIMENTS:

1. FEM – ANSYS Civil - Preprocessing: Element Type, Material/ Geometric properties, Modelling, Mesh Generation - Solution: Loads, Constraints - Post Processing
2. FEM Analysis of RCC Beam - Column - Slab - Plane frame - Space frame.
3. Analysis of pre-stressed concrete elements.
4. Buckling analysis of steel member.
5. FEM Analysis of Bridge Structure.
6. Dynamic Analysis of Structure Subjected to Seismic Load.
7. Analysis of Retaining wall in Geotechnical module.

PRACTICAL: 60, SELF LEARNING: 0, TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level	Exp
CO1	Relate about Finite Element Model analysis and designing of RCC elements.	Remember	1, 2
CO2	Recall the fundamental concepts and design of pre-stressed concrete elements.	Remember	3
CO3	Interpret the design of steel member and bridge structure using FEM	Understand	4,5
CO4	Summarize about response of dynamic analysis of structure.	Understand	6
CO5	Analyze stability under lateral earth pressures and other forces, guiding engineers in the design	Analyze	7

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REFERENCES:

1. Cheng, J., & Wang, H. "Finite Element Analysis: Theory and Application with ANSYS", Springer, 2nd Edition, 2019.
2. Rao, S. S., "Mechanical Vibrations", Pearson, 5th Edition, 2017.
3. Logan, D.L., "A First Course in the Finite Element Method," Cengage Learning, 6th Edition, 2016.
4. Zienkiewicz, O.C., Taylor, R.L., and Zhu, J.Z., "The Finite Element Method: Its Basis and Fundamentals," Elsevier, 7th Edition, 2013.

Mapping of COs with POs and PSOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	3
CO2	3	3	3	2	3
CO3	3	3	3	2	3
CO4	3	3	3	2	3
CO5	3	3	3	2	3
Avg.	**3**	**3**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

ST24P22	TECHNICAL PRESENTATION - II	Category	L	T	P	SL	C
		EEC	0	0	30	0	1

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

A solid grasp of the relevant technical concepts, along with prior coursework in communication or presentation skills, is essential. Additionally, familiarity with basic research methodologies will help students effectively convey their ideas in a technical presentation context.

OBJECTIVES:

- To gather and review relevant literature on a chosen, course-oriented topic aligned with current trends in their field of interest. The course involves compiling at least 30 recent research papers and developing a comprehensive technical report of 30–50 pages with proper structure. Students are also required to deliver a 20-minute presentation using OHP or PowerPoint, followed by a 10-minute discussion.

1. The students have to refer the journals and conference proceedings and collect the literature.
2. The student can select a course-oriented topic.
3. The students have to collect at least 30 research papers published in the last decades.
4. Using Power Point, the student has to make presentation for 20 minutes followed by 10 minutes discussion.
5. The student has to make five presentations in the semester.
6. The student has to write a technical report for about 30 - 50 pages (Title page, one page Abstract, Review of Research paper under various sub - headings, concluding remarks and list of references).
7. The technical report has to be submitted to the course coordinator one week before the final presentation.

PRACTICAL: 30, SELF LEARNING: 0, TOTAL: 30 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the area of interest of the student.	Apply
CO2	Identify the thrust areas by referring journals, conference proceedings etc.	Apply
CO3	Outline the literature collection.	Understand
CO4	Demonstrate his/her own ideas in the current topic.	Understand
CO5	Perceive about report writing and presentation.	Evaluate

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REFERENCES:

1. Booth, W.C., Colomb, G.G., & Williams, J.M. ,"The Craft of Research", University of Chicago Press, 2008
2. Day, R.A., & Gastel, B,"How to Write and Publish a Scientific Paper", Cambridge University Press,2012.
3. Alley, M, "The Craft of Scientific Presentations: Critical Steps to Succeed and Critical Errors to Avoid," Springer, 2013.
4. Turabian, K.L. (2018), "A Manual for Writers of Research Papers, Theses, and Dissertations," University of Chicago Press, 9th Edition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	-	3
CO2	3	3	3	-	3
CO3	3	3	3	-	3
CO4	3	3	3	-	3
CO5	3	3	3	-	3
Avg.	3	3	3	-	3

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637215, Centre for Academic Courses

ST24T31	DESIGN OF SUB STRUCTURES	Category	L	T	P	SL	C
		PCC	45	0	0	45	3

PREREQUISITE:

It Requires Prior Knowledge in Strength of Materials, Structural Analysis, Geotechnical Engineering, and Engineering Mathematics.

OBJECTIVES:

- To understand site investigation techniques and interpret bore logs, soil data, and geotechnical reports for foundation design. The course covers various foundation types, including footings, rafts, piles, drilled shafts, and caissons, along with their applications, capacity, settlement, and structural supports. It also includes the design of machine foundations considering soil-structure interaction and relevant design criteria.

UNIT - I	SUBSURFACE EXPLORATION	[9]

Purpose - Programme and Procedures - Interpretation of bore logs, soil data and exploration reports.

UNIT - II	SHALLOW FOUNDATIONS	[9]

Types of foundations and their specific applications - depth of foundation - bearing capacity and Settlement estimates - structural design of isolated footings strip, rectangular and trapezoidal combined footings - strap - balanced footings - raft foundation - Approximate flexible method of raft design - Compensated foundations.

UNIT - III	DEEP FOUNDATIONS	[9]

Types of Piles and their applications - Load capacity - Settlements - Group action - Testing of piles - Design of piles and pile caps - Lateral load capacity of piles.

UNIT - IV	FOUNDATIONS FOR BRIDGES AND SPECIAL STRUCTURES	[9]

Drilled shaft foundations and caissons for bridges - Foundations for transmission line towers - Chimneys - Silos - Structural Design of supports for foundation excavations - Design of Anchors.

UNIT - V	MACHINE FOUNDATIONS	[9]

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

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

K.S.R. College of Engineering, Tiruchengode-637215, Centre for Academic Courses

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Conduct site investigations and accurately interpret bore logs, soil data, and exploration reports.	Apply
CO2	Analyze and design foundation types, including footings, rafts, and settlement considerations.	Apply
CO3	Test, and design various pile types and pile caps.	Apply
CO4	Design drilled shafts, caissons, tower foundations, chimneys, silos, supports, and anchors.	Apply
CO5	Analyze types, design criteria, soil-structure interaction, and design machine foundations.	Apply

REFERENCES:

1. Tomlinson, M.J., Foundation Design and Construction, Pearson India, Chennai, Seventh Edition, 2017.
2. Bowels, J. E., Foundation analysis and Design, McGraw Hill International Book Co, Fifth Edition, 2017.
3. Braja M. Das., Principles of Foundations Engineering, Cengage India Private limited, Noida, Eighth Edition, 2017.
4. Swami Saran., Analysis and Design of Substructures, CBS Publishers and Distributors Pvt. Ltd., New Delhi, Second Edition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	3
CO2	3	-	3	2	3
CO3	3	-	3	3	3
CO4	3	-	3	2	3
CO5	3	-	3	3	3
Avg.	3	-	3	3	3

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637 215. Centre for Academic Courses

ST24P31	PROJECT WORK PHASE - I	Category	L	T	P	SL	C
		EEC	0	0	180	0	6

PREREQUISITE:

Basic understanding of research methodology and technical knowledge in the core subject area.

OBJECTIVES:

- To assign faculty supervisors for guiding students in identifying and defining research problems or case studies relevant to their discipline. The course supports literature review, methodology formulation, and effective execution of project work.

1. Every student shall have a supervisor who is the member of the faculty of the institution. Selection of faculty supervisor has to be completed within the first two weeks from the day of beginning of third semester.
2. The students should make discussion with his supervisor for selecting topic.
3. In consultation with supervisor, student has to collect research papers and journals.
4. Preferably it can be an experimental work or it can be a case study.
5. A detailed study of the collected literatures to be carried out.
6. The methodology should be framed and works carried out based on the framed methodology.
7. Phase - I project report should be submitted at the end of the semester as per guidelines.
8. This project report should be evaluated jointly by external and internal examiners.

PRACTICAL: 180, SELF LEARNING: 0, TOTAL: 180 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify a suitable project topic through consultation with a faculty supervisor.	Appiy
CO2	Collect and analyze relevant literature to understand the research background.	Analyze
CO3	Develop a structured methodology to carry out experimental work or case studies.	Create
CO4	Prepare a detailed project report following academic and institutional guidelines.	Analyze
CO5	Demonstrate research skills and project planning through evaluation by internal and external examiners.	Understand

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	3
CO4	2	3	2	2	2
CO5	3	2	3	3	2
Avg.	**3**	**2**	**3**	**3**	**2**

1-Low, 2-Medium, 3-High

Chairman (BoS)

ST24P32	PRACTICAL TRAINING	Category	L	T	P	SL	C
		EEC	0	0	30	0	1

PREREQUISITE:

OBJECTIVES:

- To enable students to identify suitable training domains with faculty guidance and explore relevant literature and industrial resources for applied learning. The course offers practical exposure through fieldwork or case study analysis, linking industry practices with academic concepts.

1. Students should consult with their faculty in-charge to choose the domain or area of industry for their practical training.
2. In consultation with the faculty, students must gather relevant literature, technical manuals, and industry reports related to the training domain.
3. The practical training may preferably involve field/industrial work or can be a case study-based analysis in a relevant area of civil/structural engineering.
2. A comprehensive study of the collected materials and current industry practices must be undertaken to understand the background and recent developments in the chosen domain.
3. Based on literature and industry requirements, a methodology must be developed for documenting and analysing the training process and experiences.
4. A detailed Practical Training Report must be submitted at the end of the semester, formatted as per institutional guidelines.
5. The report will be evaluated jointly by internal and external examiners, considering the technical content, learning outcomes, and presentation quality.

PRACTICAL: 30, SELF LEARNING: 0, TOTAL: 30 PERIODS

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637 215. Centre for Academic Courses

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify and select an appropriate domain of practical training through faculty consultation.	Apply
CO2	Collect and study literature, manuals, and technical documentation related to the training domain.	Understand
CO3	Analyze technical processes and practices observed during field/industrial work.	Analyze
CO4	Develop a detailed technical report based on the findings and methodologies adopted.	Create
CO5	Present training outcomes clearly and professionally, justifying observations and conclusions.	Evaluate

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	2	2
CO2	2	2	2	3	2
CO3	3	2	3	3	3
CO4	2	3	3	3	2
CO5	1	3	2	2	3
Avg.	2	2	2	3	2

1-Low, 2-Medium, 3-High

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K.S.R. College of Engineering. Tiruchengode-637215. Centre for Academic Courses

ST24P41	PROJECT WORK PHASE - II	Category	L	T	P	SL	C
		EEC	0	0	360	0	12

PREREQUISITE:

Basic understanding of research methodology and technical knowledge in the core subject area.

OBJECTIVES:

- To provide each student with a faculty supervisor for continuous guidance in identifying and defining a research problem or case study relevant to their discipline. The course supports literature review, methodology development, and effective execution of the project work.

1. Every student shall have a supervisor who is the member of the faculty of the institution. Selection of faculty supervisor has to be completed within the first two weeks from the day of beginning of third semester.
2. The students should make discussion with his supervisor for selecting topic.
3. In consultation with supervisor, student has to collect research papers and journals.
4. Preferably it can be an experimental work or it can be a case study.
5. A detailed study of the collected literatures to be carried out.
6. The methodology should be framed and works carried out based on the framed methodology.
7. Phase - I project report should be submitted at the end of the semester as per guidelines.
8. This project report should be evaluated jointly by external and internal examiners.

PRACTICAL: 360, SELF LEARNING: 0, TOTAL: 360 PERIODS

Chairman (BoS)

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify a suitable project topic through consultation with a faculty supervisor.	Apply
CO2	Collect and analyze relevant literature to understand the research background.	Analyze
CO3	Develop a structured methodology to carry out experimental work or case studies.	Create
CO4	Prepare a detailed project report following academic and institutional guidelines.	Analyze
CO5	Demonstrate research skills and project planning through evaluation by internal and external examiners.	Understand

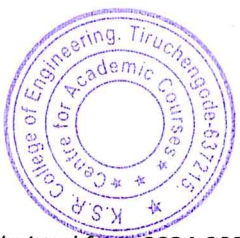
Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PSO1	PSO2
CO1	2	2	2	2	2
CO2	3	2	3	3	2
CO3	3	2	3	3	3
CO4	2	3	2	2	2
CO5	3	2	3	3	2
Avg.	3	2	3	3	2

1-Low, 2-Medium, 3-High

Chairman (BoS)

PROFESSIONAL ELECTIVE COURSES



ST24E01	ADVANCED CONCRETE TECHNOLOGY	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE

To study advanced concrete technology, need a solid foundation in basic concrete technology, including mix design and material properties, as well as understanding structural mechanics and construction practices. Familiarity with material science and durability aspects is also essential.

OBJECTIVES:

- This course focuses on the classification, grading, and testing of concrete, along with analyzing its fresh and hardened properties such as strength, durability, creep, and shrinkage. It covers concrete mix design techniques to optimize performance and maintain quality control.

UNIT - I	CONCRETE MAKING MATERIALS	(9)

Aggregates classification - Indian standard (IS) Specifications - Properties, Grading - Methods of combining aggregates - specified grading - Testing of aggregates. Cement, Grade of cement - Chemical composition - Testing of cement - Hydration of cement - Structure of hydrated cement - Special cements - Water - Chemical admixtures - Mineral admixtures.

UNIT - II	PROPERTIES OF CONCRETE	(9)

Properties of fresh concrete - Hardened concrete - Strength - Elastic properties - Creep and Shrinkage - Variability of concrete strength - Durability of concrete.

UNIT - III	MIX DESIGN	(9)

Principles of concrete mix design - Methods of concrete mix design - Testing of concrete - Statistical quality control - sampling and acceptance criteria.

UNIT - IV	SPECIAL CONCRETE	(9)

Light weight concrete - Heavy density concrete - Fly ash concrete - Fibre reinforced concrete - Sulphur infiltrated Concrete - Polymer Concrete - Super plasticized concrete - Hyper plasticized concrete - High performance concrete - High performance fibre reinforced concrete - Self-compacting concrete.

UNIT - V	MICROSTRUCTURAL ANALYSIS	(9)

X- Ray Diffraction - Differential Thermal Analysis - Thermo gravimetry Analysis - Atomic Absorption Spectroscopy - Conduction Calorimetry - Potentiometric Methods - X-Ray Fluorescence Analysis - Neutron Activation Analysis - Mossbauer Spectroscopy - Nuclear UV Absorption Spectroscopy - Electron Microscopy - Surface Area - Helium Pycnometry – Micro hardness - Mercury Porosimetry - Other Techniques and Standards and Specifications.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate constituent materials of concrete, different types of cement, composition, properties, test of cement and properties of aggregates.	Understand
CO2	Interpret the fresh, hardened and durability properties of concrete.	Understand
CO3	Identify the principles of mix proportioning and Mix design.	Apply
CO4	Summarize types of special concrete and their properties.	Understand
CO5	Outline the standards and specifications of various micro structural analysis Techniques	Understand

REFERENCES:

1. Shetty, M.S., "Concrete Technology - Theory and Practice", S.Chand and Company,8th Edition, 2018.
2. Santhakumar, A.R., "Concrete Technology", Oxford University Press, 2nd Edition, 2018.
3. Neville, A.M., "Properties of Concrete", Pearson Education India, Chennai, 5th Edition, 2019.
4. Ravi Gupta, Harshal Pandule, Amir Ali Plasterwala, "Advanced Concrete Technology" 1st Edition, 2020.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

College of Engineering, Tiruchengodu - 637 215 Centre for Academic Courses

Chairman (BoS)

ST24E02	MAINTENANCE AND REHABILITATION OF STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

It needs a basic knowledge of Structural Engineering, Strength of Materials, and Concrete Technology. Understanding of Construction Materials and Design of Structures is also required. Familiarity with Construction Techniques is beneficial.

OBJECTIVES:

- Understand how environmental conditions and construction errors influence the durability and serviceability of structures, while exploring the causes of corrosion and various protection methods. This includes recognizing the importance of repair and rehabilitation strategies to maintain and restore structural performance over time.

UNIT - I	INFLUENCE ON SERVICEABILITY AND DURABILITY	(9)

Effects due to climate – Temperature – Chemicals - Wear and Erosion - Design and Construction Errors - Corrosion Mechanism - Effects of Cover Thickness and Cracking - Methods of Corrosion Protection - Corrosion Inhibitors - Corrosion Resistant Steels – Coatings - Cathodic Protection.

UNIT - II	MAINTENANCE AND REPAIR STRATEGIES	(9)

Definitions: Maintenance - Repair and Rehabilitation - Facts of Maintenance - Importance of Maintenance - Preventive Measures on Various Aspects Inspection - Assessment Procedure for Evaluating a Damaged Structure, Causes of Deterioration - Testing Techniques.

UNIT - III	MATERIALS FOR REPAIR	(9)

Special Concretes and Mortar - Concrete Chemicals - Special Elements for Accelerated Strength Gain - Expansive Cement - Polymer Concrete - Sulphur Infiltrated Concrete - Ferro Cement - Fiber Reinforced Concrete.

UNIT - IV	TECHNIQUES FOR REPAIR	(9)

Rust Eliminators and Polymers Coating for Rebar's During Repair Foamed Concrete, mortar and Dry Pack - Vacuum Concrete - Gunite and Shotcrete - Epoxy injection - Mortar Repair for Cracks - Shoring and Underpinning.

UNIT - V	REHABILITATION OF STRUCTURES	(9)

Repairs to overcome low member strength Deflection Cracking - Chemical Disruption - Weathering Wear - Fire Leakage - Marine Exposure - Engineered Demolition Techniques for Dilapidated Structures Case Studies.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

K.S.R. College of Engineering. Tiruchengode-637215. Centre for Academic Courses.

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Illustrate the serviceability and durability of concrete with effects due to climate, temperature, chemicals, wear and erosion.	Understand
CO2	Outline the importance of maintenance and inspection of structures with various repairing strategies.	Understand
CO3	Summarize the types of materials for Repair.	Understand
CO4	Demonstrate the various techniques for repair in concrete structures.	Understand
CO5	Explain remedies for failures in structure due to design and construction errors.	Understand

REFERENCES:

1. Shetty, M.S., "Concrete Technology", Theory and Practice, S.Chand and Company, 8th Edition, 2018.
2. Allen R.T, and Edwards S.C., "Repair of Concrete Structures", Blakie and Sons, 1st Edition, 2011.
3. Dayaratnam, P. and Ramana Rao, N.V., "Maintenance and Durability of Concrete Structures", University Press, 1st Edition, 1997.
4. Palaniappan, N., "Estate Management", Anna Institute of Management, 1st Edition, 1992.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

College of Engineering, Tiruchengode-637 215. Centre for Academic Courses K.S.R.

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ST24E03	WIND ANALYSIS AND DESIGN OF STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a foundational understanding of structural engineering principles, including static and dynamic analysis. Familiarity with relevant codes and standards, as well as basic knowledge of fluid mechanics, is also essential for effective comprehension of wind effects on structures.

OBJECTIVES:

- This course covers the fundamental characteristics of wind, its measurement techniques, and its dynamic effects on structures. It includes wind tunnel studies, impact analysis on tall structures, and design strategies for wind-resistant construction in line with IS, ASCE, and NBC codes.

UNIT – I	INTRODUCTION	(9)

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

UNIT – II	WIND TUNNEL STUDIES	(9)

Wind Tunnel Studies - Types of tunnels - Modelling requirements - Interpretation of Results - Aero-elastic models

UNIT – III	EFFECT OF WIND ON STRUCTURES	(9)

Classification of structures - Rigid and Flexible - Effect of wind on structures - Static and dynamic effects on Tall buildings - Chimneys.

UNIT – IV	DESIGN OF SPECIAL STRUCTURES	(9)

Design of Structures for wind loading - IS, ASCE and NBC code provisions - Design of Tall Buildings - Chimneys - Transmission towers - Industrial sheds

UNIT – V	CYCLONE EFFECTS	(9)

Cyclone effect on Low rise structures - Sloped roof structures - Tall buildings - Effect of Cyclone on Claddings - Design of Cladding - use of Code Provisions in Cladding Design - Analytical Procedure and Modeling of Cladding.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

K.S.R. College of Engineering. Tiruchengode-637 215. Centre for Academic Courses.

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Outline types of wind and their characteristics.	Understand
CO2	Interpret tunnels and inspect modeling requirements.	Understand
CO3	Analyze the effect of wind on different structures.	Analyze
CO4	Categorize various code provisions for the design of special structures for wind load.	Analyze
CO5	Identify the Structures as cyclone resistant	Apply

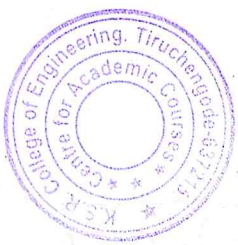
REFERENCES:

1. Peter Sachs, Wind Forces in Engineering, Pergamon Press, New York, 2nd Edition, 2013.
2. Cook. N.J., The Designer's Guide to Wind Loading of Building Structures: Static structures, Butterworths, 1st Edition,2008.
3. John D. Holmes, Wind Loading of Structures, CRC Press, North America, 4th Edition,2021
4. Kolousek.V, Pirner.M, Fischer.O and Naprstek.J., Wind Effects on Civil Engineering Structures, Elsevier Publications, California, 1st Edition, 1984.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-Low, 2-Medium, 3-High



Chairman (BoS)

ST24E04	OPTIMIZATION IN STRUCTURAL DESIGN	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Optimization in Structural Design includes a solid foundation in Structural Analysis and Design Principles. Knowledge of Mathematics, particularly in Linear Algebra and Calculus, is essential. Familiarity with Computer-Aided Design (CAD) tools and basic Programming is also beneficial.

OBJECTIVES:

- This course introduces the basic principles of structural optimization, focusing on objective functions, constraints, and classical techniques. It covers linear, non-linear, geometric, and dynamic programming methods for solving complex design problems.

UNIT - I	BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES	(9)

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity - Behaviour and other constraints - Design space - Feasible and infeasible - Convex and Concave - Active constraint - Local and global optima. Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints - (Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).

UNIT - II	LINEAR AND NON-LINEAR PROGRAMMING	(9)

LINEAR PROGRAMMING: Formulation of problems - Graphical solution - Analytical methods - Standard form - Slack, surplus and artificial variables - Canonical form - Basic feasible solution - simplex method - Two phase method - Penalty method - Duality theory - Primal - Dual algorithm. NON-LINEAR PROGRAMMING: One Dimensional minimization methods: Unidimensional - Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained Optimization Techniques.

UNIT - III	GEOMETRIC PROGRAMMING	(9)

Posynomial - Degree of difficulty - Reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty.

UNIT - IV	DYNAMIC PROGRAMMING	(9)

Bellman's principle of optimality - Representation of a multistage decision problem - Concept of sub-optimization problems using classical and tabular methods.

UNIT - V	STRUCTURAL APPLICATIONS	(9)

Methods for optimal design of structural elements - Continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. structures such as multistory buildings, water tanks and bridges.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

COs	Course Outcome	Cognitive Level
CO1	Explain the basic concepts in optimization techniques	Understand
CO2	Analyze various methods of Linear and Non-Linear programming	Analyze
CO3	Solve problems with degree of difficulty in geometric programming	Apply
CO4	Identify the concept of sub-optimization problems using classical and tabular methods.	Apply
CO5	Apply various methods for optimal design of structural elements.	Apply

REFERENCES:

1. Spunt, Optimization in Structural Design (Civil Engineering and Engineering Mechanics Services), Prentice-Hall, 1st Edition, 1971.
2. Rao, S.S., Optimization Theory and applications, Wiley Eastern Limited, 1st Edition, 1984.
3. Lucas Pun, Introduction to Optimization in Practice, John Wiley & Sons Inc, 1st Edition, 2001.
4. Iyengar. N.G.R and Gupta. S.K., Structural Design Optimization, Affiliated East West Press Ltd, 1st Edition, 1997.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-Low, 2-Medium, 3-High

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ST24E05	SOIL STRUCTURE INTERACTION	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Soil Structure Interaction includes a solid understanding of basic soil mechanics, foundation engineering, and structural analysis. Familiarity with geotechnical principles and concepts of elasticity and material behavior is also essential.

OBJECTIVES:

- This course focuses on the fundamental principles of soil-foundation interaction and their impact on structural stability. It involves the analysis of soil models like Winkler, elastic continuum, and elastic-plastic behavior, along with the study of beams, plates, and piles on elastic foundations.

UNIT - I	SOIL FOUNDATION INTERACTION	(9)

Introduction to Soil - Foundation Interaction Problems, Soil Behavior, Foundation Behavior, Interface Behavior, Scope of Soil Foundation Interaction. Analysis, Soil Response Models, Winkler, Elastic Continuum, Two Parameter Elastic Models, Elastic Plastic Behavior, Time Dependent Behavior.

UNIT - II	BEAM ON ELASTIC FOUNDATION- SOIL MODELS	(9)

Infinite Beam, Two Parameters, Isotropic Elastic Half Space, Analysis of Beams of Finite Length, Classification of Finite Beams in Relation to their Stiffness.

UNIT - III	PLATE ON ELASTIC MEDIUM	(9)

Infinite Plate, Winkler, Two Parameters, Isotropic Elastic Medium, Thin and Thick Plates, Analysis of Finite Plates, Rectangular and Circular Plates, Numerical Analysis of Finite Plates, Simple Solutions.

UNIT - IV	ELASTIC ANALYSIS OF PILE	(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.

UNIT - V	LATERALLY LOADED PILE	(9)

Load Deflection Prediction for Laterally Loaded Piles, Sub grade Reaction and Elastic Analysis, Interaction Analysis, Pile Raft System, Solutions through Influence Charts.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:		
At the end of the course, the students will be able to:		
COs	Course Outcome	Cognitive Level
CO1	Illustrate the concept of soil interaction, linear and non- linear behavior of soil.	Understand
CO2	Analyze infinite and finite length of beams with relation to their stiffness.	Analyze
CO3	Identify the elastic analysis of various plates.	Apply
CO4	Analyze the effects of elastic analysis of pile on the behaviour of a structure	Analyze
CO5	Analyze the structure with soil-structure interaction effects by lumped mass model.	Analyze

REFERENCES:

1. Selva Durai, A.P.S., Elastic Analysis of Soil Foundation Interaction, Elsevier Science Ltd, New York, 1st Edition, 2013.
2. Scott, R.F., Foundation Analysis, Prentice Hall, Englewood, 1st Edition, 2016.
3. ACI 336, Suggested Analysis and Design Procedures for Combined Footings and Mats, American Concrete Institute, New Delhi, 1st Edition, 2002.
4. Poulos, H.G., and Davis, E.H., Pile Foundation Analysis and Design, John Wiley and Sons, New York, 2nd Edition, 2009.

Mapping of COs with POs and PSOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

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ST24E06	STORAGE STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Storage Structures include basic knowledge of structural analysis, material mechanics, and design principles. Familiarity with IS codes and foundation design concepts is also essential.

OBJECTIVES:

- This course covers the design principles of steel and concrete water tanks, including components like stays, joints, and foundations. It includes the analysis and design of steel and concrete bunkers and silos, following IS code provisions.

UNIT - I	STEEL WATER TANKS	(9)

Design of rectangular riveted steel water tank - Tee covers - Plates - Stays - Longitudinal and transverse beams - Design of staging - Base plates - Foundation and anchor bolts - Design of pressed steel water tank - Design of stays - Joints - Design of hemispherical bottom water tank - Side plates - Bottom plates - Joints - Ring girder Design of staging and foundation.

UNIT - II	CONCRETE WATER TANKS	(9)

Design of Circular tanks - Hinged and fixed at the base - IS method of calculating shear forces and moments - Hoop tension - Design of tank - Dome - Ring girders - Conical dome - Staging - Bracings - Raft foundation - Design of rectangular tanks - Approximate methods and IS methods - Design of underground tanks - Design of base slab and side wall - Check for uplift.

UNIT - III	STEEL BUNKERS AND SILOS	(9)

Design of square bunker - Jansen's and Airy's theories - Indian Standard (IS) Codal provisions - Design of side plates - Stiffeners - Hooper - Longitudinal beams - Design of cylindrical silo - Side plates - Ring girder - Stiffeners.

UNIT - IV	CONCRETE BUNKERS AND SILOS	(9)

Design of square bunker - Side Walls - Hopper bottom - Top and bottom edge beams - Design of cylindrical silo - Wall portion - Design of conical hopper - Ring beam at junction.

UNIT - V	PRESTRESSED CONCRETE WATER TANKS	(9)

Principles of circular prestressing - Design of prestressed concrete circular water tanks.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Analyze and design rectangular and pressed steel water tanks, including staging and foundations.	Analyze
CO2	Apply IS methods to design circular and rectangular concrete tanks, including Intze tanks and underground tanks	Apply
CO3	Design square and cylindrical steel bunkers and silos, focusing on structural components and stability.	Create
CO4	Design square and cylindrical concrete bunkers and silos, including conical hoppers and ring beams.	Create
CO5	Apply circular prestressing principles to design prestressed concrete circular water tanks.	Apply

REFERENCES:

1. Krishna Raju N., "Advanced Reinforced Concrete Design", Third Edition CBS Publishers and Distributors,3rd Edition 2016.
2. Punmia B.C, Ashok Kumar Jain, Arun K.Jain, "R.C.C. Designs Reinforced Concrete Structures", Laxmi Publications Pvt. Ltd., New Delhi, 10thEdition, 2015.
3. Gambhir.M.L., "Design of Reinforced Concrete Structures", Prentice Hall of India Private Limited, 4th Edition n,2012.
4. Bhavikatt S.S., "Design of Steel Structures" Limits State Method as per IS: 800:2007, TechSar Pvt. Ltd 5thEdition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E07	FRACTURE MECHANICS OF CONCRETE STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Basic knowledge of concrete materials and structural engineering, Understanding of mechanics of materials and structural analysis. Familiarity with strength of materials and stress-strain behavior.

OBJECTIVES:

- This course introduces the fundamental principles of fracture mechanics in concrete structures, focusing on crack initiation and propagation mechanisms. It explores the fracture properties of concrete, various analytical models, and their impact on structural behavior. Students will also learn experimental methods to evaluate fracture toughness and durability.

UNIT - I	INTRODUCTION TO FRACTURE MECHANICS	(9)

Overview of fracture mechanics in concrete structures - Concepts of linear elastic fracture mechanics (LEFM) and non-linear fracture mechanics (NLFM) - Types of fractures: brittle fracture, ductile fracture, and fatigue - Energy release rate and stress intensity factors.

UNIT - II	CRACK INITIATION AND PROPAGATION	(9)

Mechanisms of crack initiation in concrete - Crack propagation under various loading conditions - Fracture toughness and critical stress intensity factor - Factors influencing crack growth: temperature, loading rate, and material properties.

UNIT - III	FRACTURE MODELS FOR CONCRETE	(9)

Griffith's theory of brittle fracture - Cohesive crack models and their application to concrete - Fictitious crack models and crack tip opening displacement (CTOD) - Size effect in fracture mechanics and Bazant's size effect law.

UNIT - IV	EXPERIMENTAL METHODS FOR FRACTURE TESTING	(9)

Testing methods to determine fracture properties of concrete - Three-point bending tests and notched beam tests - Determination of fracture energy and toughness - Application of fracture mechanics in the design and analysis of concrete structures.

UNIT - V	APPLICATIONS OF FRACTURE MECHANICS IN CONCRETE	(9)

Durability and fracture behavior in reinforced concrete structures - Application to large-scale structures: dams, bridges, and high-rise buildings - Fiber-reinforced concrete and fracture performance - Advanced techniques in crack monitoring and fracture prevention.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the basic principles and concepts of fracture mechanics.	Understand
CO2	Analyze the behavior of cracks in concrete under various loading conditions.	Analyze
CO3	Apply fracture models to assess structural performance of concrete.	Apply
CO4	Interpret fracture toughness and size effects in concrete structures.	Evaluate
CO5	Choose the experimental techniques to measure fracture properties.	Apply

REFERENCES:

1. Shah, S. P., and Carpinteri, A., "Fracture Mechanics of Concrete: Applications of Fracture Mechanics to Concrete, Rock, and Other Quasi-Brittle Materials," Wiley, 1st Edition, 1995.
2. Bazant, Z. P., and Planas, J., "Fracture and Size Effect in Concrete and Other Quasi brittle Materials," CRC Press, 1st Edition, 19970.
3. Karihaloo, B. L., "Fracture Mechanics and Structural Concrete," Longman Scientific and Technical, 1st Edition, 1995.
4. Jenq, Y.S., and Shah, S.P., "Two Parameter Fracture Model for Concrete," Journal of Engineering Mechanics, ASCE, 1985.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E08	DESIGN AND CONSTRUCTION OF FERROCEMENT STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should be familiar with reinforced concrete design, structural analysis, and materials science. Basic knowledge of concrete technology and relevant design codes is also required.

OBJECTIVES:

- This course provides insights into ferrocement materials, comparing their properties with reinforced concrete and applying bending analysis techniques. It covers crack control, ductility under dynamic loads, and shaping ferrocement for strength in composite structures with RCC, steel, and masonry.

UNIT - I	FERROCEMENT AS A STRUCTURAL MATERIAL	(9)

Ferrocement - Definition - Constituent materials of Ferrocement - Distinct characteristics of Ferrocement versus reinforced concrete - Similarities between Ferrocement and reinforced concrete - Mechanical properties - Advantages of Ferrocement as a construction material - Ferrocement for structural applications - Construction methods - Design parameters.

UNIT - II	ANALYSIS METHODS	(9)

Effective area of reinforcement - Typical moment curvature response - Analysis methods for bending under service loads - Flexure formula for un cracked section, transformed area method for the cracked section - Analysis methods for nominal bending resistance - Compatibility method - Simplified method based on all tensile reinforcement yielding - Simplified method using plastic moment - Simplified method using design chart or prediction equation - Computation of deflection.

UNIT - III	DESIGN METHODS THROUGH CRACK WIDTH AND DUCTILITY	(9)

Design based on crack width - Relationship between crack width - Its spacing and stress in steel wire - Equation establishing relationships between crack width - Spacing of cracks, modular ratio, modulus of elasticity and tensile stress of mortar - Crack control method of design - Applied to pipes, silos, water tanks and waterproofing systems - Design of ductility - Strain energy absorbed per unit volume of ferrocement - Design of structures subjected to dynamic loading -Earthquake, wind, machine foundations

UNIT - IV	DESIGN THROUGH SHAPE AND COMPOSITE CONSTRUCTION	(9)

Shaping ferrocement to gain strength - Stress pattern changed due to shaping - Different shapes and stress Patterns like flexure to compression - Different ways of giving forms - Boxing, corrugating, folding, ribbing, stiffening, arching, waffling - Design of composite structures of ferrocement with RCC - Steel and masonry - Precast ferrocement elements with in-built RCC framework - Joints of precast members as structural members their design and construction - Confining and strengthening damaged structures, retrofitting.

UNIT - V	FERROCEMENT CONSTRUCTIONS	(9)

Applications in building construction: Parabolic foundations - Under-reamed piles - Paneled cavity walls and box-sectioned hollow floors - Hollow beams - Stiffened plates as slabs - Design and construction of multi-storied buildings and mass scale housing using in-situ mortaring

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method and method of joining precast walling and floor panels - Water and soil retaining structures: Applications in water treatment and effluent treatment plants and in Irrigation, Highways and Bridges .

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Recall the ferrocement characteristics, properties, advantages.	Apply
CO2	Analyze the methods for bending under service loads, compatibility method, tensile reinforcement yielding, simplified method using plastic moment.	Analyze
CO3	Analyze the Impact of Equation establishing relationships between crack width, spacing of cracks, modular ratio, modulus of elasticity and tensile stress.	Analyze
CO4	Discover various forms for stress pattern under loading- cavity walls, hollow floors, hollow columns and beams, stiffened plates in compression and flexure.	Analyze
CO5	Illustrate ferrocement constructions of precast walling and floor panels, water treatment and effluent treatment plants and in Irrigation, highways and bridges.	Understand

REFERENCES:

1. Stanley Abercrombie, "Ferrocement Building with Cement Sand and Wire Mesh", Hill Family Books, America, 1st Edition, 2008
2. Naaman, A E., Ferrocement and laminated cementations composites, Techno-press, Ann Arbor, Michigan, U S A, 2000.
3. Arun N. Purandare, Design of Composite Structures in Ferrocement, InSc International Publisher, 1st Edition, 2021.
4. Arun N Purandare, Mrudula Kulkarni, Theory and Behaviour of Ferrocement in Construction, InSc International Publisher, 1st Edition ,2021

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E09	DESIGN OF FORMWORK	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

A solid understanding of structural analysis, construction materials, and reinforced concrete design is required. Knowledge of construction safety standards and temporary structures is beneficial.

OBJECTIVES:

- This course enhances students' understanding of formwork design and construction, covering various materials and their specific applications. It examines the structural behavior of formwork under different loading conditions and emphasizes safety standards and failure prevention.

UNIT - I	OVERVIEW OF FORMWORK	(9)

Introduction to formwork: Definition, purpose, and importance in construction - Materials for formwork: Timber - Plywood - Steel - Aluminum - Plastic - Types of formwork systems: Traditional, modular - Reusable formwork - Essential factors in formwork design: Strength, stiffness, safety, and economy.

UNIT - II	DESIGN OF FORMWORK FOR BEAMS, SLABS, AND COLUMNS	(9)

Load calculations: Concrete pressure, live loads, and construction loads - Formwork for beams, slabs, and columns: Design principles - Stability, and deflection criteria - Calculation examples for various formwork elements.

UNIT - III	FORMWORK FOR SPECIAL STRUCTURES	(9)

Formwork for large and special structures: Bridges – Tunnels - Retaining walls - Slip form construction - Principles, design, and case studies - Climbing formwork: Application in high-rise construction and safety considerations.

UNIT - IV	FORMWORK SAFETY AND FAILURE PREVENTION	(9)

Common formwork failures: Causes and prevention methods - Inspection and quality control: Ensuring formwork stability and performance - Safety standards and guidelines: OSHA regulations, formwork failure case studies - Proper handling, erection, and dismantling of formwork systems.

UNIT - V	SUSTAINABLE FORMWORK AND ADVANCED TECHNOLOGIES	(9)

Modern formwork systems: Modular, precast, and reusable systems - Sustainability in formwork: Eco-friendly materials, recycling, and cost efficiency - Advanced technologies: Innovations in formwork design, automation, and digital monitoring - Case studies of sustainable formwork projects.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand and apply formwork design principles for various structures.	Understand
CO2	Analyze and evaluate the materials and systems used in formwork construction.	Analyze
CO3	Apply formwork design to special and complex structures.	Apply
CO4	Identify safety and quality control in formwork erection and dismantling.	Apply
CO5	Organize sustainable and innovative formwork solutions in modern construction.	Apply

REFERENCES:

1. Austin, C. K. "Formwork for Concrete Structures," McGraw-Hill, 3rd Edition, 2019.
2. Hurd, M. K., "Formwork for Concrete," American Concrete Institute, 8th Edition, 2012.
3. Kumar Neeraj Jha, "Formwork for Concrete Structures," Tata McGraw-Hill, 2nd Edition, 2012.
4. Peurifoy, R. L., Schexnayder, C., and Shapira, A., "Construction Planning, Equipment, and Methods," McGraw-Hill, 9th Edition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E10	NON-LINEAR ANALYSIS OF STRUCTURE	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a solid grasp of structural analysis, mechanics of materials, and linear elastic analysis, including matrix and finite element methods. A background in calculus, differential equations, and material behavior is essential. Understanding structural stability and basic computational methods is also important.

OBJECTIVES:

- This course introduces the fundamental principles of structural non-linearity, including geometric and material non-linearity, and their effects on structural behavior. It equips students with analytical and computational methods, including finite element techniques, for solving complex non-linear problems.

UNIT - I	INTRODUCTION TO NON-LINEAR STRUCTURAL ANALYSIS	(9)

Introduction to linear Vs non-linear behavior - Types of non-linearity's: geometric - material, and boundary condition non-linearity's - Examples of non-linear structural problems - Mathematical formulation of non-linear problems - Incremental and iterative solution methods - Stability in non-linear systems.

UNIT - II	GEOMETRIC NON-LINEARITY	(9)

Introduction to geometric non-linearity: large deformations and large rotations - Non-linear strain-displacement relations - Principle of virtual work for non-linear systems - Analysis of structures undergoing large deflections - Cables, arches, and shells - Stability issues and buckling in geometrically non-linear systems.

UNIT - III	MATERIAL NON-LINEARITY	(9)

Material non-linearity: stress-strain relationships beyond the elastic limit - Elasto-plasticity, viscoelasticity, and damage mechanics - Yield criteria (von Mises, Tresca) - Hardening models: isotropic and kinematic hardening - Post-yield behavior and plastic hinge formation in structures - Applications in concrete, steel, and composite materials.

UNIT - IV	NUMERICAL METHODS FOR NON-LINEAR ANALYSIS	(9)

Numerical techniques for solving non-linear problems: Newton-Raphson method - Modified Newton-Raphson method - Arc-length method. Finite element method (FEM) in non-linear analysis - Convergence and solution accuracy - Mesh sensitivity analysis and adaptive meshing techniques - Applications in solving complex non-linear structural problems.

UNIT - V	APPLICATIONS OF NON-LINEAR ANALYSIS	(9)

Practical applications of non-linear analysis in structural engineering - Seismic analysis and response of structures under extreme loading conditions - Non-linear static and dynamic analysis of buildings - bridges - and other infrastructure - Case studies: performance-based design and non-linear pushover analysis - Non-linear analysis in design codes and standards.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the fundamental principles of non-linear structural analysis.	Understand
CO2	Analyze the behavior of structures under geometric non-linearity.	Analyze
CO3	Analyze material non-linearity and its effects on structural response.	Analyze
CO4	Identify numerical methods for solving non-linear structural problems.	Apply
CO5	Analyze and assess real-world structures using non-linear analysis techniques.	Analyze

REFERENCES:

1. K.J. Bathe, "Finite Element Procedures," Prentice Hall, 2nd Edition, 2014.
2. J.N. Reddy, "An Introduction to Nonlinear Finite Element Analysis," Oxford University Press, 2nd Edition, 2015.
3. Ted Belytschko, Wing Kam Liu, Brian Moran, "Nonlinear Finite Elements for Continua and Structures," Wiley, 1st Edition, 2000.
4. R. C. Hibbeler, "Structural Analysis," Pearson Education, 9th Edition, 2017.

Mapping of COs with POs and PSOs					
COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E11	PRESTRESSED CONCRETE STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Understanding of static and dynamic loads, equilibrium, and analysis of beams, frames, and trusses, Knowledge of reinforced concrete design principles, including stress-strain relationships and design codes and basic concepts in structural engineering, including load calculations and structural behavior.

OBJECTIVES:

- This course covers prestressing principles, stress analysis, losses, and cable layouts. It includes the design of flexural, tension, and compression members as per IS:1343, along with continuous and composite beams. Applications like prestressed pipes, tanks, columns, and piles are also explored.

UNIT - I	PRINCIPLES OF PRESTRESSING	(9)

Principles of Prestressing - Types and Systems of Prestressing - Need for High Strength Concrete and High Tensile Steel - Types of Tensioning - Analysis of Sections for Stresses by Stress Concept - Strength Concept and Load Balancing Concept - Short- and long-term Deflection - Losses in Prestressing, Camber and Cable Layouts.

UNIT - II	DESIGN OF FLEXURAL MEMBERS	(9)

Behaviour of Flexural Members - Determination of Ultimate Flexural Strength - IS: 1343 Codal Provisions - Design of Flexural Members - Design for Combined Bending, Shear and Torsion - Design of Anchorage Zone.

UNIT - III	DESIGN OF CONTINUOUS BEAMS	(9)

Analysis and Design of Continuous Beams - Methods of Achieving Continuity - Concept of Linear Transformations - Concordant Cable Profile - Cap 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 - Application in the Design of Columns and Piles.

UNIT - V	DESIGN OF COMPOSITE MEMBERS	(9)

Composite Beams - Analysis and Design, Ultimate Strength - Applications. Partial Prestressing - its Advantages and Applications. Case studies: Bunkers - Electric poles - Circular Prestressing - Railway slabs.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)
K.S.R. College of Engineering

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand prestressing principles, high-strength materials, tensioning methods, and stress evaluation.	Understand
CO2	Analyze flexural members in prestressed concrete by determining ultimate flexural strength and interpreting IS: 1343 provisions.	Analyze
CO3	Analyze continuous beams in prestressed concrete structures by understanding methods of achieving continuity.	Analyze
CO4	Examine tension and compression members in prestressed concrete structures, including prestressed pipes, water tanks, columns, and piles.	Analyze
CO5	Analyze the stresses and ultimate strength of prestressed composite beams and partially prestressed structures.	Analyze

REFERENCES:

1. KrishnaRaju, N., "Prestressed concrete", McGraw Hill Education Private Limited, 6thEdition, 2018.
2. Shamsher Bahadur Singh., "Analysis and Design of Prestressed Concrete Structures", Wiley India Pvt Ltd., 1st Edition, 2023.
3. Pandit, G. S. and Gupta, S. P., "Prestressed concrete", CBS Publishers and Distributors Private Limited, 1st Edition, 2019.
4. Ramesh babu S., "Prestressed Concrete Structures", Sree Kamalamani Publications, 1stEdition, 2018.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E12	SPECIAL CONCRETE	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Understanding of conventional concrete mix design, properties, and testing methods, Familiarity with the properties and behavior of different construction materials and experience with designing and proportioning concrete mixes for various applications.

OBJECTIVES:

- This course explores advanced concretes such as fiber reinforced concrete, ferrocement, lightweight, and high-density concrete, focusing on their properties, applications, and innovations. It covers large volume fly ash and slag concretes, polymer concretes with latex modification, and durability aspects.

UNIT - I	FIBRE REINFORCED CONCRETE AND FERROCEMENT	(9)

Fibre reinforced concrete - Types of fibre - Properties of fibres - Factors affecting the properties of FRC - Workability - Mixing - Application - Different types of fibre reinforced concrete - Current development in FRC - Ferrocement - Casting Techniques - Applications.

UNIT - II	LIGHT WEIGHT CONCRETE AND HIGH-DENSITY CONCRETE	(9)

Light weight concrete - Lightweight Aggregate concrete - Structural light weight concrete - Workability - Design of lightweight Aggregate Concrete Mix - Mixing procedure - Aerated concrete - No fines concrete - High density concrete - Types of radiation Hazards - Use of Concrete for radiation shielding.

UNIT - III	HIGH VOLUME FLY ASH AND SLAG CONCRETE	(9)

Introduction - High volume fly ash & slag concrete - Mechanism of hydration - Mix proportion - Properties of Fresh & Hardened Concrete - Durability Aspects of High-Volume fly Ash Concrete and slag concrete.

UNIT - IV	POLYMER MODIFIED MORTAR AND CONCRETE	(9)

Introduction - Application - General principle - Latex modification, Redispersible polymer powders - Water Soluble Polymers - Liquid Resins - Monomers - Latex Modified Systems - Materials - Mix Proportioning - Mixing - Placing & Curing - Types of polymer concrete - Durability properties - Applications.

UNIT - V	CONCRETE UNDER SPECIAL CIRCUMSTANCES	(9)

High Strength and High Performance Concrete - Self compacting concrete - Selfcuring concrete, Geopolymer concrete - Bacterial concrete - Nano materials in concrete.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the constituent materials of fibre reinforced concrete, properties of fibre, ferro cement and its applications.	Understand
CO2	Illustrate workability, mixing procedure of light weight and high-density concrete.	Understand
CO3	Interpret the properties and durability of the high-volume fly ash and slag concrete.	Understand
CO4	Identify the types of polymers, mixing proportion and durability properties and its applications.	Apply
CO5	Choose different types of concrete under special circumstances.	Apply

REFERENCES:

1. Shetty, M.S., "Concrete Technology - Theory and Practice", S.Chand and Company, 18th Edition, 2018.
2. Santhakumar, A.R., "Concrete Technology", Oxford University Press, 2nd Edition, 2018.
3. Gambir, M.L., "Concrete Technology", Tata McGraw Hill Publishing Co. Ltd, 5th Edition, 2017.
4. Bartos. P.J.M., "Special Concretes - Workability and Mixing", CRC Press, 1st Edition, 2019.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E13	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Fundamental understanding of structural analysis, mechanics of materials, and design principles for steel and concrete structures. Knowledge of load distribution, behavior of composite materials, and familiarity with design codes for steel and concrete is essential. Proficiency in applying limit state design methods is recommended.

OBJECTIVES:

- This course introduces steel-concrete composite construction, covering shear connections and design of beams, slabs, and columns. It also includes the design of composite box girder bridges and their behavior under effects like temperature and creep.

UNIT - I	INTRODUCTION	(9)

Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures - Introduction to Steel - Concrete - Steel Sandwich Construction - Introduction - Limit states of composite sections - Shear connectors - Type of shear connectors - Degree of shear connection - partial and complete shear connections - Strength of shear connectors - Analysis and design of composite beams without profile sheet.

UNIT - II	DESIGN OF COMPOSITE BEAMS	(9)

Behavior of Composite Beams - Design of Composite Beams - Propped condition - Un propped condition - Deflection of composite beams - Beam with profile sheeted deck slab - Design of partial shear connection.

UNIT - III	DESIGN OF COMPOSITE SLABS	(9)

Introduction - Behavior of Composite slabs - profiled sheeting - Sheeting parallel to span - sheeting perpendicular to span - Analysis and design of composite floor system.

UNIT - IV	DESIGN OF COMPOSITE COLUMNS	(9)

Behavior of Composite Column - Types of Composite columns - Design of encased columns - design of in-filled columns - axial, uni-axial and bi-axially loaded columns.

UNIT - V	COMPOSITE BOX GIRDER BRIDGES AND CASE STUDIES	(9)

Introduction - Behavior of Box Girder Bridges - Design Concepts. Temperature - shrinkage and creep - vibration of composite section - Cyclic behavior of composite section - case studies.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand basic ideas on steel – concrete composite in construction	Understand
CO2	Identify the behavior of composite beams and columns	Apply
CO3	Analyze composite beams, columns and trusses	Analyze
CO4	Categorize the behavior of composite girder bridges.	Analyze
CO5	Interpret knowledge from the case studies deals with composite construction.	Understand

REFERENCES:

1. Johnson R.P, "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Wiley-Blackwell, 3rd Edition, 2004.
2. Narayanan. R, "Steel-Concrete Composite Structures", CRC Press, 1st Edition, 2019.
3. Oehlers D.J. and Bradford M.A., "Composite Steel and Concrete Structural Members, Fundamental behavior", Pergamon, 1st Edition, 2013.
4. Owens, G.W. and Knowles, P., "Steel Designers Manual, Steel Concrete Institute (UK)", Oxford Blackwell Scientific Publications, 5th Edition, 1993.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E14	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a basic understanding of structural mechanics, material properties, and behavior under loading. Familiarity with concepts in measurements, data acquisition systems, and error analysis is essential. Proficiency in using laboratory equipment and interpreting experimental data is recommended.

OBJECTIVES:

- This course covers experimental stress analysis, including strain gauges, sensors, and non-destructive testing methods. It focuses on vibration monitoring, structural diagnostics, and tools for assessing and maintaining structural integrity.

UNIT - I	FORCES AND STRAIN MEASUREMENT	(9)

Choice of Experimental Stress Analysis Methods - Errors in Measurements - Strain Gauge - Principle, types, performance and uses - Photo Elasticity - Principle and Applications - Hydraulic Jacks and Pressure Gauges - Electronic Load Cells - Design of Load Cell, Proving Rings - Calibration of Testing Machines - Long-Term Monitoring - Vibrating Wire Sensors - Fibre Optic Sensors.

UNIT - II	VIBRATION AND TEMPERATURE MEASUREMENTS	(9)

Characteristics of Structural Vibrations - Linear Variable Differential Transformer (LVDT) - Transducers for Velocity and Acceleration Measurements - Vibration Meter - Seismographs - Vibration Analyzer - Display and Recording of Signals - Cathode Ray Oscilloscope - XY Plotter - Chart Plotters - Digital Data Acquisition Systems - Thermo Couple Gauge.

UNIT - III	NON-DESTRUCTIVE STRUCTURE AND WIND FLOW MEASURES	(9)

Load Testing on Structures, Buildings, Bridges & Towers - Rebound Hammer - Acoustics Emission - Ultrasonic Testing Principles & Application - Holography - Use of Laser for Structural Testing - Brittle Coating, Advanced NDT Methods - Ultrasonic Pulse Echo - Impact Echo - Impulse Radar Techniques GECOR - Ground Penetrating Radar (GPR) - Principles of Pressure and Flow Measurements - Pressure Transducers - Wind Tunnel and its use in Structural Analysis - Structural Modeling - Direct and Indirect Model Analysis.

UNIT - IV	DISTRESS MEASUREMENTS AND CONTROL	(9)

Diagnosis of Distress in Structures - Crack Observation and Measurements - Corrosion of Reinforcement in Concrete - Half cell - Construction and use - Damage Assessment - Controlled Blasting for Demolition - Techniques for Residual Stress Measurements - Permeability Measurements.

UNIT - V	RESEARCH TECHNIQUES, STANDARDS AND SPECIFICATIONS	(9)

X- Ray Diffration - Differential Thermal Analysis - Thermo gravimetry Analysis - Atomic Absorption Spectroscopy - Conduction Calorimetry - Potentiometric Methods - X-Ray Fluorescence Analysis - Neutron Activation Analysis - Mossbauer Spectroscopy - Nuclear UV Absorption Spectroscopy - Electron Microscopy - Surface Area - Helium Pycnometry – Microhardness - Mercury Porosimetry - Other Techniques and Standards and Specifications.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain various stress analysis methods and testing methods.	Understand
CO2	Identify characteristics of structural vibrations and acceleration measurements.	Apply
CO3	Demonstrate on various testing methods and technologies in non-destructive structure and wind flow measures.	Understand
CO4	Illustrate diagnosis of distress in structures, distress measurements and control.	Understand
CO5	Demonstrate research techniques, standards and specifications.	Understand

REFERENCES:

1. Dr.Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, 4th Edition, 2009.
2. Dalley, J.W. and Riley, W.F., "Experimental Stress Analysis", McGraw Hill Book Company, 3rd Edition, 1991.
3. Srinath, L.S., Raghavan, M.R., Lingaiah, K., Gargesha,G., Pant, B. and Ramachandra.K., "Experimental Stress Analysis", Tata McGraw Hill Company, 1st Edition,1984.
4. Bray, D.E. and Stanley, R.K., "Course Material on Non-destructive Evaluation", McGraw Hill Publishing Company, 1st Edition,1989.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E15	INDUSTRIAL STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should possess a solid understanding of structural analysis and design principles. Familiarity with construction materials, load-bearing systems, and relevant industry codes is essential for effectively designing and analyzing industrial structures.

OBJECTIVES:

- This course covers the planning and design of industrial structures, focusing on layouts, roofs, and key elements like gantry girders and foundations. It includes power plant components such as chimneys and cooling towers, and transmission structures like towers and substations.

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 from Factories Act.

UNIT - II	ROOF FOR INDUSTRIAL BUILDINGS	(9)

Roofs for Industrial Buildings - Steel and RC - Folded Plates and Shell Roofs.

UNIT - III	MISCELLANEOUS STRUCTURES	(9)

Gantry Girders - Design of Corbels and Nibs - Machine Foundations.

UNIT - IV	POWERPLANT STRUCTURES	(9)

Bunkers and Silos - Chimneys and Cooling Towers - High Pressure Boilers and Piping Design - Nuclear Containment Structures.

UNIT - V	POWER TRANSMISSION STRUCTURES	(9)

Cables - Transmission Line Towers - Substation Structures - Tower Foundations - Testing Towers.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Summarize basic concept of planning and requirements of industrial structures.	Understand
CO2	Demonstrate Industrial building and industrial roofing structures.	Understand
CO3	Construct a gantry girder with corbels and nibs for a specific load.	Apply
CO4	Analyze field problems in power plant structures.	Analyze
CO5	Explain concept of power transmission structures.	Understand

REFERENCES:

1. Srinivasalu, P. and Vaidyanathan, C.V., "Handbook of Machine Foundations", Tata McGraw Hill, 1st Edition, 2017.
2. Unnikrishna Pillai, S , Devdas Menon., "Reinforced Concrete Design", Tata McGraw Hill, 4th Edition, 2021.
3. Sharma, N, "Reinforced Cement Concrete Design", S K Kataria & Sons, 1st Edition, 2014.
4. Varghese, P.C., Advanced Reinforced Concrete Design, Prentice Hall of India Private Limited, 2nd Edition, 2011.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

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ST24E16	EARTHQUAKE RESISTANT STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a strong foundation in structural analysis and dynamics, particularly in understanding the behavior of structures under dynamic loads. Familiarity with seismic design codes and concepts of structural stability is also essential for effective study in this area.

OBJECTIVES:

- This course covers earthquake ground motion, structural response analysis, and seismic design based on Indian codes. It includes assessment of RCC and masonry structures, focusing on damage control and earthquake-resistant strategies.

UNIT - I	INTRODUCTION	(9)

Earthquake Ground Motion: Engineering seismology - Seismic zoning map of India - Strong motion studies in India - Strong motion characteristics - Evaluation of seismic design parameters - Structural Dynamics: Initiation into structural dynamics - Dynamics of Single degrees of freedom (SDOF) systems - Theory of seismic pickup - Numerical evaluation of dynamic response - Response spectra - Dynamics of MDOF systems.

UNIT - II	CONCEPTS OF EARTHQUAKE RESISTANT DESIGN	(9)

Basic elements of earthquake resistant design - Identification of seismic damages in RCC buildings - Effect of structural irregularities on performance of RCC buildings during earthquakes - Earthquake resistant building architecture.

UNIT - III	SEISMIC ANALYSIS AND MODELING OF RCC STRUCTURES	(9)

Code based procedure for determination of design lateral loads - Infill walls - Seismic analysis procedure as per IS 1893 code - Equivalent static force method - Response spectrum method - Time history analysis - Mathematical modelling of multi-storey RCC buildings.

UNIT - IV	EARTHQUAKE RESISTANT DESIGN OF RCC STRUCTURES	(9)

Ductility considerations - Earthquake resistant design of multi-storey RCC buildings - Shear walls based on IS 13920 code - Capacity based design.

UNIT - V	EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES	(9)

Identification of damages and non-damages in masonry buildings - Elastic properties of structural masonry - Lateral load analysis of masonry buildings - Seismic analysis and design of one-storey and two-storey masonry buildings.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Interpret the performance and response of the structure during earthquake.	Understand
CO2	Analyze the structures to resist earthquake forces by different methods.	Analyze
CO3	Analyze the structures subjected to earthquake loading by different methods.	Analyze
CO4	Apply ductile detailing of reinforced concrete and masonry buildings as per codal provisions.	Apply
CO5	Analyze the concepts of the earthquake resistant design of masonry structures.	Analyze

REFERENCES:

1. Mohiuddin Ali Khan., Earthquake-Resistant Structures, Design, Build, and Retrofit, Butterworth-Heinemann, 1st Edition, 2013.
2. Pankaj Agarwal, and Manish Shrikhande., Earthquake Resistant Design of Structures, Prentice Hall of India, 5thEdition, 2009.
3. Paulay, T. and Priestley, M.J.N., Seismic Design of Reinforced Concrete and Masonry buildings, John Wiley and Sons, 1st Edition,1992.
4. Duggal, S.K., Earthquake Resistant Design of Structures, Oxford University Press, 2nd Edition, 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

ST24E17	DESIGN OF TALL BUILDINGS	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a solid foundation in structural analysis, behavior of materials, and design of reinforced concrete and steel structures. Knowledge of wind and seismic load analysis, as well as familiarity with lateral load-resisting systems, is essential. Understanding of building codes and standards for high-rise construction is recommended.

OBJECTIVES:

- This course covers the behavior and design of tall buildings under lateral loads, focusing on systems like frames and shear walls. It includes analysis, modeling, and use of software tools for structural design.

UNIT - I	INTRODUCTIONOF TALL BUILDINGS	(9)

Design Philosophy, Materials - Evolution of tall buildings - Classification of Buildings - Low-rise, medium-rise, high rise - Ordinary framed buildings & Shear-wall buildings - Behaviors of buildings under lateral loads like Wind loads, Earthquake loads & Blast loads - Basic structural & functional design requirements - Strength, and Stiffness & Stability.

UNIT - II	LATERAL LOAD RESISTING ELEMENTS	(9)

Frames, Shear walls & Tubes - Shear, Bending & combine modes of deformation - Structural behavior of Rigid frames - Simplified methods of analysis - Substitute frame method, Portal method, Cantilever method, Equivalent frame method - Structural behaviour of Shear walls - Approaches of analysis - Elastic continuum approach & Discrete approach - Structural behavior of Tubes - Actions.

UNIT - III	BEHAVIOUR OF STRUCTURAL SYSTEMS	(9)

Frame building, Shear wall building - Shear walls acting with frames - Single framed tubes - Other structural forms - Staggered Wall-beam system - Tube-in-tub system - Base isolation technique for earthquake resistance - Load distribution in a tall building - Load resisted by different shear walls & frames - Determinate & indeterminate problems – Equivalent Stiffness method.

UNIT - IV	ANALYSIS AND DESIGN	(9)

Modeling for approximate analysis - Accurate analysis and reduction techniques - Analysis of structures as an integral unit - Analysis for member forces - Drift and twist - Computerized 3D analysis - Design for differential movement - Creep and Shrinkage effects - Temperature Effects and Fire Resistance.

UNIT - V	MODERN METHODS	(9)

Modern concepts -Analysis of tall buildings by Stiffness method – Available Software's for analysis of tall buildings.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the modern concepts and evolution of high rise building structures.	Understand
CO2	Evaluate lateral load resisting elements by different methods.	Evaluate
CO3	Illustrate the behavior of shear walls and base isolation technique for earthquake resistance.	Understand
CO4	Design of tall buildings by various analysis methods.	Create
CO5	Identify software for analysis of tall buildings.	Apply

REFERENCES:

1. Bryan Stafford Smith and Alex Coull, Tall Building Structures: Analysis and Design, Wiley India Private Limited, New York,1st Edition, 2011.
2. Bungale S. Taranath, Structural Analysis and Design of Tall Buildings: Steel and Composite Construction, CRC Press, New York, 1st Edition, 2011.
3. Lin, T.Y. and Burry D.Stotes., Structural Concepts and Systems for Architects and Engineers, Van Nostrand Reinhold Co., New York, 2nd Edition, 1994.
4. Lynn S. Beedle, Advances in Tall Buildings, Van Nostrand Reinhold Co., New York, 1st Edition, 1986.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-Low, 2-Medium, 3-High

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ST24E18	DESIGN OF OFFSHORE STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Students should have a solid understanding of structural engineering principles, particularly in the context of fluid dynamics and environmental loads. Familiarity with materials used in marine applications and relevant offshore design codes is also essential for effective study and design.

OBJECTIVES:

- This course aims to provide an understanding of environmental loads acting on offshore structures and their behavior under various loading conditions. It focuses on the design of offshore structures using relevant codes and standards, along with the analysis of their dynamic response and stability.

UNIT - I	INTRODUCTION TO OFFSHORE STRUCTURES	(9)

Types of Offshore Structures: Fixed, floating, and compliant structures - Marine Environment: Wind, waves, currents, and seismic forces - Design Criteria: Safety, functionality, and durability - Introduction to Offshore Engineering Standards: API, ISO, DNV GL.

UNIT - II	ENVIRONMENTAL LOADS ON OFFSHORE STRUCTURES	(9)

Wave Load Theories: Airy's Stokes - Non-linear wave theories - Current and Wind Loads: Methods of calculation - Combined Load Effects - Wave-current interaction - Application of IS and API standards for load calculation.

UNIT - III	STRUCTURAL ANALYSIS OF OFFSHORE STRUCTURES	(9)

Static and Dynamic Analysis: Methods and approaches - Stability and Buoyancy - Free surface effects - Meta centric height - Fatigue Analysis - S-N curves - Fatigue life estimation - Case Studies: Analysis of jackets - TLPs, and SPAR platforms.

UNIT - IV	DESIGN OF OFFSHORE STRUCTURES	(9)

Design Principles - Load and resistance factor design - Allowable stress design - Material Selection - Corrosion - Wear - Material degradation - Structural Systems – Bracings – Jackets - decks - Topside facilities - Software Applications - Use of software in offshore structural design.

UNIT - V	SPECIAL TOPICS IN OFFSHORE ENGINEERING	(9)

Offshore Wind Energy Structures - Design and analysis of wind turbine foundations - Subsea Structures - Pipelines, risers, and subsea manifolds - Decommissioning of Offshore Structures: Methods and challenges - Emerging Trends: Floating LNG platforms - Deepwater exploration - Environmental impact.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

Course Outcome	Description	Cognitive Level
CO1	Understand the types and functions of offshore structures	Understand
CO2	Apply relevant codes and standards for environmental load calculation	Apply
CO3	Analyze the behavior of offshore structures under different loading conditions	Analyze
CO4	Examine offshore structures to ensure stability and durability	Analyze
CO5	Utilize modern tools and techniques in the design and analysis of offshore structures	Apply

REFERENCES:

1. Ben C. Gerwick, Jr., "Construction of Marine and Offshore Structures," CRC Press, 4th Edition, 2023.
2. Subrata K. Chakrabarti, "Handbook of Offshore Engineering," Elsevier, 2nd Edition, 2022.
3. API RP 2A-WSD, "Recommended Practice for Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design," 23rd Edition, 2020.
4. C. G. Oliver, "Offshore Structural Engineering: Reliability and Risk Assessment," CRC Press, 2021.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

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ST24E19	CHEMISTRY OF CEMENT AND CONCRETE	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Basic knowledge of chemistry and material science, including construction material properties, along with familiarity with fundamental civil engineering concepts.

OBJECTIVES:

- To understand the composition, manufacturing, hydration, setting, and hardening of Portland cement and analyze its physicochemical and mechanical properties and evaluate the role of pozzolanic materials, blast furnace slag, and micro-silica in enhancing concrete performance.

UNIT - I	PORTLAND CEMENT	(9)

Composition - Manufacture of Portland Cement Clinker - Production of Cement - Components and Their Phase Relationships - Constitutions and Specifications of Portland Cement.

UNIT - II	HYDRATION, SETTING AND HARDENING OF PORTLAND CEMENT	(9)

Introduction - Hydration of Pure Clinker Minerals - Interaction in the Hydration of Clinker Minerals - Hydration of Portland Cement - Setting of Portland cement - Hydrated PC Paste - Strength of Hydrated Cement - PC Hydration at Elevated Temperature.

UNIT - III	PHYSICOCHEMICAL AND MECHANICAL PROPERTIES OF PORTLAND CEMENT	(9)

Introduction - Heat of Hydration - Setting Time - Strength - Instantaneous and Time - Dependant Strains Under Load - Drying Shrinkage - Durability.

UNIT - IV	POZZOLANIC AND BLAST FURNACE SLAG CEMENT	(9)

Introduction - Types of Pozzolanic Materials - Mixture of Pozzolanic Materials with lime - Cement Containing Pozzolanic Materials - Fresh, Mechanical, Transportation and Durability properties of concrete. Blast Furnace Slag - Processing - Composition - Slag activation - Hydration Modelling of GGBS cements - Hydraulic activity of slag - Portland Slag Cement and Blast furnace cement - Super-Sulfated cement.

UNIT - V	MICRO-SILICA AS AN ADDITION	(9)

Introduction - The Material - Effects on fresh concrete - Setting and Hardening of Concrete - Mechanical properties and Durability of Hardening Concrete - Practical Use of Micro-silica in concrete - Production of Micro-silica - Health and safety - standards and specifications - Mix design criteria.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify the manufacture, components and specifications of Portland cement.	Apply
CO2	Outline the hydration, setting and hardening processes of Portland cement.	Understand
CO3	Summarize the physicochemical and mechanical properties of Portland cement.	Understand
CO4	Rephrase the role of pozzolanic materials and blast furnace slag in concrete	Understand
CO5	Relate the practical use, production, and mix design criteria of micro-silica in concrete.	Remember

REFERENCES:

1. Lea's, Chemistry of Cement and concrete, Butter worth-Heinemann, Oxford, 5th Edition, 2019.
2. Taylor, H.F.W., Cement Chemistry, Thomas Telford Publishing, 2nd Edition, 1997.
3. Neville, A.M., Properties of Concrete, Pearson Education, 5th Edition, 2012.
4. Mehta, P.K., and Monteiro, P.J.M., Concrete: Microstructure, Properties, and Materials, McGraw Hill, fourth Edition, 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

College of Engineering, Tiruchengode-637 215 * Centre for Academic Courses * K.S.R.

Chairman (BoS)

ST24E20	SOFT COMPUTING IN STRUCTURAL ENGINEERING	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Basic concepts of evolutionary algorithms and optimization techniques. Understanding of basic data structures (arrays, lists, trees) and algorithms for problem-solving and optimization. Understanding of complex structural systems and analysis methods.

OBJECTIVES:

- To provide a comprehensive understanding of artificial neural networks (ANNs), including their fundamental architecture.
- To demonstrate BAM, and ART and their applications in solving structural engineering problems.
- To introduce the fundamental concepts of fuzzy logic, including fuzzy sets, relation and to explore fuzzy quantifiers.
- To understand the genetic algorithms (GA), including the representation of design variables, objective functions, and constraints.
- To familiarize with the advanced hybrid computational techniques.

UNIT - I	NEURAL NETWORKS AND THEIR ARCHITECTURES	(9)

Basic Concepts of Neural Networks - ANN Architecture - Learning Methods in ANN - Back Propagation Network (BPN) - Learning Method and Effect of Tuning Parameters - Input Normalization - Application to structural engineering problems.

UNIT - II	ASSOCIATIVE MEMORY, ADAPTIVE RESONANCE THEORY AND APPLICATIONS	(9)

Kosko's Discrete Bi-directional Associative Memory (BAM) – Evolution Equation -Vector Quantization - Architecture of Adaptive Resonance Theory (ART) - Application to Structural Engineering Problems.

UNIT - III	FUZZY LOGIC	(9)

Fuzzy sets and relations – Fuzzy sets and Crisp sets - Predicate logic - Fuzzy quantifiers - Fuzzy Rule based systems – Fuzzification and Defuzzification methods - Application to controllers- Application to structural Engineering problems.

UNIT - IV	GENETIC ALGORITHMS	(9)

Basic concepts - Representation of design variables, objective function and constraints - Genetic operators - Reproduction - Selection - Cross over - Mutation - Choice of population - Survival of the fittest - Generation - Generation history - Convergence of GA - Optimal design using GA - Application to structural engineering problems.

UNIT - V	HYBRID SYSTEMS AND SUPPORT VECTOR MACHINES	(9)

Neuro - Fuzzy Hybrids - Fuzzy genetic hybrids - Neuro genetic hybrid - Fuzzy BPN - Fuzzy Art Map - Fuzzy controlled GA - Support vector regression - Classifications.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate and implement back propagation neural networks (BPNs) for structural engineering applications	Understand
CO2	Utilize Kosko's BAM and ART architectures, applying vector quantization techniques, and implementing evolution equations	Apply
CO3	Illustrate fuzzy logic techniques, including the use of fuzzy sets, predicate logic, and fuzzy rule-based systems, to design and optimize controllers	Understand
CO4	Apply genetic algorithms to optimize design problems in structural engineering.	Apply
CO5	Construct designing and implementing various hybrid models, such as neuro-fuzzy, fuzzy-genetic, and neuro-genetic systems.	Apply

REFERENCES:

1. Jamshid Ghaboussi, "Soft Computing in Engineering", CRC Press, 1st Edition, 2020.
2. Rajasekaran S. and VijayalakshmiPai G. A., "Neural Networks, Fuzzy Systems and Evolutionary Algorithms: Synthesis and Applications", Prentice Hall of India, 2nd Edition, 2017.
3. Goldberg D. E., "Genetic Algorithms in Search Optimization and Machine Learning", Pearson Education India, 1st Edition, 2008.
4. Frances Buontempo, "Genetic Algorithms and Machine Learning for Programmers: Create AI Models and Evolve Solutions, Pragmatic Bookshelf, 1st Edition, 2019.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	2	3
CO2	3	-	3	2	3
CO3	3	-	3	2	3
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	**3**	**-**	**3**	**2**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

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ST24E21	STABILITY OF STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE: The stability of structures requires adequate load-bearing capacity, proper geometry, equilibrium, sufficient support, resistance to buckling, ductility, redundancy, lateral force resilience, quality materials, a factor of safety, adherence to design codes, and consideration of environmental factors.

OBJECTIVES:

- To study the elastic and inelastic buckling behavior of columns, beam-columns, frames, and thin plates using analytical, approximate, numerical, and experimental methods, and to understand lateral and torsional buckling in beams through energy and equilibrium approaches.

UNIT - I	STABILITY OF COLUMNS	(9)

Concept of elastic structural stability - Analytical approaches to stability - Characteristics of stability analysis - Elastic buckling of columns - Equilibrium, Energy and Imperfection approaches - non-prismatic columns - Built up columns - Orthogonality of buckling modes - Effect of shear on buckling load - Large deflection theory.

UNIT - II	METHOD OF ANALYSIS AND INELASTIC BUCKLING	(9)

Approximate Methods - Rayleigh and Galerkin's methods - Numerical methods - Finite Difference and Finite Element - Analysis of columns - Experimental study of column behaviour - South well plot - Column curves - Derivation of column design formula - Effective length of columns - Inelastic behaviour - Tangent modulus and double modulus Theory.

UNIT - III	BEAM, COLUMNS AND FRAMES	(9)

Beam column behaviour - Standard case - Continuous columns and beam columns - Column on elastic foundation - Buckling of frames - Single story portal frames with and without side sway - Classical and stiffness methods - Approximate Evaluation of critical Loads in multi-storeyed Frames - Use of woods charts.

UNIT - IV	CONCEPT OF TORSIONAL BUCKLING	(9)

Lateral buckling of beams - Energy method - Application to symmetric and simply symmetric I beam - Simply supported and cantilever beams - Narrow rectangular cross sections - Torsional buckling - Uniform and Non-Uniform torsion on open cross section - Flexural torsional buckling - Equilibrium and energy approach.

UNIT - V	BUCKLING OF THIN PLATES	(9)

Isotropic rectangular plates - Governing differential equations - Simply supported on all edges - Use of energy methods - Plates with stiffeners - Concept of numerical techniques.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

K.S.R. College of Engineering

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Estimate Stability of columns by analytical approaches	**Evaluate**
CO2	Examine the theory of inelastic buckling.	**Analyze**
CO3	Evaluate the behavior of portal frames and beam columns.	**Evaluate**
CO4	Evaluate the torsional buckling of various sections.	**Evaluate**
CO5	Inspect the buckling of thin plates with stiffness by energy methods.	**Analyze**

REFERENCES:

1. Chandrasekaran, N., Stability of Structures, Oxford University Press, New Delhi, First Edition, 2011.
2. Timoshenko, S.P., and Gere, J.M., Theory of Elastic Stability, McGraw Hill, New York, Second Edition, 2009.
3. Brush, D.O., and Almroth, B.O., Buckling of Bars, Plates, and Shells, McGraw Hill, New York, First Edition, 1975.
4. Chajes, A., Principles of Structural Stability Theory, Dover Publications, New York, Reprint Edition, 2009.

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	2
CO2	3	-	2	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	2	3	2
Avg.	**3**	**-**	**2**	**3**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

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ST24E22	CORROSION OF STEEL IN CONCRETE	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

Basic knowledge of reinforced concrete design, materials science, and electrochemistry.

OBJECTIVES:

- To study corrosion mechanisms of steel in concrete, assessment techniques, monitoring using sensors and instruments, protection methods including inhibitors and coatings, and electrochemical rehabilitation with microscopic analysis of the concrete-steel interface.

UNIT - I	PRINCIPLES AND THEORIES OF STEEL CORROSION IN CONCRETE	(9)

Types of corrosion of rebars - Chloride induced corrosion of steel in concrete - Carbonation of concrete and its effect on corrosion of steel - Influence of stray current on corrosion of reinforcing steel in concrete - Corrosion of steel in prestress concrete.

UNIT - II	MEASUREMENT OF CORROSION OF STEEL IN CONCRETE	(9)

Half-cell potential measurement - Potential mapping to identity anodic and cathodic sites - Linear polarization technique - Electrochemical impedance Spectroscopy - Weight loss measurements - Micro-Cell corrosion study - Galvanostatic pulse - Measurements - Custom sweep and resistance test.

UNIT - III	INSITU CORROSION MONITORING OF STRUCTURES	(9)

Embeddable electrodes and sensors for Reinforced Concrete Structures - Use of Portable Equipment's and Instruments for Corrosion Monitoring - Interpretation of Test Results.

UNIT - IV	CORROSION CONTROL	(9)

Anodic and Cathodic Protection - Corrosion inhibitors - Anodic - Cathodic and Mixed Inhibitors - Inhibitor Efficiency - Corrosion Protection by Surface Coatings to Steel and Concrete - Determination of Coating Performance - Alternate Reinforcing Materials.

UNIT - V	ELECTRO CHEMICAL CORROSION PROTECTION IN REINFORCED CONCRETE	(9)

Electrochemical Chloride Removal - Electrochemical Re alkalization - Principles of Cathodic Protection by Impressed Current Method and Sacrificial Anode Type - Microscopic Study of Concrete and Steel Interface - Image techniques.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the basic principles of corrosion of steel in concrete.	Understand
CO2	iiiustrate different techniques on measurement of corrosion of steel in concrete.	Understand
CO3	Demonstrate the in-situ corrosion monitoring systems in structures.	Understand
CO4	Explain various methods of the corrosion prevention and alternate reinforcing materials.	Understand
CO5	Demonstrate electro chemical corrosion protection in reinforced concrete.	Understand

REFERENCES:

1. Broomfield, John P., Corrosion of Steel in Concrete: Understanding, Investigation and Repair, CRC Press, Boca Raton, 3rd Edition, 2023.
2. Elsener, Bernhard., Corrosion in Reinforced Concrete Structures, CRC Press, Boca Raton, 2nd Edition, 2021.
3. Raupach, Michael., Monitoring and Modelling Chloride Transport and Corrosion in Concrete, CRC Press, Boca Raton, 1st Edition, 2020.
4. Lars-Olof Nilsson, Corrosion of Steel in Concrete: Prevention, Diagnosis, Repair, Springer, Berlin, First Edition, 2018.

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	2	2	2
CO2	3	-	2	3	2
CO3	3	-	3	3	3
CO4	2	-	2	2	3
CO5	3	-	3	3	3
Avg.	3	-	2	3	3

1-Low, 2-Medium, 3-High

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Chairman (BoS)

ST24E23	ASEISMIC DESIGN OF STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE: To study the earthquake concepts, behaviours, analysis of the structures.

OBJECTIVES:

- To study the basic concepts of earthquakes, determine load parameters, understand Indian standard provisions, identify structural behavior of buildings, and analyze structures using various software tools.

UNIT - I	INTRODUCTION	(9)

Basic Seismology - General Features of Tectonics of Seismic Regions- Earthquake Terminology - Definitions -Earthquake History - Behavior of Buildings, Dams and Bridges in Past Earthquakes - Seismographs - Accelerographs - Types of Earthquakes - Fault Rupture Parameters - Earthquake Ground Motion Characteristics - Deterministic and Probabilistic Approach - Response Spectra - Design Spectra.

UNIT - II	EARTHQUAKE RESPONSE	(9)

Earthquake Response to Elastic and Inelastic Buildings - Application to Response Spectrum Theory - Base Exited Motion - Ground Motion Parameters - Modal Response Contribution - Modal Participation Factor - Response History - Spectral Analysis - Multiple Support Excitation - Earthquake Response to Continuous Systems on Rigid Base - Approximate Methods for Lateral Load Analysis.

UNIT - III	IS CODE PROVISIONS	(9)

Design Criteria Strength, Deflection, Ductility and Energy Absorption - Cyclic Behaviour of Structures - Codal Provisions of Design of Buildings as per IS 1893 and IS 4326 - Ductile Detailing of Structures as per IS 13920. Behaviour - Design of Masonry Structures as per IS 13827 and IS13828.

UNIT - IV	BEHAVIOUR OF RC STRUCTURES	(9)

Analysis and Design of Frames for Lateral Loads - Capacity Design - Shear Wall Frame System - Coupled Shear Wall - Design of Rectangular and Flanged Shear Walls - Ductile Detailing of Frames for Earthquake Forces.

UNIT - V	SPECIAL TOPICS	(9)

Modern Concepts - Base Isolation, Passive Control and Active Control Systems - Computer Analysis and Design of Buildings for Earthquake Loads using Software Packages like ETABS, ANSYS, and SAP2000.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

K.S.R. College of Engineering, Tiruchengode-637 215. Centre for Academic Courses

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Illustrate the fundamental concept of earthquakes.	Understand
CO2	Evaluate the response of structures to different types of dynamic loads.	Evaluate
CO3	Identify the need for IS code specification for earthquake resistant design.	Apply
CO4	Inspect the Seismic Analysis of Structure.	Analyze
CO5	Develop the skills in software used for analysis and design of buildings for earthquake.	Create

REFERENCES:

1. Anil K. Chopra., Dynamics of Structures – Theory and Applications to Earthquake Engineering, Pearson, New Delhi, Fifth Edition, 2019.
2. Pankaj Agarwal, and Manish Shrikhande., Earthquake Resistant Design of Structures, Prentice Hall of India Pvt. Ltd., New Delhi, Fifth Edition, 2011.
3. Duggal, S.K., Earthquake Resistant Design of Structures, Oxford University Press, New York, Second Edition, 2013.
4. Brebbia, C. A., Earthquake Resistant Engineering Structures, WIT Press, Southampton, First Edition, 2015.

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	2	-	3	2	3
CO3	2	-	3	3	3
CO4	3	-	3	2	3
CO5	3	-	3	3	3
Avg.	**3**	**-**	**3**	**3**	**3**

1-Low, 2-Medium, 3-High

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ST24E24	DESIGN OF BRIDGES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE:

To excel in bridge design and analysis, you need a solid grasp of structural analysis principles, including load distribution and force calculations. You should also understand materials science, focusing on the properties and behavior of concrete and steel. Additionally, familiarity with fundamental design principles and engineering mechanics, along with knowledge of relevant design codes and specifications.

OBJECTIVES:

- To understand the classification, planning, and design of road bridges as per I.R.C. specifications, apply load distribution theories to various bridge types, describe design principles for continuous, box girder, and cantilever bridges, study prestressed bridge concepts, and design riveted, welded plate girders, bearings, and bridge foundations.

UNIT - I	INTRODUCTION	(9)

Classification - Investigations and Planning - Choice of Type - I.R.C. Specifications for Road Bridges & Loads, Forces Acting on Bridges - General Design Considerations.

UNIT - II	SHORT SPAN BRIDGES	(9)

Load Distribution Theories - Analysis and Design of Slab Culverts - Tee Beam and Slab Bridges.

UNIT - III	LONG SPAN GIRDER BRIDGES	(9)

Design Principles of Continuous Bridges - Box Girder Bridges -Balanced Cantilever Bridges.

UNIT - IV	DESIGN OF PRESTRESSED BRIDGES	(9)

Flexural and Torsional parameters - Courbon's theory - Distribution Co-Efficiently Exact Analysis - Design of girder section Maximum and Minimum Prestressing Forces - Eccentricity - Live Load and Dead Load Shear Forces - Cable Zone in Girder - Check for Stresses at Various Sections - Check for Diagonal Tension - Diaphragms–End Block - Short Term and Long Term Deflections.

UNIT - V	DESIGN OF PLATE GIRDER BRIDGES, BEARINGS AND SUBSTRUCTURES	(9)

Design of Riveted and Welded Plate Girder Bridges for Highway and Railway Loading - Wind Effects - Main Section, Splicing, Curtailment, Stiffeners - Different Types of Bearings - Design of Bearings - Design of Masonry and Concrete Piers and Abutments - Types of Bridge Foundations - Design of Foundations.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain various types and Specifications of Bridge Structures.	Understand
CO2	Illustrate the load Distribution and Design of Slabs in Bridge Structure.	Understand
CO3	Recall the various types of long span girder Bridges.	Remembering
CO4	Identify the Various Load Calculation and Design of Prestressed Bridges.	Apply
CO5	Examine the Plate Girder bridges and types of bridge foundations.	Analyze

REFERENCES:

1. Krishnaraju,N., Design of Bridges, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, Fifth Edition, 2019.
2. Ponnuswamy, S., Bridge Engineering, McGraw-Hill Education, New Delhi, Third Edition, 2017.
3. Johnson Victor, D., Essentials of Bridge Engineering, Oxford and IBH Publishing Co. Pvt.Ltd., New Delhi, Sixth Edition, 2019.
4. Jagadeesh, T.R. and Jayaram, M.A., Design of Bridge Structures, Prentice Hall of India Pvt. Ltd., New Delhi, Second Edition, 2009.

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	2
CO2	3	-	2	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	2	3	2
Avg.	**3**	**-**	**2**	**3**	**3**

1-Low, 2-Medium, 3-High

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Chairman (BoS)

ST24E25	DESIGN OF PLATE AND SHELL STRUCTURES	Category	L	T	P	SL	C
		PEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE: Knowledge of Structural Analysis and Design of Reinforced Concrete Structures.

OBJECTIVES:

- To understand folded plate behavior and design using ACI and ASCE methods, learn shell types and membrane theory, study space frame configuration and design philosophy, analyze space frames using formex algebra, and design grid floor systems.

UNIT - I	DESIGN OF FOLDED PLATES	(9)

Folded Plate Structures-Structural Behavior - Types- Design by ACI - ASCE Task Committee Method.

UNIT - II	THEORY OF SHELLS	(9)

Classification of Shells - Structural Action - Membrane Theory - Shells of Revolution and Shells of Translation -Examples - Limitations of membrane theory.

UNIT - III	SPACE FRAME - DESIGN PHILOSOPHY	(9)

Space Frames - Configuration - Types of Nodes - General Principles of Design Philosophy – Behaviour.

UNIT - IV	ANALYSIS OF SPACE FRAMES	(9)

Analysis of Space Frames - Formex Algebra, For Main and Detailed Design of Space Frames.

UNIT - V	GRID FLOORS	(9)

General Features-Analysis of Grid Floors-Design Examples.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Design types of folded plate structures by ACI and ASCE task committee method	Analyze
CO2	Examine the structural action of different types of shells and its translation	Analyze
CO3	Design space frames with different nodes and its behaviour	Create
CO4	Analyze and design of space frames in construction	Analyze
CO5	Analyze and design grid floors	Analyze

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REFERENCES:

1. Timoshenko, S. and Woinowsky - Krieger S., Theory of Plates and Shells, McGraw Hill Education, New Delhi, Second Edition, 2017
2. Ramasamy, G.S., Design and Construction of Concrete Shells Roofs, CBS Publishers, New Delhi, First Edition, 2005
3. Chatterjee, B.K., Theory and Design of Concrete Shells, Chapman and Hall Press, New york, First Edition, 1988.
4. Farshad, M., Design and Analysis of shell structures, Springer, Netherlands, Second Edition, 1992.

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	2
CO2	3	-	2	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	2	3	2
Avg.	**3**	**-**	**2**	**3**	**3**

1-Low, 2-Medium, 3-High

Chairman (BoS)

K.S.R. College of Engineering, Tiruchengode-637215, Centre for Academic Courses

AUDIT COURSES

AX24A01	DISASTER MANAGEMENT	Category	L	T	P	SL	C
		AC	30	0	0	30	0

(Common to All Branches)

PREREQUISITE:

A basic understanding of geography, environmental science, and public health is a prerequisite for studying disaster management.

OBJECTIVES:

To enable students to understand the nature, causes, and impacts of natural and manmade disasters, identify disaster prone areas with special reference to India, and develop knowledge on disaster preparedness, management strategies, risk assessment techniques, and sustainable approaches for effective disaster mitigation and community resilience.

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, Green economy, Blue economy, Global Co-operation in Risk Assessment and Warning, People's Participation in Risk Assessment, Strategies for Survival.

TOTAL(L:30, SL:30): 60 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the definitions, differences, and classifications of disasters and hazards	Understand
CO2	Discuss the destruction of ecosystems and the loss of human and animal life resulting from different disaster events.	Understand
CO3	Compare the vulnerability of different regions in India to various natural disasters.	Understand
CO4	Summarize the methods and technologies used in assessing and monitoring disaster risks.	Understand
CO5	Describe the concept, elements, and current global and national scenarios of disaster risk.	Understand

TEXT BOOKS:

1. Gupta, Harsh K., "Disaster Management", Universities Press, Hyderabad, 2nd Edition, 2013.
2. Satendra, "Disaster Management in India: Perspectives, Issues and Strategies", National Institute of Disaster Management, New Delhi, 1st Edition, 2018.

REFERENCES:

1. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi, 2009.
2. Nishitha Rai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company, 2007.
3. Sahni, Pardeep et.al., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi, 2001.
4. Sharma, R.K. and Sharma, G. "Natural Disaster Management: Causes, Effects and Mitigation", Deep & Deep Publications, New Delhi, 2005.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	1	1
CO2	2	1	2	2	1
CO3	2	1	2	2	2
CO4	2	1	2	2	2
CO5	2	1	2	1	2
Avg.	**2**	**1**	**2**	**2**	**2**

1-low, 2-medium, 3-high

Chairman (BoS)

AX24A02	VALUE EDUCATION	Category	L	T	P	SL	C
		AC	30	0	0	30	0

(Common to All Branches)

PREREQUISITE:

Basic understanding of moral principles, social responsibilities, and a willingness to engage in self-reflection and personal growth.

OBJECTIVE:

To foster self-development, strengthen human values, and promote overall personality growth and social empowerment through value-based education.

UNIT - I	INTRODUCTION TO VALUE EDUCATION	(6)

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

UNIT - II	IMPORTANCE OF VALUES	(6)

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

UNIT - III	INFLUENCE OF VALUE EDUCATION	(6)

Personality and Behaviour development – Soul and Scientific attitude. Positive Thinking, Integrity and discipline, Punctuality, Love and Kindness, avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship Happiness Vs suffering, love for truth.

UNIT - IV	REINCARNATION THROUGH VALUE EDUCATION	(6)

Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature Character and Competence – Holy books Vs Blind faith, Self-management and Good health, Science of reincarnation.

UNIT - V	VALUE EDUCATION IN SOCIAL EMPOWERMENT	(6)

Equality, Nonviolence, Humility, Role of Women, all religions and same message, mind your Mind, Self-control, Honesty, Studying effectively.

TOTAL(L:30,SL:30): 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Gain knowledge of self-development	Understand
CO2	Learn the importance of Human values	Understand
CO3	Develop the overall personality through value education	Understand
CO4	Overcome the self-destructive habits with value education	Understand
CO5	Interpret social empowerment with value education	Understand

Chairman (BoS)

TEXT BOOKS:

1. Chakravarthy, S.K. "Values and Ethics for organizations Theory and practice", Oxford University Press, New Delhi, 1999.
2. Chitakra, M.G. "Education and Human Values", A.P.H. Publishing Corporation, New Delhi, 2003.

REFERENCES:

1. Satchidananda, M.K, "Ethics, Education, Indian Unity and Culture", Ajantha Publications, Delhi, 1991.
2. Das, M.S., Gupta, V.K. "Social Values among Young adults: A changing Scenario", M.D. Publications, New Delhi, 1995.
3. Bandiste, D.D., "Humanist Values: A Source Book", B.R. Publishing Corporation, Delhi, 1999.
4. Ruhela, S.P., "Human Values and education", Sterling Publications, New Delhi, 1986.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	2	-	2
CO2	1	2	1	-	1
CO3	2	2	2	-	2
CO4	2	1	1	-	1
CO5	1	2	2	-	2

1 - Low, 2 - Medium, 3 - High

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AX24A03	CONSTITUTION OF INDIA	Category	L	T	P	SL	C
		AC	30	0	0	30	0

(Common to All Branches)

PREREQUISITE:

Basic awareness of Indian history, civics, and political system at the school level, along with an Interest in understanding the democratic framework and governance of India.

OBJECTIVE:

- To provide a comprehensive understanding of the India Constitution, including its basic structure, fundamental rights and duties, directive principles, the functioning of the Union and State governments, and the electoral system.

UNIT - I	INTRODUCTION TO INDIAN CONSTITUTION	(6)

Indian Constitution: Necessity of the Constitution, Societies before and after the Constitution adoption. Introduction to the Indian constitution, Making of the Constitution, Role of the Constituent Assembly.

UNIT - II	FUNDAMENTAL RIGHTS AND DUTIES	(6)

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 - III	UNION GOVERNMENT	(6)

Parliamentary System, Union Executive – President, Prime Minister, Union Cabinet, Parliament – LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism.

UNIT - IV	STATE GOVERNMENT	(6)

State Government – Structure and Functions – Governor – Chief Minister – Cabinet – State Legislature – Judicial System in States – High Courts and other Subordinate Courts.

UNIT - V	ELECTION COMMISSION	(6)

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

TOTAL(L:30,SL:30): 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the basic structure of Indian Constitution.	Understand
CO2	Remember their Fundamental Rights, DPSP's and Fundamental Duties (FD's) of our constitution.	Understand
CO3	Know about our Union Government, political structure & codes, procedures.	Understand
CO4	Understand our State Executive of India.	Understand
CO5	Understand our Elections system of India.	Understand

Chairman (BoS)

TEXT BOOKS:

1. Durga Das Basu, "Introduction to the Constitution of India", Lexis Nexis Publisher, New Delhi, Twenty-Three Edition, 2018.
2. P.M. Bakshi, "The Constitution of India", Universal law Publishing, New Delhi, Fifteenth Edition, 2018.

REFERENCES:

1. Brij Kishore sharma, "Introduction to the Constitution India", PHI Learning Pvt. Ltd, New Delhi, Seventh Edition, 2015.
2. M. Laxmikanth, "Indian Polity", Tata McGraw Hill, New Delhi, Sixth Edition, 2017.
3. P. K. Agarwal, "Constitution of India", Prabhat Publishers, New Delhi, Second Edition, 2015. M.P. Jain, "Indian Constitution Law", Lexis Nexis Publisher, New Delhi, Seventh Edition, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	2	1	-	2
CO2	2	2	1	-	2
CO3	2	2	1	-	2
CO4	1	2	1	-	1
CO5	1	2	1	-	2

1 - Low, 2 - Medium, 3 - High

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AX24A04	INDIAN KNOWLEDGE SYSTEM	Category	L	T	P	SL	C
		AC	30	0	0	30	0

(Common to All Branches)

PREREQUISITE:

Basic knowledge of Indian history and culture, and an interest in exploring traditional systems of knowledge across disciplines such as science, technology, humanities, and philosophy.

OBJECTIVE:

- To provide an understanding of the historical evolution, key features, and multidisciplinary applications of the Indian Knowledge System, encompassing its contributions to humanities, science, engineering, socio-religious practices, and the need for its protection and preservation.

UNIT - I	INTRODUCTION TO INDIAN KNOWLEDGE SYSTEM	(6)

Importance of Ancient Knowledge System, Definition, concept, and scope of Indian Knowledge System (IKS), IKS based approaches on knowledge paradigms, IKS in modern India, Some unique Aspects of IKS.

UNIT - II	TRADITIONAL KNOWLEDGE IN HUMANITIES AND SCIENCES	(6)

Linguistics, Number and measurements - Mathematics, Chemistry, Physics, Art, Astronomy, Astrology, Crafts and Trade in India and Engineering and Technology.

UNIT - III	TRADITIONAL KNOWLEDGE IN PROFESSIONAL DOMAIN	(6)

Town planning and architecture Construction, Health, wellness and Psychology – Medicine, Agriculture, Governance and public administration, United Nations Sustainable development goals.

UNIT - IV	APPLIED TRADITIONAL KNOWLEDGE	(6)

Myths, Rituals, Spirituals, Taboos and Belief System, Folk Stories, Songs, Proverbs, Dance, Play, Acts and Traditional Narratives, Agriculture, animal husbandry, Forest, Sacred Groves, Water Mills, Sacred Water Bodies, Land, water and Soil Conservation and management Practices, Indigenous Bio-resource Conservation, Utilization Practices and Food Preservation Methods, Handicrafts, Wood Processing and Carving-Fiber Extraction and Costumes

UNIT - V	PROTECTION OF INDIAN KNOWLEDGE SYSTEM	(6)

Documentation and Preservation of IKS, approaches for conservation and Management of nature and bio-resources, Approaches and strategies to protection and conservation of IKS.

LECTURE: 30,SL:30, TOTAL: 60 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the historicity of Indian Knowledge System.	Understand
CO2	Explain the features of traditional knowledge in humanities and sciences.	Understand
CO3	Develop familiarity with science, engineering and technology of IKS.	Understand
CO4	Understand the importance of functional, aesthetic, and socio-religious concept of IKS.	Understand
CO5	Understand the concepts of protection of IKS.	Understand

Chairman (BoS)

TEXT BOOKS:

1. B Mahadevan, Vinayak Rajat Bhat, Nagendra Pavana R N, "Introduction to Indian Knowledge System Concepts and Applications", PHI Learning Private Ltd, 2022, ISBN-978-93-91818-21-0.
2. Amit Jha, "Traditional Knowledge System in India", Atlantic Publishers and Distributors (P) Ltd., 2009, ISBN-13: 978-8126912230

REFERENCES:

1. Kapil Kapoor, Avadesh Kumar Singh, "Knowledge Traditions and Practices of India", Vol. 1, DK Print World (P) Ltd., 2005, ISBN 81-246-0334.
2. D.N. Bose, S.N. Sen, B. V. Subbarayappa, "A Concise History of Science in India", Indian National Science Academy, New Delhi, 2009.
3. S. N. Sen, K. S. Shukla, "History of Astronomy in India", Indian National Science Academy, Second Edition, New Delhi, 2000.
4. Dr. Ravindra Singh Rana, "Indian Knowledge System of Materials in Science and Technology", Walnut Publication, 2023.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	0	2
CO2	2	2	1	0	2
CO3	3	2	1	0	3
CO4	2	2	2	0	2
CO5	2	2	1	0	2

1 - Low, 2 - Medium, 3 – High

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OPEN ELECTIVES

ST24O01	PRINCIPLES OF SUSTAIBALE DEVELOPEMENT	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic knowledge of environmental science and understanding of economic and social systems are prerequisites for studying the principles of sustainable management.

OBJECTIVES:

- To understand the environmental, social, and economic dimensions of sustainability; explore global principles and agreements; and develop an action-oriented mindset to apply sustainable practices in personal, professional, and policy decisions.

UNIT - I	SUSTAINABILITY AND DEVELOPMENT CHALLENGES	(9)

Definition of sustainability - Environmental, Economic and Social dimensions of sustainability - Sustainable Development Models - Strong and Weak Sustainability - Defining Development- Millennium Development Goals - Mindsets for Sustainability : Earthly, Analytical, Precautionary, Action and Collaborative - Syndromes of Global Change: Utilization Syndromes, Development Syndromes, and Sink Syndromes - Core problems and Cross Cutting Issues of the 21 Century - Global, Regional and Local environmental issues - Social insecurity - Resource Degradation - Climate Change - Desertification

UNIT - II	PRINCIPLES AND FRAME WORK	(9)

History and emergence of the concept of sustainable development - Our Common Future - Stockholm to Rio plus 20 - Rio Principles of Sustainable Development - Precautionary Principle - Polluter Pays Principle - Role of Civil Society, Business and Government - Natural Step - Peoples Earth Charter - Business Charter for Sustainable Development - UN Global Compact - Agenda 21

UNIT - III	SUSTAINABLE LIVELI HOOD	(9)

The Unjust World and inequities - Quality of Life - Poverty, Population and Pollution - Combating Poverty - Millennium Development Goals, Indicators, Targets, Status and intervention areas - Demographic dynamics of sustainability - Strategies to end Rural and Urban Poverty and Hunger - Sustainable Livelihood Framework - Health, Education and Empowerment of Women, Children, Youth, Indigenous People, Non-Governmental Organizations, Local Authorities and Industry for Prevention, Precaution , Preservation and Public participation.

UNIT - IV	SUSTAINABLE SOCIO-ECONOMIC SYSTEM	(9)

Protecting and Promoting Human Health - Investing in Natural Capital - Agriculture, Forests, Fisheries - Food security and nutrition and sustainable agriculture - Water and sanitation - Biodiversity conservation and Ecosystem integrity - Ecotourism - Urbanization and Sustainable Cities - Sustainable Habitats - Green Buildings - Sustainable Transportation - Sustainable Consumption and Production - Sustainable Mining - Sustainable Energy - Climate Change - Mitigation and Adaptation - Safeguarding Marine Resources - Financial Resources and Mechanisms

UNIT - V	ASSEESING PROGRESS AND WAY FORWARD	(9)

Nature of sustainable development strategies and current practice - Sustainability in global, regional and national context - Rio Plus 20 - Approaches to measuring and analysing sustainability - limitations of GDP- Ecological Footprint- Human Development Index- Human Development Report - National initiatives for Sustainable Development - Hurdles to Sustainability - Operational

guidelines - Science and Technology for sustainable development - Performance indicators of sustainability and Assessment mechanism - Inclusive Green Growth and Green Economy - National Sustainable Development Strategy Planning - Governance - Science and Technology- Sustainability Education

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the key concepts and dimensions of sustainability and global environmental challenges.	Understand
CO2	Interpret major principles, frameworks, and global agreements on sustainable development.	Analyze
CO3	Assess livelihood strategies and the role of marginalized groups in sustainable development.	Analyze
CO4	Analyze sustainable socio-economic systems including agriculture, energy, and urban development.	Analyze
CO5	Apply sustainability indicators and tools to evaluate progress and recommend future strategies.	Apply

REFERENCES

1. Barry Dalal Clayton and Stephen Bass, Sustainable Development Strategies- a resource book", Earthscan Publications Ltd, London, 2002.
2. Karel Mulder, Sustainable Development for Engineers - A Handbook and Resource Guide, Green Leaf Publishing, 2006.
3. MoEF "Sustainable Development in India –stocktaking in the Run up to Rio plus 20", Ministry of Environment and Forests, Government of India, New Delhi. 2012,
4. UNEP, Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication, www.unep.org/greeneconomy, ISBN: 978-92-807-3143-9, 2011

Mapping of COs with POs and PSOs

COs / POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	3	2
CO2	3	-	2	3	3
CO3	3	-	3	3	3
CO4	3	-	3	3	3
CO5	3	-	2	3	2
Avg.	3	-	2	3	3

1-low, 2-medium, 3-high

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ST24O02	FAILURE ANALYSIS OF STRUCTURES	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

A basic understanding of structural engineering principles, material science, and mechanics of materials is essential. Familiarity with construction practices and failure modes in civil structures will aid comprehension. Knowledge of engineering mathematics and analytical modeling is also recommended.

OBJECTIVES:

- To understand the causes and types of structural failures, explore material defects, loading and environmental factors, apply failure theories, study structural system behavior, and examine smart structures with sensors and adaptive systems.

UNIT - I	Introduction to Failure Mechanisms	(9)

Causes of failure - Types of failure - Why, what, how - Durability of materials - Landmark - Case - Performance and shape inadequacy - Statistics and reliability - Life cycle assessment

UNIT - II	Structural Failures and Material Deterioration	(9)

Structural failure - Material and load effects - Environment effect - Non-structural and structural repairs - Biocidal treatment and use of preservatives - Deterioration of wood

UNIT - III	Failure Analysis and Safety Evaluation	(9)

Macro micro level failures - Component and sub-system failures - Failure theories - Analytical models - Cases and type of problem in components - Safety evaluation.

UNIT - IV	Structural System Failures and Rehabilitation Techniques	(9)

Structural systems - case studies - Pin-jointed steel systems - Rigid jointed frames - Concrete walls arches - Reinforced concrete beams and frames - Shells - Repair of concrete bridge and water retaining structures.

UNIT - V	Maintenance, Refurbishment, and Smart Systems	(9)

Bridge maintenance techniques - The refurbishment of buildings, legal responsibilities - Case studies - Definition of smartness - Sensors - Automatic and adaptive systems - Smart components.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Identify and classify different types of structural failures and explain the underlying causes.	Understand
CO2	Explain the mechanisms of structural failure due to material inadequacies and load effects.	Understand
CO3	Classify failure types in structural components through real-world case studies and diagnostics.	Analyze
CO4	Explain the behaviour of different structural systems, including steel trusses, rigid frames, shells, and arches.	Understand
CO5	Describe various bridge maintenance techniques and evaluate their applicability in different scenarios.	Understand

REFERENCES:

1. D Schiff, "Dynamic Analysis & Failure Modes of Simple Structures", John Wiley & Sons Inc, ISA, First Edition, 1990.
2. Wanhill R, Barter S, Molent L, "Fatigue Crack Growth Failure and Lifing Analyses for Metallic Aircraft Structures and Components", Springer, Germany, Nineteenth Edition, 2019.
3. Ravindran G, Mahesh V, Kassem M M, "Failure Analysis: Structural Health Monitoring of Structure and Infrastructure Components", Intech Open, United Kingdom, First Edition, 2023.
4. https://archive.nptel.ac.in/courses/112/107/112107241/

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	3	-	3	2	3
CO3	3	-	3	2	2
CO4	3	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-Low, 2-Medium, 3-High

Chairman (BoS)

ST24O03	SMART MATERIALS AND SMART STRUCTURES	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

(M.E.- STRUCTURAL ENGINEERING)

PREREQUISITE: Basic knowledge of structural engineering, mechanics of materials, and civil engineering materials.

OBJECTIVES:

- To study the functions of smart materials and structures with integrated sensing and actuation, understand strain measurement techniques, explore sensing technologies, examine actuator systems like piezoelectric and shape memory materials, and understand data acquisition, signal processing, and control in smart structures.

UNIT - I	INTRODUCTION	(9)

Introduction to smart materials and structures - Instrumented structure functions and response - sensing systems - Self-diagnosis - Signal processing consideration - Actuation systems and effectors.

UNIT - II	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 - III	SENSORS	(9)

Sensing technology - Types of sensors - Physical measurement using piezo electric strain measurement - Inductively read transducers - LVDT - Fibre optic techniques - Chemical and bio-chemical sensing in structural assessment - Absorptive chemical sensors - Spectroscopes - Fibre optic chemical sensing systems and Distributed measurement.

UNIT - IV	ACTUATORS	(9)

Actuator techniques - Actuator and actuator materials - Piezoelectric and electro structure material - Mange to stricture material - Shape memory alloys - Electro rheological fluids - Electromagnetic actuation - Role of actuators and actuator materials.

UNIT - V	SIGNAL PROCESSING AND CONTROL SYSTEMS	(9)

Data acquisition and processing - Signal processing and control for smart structures - Sensors as geometrical Processors - Signal processing - Control system - Linear and nonlinear.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain about the instrumented structure functions and response in modern engineering.	Understand
CO2	Examine the strain measuring techniques using strain gauges.	Analyze
CO3	Choose sensors according to their applications in structures	Apply
CO4	Classify the actuator materials based on their applications	Analyze
CO5	Explain about data acquisition system and control system.	Understand

REFERENCES:

1. Srinivasan, A. V., Michael Mc Farland D., Smart Structures Analysis and Design, Cambridge University Press, England, South Asian Edition, 2010.
2. Peter L. Reece., Smart Materials and Structures: New Research, Nova Science Publishers Inc., New York, First Edition, 2007.
3. Gustav Gautschi., Piezoelectric Sensorics, Springer, New York, Second Edition, 2006.
4. Gandhi, M.V., and Thompson, B.D., Smart materials and structures, Springer, New York, First Edition, 2014

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	3
CO2	2	-	3	2	3
CO3	2	-	3	3	3
CO4	3	-	3	2	3
CO5	3	-	3	3	3
Avg.	3	-	3	3	3

1-low, 2-medium, 3-high

Chairman (BoS)

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PE24O01	SWITCHING CONCEPTS AND POWER SEMICONDUCTOR DEVICES	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic understanding of semiconductor devices and circuit theory, including diode and transistor operation, is essential to grasp power device switching behavior and protection strategies.

OBJECTIVE:

- To analyze, model, and simulate the operation of current- and voltage-controlled power semiconductor devices along with their firing and protection circuits.

UNIT - I	INTRODUCTION OF SWITCHING CONCEPTS	(9)

Need for switching in power electronic circuits – Switching Characteristics – Ideal switch, practical switch – Types of switches – Comparison of switching devices – Future trends in power devices.

UNIT - II	CURRENT CONTROLLED DEVICES	(9)

Power Diode, Thyristors and BJT's: Construction, static and dynamic characteristics – Negative temperature coefficient and secondary breakdown – Power Darlington – Series and parallel operation – Comparison of BJT and Thyristor – Steady state and dynamic models of BJT and Thyristor – Simulation of Thyristor and BJT.

UNIT - III	VOLTAGE CONTROLLED DEVICES	(9)

Principle of voltage-controlled devices – Power MOSFETs and IGBTs: Construction, Types, Static and switching characteristics – Series and parallel operation – Steady state and dynamic models of MOSFET and IGBTs – Basics of GTO, MCT, FCT, RCT and IGCT – Simulation of MOSFET and IGBT.

UNIT - IV	FIRING PROTECTION CIRCUITS	(9)

Necessity of isolation, Pulse transformer, Opto coupler – Gate Drives Circuit: SCR, MOSFET, IGBTs and base driving for power BJT – Over voltage, over current and gate protections – Design of snubbers.

UNIT - V	THERMAL PROTECTION CIRCUITS	(9)

Heat Transfer: Conduction, convection and radiation – Cooling: liquid cooling, vapor-phase cooling – Guidance for heat sink selection – Thermal resistance and impedance – Electrical analogy of thermal components – Heat sink types and design – Mounting types.

LECTURE: 45, SELF LEARNING = 45, TOTAL = 90 PERIODS

K.S.R. College of Engineering, Tiruchengode-637215. Centre for Academic Courses

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Summarize the power semiconductor device types and characteristics.	Understand
CO2	Explain the construction, operating principles, and characteristics of various current control devices.	Understand
CO3	Explain the construction, operating principles, and characteristics of voltage-controlled devices.	Understand
CO4	Design the firing and protection circuits for power devices.	Apply
CO5	Explain the various methods of thermal protection and cooling.	Understand

TEXT BOOKS:

1. Rashid M.H., "Power Electronics Circuits, Devices and Applications", Prentice Hall India, New Delhi, Third Edition, 2013.
2. Singh M.D., Khanchandani K.B., "Power Electronics", Tata McGraw-Hill, 2014.

REFERENCES:

1. Ned Mohan, Undcland and Robins, "Power Electronics – Concepts, Applications and Design, John Wiley and Sons, Singapore, Third Edition, 2009.
2. Joseph Vithayathil, Power Electronics: Principles and Applications, Delhi, Tata McGraw-Hill, 2010.
3. Simon Ang and Alejandro Oliva, "Power Switching Converters", Taylor & Francis Group, 2010.
4. Christophe P. Basso, Switch-Mode Power Supplies, McGraw-Hill, 2014.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	1	-	-
CO2	3	2	2	-	-
CO3	3	2	1	-	-
CO4	3	3	3	-	-
CO5	3	3	3	-	-

1 - Low, 2 - Medium, 3 - High

Chairman (BoS)

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PE24O02	SMART GRID TECHNOLOGY	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic knowledge of electrical power systems and communication networks is required to understand the integration and automation aspects of Smart Grid technologies.

OBJECTIVE:

- To understand the concepts, components, and communication technologies essential for implementing and operating Smart Grids effectively.

UNIT - I	INTRODUCTION	(9)

Electrical Grid – Definition of Smart Grid – Opportunities, Challenges and Benefits of Smart Grid – Difference between conventional and Smart Grid – Operating Principles and Models of Smart Grid Components – Implementation of Smart Grid – Early Smart Grid initiatives in India – Overview of the technologies required for the Smart Grid.

UNIT - II	SMART METERING AND DEMAND-SIDE INTEGRATION	(9)

Introduction – Smart metering – Smart meters – An overview of the hardware used – Communications infrastructure and protocols for smart metering, Demand – Side integration – Services provided by DSI – Implementations of DSI – Hardware support to DSI implementations – Flexibility delivered by prosumers from the demand side – System support from DSI.

UNIT - III	DISTRIBUTION AUTOMATION	(9)

Distribution automation – Automated Meter Reading (AMR) – Advanced Metering Infrastructure (AMI) – Intelligent Electronic Devices (IED) – Fault Location Isolation and Service Restoration (FLISR) – Outage Management Systems (OMS) – High Efficiency Distribution Transformers.

UNIT - IV	TRANSMISSION SYSTEM AUTOMATION	(9)

Substation automation, Feeder Automation – Supervisory Control and Data Acquisition (SCADA) – Energy Management System (EMS) – Phasor Measurement Units (PMU) – Wide Area Monitoring Systems (WAMS).

UNIT - V	HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS	(9)

Local Area Network (LAN) – House Area Network (HAN) – Wide Area Network (WAN) – Broadband over Power Line (BPL) – IP-based Protocols – Basics of Web Service and CLOUD Computing to make Smart Grids smarter – Cyber Security for Smart Grid.

LECTURE: 45, SELF LEARNING = 45, TOTAL = 90 PERIODS

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

COs	Course Outcome	Cognitive Level
CO1	Portray the components used in smart grid technologies.	Understand
CO2	Illustrate the concept of smart metering and demand-side integration.	Understand
CO3	Elucidate the concepts of distribution automation in the smart grid.	Understand
CO4	Outline the automated transmission systems in the smart grid.	Understand
CO5	Enlighten the significance of high-performance computing in the smart grid.	Understand

TEXT BOOKS:

1. Stuart Borlase, Smart Grid: Infrastructure, Technology and Solutions, CRC Press, United States, First Edition, 2012.
2. James Momoh, Smart Grid: Fundamentals of Design and Analysis, John Wiley and Sons, United States, First Edition, 2012.

REFERENCES:

1. Janaka Ekanayake, Nick Jenkins, Kithsiri Liyanage, Jianzhong Wu, Akihiko Yokoyama, Smart Grid Technology and Applications, John Wiley and Sons, United States, First Edition, 2012.
2. Xi Fang, Satyajayant Misra, Guoliang Xue, and Dejun Yang, Smart Grid–The New and Improved Power Grid: A Survey, IEEE Transactions on Smart Grids, 2012.
3. Ryszard Strzelecki, Grzegorz Benysek, Power Electronics in Smart Electrical Energy Networks, Springer, New Zealand, First Edition, 2008.
4. https://nptel.ac.in/courses/108/107/108107113/.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	-	-
CO2	3	2	2	-	-
CO3	3	2	2	-	-
CO4	3	2	2	-	-
CO5	3	2	2	-	-

1- Low, 2 - Medium, 3 - High

Chairman (BoS)

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PE24O03	RENEWABLE ENERGY TECHNOLOGY	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic understanding of electrical circuits, energy systems, and environmental science is essential to grasp the technologies and integration of renewable energy sources.

OBJECTIVE:

- To study various renewable energy technologies, storage systems, and their integration with the power grid for sustainable energy solutions.

UNIT - I	INTRODUCTION TO RENEWABLE ENERGY	(9)

Energy Scenario – Classification of Energy Sources – Energy needs of India and energy consumption patterns – Worldwide Potentials of these sources – Energy efficiency, energy security – Energy and its environmental impacts – Distributed generation.

UNIT - II	SOLAR PV AND THERMAL SYSTEMS	(9)

Solar Radiation – Radiation Measurement – Solar thermal Systems: Types of collectors, efficiency calculations – Photovoltaic (PV) technology: Present status, solar cells, cell technologies – characteristics of PV systems – equivalent circuit – array design – building integrated PV system, its components, sizing and economics – Peak power operation – series and parallel connections – maximum power point tracking – Applications.

UNIT - III	WIND ENERGY	(9)

Wind speed and power relation – power extracted from wind – wind distribution and wind speed predictions – Wind power systems: system components, Types of turbines, Turbine rating – Choice of generators – turbine rating – electrical load matching – Variable speed operation – maximum power operation – control systems – system design features.

UNIT - IV	ENERGY STORAGE SYSTEM	(9)

Energy storage – Battery – types, equivalent circuit, performance characteristics – battery design – charging and charge regulators – Battery management – Flywheel-energy relations – components – benefits over battery – Fuel Cell energy storage systems – Ultra Capacitors.

UNIT - V	GRID INTEGRATION	(9)

Standalone systems – Concept of Micro Grid and its components – load sharing – system sizing – Hybrid system economics – Interface requirements – Stable operation – Transient – safety, operating limits of voltage, frequency, stability margin, energy storage, and load scheduling – Effect on power quality – Case study on Standalone and grid-interactive solar systems and wind systems.

LECTURE: 45, SELF LEARNING = 45, TOTAL = 90 PERIODS

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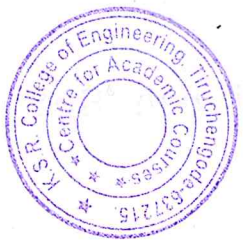

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Describe the various energy sources and environmental aspects of energy.	Understand
CO2	Explain the principle of solar photovoltaic systems and their applications.	Understand
CO3	Familiarize with the wind energy conversion process and control of the wind system.	Understand
CO4	Explain the energy storage system and management.	Understand
CO5	Examine real-world case studies to understand the practical applications of solar and wind energy in both standalone and grid-connected systems.	Apply

TEXT BOOKS:

1. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning, New Delhi, third Edition, 2015.
2. Kothari D.P., Singal, K.C., and Rakesh Ranjan, Renewable Energy Sources and Emerging Technologies, PHI Learning, Third Edition, 2021.

REFERENCES:

1. Rai, G.D., Non-conventional energy sources, Khanna Publishers, Second Edition, 2012.
2. Dr.Reeta Pawar, Dr. M.V.K. Srivani, Prof. Thorat S.K., Itum Ruti, "Fundamentals of Renewable Energy Conservation and Technology", AG Publishing House,2023.
3. Khan, B.H. Non-conventional Energy Resources, Tata McGraw-Hill Publishing Company, New Delhi, First Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	2	2	-	-
CO2	2	2	2	-	-
CO3	2	2	2	-	-
CO4	2	2	3	-	-
CO5	2	2	3	-	-

1 - Low, 2 - Medium, 3 - High

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PE24O04	ENERGY MANAGEMENT AND CONSERVATION	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic knowledge of thermodynamics, electrical systems, and economic principles is essential to understand energy flow, auditing, and management strategies.

OBJECTIVE:

- To impart knowledge on energy management practices, auditing techniques, and economic evaluation for enhancing energy efficiency in various systems.

UNIT - I	INTRODUCTION TO ENERGY MANAGEMENT AND AUDIT	(9)

Classification of energy – Energy scenario – Energy needs of a growing economy – Energy pricing in India – Energy and environment – Energy conservation act. Energy Audit: Types and methodology – Energy audit instruments – Role of energy managers and auditors.

UNIT - II	THERMAL UTILITIES	(9)

Steam: Introduction, Properties of steam, Steam distribution systems – Boilers: Types and classification, Performance evaluation of boilers – Losses in boiler – Energy conservation opportunities in boilers – Waste heat recovery: Classification, Advantages and applications, commercially viable waste heat recovery devices, Saving potential.

UNIT - III	ELECTRICAL AND LIGHTING SYSTEM	(9)

Introduction to electric power supply systems – Electrical load management and maximum demand control – Power factor improvement and its benefit, Basic parameters and terms in lighting systems – Luminous performance Characteristics of commonly used luminaries and Energy saving opportunities in lighting systems.

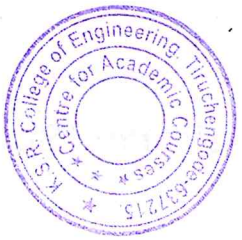
UNIT - IV	ENERGY CONSERVATION IN BUILDINGS AND ECBC	(9)

About Energy Conservation Building Code (ECBC) – Building envelope, Fenestrations, Insulation, HVAC, Lighting, Water pumping, Inverter – Elevators and Escalators – Star labeling for existing buildings.

UNIT - V	ECONOMICS	(9)

Investment – Need, Appraisal and criteria – Financial analysis techniques – Simple payback period – Return on investment – Net present value – Internal rate of return – Cash flows, Risk and sensitivity analysis – Financing options – Energy performance contracting and role of ESCOs.

LECTURE: 45, SELF LEARNING = 45, TOTAL = 90 PERIODS



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COURSE OUTCOMES:
At the end of the course, the learners will be able to:

COs	Course Outcome	Cognitive Level
CO1	Interpret the importance of energy, energy conservation and energy audit.	Understand
CO2	Examine the energy-saving opportunities in thermal systems.	Apply
CO3	Apply the energy-saving opportunities in lighting systems.	Apply
CO4	Assess the energy conservation in buildings and ECBC.	Understand
CO5	Analyze the different financial management techniques for energy management.	Analyze

TEXT BOOKS:

1. Guide Books for National Certification Examination for energy managers and Auditors, third Edition, Bureau of Energy Efficiency, 2010.
2. Wayne C. Turner & Steve Doty, Energy Management Handbook, Seventh Edition, The Fairmont Press, 2009.

REFERENCES:

1. https://beeindia.gov.in/
2. Barny L. Capehart, Wainey C. Turner, William J. Kennedy, Guide to Energy Management, Seventh Edition, The Fairmont Press, 2012.
3. Barney L. Capehart, Wayne C. Turner, William J. Kennedy, "Guide to Energy Management", CRC press, Taylor & Francis group, Eighth Edition, 2016.
4. Witte. L.C., P.S. Schmidt, D.R. Brown, Industrial Energy Management and Utilization, Hemisphere, First Edition, 1988.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	1	-	-	-
CO2	2	1	-	-	-
CO3	2	1	-	-	-
CO4	2	1	-	-	-
CO5	2	1	-	-	-

1 - Low, 2 - Medium, 3 - High

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CN24O01	ENERGY EFFICIENT BUILDINGS	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

(M.E.- CONSTRUCTION ENGINEERING AND MANAGEMENT)

PREREQUISITE: A basic understanding of building construction processes, materials, and structural systems. Knowledge of environmental science concepts, including energy flows, sustainability, and environmental impact.

OBJECTIVES:

- To understand energy-efficient building design principles and technologies for sustainable construction and to evaluate energy conservation strategies for different climates.

UNIT - I	INTRODUCTION	(9)

Energy Required for Building Construction - Heat Transfer – Measuring Conduction – Thermal Storage – Measurement of Radiation – The Greenhouse Effect – Psychometric Chart – Measuring Latent and Sensible Heat. Thermal Comfort – Site Planning and Development – Temperature – Humidity – Wind – Optimum Site Locations – Sun Protection – Types of Shading Devices – Conservation – Heating and Cooling loads.

UNIT - II	PASSIVE SOLAR HEATING AND COOLING	(9)

General Principles of Passive Solar Heating – Key Design Elements - Direct gain Trombe Walls, Water Walls, Convective Air Loops – Concepts – Case Studies – General Principles of Passive Cooling – Ventilation – Predicting Ventilation in Buildings – Window Ventilation Calculations - Radiation – Evaporation and Dehumidification – Mass Effect – Load Control – Air Filtration and odour Removal – Heat Recovery in Large Buildings.

UNIT - III	DAYLIGHTING AND ELECTRICAL LIGHTING	(9)

Materials, Components and Details - Insulation – Optical Materials – Radiant Barriers Glazing Materials - Day Lighting – Sources and Concepts – Building Design Strategies – Case Studies – Electric Lighting –Light Distribution – Electric Lighting Control for day lighted buildings – Illumination requirement – Components of Daylight factor – Recommended Daylight Factors – Day Lighting Analysis – Supplementary Artificial Lighting Design.

UNIT - IV	HEAT CONTROL AND VENTILATION	(9)

Requirements – Heat Transmission Through Building Sections – Thermal Performance of Building Sections – Orientation of Buildings – Building Characteristics for Various Climates – Thermal Design of Buildings Influence of Design Parameters – Mechanical Controls – Examples. Ventilation – Requirements – Minimum Standards for Ventilation – Ventilation Design – Energy Conservation in Ventilating systems – Design for Natural Ventilation.

UNIT - V	DESIGN FOR CLIMATIC ZONES	(9)

Energy Efficiency – an Overview of Design Concepts and Architectural Interventions – Energy Efficient Buildings for Various Zones – Cold and Cloudy – Cold and Sunny – Composite – Hot and Dry – Moderate – Warm and Humid – Case Studies of Residences, Office Buildings and other Buildings in Each Zones – Energy Audit – Certification.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explain the energy requirement of the building construction.	Understand
CO2	Obtain the key design principles for energy efficient buildings.	Create
CO3	Articulate the concepts of day lighting and components of daylight factor.	Remember
CO4	Explain the heat transmission, heat control and ventilation.	Evaluate
CO5	Explain about the energy efficient buildings for various zones.	Understand

REFERENCES:

1. Hossam, A. and Gabbar., Energy Conservation in Residential, Commercial, and Industrial Facilities, Wiley-Blackwell, New Delhi, First Edition, 2018.
2. National Renewable Energy Laboratory, Passive Solar Design Strategies: Guidelines for Home Building, Central Tennessee and Northern Alabama, Scholar's Choice, First Edition, 2015.
3. Mark DeKay. and Brown, G. Z., Sun, Wind and Light Architectural Design Strategies, John Wiley & Sons, New Delhi, Third Edition, 2014.
4. Moore, F., Environmental Control Systems Heating, Cooling, Lighting, McGraw Hill, New York, First Edition, 2002.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	2	3
CO2	3	-	2	2	3
CO3	2	-	3	2	3
CO4	2	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-low, 2-medium, 3-high

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CN24O02	ECONOMICS AND FINANCE MANAGEMENT IN CONSTRUCTION	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

(M.E.- CONSTRUCTION ENGINEERING AND MANAGEMENT)

PREREQUISITE: A foundational understanding of construction project management, including planning and execution processes. Basic knowledge of financial principles such as cost estimation, budgeting, and economic analysis.

OBJECTIVES:

- To equip students with the skills to analyze and manage financial aspects of construction projects, including cash flow, investment evaluation, and financial management techniques.

UNIT - I	BASIC PRINCIPLES	(9)

Time Value of Money – Cash Flow diagram – Nominal and effective interest- continuous interest. Single Payment Compound Amount Factor (P/F, F/P) – Uniform series of Payments (F/A, A/F, F/P, A/P) – Problem time zero (PTZ) - equation time zero (ETZ). Constant increment to periodic payments – Arithmetic Gradient (G), Geometric Gradient (C).

UNIT - II	COMPARING ALTERNATIVES PROPOSALS	(9)

Comparing alternatives- Present Worth Analysis, Annual Worth Analysis, Future Worth Analysis, Rate of Return Analysis (ROR) and Incremental Rate of Return (IROR) Analysis, Benefit/Cost Analysis, Break Even Analysis.

UNIT - III	EVALUATING ALTERNATIVE INVESTMENTS	(9)

Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.

UNIT - IV	FUNDS MANAGEMENT	(9)

Project Finance – Sources of finance - Long-term and short -term finance, Working Capital Management, Inventory valuation, Mortgage Financing - International financial management-foreign currency management.

UNIT - V	FUNDAMENTALS OF MANAGEMENT ACCOUNTING	(9)

Management accounting, Financial accounting principles- basic concepts, Financial statements – accounting ratios - funds flow statement – cash flow statement.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Apply knowledge on concept of cash flow and payment factors.	Apply
CO2	Evaluate worth analysis and comparing alternatives.	Analyse
CO3	Analyse value added tax and alternative investments.	Analyse
CO4	Recognize the importance of working capital management, budgeting and control.	Remember
CO5	Prepare income, profit and loss statements and implement management accounting.	Understand

REFERENCES:

1. Collier, C. and Gla Gola, C., Engineering Economics & Cost Analysis, Addison Wesley Education Publishers, New Delhi, Third Edition, 2017.
2. Shrivastava, U.K., Construction Planning and Management, Galgotia Publications, New Delhi, Third Edition, 2016.
3. Patel, B.M., Project Management - Strategic Financial Planning, Evaluation and Control, Vikas Publishing House, Chennai, Second Edition, 2011
4. https://nptel.ac.in/courses/105/103/105103023/

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	2	3
CO2	3	-	2	2	3
CO3	2	-	3	2	3
CO4	2	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-low, 2-medium, 3-high

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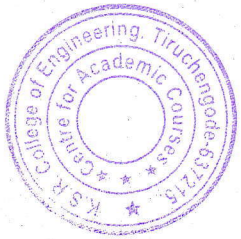

CN24O03	STRESS MANAGEMENT	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

(M.E.- CONSTRUCTION ENGINEERING AND MANAGEMENT)

PREREQUISITE: Basic understanding of human behavior, communication, and workplace dynamics. Familiarity with personal time management and self-regulation techniques. An interest in self-development, mental well-being, and emotional intelligence is beneficial.

OBJECTIVES:

- To help students identify stress triggers and effectively manage them through practical strategies and to develop skills in time management, crisis handling, workplace communication, and self-improvement.

UNIT - I	UNDERSTANDING STRESS	(9)

Meaning – Symptoms – Works Related Stress – Individual Stress – Reducing Stress – Burnout.

UNIT - II	COMMON STRESS FACTORS TIME & CAREER PLATEAUING	(9)

Time Management – Techniques – Importance of planning the day – Time management schedule – Developing concentration – Organizing the Work Area – Prioritizing – Beginning at the start – Techniques for conquering procrastination – Sensible delegation – Taking the right breaks – Learning to say 'No'.

UNIT - III	CRISIS MANAGEMENT	(9)

Implications – People issues – Environmental issues –Psychological fall outs – Learning to keep calm – Preventing interruptions – Controlling crisis – Importance of good communication – Taking advantage of crisis – Pushing new ideas – Empowerment.

UNIT - IV	WORK PLACE HUMOUR	(9)

Developing a sense of Humour – Learning to laugh – Role of group cohesion and team spirit – Using humour at work – Reducing conflicts with humour.

UNIT - V	SELF DEVELOPMENT	(9)

Improving Personality – Leading with Integrity – Enhancing Creativity – Effective decision Making – Sensible Communication – The Listening Game – Managing Self – Meditation for peace – Yoga for Life.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Recognize your stress triggers and how to manage them.	Apply
CO2	Apply the time management skills in effective manner.	Apply
CO3	Handle the various crisis with full of confidence.	Evaluate
CO4	Solve the various conflicts with humour sense.	Apply
CO5	Improve the personality, creativity and decision making skills.	Create

REFERENCES:

1. Argyle., The Psychology of Happiness, Tata McGraw Hill, New Delhi, Second Edition, 2012.
2. Bartlet., Stress Perspectives & Process, Tata McGraw Hill, New Delhi, Sixth Edition, 2012.
3. Juan, R. Alascal Brucata. Laurel Brucata. and Daisy Chauhan., Stress Mastery, Pearson Education, New Delhi, Fourth Edition.
4. Jeff Davidson., Managing Stress, Prentice Hall of India, New Delhi, Fourth Edition, 2012.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	2	2	3
CO2	3	-	2	2	3
CO3	2	-	3	2	3
CO4	2	-	3	2	3
CO5	3	-	3	2	3
Avg.	3	-	3	2	3

1-low, 2-medium, 3-high

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ET24O01	EMBEDDED SYSTEMS	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Fundamentals of digital electronics and microprocessors, along with basic programming knowledge in C or assembly language.

OBJECTIVE:

- To design, model, and develop reliable embedded systems using both hardware and software components across diverse application domains.

UNIT - I	OVERVIEW OF EMBEDDED SYSTEMS	(9)

Embedded Systems Vs General computing systems – Selection of Embedded processor – DMA – Memory devices – Memory management methods – Memory mapping, cache replacement policies – Timer and Counting devices, Watchdog Timer, Real Time Clock – Software Development tools – IDE, assembler, compiler, linker, simulator, debugger, In-circuit emulator, Target Hardware Debugging – Overview of functional safety standards for embedded systems.

UNIT - II	EMBEDDED NETWORKING	(9)

I/O Device Ports & Buses – Multiple interrupts and interrupt service mechanism – Serial communication protocols: RS232 standard – RS485 – USB – Inter Integrated Circuits (I2C) – CAN Bus – Parallel communication using PCI, PCI-X buses, ARM bus – Wireless protocol: Wi-Fi – Bluetooth – Zigbee – Introduction to Device Drivers.

UNIT - III	HARDWARE/SOFTWARE MODELLING	(9)

Modeling embedded systems – Embedded software development approach – Overview of UML modeling – UML diagrams – Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling – Features Comparing Single-processor Architectures and Multi-Processor Architectures – Design approach on parallelism in Uniprocessors and Multiprocessors.

UNIT - IV	RTOS BASED EMBEDDED SYSTEM DESIGN	(9)

Introduction to basic concepts of RTOS – Task, Process & threads – Interrupt routines in RTOS – Multiprocessing and Multitasking – Preemptive and non-preemptive scheduling – Task communication – Context switching – Shared memory – Message passing – Interprocess communication – synchronization between processes – Semaphores – Mailbox – Pipes – Priority inversion – Priority inheritance – Comparison of Real-time Operating systems: VxWorks, uC/OS-II, RT Linux.

UNIT - V	EMBEDDED SYSTEM APPLICATION DEVELOPMENT	(9)

Objective, need, different phases and Modelling of the EDLC – Choice of Target Architectures for Embedded Application Development – Data Dominated Systems – Case studies: Digital Camera – Adaptive Cruise control in a Car – Mobile Phone software for key inputs.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

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COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Demonstrate the functionalities of processor internal blocks, with their requirement.	Apply
CO2	Recognize the Bus standards chosen based on interface overheads without sacrificing processor performance.	Apply
CO3	Illustrate that using multiple CPUs based on either hardcore or softcore helps data overhead management with processing speed reduction.	Apply
CO4	Describe the role and features of the RT operating system, that makes multitask execution possible by processors	Apply
CO5	Recommend Embedded consumer product design based on phases of product development.	Apply

TEXT BOOKS

1. Rajkamal, "Embedded System: Architecture, Programming, Design", TMH, 2011.
2. Peckol, "Embedded system Design", John Wiley & Sons, 2010.

REFERENCES:

1. Rajiv Chopra, "Advanced Computer Architecture", S. Chand, 2010.
2. Elicia White, "Making Embedded Systems", O'Reilly Series, SPD, 2011.
3. Bruce Powel Douglass, Real-Time UML Workshop for Embedded Systems, Elsevier, 2011.
4. Lyla B.Das, "Embedded Systems: An Integrated Approach", Pearson, 2013.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	2	-	3	-	-
CO2	2	-	1	-	-
CO3	2	-	2	-	-
CO4	2	-	3	-	-
CO5	2	-	1	-	-

1 - Low, 2 - Medium, 3 - High

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ET24O02	EMBEDDED CONTROL	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic understanding of electrical machines, power electronics, and microcontrollers. Familiarity with control systems and programming in C/C++ is advantageous.

OBJECTIVE:

- To develop intelligent, embedded-controlled electric drive systems for industrial automation and robotic applications.

UNIT - I	INTRODUCTION TO ELECTRICAL DRIVES	(9)

Electric drive and its classification, Four-quadrant drive, dependence of load torque on various factors, Dynamic of motor – load Combination – Sold controlled Drives – Machine learning and optimization techniques for electrical drives – IoT for Electrical drives applications.

UNIT - II	OVERVIEW OF EMBEDDED PROCESSOR	(9)

Embedded Processor architecture – RTOS – Hardware/software co-design-Programming with Soc processors.

UNIT - III	INDUCTION MOTOR CONTROL	(9)

Types-speed control methods – PWM techniques – VSI fed three-phase induction motor – Fuzzy logic based speed control for three-phase induction motor – FPGA based three-phase induction motor control.

UNIT - IV	BLDC MOTOR CONTROL	(9)

Overview of BLDC motor – speed control methods – PWM techniques – ARM processor-based BLDC motor control – ANN for BLDC motor control application.

UNIT - V	INDUSTRIAL AUTOMATION & ROBOTICS CONTROL	(9)

Industrial Automation: Role of embedded systems in automation, including PLCs, HMIs, and communication protocols.

Robotics: Integration of embedded control in robotic systems, covering sensors, actuators, kinematics, and path planning.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Interpret the significance of embedded control for electrical drives.	Understand
CO2	Describe various control strategy for electric drives.	Understand
CO3	Apply control techniques like PWM, fuzzy logic, and FPGA to implement speed control for induction motors.	Apply
CO4	Apply ARM-based and ANN-based methods to control the speed of BLDC motors in embedded systems.	Apply
CO5	Apply embedded control strategies for industrial automation and robotic systems using sensors, actuators, and communication interfaces.	Apply

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TEXT BOOKS:

1. R.Krishnan, "Electric Motor Drives-Modeling, Analysis and Control", Prentice-Hall of India Pvt. Ltde., New Delhi, 2010.
2. Vedamsubramanium, "Electric Drives – Concepts and Applications", Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2002

REFERENCES:

1. K. Venkataratnam, Special Electrical Machines, Universities Press, 2014.
2. Steve Furber, 'ARM system on chip architecture', Addisson Wesley, 2010.
3. Ron Sass and Andrew G. Sehmid, Embedded System Design with Platform FPGAs: Principles and Practices, Elsevier, 2010.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	1	-	2	-	-
CO2	1	1	3	-	-
CO3	2	-	-	-	-
CO4	1	2	3	-	-
CO5	2	-	-	-	-

1 - Low, 2 - Medium, 3 - High

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ET24O03	EMBEDDED AUTOMATION	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Basic knowledge of digital electronics, microcontrollers, and programming in C or any procedural language. Familiarity with electronics lab tools is an added advantage.

OBJECTIVE:

- To develop embedded C programming skills for real-time applications involving microcontroller interfacing, vision systems, and home automation.

UNIT - I	INTRODUCTION TO EMBEDDED C PROGRAMMING 9	(9)

C Overview and Program Structure – C Types, Operators and Expressions – C Control Flow – C Functions and Program Structures – C Pointers and Arrays – FIFO and LIFO – C Structures – Development Tools.

UNIT - II	AVR MICROCONTROLLER	(9)

ATMEGA 16 Architecture – Nonvolatile and Data Memories – Port System – Peripheral Features: Time Base, Timing Subsystem, Pulse Width Modulation, USART, SPI, Two Wire Serial Interface, ADC, Interrupts – Physical and Operating Parameters.

UNIT - III	HARDWARE AND SOFTWARE INTERFACING WITH 8-BIT SERIES CONTROLLERS	(9)

Lights and Switches – Stack Operation – Implementing Combinational Logic – Expanding I/O – Interfacing Analog to Digital Convertors – Interfacing Digital to Analog Convertors – LED Displays: Seven Segment Displays, Dot Matrix Displays – LCD Displays – Driving Relays – Stepper Motor Interface – Serial EEPROM – Real Time Clock – Accessing Constants Table – Arbitrary Waveform Generation – Communication Links – System Development Tools.

UNIT - IV	VISION SYSTEM	(9)

Fundamentals of Image Processing – Filtering – Morphological Operations – Feature Detection and Matching – Blurring and Sharpening – Segmentation – Thresholding – Contours – Advanced Contour Properties – Gradient – Canny Edge Detector – Object Detection – Background Subtraction.

UNIT - V	HOME AUTOMATION	(9)

Home Automation – Requirements – Water Level Notifier – Electric Guard Dog – Tweeting Bird Feeder – Package Delivery Detector – Web Enabled Light Switch – Curtain Automation – Android Door Lock – Voice Controlled Home Automation – Smart Lighting – Smart Mailbox – Electricity Usage Monitor – Proximity Garage Door Opener – Vision Based Authentic Entry System.

LECTURE: 45, SELF LEARNING: 45, TOTAL: 90 PERIODS

Chairman (BoS)

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Understand the 8-bit series microcontroller architecture, features and pin details.	Understand
CO2	Write embedded C programs for embedded system applications.	Apply
CO3	Develop real-time systems using AVR microcontrollers.	Understand
CO4	Develop the systems based on the vision mechanism.	Apply
CO5	Develop a real-time home automation system for home needs.	Apply

TEXT BOOKS:

1. Dhananjay V. Gadre, Programming and Customizing the AVR Microcontroller, McGraw-Hill, 2001.
2. Joe Pardue, C Programming for Microcontrollers, Smiley Micros, 2005.

REFERENCES:

1. Steven F. Barrett, Daniel J. Pack, ATMEL AVR Microcontroller Primer: Programming and Interfacing, Morgan & Claypool Publishers, 2012.
2. Mike Riley, "Programming Your Home - Automate with Arduino, Android and Your Computer", Pragmatic Programmers, Llc, 2012.
3. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2011.
4. Kevin P. Murphy, "Machine Learning - a Probabilistic Perspective", The MIT Press, Cambridge, Massachusetts, London, 2012.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	-	-
CO2	3	2	3	-	-
CO3	3	2	3	-	-
CO4	3	2	3	-	-
CO5	3	2	3	-	-

1 - Low, 2 - Medium, 3 - High

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CU24O01	PRINCIPLES OF MULTIMEDIA	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

Students should be familiar with networking and compression techniques.

OBJECTIVES:

This course introduces the fundamentals and importance of multimedia. It covers key multimedia elements and the use of tools and authoring techniques to create interactive content. Students will learn to develop, test and deploy multimedia applications for both web and mobile platforms using relevant technologies.

UNIT - I	INTRODUCTION	(9)

Introduction to Multimedia – Characteristics of Multimedia Presentation – Multimedia Components – Promotion of Multimedia Based Components – Digital Representation – Media and Data Streams – Multimedia Architecture – Multimedia Documents, Multimedia Tasks and Concerns, Production, Sharing and distribution, Hypermedia, WWW and Internet, Authoring, Multimedia over wireless and mobile networks.

UNIT - II	ELEMENTS OF MULTIMEDIA	(9)

Text-Types, Font, Unicode Standard, File Formats, Graphics and Image data representations – Data types, file formats, color models, video – Color models in video, analog video, digital video, file formats, video display interfaces, 3D video and TV: Audio – Digitization, SNR, SQNR, quantization, audio quality, file formats - MIDI: Animation- Key Frames and Tweening - 2D and 3D Animation.

UNIT - III	MULTIMEDIA TOOLS	(9)

Authoring Tools – Features and Types – Card and Page Based Tools – Icon and Object Based Tools – Time Based Tools – Cross Platform Authoring Tools – Editing Tools – Painting and Drawing Tools – 3D Modeling and Animation Tools – Image Editing Tools – Sound Editing Tools – Digital Movie Tools.

UNIT - IV	MULTIMEDIA SYSTEMS	(9)

Compression Types and Techniques: CODEC, Text Compression: GIF Coding Standards, JPEG standard – JPEG 2000, Basic audio compression – ADPCM, MPEG Psychoacoustics, Basic Video compression techniques – MPEG, H.26X – Multimedia Database System – User Interfaces – OS Multimedia Support – Hardware Support – Real Time Protocols – Play Back Architectures – Synchronization – Document Architecture – Hypermedia Concepts: Hypermedia Design – Digital Copyrights, Content analysis.

UNIT - V	MULTIMEDIA APPLICATIONS FOR THE WEB AND MOBILE PLATFORMS	(9)

ADDIE Model – Conceptualization – Content Collection – Storyboard–Script Authoring Metaphors – Testing – Report Writing – Documentation. Multimedia for the web and mobile platforms. Virtual Reality, Internet multimedia content distribution, Multimedia Information sharing – Social media sharing, cloud computing for multimedia services, interactive cloud gaming. Multimedia information retrieval.

TOTAL(T:45, SL:45) : 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Explore multimedia components, architecture, and data streams by constructing basic multimedia documents.	Understand
CO2	Describe the multimedia elements to select appropriate models, formats, and standards for integrating content into multimedia applications.	Understand

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CO3	Use multimedia authoring and editing tools to develop interactive multimedia content across different platforms.	Apply
CO4	Implement multimedia compression techniques and synchronization protocols to manage multimedia storage, retrieval and playback systems efficiently.	Apply
CO5	Develop ADDIE model and relevant frameworks to conceptualize and deploy multimedia content for web and mobile platforms.	Apply

REFERENCES:

1. Li, Ze-Nian, Drew, Mark, Liu, Jiangchuan, "Fundamentals of Multimedia", Springer, Germany, Third Edition, 2021.
2. Prabhat K. Andleigh, Kiran Thakrar, "Multimedia Systems Design", Pearson Education, London, First Edition 2015.
3. Gerald Friedland, Ramesh Jain, "Multimedia Computing", Cambridge University Press, United Kingdom, First Edition 2018.
4. Ranjan Parekh, "Principles of Multimedia", McGraw-Hill Education, New York, Second Edition, 2017.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	-
CO2	3	-	3	3	-
CO3	3	-	3	3	-
CO4	3	-	3	3	-
CO5	3	-	3	3	-

1 - Low, 2 - Medium, 3 - High

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CU24O02	IoT FOR SMART SYSTEMS	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:

A solid understanding of basic of Micro Controllers and Sensors and Real Time IoT development Tools.

OBJECTIVES:

This course provides a foundational understanding of the Internet of Things (IoT), including its core concepts and architectures. It familiarizes students with various communication protocols, networking models, and IoT implementation tools. The course also explores diverse real-world applications of IoT across multiple domains.

UNIT - I	INTRODUCTION TO INTERNET OF THINGS	(9)

Overview, Hardware and software requirements for IOT– Sensor and actuators – Technology drivers, Business drivers, Typical IoT applications – Trends and implications.

UNIT - II	IOT ARCHITECTURE	(9)

IoT reference model and architecture – Node Structure – Sensing, Processing, Communication, Powering, Networking – Topologies, Layer/Stack architecture, IoT standards, Cloud computing for IoT, Bluetooth, Bluetooth Low Energy beacons.

UNIT - III	PROTOCOLS AND WIRELESS TECHNOLOGIES FOR IOT	(9)

NFC, SCADA and RFID, Zigbee MIPI, M-PHY, UniPro, SPMI, SPI, M-PCIe, GSM, CDMA, LTE, GPRS, small cell. Wireless technologies for IoT: WiFi (IEEE 802.11) – Bluetooth/Bluetooth Smart, ZigBee/ZigBee Smart, UWB (IEEE 802.15.4), 6LoWPAN, Proprietary systems – Recent trends.

UNIT - IV	IoT PROCESSORS	(9)

Services/Attributes: Big-Data Analytics for IoT – Dependability – Interoperability – Security, Maintainability. Embedded processors for IoT: Introduction to Python programming – Building IoT with RASPERRY PI and Arduino.

UNIT - V	CASE STUDIES	(9)

Industrial IoT – Home Automation – Smart cities, Smart Grid connected vehicles – Electric vehicle charging, Environment, Agriculture – Productivity Applications – IoT Defense

TOTAL (L:45, SL:45) : 90 PERIODS

COURSE OUTCOMES:

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

COs	Course Outcome	Cognitive Level
CO1	Articulate the main concepts, key technologies, strength and limitations of IoT.	Understand
CO2	Identify the architecture, infrastructure models of IoT	Understand
CO3	Analyze the networking and Protocols are used for communication in IoT	Analyze
CO4	Analyze and design different models for IoT implementation through various IoT Processors.	Analyze
CO5	Identify and design the new models for market strategic interaction	Apply

REFERENCES:

1. Arshdeep Bahga, Vijai Madisetti: A Hands-on Approach: Internet of Things, Universities Press, 2015.

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2. Oliver Hersent, David Boswarthick, Omar Elloumi, the Internet of Things, Wiley, 2016.
3. Samuel Greengard, The Internet of Things, The MIT press, 2015
4. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley, 2014.
5. Jean-Philippe Vasseur, Adam Dunkels, Interconnecting Smart Objects with IP: The Next Internet, Morgan Kuffmann Publishers, 2010.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	-
CO2	3	-	3	3	-
CO3	3	-	3	3	-
CO4	3	-	3	3	-
CO5	3	-	3	3	-

1 - Low, 2 - Medium, 3 - High

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CU24O03	MEMS AND NEMS	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:
Engineering Physics- I & II , Engineering Chemistry - I & II

OBJECTIVES:

This course introduces learners to micro and nanoscale systems, materials, and the fundamental principles of MEMS and NEMS. It covers microsystem fabrication processes, the design and operation of MEMS sensors and actuators using various actuation techniques.

UNIT - I	OVERVIEW AND INTRODUCTION	(9)

New trends in Engineering and Science: Micro and Nanoscale systems Introduction to Design of MEMS and NEMS, Overview of Nano and Microelectromechanical Systems, Applications of Micro and Nano electro-mechanical systems, Microelectromechanical systems, devices and structures Definitions, Materials for MEMS: Silicon, silicon compounds, polymers, metals.

UNIT - II	MEMS FABRICATION TECHNOLOGIES	(9)

Microsystem fabrication processes: Photolithography, Ion Implantation, Diffusion, Oxidation. Thin film depositions: LPCVD, Sputtering, Evaporation, Electroplating; Etching techniques: Dry and wet etching, electrochemical etching; Micromachining: Bulk Micromachining, Surface Micromachining, High Aspect-Ratio (LIGA and LIGA-like) Technology; Packaging: Microsystems packaging, Essential packaging technologies, Selection of packaging materials.

UNIT - III	MICROSENSORS	(9)

MEMS Sensors: Design of Acoustic wave sensors, resonant sensors, Vibratory gyroscope, Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Microsensors. Case study: Piezo-resistive pressure sensor

UNIT - IV	MICRO ACTUATORS	(9)

Design of Actuators: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric crystals, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators), Micromechanical Motors and pumps. Case study: Comb drive actuators

UNIT - V	NANOSYSTEMS AND QUANTUM MECHANICS	(9)

Atomic Structures and Quantum Mechanics, Molecular and Nanostructure Dynamics: Schrodinger Equation and Wave function Theory, Density Functional Theory, Nanostructures and Molecular Dynamics, Electromagnetic Fields and their Quantization, Molecular Wires and Molecular Circuits.

TOTAL (L:45, SL:45) : 45 PERIODS

COURSE OUTCOMES:
At the end of the course, the learners will be able to:

COs	Course Outcome	Cognitive Level
CO1	Explain the fundamentals of micro and nanoscale systems, including MEMS/NEMS design concepts.	Understand
CO2	Describe various microsystem fabrication techniques such as photolithography, thin-film deposition and micromachining processes.	Understand
CO3	Illustrate the structure, function, and engineering principles of MEMS sensors like acoustic wave, resonant, gyroscopic, capacitive and piezo resistive sensors.	Understand

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CO4	Summarize different actuation mechanisms in micro actuators, including thermal, piezoelectric, electrostatic and shape memory alloy-based designs.	Understand
CO5	Discuss key concepts of quantum mechanics and Nano system behavior, including molecular dynamics and wave function theory.	Understand

TEXTBOOKS:

1. Tai Ran Hsu, "MEMS and Microsystems Design and Manufacture", First edition, Tata McGraw-Hill, India, 2002.
2. Stephen D. Senturia," Microsystem Design", Second edition, Springer, India, 2004.
3. M.J. Madou, "Fundamentals of Micro Fabrication", CRC Press, New Delhi, Second edition, 2002
4. Chang Liu, "Foundations of MEMS", Second edition, Pearson Education Limited, India, 2006

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	-	2	2	-	3
CO2	-	2	2	-	3
CO3	-	2	2	-	3
CO4	-	3	3	-	3
CO5	-	3	3	-	3

1 - Low, 2 - Medium, 3 - High

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CU24O04	INTRODUCTION TO COGNITIVE RADIO NETWORK	Category	L	T	P	SL	C
		OEC	45	0	0	45	3

PREREQUISITE:
Digital Communication.

OBJECTIVES:

This course introduces students to cognitive radio networks, focusing on their architecture and importance in efficient spectrum utilization. It covers spectrum sensing techniques, dynamic spectrum allocation using optimization methods, and various access models.

UNIT - I	INTRODUCTION TO COGNITIVE RADIO	(9)

Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.

UNIT - II	SPECTRUM SENSING	(9)

Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models.

UNIT - III	OPTIMIZATION TECHNIQUES	(9)

Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming.

UNIT - IV	DYNAMIC SPECTRUM	(9)

Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols.

UNIT - V	SPECTRUM TRADING AND RESEARCH CHALLENGES	(9)

Spectrum Trading: Introduction to spectrum trading, classification to spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential). Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross layer design for cognitive radio networks.

TOTAL (L:45, SL:45): 90 PERIODS

COURSE OUTCOMES:
At the end of the course, the learners will be able to:

COs	Course Outcome	Cognitive Level
CO1	Demonstrate knowledge of cognitive radio architecture, functions, and applications.	Understand
CO2	Analyze and apply spectrum sensing techniques for detecting spectrum holes and managing shared resources.	Analyse
CO3	Solve dynamic spectrum allocation problems using mathematical optimization techniques.	Apply
CO4	Compare and contrast centralized and distributed spectrum access strategies and their real-world applications.	Apply
CO5	Identify and propose solutions for key research challenges in cognitive radio networks.	Understand

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REFERENCES:

1. Cognitive Radio, Software Defined Radio and Adaptive Wireless Systems", Hüseyin Arslan, Springer, ISBN 978-1-4020-5541-6 (HB), 2007.
2. Kwang-Cheng Chen, Ramjee Prasad, Cognitive radio networks, John Wiley & Sons Ltd., New York, 2009
3. Bruce Fette, Cognitive radio technology, Elsevier, Second edition, 2009.
4. Huseyin Arslan, Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, Soren Anderson, Optimizing Wireless Communication Systems, Springer, 2009.

Mapping of COs with POs and PSOs

COs/ POs	PO1	PO2	PO3	PO4	PO5
CO1	3	-	3	3	-
CO2	3	-	3	3	-
CO3	3	-	3	3	-
CO4	3	-	3	3	-
CO5	3	-	3	3	-

1 - Low, 2 - Medium, 3 - High

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