K.S. Rangasamy College of Technology

(Autonomous)

CURRICULUM & SYLLABUS

of

M.E. Structural Engineering

(For the Batch Admitted in 2025– 2026)

R 2025

Programme Accredited by NAAC with 'A++' Grade,
Approved by AICTE, Affiliated to Anna University, Chennai

KSR Kalvi Nagar, Tiruchengode – 637 215.
Namakkal District, Tamil Nadu, India

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

CHAIRMAN
Board of Studies
Faculty of Civil Engineering
K.S.Rangasamy College of Technology
TIRUCHENGODE - 637 215

DEPARTMENT OF CIVIL ENGINEEIRNG

VISION OF THE DEPARTMENT

- To empower the graduates to excel as a competent Professional in the areas of Design and Development of Safe, Healthy, Sustainable and Eco friendly Infrastructure for overall development of the Society.

MISSION OF THE DEPARTMENT

- To provide quality education through interdisciplinary research and innovative practices for the Betterment of human society in teaching and learning.
- To develop creative solutions for a wide range of challenges in Civil Engineering by adopting modern Tools and Techniques.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Gain knowledge and skills in structural engineering which will enable them to have a career and professional accomplishment in the public or private sector organizations.

PEO2: Become consultants in Structural Engineering and solve complex real-life issues related to the analysis, design and maintenance of structures under various environmental conditions.

PEO3: Contribute to the enhancement of knowledge in Structural Engineering by performing quality research in institutions of international repute or Research organizations or Academia.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1: Ability to individually carryout the STEM based (Science, Technology, Engineering, and Mathematics) research project.

PO2: Ability to write, present and publish technical articles in reputed international/national conferences and journals.

PO3: The skill developed by the student should be at a level of higher than the requirements in the appropriate bachelor program.

PO4: Ability to acquire in depth knowledge of engineering design concepts and application of the same to solve complex engineering problems.

PO5: Ability to find optimum safe and cost effective solutions in the development of mechanical systems taking into consideration sustainability, societal, environmental and public health aspects.

PO6: Ability to support professional ethics and social responsibilities consistent with their roles as design engineers.

Program Educational Objectives (PEOs)	Program Outcomes (POs)					
	PO1	PO2	PO3	PO4	PO5	PO6
PEO 1	3	2	3	3	2	1
PEO 2	3	2	3	3	2	1
PEO 3	3	2	3	3	2	1

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Year	Sem.	Course Name	POs					
			1	2	3	4	5	6
I	I	Applied Mathematics for Structural Engineering						
		Theory of Elasticity and Plasticity						
		Structural Dynamics and Earthquake Engineering						
		Research Methodology and IPR						
		Stability of Structures						
		Theory of Plates and Shells						
		Design of Tall Buildings						
		Design of Structures for Dynamic Loads						
		Fracture Mechanics of Concrete Structures						
		Design of Formwork						
		English for Research Paper Writing						
		Advanced Concrete Technology Laboratory						
		Technical Seminar						
	II	Advanced Steel Design						
		Advanced Reinforced Concrete Design						
		Finite Element Analysis						
		Structural Health Monitoring						
		Design of Sub Structures						
		Structural Optimization						
		Bridge Engineering						
		Non-linear Analysis of Structures						
		Life Cycle Assessment of Structures						
		Soil Structure Interaction						
		Design of Shell and Spatial Structures						
		Off Shore Structures						
		Experimental Methods and Model Analysis						
		Matrix Method of Structural Analysis						
		Wind and Cyclone Effect on Structures						
		Disaster Management						
		Advanced Structural Engineering Laboratory						
		Computer Aided Design and Detailing laboratory						
` II	III	CADD for Structures						
		Design of Industrial Structures						
		Disaster Resistant Structures						
		Industrial Steel Structures						
		Corrosion Engineering						
		Reliability Analysis of Structures						
		Advanced Prestressed Concrete						
		Advanced Concrete Technology						
		Earthquake resistant design of Structures						

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		Maintenance and Rehabilitation of Structures						
		Design of Steel Concrete Composite Structures						
		Mechanics of Fiber Reinforced Polymer Composite Materials						
		Project Work Phase - I						
		Inplant Training						
	IV	Project Work Phase - II						

K.S. RANGASAMY COLLEGE OF TECHNOLOGY

Credit Distribution for M.E. (Structural Engineering) Program: 2025 - 2026 Batch

S.No.	Category	Credits per Semester				Total Credits	%
		I	II	III	IV		
1.	PC	17	14	-	-	**31**	**42.46**
2.	PE	3	6	6	-	**15**	**20.56**
3.	CG	1	-	10	16	**27**	**36.98**
4.	AC	-	-	-	-	**-**	
Total		**21**	**20**	**16**	**16**	**73**	**100**

PC – PROFESSIONAL CORE

PE – PROFESSIONAL ELECTIVES

CG - CAREER GUIDANCE COURSES

AC- AUDIT COURSES

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PROFESSIONAL CORE COURSES (PC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE 101	Applied Mathematics for Structural Engineering	PC	5	3	1	0	4	Engineering Mathematics, Probability and Statistics
2.	70 PSE 102	Theory of Elasticity and Plasticity	PC	5	3	1	0	4	Fundamentals of Mathematics, Strength of Material
3.	70 PSE 103	Structural Dynamics	PC	5	3	1	0	4	Fundamentals of Mathematics
4.	70 PIS 001	Research Methodology and IPR	PC	3	3	0	0	3	Nil
5.	70 PSE 1P1	Advanced Concrete Technology Laboratory	PC	4	0	0	4	2	Concrete Technology
6.	70 PSE 201	Advanced Steel Design	PC	3	3	0	0	3	Steel member design and foundation design
7.	70 PSE 202	Advanced Reinforced Concrete Design	PC	3	3	0	0	3	Design of RC elements
8.	70 PSE 203	Finite Element Analysis	PC	5	3	0	0	4	Knowledge of forces and resolution and equilibrium concepts.
9.	70 PSE 2P1	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2	Basic RC and steel design theory and design
10.	70 PSE 2P2	Computer Aided Design and Detailing laboratory	PC	4	0	0	4	2	CAD for structures

PROFESSIONAL ELECTIVES (PE)

SEMESTER I, PROFESSIONAL ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE E11	Stability of Structures	PE	3	3	0	0	3	Strength of materials and Structural Analysis
2.	70 PSE E12	Theory of Plates and Shells	PE	3	3	0	0	3	Strength of materials and its mechanics
3.	70 PSE E13	Design of Tall Buildings	PE	3	3	0	0	3	Industrial Structures
4.	70 PSE E14	Design of Structures for Dynamic Loads	PE	3	3	0	0	3	Structural Dynamics
5.	70 PSE E15	Fracture Mechanics of Concrete Structures	PE	3	3	0	0	3	Basic Strength of material
6.	70 PSE E16	Design of Formwork	PE	3	3	0	0	3	Design of RCC and Steel Structures

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SEMESTER II, PROFESSIONAL ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE E21	Structural Health Monitoring	PE	3	3	0	0	3	Nil
2.	70 PSE E22	Design of Sub Structures	PE	3	3	0	0	3	Foundation design
3.	70 PSE E23	Structural Optimization	PE	3	3	0	0	3	Nil
4.	70 PSE E24	Bridge Engineering	PE	3	3	0	0	3	Design concepts of RCC, Prestressed concrete and steel structures.
5.	70 PSE E25	Non-linear Analysis of Structures	PE	3	3	0	0	3	Finite element methods
6.	70 PSE E26	Life Cycle Assessment of Structures	PE	3	3	0	0	3	Construction Materials and Repair and Rehabilitation of Structures

SEMESTER II, PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE E31	Soil Structure Interaction	PE	3	3	0	0	3	Geotechnical Engineering
2.	70 PSE E32	Design of Shell and Spatial Structures	PE	3	3	0	0	3	Theory of elasticity and plasticity.
3.	70 PSE E33	Off Shore Structures	PE	3	3	0	0	3	Nil
4.	70 PSE E34	Experimental Methods and Model Analysis	PE	3	3	0	0	3	Fundamentals of Mathematics and Structural Analysis
5.	70 PSE E35	Matrix Method of Structural Analysis	PE	3	3	0	0	3	Mechanics of structures and structural analysis.
6.	70 PSE E36	Wind and Cyclone Effect on Structures	PE	3	3	0	0	3	Analysis of Structures

SEMESTER III, PROFESSIONAL ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE E41	CADD for Structures	PE	3	3	0	0	3	Nil
2.	70 PSE E42	Design of Industrial Structures	PE	3	3	0	0	3	Steel Structures
3.	70 PSE E43	Disaster Resistant Structures	PE	3	3	0	0	3	Nil
4.	70 PSE E44	Industrial Steel Structures	PE	3	3	0	0	3	Steel Structures
5.	70 PSE E45	Corrosion Engineering	PE	3	3	0	0	3	RCC and Steel Structures
6.	70 PSE E46	Reliability Analysis of Structures	PE	3	3	0	0	3	Structural Analysis

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SEMESTER III, PROFESSIONAL ELECTIVE V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE E51	Advanced Prestressed Concrete	PE	3	3	0	0	3	Nil
2.	70 PSE E52	Advanced Concrete Technology	PE	3	3	0	0	3	Concrete Technology
3.	70 PSE E53	Earthquake resistant design of Structures	PE	3	3	0	0	3	Dynamics of Structures
4.	70 PSE E54	Maintenance and Rehabilitation of Structures	PE	3	3	0	0	3	Construction materials and practices
5.	70 PSE E55	Design of Steel Concrete Composite Structures	PE	3	3	0	0	3	RCC and Steel Structures
6.	70 PSE E56	Mechanics of Fiber Reinforced Polymer Composite Materials	PE	3	3	0	0	3	Construction Materials and Concrete Technology

AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PAC 001	English For Research Paper Writing	AC	2	2	0	0	0	-NIL-
2.	70 PAC 002	Disaster Management	AC	2	2	0	0	0	-NIL-
3.	70 PAC 003	Constitution of India	AC	2	2	0	0	0	-NIL-

CAREER GUIDANCE COURSES (CG)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-Requisite
1.	70 PSE 1P2	Technical Seminar	CG	2	0	0	2	1	Nil
2.	70 PSE 3P1	Project Work Phase - I	CG	16	0	0	16	08	Nil
3.	70 PSE 3P2	Inplant Training	CG	0	0	0	0	2	Nil
4.	70 PSE 4P1	Project Work Phase - II	CG	32	0	0	32	16	Project Work Phase - I

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K.S.RANGASAMY COLLEGE OF TECHNOLOGY, TIRUCHENGODE -637215
(An Autonomous Institution, Affiliated to Anna University, Chennai)

COURSES OF STUDY
(For the Batch Admitted in 2025 - 2026)

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	70 PSE 101	Applied Mathematics for Structural Engineering	PC	5	3	1	0	4
2.	70 PSE 102	Theory of Elasticity and Plasticity	PC	5	3	1	0	4
3.	70 PSE 103	Structural Dynamics	PC	5	3	1	0	4
4.	70 PIS 001	Research Methodology and IPR	PC	3	3	0	0	3
5.	70 PSE E1*	Professional Elective I	PE	3	3	0	0	3
6.	70 PAC 001	English for Research Paper Writing	AC	2	2	0	0	0
PRACTICALS								
7.	70 PSE 1P1	Advanced Concrete Technology Laboratory	PC	4	0	0	4	2
8.	70 PSE 1P2	Technical Seminar	CG	2	0	0	2	1
			Total	29	17	3	6	21

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	70 PSE 201	Advanced Steel Design	PC	3	3	0	0	3
2.	70 PSE 202	Advanced Reinforced Concrete Design	PC	3	3	0	0	3
3.	70 PSE 203	Finite Element Analysis	PC	5	3	1	0	4
4.	70 PSE E2*	Professional Elective II	PE	3	3	0	0	3
5.	70 PSE E3*	Professional Elective III	PE	3	3	0	0	3
6.	70 PAC 002	Disaster Management	AC	2	2	0	0	0
PRACTICALS								
7.	70 PSE 2P1	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
8.	70 PSE 2P2	Computer Aided Design and Detailing laboratory	PC	4	0	0	4	2
Total				**27**	**17**	**1**	**8**	**20**

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SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	70 PSE E4*	Professional Elective IV	PE	3	3	0	0	3
2.	70 PSE E5*	Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
3.	70 PSE3P1	Project Work Phase - I	CG	16	0	0	16	8
4.	70 PSE3P2	Inplant Training	CG	0	0	0	0	2
Total				**22**	**6**	**0**	**16**	**16**

SEMESTER IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
PRACTICALS								
1.	70 PSE4P1	Project Work Phase - II	CG	32	0	0	32	16
Total				**32**	**0**	**0**	**32**	**16**

TOTAL NUMBER OF CREDITS TO BE EARNED FOR AWARD OF THE DEGREE = 73

Note:

PC- Professional Core Courses; PE- Professional Elective Courses; CG-Career Guidance Courses; AC- Audit Courses.

L: Lecture

T: Tutorial

P: Practical

C: Credit

1 Hour Lecture = 1 credit

1 Tutorial = 1 credit

2 Hours Practical = 1 credit

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70 PSE101	Applied Mathematics for Structural Engineering	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To describe the various methods of finding eigenvalues of matrices
- To understand the least square method to find the curve of best fit
- To get exposed to the functional optimization related problems
- To acquire knowledge of solving partial differential equations using Laplace transform
- To familiarize the techniques of Fourier transform for solving the boundary value problems

Pre-requisites

- Matrices and Calculus

Course Outcomes

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

CO1	Apply various iteration techniques to find the eigenvalues of matrices.	Apply
CO2	Use method of least square to find the best fit of curves and analyze interpolation problems.	Understand
CO3	Compute the solutions for functional optimization problems.	Apply
CO4	Solve partial differential equations using Laplace transform.	Apply
CO5	Apply Fourier transform techniques to solve the boundary value problems.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	**2**	**3**	**4**	5	6
CO1	3	3	2	1	2	-
CO2	3	3	2	1	2	-
CO3	2	2	-	-	-	-
CO4	3	3	2	1	2	-
CO5	3	3	2	1	2	-

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	20	10	30
Apply	30	40	50
Analyse	-	-	-
Evaluate	-	-	-
Create	-	-	-
Total	10	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E – Structural Engineering

70 PSE 101 - Applied Mathematics for Structural Engineering

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	40	60	100

Eigenvalue Problems* Solution of system of linear equation by Gauss Seidal iterative method – Eigen value and eigen vector by iterative methods: Power method – Jacobi method – Given's method – House holder method.	[9]
Regression Analysis* Curve fitting by the method of least squares – Fitting a curve of the form $y = ax^b$ and $y = ae^{bx}$. Interpolation: polynomial approximation – Lagrange's method – Newton's method.	[9]
Calculus of Variations* Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz method.	[9]
Laplace Transform Techniques for Partial Differential Equations* Laplace transform: Definitions – Properties – Dirac delta function – Unit step functions – Convolution theorem – Inverse Laplace transform: Complex inversion formula – Solutions to partial differential equations: Heat equation – Wave equation.	[9]
Fourier Transform Techniques for Partial Differential Equations* Fourier transform: Definitions – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation – Wave equation – Laplace and Poisson's equations.	[9]
Total Hours (45+15) (Tutorial)	**60**

Text Book(s):

1. Jain M K, Iyengar S R K and Jain R K, "Numerical Methods: For Scientific and Engineering Computation", 8th Edition, New Age International Private Limited, New Delhi, 2022.
2. Sankara Rao K, "Introduction to Partial Differential Equations", 3rd Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2011.

Reference(s):

1. Grewal B S, "Numerical methods in Engineering and Science, 11thEdition, Khanna Publishers, New Delhi, 2013.
2. Gupta A S, "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi 1999.
3. Rajasekaran S, "Numerical Methods in Science and Engineering: A Practical Approach", S.Chand& Co., New Delhi, 1st Edition, 1999 (Reprint 2012).
4. James G, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2004.

*SDG 4 – Quality Education

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Eigenvalue Problems**	
1.1	Solution of system of linear equation by Gauss Seidal iterative method	2
1.2	Eigen value and eigen vector by iterative methods: Power method	2
1.3	Jacobi method	2
1.4	Given's method	2
1.5	House holder method	2
1.6	Tutorial	2
2.0	**Regression Analysis**	
2.1	Curve fitting by the method of least squares	2
2.2	Fitting a curve of the form $y = ax^b$ and $y = ae^{bx}$	2
2.3	Interpolation: polynomial approximation	2
2.4	Lagrange's method	2
2.5	Newton's method	2
2.6	Tutorial	2
3.0	**Calculus of Variations**	
3.1	Concept of variation and its properties	1
3.2	Euler's equation	2
3.3	Functional dependent on first and higher order derivatives	2
3.4	Functionals dependent on functions of several independent variables	1
3.5	Variational problems with moving boundaries	1
3.6	Isoperimetric problems	1
3.7	Ritz method	2
3.8	Tutorial	2
4.0	**Laplace Transform Techniques for Partial Differential Equations**	
4.1	Laplace transform: Definitions – Properties	1
4.2	Dirac delta function – Unit step functions	2
4.3	Convolution theorem	2
4.4	Inverse Laplace transform: Complex inversion formula	1
4.5	Solutions to partial differential equations: Heat equation	2
4.6	Solutions to partial differential equations: Wave equation	2
4.7	Tutorial	2
5.0	**Fourier Transform Techniques for Partial Differential Equations**	
5.1	Fourier transform: Definitions – Properties	1
5.2	Transform of elementary functions	1
5.3	Convolution theorem – Parseval's identity	1
5.4	Solutions to partial differential equations: Heat equation	2
5.5	Solutions to partial differential equations: Wave equation	2
5.6	Laplace's equation	2
5.7	Poisson's equation	1
5.8	Tutorial	2

Course Designer(s)

1. **Dr.D.Tamizharasan** -tamizharasan@Ksrct.Ac.In

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70 PSE102	Theory of Elasticity and Plasticity	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To understand the concepts of stresses, strains and stress-strain relationships, basic theory of elasticity and failure criteria.
- To expose the two dimensional problems in Cartesian and polar coordinates.
- To make familiar with problem formulations and solution techniques.
- To familiarize with the principle of torsion of prismatic bars of non circular sections.
- To Learn different energy methods and also basics of plasticity.

Pre-requisites

Fundamentals of Mathematics, knowledge of basic Science

Course Outcomes

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

CO1	Understand the equilibrium equation and stress-strain relationship with various Coordinate Systems.	Analyse
CO2	Analyse the problem with bi-harmonic equations.	Analyse
CO3	Identify the different approaches for solving the torsional problems and thin walled open and closed sections	Analyse
CO4	Analyse the elasticity problems with various energy methods.	Analyse
CO5	State the assumptions of plasticity and solve plastic problems.	Apply

Mapping with Programme Outcomes

COs	POs					
	1	**2**	**3**	**4**	5	6
CO1	3	3	2	2	3	-
CO2	3	3	3	2	3	3
CO3	2	3	3	3	2	2
CO4	2	2	3	3	2	1
CO5	2	3	2	3	2	2

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E – Structural Engineering

70 PSE 102 - Theory of Elasticity and Plasticity

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	40	60	100

Elasticity Analysis of stress and strain, equilibrium equations – Compatibility equations – stress strain relationship. Generalized Hooke's law.	[9]
Elasticity Solution Plane stress and plane strain problems -Two dimensional problems in Cartesian and Polar co-ordinates - Airy's stress function – Bi harmonic equation – Saint Venant's principle.	[9]
Torsion of Non Circular Section St.venant's approach – Prandtl's approach – membrane analogy – Torsion of thin walled open and closed sections.	[9]
Energy Methods Strain energy - Principle of Virtual Work-Energy theorem - Rayleigh Ritz method-finite difference method – application to elasticity problems.	[9]
Plasticity Physical assumption – Yield criteria - Yield surface, Flow rule – Plastic stress strain relationship-Elastic – Plastic problems in bending - Torsion and Thick cylinders.	[9]
Total Hours (45+15)	60

Text Book(s):

1. Sadhu singh," Theory of Elasticity", Khanna Publishers, New Delhi, 2013.
2. Sadhu singh," Theory of Plasticity", Khanna Publishers, New Delhi, 2011.

Reference(s):

1. S. Timoshenko.S and J.N Goodier.," Theory of Elasticity", Mc Graw Hill Book Co., New York, 2010
2. H Jane Helena, "Theory of Elasticity and Plasticity", PHI Learning Pvt. Ltd., 2016.
3. L.S.Srinath, "Advanced Mechanics of Solids", Tata McGraw Hill, New Delhi, Third Edition, 2011
4. Sadhu singh, "Applied Stress Analysis", Khanna Publishers, New Delhi, 2007.

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Passed in the BOS Meeting Held on 17.06.2025
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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Elasticity**	
1.1	Analysis of stress and strain in 2D and 3D system - Introduction	1
1.2	Longitudinal Vibrations Equation of motion, SDOF analysis	1
1.3	Equation of Equilibrium – 2D (Cartesian & Polar coordinate system) & Problems	1
1.4	Equation of Equilibrium - 3D (Cartesian system) & Problems	2
1.5	Compatibility equation	1
1.6	Analysis of stress – 2D(Cartesian & Polar coordinate system) & Problems	1
1.7	Analysis of strain – 2D(Cartesian & Polar coordinate system) & Problems	1
1.8	Specification of stress and strain –2D & 3D & Problems	1
1.9	Generalized Hook's law, Stress-Strain relationship- Mohr Circle	2
2.0	**Elasticity Solution**	
2.1	Plane Stress and Plane Strain Problems.	1
2.2	Derivation of Airy's stress functions in cartesian coordinate system	2
2.3	Derivation of Airy's stress functions in polar coordinate system	2
2.4	Application of Airy's stress functions	2
2.5	Problems in airy's stress functions	2
2.6	Thick cylinders under uniform pressure	1
2.7	Bi harmonic equation	1
2.8	Saint Venant's principle	1
2.9	Shrink & Force fit & Problems	2
2.10	Problem	2
3.0	**Torsion of Non Circular Section**	
3.1	Torsion of non-circular by St. Venant's approach	2
3.2	Torsion of circular Prismatic bar by St. Venant's approach	2
3.3	Torsion of non-circular by Prandtl approach & Problems	2
3.4	Torsion of Prismatic bar by Prandtl approach & Problems	2
3.5	Membrane analogy of torsion of Closed section	2
3.6	Torsion of thin walled open and closed sections	2
4.0	**Energy Methods**	
4.1	Introduction to energy theorem	1
4.2	Strain Energy for 2D & 3D stress system	1
4.3	Complimentary energy theorem	1
4.4	Principle of Virtual Work	1
4.5	Energy theorem	1
4.6	Rayleigh Ritz method	1
4.7	Finite difference method	1
4.8	Engesser's theorem &Castingliano's theorem	1
	Problems in energy method	2
5.0	**Plasticity**	
5.1	Physical assumption	1
5.2	Yield criteria and Yield surface	2
5.3	**Plastic stress strain relations,** Flow rule	2
5.4	Tresca criteria & Problems	2
5.5	**Von mises criteria & Problems**	2
5.6	Plastic problems in bending	1
5.7	Plastic problems in Torsion	1
5.8	Plastic problems in Thick cylinders	1

Course Designer(s)

1. Dr.J.Abdul Bari - abdulbari@ksrct.ac.in

R2/ w.e.f. 01.08.2025
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70 PSE 103	Structural Dynamics and Earthquake Engineering	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To know the fundamentals of vibrations of SDOF system
- To gain knowledge on free and forced vibration of MDOF system
- To understand the basic principles of dynamics, different methods of multi degree of freedom system and their dynamic response, modeling
- To evaluate the free and forced vibration analysis of continuous system
- To know the practical applications of structural dynamics

Pre-requisites

Fundamentals of Mathematics, knowledge of basic Science

Course Outcomes

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

CO1	Analyse the single degree of freedom with free vibration.	Analyse
CO2	Analyse the single degree of freedom forced vibration with harmonic excitation.	Analyse
CO3	Analyse the two degree of freedom with free vibration.	Analyse
CO4	Analyse the Multi degree of freedom with free and forced vibration.	Analyse
CO5	Apply the principle of vibration to the sub structure design..	Apply

Mapping with Programme Outcomes

COs	POs					
	1	**2**	**3**	**4**	5	6
CO1	2	2	3	2	2	3
CO2	-	-	3	-	2	3
CO3	2	2	3	2	2	3
CO4	-	-	3	-	2	3
CO5	1	1	3	2	3	3

3 - Strong; 2 - Medium; 1 - Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E – Structural Engineering

70 PSE 103 - Structural Dynamics and Earthquake Engineering

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	1	0	60	4	40	60	100

Principles of Vibration Analysis Equations of Motion by equilibrium and energy methods, Free & Forced vibration of single degree of freedom systems, Effect of damping – transmissibility	[9]
Multi Degree of Freedom System Formulation of Structure, property matrices - Eigen value problems – problems on two degree of freedom system – Mode shapes - Orthonormality of modes	[9]
Dynamic Analysis of Multi Degree of Freedom Multi degree of freedom systems, Orthogonality of normal modes, approximate methods- Dunkerly's method Holzer method- Stodola method-Rayleigh's method- Rayleigh Ritz method-Mode superposition technique Numerical integration techniques	[9]
Dynamic Analysis of Continuous Systems Free and forced vibration of continuous system –Rayleigh Ritz method – formulation using conservation of energy- formulation using virtual work.	[9]
Practical Applications Idealization of multi-storeyed frames – Impact loading - blast loading - aerodynamics, gust phenomenon principles of analysis..	[9]
Total Hours (45+15)	**60**

Text Book(s):

1. Madhujith Mukhopadhyay "Structural Dynamics (Vibration & systems)" ,Ane books Pvt.Ltd, 2015.
2. M Paz, " Structural Dynamics-Theory and Computation", Springer, 2007.

Reference(s):

1. Anil K Chopra, "Dynamics of Structures – Theory and Applications to Earthquake Engineering", Prentice Hall,New Delhi, 2007.
2. Roy R Craig and Andrew J.Kurdila," Fundamentals of Structural dynamics", John Wiley and Sons, 2011.
3. R W Clough and J Penzien, "Dynamics of Structures", McGraw Hill Book Co. Ltd, 2003.
4. J L Humar, "Dynamics of Structures", Prentice Hall on India Pvt. Ltd, 2000.

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Principles of Vibration Analysis**	
1.1	Free vibration of single degree of freedom systems, Simple Harmonic motion	1
1.2	Longitudinal Vibrations Equation of motion, SDOF analysis	1
1.3	Undamped SDOFs- dynamic equation of motion with electrical equivalent	1
1.4	Tutorial	2
1.5	Newtons law of motion, D'Alemberts principle- equivalent stiffness	1
1.6	Springs are connected in series and parallel, frequency and period, problems	1
1.7	Amplitude of motion, Energy method for the equation of motion	1
1.8	Damped SDOFs- underdamped, overdamped and critically damped	1
1.9	Logarithmic decrement ,method of determining damping	1
1.10	Tutorial	2
2.0	**Multi Degree of Freedom System**	
2.1	Forced vibration of single degree of freedom system	1
2.2	Undamped harmonic excitation	2
2.3	Damped harmonic excitation with electrical equivalent	1
2.4	Tutorial	1
2.5	Response to support motion Torsional vibration and Dynamic Magnification Factor	2
2.6	Impulsive loading problems using Fourier series	1
2.7	Forced vibration problems using Laplace transform method	1
2.8	Numerical evaluation of Duhamel's integral for damped system	2
2.9	Tutorial	2
3.0	**Dynamic Analysis of Multi Degree of Freedom**	
3.1	Two degrees of freedom	2
3.2	Principle modes of vibration and equation of motion for two degree of freedom	2
3.3	Two degrees of freedom for torsional system, Vibrations of undamped Two degrees of freedom	2
3.4	Tutorial	2
3.5	Forced Vibrations and Undamped forced vibration for two degrees of freedom	2
4.0	**Multi Degree of Freedom**	
4.1	Stiffness, mass, damping matrices and Influence Coefficient	2
4.2	Modal analysis – damped undamped free vibration	2
4.3	Matrix Method and Matrix Iteration Method	2
4.4	Tutorial	2
4.5	Dunkerleys ,Stodola's , Rayleigh's and Holzer Method	2
4.6	Dynamic analysis method to evaluate lateral forces, Static and dynamic condensation	2
4.7	Tutorial	2
5.0	**Vibration Analyse in Sub Structure**	
5.1	Base Isolation and design of bearings	2
5.2	Machine foundation- types , basic and design criteria	2
5.3	MSD Method of analysis	2
5.4	Tutorial	2
5.5	EHS Method of Analysi	1
5.6	Tschebotarioff's reduced frequency method- design problems	2

Course Designer(s)

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70 PIS 001	Research Methodology and IPR	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To understand the principles of research process.
- To develop knowledge in analytical skills for collection of research data.
- To understand the procedure in the preparation of reports.
- To accomplish basic idea about the process involved in intellectual property rights.
- To enlighten the process of patent filing.

Pre-requisites

NIL

Course Outcomes

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

CO1	To understand the research process and design.	Analyse
CO2	To gain the knowledge about sources and collection of research data	Analyse
CO3	To understand the procedure of data analysis, preparation of reports and checking plagiarism	Analyse
CO4	To gain the knowledge on Trade mark and functions of UNESCO in IPR	Analyse
CO5	To enlighten the benefits, E-filing and Examinations related to patents	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	2	2
CO2	3	3	2	2	2	2
CO3	3	3	2	2	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	2	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022								
Common to all Branches								
70 PIS 001 - Research Methodology and IPR								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	3	0	0	60	3	40	60	100

Research Design Overview of research process and design- Use of Secondary and exploratory data to answer the research question, Qualitative research, Observation studies, Experiments and Surveys, Selection of the Right Medium and Journal for publication, Translation of Research	[9]
Data Collection and Sources Measurements, Measurement Scales, Questionnaires and Instruments, Sampling and methods. Data - Preparing, Exploring, examining and displaying.	[9]
Data Analysis and Reporting Overview of Multivariate Analysis, Hypotheses testing and Measures of Association. Presenting Insights and findings using written reports and oral presentation. Checks for Plagiarism, Falsification, Fabrication, and Misrepresentation	[9]
Intellectual Property Rights Intellectual Property – The concept of IPR, Evolution and development of concept of IPR, IPR development process, Trade secrets, utility Models, IPR & Bio diversity, Role of WIPO and WTO in IPR establishments, Right of Property, Common rules of IPR practices, Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance.	[9]
Patents Patents – objectives and benefits of patent, Concept, features of patent, Inventive step, Specification, Types of patent application, process E-filling, Examination of patent, Grant of patent, Revocation, Equitable Assignments, Licences, Licensing of related patents, patent agents, Registration of patent agents.	[9]
Total Hours	45

Text Book(s):	
1.	David I. Bainbridge, “Intellectual Property”, Longman, 9th Edition, 2012.
2.	*Cooper Donald R, Schindler Pamela S and Sharma JK, “Business Research Methods”, Tata McGraw Hill Education, 11e (2012).*
Reference(s):	
1.	Chawla H S., “Introduction to Intellectual Property Rights”, CBS PUB & DIST PVT Limited, INDIA, 2019..
2.	Catherine J. Holland, “Intellectual property: Patents, Trademarks, Copyrights, Trade Secrets”, Entrepreneur Press, 2007
3.	David Hunt, Long Nguyen, Matthew Rodgers, “Patent searching: tools & techniques”, Wiley, 2007
4.	Arun K. Narasani, Kankanala K.C., Radhakrishnan V., “Indian Patent Law and Practice”, Oxford University Press, 2010.
5.	Richard Stim, “Patent, Copyright & Trademark - An Intellectual Property Desk Reference”, NOLO Publishers, 2020.
6.	The Institute of Company Secretaries of India, Statutory body under an Act of parliament, “Professional Programme Intellectual Property Rights, Law and practice”, September 2013.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Research Design**	
1.1	Overview of research process and design	1
1.2	Use of Secondary and exploratory data to answer the research question	2
1.3	Qualitative research	1
1.4	Observation studies	1
1.5	Experiments and Surveys	1
1.6	Selection of the Right Medium and Journal for publication	2
1.7	Translation of Research	1
2.0	**Data Collection and Sources**	
2.1	Measurements, Measurement Scales	2
2.2	Questionnaires and Instruments	2
2.3	Sampling and methods	2
2.4	Data - Preparing, Exploring, examining and displaying	1
3.0	**Data Analysis and Reporting**	
3.1	Overview of Multivariate analysis	1
3.2	Hypotheses testing and Measures of Association	1
3.3	Presenting Insights	2
3.4	Findings using written reports and oral presentation	1
3.5	Checks for Plagiarism	2
3.6	Falsification	1
3.7	Fabrication, and Misrepresentation	1
4.0	**Intellectual Property Rights**	
4.1	Intellectual Property – The concept of IPR	1
4.2	Evolution and development of concept of IPR, IPR development process	1
4.3	Trade secrets, utility Models, IPR & Bio diversity	1
4.4	Role of WIPO and WTO in IPR establishments	2
4.5	Right of Property, Common rules of IPR practices	1
4.6	Types and Features of IPR Agreement, Trademark, Functions of UNESCO in IPR maintenance	2
5.0	**Patents**	
5.1	Patents – objectives and benefits of patent, Concept, features of patent	1
5.2	Inventive step, Specification, Types of patent application	1
5.3	Process E-filling, Examination of patent	1
5.4	Grant of patent, Revocation	2
5.5	Equitable Assignments, Licences, Licensing of related patents	1
5.6	Patent agents, Registration of patent agents	1

Course Designer(s)

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R2/ w.e.f. 01.08.2025
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Approved in Academic Council Meeting held on 19.07.2025

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70 PAC 001	English for Research Paper Writing	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

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

Pre-requisites

-NIL-

Course Outcomes

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

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

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PAC 001 - English for Research Paper Writing

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	0	30	0	40	60	100

Introduction to Research Paper Writing Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	[6]
Presentation Skills Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	[6]
Title Writing Skills Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	[6]
Result Writing Skills Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	[6]
Verification Skills Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first time submission	[6]
Total Hours	30

Text Book(s):

1.	Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006

Reference(s):

1.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
2.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.
3.	Phill Williams, Advanced Writing skills for students of English, Rumian Publishers, 2018
4.	Sudhir S. Pandhye, English Grammar and Writing Skills, Notion Press, 2017.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Research Paper Writing**	
1.1	Planning and Preparation, Word Order	2
1.2	Breaking up long sentences, Structuring Paragraphs and Sentences	1
1.3	Being Concise and Removing Redundancy	2
1.4	Avoiding Ambiguity and Vagueness	1
2.0	**Presentation Skills**	
2.1	Clarifying Who Did What, Highlighting Your Findings	2
2.2	Hedging and Criticizing	2
2.3	Paraphrasing and Plagiarism, Sections of a Paper	1
2.4	Abstracts, Introduction	1
3.0	**Title Writing Skills**	
3.1	Key skills are needed when writing a Title	1
3.2	Key skills are needed when writing an Abstract, key skills are needed when writing an Introduction	2
3.3	Skills needed when writing a Review of the Literature	2
3.4	Methods, results, discussion, conclusions, the final check	1
4.0	**Result Writing Skills**	
4.1	Skills are needed when writing the Methods	2
4.2	Skills needed when writing the Results	1
4.3	Skills are needed when writing the Discussion	1
4.4	Skills are needed when writing the Conclusions	2
5.0	**Verification Skills**	
5.1	Useful phrases	2
5.2	Checking Plagiarism	2
5.3	How to ensure paper is as good as it could possibly be the first time submission	2

Course Designer

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R2/ w.e.f. 01.08.2025
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70 PSE 1P1	Advanced Concrete Technology Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To design concrete mixes using industrial by-products for sustainable construction
- To assess the workability and flow properties of self-compacting concrete
- To evaluate the mechanical properties of fiber-reinforced concrete
- To analyze the durability of concrete through water, acid, and sulfate resistance tests
- To perform non-destructive tests for quality assessment of concrete structures

Pre-requisites

- Courses – Concrete Technology

Course Outcomes

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

CO1	Design concrete mixes using industrial by-products to enhance sustainability	Apply
CO2	Evaluate the workability and flow properties of self-compacting concrete	Analyse
CO3	Determine the mechanical properties of fiber-reinforced concrete	Apply
CO4	Assess the durability of concrete through chloride, acid, and sulfate resistance tests.	Apply
CO5	**Perform**non-destructive testing to ensure concrete quality and strength	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	-	-	3	2	
CO2	3	-	-	3	2	
CO3	3	-	-	3	2	
CO4	3	-	-	3	2	
CO5	3	-	-	3	2	
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Lab Experiments Assessment (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	Lab	Activity		
Remember	-	-	-	-
Understand	-	-	-	-
Apply	25	12	50	
Analyse	25	13	50	
Evaluate	-	-	-	-
Create	-	-	-	-
Total	50	25	100	-

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Rangasamy College of Technology – Autonomous R2022								
M.E – Structural Engineering								
70 PSE 1P1 - Advanced Concrete Technology Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
I	0	0	4	60	2	60	40	100

List of Experiments:

1. Perform mix design for concrete with industrial by-products
2. Perform slump flow test on self-compacting concrete
3. Perform L Box test for self-compacting concrete
4. Determine the mechanical properties of fibre reinforced concrete specimens
5. Determine the young's modulus of fibre reinforced concrete specimens
6. Perform the Water Absorption Test on Concrete.
7. Determine the amount of chloride content present in sample of concrete
8. Perform the Acid resistance test on concrete
9. Perform the sulphate resistance test on concrete
10. Perform non-destructive test on concrete

Reference(s)

1.	"Advanced Concrete Technology - Lab Manual", Department of Civil Engineering, KSRCT.
2.	IS: 10262 – 2019, Concrete Mix Proportioning - Guidelines (Second Revision)
3.	A R Santhakumar, "Concrete Technology, Oxford Higher Education, New Delhi, 2018
4.	IS 516 – Method of Test for Strength of Concrete -Specification BIS, New Delhi

Course Designer(s)

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE 1P2	Technical Seminar	Category	L	T	P	Credit
		CG	0	0	2	1

Objective

- To encourage the students to study advanced engineering developments.
- To prepare and present technical reports.
- To encourage the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.
- To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced.
- To encouraged the students to use various teaching aids such as overhead projectors, power point presentation and demonstrative models.

Prerequisite

Basic knowledge about Civil Engineering Topics.

Course Outcomes

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

CO1	Establish motivation for any topic of interest and develop a thought process for technical presentation.	Analyse
CO2	Organize a detailed literature survey and build a document with respect to technical presentations.	Analyse
CO3	Analysis and comprehension of proof-of-concept and related data.	Analyse
CO4	Effective presentation and improve soft skills.	Analyse
CO5	Make use of new and recent technology (e.g. graphical abstract) for creating technical reports.	Apply

Mapping with Programme Outcomes

Cos	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3	2	3
CO2	3	3	3	2	2	2
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	3	3
3- Strong;2-Medium;1-Some						

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K.S.Rangasamy College of Technology–Autonomous R2022								
70 PSE 1P2-TECHNICAL SEMINAR								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	0	0	2	30	1	100	-	100

The students will work for two hours per week guided by a group of staff members. They will be asked to talk on any topic of their choice related to Structural Engineering and to engage in dialogue with the audience.

A brief copy of their talk also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic.

They will also answer the queries on the topic. The students as the audience also should interact.

Evaluation will be based on the technical presentation and the report and also on the interaction during the seminar.

Total Hours	**30**

Course Designers

1. Dr.S.Gunasekar -gunasekar@ksrct.ac.in

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70 PSE 201	Advanced Steel Design	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To know about the analysis and design of steel structures.
- To understand about the different types of steel connections
- To know about the analysis and design of cold formed steel structures
- To understand the analysis and design of special steel structures
- To demonstrate advanced design philosophies and concepts.

Pre-requisites

Courses –Strength of Materials, Design of Steel Structures

Course Outcomes

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

CO1	Assess the general behaviour of beam –column employ them to design beam-column – crane column.	Analyse
CO2	Classify the different types of connection and identity suitable connections to apply for required situation.	Analyse
CO3	Analyse the cold formed steel sections and design them.	Analyse
CO4	Evaluate the various forces acting on self-supporting chimney guyed steel chimney and design them.	Analyse
CO5	Calculate the base shear and employ them to design a structure.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	3	3	2
CO2	3	3	3	3	3	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE 201- Advanced Steel Design

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Analysis and Design of Beam Column Introduction-General Behaviour of beam column-Beam column under bi-axial loading-Design of beam-columns-Beams column subjected to tension and bending-crane column.	[9]
Behaviour and Design of Joints Connection Behaviour – Design Requirements of Bolted and welded Connection – Un stiffened and stiffened Seat connection – Framed connection – Moment resistant connection – Tee Stub and End plate connections –Column Stiffeners and other reinforcements – design of moment resistant base plate - -concept of semi rigid connections.	[9]
Analysis and Design of Cold Formed Steel Structures Types of cross sections – Concept of local buckling and effective width –Design of compression and tension members – Concept of lateral buckling- Design of beams-Combined stresses and connections – Empirical design of Z –Purlins with lips and wall studs.	[9]
Analysis and Design of Special Structures Design of self-supporting chimney and guyed steel stacks-Design of bunkers and silos.	[9]
Seismic Design of Steel Structures Base shear calculations –IS 1893-2002,codal provisions – Design and detailing-IS 800-2007(Theory only)	[9]
Total Hours	45

Text Book(s):	
1.	Subramaniam.N.,“Design of Steel Structures “,(As per IS 800-2007),Oxford University Press,2014.
2.	Bhavikatti SS, “Design of Steel Structures”, I.K.International Publishing House Pvt. Ltd 2012
Reference(s):	
1.	Duggal S K., ’’Limit State Design of Steel Structures,Tata McGraw Hill, New Delhi, 2014.
2.	S.Ramachandra “Design of Steel Structures” Standard Publications, New Delhi,2011
3.	Teaching Resources for Structural Steel Design, INSDAG, Kolkatta.
4.	Design of Steel Structure, Punmia B.C, Jain Ashok K.R, Jain Arun K.R, Lakshmi Publishers, 2011.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Analysis and Design of Beam Column**	
1.1	Introduction-General Behaviour of beam column	1
1.2	Beam column under bi-axial loading	2
1.3	Design of beam	2
1.4	Columns-Beams column subjected to tension	1
1.5	Bending-crane column	2
2.0	**Behaviour and Design of Joints**	
2.1	Connection Behaviour	1
2.2	Design Requirements of Bolted and welded Connection	1
2.3	Un stiffened and stiffened Seat connection – Framed connection	1
2.4	Moment resistant connection – Tee Stub and End plate connections	1
2.5	Column Stiffeners and other reinforcements	1
2.6	Design of moment resistant base plate	2
2.7	Concept of semi rigid connections.	1
3.0	**Analysis and Design of Cold Formed Steel Structures**	
3.1	Types of cross sections	1
3.2	Concept of local buckling and effective width	1
3.3	Design of compression and tension members	1
3.4	Tutorial	2
3.5	Concept of lateral buckling	1
3.6	Design of beams-Combined stresses and connections	1
3.7	Empirical design of Z.	1
3.8	Purlins with lips and wall studs.	2
4.0	**Analysis and Design of Special Structures**	
4.1	Design of self-supporting chimney.	3
4.2	Guyed steel stacks.	3
4.3	Design of bunkers.	3
4.4	Design of silos.	3
5.0	**Seismic Design of Steel Structures**	
5.1	Base shear calculations	3
5.2	IS 1893-2002,codal provisions	3
5.3	Design and detailing-IS 800-2007(Theory only)	2

Course Designer

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70 PSE 202	Advanced Reinforced Concrete Design	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To apply various limit states and design beams & columns
- To learn the design of special RC elements
- To perform the design of flat slab and grid floors
- To study the inelastic behavior of RC beams
- To gain knowledge in detailing codes

Pre-requisites

Courses –Structural Analysis &RCC Design

Course Outcomes

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

CO1	Design the elements under flexure, shear, torsion and compression	Analyse
CO2	Perform the design of special RC elements	Analyse
CO3	Learn the design of flat slabs and grid floors	Analyse
CO4	Analyse the inelastic behavior of RC beams	Analyse
CO5	Draw the reinforcement detailing of structural elements	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	3	3	2	2
CO2	3	3	3	3	2	2
CO3	3	3	3	3	2	2
CO4	3	3	2	3	2	2
CO5	3	2	3	2	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
M.E - Structural Engineering								
70 PSE 202 - Advanced Reinforced Concrete Design								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Design of Beams and Columns Design for Limit state of collapse- Design for limit state of serviceability- Calculation of deflection and crack width. -Design of beams for combined effect of shear, bending moment and torsion. Design of beams curved in plan and spandrel beams - Design of slender columns	[9]
Design of Special RC Elements Design of RC walls- Shear walls-Classification and Design principles.-Design of rectangular and flanged Shear walls- Design of Corbels- Design of Deep beams	[9]
Design of Flat Slab and Grid Floors Yield line theory of slabs – Hillerberg's method of design of slab – Design of flat Slab –shear in flat slab - Approximate analysis and Design of grid floors	[9]
Inelastic Behaviour of RC Beams Inelastic behaviour of concrete beams – Moment Rotation curves – Moment redistribution – Baker's method of analysis and design – Design of cast in situ joints in frame	[9]
Detailing Requirements Design and detailing of structural members - Reinforcement detailing as per SP: 34 & IS:5525 - Earthquake Resistant Design – Detailing requirements for Ductility as per IS:13920	[9]
Total Hours	45

Text Book(s):	
1.	Varghese, P.C. "Advanced Reinforced Concrete Design", PHI Learning Pvt. Ltd.,2015.
2.	Krishna Raju N and Pranesh RN., "Design of Reinforced Concrete Structures", New Age International Publishers, New Delhi,2018.
Reference(s):	
1.	Unnikrishna Pillai S, Devdas Menon, "Reinforced Concrete Design", McGraw-Hill Education, India, New Delhi, 2021
2.	Ramamrutham S, Design of Reinforced Concrete Structures, Dhanpat Rai Publications, New Delhi, 2016
3.	SP 34 – Handbook on Concrete reinforcement and detailing – Fifth reprint, 1999
4.	IS 13920 :2016 – Ductile detailing of Reinforced Concrete structures subjected to seismic forces – Code of Practice

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Design of Beams and Columns**	
1.1	Design for Limit state of collapse& serviceability	1
1.2	Calculation of deflection and crack width	1
1.3	Design of beams for combined effect of shear, bending moment and torsion.	1
1.4	Design of beams curved in plan	2
1.5	Design of Spandrel beams	2
1.6	Design of slender columns	1
2.0	**Design of Special RC Elements**	
2.1	Design of RC walls	1
2.2	Shear walls Classification and Design principles	1
2.3	Design of rectangular and flanged Shear walls	2
2.4	Design of Corbels	2
2.5	Design of Deep beams	2
3.0	**Design of Flat Slab and Grid Floors**	
3.1	Yield line theory of slabs	1
3.2	Hillerberg's method of design of slab	2
3.3	Design of flat Slab	2
3.4	Shear in flat slab Approximate analysis	1
3.5	Design of grid floors	2
4.0	**Inelastic Behaviour of RC Beams**	
4.1	Inelastic behaviour of concrete beams	1
4.2	Moment Rotation curves	2
4.3	Moment redistribution	2
4.4	Baker's method of analysis and design	3
4.5	Design of cast in situ joints in frame	2
5.0	**Detailing Requirements**	
5.1	Design and detailing of structural members	2
5.2	Reinforcement detailing as per SP : 34	2
5.3	Reinforcement detailing as per IS:5525	2
5.4	Earthquake Resistant Design	2
5.5	Detailing requirements for Ductility as per IS:13920	2

Course Designer

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70 PSE 203	Finite Element Analysis	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To know the procedure and to solve two dimensional problems
- To appreciate the use of FEM to a range of Engineering Problems.
- To learn the concept of material and geometric Non-linearity
- To know the realistic engineering problem through computational simulations.

Pre-requisites

Fundamentals of Mathematics, knowledge of forces and resolution and equilibrium concepts.

Course Outcomes

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

CO1	Construct and solve the element equation for one dimensional structural element.	Analyse
CO2	Describe the concept of two dimensional elements.	Analyse
CO3	Analyse the 2D problems using isoparametric quadrilateral elements and Implement the Gaussian Quadrature expression for numerical integration.	Analyse
CO4	Identify the concepts of Non-linear Analysis of the structures.	Analyse
CO5	Apply the knowledge on application of Finite Element method	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	-	2	-
CO2	3	2	3	3	2	3
CO3	2	3	3	2	3	2
CO4	3	2	3	2	3	-
CO5	3	3	3	3	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE 203- Finite Element Analysis

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	40	60	100

Introduction to Finite Element Analysis Introduction-basic concepts of finite element analysis-steps in finite element analysis-Weighted Residual methods –Variational formulation of boundary value problem Finite element modeling - Element equation-Linear and quadratic shape functions- Bar, Beam and Truss Elements.	[9]
Finite Element Analysis of 2D Problems Basic boundary value problem in 2 Dimensions – Triangular, quadrilateral, higher order elements-Poisson and Laplace equation-weak formulation-Linear strain triangular elements.	[9]
Isoparametric Formulation Natural co-ordinate systems-Lagrangian interpolation polynomials-Isoperimetric element formulation-axisymmetry element-Numerical integration- one and two point problems.	[9]
Non-Linear Analysis Definition – geometric and material nonlinearity – strain displacement – stress- strain–finite element format – software usage for large deflection – software for inelastic behaviour	[9]
Practical Application of Finite Element Analysis Modeling and analysis using software packages-types of analysis-meshing-material properties and boundary conditions-Error evaluation.	[9]
Total Hours (45+15)	60

Text Book(s):

1.	Chandrupatla and Belegundu “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd. New Delhi, 4th Edition, 2015.
2.	P.Seshu, “Finite Element Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 2009.

Reference(s):

1.	Madhujit Mukhopadhyay,Abdul Hamid Sheikh., Matrix and Finite element Analyses of Structures. Ane Books India.2008.
2.	Reddy J N, “Finite Element Method”, Tata McGraw Hill publishing Co Ltd, New Delhi, 3rdEdition, 2006.
3.	Bathe K.J., Cliffs, N.J. “Finite Element Procedures in Engineering Analysis”, PHILearning, Eastern Economy Editions, 2009..
4.	Logan Deryl L., “A First Course in Finite Element Method”, Thomson Brook/Cole, 5th Ed.2012.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Finite Element Analysis**	
1.1	Basic Concepts of Finite element analysis	1
1.2	Steps in finite element analysis	1
1.3	Weighted Residual methodsand Weak formulation	1
1.4	Variational formulation of boundary value problem	1
1.5	Finite element modeling	1
1.6	Tutorial- Rayleigh Ritz method	2
1.7	Element equation-Linear and quadratic	2
1.8	Shape functions- Bar and Beam Elements	2
1.9	Shape functions- Truss Elements	2
2.0	**Finite Element Analysis of 2D Problems**	
2.1	Basic boundary value problem in 2 Dimensions	1
2.2	Element stiffness matrix for Triangular element. quadrilateral, higher order elements	2
2.3	Constant strain triangle – Isoparametric representation	2
2.4	Potential energy approach – Element stiffness matrix, force terms and stress calculations	2
2.5	Element stiffness matrix for quadrilateral and higher order elements	2
2.6	Poisson equation	1
2.7	Laplace equation	1
2.8	Tutorial-Problems in two dimensional stress field	2
2.9	Linear strain triangular elements	1
3.0	**Isoparametric Formulation**	
3.1	Natural co-ordinate systems	2
3.2	Four node quadrilateral elements	2
3.3	Lagrangian interpolation functions	2
3.4	Isoperimetric element formulation	2
3.5	Axisymmetry element	2
3.6	Numerical Integration - One point formula and two point formula	2
3.7	Tutorial-Problems in numerical integration using Gauss quadrature formula	2
4.0	**Non-Linear Analysis**	
4.1	Basic Concepts of Non-Linear Analysis	1
4.2	Geometric and Material nonlinearity	1
4.3	Strain displacement	1
4.4	Stress- Strain behavior of Non-linear analysis	1
4.5	Finite element format for non-linear analysis	1
4.6	Software usage for large deflection	1
4.7	Software for inelastic behaviour	1
4.8	Iteration methods and iterative methods, Newtons Raphson Method	1
4.9	Tutorials on Non-linear analysis problems	2
5.0	**Practical Application of Finite Element Analysis**	
5.1	Convergence and requirements	1
5.2	Modeling and analysis using software packages	2
5.3	Types of analysis	1
5.4	Types of meshing- Ill conditioned elements	1
5.5	Properties and boundary conditions	1
5.6	Discretisation errors	1
5.7	Error evaluation	1
5.8	Auto and Adaptive Mesh Generation Techniques	1

Course Designer

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70 PAC 002	Disaster Management	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

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

Pre-requisites

-NIL-

Course Outcomes

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

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

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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M.E - Structural Engineering

70 PAC 002 – Disaster Management

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	0	30	0	40	60	100

Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	[6]
Repercussions of Disasters and Hazards 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.	[6]
Disaster Prone Areas In India 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	[6]
Disaster Preparedness and Management 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.	[6]
Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	[6]
Total Hours	30

Text Book(s):

1.	Goel S. L., Disaster Administration and Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2.	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.

Reference(s):

1.	Sahni, Pardeepet.al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, 2001.
2.	Subramanian R,"Disaster Management", Vikas publishing Housing Pvt. Ltd., 2018.
3.	Chu-huaKuei, Christian N Madu, Handbook of Disaster Management Risk Reduction & Management: Climate change and Natural Disaster, world scientific, 2017.
4.	JankiAndharia, Disaster studies: Exploring Intersectional ties in Disaster Discourse, Springer, 2020.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Disaster: Definition, Factors and Significance	2
1.2	Difference between Hazard and Disaster	2
1.3	Natural and Manmade Disasters	2
1.4	Difference, Nature	2
1.5	Types and Magnitude	1
2.0	**Repercussions of Disasters and Hazards**	
2.1	Economic Damage, Loss of Human and Animal Life	2
2.2	Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones	2
2.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
2.4	Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents	1
2.5	Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts	2
3.0	**Disaster Prone Areas In India**	
3.1	Study of Seismic Zones	1
3.2	Areas Prone to Floods and Droughts	2
3.3	Landslides and Avalanches	2
3.4	Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami	2
3.5	Post-Disaster Diseases and Epidemics	2
4.0	**Disaster Preparedness and Management**	
4.1	Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard	2
4.2	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.4	Application of Remote Sensing, Data from Meteorological and other Agencies	2
4.5	Media Reports: Governmental and Community Preparedness	1
5.0	**Risk Assessment**	
5.1	Disaster Risk: Concept and Elements	2
5.2	Disaster Risk Reduction, Global and National Disaster Risk Situation	2
5.3	Techniques of Risk Assessment	2
5.4	Global Co-Operation in Risk Assessment and Warning	2
5.5	People's Participation in Risk Assessment. Strategies for Survival	1

Course Designer

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Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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60 PSE 2P1	Advanced Structural Engineering Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To explain about the behavior of beams and slabs in flexure and shear
- To understand the concepts of Strain recording instruments
- To know about the measurement of vibration.
- To illustrate about the Dynamic testing of cantilever beams
- To identify the Static cyclic testing of single bay two storied frames

Pre-requisites

Strength of Materials, Structural Analysis, Design of Reinforced Concrete design, Design of Steel Structures, Experimental Methods and Model Analysis.

Course Outcomes

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

CO1	Construct the concrete beam and absorb the behavior of flexural member for different loading conditions.	Analyse
CO2	Demonstrate the testing for strength and deflection behavior of steel sections.	Analyse
CO3	Illustrates the behavior of column under axial load and compute the direct and bending stresses.	Analyse
CO4	Familiarize the behavior of cantilever beam under dynamic loading and evaluate the mode shapes.	Analyse
CO5	Employ the static cyclic testing on frames and predict the stiffness and energy dissipation of the frame.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	1	1	1	1	2
CO2	3	1	1	1	1	2
CO3	3	2	2	1	1	2
CO4	3	2	3	2	2	2
CO5	3	2	3	2	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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K.S.Rangasamy College of Technology – Autonomous R2022								
M.E – Structural Engineering								
70 PSE 2P1 - Advanced Structural Engineering Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

List of Experiments:

1. 1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behavior.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
4. Dynamic testing of cantilever beams.
   a. To determine the damping coefficients from free vibrations.
   b. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied frames and evaluate
   a. Drift of the frame
   b. Stiffness of the frame.

Energy dissipation capacity of the frame

Text book(s)	
1.	Sadhu Singh, " Experimental Stress Analysis", Khanna Publications, New Delhi, 2000.
Reference(s)	
1.	Dalleey J W, and Riley W F, "Experimental Stress Analysis", McGraw-Hill, Inc. New York, 1991.
2.	Srinath L.S, Raghavan M.R, Lingaish K, Gargesha G, Paint B, and Ramachandra K, "Experimental Stress Analysis", Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1984.

Course Designer(s)

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE 2P2	Computer Aided Analysis and Design Laboratory	Category	L	T	P	Credit
		PC	0	0	4	2

Objectives

- To learn the principles of computer graphics and application packages, optimization and artificial intelligence.
- To expose students to computer aided drafting.
- To familiarize students with 2D objects in drawing and enable them to prepare plan, elevation and sectional drawings.
- To expose students to 3D modelling.

Pre-requisites

Basic knowledge in computer operation and Civil Engineering design software's.

Course Outcomes

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

CO1	To work on spreadsheets and worksheets.	Analyse
CO2	To understand regression and matrix inversion concepts.	Analyse
CO3	To arrive at C programs to solve problems using numerical techniques.	Analyse
CO4	To use computer methods of structural analysis to solve structural problems.	Analyse
CO5	To work on finite element programming to solve real time problems.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	3	3	2	2	2
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	3	3

3 - Strong; 2 - Medium; 1 – Some

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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K.S.Rangasamy College of Technology – Autonomous R2022								
M.E – Structural Engineering								
70 PSE 2P2 - Computer Aided Analysis and Design Laboratory								
Semester	**Hours/Week**			**Total Hrs**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	0	0	4	60	2	60	40	100

List of Experiments:

Module 1: Analysis, design and drafting with commercial software: (3 D modelling – RCC & STEEL).

(a) Modelling and analysis - applying known concepts of structural components, codal provisions for loads and dimensioning, analysis procedures etc.

(b) Design using software or manual designusing spreadsheets software or Macros.

(c) Drafting / detailing using commercial CAD software. (Different groups may be assigned different buildings/structures).

Module 2: Programming for structural engineering using MATLAB or any programming language choice of student. Exercises include, but not limited to: Solution using Newton Raphson method, Gauss elimination, Gauss-Jordan method, Linear Regression, Curve fitting by Polynomial Regression, Eigen value extraction by power method etc.

Module 3: Finite Element software fundamentals - modelling, analysis and postprocessing of simple planar, wire and shell models – introduction to different types of meshes, elements, analysis steps etc.

Text book(s)

1. Rajaraman, V., Computer Oriented Numerical Methods, Prentice – Hall of India, 2004.

Reference(s)

1. Krishnamoorthy C. S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 1991.
2. Hinton E. and Owen D. R. J., Finite Element Programming, Academic Press, 1977.

Course Designer(s)

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE 3P1	Project Work Phase - I	Category	L	T	P	Credit
		CG	0	0	16	8

Objectives

- To import the practical knowledge to the students
- To make them to carry out the technical procedures in their project work.
- To provide an exposure to the students to refer, read and review the research articles, journals and conference proceedings relevant to their project work.
- To learn about new product development
- To learn how to apply theoretical knowledge in the field.

Pre-requisites

Basic knowledge in computer operation and Civil Engineering design software's.

Course Outcomes

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

CO1	Survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research.	Analyse
CO2	Use different experimental techniques/different software/ computational / analytical tools.	Analyse
CO3	Design and develop an experimental set up/ equipment/test rig	Apply
CO4	Conduct tests on existing set ups / equipments and draw logical conclusions from the results after analyzing them.	Apply
CO5	Work in a research environment or in an industrial environment.	Apply

Mapping with Programme Outcomes

COs	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	3	3	2	2	2
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Review I (R1)		Review II (R2)			Review III (R3)			Total (R1+R2+R3)	Internal
Literature Survey	Topic Identification & Justification	Work Plan	Approach	Conclusion	Demo-Existing System	Presentation	Report	Total	
10	10	10	20	20	10	10	10	100	100

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M.E – Structural Engineering

70 PSE 3P1- Project Work Phase-I

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	0	0	16	120	8	100	0	100

- The project work should preferably be a problem with research potential.
- The project should involve scientific research, design, generation/collection, and analysis of data, determining a solution, and must preferably bring out the individual contribution.
- The seminar should be based on the area in which the candidate has undertaken the dissertation work as per the common instructions for all branches of M.E/M. Tech.
- Three reviews will be conducted by a committee of subject experts.
- Each review has to be evaluated for 100 marks.
- Internal evaluation has to be done for 100 marks.
- The final examination shall consist of the preparation of a report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the examiners panel set by the Head and PG Project Coordinator.

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K.S.Rangasamy College of Technology – Autonomous R2022								
70 PSE 3P2 IN-PLANT TRAINING								
M.E. STRUCTURAL ENGINEERING								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	0	0	0	0	2	100	0	100

Objective(s)	• Make exposer for the students to actual working environment and enhance their knowledge • Provide students the opportunity to test their interest in a particular career before permanent commitments are made • To develop skills in the application of theory to practical work situations • Enhance the ability to improve student's creativity skills and sharing ideas • To cultivate student's leadership ability and responsibility to perform or execute the given task
Course Outcomes	**At the end of the course, the students will be able to** 1. Understand the psychology of the workers, their habits, attitudes and approach to problems along with the practices followed either at factory or at site 2. Familiarized with various Design, Manufacturing, Analysis, Automation and their appli cations along with relevant aspects of industry management 3. Understand the scope, functions and job responsibilities in various departments of an organization 4. Interpreting the theoretical knowledge with real time site conditions while executing projects 5. Develop detailed report of the complete project during the training.

- Students undergo in-plant training during second semester summer vacation (Minimum of Two weeks)
- Reports containing the observation of the students after the training with their personal comments/suggestion are to be prepared and submitted in the beginning of third semester
- A technical presentation to be done by the students immediately after submission of the report at the beginning of third semester

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70 PSE 4P1	Project Work Phase - II	Category	L	T	P	Credit
		CG	0	0	32	16

Objectives

- To implement their innovative ideas in practical
- To retrieve the hazards by adopting suitable assessment methodologies and staring it to global.
- To strengthens the students to carry out the problems on their own
- To improve the leadership skills and work in a group
- To solve complex problems and obtaining solution for them

Pre-requisites

Basic knowledge in computer operation and Civil Engineering design software's.

Course Outcomes

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

CO1	Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field.	Analyse
CO2	Write technical reports and research papers to publish at national and international level.	Analyse
CO3	Develop strong communication skills to defend their work in front of technically qualified audience.	Apply
CO4	Learn about Patent filing and IPR	Apply
CO5	Gain knowledge about new business ideas and product development	Apply

Mapping with Programme Outcomes

COs	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	3	3	2	2	2
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Internal Assessment (60)					End Semester (40)
Items	Review 1	Review 2	Review 3	Publication	
Marks	5	10	15	30	40
	Total internal marks 60				

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M.E – Structural Engineering								
70 PSE 4P1- Project Work Phase-II								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
IV	0	0	32	240	16	60	40	100

Planning & performing experiments

Based on the project proposal submitted in earlier semester, students should be able to plan, and engage in, an independent and sustained critical investigation and evaluate a chosen research topic relevant to structural engineering and civil society challenges, such as earthquake-resistant design, advanced concrete technology, and structural health monitoring.. They should be able to systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions. Senior researchers should be able to train the students such that they can work independently and are able to understand the aim of each experiment performed by them. They should also be able to understand the possible outcomes of each experiment.

Thesis writing

At the end of their project, thesis has to be written giving all the details such as aim, methodology, results, discussion and future work related to their project. Students may aim to get their research findings published in a peer-reviewed journal. If the research findings have application-oriented outcomes, the students may file patent application.

70PSE E11	Theory of Structural Stability	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Learn behaviour of structural elements under compressive loads,
- To understand the stability of columns, beams and plates under various load conditions.
- To analyse beam column behaviour along with frames.
- To know the basic theory for buckling of beams for various applications.
- To Introduce numerical techniques

Pre-requisites

knowledge of Structural Analysis, Strength of Materials & Mathematical Logic.

Course Outcomes

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

CO1	Obtain the concept of structural stability of structures	Analyse
CO2	Compare the method and analysis of structures	Analyse
CO3	Design a beam column behaviour with the portal frame	Analyse
CO4	Explain the torsional buckling in beam	Analyse
CO5	Interpret the use of energy methods with numerical techniques	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	-	3	2	3	2	2
CO2	3	3	3	2	2	2
CO3	2	-	2	3	2	1
CO4	3	3	2	2	2	3
CO5	3	3	-	2	3	-
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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M.E - Structural Engineering

70 PSE E11-Theory of Structural Stability

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Stability of Columns Concepts 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.	[9]
Methods of Analysis and in Elastic Buckling Approximate methods – Rayleigh and Galerkin 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.	[9]
Beam Columns and Frames Beam column behaviour- standard cases- Continuous columns and beam columns – Column on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Approximate evaluation of critical loads in multistoried frames – Use of Wood's charts.	[9]
Buckling of Beams Lateral buckling of beams – Energy method- Application to Symmetric and unsymmetric I beams – simply supported and Cantilever beams - Narrow rectangular cross sections- – Numerical solutions – Torsional buckling – Uniform and non uniform Torsion on open cross section - Flexural torsional buckling – Equilibrium and energy approach.	[9]
Buckling of Thin Plates Isotropic rectangular plates - Governing Differential equations - Simply Supported on all edges – Use of Energy methods – Plates with stiffeners – Numerical Techniques.	[9]
Total Hours	45

Text Book(s):

1. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall of India, 2010.
2. Ashwin Kumar, "Stability of Structures", Allied Publishers Ltd, New Delhi, 2008.

Reference(s):

1. Iyengar, N.G.R, "Structural Stability of Columns and Plates" East West Press Pvt Ltd, New Delhi, 2016
2. Timoshenko, S.P, and Gere, J.M. "Theory of Elastic stability", McGraw-Hill Company, 2010
3. Gambhir, "Stability Analysis and Design of Structures", Springer, New York, 2004.
4. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Stability of Columns**	
1.1	Concepts of Elastic Structural stability	1
1.2	Analytical approaches to stability	1
1.3	characteristics of stability analysis	1
1.4	Elastic Buckling of columns- Equilibrium	1
1.5	Energy and Imperfection approaches	1
1.6	Non-prismatic columns	1
1.7	Built up columns - orthogonality of buckling modes	1
1.8	Effect of shear on buckling load	1
1.9	Large deflection theory	1
2.0	**Methods of Analysis and in Elastic Buckling**	
2.1	Approximate methods	1
2.2	Rayleigh and Galerkin methods – numerical methods	2
2.3	Finite difference and finite Element - analysis of columns	1
2.4	Experimental study of column behaviour	1
2.5	South well plot - Column curves	2
2.6	Derivation of Column design formula	1
2.7	Effective length of Columns	1
2.8	Inelastic behaviour	1
2.9	Tangent modulus and Double modulus Theory.	1
3.0	**Beam Columns and Frames**	
3.1	Beam column behaviour	1
3.2	standard cases- Continuous columns and beam columns	1
3.3	Column on elastic foundation	1
3.4	Buckling of frames	1
3.5	Single storey portal frames with and without side sway	1
3.6	Classical and stiffness methods	1
3.7	Approximate evaluation of critical loads in multistoried frames	1
3.8	Use of Wood's charts	2
4.0	**Buckling of Beams**	
4.1	Lateral buckling of beams	1
4.2	Energy method- Application to Symmetric and unsymmetric I beams	1
4.3	simply supported and Cantilever beams	1
4.4	Narrow rectangular cross sections – Numerical solutions	2
4.5	Torsional buckling	1
4.6	Uniform and non uniform Torsion on open cross section	1
4.7	Flexural torsional buckling	1
4.8	Equilibrium and energy approach	1
5.0	**Buckling of Thin Plates**	
5.1	Isotropic rectangular plates	1
5.2	Governing Differential equations	2
5.3	Simply Supported on all edges	1
5.4	Use of Energy methods	2
5.5	Plates with stiffeners	2
5.6	Numerical Techniques	1

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E12	Theory of Plates and Shells	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the behavior of the plates and shells with different geometry under various types of loads
- To illustrate design of several of plates.
- To enable the student Analyse and design thin shell structures including domes, hyperbolic, parabolic, elliptic and cylindrical shells.
- To knowledge about thin and thick shells.
- To understand design of cylindrical shells.

Pre-requisites

Fundamentals of Mathematics, knowledge of strength of materials and its mechanics and theory of elasticity and plasticity.

Course Outcomes

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

CO1	Analyse bending of long rectangular plates using thin plate theory	Analyse
CO2	Analyse circular plates with various loading conditions	Analyse
CO3	Analyse rectangular plates using classical approach and methods	Analyse
CO4	Analyse bending of Anisotropic plates	Analyse
CO5	Design of R. C. Cylindrical shells and long shells.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	2	3	2	2	1
CO2	-	-	3	-	2	1
CO3	2	2	3	2	2	1
CO4	-	-	3	-	2	1
CO5	1	1	3	2	3	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E12-Theory of Plates and Shells

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Laterally Loaded Plates Thin Plates with small defection, Laterally loaded thin plates, governing differential equation, various boundary conditions.	[9]
Rectangular Plates Rectangular plates. Simply supported rectangular plates, Navier solution and Levy's methods, Rectangular plates with various edge conditions - Energy methods, Finite difference and Finite element methods	[9]
Circular Plates Symmetrical bending of circular plates, plates on elastic foundation.	[9]
Theory of Shells Structural behavior of thin shells – classification of shells – Translational and rotational ruled surface, Design of the following shells: spherical, conical, paraboloid and ellipsoid.	[9]
Design of Cylindrical Shells Design of R.C cylindrical shell with edge beams using theory for long shells – Design for long shells – Design of shells with ASCE manual coefficients	[9]
Total Hours	45

Text Book(s):

1. Reddy J N, “Theory and Analysis of Elastic Plates and Shells”, Second edition, CRC press,2006.
2. Timoshenko,S and Woinowsky – Kreiger,”Theory of plates and shells”.Mc Graw- Hill book Company, Newyork.1990.

Reference(s):

1. Iyengar, N.G.R, “Structural Stability of Columns and Plates” East West Press Pvt Ltd, New Delhi, 2016
2. Timoshenko, S.P, and Gere, J.M. “Theory of Elastic stability”, McGraw-Hill Company, 2010
3. Gambhir, “Stability Analysis and Design of Structures”, Springer, New York, 2004.
4. Simitser.G.J and Hodges D.H, “Fundamentals of Structural Stability”, Elsevier Ltd., 2006.

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Laterally Loaded Plates**	
1.1	Cylindrical bending of long rectangular plates - Differential equation	1
1.2	Plates with simply supported edges	1
1.3	Plates with built-in edges	1
1.4	Slope and curvature of slightly bent plates	2
1.5	Relation between bending moment and curvature	2
1.6	Various boundary conditions.	2
2.0	**Rectangular Plates**	
2.1	Small deflections of laterally loaded plates – Differential equation	1
2.2	Simply supported rectangular plates under sinusoidal loading	1
2.3	Introduction to Navier's solution	1
2.4	Simply supported rectangular plates under uniform loading	1
2.5	Simply supported rectangular plates under hydrostatic pressure	1
2.6	Simply supported rectangular plates under concentrated load	1
2.7	Simply supported rectangular plates under uniform loading over an area of a rectangle	1
2.8	Introduction to Levy's method	1
2.9	Simply supported rectangular plates under uniform loading	1
3.0	**Circular Plates**	
3.1	Symmetrical bending of laterally loaded circular plates – Differential equation	2
3.2	Circular plates with uniform loading	2
3.3	Circular plate with triangular loading	1
3.4	Circular plate with circular hole subjected to moment at the inner edge	1
3.5	Circular plate with concentrated load	1
3.6	Circular plate loaded at the centre	1
3.7	Circular plates with moments at the edges	1
4.0	**Theory of Shells**	
4.1	Simply supported rectangular plates under hydrostatic pressure	2
4.2	Bending of laterally loaded thin plates – Differential equation	1
4.3	Simply supported and fixed square and rectangular plates under uniform loading	1
4.4	Simply supported and fixed square and rectangular plates under partial loading	1
4.5	Simply supported and fixed square and rectangular plates under triangular loading	1
4.6	Simply supported and fixed square and rectangular plates under trapezoidal loading	1
4.7	Energy methods - Principle of virtual work- Principle of minimum potential energy	1
5.0	**Design of Cylindrical Shells**	
5.1	Bending of Anisotropic plates – Differential equation	2
5.2	Bending of rectangular plates	1
5.3	Bending of circular and elliptic plates	1
5.4	Classification of shells	1
5.5	Case Study – Shell Structures	1
5.6	Design of R.C cylindrical shell with edge beams using theory for long shells	1
5.7	Design for long shells	1
5.8	Design of shells with ASCE manual coefficients	1

Course Designer

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Approved in Academic Council Meeting held on 19.07.2025

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TIRUCHENGODE - 637 215

70PSE E13	Design of Tall Buildings	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- The design criteria of the tall buildings, materials used, modern concepts
- The different types of loads to be considered in designing, behaviour of structural systems, analysis.
- The design of tall structures using different methods.
- The stability analysis of the tall buildings.
- Design against wind loads as per BIS code of practice and special consideration in the design of tall structures.

Pre-requisites

Fundamentals of Mathematics, knowledge of basic Science

Course Outcomes

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

CO1	Implement design philosophies for the development of high rise structures.	Analyse
CO2	Find out the design loads for high rise buildings.	Analyse
CO3	Analyse the behaviour of tall building subjected to lateral loading.	Analyse
CO4	Perform computerized general three dimensional analysis for high rise building.	Analyse
CO5	Perform stability analysis using various methods for tall buildings.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	2	3	2	2	2
CO2	-	-	3	-	2	-
CO3	2	2	3	2	2	2
CO4	-	-	3	-	2	-
CO5	1	1	3	2	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70PSE E13 -Design of Tall Buildings

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Design Criteria Design Philosophy, Materials – Modern concepts – High Performance Concrete, Fibre Reinforced Concrete, Light weight concrete, Self Compacting Concrete.	[9]
Loading Gravity Loading – Dead load, Live load, Impact load, Construction load, Sequential loading. Wind Loading – Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods. Earthquake Loading – Equivalent lateral Load analysis, Response Spectrum Method, Combination of Loads	[9]
Behaviour of Structural Systems Factors affecting the growth, height and structural form, Behaviour of Braced frames, Rigid Frames, In filled frames, Shear walls, Coupled Shear walls, Wall – Frames, Tubular, Outrigger braced, Hybrid systems.	[9]
Analysis and Design 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.	[9]
Stability Analysis Overall buckling analysis of frames, wall – frames, Approximate methods, Second order effect of gravity loading, P – Delta Effects, Simultaneous first order and P-Delta analysis, Translational instability, Torsional Instability, Out of plumb effects, Effect of stiffness of members and foundation rotation in stability of structures.	[9]
Total Hours	45

Text Book(s):

1. Bryan Stafford Smith and Alexcoull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc. Wiley India Pvt.Ltd. New Delhi., 2011.
2. Taranath B.S, “Structural Analysis and Design of Tall Buildings”, McGraw-Hill, 1988.

Reference(s):

1. Harry G Poulos, “Tall Building Foundation Design”, Taylor & Francis., 2017.
2. Mark P Sarkisian, “Designing Tall Buildings Structure As Architecture”, Taylor & Francis., 2015.
3. Coull, A. and Smith, Stafford, B. “Tall Buildings”, Pergamon Press, London, 2003.
4. Lynn S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributors, Delhi, 1996.

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Design Criteria**	
1.1	Design Philosophy, Materials	1
1.2	Modern concepts	1
1.3	High Performance Concrete	1
1.4	Fibre Reinforced Concrete	2
1.5	Light weight concrete	2
1.6	Self Compacting Concrete.	2
2.0	**Loading**	
2.1	Gravity Loading	1
2.2	Dead load, Live load, Impact load	1
2.3	Construction load, Sequential loading	1
2.4	Wind Loading	1
2.5	Static and Dynamic Approach, Analytical method, Wind Tunnel Experimental methods.	1
2.6	Earthquake Loading	1
2.7	Equivalent lateral Load analysis	1
2.8	Response Spectrum Method	1
2.9	Combination of Loads	1
3.0	**Behaviour of Structural Systems**	
3.1	Factors affecting the growth, height and structural form	2
3.2	Behaviour of Braced frames	2
3.3	Behaviour of Rigid Frames	1
3.4	Behaviour of In filled frames	1
3.5	Shear walls, Coupled Shear walls, Wall	1
3.6	Tubular Systems	1
3.7	Outrigger braced, Hybrid systems	1
4.0	**Analysis and Design**	
4.1	Modeling for approximate analysis	2
4.2	Accurate analysis and reduction techniques	1
4.3	Analysis of structures as an integral unit	1
4.4	Analysis for member forces, drift and twist	1
4.5	Computerized 3D analysis	1
4.6	Design for differential movement	1
4.7	Creep and Shrinkage effects, Temperature Effects and Fire Resistance.	1
5.0	**Stability Analysis**	
5.1	Overall buckling analysis of frames	2
5.2	Overall buckling analysis of wall frames	1
5.3	Second order effect of gravity loading – Approximate method	1
5.4	P – Delta Effects, Simultaneous first order and P-Delta analysis	1
5.5	Translational instability	1
5.6	Torsional Instability	1
5.7	Out of plumb effects	1
5.8	Effect of stiffness of members and foundation rotation in stability of structures	1

Course Designer

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TIRUCHENGODE - 637 215

70PSE E14	Design of Structures for Dynamic Loads	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To Design factors, behaviour of structures in cyclic loads,
- To recap of structural dynamics with reference of different systems,
- To understand ductility, earth quake design of structures,
- To design of structures against blast and impact
- To Design against wind loads as per BIS code of practice and special consideration in the design of structures.

Pre-requisites

Basic knowledge of Earthquake, RCC Structures & Soil Mechanics.

Course Outcomes

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

CO1	Explain the behavior of structures under dynamic loads	Apply
CO2	Design structures for earthquake, blast and impact loads	Analyse
CO3	Perform ductile detailing	Analyse
CO4	Design against wind load as per BIS Code	Apply
CO5	Ductility Detailing should be considering for vibrations structures	Analyse

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	3	2	3	2	2
CO2	3	3	2	2	2	3
CO3	2	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	1	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E14 -Design of Structures for Dynamic Loads

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Introduction Factors affecting design against dynamic loads - Behaviour of concrete, steel, masonry and soil under impact and cyclic loads - Recap of Structural dynamics with reference to SDOF, MDOF and continuum systems – Ductility and its importance	[9]
Design Against Earthquakes Earthquake characterization - Response spectra - seismic co-efficient and response spectra methods of estimating loads - Response of framed, braced frames and shear wall buildings - Design as per BIS codes of practice - Ductility based design	[9]
Design Against Blast And Impact Displacement method for three dimensional Structure - Coordinate transformations - Analysis of space trusses and space frames	[9]
Design Against Wind Characteristics of wind - Basic and Design wind speeds - Pressure coefficient - Aero elastic and Aerodynamic effects - Design as per BIS code of practice including Gust Factor approach - tall buildings, stacks and chimneys	[9]
Special Considerations Energy absorption capacity - Ductility of the material and the structure - Detailing for ductility - Passive and active control of vibrations - New and favorable materials	[9]
Total Hours	45

Text Book(s):

1.	Paulay, .T. and Priestly, .M.N.J., “A seismic Design of Reinforced Concrete and Masonry building ", John Wiley and Sons, 2011.
2.	DamodarasamyS.R,”Basics of Structural Dynamics and Aseismic Design”, PHI Learning Pvt Ltd, New Delhi, 2009.

Reference(s):

1.	Bela Goschy, “Design of Building to withstand abnormal loads ", Butterworths, 2010.
2.	Dowling, .C.H., “Blast vibration - Monitoring and control ", Prentice Hall Inc., Englewood Cliffs, 2015.
3.	Kolousek, .V., “Wind effects on Civil Engineering Structures ", Elsevier, 2014.
4.	R.R. Craig - Structural Dynamics, John Wile 2003

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Factors affecting design against dynamic loads	1
1.2	Behaviour of concrete, steel, masonry	2
1.3	Behaviour of soil under impact and cyclic loads	2
1.4	Recap of Structural dynamics with reference to SDOF	1
1.5	Recap of Structural dynamics with reference to MDOF	1
1.6	Recap of Structural dynamics with reference to continuum systems	1
1.7	Ductility and its importance	1
2.0	**Design Against Earthquakes**	
2.1	Earthquake characterization	1
2.2	Response spectra	1
2.3	seismic co-efficient	1
2.4	response spectra methods of estimating	1
2.5	loads	1
2.6	Response of framed, braced frames and	1
2.7	shear wall buildings	1
2.8	Design as per BIS codes of practice	1
2.9	Ductility based design	1
3.0	**Design Against Blast And Impact**	
3.1	Displacement method for Structure	1
3.2	Displacement method for three dimensional Structure	2
3.3	Coordinate transformations	2
3.4	Analysis of space trusses	2
3.5	Analysis of space frames	2
4.0	**Design Against Wind**	
4.1	Characteristics of wind	1
4.2	Basic and Design wind speeds	1
4.3	Pressure coefficient	1
4.4	Aero elastic and Aerodynamic effects	2
4.5	Design as per BIS code of practice including Gust Factor approach	1
4.6	tall buildings,	1
4.7	stacks	1
4.8	chimneys	1
5.0	**Special Considerations**	
5.1	Energy absorption capacity	2
5.2	Ductility of the material and the structure	2
5.3	Detailing for ductility	1
5.4	Passive and active control of vibrations -	2
5.5	New and favorable materials	2

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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TIRUCHENGODE - 637 215

70 PSE E15	Fracture Mechanics of Concrete Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To give an outline of the total field of fracture mechanics
- To familiarize students with problems that can be solved with fracture mechanics concepts.
- To impart knowledge on the mechanisms of failure and non linear fracture mechanics.
- To study crack criteria by using Griffith's Criteria, Stress Intensity Factors, R curves.
- To apply crack concepts & numerical modelling to high strength concrete & fibre reinforced concrete.

Pre-requisites

Fundamentals of Mathematics, knowledge of basic strength of material.

Course Outcomes

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

CO1	Evaluate the fracture failure parameters	Apply
CO2	Evaluate the linear elastic fracture mechanics problems	Analyse
CO3	Explain the concept of elastic plastic fracture mechanics	Analyse
CO4	Estimate the residual life of fatigue Crack Growth in structure.	Apply
CO5	Evaluate the fracture parameters using direct and indirect methods	Analyse

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	2	3	-	2	-
CO2	2	2	3	-	2	-
CO3	1	2	-	3	2	3
CO4	2	2	3	3	2	3
CO5	2	2	3	2	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E15 -Fracture Mechanics of Concrete Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Introduction: Courses of failures of structures – case studies Fracture Mechanics Approach to Design: Energy Criterion – Stress intensity approach – Time dependent crack growth – Effect of Material Properties on Fracture..	[9]
Linear Elastic Fracture Mechanics: An atomic view of fracture – Stress concentration Effect of Flows – The Griffith Energy Balance –Comparison with the Critical Stress Criterion – Modified Griffith equation – The Energy Release rate – Instability and the R Curve – Stress analysis of cracks – Crack tip plasticity – Plane strain fracture –Mixed mode fracture.	[9]
Elastic – Plastic Fracture Mechanics: Crack –tip- opening displacement – J contour integral – Crack growth resistance curves – J controlled fracture – Crack tip constraint under large –scale yielding – Sealing model for clearage fracture..	[9]
Dynamic and Time – Dependent Fracture: Dynamic fracture and crack arrest – Creep crack growth – Viscoelastic fracture mechanics. Material Behaviour: Fracture mechanisms in metals, plastics, ceramics, ceramic composites and concrete	[9]
Application to Structures : Linear Elastic Fracture Mechanics – Elastic plastic J – integral analysis – Failure Assessment Diagrams- Application to welded structures – Primary VS secondary stresses in the FAD Method – Ductile –Tearing analysis with FAD – Probabilistic Fracture Mechanics – Fatigue crack propagation – Environmentally assisted cracking in metals.	[9]
Total Hours	45

Text Book(s):

1. Anderson,T.L. “Fracture Mechanics Fundamentals and Applications”, Taylor & Francis Group, 2015.
2. David Broek “Elementary engineering fracture mechanics” Kluwer Academic Publisher, 2012

Reference(s):

1. David Broek , Sijthoff&Noordhoff .,“Elementary engineering fracture mechanics” , Alphen aan den Rijn. Netherlands, 2012
2. Fracture mechanics of concrete structures – Theory and applications – Rilem Report – Edited by Chapman and Hall – 1989.
3. Fracture mechanics – applications to concrete – Edited by Victor, C. Li, & Z.P. Bazant – ACI SP 118.
4. Valliappan S. "Continuum Mechanics Fundamentals" (1982), Oxford IBH, N D. New Delhi.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Review of Engineering Failure Analysis	1
1.2	Brittle fracture-Ductile fracture	1
1.3	Modes of fracture failure	1
1.4	The Griffith energy Balance Approach	2
1.5	Crack tip Plasticity	2
1.6	Fracture toughness	2
2.0	**Linear Elastic Fracture Mechanics**	
2.1	Elastic crack tip stress field	1
2.2	Stress and displacement fields in isotropic elastic materials	1
2.3	Westergaard's approach (opening mode)	1
2.4	Plane Strain Fracture toughness (KIC) testing	1
2.5	Feddersen approach	1
2.6	Determination of R curve.	1
2.7	Energy released rate for DCB specimen	1
2.8	Anelastic deformation at crack tip	1
2.9	Test techniques, Various test specimens	1
3.0	**Elastic – Plastic Fracture Mechanics:**	
3.1	Critical energy release rate	2
3.2	limitation of K approach	2
3.3	Approximate shape and size of the plastic zone	1
3.4	Effective crack length	1
3.5	Effect of plate thickness	1
3.6	Elastic plastic fracture concept	1
3.7	Crack tip opening displacement	1
4.0	**Dynamic and Time – Dependent Fracture:**	
4.1	Fatigue crack growth to sharpen the tip	2
4.2	Load displacement test	2
4.3	Test methods to determine J1c	1
4.4	Mechanism of Fatigue ,Fatigue crack propagation	1
4.5	Paris law	1
4.6	Crack closure mechanism	1
4.7	Residual stresses at crack tip	1
5.0	**Application to Structures :**	
5.1	Principles of crack arrest, crack arrest in practice	2
5.2	K-R Curves, Crack resistance curve	1
5.3	Numerical Methods and Approaches in Fracture Mechanics	1
5.4	Direct methods to determine fracture parameters	1
5.5	Indirect methods to determine fracture parameters	1
5.6	variable amplitude service loading, Interaction effects.	1
5.7	Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor	1
5.8	Retardation effect	1

Course Designer

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Passed in the BOS Meeting Held on 17.06.2025
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70 PSE E16	Design of Formwork	Category	L	T	P	Credit
		PC	3	0	0	3

Objectives

- To provide a comprehensive understanding of the fundamental principles of formwork, including its importance, objectives, and key cost-reduction strategies in construction.
- To equip learners with knowledge of different types of formwork materials and systems, including their advantages, limitations, and applications in various structural elements.
- To develop the ability to apply formwork design principles in practical scenarios, ensuring the safe and efficient construction of foundations, walls, columns, slabs, and beams.
- To analyze the formwork requirements for complex structures, such as shells, domes, folded plates, overhead water tanks, cooling towers, and bridges.
- To identify the common causes of formwork failures, study case examples, and develop strategies for effective formwork management and risk mitigation in construction projects.

Pre-requisites

Basic knowledge of civil engineering

Course Outcomes

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

CO1	Recall the fundamental principles of formwork, including its importance, objectives, and key cost-reduction strategies.	Remember
CO2	Gain knowledge of different formwork, including their advantages and limitations.	Remember
CO3	Learn the principles of formwork design and its application	Remember
CO4	Explain the formwork requirements for complex structures	Understand
CO5	Identify common causes of formwork failures and analyze case studies on failure incidents.	Analyze

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	-	-	-	-	-
CO2	3	-	-	-	3	-
CO3	3	-	-	-	3	-
CO4	3	-	-	-	3	-
CO5	3	-	-	-	-	-
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	30	30
Understand	10	10	20	20
Apply	20	20	30	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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Approved in Academic Council Meeting held on 19.07.2025

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TIRUCHENGODE - 637 215

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022							
M.E. Structural Engineering							
70 PSE E16 - Design of Formwork							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES	Total
	3	0	0	60	3	40	60	100

Introduction General objectives of formwork building - Development of a Basic System - Key Areas of cost reduction - Requirements and Selection of Formwork.	[9]
Formwork Materials and Types* Timber, Plywood, Steel, Aluminium, Plastic, and Accessories. Horizontal and Vertical Formwork Supports. Flying Formwork, Table Form, Tunnel Form, Slip Form, Formwork for Precast Concrete.	[9]
Formwork Design Concepts, Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.	[9]
Formwork Design for Special Structures Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges	[9]
Formwork Failures Formwork Management Issues – Pre- and Post-Award. Formwork Failures: Causes and Case studies in Formwork Failure, Formwork Issues in Multi story Building Construction.	[9]
Total Hours:45	**45**
Text Book(s):	

1.	Hurd. M.K., “Formwork for Concrete”, Special Publication, 5th Edition American Concrete Institute, Detroit, 2003.
2.	Austin. C.K., “Formwork for Concrete”, Cleaver- Hume Press ltd., London 2006
Reference(s):	
1.	Formwork for Concrete Structures, R.L.Peurifoy, McGraw Hill India, 2010.
2.	Formwork for Concrete Structures, Kumar NeerajJha, Tata McGraw Hill Education, 2012.
3.	IS 14687: 1999, False work for Concrete Structures - Guidelines, BIS.
4.	Michael P. Hurst, Construction Press, London and New York, 2003.

** SDG 9: Industry, innovation and infrastructure*

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	Introduction	
1.1	Introduction to Formwork and Its Importance	1
1.2	Objectives of Formwork in Construction	1
1.3	Development of a Basic Formwork System	1
1.4	Key Areas of Cost Reduction in Formwork	1
1.5	Selection Criteria for Formwork Systems	1
1.6	Types of Loads Acting on Formwork	1
1.7	Safety Considerations in Formwork Design	1
1.8	Sustainability and Environmental Impact of Formwork	1
1.9	Recent Innovations in Formwork Technology	1
2.0	Formwork Materials and Types	
2.1	Overview of Formwork Materials and Their Properties	1
2.2	Timber and Plywood Formwork – Advantages and Limitations	1
2.3	Steel and Aluminum Formwork – Features and Applications	1
2.4	Plastic and Composite Formwork – Benefits and Challenges	1
2.5	Accessories Used in Formwork Construction	1
2.6	Horizontal Formwork Supports – Beams and Slabs	1
2.7	Vertical Formwork Supports – Walls and Columns	1
2.8	Flying Formwork and Table Formwork – Working and Uses	1
2.9	Tunnel Form, Slip Form, and Precast Concrete Formwork	1
3.0	Formwork Design	
3.1	Introduction to Formwork Design Concepts	1
3.2	Loads and Stresses Acting on Formwork Structures	1
3.3	Structural Requirements and Stability of Formwork	1
3.4	Design of Formwork for Foundations	1
3.5	Design of Formwork for Walls and Columns	1
3.6	Design of Formwork for Slabs and Beams	1
3.7	Formwork for High-Rise Buildings – Challenges and Considerations	1
3.8	Design Optimization and Efficiency in Formwork Systems	1
3.9	Software and Tools for Formwork Design	1
4.0	Formwork Design for Special Structures	
4.1	Introduction to Special Structures and Formwork Needs	1
4.2	Formwork for Shell Structures – Design Considerations	1
4.3	Formwork for Domes and Folded Plates	1
4.4	Formwork for Overhead Water Tanks – Challenges and Solutions	1
4.5	Natural Draft Cooling Tower – Formwork Methodology	1
4.6	Bridge Formwork – Cantilever and Suspension Systems	1
4.7	Innovative Formwork Techniques for Special Structures	1
4.8	Prefabrication and Modular Formwork in Special Structures	1
4.9	Case Studies on Unique Formwork Applications	1
5.0	Formwork Failures	
5.1	Introduction to Formwork Failures – Causes and Effects	1
5.2	Common Structural Failures in Formwork and Prevention Methods	1
5.3	Case Studies on Major Formwork Failures in Construction	1
5.4	Quality Control Measures in Formwork Construction	1
5.5	Risk Management and Safety in Formwork Operations	1
5.6	Pre-Award and Post-Award Formwork Management Strategies	1
5.7	Challenges in Multi-Story Building Formwork Construction	1
5.8	Inspection and Maintenance of Formwork Systems	1
5.9	Future Trends in Formwork Failures and Safety Improvements	1

Course Designer(s)

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E21	Structural Health Monitoring	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the concept of structural health monitoring
- To acquire knowledge on structural audit
- To understand the static field testing procedures
- To learn the dynamic field testing procedures
- To apply various repair techniques in structures

Pre-requisites

Courses –Construction Materials & Practices, Concrete Technology and Basic Sciences

Course Outcomes

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

CO1	Understand the concept and measures of structural health monitoring	Apply
CO2	Investigate the health of structure using SHM procedures	Analyse
CO3	Examine the health of structure using static field test	Analyse
CO4	Assess the health of structure using dynamic field test	Apply
CO5	Apply suitable repair and rehabilitation techniques	Analyse

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	2	3	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	3	3	3	3	2
CO5	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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M.E - Structural Engineering

70 PSE E21 -Structural Health Monitoring

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Structural Health Factors affecting Health of Structures, Causes of Distress, Regular Maintenance and monitoring structural monitoring - Concepts, Various Measures, Structural Safety in Alteration.	[9]
Structural Audit Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures	[9]
Static Field Testing Types of Static Tests -Behavior test, Diagnostic test, Proof load test, Simulation and Loading Methods, Sensor systems and hardware requirements, Static Response Measurement.	[9]
Dynamic Field Testing Types of Dynamic Field Test - Stress History Test, Dynamic Response Methods, Ambient Vibration test, Pull-back test, Hardware for Remote Data Acquisition Systems,Remote Structural Health Monitoring.	[9]
Repairs and Rehabilitations of Structures Case Studies (Site Visits), Piezo - electric materials and other smart materials, Electro–mechanical impedance (EMI) technique, Adaptations of EMI technique.	[9]
Total Hours	45

Text Book(s):

1.	Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, Structural Health Monitoring, JohnWiley and Sons, 2006
2.	Douglas E Adams, “Health Monitoring of Structural Materials and Components - Methods with Applications”, John Wiley and Sons, 2007

Reference(s):

1.	Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley , ISTE, 2006
2.	Victor Giurgiutiu, “Structural Health Monitoring” Academic Press, 2014
3.	Handbook on Repair & Rehabilitation of R.C.C. Buildings, CPWD, Govt of India, 2011
4.	Structural Health Monitoring and Intelligent Infrastructure, Two Volume SetProceedings of the 2nd International Conference on Structural Health Monitoring of Intelligent Infrastructure, Nov. 16-18, 2005, Shenzhen, China

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Structural Health**	
1.1	Introduction to Structural health monitoring	1
1.2	Factors affecting Health of Structures	1
1.3	Causes of Distress	1
1.4	Regular Maintenance and monitoring	2
1.5	Concepts in Structural monitoring	1
1.6	Various measures in structural monitoring	2
1.7	Structural Safety in Alteration.	1
2.0	**Structural Audit**	
2.1	Structural Audit – Introduction & Importance	1
2.2	Need for Assessment of Structure and Damage identification	1
2.3	Assessment of Health of Structure	1
2.4	Collapse and Investigation	2
2.5	Investigation Management	1
2.6	SHM Procedures	2
2.7	Role of sensors in SHM	1
3.0	**Static Field Testing**	
3.1	Static field testing - Concept and types	1
3.2	Behavior test - Procedure& Applications	1
3.3	Diagnostic test - Procedure& Applications	1
3.4	Proof load test - Procedure& Applications	1
3.5	Simulation and loading methods for SHM	2
3.6	Sensor Systems & Hardware requirements	2
3.7	Static response measurement	1
4.0	**Dynamic Field Testing**	
4.1	Dynamic field testing - Concept and types	1
4.2	Stress history test	1
4.3	Dynamic Load Allowance test	2
4.4	Ambient Vibration test	1
4.5	Pull-back test	1
4.6	Hardware for Remote Data Acquisition Systems	1
4.7	Remote Structural Health Monitoring.	2
5.0	**Repairs and Rehabilitations of Structures**	
5.1	Introduction to Repairs and Rehabilitations of Structures	1
5.2	Case Studies	2
5.3	Piezo - electric materials	2
5.4	Smart materials	2
5.5	Electro–mechanical impedance (EMI) technique,	1
5.6	Adaptations of EMI technique	1

Course Designer

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R2/ w.e.f. 01.08.2025
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70 PSE E22	Design of Sub Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To impart knowledge in the selection of sites for investigate and procedure of sub surface exploration
- To determine the soil condition and provide the suitable foundation.
- To design the pile foundation based on capacity of super structure.
- To understand different types of foundations and their designing methods.
- Laying foundation for other miscellaneous structures like towers and different types of machine foundations and their design.

Pre-requisites

Basic knowledge of Soil Mechanics, Geology & Mathematical

Course Outcomes

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

CO1	State the knowledge on soil exploration	Apply
CO2	Analysis the concepts of safe bearing capacity of shallow foundation	Analyse
CO3	Explain pile foundation and their types	Understand
CO4	Estimation the well foundations and sheet pile wall	Analyse
CO5	Identify the general analysis of machine foundation and soil dynamics	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	2	3	2	3	2
CO3	3	3	2	3	2	3
CO4	2	2	2	2	2	2
CO5	3	3	2	3	2	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
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Approved in Academic Council Meeting held on 19.07.2025

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M.E - Structural Engineering

70 PSE E22 -Design of Sub Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Sub Surface Exploration Purpose - Programme and Procedures – Sampling- Exploration- soil data and Bore-hole log reports.	[9]
Shallow Foundations Types of foundations and their specific applications – depth of foundation – bearing capacity and settlement estimates (Plate load) – structural design of isolated footings, strip, rectangular and trapezoidal combined footings – strap– raft foundation – Approximate flexible method of raft design.	[9]
Deep Foundations Types of Piles and their applications - Pile capacity – Settlement of piles – Pile group – Structural design of piles and pile caps.	[9]
Foundations for Other Miscellaneous Structures Design of Caissons and Well foundations - Foundations for towers –Sheet Pile wall- Coffer dams.	[9]
Machine Foundations Types - General requirements and design criteria - General analysis of machine foundations-Soil Dynamics – Vibration isolation - Guide lines for design of reciprocating engines, impact type machines, rotary type machines, framed foundations.	[9]
Total Hours	45

Text Book(s):

1. Swamy Saran , “Analysis and Design of Substructures”, Oxford and IBH Publishing Co., Pvt.Ltd., New Delhi,2018.
2. Venkatramaiah.C, “Geotechnical Engineering”, New Age International Ltd., New Delhi, 2016.

Reference(s):

1. Thomlinson, M.J. and Boorman. R. “Foundation Design and Construction”,ELBS Longman VI, 2005
2. Nayak, N.V., “Foundation Design manual for Practicing Engineers”, Dhanpat Rai and Sons, 2009.
3. Winterkorn H.F., and Fang H.Y., “Foundation Engineering Hand Book - VanNostrard - Reinhold - 2006.
4. Brain J Bell and Smith M.J.“Reinforced Concrete Foundations” George Godwin Ltd., 2011.

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Approved in Academic Council Meeting held on 19.07.2025

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Sub Surface Exploration**	
1.1	Purpose	1
1.2	Programme and Procedures	2
1.3	Sampling	1
1.4	Exploration	2
1.5	soil data	1
1.6	Bore-hole log reports	2
2.0	**Shallow Foundations**	
2.1	Types of foundations and their specific applications	1
2.2	depth of foundation	1
2.3	bearing capacity and settlement estimates (Plate load)	1
2.4	structural design of isolated footings,	1
2.5	structural design of strip, rectangular and trapezoidal combined footings	2
2.6	structural design of strap – raft foundation	2
2.7	Approximate flexible method of raft design.	1
3.0	**Deep Foundations**	
3.1	Types of Piles	1
3.2	Pile applications	1
3.3	Pile capacity	1
3.4	Settlement of piles	2
3.5	Pile group	2
3.6	Structural design of piles	1
3.7	pile caps	1
4.0	**Foundations for Other Miscellaneous Structures**	
4.1	Design of Caissons	2
4.2	Design of Well foundations	2
4.3	Foundations for towers	2
4.4	Sheet Pile wall	2
4.5	Coffer dams	1
5.0	**Machine Foundations**	
5.1	Types	1
5.2	General requirements and design criteria -	1
5.3	General analysis of machine foundations-.	1
5.4	Soil Dynamics	1
5.5	Vibration isolation	1
5.6	Guide lines for design of reciprocating engines,	1
5.7	impact type machines,	1
5.8	rotary type machines,	1
5.9	framed foundations	1

Course Designer

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R2/ w.e.f. 01.08.2025
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70 PSE E23	Structural Optimization	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To explain basics concepts of optimizing in structural design.
- To develop optimization techniques, and application of algorithms.
- To understand linear Programming methods for plastic design of frames.
- To apply Optimization theorems and using several methods.
- To evaluate different types of non – traditional optimization techniques.

Pre-requisites

Basic knowledge of Soil Mechanics, Geology & Mathematical

Course Outcomes

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

CO1	Apply the knowledge on the recent advances in optimization.	Apply
CO2	Write algorithm for Geometric and Dynamic programming.	Analyse
CO3	To know the basis of univariate and multivariate minimization.	Understand
CO4	Understand the concepts of optimization structural theorems.	Analyse
CO5	Understand the concepts of optimization problems in the Structural Engineering	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	2	3	2	3	2
CO3	3	3	2	3	2	3
CO4	2	2	2	2	2	2
CO5	3	3	2	3	2	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
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M.E - Structural Engineering

70 PSE E23 -Structural Optimization

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Introduction Basic concepts of minimum weight, minimum cost design, objective function, constraints, classical methods	[9]
Optimization Techniques and Algorithms Linear programming, Integer Programming, Quadratic Programming. Dynamic Programming and geometric Programming methods for optimal design of structural elements.	[9]
Computer Search Methods Linear Programming methods for plastic design of frames. Computer search for univariate and multivariate Minimization	[9]
Optimization Theorems Optimization by structural theorems, Maxwell, Mitchell and Heyman's Theorems for trusses and frames, fully stressed design with deflection constraints, optimality criterion methods.	[9]
Non-Traditional Optimization Techniques Methods land on national evolution – Genetic Algorithm – simulated annealing – Truss problem – Hand simulation for simple problems	[9]
Total Hours	45

Text Book(s):

1.	Spillers, William R., MacBain, Keith M, "Structural Optimization", 2006.
2.	Rao., S.S., " Optimization theory and Applications", Wiley Eastern Limited, New Delhi, 1995.

Reference(s):

1.	Christensen, Peter, Klarbring, Anders, "An Introduction to Structural Optimization", 2009, Springer.
2.	Rao, S.S., Optimization Theory and Applications" Wiley Eastern Ltd., New Delhi, 1978.
3.	Majid, K.I., "Optimum Design of Structures" Newnes-Butter Worths, London, 1974.
4.	Gallegher, R.H. and Zienkiewiez, O.C., John Wiley and Sons, "Optimum Structural Design, Theory and Applications", New York, 1973.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Basic concepts of minimum weight	1
1.2	Basic concepts of minimum cost design	2
1.3	Objective of Cost design	1
1.4	Functions	2
1.5	constraints	1
1.6	Classical methods	2
2.0	**Optimization Techniques And Algorithms**	
2.1	Basics of Optimization Techniques	1
2.2	Linear programming methods for optimal design of structural elements	1
2.3	Integer Programming methods for optimal design of structural elements	1
2.4	Quadratic Programming methods for optimal design of structural elements	2
2.5	Dynamic Programming, methods for optimal design of structural elements	2
2.6	Geometric Programming methods for optimal design of structural elements	2
3.0	**Computer Search Methods**	
3.1	Linear Programming methods for plastic design of frames	1
3.2	Concepts of Plastic design of frames	1
3.3	Computer search for univariate Minimization	1
3.4	Computer search for multivariate Minimization	2
3.5	Problems in Univariate Minimization	2
3.6	Problems in mutltivariate minimization	2
4.0	**Optimization Theorems**	
4.1	Optimization by structural theorems	2
4.2	Maxwell Theorems for trusses and frames	1
4.3	Mitchell Theorems for trusses and frames	1
4.4	Heyman's Theorems for trusses and frames	1
4.5	Fully stressed design with deflection constraints	2
4.6	optimality criterion methods	2
5.0	**Non-Traditional Optimization Techniques**	
5.1	Methods on national evolution	1
5.2	Genetic Algorithm	1
5.3	Simulated annealing	1
5.4	Truss problem	2
5.5	Hand simulation for simple problems	2
5.6	Simple problems in Non-traditional optimization techniques	2

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E24	Bridge Engineering	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To identify the Classification of bridges
- To understand the roads on bridges, design of solid slab, bridges, R.C. girder bridges, long span girder bridge and plate girder bridges.
- To Design of prestressed concrete bridges.
- To learn bearing, sub structures and footings for bridges.
- To discuss about construction and maintenance of bridges.

Pre-requisites

Basic knowledge of RCC, Steel Structures and Prestressed Concrete & Concrete Technology

Course Outcomes

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

CO1	List out the components and classification of a bridge.	Apply
CO2	Design a deep foundation and well foundation.	Analyse
CO3	List out the different forms of reinforced bridges.	Understand
CO4	List out the different forms of steel bridges.	Analyse
CO5	Show the rehabilitation for bridges.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	2	3	3	2	2	2
CO3	3	3	-	3	2	3
CO4	3	3	2	2	2	3
CO5	3	3	2	1	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E24- Bridge Engineering

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Introduction Definition and components of a bridge – layout and planning of a bridge – classification – investigation of a bridge – preliminary data collection – choice and type of a bridge – hydraulic design of a bridge – traffic design – loading – highway and railway loading – specification	[9]
Analysis of Substructure Analysis and design of foundation – shallow foundation – open foundation – deep foundation – pile foundation – well foundation – caisson foundation – piers and abutments – bridge bearing – steel rocker and roller bearings – reinforced concrete rocker and roller bearings – elastomeric bearings.	[9]
Analysis of Superstructure Reinforced concrete and prestressed concrete bridge: Straight and curved bridge decks - decks of various types – slab hollow and voided slab – beam – slab box – reinforced concrete slab bridge – load distribution – Pigeaud's theory – skew slab deck – RC tee beam and slab bridge – continuous beam bridge – fixed point method – influence lines – balanced Cantilever bridge – rigid frame bridge – box girder bridge – bow string girder bridge – Pre-stressed concrete bridge – analysis and design for static, moving and dynamic loading.	[9]
Steel Bridge Plate girder bridge – box girder bridge – composite beam bridge – truss bridge – influence lines for forces in members – suspension bridge – cable stayed bridge – analysis for static, moving and dynamic loading.	[9]
Construction And Maintenance Construction methods – short span – long span - false work for concrete bridges – construction management – inspection and maintenance – lesson from bridge – rehabilitation of a bridge failures – load testing of bridges.	[9]
Total Hours	45

Text Book(s):

1. Ponnuswamy, S., "Bridge Engineering", Tata McGraw –Hill Pub co., New Delhi, 2010.
2. Taylor, F.W., Thomson, S.E., and Smulski, E., "Reinforced Concrete Bridges", John Wiley and Sons, Newyork, 2005.

Reference(s):

1. Jhnson Victor, D., "Essentials of Bridge Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, 2009.
2. Krishna Raju, N., "Design of Bridge", Oxford Publishing Co Pvt. Ltd., New Delhi, 2008.
3. Bakht B and Jaeger L.G.., "Bridge Deck Analysis Simplified", McGraw – Hill, International Studnets' edition, Singapore, 2017.
4. Raina, V.K. "Concrete Bridge Practice" Tata McGraw – Hill Publishing Co, New Delhi.2001.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Definition and components of a bridge	1
1.2	layout and planning of a bridge	1
1.3	classification	1
1.4	investigation of a bridge	1
1.5	preliminary data collection	1
1.6	choice and type of a bridge	1
1.7	hydraulic design of a bridge	1
1.8	traffic design	1
1.9	loading – highway and railway loading – specification	1
2.0	**Analysis of Substructure**	
2.1	Analysis and design of foundation	1
2.2	shallow foundation – open foundation	1
2.3	deep foundation – pile foundation	1
2.4	well foundation – caisson foundation.	1
2.5	piers and abutments – bridge bearing	2
2.6	steel rocker and roller bearings	1
2.7	reinforced concrete rocker and roller bearings	1
2.8	elastomeric bearings	1
3.0	**Analysis of Superstructure**	
3.1	Reinforced concrete and prestressed concrete bridge:	1
3.2	Straight and curved bridge decks - decks of various types	1
3.3	slab hollow and voided slab – beam – slab box	1
3.4	Reinforced concrete slab bridge – load distribution – Pigeaud's theory – skew slab deck	1
3.5	RC tee beam and slab bridge – continuous beam bridge – fixed point method	1
3.6	influence lines –balanced Cantilever bridge – rigid frame bridge –	1
3.7	box girder bridge – bow string girder bridge	1
3.8	Pre-stressed concrete bridge – analysis and design for static, moving and dynamic loading	2
4.0	**Steel Bridge**	
4.1	Plate girder bridge	2
4.2	box girder bridge – composite beam bridge	1
4.3	truss bridge – influence lines for forces in members	2
4.4	suspension bridge	1
4.5	cable stayed bridge	1
4.6	analysis for static,	1
4.7	moving and dynamic loading	1
5.0	**Construction And Maintenance**	
5.1	Construction methods	1
5.2	short span – long span	1
5.3	false work for concrete bridges	1
5.4	construction management	2
5.5	inspection and maintenance	1
5.6	lesson from bridge	1
5.7	rehabilitation of a bridge failures	1
5.8	load testing of bridges	1

Course Designer

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TIRUCHENGODE - 637 215

70 PSE E25	Non Linear Analysis of Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Analyse the bar system considering the material and geometric nonlinearity.
- Perform inelastic analysis of flexural members.
- Perform vibration analysis of flexural members.
- Perform elastic and inelastic analysis of Plates.
- Perform nonlinear and instability analysis of elastically supported beams.

Pre-requisites

Basic knowledge of Soil Mechanics, Geology & Mathematical

Course Outcomes

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

CO1	Describe the concept of Non-Linear Analysis of the structures	Apply
CO2	Analyse the members subjected to deformations and analysis of bars with and without restraints	Analyse
CO3	Apply the knowledge of vibration theory on flexural members and identify its behaviour under cyclic loading	Understand
CO4	Identify the Non-linear behaviour of plates.	Analyse
CO5	Solve the elemental equation of beams Non linear vibrations	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	2	3	2	3	2
CO3	3	3	2	3	2	3
CO4	2	2	2	2	2	2
CO5	3	3	2	3	2	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E25-Non Linear Analysis of Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Introduction to Nonlinear Analysis : Material nonlinearity, geometric nonlinearity; statically determinate and statically indeterminate bar systems of uniform and variable thickness.	[9]
Inelastic Analysis of Flexural Members: Inelastic analysis of uniform and variable thickness members subjected to small deformations; inelastic analysis of bars of uniform and variable stiffness members with and without axial restraints.	[9]
Vibration Theory and Analysis of Flexural Members: Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform and variable stiffness members under cyclic loading	[9]
Elastic and Inelastic Analysis of Plates: Elastic and inelastic analysis of uniform and variable thickness plates	[9]
Nonlinear Vibration and Instability: Nonlinear vibration and Instabilities of elastically supported beams.	[9]
Total Hours	45

Text Book(s):

1.	Gang Li, Kevin Wong ,"Theory of Nonlinear Structural Analysis: The Force Analogy Method for Earthquake Engineering", Wiley,1st edition (23 June 2014).
2.	Fertis, D.G, Non-linear Mechanics, CRC Press, 1999.

Reference(s):

1.	Sathyamoorthy.M, Nonlinear Analysis of Structures, CRC Press, 2010.
2.	Reddy.J.N, Non-linear Finite Element Analysis, Oxford University Press, 2008.
3.	F.C. Filippou and G.L. Fenves, "Methods of Analysis for Earthquake-Resistant Structures" from "Earthquake Engineering, From Engineering Seismology to Performance-Based Engineering", CRC Press, 2004.
4.	McGuire, William; Gallagher, Richard H.; and Ziemian, Ronald D., "Matrix Structural Analysis, 2nd Edition" 2000.

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Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Nonlinear Analysis**	
1.1	Material nonlinearity	1
1.2	Geometric nonlnearity	1
1.3	Statically determinate bar systems of uniform thickness	1
1.4	Statically indeterminate bar systems of uniform thickness	2
1.5	Statically determinate bar systems of variable thickness	2
1.6	Statically indeterminate bar systems of variable thickness	2
2.0	**Inelastic Analysis of Flexural Members**	
2.1	Inelastic analysis of uniform thickness members subjected to small deformations	1
2.2	Inelastic analysis of variable thickness members subjected to small deformations	1
2.3	Inelastic analysis of bars of uniform stiffness members with axial restraints	1
2.4	Inelastic analysis of bars of variable stiffness members with axial restraints	2
2.5	Inelastic analysis of bars of uniform stiffness members without axial restraints	2
2.6	Inelastic analysis of bars of variable stiffness members without axial restraints	2
3.0	**Vibration Theory and Analysis of Flexural Members**	
3.1	Vibration theory – Basic introductions	1
3.2	Analysis of Flexural Members	1
3.3	Hysteretic Models	1
3.4	Analysis of uniform stiffness members under cyclic loading	2
3.5	Analysis of variable stiffness members under cyclic loading	2
3.6	Problems related to cyclic loading	2
4.0	**Elastic and Inelastic Analysis of Plates**	
4.1	Elastic analysis of uniform plates	2
4.2	In Elastic analysis of uniform plates	2
4.3	Elastic analysis of variable thickness plates	2
4.4	In Elastic analysis of variable thickness plates	2
4.5	Simple Problems	1
5.0	**Nonlinear Vibration and Instability**	
5.1	Nonlinear vibration	3
5.2	Instabilities of elastically supported beams	3
5.3	Problems related to nonlinear vibrations	3

Course Designer

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R2/ w.e.f. 01.08.2025
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Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E26	Life Cycle Assessment of Structures	Category	L	T	P	Credit
		PE	3	0	0	0

Objectives

- To understand probability concepts in structural reliability
- To learn reliability measures and performance functions
- To explore FOSM and Monte Carlo simulation methods
- To analyze system reliability in different configurations
- To apply statistical methods for reliability assessment

Pre-requisites

Basic knowledge of Structural Analysis

Course Outcomes

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

CO1	An ability to design a building or a group of buildings with all the due considerations of sustainable planning and design principles	Remember
CO2	Ability to use energy simulation tools and its result analysis	Understand
CO3	To balance human needs with environmental concerns in architectural design	Apply
CO4	Ability to critically analyses buildings with respect to Bio-climatic and GRIHA/LEED related	Analyse
CO5	Evaluate economic and environmental impacts using LCC	Analyse

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	3	-	-	-
CO2	3	2	2	-	-	-
CO3	3	2	2	-	-	-
CO4	3	2	2	-	-	-
CO5	3	2	2	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Semester Examination (Marks)
	1	2	
Remember	30	10	30
Understand	30	10	20
Apply		20	30
Analyse		20	20
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

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B.E. Civil Engineering								
70 PSE E26 - Life Cycle Assessment of Structures								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Introduction and Terminology* History of LCA, Aspects of LCA, variants of LCA, Life cycle stages, end of life, Functional unit, System boundary, Life Cycle Inventory (LCI) data base, Life Cycle Management (LCM), Life Cycle Energy Analysis (LCEA), Carbon Accounting.	[9]
Life Cycle Assessment in Building Industry* Material level, Product Level, building level, Industry level, LCA and Design process, Pre-design, Schematic Design and Design Development Stage.LCA process and impact categories: Inventory Analysis, Impact assessment, interpretation, Different impact categories like Global Warming Potential (GWP), Acidification Potential (AP), Eutrophication Potential (EP), Smog Formation Potential, Fossil fuel and Ozone Depletion Potential.	[9]
Different Tools For LCA* Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions	[9]
Reliability Analysis* Figure of Merit (FOM), Parameter selection for FOM, Selection based on FOM, Building into components-three phase building breaking down a materials, Criteria for material selection	[9]
Life Cycle Costing (LCC) Tool * Component characteristics of an element group, Input for energy Calculation, LCC calculations conduct of LCI and LCC calculations, Slective Assessment, Normalization and Weighing Factors LCA and LCC for different materials. Case studies- Two and Three variants of a house, office building, retrofitting buildings	[9]
Total Hours:45	**45**
Text Book(s):	

1.	A. Kapur and T.E. Graedel: Industrial Ecology. Encyclopedia of Energy, Volume 3, 2004.
2.	Environmental life cycle analysis by David Ciambrone, CRC-Press 1997.
Reference(s):	
1.	Life-cycle analysis of energy systems from methodology to applications, by Bent Sorensen, Published by Royal Society of Chemistry, June 2011.
2.	Lifecycle Assessment: Principles and Practice Chapter 1.
3.	R. A. Frosch and N. E. Gallopoulos: Strategies for Manufacturing, Scientific American 261 (3), 144-152 1989.
4.	Hauschild, M.Z., Rosenbaum, R.K., and Olsen, S.I., Life Cycle Assessment: Theory and Practice, Springer, 2018

* *SDG 9: Industry, innovation and infrastructure*

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Course Contents and Lecture Schedule		
S. No.	**Topics**	**No. of hours**
1.0	**Introduction and Terminology**	
1.1	Fundamentals of Life Cycle Assessment (LCA)	1
1.2	History and evolution of LCA methodologies	1
1.3	Life Cycle Stages: Raw materials to end-of-life	1
1.4	Functional unit and system boundary definition	1
1.5	Life Cycle Inventory (LCI) and data collection methods	1
1.6	Life Cycle Management (LCM) and its applications	1
1.7	Environmental impact categories and their significance	1
1.8	Role of LCA in sustainability and green buildings	1
1.9	Case studies on LCA applications in construction	1
2.0	**Life Cycle Assessment in Building Industry**	
2.1	Material, product, building, and industry-level LCA	1
2.2	Integration of LCA in building design and construction	1
2.3	LCA in different design stages (Pre-design, schematic, and development)	1
2.4	LCA and environmental impact categories (e.g., GWP, AP, EP)	1
2.5	Role of energy efficiency and carbon footprint in LCA	1
2.6	Case studies on LCA-based sustainable design decisions	1
2.7	Regulatory frameworks and certifications (LEED, GRIHA, BREEAM)	1
2.8	Challenges and limitations of LCA in construction	1
2.9	Comparative LCA for different construction materials	1
3.0	**Different Tools For LCA**	
3.1	Introduction to LCA software and databases	1
3.2	Probability mass function and probability density function	1
3.3	Mathematical expectation and Chebyshev's theorem in LCA	1
3.4	Probability distributions in LCA (Binomial, Poisson, Normal)	1
3.5	Statistical methods for uncertainty analysis in LCA	1
3.6	Sensitivity analysis for impact assessment	1
3.7	Normalization and weighting in impact assessment	1
3.8	Comparative analysis of LCA tools (SimaPro, OpenLCA, GaBi)	1
3.9	Hands-on demonstration of an LCA tool	1
4.0	**Reliability Analysis**	
4.1	Concept of reliability in structural assessment	1
4.2	Failure modes, limit states, and risk assessment	1
4.3	Reliability index and factor of safety in LCA	1
4.4	First Order Second Moment (FOSM) method application	1
4.5	Advanced First Order Second Moment (AFOSM) method	1
4.6	Monte Carlo simulation for structural reliability	1
4.7	Load and resistance factor design (LRFD) concepts	1
4.8	Reliability-based design and decision-making	1
4.9	Application of reliability analysis in green buildings	1
5.0	**Life Cycle Costing (LCC) Tool**	
5.1	Fundamentals of Life Cycle Costing (LCC)	1
5.2	Relationship between LCA and LCC in decision-making	1
5.3	Key components and calculations in LCC	1
5.4	Conducting an LCA and LCC for structural materials	1
5.5	Integration of LCA and LCC for sustainable construction	1
5.6	Energy efficiency assessment through LCA and LCC	2
5.7	Case studies on LCA and LCC applications in buildings	2

Course Designer(s)

1. Dr.K.VijayaSundravel - vijayasundravel@ksrct.ac.in

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E31	Soil Structure Interaction	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To know Soil foundation interaction problems, behaviors and models.
- To understand the elastic foundation soil models and plate on elastic medium
- To design plate types, numerical analysis of finite plates,
- To develop elastic analysis of single pile and group of piles based on settlement.
- Interaction analysis of piles and about the analysis of laterally loaded piles.

Pre-requisites

Basic knowledge of Soil Mechanics, Foundation Design & Geology.

Course Outcomes

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

CO1	Generate concepts of soil structure Interaction	Apply
CO2	Assess the soil models as isotropic elastic half-space	Analyse
CO3	Formulate winkler foundation model for elastic continum	Understand
CO4	Calculate elastic medium for rectangular and circular plates	Analyse
CO5	Estimate the load distribution in pile.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	3	2	3
CO2	3	3	3	2	2	2
CO3	3	3	2	3	2	2
CO4	3	3	2	2	2	2
CO5	3	3	2	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E31-Soil Structure Interaction

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Soil-Foundation Interaction Introduction to soil-foundation interaction problems – Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Elastic continuum, two parameter elastic models, Elastic plastic behaviour, Time dependent behaviour.	[9]
Beam on Elastic Foundation- Soil Models Infinite beam, two parameters, Isotropic elastic half-space, Analysis of beams of finite length, Classification of finite beams in relation to their stiffness.	[9]
Plate on Elastic Medium 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.	[9]
Elastic Analysis of Pile Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in pile.	[9]
Laterally Loaded Pile Load deflection prediction for laterally loaded piles, Sub grade reaction and elastic analysis, Interaction analysis, Pile raft system, Solutions through influence charts.	[9]
Total Hours	45

Text Book(s):

1. Selvadurai, A.P.S., “Elastic Analysis of Soil Foundation Interaction”, Elsevier, 2009
2. Poulos, H.G., and Davis, E.H., “Pile Foundation Analysis and Design”, John Wiley, 2001

Reference(s):

1. Scott, R.F., “Foundation Analysis”, Prentice Hall, 2011
2. Structure-Soil Interaction – State of Art Report”, Institution of Structural Engineers, 2018
3. ACI 336, “Suggested Analysis and Design Procedures for combined footings and Mats”, American Concrete Institute, Delhi, 2011
4. Prakash, S., and Sharma, H. D., “Pile Foundations in Engineering Practice.”John Wiley & Sons, New York, 1990.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Soil-Foundation Interaction**	
1.1	Introduction to soil	1
1.2	foundation interaction problems	1
1.3	Soil behaviour, Foundation behaviour	1
1.4	Interface behaviour	2
1.5	Scope of soil foundation interaction analysis	1
1.6	Soil response models	1
1.7	Elastic continuum, two parameter elastic models	1
1.8	Elastic plastic behaviour	1
1.9	Time dependent behaviour	1
2.0	**Beam on Elastic Foundation- Soil Models**	
2.1	Infinite beam,	1
2.2	two parameters,	2
2.3	Isotropic elastic half-space,	2
2.4	Analysis of beams of finite length,	1
2.5	Classification of finite beams	2
2.6	Classification of finite beams in relation to their stiffness	1
3.0	**Plate on Elastic Medium**	
3.1	Infinite plate, Winkler	1
3.2	Two parameters	1
3.3	Isotropic elastic medium,	1
3.4	Thin and thick plates,	1
3.5	Analysis of finite plates,	1
3.6	rectangular and circular plates,	1
3.7	Numerical analysis of finite plates, Simple solutions	1
3.8	Simple solutions	2
4.0	**Elastic Analysis of Pile**	
4.1	Elastic analysis of single pile,	2
4.2	Theoretical solutions for settlement	2
4.3	Theoretical solutions for settlement and load distributions,	2
4.4	Analysis of pile group	1
4.5	Interaction analysis,	1
4.6	Load distribution in pile.	1
5.0	**Laterally Loaded Pile**	
5.1	Load deflection prediction for laterally loaded piles,	2
5.2	Sub grade reaction and	2
5.3	elastic analysis,	1
5.4	Interaction analysis,	2
5.5	Pile raft system, ,	1
5.6	Solutions through influence charts	1

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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TIRUCHENGODE - 637 215

70 PSE E32	Design of Shell and Spatial Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Classification of shells, membrane theory of shells, and design of folded plate structures
- Design philosophy of space frame, optimization techniques and structural theorems
- Study the behaviour and design of shells, folded plates, space frames and application of FORMIAN software.
- To expose the students the principles of design of folded plates.
- Students will be introduced to general principles of design Philosophy and behaviour.

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Pre-requisites

Fundamentals of Mathematics, knowledge of strength of materials and its mechanics and theory of elasticity and plasticity.

Course Outcomes

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

CO1	Analyse various types of shells and using membrane theory.	Apply
CO2	Analyse various shapes of plates using various methods.	Analyse
CO3	Principles and design philosophy of space frames.	Understand
CO4	Analyse and design space frames.	Analyse
CO5	Analyse various optimization structural members.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	1	3	1	1
CO2	3	3	1	3	1	1
CO3	3	3	1	3	1	1
CO4	3	3	1	3	1	1
CO5	3	3	1	3	1	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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TIRUCHENGODE - 637 215

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E32- Design of Shell and Spatial Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Membrane Theory of Shells Classification of shells – Types of shells – Structural action – Membrane theory – Shells of revolution and shells of translation – Examples – Limitations of membrane theory.	[9]
Design of Folded Plates Folded Plate structures – structural behaviour – Types – Design by ACI – ASCE Task Committee method.	[9]
Space Frame - Design Philosophy Space frames – configuration – types of nodes – general principles of design Philosophy – Behaviour	[9]
Analysis of Space Frames Analysis of space frames – Formex Algebra, Formian – Detailed design of Space frames	[9]
Optimization Optimization by structural theorems – Maxwell, Mirchell and Heyman's Theorems for trusses and frames – Fully stressed design with deflection constraints – Genetic Algorithm.	[9]
Total Hours	45

Text Book(s):

1.	Timoshenko, S. and Krieger S.W. "Theory of Plates and Shells", McGraw Hill book company, New York,2003
2.	Reddy J.N " Theory and analysis of elastic plates and shells", McGraw Hill Book company, New York, 2006.

Reference(s):

1.	Ramasamy, G.S., "Design and Construction of Concrete Shell Roofs", CBS Publishers, New Delhi, 1999.
2.	Belegundu, A.D., "Optimization Concepts and Applications in Engineering ", Pearson Education, 2002.
3.	Bangash M.Y.H, Bangash., T "Elements of Spatial Structures: Analysis and Design", Thomas Telford, 2003.
4.	KokKeong Choong., "Recent Advances in Analysis, Design and Construction of Shell & Spatial Structures in the Asia-Pacific Region Kindle Edition", CRC Press; 1st edition 2019.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Membrane Theory of Shells**	
1.1	Shell surfaces	1
1.2	Classification of shell surfaces	1
1.3	Surfaces of revolution	1
1.4	Δ-forms of surfaces	2
1.5	Folded plates	2
1.6	Characteristics of shell surfaces.	2
2.0	**Design of Folded Plates**	
2.1	Surfaces and its related aspects	1
2.2	Curvatures of a surface	1
2.3	Curves and related aspects	1
2.4	Structural behaviour of shell	1
2.5	Stress-strain relationships	1
2.6	Equilibrium equations	1
2.7	Equilibrium equations for thin shell elements in membrane state	1
2.8	Curvilinear coordinate system	1
2.9	Shells of revolution	1
3.0	**Space Frame - Design Philosophy**	
3.1	Analysis of shells	2
3.2	Membrane analysis	2
3.3	Axisymmetric loading	1
3.4	Concentrated load – Self weight	1
3.5	Uniform loading – Pressure loading	1
3.6	Hydrostatic loading	1
3.7	Non-axisymmetric loading – Wind load	1
4.0	**Analysis of Space Frames**	
4.1	Spherical domes under concentrated load and under self-weight	2
4.2	Bending analysis	1
4.3	Axisymmetric case – Equilibrium equations for thin shells of revolution in bending	1
4.4	Equilibrium equations in orthogonal curvilinear coordinate system	1
4.5	Bending equation of spherical lattice domes	1
4.6	Cylindrical shells – Equilibrium equations – DKJ theory	1
4.7	Cylindrical shells – Equilibrium equations – Jenkin's theory	1
5.0	**Optimization**	
5.1	Beam method of analysis	2
5.2	Merits and demerits – Case studies for simply supported cylindrical shells – without and with edge beams	1
5.3	Design of shells based on membrane theory - Shells having semicircular directrix	1
5.4	Design of shells based on membrane theory - Shells with circular directrix	1
5.5	Design of shells based on beam theory	1
5.6	Design aspects of paraboloid, hyperboloid and hyperbolic paraboloid shells	1
5.7	Analysis and structural behaviour of folded plates and its various types	1
5.8	Design of folded plates by ACI-ASCE Task Committee method	1

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E33	Off Shore Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the demand for coastal and offshore structures, overview of different types of ocean structures.
- To get exposed to structural geometry, analysis methods, design techniques, construction practice, different types of material, guidelines associated with selection of materials for marine environment.
- To learn various types of structural systems/forms, brief overview of various environmental loads.
- To be familiar with the problems associated with the material behavior in marine environment and various protection methods.
- To understand the inspection and testing methods, repair and rehabilitation processes.

Pre-requisites

Fundamentals of Mathematics, knowledge of Mechanics of Materials, Statics, Concrete Technology and Concrete Design

Course Outcomes

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

CO1	Understand the functions and behaviour of offshore structures	Apply
CO2	Identify the different types of loads acting on the structures	Analyse
CO3	Understand the behaviour of waves and its effects on structures	Understand
CO4	Evaluate the behaviour of structures for its dynamic loads	Analyse
CO5	Design of offshore structures with failure probability	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	2	3	-	2	2
CO2	2	2	3	-	2	2
CO3	1	2	1	3	2	-
CO4	2	2	3	3	2	2
CO5	2	2	3	2	3	-
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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K.S.Rangasamy College of Technology
TIRUCHENGODE - 637 215

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E33-Off Shore Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Wave Theories Wave generation process, small, finite amplitude and nonlinear wave theories.	[9]
Forces of Offshore Structures Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.	[9]
Offshore Soil and Structure Modelling Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.	[9]
Analysis of Offshore Structures Static method of analysis, foundation analysis and dynamics of offshore structures.	[9]
Design of Offshore Structures Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.	[9]
Total Hours	45

Text Book(s):

1.	Reddy. D. V and Swamidas A. S. J., Essential of Offshore Structures, CRC Press, 2013.
2.	Chakrabarti. S.K, "Hydrodynamics of Offshore Structures", Computational mechanics Publications, 1987.

Reference(s):

1.	API RP 2A-WSD, Planning, Designing and Constructing Fixed Offshore Platforms – Working Stress Design – API Publishing Services, 2005
2.	James F. Wilson, Dynamics of Offshore Structures, John Wiley and Sons, Inc, 2003.
3.	Reddy, D. V. and Arockiasamy, M., Offshore Structures, Vol. 1 and Vol. 2, Krieger Publishing Company,1991..
4.	Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010.

R2/ w.e.f. 01.08.2025
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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Wave Theories**	
1.1	Types of offshore structures and conceptual development	1
1.2	Analytical models for jacket structures	1
1.3	Materials and their behaviour under static and dynamic loads	1
1.4	Statutory regulations	2
1.5	Allowable stresses	2
1.6	Various design methods and Code Provisions	2
2.0	**FORCES OF OFFSHORE STRUCTURES**	
2.1	Design specification of API, DNV, Lloyd's and other classification societies	1
2.2	Construction of jacket and gravity platforms 2894 Module II Loads on offshore structures	1
2.3	Environmental loads due to wind, wave, current and buoyancy	1
2.4	Morison's Equation	1
2.5	Maximum wave force on offshore structure	1
2.6	Concept of Return waves	1
2.7	Principles of Static and dynamic analyses of fixed platforms	1
2.8	Use of approximate methods	1
2.9	Design of structural elements	1
3.0	**OFFSHORE SOIL AND STRUCTURE MODELLING**	
3.1	Introduction to tubular joints	2
3.2	Possible modes of failure	2
3.3	Eccentric connections and offset connections	1
3.4	Cylindrical and rectangular structural members	1
3.5	In plane and multi plane connections	1
3.6	Parameters of in-plane tubular joints	1
3.7	Kuang's formulae	1
4.0	**ANALYSIS OF OFFSHORE STRUCTURES**	
4.1	Elastic stress distribution	2
4.2	Punching shear Stress	2
4.3	Overlapping braces	1
4.4	Stress concentration	1
4.5	Chord collapse and ring stiffener spacing	1
4.6	Stiffened tubes	1
4.7	External hydrostatic pressure	1
5.0	**DESIGN OF OFFSHORE STRUCTURES**	
5.1	Fatigue of tubular joints	2
5.2	Fatigue behaviour	1
5.3	Palmgren-Miner cumulative damage rule	1
5.4	Blast walls; Platform survival capacity and Plastic design methods.	1
5.5	Blast Mitigation	1
5.6	Design of structures for high temperature	1
5.7	Fire Rating for Hydrocarbon fire	1
5.8	Behavior of steel at elevated temperature	1

Course Designer

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70 PSE E34	Experimental Methods and Model Analysis	Category	L	T	P	Credit
			3	0	0	3

Objectives

- To understand the different experimental stress analysis methods and their application in structural testing
- To explore the principle, types, and applications of strain gauges in measuring forces and strains
- To familiarize students with photo elasticity principles and their role in stress analysis
- To gain knowledge of modern strain measurement devices like hydraulic jacks, electronic load cells, proving rings, and their calibration
- To introduce the concept of long-term structural health monitoring using advanced sensors such as vibrating wire and fibre optic sensors

Pre-requisites

Strength of Materials and Basic Physical Science and Electronics Courses

Course Outcomes

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

CO1	Understand various force and strain measuring equipment	Remember
CO2	Demonstrate the strain measuring equipment	Understand
CO3	Apply the principles of photo elasticity to analyze stress distribution in materials	Apply
CO4	Apply suitable non-destructive testing methods.	Apply
CO5	Evaluate long-term structural health using advanced sensors	Analyse

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	-	-	-	-	-
CO2	3	-	-	-	-	-
CO3	3	-	-	2	-	-
CO4	3	-	-	-	3	-
CO5	3	-	-	3	-	-
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	30	30
Understand	10	10	20	20
Apply	20	20	30	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022								
M.E - Structural Engineering								
70 PSE E34-Experimental Techniques and Instrumentation								
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Force and Strain Measurements Basic Concept – Measurements of displacement, strain pressure, force, torque etc, Strain gauges (Mechanical, Electrical, Acoustical etc) – Strain gauge circuits – potentiometer and wheat stone bridge – Rosette analysis. Hydraulic Jack, Load cell and Proving Ring.	[9]
Vibration Measurements Linear Variable Differential Transducers (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs.	[9]
Data Acquisition Systems Indicating and recording devices – Static and dynamic data recording –Data acquisition and processing systems – Cathode Ray Oscilloscope – XY Plotter – Chart plotters – Digital data acquisition systems.	[9]
Photo elasticity Photoelasticity – Optics of photoelasticity – Polariscope – Isoclinics and Isochromatics– Methods of stress separation	[9]
Non Destructive Testing Methods Ultrasonic testing principles and application – Rebound Hammer – Holography – Use of laser for structural testing – Advanced NDT methods – Ultrasonic pulse echo, impact echo, impulse radar techniques, GECOR, Ground penetrating radar (GPR).	[9]
Total Hours	45

Text Book(s):	
1.	Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi,1996
2.	Dally J W and Riley W.F, “Experimental stress Analysis”, McGraw-Hill, Inc. NewYork, 1991
Reference(s):	
1.	Rangan C S., ”Instrumentation – Devices and Systems”, Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 1997
2.	Sirohi. R.S.,Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997
3.	Charles J Hellier, Handbook of Nondestructive Evaluation, Second Edition, Mc graw Hill Education,2012
4.	Ravisankar.K. and Chellappan.A., “Advanced course on Non-Destructive Testing and Evaluation of Concrete Structures” SERC, Chennai, 2007.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Force and Strain Measurements**	
1.1	Introduction to force and strain measurements	1
1.2	Explanation of displacement , strain pressure, force & torque	1
1.3	Various strain gauges – Mechanical Strain gauges - Principle & Working	1
1.4	Electrical Strain gauges - Principle & Working	1
1.5	Acoustical Strain gauges - Principle & Working	1
1.6	Working of potentiometer	1
1.7	Working of Wheat stone bridge	1
1.8	Rosette analysis concepts and formulas	1
1.9	Rosette analysis problems	2
1.10	Use of Hydraulic jack, load cell and proving ring	1
2.0	**Vibration Measurements**	
2.1	Introduction to transducers	1
2.2	Linear Variable Differential Transducers – Operation and use	1
2.3	Transducers for velocity measurements	1
2.4	Transducers for acceleration measurements	1
2.5	Vibration meter – Principle and working	1
2.6	Working principle of Seismographs	1
2.7	Seismogram and its inference	1
3.0	**Data Acquisition Systems**	
3.1	Introduction to data acquisition systems	1
3.2	Static data recording devices	2
3.3	Dynamic data recording devices	1
3.4	Data acquisition and processing systems	1
3.5	Cathode Ray Oscilloscope – Operation and use	1
3.6	XY Plotter – Principle & Construction	1
3.7	Chart plotter	1
3.8	Digital data acquisition systems	1
4.0	**Photoelasticity**	
4.1	Introduction to photoelasticity& Principles	1
4.2	Optics of photoelasticity	1
4.3	Plane Polariscope – Working principle	1
4.4	Circular Polariscope – Working principle	1
4.5	Isoclinics and isochromatics – Properties & importance	1
4.6	Methods of stress seperation	2
5.0	**Non Destructive Testing Methods**	
5.1	Introduction to NDT and its scope	1
5.2	Ultrasonic testing principles and application	1
5.3	Rebound hammer – Working Principle	1
5.4	Holography& its uses	1
5.5	Use of laser for structural testing	1
5.6	Advanced NDT methods- Ultrasonic pulse echo method	2
5.7	Impact echo method	1
5.8	Impulse radar techniques	1
5.9	GECOR	1
5.10	Ground penetrating radar (GPR).	1

Course Designer

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70 PSE E35	Matrix Method of Structural Analysis	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the basics in measurements, strain gauge types, and applications
- To understand various devices for vibration measurement
- To acquire knowledge in data acquisition systems
- To learn photo elasticity and its applications
- To perform nondestructive testing methods in structures

Pre-requisites

Fundamentals of Mathematics, knowledge of basic Science

Course Outcomes

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

CO1	Understand the concepts of energy theorems	Apply
CO2	Formulation of stiffness and flexibility matrix for various co-ordinates	Analyse
CO3	To solve the beam using stiffness and flexibility methods	Understand
CO4	To solve the frame using stiffness and flexibility methods	Analyse
CO5	To understand the concepts of solving the truss using stiffness and flexibility methods	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	
CO2	3	3	3	2	3	3
CO3	2	3	3	3	2	2
CO4	2	2	3	3	2	1
CO5	2	3	2	3	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E35-Matrix Method of Structural Analysis

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Concepts In Structural Analysis Structure-Loads-Response-Equilibrium of Force-Compatibility of Displacements-Force-Displacement relation-Levels of structural analysis-Energy methods-Energy concepts based on displacement and force field.	[9]
Matrix Concepts and Matrix Analysis of Structures Matrix-matrix operations-linear simultaneous equations-Eigen values and Eigen vectors-coordinate systems-transformation matrix-stiffness and flexibility matrix-Equivalent joint loads-stiffness and flexibility methods.	[9]
Matrix Analysis of Structures With Axial Elements Introduction-axial stiffness and flexibility matrix-analysis by conventional stiffness method for axial element (2 DOF)-analysis by flexibility method. Analysis by conventional stiffness method for plane truss element (4 DOF) - analysis by flexibility method.	[9]
Matrix Analysis of Beams Conventional stiffness method for beams-beams element stiffness (4 DOF)-generation of stiffness matrix for continuous beams-Flexibility method for continuous beams-force transformation matrix-element flexibility matrix-analysis procedure.	[9]
Matrix Analysis of Plane Frames Conventional stiffness method for plane frame-element stiffness matrix(6DOF)-generation of structural stiffness matrix and analysis procedure-flexibility method for plane frames-force transformation matrix-element flexibility matrix and analysis procedure.	[9]
Total Hours	45

Text Book(s):

1.	Devados Menon, “Advanced Structural Analysis”, Narosa Publishing House,New Delhi,2010.
2.	Vaidyanadhan.R and Perumal.P, “Comprehensive structural Analysis – Vol.1 & Vol2”, Laxmi Publications, New Delhi, 2016.

Reference(s):

1.	Madhujit Mukhopadhyay,Abdul Hamid Sheikh,”Matrix and Finite Element Analyses of Structures”, .Ane books India,2009.
2.	Rajesekaran S. and Sankara Subramanian G. “Computational Structural Mechanics”, Prentice Hall of India Pvt Ltd, New Delhi, 2011.
3.	Manickaselvam M.K.,” Elements of Matrix And Stability Analysis of Structures”, Khanna Publishers, New Delhi,2004.
4.	T.S.Thandavamoorthy “Structural Analysis” Oxford University Press, New Delhi, 2011.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Concepts In Structural Analysis**	
1.1	Introduction – Forces and Displacement Measurements	1
1.2	Equilibrium of Force	1
1.3	Compatibility of Displacements	1
1.4	Types of Structures, load and response	1
1.5	Force- Displacement relation	1
1.6	Levels of structural analysis	1
1.7	Energy methods	1
1.8	Energy concepts based on displacement field	1
1.9	Energy concepts based on force field	1
2.0	**Matrix Concepts and Matrix Analysis of Structures**	
2.1	Matrix Operations	1
2.2	Linear Simultaneous Equations	1
2.3	Eigen values	1
2.4	Eigen vectors	1
2.5	Coordinate Systems	1
2.6	Transformation Matrix	1
2.7	Stiffness And Flexibility Matrix	1
2.8	Equivalent joint loads	1
2.9	Stiffness And Flexibility Methods simple problems	1
3.0	**Matrix Analysis of Structures With Axial Elements**	
3.1	Introduction on axial elements	1
3.2	Axial Stiffness and Flexibility Matrix	1
3.3	Analysis By Conventional Stiffness Method For Axial Element (2 DOF)	2
3.4	Analysis By Flexibility Method	2
3.5	Analysis by conventional stiffness method for plane truss element (4 DOF)	2
3.6	Analysis By Flexibility Method	1
4.0	**Matrix Analysis of Beams**	
4.1	Conventional stiffness method for beams	1
4.2	Beams element stiffness (4 DOF)	1
4.3	Generation of stiffness matrix for continuous beams	1
4.4	Flexibility method for continuous beams	1
4.5	Force Transformation Matrix	1
4.6	Element Flexibility Matrix	1
4.7	Analysis for the flexibility matrix	1
4.8	Problems in Flexibility matrix	1
5.0	**Matrix Analysis of Plane Frames**	
5.1	Conventional stiffness method for plane frame	1
5.2	Element stiffness matrix(6DOF)	1
5.3	Generation of structural stiffness matrix	1
5.4	Analysis Procedure for structural stiffness matrix	2
5.5	Flexibility method for plane frames	2
5.6	Force transformation matrix	1
5.7	Element flexibility matrix and analysis procedure	1

Course Designer

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TIRUCHENGODE - 637 215

70 PSE E36	Wind and Cyclone Effect on Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Understand wind characteristics, measurement methods, and dynamic effects.
- Analyze wind impact on rigid and flexible structures, including vortex shedding.
- Apply code provisions for designing wind-resistant structures.
- Examine cyclone effects on structures and cladding design.
- Explore wind tunnel testing, modeling, and data analysis.

Pre-requisites

Structural Analysis and Structural Design

Course Outcomes

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

CO1	Explain wind characteristics, measurement methods, and dynamic effects.	Analyse
CO2	Analyze wind effects on various structures, including tall buildings and chimneys	Analyse
CO3	Design some special structures subjected to wind loading	Apply
CO4	Design of structures for cyclone	Analyse
CO5	Utilize wind tunnel studies for structural analysis	Analyse

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	3		2	
CO2	3	3	3		2	
CO3	3	3	3		2	
CO4	3	3	3		2	
CO5	3	3	3		2	
3 - Strong; 2 - Medium; 1 – Some						

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022							
M.E. Structural Engineering							
70 PSE E36 - Wind and Cyclone Effect on Structures							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Wind Characteristics and Load Parameters Introduction, Types of wind – Characteristics of wind – Method of Measurement of wind velocity, variation of wind speed with height, shape factor, aspect ratio, drag and lift effects - Dynamic nature of wind –Pressure and suctions - Spectral studies, Gust factor	[9]
Effect of Wind on Structures * Classification of structures – Rigid and Flexible – Effect of wind on structures –Vortex shedding, translational vibration of structures - Static and dynamic effects on Tall buildings – Chimneys	[9]
Design of Special Structures* Design of Structures for wind loading – as per IS, ASCE and NBC code provisions – Design of Industrial Structures– Tall Buildings – Chimneys – Transmission towers and steel monopoles	[9]
Cyclone Effects * 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.	[9]
Wind Tunnel Studies * Wind Tunnel Studies, Types of wind tunnels, Types of wind tunnel models - Modelling requirements - Aero dynamic and Aero-elastic models, Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design	[9]
Total Hours:	45

Text Book(s):	
1.	Vinayagamurthy, G. and Parammasivam, K.M., “Recent Developments in Wind Engineering: Select Proceedings of NCWE 2024”, Springer, 2024.
2.	Holmes, J.D. and Bekele, S., “Wind Loading of Structures (4th Edition)”, Routledge, 2021.
Reference(s):	
1.	Simiu, E. and Yeo, D.H., “Wind Effects on Structures: Modern Structural Design for Wind”, Wiley, 2020.
2.	Solari, G., and Biondini, F., “Wind Engineering: A Handbook for Structural Engineers and Architects”, CRC Press, 2019.
3.	Kareem, A. and Kline, P., “Wind Engineering: A Guide to the Wind-Resistant Design of Buildings”, Wiley, 2018.
4.	Baker, C. and Allsopp, L., “Wind Load Calculations and Structural Design of Buildings”, Butterworth-Heinemann, 2017.

* *SDG 9: Industry, innovation and infrastructure*

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Wind Characteristics and Load Parameters**	
1.1	Introduction to Wind Engineering	1
1.2	Types of Wind (steady, gusty, cyclonic, tornadoes)	1
1.3	Characteristics of Wind: Speed, Direction, and Turbulence	1
1.4	Wind Velocity Measurement Techniques	1
1.5	Variation of Wind Speed with Height (Logarithmic/Power Law)	1
1.6	Shape Factor and Aspect Ratio	1
1.7	Drag and Lift Forces on Structures	1
1.8	Dynamic Nature of Wind: Pressure and Suction Effects	1
1.9	Spectral Studies and Gust Factor	1
2.0	**Effect of Wind on Structures**	
2.1	Classification of Structures: Rigid and Flexible	1
2.2	Effects of Wind on Different Types of Structures	1
2.3	Vortex Shedding and Aerodynamic Instability	1
2.4	Translational Vibration and Galloping of Structures	1
2.5	Static and Dynamic Wind Effects on Tall Buildings	1
2.6	Wind Effects on Chimneys and Slender Structures	1
2.7	Damping Effects and Wind-Induced Vibrations	1
2.8	Wind Tunnel Studies for Structure Response	1
2.9	Case Studies of Wind Effects on Various Structures	1
3.0	**Design of Special Structures**	
3.1	Design Principles for Wind-Resistant Structures	1
3.2	Estimation of Wind Loads as per IS 875, ASCE 7, and NBC	1
3.3	Design of Industrial Structures under Wind Loads	1
3.4	Wind Design Considerations for Tall Buildings	1
3.5	Wind Loading on Chimneys and Transmission Towers	1
3.6	Design of Steel Monopoles and Tall Structures	1
3.7	Advanced Computational Methods for Wind Load Estimation	1
3.8	Case Studies of Wind-Resistant Design	1
3.9	Use of Software in Wind Load Design	1
4.0	**Cyclone Effects**	
4.1	Cyclonic Wind Characteristics	1
4.2	Effects of Cyclones on Low-Rise Buildings and Sloped Roofs	1
4.3	Cyclone Effects on Tall Buildings	1
4.4	Impact of Wind-Borne Debris on Structures	1
4.5	Design of Cladding Systems for Cyclone Protection	1
4.6	IS Code Provisions for Cyclonic Design	1
4.7	Analytical Modeling for Cyclone Effects	2
4.8	Use of Simulation Tools for Cyclone Impact	1
5.0	**Wind Tunnel Studies**	
5.1	Importance of Wind Tunnel Testing	1
5.2	Types of Wind Tunnels: Subsonic, Supersonic, Boundary Layer	1
5.3	Types of Wind Tunnel Models: Rigid, Aeroelastic, Pressure	2
5.4	Aeroelastic Studies and Dynamic Response Prediction	1
5.5	Wind Tunnel Data Analysis and Load Combination Factors	2
5.6	Application of Wind Tunnel Studies in Design	2

Course Designer(s)

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70 PSE E41	CADD for Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To gain knowledge on Computer graphics and drafting software packages
- To Analyse the structure using computer methods
- To acquire knowledge on computer aided designing and detailing
- To know Project scheduling using CPM and PERT
- To learn theartificial intelligence systems

Pre-requisites

Courses –Structural Analysis, RCC and Steel Design

Course Outcomes

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

CO1	Choose software packages for 2D drafting	Apply
CO2	Perform structural analysis using software	Analyse
CO3	Design the structures with computer methodologies	Understand
CO4	Optimize the structural design with the help of software	Analyse
CO5	Apply artificial intelligence in construction industry	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	2	3	2
CO2	3	3	3	3	3	2
CO3	3	3	3	3	3	2
CO4	3	2	3	2	3	2
CO5	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E41- CADD for Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Computer Graphics Graphic primitives - Transformations - Basics of 2D drafting - Modeling of curves and surfaces – Solid modeling - Graphic standards - Drafting software packages and usage	[9]
Structural Analysis Computer methods of structural analysis - Finite Element programming – Analysis through application packages	[9]
Structural Design Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials	[9]
Optimization Linear programming - Simplex algorithm - Post-optimality analysis – Project scheduling - CPM and PERT applications Genetic algorithm and applications	[9]
Artificial Intelligence Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network.	[9]
Total Hours	45

Text Book(s):

1.	Unnikrishna Pillai S, Devdas Menon, “Reinforced Concrete Design”, McGraw-Hill Education, India, New Delhi, 2021
2.	Punmia B C and Jain,A.K, “Comprehensive Design of Steel Structures”, Laxmi Publications, 2017

Reference(s):

1.	Devdas Menon, Advanced Structural Analysis, Narosa publications, New Delhi, 2019
2.	Peter W, Christensen, Anders Klarbring “An Introduction to Structural Optimisation”, Springer 2009.
3.	Meghre A S and Kadam K M, Finite Element Method in Structural Analysis, Khanna Publishers, New Delhi, 2014
4.	KavehA, “Applications of Metaheuristic Optimization Algorithms in Civil Engineering”, Springer, 2017

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Computer Graphics**	
1.1	Introduction to computer graphics	1
1.2	Graphic primitives	1
1.3	Transformations	1
1.4	Basics of 2D drafting	1
1.5	Modeling of curves and surfaces	1
1.6	Solid modeling	1
1.7	Graphic standards	1
1.8	Drafting software packages and usage	2
2.0	**Structural Analysis**	
2.1	Fundamentals of Structural Analysis	1
2.2	Computer methods of structural analysis	1
2.3	Various software used for Analysis	2
2.4	FEM technique	1
2.5	Finite Element programming	2
2.6	Analysis through application packages	2
3.0	**Structural Design**	
3.1	Fundamentals of RCC and Steel design	1
3.2	Codal Provisions	1
3.3	Computer aided design of steel structures	2
3.4	Computer aided design of RCC structures	2
3.5	Reinforcement detailing	1
3.6	Structural Steel detailing	1
3.7	Bill of materials	1
4.0	**Optimization**	
4.1	Linear programming	2
4.2	Simplex algorithm	1
4.3	Post optimality analysis	1
4.4	Project scheduling	1
4.5	CPM technique	1
4.6	PERT technique	1
4.7	Genetic algorithm and applications	2
5.0	**Artificial Intelligence**	
5.1	Introduction to Artificial intelligence	1
5.2	Heuristic search	1
5.3	Knowledge based expert systems	2
5.4	Architecture and applications of KBES	2
5.5	Expert system shells	1
5.6	Principles of neural network	2

Course Designer

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70 PSE E42	Design of Industrial Structure	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Design of Steel Gantry Girders.
- Design of Steel Portal, Gable Frames.
- Design of Steel Bunkers and Silos.
- Design of Chimneys and Water Tanks.
- Design of Tubular Structures

Pre-requisites

Knowledge of portal frame analysis, structural steel design, foundation design

Course Outcomes

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

CO1	Explain the planning and functional requirements of Industrial Structures	Apply
CO2	Design the Pre – Engineered structures and foundations	Analyse
CO3	Demonstrate the structural aspects of machine foundation and containment structures.	Understand
CO4	Design the Turbo generator foundations & conveyor systems.	Analyse
CO5	Design of offshore structures with failure probability	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	1	2	3	2	3	2
CO2	3	2	3	2	3	2
CO3	1	2	3	2	3	2
CO4	3	2	3	2	3	2
CO5	2	2	3	2	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70PSE E42- Design of Industrial Structure

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	60	3	40	60	100

Steel Gantry Girders Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction	[9]
Portal Frames Design of portal frame with hinge base, design of portal frame with fixed base – Gable Structures – Lightweight Structures	[9]
Steel Bunkers and Silos Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners..	[9]
Chimneys Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.	[9]
Water Tanks Design of rectangular riveted steel water tank – Tee covers – Plates – Stays – Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts	[9]
Total Hours	45

Text Book(s):	
1.	Ram Chandra., "Design of Steel Structures", 13th Ed., Standard Publishers, 2011.
2.	Koncz, J, "Manual of Precast Construction Vol I & II" Bauverlay GMBH, 1971.
Reference(s):	
1.	Punmia B. C., Jain Ashok Kr., Jain Arun Kr., "Design of Steel Structure", Lakshmi Publishers, 2011.
2.	Subramaniyam, N. "Design of Steel Structures", (As per IS 800-2007), Oxford University press, 2014..
3.	Handbook on Functional Requirements of Industrial buildings, SP32 – 1986, Bureau of Indian Standards, New Delhi 1990
4.	Henn W., "Buildings for Industry, vols.I and II", London Hill Books, 1995.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Steel Gantry Girders**	
1.1	Introduction	1
1.2	Loads acting on gantry girder	1
1.3	Permissible stress	1
1.4	Types of gantry girders and crane rails	2
1.5	Crane data, maximum moments	2
1.6	Shears, construction	2
2.0	**Portal Frames**	
2.1	Design of portal frame with hinge base	1
2.2	Design of portal frame with fixed base	1
2.3	Gable Structures	1
2.4	Lightweight Structures	1
2.5	Suspended roof structures analysis	1
2.6	Suspended roof structure design	1
2.7	Design of Foundations for industrial structures	1
2.8	Types of power plants	1
2.9	Design philosophy of Turbo generator foundation	1
3.0	**Steel Bunkers and Silos**	
3.1	Design of square bunker	2
3.2	Jansen's and Airy's theories	2
3.3	IS Code provisions	1
3.4	Design of side plates	1
3.5	Stiffeners	1
3.6	Hooper	1
3.7	Longitudinal beams Design of cylindrical silo	1
4.0	**Chimneys**	
4.1	Introduction	2
4.2	Dimensions of steel stacks	2
4.3	Chimney lining, breech openings and access ladder	1
4.4	Loading and load combinations	1
4.5	Design considerations & stability consideration	1
4.6	Design of base plate	1
4.7	Design of foundation bolts, design of foundation.	1
5.0	**Water Tanks**	
5.1	Design of rectangular riveted steel water tank	2
5.2	Tee covers	1
5.3	Plates – Stays	1
5.4	Longitudinal and transverse beams	1
5.5	Design of staging	1
5.6	Base plates	1
5.7	Foundation and anchor bolts	1
5.8	Case Study	1

Course Designer

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70 PSE E43	Disaster Resistant Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To analyses the behavior of life line structures during disasters.
- To study about the safety analysis of community structures.
- To assess the procedure for damaged structures, along with ground improvement techniques.
- To gain the knowledge of detailing of Structures and Components
- To understand the concept of designing structures to withstand disaster.

Pre-requisites

Courses –Disaster Management

Course Outcomes

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

CO1	Apply the design philosophy for resisting natural calamities.	Apply
CO2	Evaluate the response of dams, bridges and identify strengthening techniques.	Analyse
CO3	Discuss the damage assessment and retrofitting.	Understand
CO4	Describe the use of modern analysis, design and detailing for life line structures.	Analyse
CO5	Evaluate the techniques of damage assessment.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	3	3	2
CO2	3	3	3	3	3	3
CO3	3	2	3	2	3	3
CO4	2	2	3	3	2	2
CO5	3	3	3	3	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E43- Disaster Resistant Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Behaviour of Life-Line Structures Philosophy for design to resist earthquake, cyclone and flood, tsunami, National and International codes of practice, By-Law of urban and semi-urban areas – Traditional and modern structures.	[9]
Community Structures Response of dams, bridges, buildings ,Strengthening measures , Safety analysis and rating – Reliability assessment	[9]
Rehabilitation and Retrofitting Testing and evaluation - Classification of structures for safety point of view – methods of strengthening for different disasters - qualification test – different techniques	[9]
Detailing of Structures and Components Use of modern materials and their impact on disaster reduction, Use of modern analysis, design and construction techniques optimization for performance.	[9]
Damage Assessment of Structures Damage surveys - Maintenance and modifications to improve hazard resistance - Different types of foundation and its impact on safety - Ground improvement techniques.	[9]
Total Hours	45

Text Book(s):

1.	D.J Dowrick, “Earthquake Resistant Designs”, Wiley Ed Second, 2009.
2.	R.T Allen and S.C Edwards, “Repair of Concrete Structures”, Blakie and Sons,1993.

Reference(s):

1.	R.N. Raiker, “Learning from failures - Deficiencies in Design, Construction and Service”, R & D Center (SDCPL) RaikerBhavan, Bombay, 1987.
2.	A. M. Nevile, “Properties of Concrete”, Pearson Ed Fifth, 2013.
3.	N. Subramanian, “Design of Reinforced Concrete Structures”, Oxford University Press Ed Second, 2014.
4.	CPWD “Handbook on Repairs and Rehabilitation of RCC Buildings”, 2002

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Behaviour of Life-Line Structures**	
1.1	Philosophy for design to resist earthquake.	1
1.2	Cyclone and flood, tsunami.	1
1.3	National and International codes of practice.	1
1.4	By-Law of urban.	2
1.5	Semi-urban areas.	2
1.6	Traditional and modern structures.	2
2.0	**Community Structures**	
2.1	Response of dams, bridges, buildings	1
2.2	Response of bridges.	1
2.3	Response of buildings.	1
2.4	Strengthening measures.	2
2.5	Safety analysis and rating.	2
2.6	Reliability assessment.	2
3.0	**Rehabilitation and Retrofitting**	
3.1	Testing and evaluation	1
3.2	Classification of structures for safety point of view	2
3.3	Methods of strengthening for different disasters	2
3.4	Qualification test	2
3.5	Different techniques	2
4.0	**Detailing of Structures and Components**	
4.1	Use of modern materials	2
4.2	Modern materials impact on disaster reduction	2
4.3	Use of modern analysis	1
4.4	Design techniques optimization for performance	2
4.5	Construction techniques optimization for performance	2
5.0	**Damage Assessment of Structures**	
5.1	Damage surveys	1
5.2	Maintenance to improve hazard resistance	1
5.3	Modifications to improve hazard resistance	1
5.4	Different types of foundation	2
5.5	Different types of foundation impact on safety	2
5.6	Ground improvement techniques.	2

Course Designer

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70 PSE E44	Industrial Steel Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn guidelines for industrial structures
- To acquire knowledge in design of roof and gantry girders
- To learn the design of special structures in industries
- To perform the design of tower structures
- To learn the behavior and design of pre engineering buildings

Pre-requisites

Courses –Strength of Materials, Design of Steel Structures

Course Outcomes

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

CO1	Classify the different types of industrial structures based on planning and functional requirements.	Apply
CO2	Assess the general behavior of steel shell roofs and design of gantry girders and gantry columns.	Analyse
CO3	Evaluate the various forces acting on Bunkers, silos, chimney's, cooling towers steel storage tanks and design them.	Understand
CO4	Calculate the different types of forces acting on towers and design the tower foundations.	Analyse
CO5	Analysis and design of pre-engineered structures	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	3	3	2
CO2	3	3	3	3	3	3
CO3	3	2	3	2	3	3
CO4	3	2	3	3	2	2
CO5	3	3	3	3	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E44- Industrial Steel Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Planning and Functional Requirements Classification of Industries and Industrial structures –planning for lay out Requirements regarding Lighting, Ventilation and Fire safety- Protection against noise and vibration- guide lines from factories Act.	[9]
Industrial Building Roofs for Industrial Buildings- Steel shell roofs- Gantry Girders- Design of gantry columns	[9]
Industrial Appurtenances Bunkers and Silos - Chimney and cooling Towers – Design of steel storage tanks	[9]
Design of Lattice Towers Micro wave towers - Transmission Line Towers – pipe track structures- Tower Foundations – Testing towers.	[9]
Design of Pre Engineered Structures Introduction-section specification-Types of assemblies –analysis and design of pre engineered structure- connection details	[9]
Total Hours	45

Text Book(s):

1.	Santhakumar A.R., and Murthy S.S.,"Transmission Line structures", Tata Mc Graw- Hill, 1992.
2.	Subramaniam.N., "Design of Steel Structures ",(As per IS 800-2007)", Oxford university press, 2014.

Reference(s):

1.	Shiyekar M.R., "Limit State Design in Structural Steel", PHI Learning Private Limited, New Delhi, 2013..
2.	Rajagopalan K., "Storage Structures", Oxford IBH Publishing Company Ltd, 1989.
3.	IS 800 – 2007, "Code of Practice for General Construction in steel", BIS, New Delhi.
4.	Teaching Resources for Structural Steel Design, INSDAG, Kolkata, 2010.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Planning and Functional Requirements**	
1.1	Classification of Industries	1
1.2	Classification of Industrial structures	1
1.3	Planning for lay out Requirements regarding Lighting	2
1.4	Ventilation	1
1.5	Fire safety	1
1.6	Protection against noise and vibration	1
1.7	Guide lines from factories Act.	2
2.0	**Industrial Building**	
2.1	Roofs for Industrial Buildings	2
2.2	Steel shell roofs	2
2.3	Gantry Girders	2
2.4	Design of gantry columns	3
3.0	**Industrial Appurtenances**	
3.1	Bunkers	1
3.2	Silos	1
3.3	Chimney	2
3.4	Cooling Towers	2
3.5	Design of steel storage tanks	3
4.0	**Design of Lattice Towers**	
4.1	Micro wave towers	1
4.2	Transmission Line Towers	1
4.3	Pipe track structures	2
4.4	Tower Foundations	2
4.5	Testing towers	3
5.0	**Design of Pre Engineered Structures**	
5.1	Introduction-section specification	1
5.2	Types of assemblies	1
5.3	Analysis of pre-engineered structure	2
5.4	Design of pre-engineered structure	3
5.5	Connection details	2

Course Designer

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70 PSE E45	Corrosion Engineering	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To rationalize the periodic properties such as corrosive environments
- To recall the basics of Electrochemical and Polarization
- To endow with an overview of Corrosive concentration
- To enable the students with various concepts like corrosion testing
- To implement the principles of corrosion prevention

Pre-requisites

Courses –Strength of Materials, Design of Steel Structures, Concrete Technology

Course Outcomes

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

CO1	Define the basic concepts on corrosion.	Apply
CO2	Discuss the testing and evaluation of forms of corrosion	Analyse
CO3	Describes the different types of corrosive environments.	Understand
CO4	Illustrate the concepts of corrosion testing.	Analyse
CO5	Apply the corrosion prevention.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	3	3	2	2
CO2	3	3	3	3	2	3
CO3	3	2	3	2	3	2
CO4	2	2	2	3	2	2
CO5	3	3	3	3	3	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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M.E - Structural Engineering

70 PSE E45- Corrosion Engineering

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Introduction Cost of Corrosion – Corrosion Engineering – Definition of Corrosion – Environments – Corrosion Damage – Classification of Corrosion. Corrosion Principles : Introduction – Corrosion Rate Expressions. Electrochemical Aspects : Electrochemical Reactions – Polarisation – passivity, Environmental Effects: Effect of oxygen and oxidizers – Effect of Velocity – Effect of temperature – Effects of Corrosive concentration – Effect of Galvanic Coupling – Metallurgical Aspects.	[9]
Forms of Corrosion Galvanic Corrosion : EMF and Galvanic Series – Environmental Effects – Distance Effect – Area Effect – Prevention. Crevice Corrosion: Environmental Factors – Mechanism – Combating Crevice Corrosion – Filiform Corrosion. Pitting – Solution composition – Velocity – Metallurgical Variables – Evaluation & Prevention of pitting damage. Intergranularcorrosion .Austentic Stainless Steels – Weld Decay – Knife Line Attack. Selective Leaching: Dezincification Characteristics, Mechanism, prevention – Graphitization – Other Alloy systems. Erosion Corrosion: Surface Films – Velocity – Turbulence – Impingement - Galvanic Effect – Combating Erosion corrosion. Stress corrosion: crack morphology – Stress effects – time to cracking – Environmental & Metallurgical factors – Mechanism – methods of prevention – corrosion Factors – Hydrogen Blistering – Hydrogen Embrittlement – Prevention.	[9]
Corrosive Environments Mineral Acids: Sulfuric Acid – Nitric Acid – Hydrochloric Acid – Hydrofluoric Acid – Phosphoric Acid. Organic Acids – Alkalies – Atmosphere Corrosion – Sea water – Fresh water – High purity water – soils – Aerospace – Biological corrosion – Human body – Corrosion of metals by halogens – Liquid metals and fused salts – sewage and plant – waste treatment – Dew point corrosion – liquid metal embrittlement of cracking – Hydrogen peroxide – Rebar corrosion.	[9]
Corrosion Testing Introduction – Classification – Purpose – Materials and specimens – surface preparation – Measuring & Weighing – Exposure Techniques – Duration – Planned Interval Tests Aeration – Cleaning specimens after exposure – temperature – Standard expressions for corrosion rate – Galvanic corrosion high temperature and pressure – Erosion – Intergranular corrosion – pitting & stress corrosion – NACE Test methods – Linear polarization – paint Tests – Sea water tests – Miscellaneous tests of metals.	[9]
Corrosion Prevention Materials Selection: Metals & Alloys – Metal purification. Alteration of Environment: changing mediums – Inhibitors. Design: Wall Thickness – Design Rules. Cathodic& Anodic protection – comparison. Coatings: Metallic & other Inorganic coatings – Organic coatings – corrosion control standards – Failure Analysis.	[9]
Total Hours	45

Text Book(s):

1.	Mars G. Fontana, Corrosion Engineering Third Edition Mc. Graw – Hill Book Company, New York 1988.
2.	Raoul Francois, “Corrosion and its Consequences for Reinforced Concrete Structures”, ISTE Press – Elsevier, 2018

Reference(s):

1.	J. H. Brophy, R. M.Rose, “The structure and Properties of Materials,” Wiley Inter-science Inc., New York, 1994
2.	Amir Poursaee, “Corrosion of Steel in Concrete Structures”, Woodhead Publishing, 2016
3.	Pierre R. Roberge, “Handbook of Corrosion Engineering”, McGraw-Hill Education, 2012.
4.	M. D. Allen,“Corrosion in Civil Engineering, The Institution of Civil Engineers, 2015.

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Approved in Academic Council Meeting held on 19.07.2025

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Planning and Functional Requirements**	
1.1	Cost of Corrosion	1
1.2	Corrosion Engineering	1
1.3	Definition of Corrosion – Environments	1
1.4	Corrosion Damage – Classification of Corrosion.	1
1.5	Corrosion Principles.	1
1.6	Introduction – Corrosion Rate Expressions.	1
1.7	Electrochemical Aspects: Electrochemical Reactions – Polarisation – passivity.	1
1.8	Environmental Effects: Effect of oxygen and oxidizers – Effect of Velocity – Effect of temperature	1
1.9	Effects of Corrosive concentration – Effect of Galvanic Coupling – Metallurgical Aspects	1
2.0	**FORMS OF CORROSION**	
2.1	Galvanic Corrosion : EMF and Galvanic Series – Environmental Effects – Distance Effect – Area Effect	1
2.2	Prevention. Crevice Corrosion: Environmental Factors – Mechanism – Combating Crevice Corrosion	1
2.3	Filiform Corrosion. Pitting – Solution composition – Velocity – Metallurgical Variables	1
2.4	Evaluation & Prevention of pitting damage. Intergranularcorrosion .Austentic Stainless Steels – Weld Decay – Knife Line Attack.	1
2.5	Selective Leaching: Dezincification Characteristics, Mechanism, prevention – Graphitization – Other Alloy systems.	1
2.6	Erosion Corrosion: Surface Films – Velocity – Turbulence – Impingement - Galvanic Effect	1
2.7	Combating Erosion corrosion. Stress corrosion: crack morphology	1
2.8	Stress effects – time to cracking – Environmental & Metallurgical factors	1
2.9	Mechanism – methods of prevention – corrosion Factors – Hydrogen Blistering – Hydrogen Embrittlement – Prevention.	1
3.0	**CORROSIVE ENVIRONMENTS**	
3.1	Mineral Acids: Sulfuric Acid – Nitric Acid	1
3.2	Hydrochloric Acid – Hydrofluoric Acid	1
3.3	Phosphoric Acid. Organic Acids – Alkalies	1
3.4	Atmosphere Corrosion – Sea water – Fresh water	1
3.5	High purity water – soils – Aerospace	1
3.6	Biological corrosion – Human body – Corrosion of metals by halogens	1
3.7	Liquid metals and fused salts – sewage and plant – waste treatment	1
3.8	Dew point corrosion – liquid metal embrittlement of cracking	1
3.9	Hydrogen peroxide – Rebar corrosion	1
4.0	**CORROSION TESTING**	
4.1	Introduction – Classification – Purpose – Materials and specimens	1
4.2	surface preparation – Measuring & Weighing – Exposure Techniques	1
4.3	Duration – Planned Interval Tests Aeration	1
4.4	Cleaning specimens after exposure	1
4.5	temperature – Standard expressions for corrosion rate	1
4.6	Galvanic corrosion high temperature and pressure – Erosion	1
4.7	Intergranular corrosion pitting & stress corrosion	1
4.8	NACE Test methods – Linear polarization	1
4.9	Paint Tests – Sea water tests – Miscellaneous tests of metals.	1
5.0	**CORROSION PREVENTION**	
5.1	Materials Selection: Metals & Alloys	1

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5.2	Metal purification.	1
5.3	Alteration of Environment: changing mediums – Inhibitors	1
5.4	Design: Wall Thickness	1
5.5	Design Rules	1
5.6	Cathodic& Anodic protection – comparison	1
5.7	Coatings: Metallic & other Inorganic coatings	1
5.8	corrosion control standards	1
5.9	Failure Analysis.	1

Course Designer

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70 PSE E46	Reliability Analysis of Structures	Category	L	T	P	Credit
		PC	3	0	0	0

Objectives

- To understand probability concepts in structural reliability
- To learn reliability measures and performance functions
- To explore FOSM and Monte Carlo simulation methods
- To analyze system reliability in different configurations
- To Apply statistical methods for reliability assessment

Pre-requisites

Basic knowledge of Physics

Course Outcomes

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

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

Mapping with Programme Outcomes

COs	POs					
	1	2	3	4	5	6
CO1	3	2	3	-	-	-
CO2	2	1	-	-	-	-
CO3	3	2	2	-	-	-
CO4	2	-	1	-	-	-
CO5	2	2	1	-	-	-

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)
	1	2	
Remember	30	10	30
Understand	30	10	20
Apply		20	30
Analyse		20	20
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

B.E. Civil Engineering

70 PSE E46 - Reliability Analysis of Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Data Analysis* Graphical representation Histogram, frequency polygon, Measures of central tendency- grouped and ungrouped data, measures of dispersion, measures of asymmetry. Curve fitting and Correlation: Fitting a straight line, curve of the form $y = ab^x$, and parabola, Coefficient of correlation	[9]
Probability Concepts* Random events-Sample space and events, Venn diagram and event space, Measures of probability interpretation, probability axioms, addition rule, multiplication rule, conditional probability, probability tree diagram, statistical independence, total probability theorem and Baye's theorem	[9]
Random Variables* Probability mass function, probability density function, Mathematical expectation, Chebyshev's theorem. Probability distributions: Discrete distributions- Binomial and poison distributions, Continuous distributions, Normal, Log normal distributions	[9]
Reliability Analysis* Measures of reliability-factor of safety, safety margin, reliability index, performance function and limiting state. Reliability Methods-First Order Second Moment Method (FOSM), Point Estimate Method (PEM), and Advanced First Order Second Moment Method (Hasofer-Lind's method).	[9]
System Reliability* Influence of correlation coefficient, redundant and non-redundant systems series, parallel and combined systems, Uncertainty in reliability assessments- Confidence limits, Bayesian revision of reliability. Simulation Techniques: Monte Carlo simulation- Statistical experiments, sample size and accuracy, Generation of random numbers, random numbers with standard uniform distribution, continuous random variables, discrete random variables	[9]
Total Hours:45	**45**
Text Book(s):	

1.	A Papoulis, Probability, Random Variables and Stochastic Processes, McGraw-Hill, New York, 2017.
2.	R E Melchers, Structural Reliability Analysis and Prediction, Third Edition, John Wiley & Sons Ltd, Chichester, England,2018.
Reference(s):	
1.	Srinivasan Chandrasekaran, Offshore Structural Engineering: Reliability and Risk Assessment, CRC Press, Florida, 2016.
2.	Jack R Benjamin, C. Allin Cornell, Probability, Statistics, and Decision for Civil Engineers, Dover Publications, New York, 2014.
3.	Nowak, A.S., & Collins, K.R. – *Reliability of Structures*, CRC Press, 2nd Edition, 2012.
4.	Ang, A.H.S., & Tang, W.H. – *Probability Concepts in Engineering: Emphasis on Applications to Civil and Environmental Engineering*, Wiley, 2nd Edition, 2006.

* *SDG 9: Industry, innovation and infrastructure*

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Data Analysis**	
1.1	Basics of structural reliability and importance	1
1.2	Probability concepts in reliability analysis	1
1.3	Random variables and probability distributions	1
1.4	Mathematical expectation and Chebyshev's theorem	1
1.5	Safety margin and reliability index	1
1.6	Factor of safety and performance functions	1
1.7	First Order Second Moment (FOSM) method	1
1.8	Advanced First Order Second Moment (AFOSM) method	1
1.9	Probability applications in reliability	1
2.0	**Probability Concepts**	
2.1	Probability and Statistical Methods in Reliability	1
2.2	Bayes' theorem and its application in reliability	1
2.3	Conditional probability and statistical independence	1
2.4	Total probability theorem and probability tree diagrams	1
2.5	Discrete probability distributions: Binomial and Poisson	1
2.6	Continuous probability distributions: Normal and Log-normal	1
2.7	Probability density functions and cumulative distributions	1
2.8	Statistical sampling methods and confidence limits	1
2.9	Regression and correlation in reliability studies	1
2.10	Statistical applications in reliability	2
3.0	**Random Variables**	
3.1	Measures of reliability and reliability assessment	1
3.2	Reliability-based design principles	1
3.3	Load and resistance factor design (LRFD) concepts	1
3.4	Monte Carlo simulation for structural reliability	1
3.5	Point Estimate Method (PEM) in reliability	1
3.6	Failure modes and limit state functions	1
3.7	Hasofer-Lind's reliability index	1
3.8	Importance sampling techniques in reliability studies	1
3.9	Mass moment of inertia of thin rectangular section.	1
3.10	Reliability performance evaluation	2
4.0	**Reliability Analysis**	
4.1	Concept of system reliability	1
4.2	Series, parallel, and combined system reliability	1
4.3	Influence of correlation coefficients on system reliability	1
4.4	Redundant and non-redundant systems	1
4.5	Bayesian approach in reliability assessment	1
4.6	Reliability assessment of bridges and high-rise structures	1
4.7	Application of reliability analysis in seismic design	1
5.0	**System Reliability**	
5.1	Basics of simulation techniques in reliability	1
5.2	Monte Carlo simulation: Concepts and methodology	1
5.3	Sample size and accuracy in simulations	1
5.4	Generation of random numbers for simulations	1
5.5	Random number distributions: Uniform and Normal	1
5.6	Application of simulation in structural failure prediction	1
5.7	Uncertainty modeling in structural design	1

Course Designer(s)

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70 PSE E51	Advanced Prestressed Concrete	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Understand the principles and general mechanical behavior of prestressed concrete
- To Analyse the transfer of prestress and time dependent factors like losses of prestress
- Design of prestressed concrete flexural members
- Design of tension and compression members in prestressed concrete.
- Analyse and design of composite members and special structural elements like water tank, poles, pipes.

Pre-requisites

Fundamentals of Mathematics, knowledge in mechanics.

Course Outcomes

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

CO1	Evaluate the internal forces and deflection in prestressed concrete.	Apply
CO2	Design the pre-stressing layout and understand the behavior of pre-stressed concrete elements under practical loading conditions	Analyse
CO3	Practice the Analysis and design of continuous beams and extend the knowledge on concept of linear transformation.	Understand
CO4	Outline the design of tension and compression members in prestressing.	Analyse
CO5	Illustrates the design of composite members and partial prestressing.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	1	1	3	2	3
CO2	2	1	2	3	2	3
CO3	3	2	2	2	1	3
CO4	2	2	1	2	3	3
CO5	1	2	1	1	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E51- Advanced Prestressed Concrete

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Principles of Prestressing Principles of Prestressing - types and systems of prestressing, need for High Strength materials, Analysis methods losses, deflection (short-long term), camber, cable layouts.	[9]
Design of Flexural Members Behaviour of flexural members, determination of ultimate flexural strength – Codal provisions -Design of flexural members, Design for shear, bond and torsion. Design of end blocks.	[9]
Design of Continuous Beams Analysis and design of continuous beams - Methods of achieving continuity – concept of linear transformations, concordant cable profile and gap cables	[9]
Design of Tension and Compression Members Design of tension members - application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - its application in the design piles, flagmasts and similar structures.	[9]
Design of Composite Members Composite beams - analysis and design, ultimate strength - their applications. Partial prestressing - its advantages and applications	[9]
Total Hours	45
Text Book(s):	

1.	N.Krishna Raju, “Prestressed Concrete”, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2018.
2.	Lin, T.Y & Burns, “Design of Prestressed Concrete Structures” John Wiley & Sons, 1982.
Reference(s):	
1.	Devadas Menon & A.K Sengupta, “Prestressed Concrete Structure (Web Course)”, NPTEL Course Notes, 2008.
2.	Krishna Raju.N, “Problems & Solutions – Prestressed Concrete”, CBS Publishers & Distributors., New Delhi, 2015.
3.	Rajagopalan.N “Prestressed Concrete”, Narosa Publishing House, 2005.
4.	IS: IS 1343: 2012, “Prestressed Concrete - Code of Practice” Second Revision

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Principles of Prestressing**	
1.1	Principles of Prestressing	2
1.2	Types and systems of prestressing	2
1.3	Analysis methods losses	2
1.4	Deflection (short-long term)	2
1.5	Cable layouts	1
2.0	**Design of Flexural Members**	
2.1	Behaviour of flexural members	1
2.2	Determination Of Ultimate Flexural Strength	1
2.3	Codal provisions	1
2.4	Design of flexural members	2
2.5	Design for shear,	1
2.6	Design for bond	1
2.7	Design for torsion	1
2.8	Design of end blocks	1
3.0	**Design of Continuous Beams**	
3.1	Analysis of continuous beams	2
3.2	Design of continuous beams	2
3.3	Methods of achieving continuity	2
3.4	Concept of linear transformations	1
3.5	Concordant cable profile and gap cables	2
4.0	**Design of Tension and Compression Members**	
4.1	Design of tension members	1
4.2	Application in the design of prestressed pipes	1
4.3	Prestressed concrete cylindrical water tanks	1
4.4	Design of compression members with flexure	2
4.5	Design of compression members without flexure	2
4.6	Application in the design piles, flagmasts and similar structures	2
5.0	**Design of Composite Members**	
5.1	Composite beams- Introduction	1
5.2	Analysis and design of Composite beams	2
5.3	Ultimate strength of Composite beams	2
5.4	Partial prestressing	2
5.5	Advantages and Applications of Partial prestressing	2

Course Designer

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70 PSE E52	Advanced Concrete Technology	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To understand the knowledge of properties of durability of concrete.
- To conduct various tests on properties of special concretes.
- To gain knowledge about formwork and quality control.
- To gain knowledge about the properties of concreting under special circumstances.
- To understand the Mix design using IS method.

Pre-requisites

Basic knowledge of properties of concrete making materials.

Course Outcomes

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

CO1	Discuss about the methods of concrete mix design	Apply
CO2	Describe the special concretes	Analyse
CO3	Outline the durability of concrete.	Understand
CO4	Identify the concepts form work and quality control	Analyse
CO5	Illustrate the behavior of concreting under special circumstances.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	2	2	2	2
CO2	3	3	2	2	2	2
CO3	3	3	-	-	2	1
CO4	2	2	-	3	3	1
CO5	3	2	2	3	3	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E52- Advanced Concrete Technology

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Introduction Concrete: Past, Present and Future- Constituent Materials --Strength of Concrete-Dimensional Stability of Concrete - Chemical and Mineral Admixtures-Properties of Fresh and hardened Concrete - Principles of Concrete Mix Design-Methods of Concrete mix design.	[9]
Special Concretes Lightweight and Heavy Weight Concrete-High Strength Concrete-High Performance Concrete-Polymers in Concrete-Steel fiber Reinforced Concrete-Ferrocement Concrete-Vaccum Concrete-Ready Mixed Concrete-SIFCON – SIMCON.	[9]
Durability of Concrete Permeability-chemical attack-sulphate attack-Quality of water - marine conditions-Thermal properties of concrete-fire resistance-methods of making durable concrete - Mass Concrete-Formwork-Structural Concrete Block Masonry -Quality Control of Concrete Construction.	[9]
Formwork and Quality Control Formwork Materials and Systems-Specifications-Design-Recommendations of IS 456-2000 on Quality -Errors in Concrete Constructions-Quality Management.	[9]
Concreting Under Special Circumstances Underground Construction-Concreting in Marine Environment-Under water Construction-Hot weather and Cold weather concreting. Tests on Concrete: Evaluation of Strength of existing structures-investigation Techniques-Tests on Hardened Concrete-Non Destructive Testing-Semi destructive testing techniques-Tests on fresh Concrete.	[9]
Total Hours	45

Text Book(s):

1. Shetty M.S., Concrete Technology, S.Chand and Company Ltd, New Delhi, 2011.
2. Santha Kumar A.R., Concrete Technology, Oxford Higher Education, New Delhi, 2018.

Reference(s):

1. Neville, A.M., Properties of Concrete, Pitman Publishing Limited, London, 2010
2. Gambir,M.L. “Concrete Technology”, Tata McGraw Hill, Publishing Co,Ltd,NewDelhi,2011.
3. Krishnaraju.N, “Design of Concrete mixes”, Sehgal Educational Consultants Pvt.Ltd., Faridabad, 2010.
4. Kumar. Neeraj Jha, “Formwork for Concrete Structures”, McGraw Hill Education, 2017.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Introduction about concrete and concrete making materials	1
1.2	Concrete - Past, Present and Future	1
1.3	Constituent Materials - Concrete	1
1.4	Strength of Concrete	1
1.5	Dimensional Stability of Concrete	1
1.6	Chemical and Mineral Admixtures	1
1.7	Properties of Fresh and hardened Concrete	1
1.8	Principles of Concrete Mix Design	1
1.9	Methods of Concrete mix design.	1
2.0	**Special Concretes**	
2.1	Lightweight and Heavy Weight Concrete	1
2.2	High Strength Concrete	1
2.3	High Performance Concrete	1
2.4	Polymers in Concrete	1
2.5	Steel fiber Reinforced Concrete	1
2.6	Ferro cement Concrete	1
2.7	Vacuum Concrete	1
2.8	Ready Mixed Concrete	1
2.9	SIFCON – SIMCON	1
3.0	**Durability of Concrete**	
3.1	Permeability & chemical attack	1
3.2	sulphate attack & Quality of water	2
3.3	marine conditions	1
3.4	Thermal properties of concrete - fire resistance	2
3.5	methods of making durable concrete	1
3.6	Mass Concrete	1
3.7	Formwork for concrete	1
3.8	Structural Concrete & Block Masonry	
3.9	Quality Control of Concrete Construction.	
4.0	**Formwork and Quality Control**	
4.1	Formwork Materials and Systems	1
4.2	Specifications	2
4.3	Design	2
4.4	Recommendations of IS 456- 2000 on Quality	1
4.5	Recommendations of IS 456- 2000 on Quality	1
4.6	Errors in Concrete Constructions	1
4.7	Quality Management.	1
5.0	**Concreting Under Special Circumstances**	
5.1	Underground Construction	1
5.2	Concreting in Marine Environment	1
5.3	Under water Construction	1
5.4	Hot weather and Cold weather concreting	1
5.5	Tests on Concrete: Evaluation of Strength of existing structures-investigation Techniques	2
5.6	Tests on Hardened Concrete-Non Destructive Testing	1
5.7	Semi destructive testing techniques	1
5.8	Tests on fresh Concrete	1

Course Designer

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70 PSE E53	Earthquake resistant design of Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To learn the fundamentals of seismology and basic earthquake mechanisms, tectonics types of ground motion, and propagation of ground motion.
- Determine the maximum dynamic response of an elastic vibrating structure to a given forcing function
- Learn the fundamentals of building code based structural design
- Determine the static design base shear based on the type of structural system, irregularity, location and occupancy
- Recognize special conditions such as irregular buildings, building separation, P-delta

Pre-requisites

Fundamentals of Mathematics, knowledge of basic Science

Course Outcomes

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

CO1	Identify the causes and effects of earthquake and describe the terms related to earthquake.	Apply
CO2	Define the basic concepts of elements of vibration and behavior of structures under cyclic loading.	Analyse
CO3	Practice the codal provisions for design and detailing of earthquake resistant structures.	Understand
CO4	Formulate the design principles for Non-engineered buildings and design provisions for bridges and dams.	Analyse
CO5	Categorize the new concepts on different types of base isolation techniques.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	-
CO2	3	3	3	2	3	3
CO3	2	3	3	3	2	2
CO4	2	2	3	3	2	1
CO5	2	3	2	3	2	2
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

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Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PSE E53 - Earthquake resistant design of Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Elements of Seismology Elements of Engineering Seismology, Characteristics of Earthquakes, History, Seismic Susceptibility of Indian Subcontinent, Performance of structures during past earthquakes, Lessons learnt from past earthquakes.	[9]
Theory of Vibrations Theory of vibrations ,Building Systems , Rigid Frames, Braced Frames, Shear Walls, Behavior of RC, Steel and Prestressed concrete elements under cyclic loading ,Soil liquefaction and prevention methods	[9]
Codal Provisions for Design & Detailing Concept of Earthquake Resistant Design, Response Spectrum ,Design Spectrum Provisions of Seismic Code IS 1893 (Part I) – 2002 ,Structural Configuration , 3 D computer analysis of building (Theory) ,Design and Detailing of Frames, Shear Walls and Framed Walls ,Provisions of IS-13920.	[9]
Non Engineered Buildings Design of Non Engineered construction, strengthening of buildings, Design Provisions for Bridges and Dams	[9]
Base Isolation Techniques Modern Concepts –Base Isolation, Adoptive systems and Case studies.	[9]
Total Hours	45

Text Book(s):

1.	Dr.Vinod," Earthquake-resistant design of building structures", Rajkamal Press,Delhi.First edition-2013,
2.	Shashikant K.Duggal, Earthquake resistant design of structures", Oxford Higher Education India 2013,.

Reference(s):

1.	Anil K Chopra, "Dynamics of structures – Theory and applications to Earthquake Engineering", Prentice Hall Inc., 2001.
2.	Minoru Wakabayashi, "Design of Earthquake Resistant Buildings", McGraw –Hill Book Company, Newyork, 1986
3.	Clough R.W. and Penzien J., 'Dynamics of Structures', McGraw-Hill, 2nd edition,1992
4.	Pankaj Agarwal & Manish Shrikhande, "Earthquake Resistant Design of Structures", PHI Learning Pvt Ltd, New Delhi, 2008.

R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Elements of Seismology**	
1.1	Elements of Engineering Seismology	1
1.2	Characteristics of Earthquakes	1
1.3	Seismic Susceptibility of Indian Subcontinent	1
1.4	Performance of structures during past earthquakes	2
1.5	Lessons learnt from past earthquakes	1
2.0	**Theory of Vibrations**	
2.1	Theory of vibrations	1
2.2	Building Systems	1
2.3	Rigid Frames and Braced Frames	2
2.4	Behavior of RC under cyclic loading	1
2.5	Behavior of Steel elements under cyclic loading	1
2.6	Behavior of Prestressed concrete elements under cyclic loading	1
2.7	Soil liquefaction and prevention methods	2
3.0	**Codal Provisions for Design & Detailing**	
3.1	Concept of Earthquake Resistant Design	1
3.2	Response Spectrum	1
3.3	Design Spectrum	1
3.4	Provisions of Seismic Code IS 1893 (Part I) – 2002	1
3.5	3 D computer analysis of building (Theory)	2
3.6	Design and Detailing of Frames	1
3.7	Shear Walls and Framed Walls	1
3.8	Provisions of IS-13920	1
4.0	**Non Engineered Buildings**	
4.1	Design of Non Engineered construction	2
4.2	Strengthening of buildings	1
4.3	Design Provisions for Bridges	3
4.4	Design Provisions for Dams	3
5.0	**Base Isolation Techniques**	
5.1	Modern Concepts	1
5.2	Base Isolation	3
5.3	Adoptive systems	3
5.4	Case studies	2

Course Designer

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R2/ w.e.f. 01.08.2025
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Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E54	Maintenance and Rehabilitation of Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- To study the quality assurance for concrete construction, causes of deterioration of concrete structures.
- To study the different types of techniques for repair and rehabilitation of structure.
- To design and suggest repair strategies for deteriorated concrete structures including repairing with composites.
- To understand the strength and durability properties, their effects due to climate and temperature.
- To understand the mechanism of deterioration of concrete, damage assessment, repair materials

Pre-requisites

Fundamentals of Mathematics, knowledge of properties of construction materials and itsmechanics and concrete technology.

Course Outcomes

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

CO1	Learn the properties related to mechanics of deterioration of concrete.	Apply
CO2	Evaluate the basic concepts of the corrosion.	Analyse
CO3	Point out various types of techniques to repair crack, wear, fire and leakage.	Understand
CO4	Study the various types and properties of repair materials.	Analyse
CO5	Describe the various demolition techniques and demolition methods	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	2	1	1	3	2	3
CO2	2	1	2	3	2	3
CO3	3	2	2	2	1	3
CO4	2	2	1	2	3	3
CO5	1	2	1	1	3	3
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	20
Understand	10	10	20
Apply	20	20	30
Analyse	20	20	30
Evaluate	-	-	-
Create	-	-	-
Total	60	60	100

R2/ w.e.f. 01.08.2025
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Syllabus

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M.E - Structural Engineering

70 PSE E54 - Maintenance and Rehabilitation of Structures

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Introduction Quality assurance for concrete construction as built concrete properties strength, permeability, thermal properties and cracking. Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors.	[9]
Durability of Structures Corrosion mechanism – diagnosis- causes and effects - cover thickness and cracking, measurements for corrosion - methods of corrosion protection, corrosion inhibitors, corrosion resistant steels, coatings, cathodic protection.	[9]
Maintenance and Repair Strategies Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance importance of Maintenance Preventive measures on various aspects. Inspection, Assessment procedure for evaluating a damaged structure causes of deterioration - testing techniques.	[9]
Materials for Repair Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement concrete, fibre reinforced concrete, eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete.	[9]
Techniques for Repair and rehabilitation of structures Rust, Gunite and Shotcrete Epoxy injection, Mortar repair for cracks, shoring and underpinning. Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering wear, fire, leakage, marine exposure Engineered demolition techniques for Dilapilated structures - case studies	[9]
Total Hours	45

Text Book(s):

1. Denison Campbell, Allen and Harold Roper, “Concrete Structures – Materials, Maintenance and Repair”, Longman Scientific and Technical UK, 2001.
2. Peter H. Emmons, “Concrete Repair and Maintenance”, Galgotia Publications Ed Second, 2010.

Reference(s):

1. R.T. Allen and S.C. Edwards, “Repair of Concrete Structures”, Blakie and Sons, UK, 2007.
2. Vidivelli, B. “Repair and Rehabilitation of Structures”, Standard Publishers & Distributors, ND,2010.
3. Robert.TRatay, “Forensic Structural Engineering Handbook”, Mc Graw Hill, 2009.
4. S Macdonald ,“Concrete – Building Pathology”, John Wiley and Sons Ed First, 2002

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Introduction	1
1.2	Quality assurance for concrete	1
1.3	Permeability of Concrete	1
1.4	Thermal Properties and Cracking	2
1.5	Effects due to climate, temperature, chemicals, wear and erosion	2
1.6	Design and construction errors	2
2.0	**Durability of Structures**	
2.1	Corrosion Mechanism	1
2.2	Causes and Effectsof Corrosion	1
2.3	Cover Thickness and Cracking	2
2.4	Measurements for Corrosion	1
2.5	Methods of Corrosion Protection	1
2.6	Corrosion Inhibitors	1
2.7	Corrosion Resistant Steels	1
2.8	Coatings for reinforcement	1
2.9	Cathodic Protection	2
3.0	**Maintenance and Repair Strategies**	
3.1	Various types of Repair and Rehabilitation Techniques	2
3.2	Maintenance of Structures	2
3.3	Facets of Maintenance	1
3.4	Importance of Maintenance and Their Preventive Measures	1
3.5	Inspection and their types	1
3.6	Assessment procedure for evaluating a damaged structures	1
3.7	Testing Techniques.	1
4.0	**Materials for Repair**	
4.1	Special concretes and mortar	2
4.2	Concrete Chemicals	1
4.3	Special Elements for Accelerated Strength Gain	1
4.4	Expansive cement	1
4.5	Polymer Concrete, Sulphur Infiltrated Concrete	1
4.6	Ferro Cement Concrete, Fibre Reinforced Concrete	1
4.7	Foamed Concrete, Mortar and Dry Pack, Vacuum Concrete	1
5.0	**Techniques for Repair and rehabilitation of structures**	
5.1	Rust, Gunite and Shotcrete Epoxy injection	2
5.2	Mortar Repair for Cracks	1
5.3	Shoring and Underpinning	1
5.4	Repairs to overcome low member strength	1
5.5	Deflection, Cracking, Chemical Disruption, Weathering Wear	1
5.6	Fire and Leakage	1
5.7	Marine Exposure Engineered Demolition Techniques for Dilapilated Structures	1
5.8	Case Studies	1

Course Designer

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R2/ w.e.f. 01.08.2025
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60 CE E55	Design of Steel Concrete Composite Structures	Category	L	T	P	Credit
		PE	3	0	0	3

Objectives

- Understand the basics of steel-concrete composite construction.
- Analyze and design composite beams, columns, and slabs.
- Ensure effective shear connection and load transfer.
- Design shear connectors and composite connections.
- Apply design principles to practical composite structures.

Prerequisite

Design of Steel Structures

Course Outcomes

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

CO1	Understand the fundamentals of steel-concrete composite structures.	Remember, Understand, Apply
CO2	Design composite beams, columns, and slabs effectively.	Remember, Understand, Apply
CO3	Analyze shear connections and load transfer mechanisms.	Remember, Understand, Apply
CO4	Design efficient shear connectors and structural connections.	Remember, Understand, Apply
CO5	Apply composite design principles to real-world structures.	Remember, Understand, Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	3			
CO2	3	3	3			
CO3	3	2	2			
CO4	3	3	3			
CO5	3	3	3			
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember (Re)	20	20	40
Understand (Un)	20	20	40
Apply (Ap)	20	20	20
Analyse (An)	-	-	-
Create (Cr)	-	-	-

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M.E - Structural Engineering								
70 PSE E55 - Design of Steel concrete Composite Structures								
Semester	Hours / Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
	3	0	0	45	3	40	60	100

Introduction** Introduction to steel - concrete composite construction – Coes – Composite action – Serviceability and - Construction issues.	**[09]**
Design of Connections** Shear connectors – Types – Design of connections in composite structures – Degree of shear connection – Partial shear interaction.	**[09]**
Design of Composite Members** Design of composite beams, slabs, columns, beam – columns - design of composite trusses.	**[09]**
Composite Box Girder Bridges** Introduction - behaviour of box girder bridges - design concepts.	**[09]**
Case Studies** Case studies on steel - concrete composite construction in buildings - seismic behavior of composite structures.	**[09]**
Total Hours	**45**

Textbook(s):

1.	Johnson R.P., “Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings”, Vol.I, Blackwell Scientific Publications, 2004.
2.	Oehlers D.J. and Bradford M.A., “Composite Steel and Concrete Structural Members, Fundamental behaviour”, Pergamon press, Oxford, 1995.

Reference(s):

1.	Owens.G.W and Knowles.P, ”Steel Designers Manual”, Steel Concrete Institute(UK), Oxford Blackwell Scientific Publications, 1992.
2.	D.J. Victor, “Essentials of Bridge Engineening,” Oxford & IBH Publishing, New Delhi, 2001
3.	N. Krishna Raju, “Design of Bridges,” Oxford & IBH Publishing, New Delhi, 1998.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction**	**9**
1.1	Introduction to steel	1
1.2	Concrete composite construction	2
1.3	Coes	1
1.4	Composite action	2
1.5	Serviceability	1
1.6	Construction issues.	1
2	**Design of Connections**	**9**
2.1	Shear connectors and its type	3
2.2	Design of connections in composite structures.	2
2.3	Degree of shear connection	2
2.4	Partial shear interaction.	2
3	**Design of Composite Members**	**9**
3.1	Design of composite beams	2
3.2	Design of composite slabs	2
3.3	Design of composite columns	1
3.4	Beam – columns	1
3.5	Design of composite trusses	3
4	**Composite Box Girder Bridges**	**9**
4.1	Introduction	3
4.2	Behavior of box girder bridges	3
4.3	Design concepts.	3
5	**Case Studies**	**9**
5.1	Case studies on steel	3
5.2	Concrete composite construction in buildings	3
5.3	Seismic behavior of composite structures.	3
	Total	**45**

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PSE E56	Mechanics of Fiber Reinforced Polymer Composite Materials	Category	L	T	P	Credit
		PC	3	1	0	4

Objectives

- To understand traditional materials like metals and polymers, and summarize the different manufacturing processes.
- To comprehend the key constituents of an FRP composite and common types of fiber.
- To Understand the problems involving the calculation of basic mechanical properties
- To Compare and contrast the different failure mechanisms.
- To Evaluate the suitability of different FRP composite materials

Pre-requisites

Basic knowledge of Engineering Mechanics, Reinforced Concrete Structures.

Course Outcomes

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

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

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	2	1			
CO2	3	2	1			
CO3	3	2	1			
CO4	3	2	1			
CO5	3	2	1			
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		Model Examination (Marks)	End Sem Examination (Marks)
	1	2		
Remember	10	10	30	30
Understand	10	10	20	20
Apply	20	20	30	30
Analyse	20	20	20	20
Evaluate	-	-	-	-
Create	-	-	-	-
Total	60	60	100	100

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K.S.Rangasamy College of Technology – Autonomous R2022

B.E. Civil Engineering

70 PSE E56 - Mechanics of Fiber Reinforced Polymer Composite Materials

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	1	0	60	4	40	60	100

Introduction to Composite Materials Introduction to Composites, Classifying composite materials, commonly used fiber and matrixconstituents, Composite Construction, Properties of Unidirectional Long Fiber Composites and ShortFiber Composites.	[9]
Stress Strain Relations Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticityfor Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses	[9]
Analysis of Laminated Composites * Governing equations for anisotropic and orthotropic plates. Angle-ply and cross ply laminates –Static, Dynamic and Stability analysis for Simpler cases of composite plates, Inter laminar stresses	[9]
Failure and Fracture of Composites Displacement, Velocity and acceleration, their relationship – Relative motion – Plane Motion - Rectilinear motion -–Projectile motion	[9]
Applications and Design Meal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design withComposites, Review, Environmental Issues	[9]
Total Hours:45 (Tutorial)	45

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

* *SDG 9: Industry, innovation and infrastructure*

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Composite Materials**	
1.1	Introduction to Composites	1
1.2	Classifying Composite Materials	1
1.3	Commonly Used Fiber Constituents	1
1.4	Commonly Used Fiber Constituents with examples	1
1.5	Commonly Used Matrix Constituents	1
1.6	Composite Construction and properties	1
1.7	Composite Construction and manufacturing processes.	1
1.8	Properties of Unidirectional Long Fiber Composites	1
1.9	Properties of Short Fiber Composites	1
2.0	**Stress Strain Relations**	
2.1	Stress and Strain - Review	1
2.2	Material Behavior	1
2.3	Hooke's Law for Isotropic Materials - Review	1
2.4	Hooke's Law for Orthotropic Materials	1
2.5	Hooke's Law for Anisotropic Materials	1
2.6	Linear Elasticity for Anisotropic Materials	1
2.7	Rotation of Stresses	1
2.8	Rotation of Strains	1
2.9	Residual Stresses	1
3.0	**Analysis of Laminated Composites**	
3.1	Introduction to Plate Theory	1
3.2	Governing Equations for Orthotropic Plates	1
3.3	Governing Equations for Anisotropic Plates	1
3.4	Angle-Ply Laminates	1
3.5	Cross-Ply Laminates	1
3.6	Static Analysis of Composite Plates	1
3.7	Dynamic Analysis of Composite Plates	1
3.8	Stability Analysis of Composite Plates	1
3.9	Interlaminar Stresses	1
4.0	**Failure and Fracture of Composites**	
4.1	Displacement, Velocity, and Acceleration	1
4.2	Relationship between Displacement, Velocity, and Acceleration	1
4.3	Relative Motion - 1D	1
4.4	Vectors and Vector Operations (Review)	2
4.5	Plane Motion - Kinematics	1
4.6	Analysis of Projectile Motion	1
4.7	Projectile Motion with problems and Circular Motion	2
5.0	**Applications and Design**	
5.1	Metal Matrix Composites (MMCs	1
5.2	Ceramic Matrix Composites	1
5.3	Applications of Composites	1
5.4	Composite Joints	1
5.5	Design with Composites	2
5.6	Review of Composite Materials and Mechanics	1
5.7	Environmental Issues related to Composites	2

Course Designer(s)

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PAC 001	English for Research Paper Writing	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

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

Pre-requisites

-NIL-

Course Outcomes

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

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

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-
Total	100	100

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M.E - Structural Engineering							
70 PAC 001 - English for Research Paper Writing							
Semester	**Hours/Week**			**Total Hours**	**Credit**	**Maximum Marks**	
	L	T	P		C	CA	ES	Total
II	2	0	0	30	0	40	60	100

Introduction to Research Paper Writing Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	[6]
Presentation Skills Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction	[6]
Title Writing Skills Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	[6]
Result Writing Skills Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	[6]
Verification Skills Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first time submission	[6]
Total Hours	30

Text Book(s):	
1.	Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011
2.	Day R How to Write and Publish a Scientific Paper, Cambridge University Press 2006
Reference(s):	
1.	Goldbort R Writing for Science, Yale University Press (available on Google Books) 2006
2.	Highman N, Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book 1998.
3.	Phill Williams, Advanced Writing skills for students of English, Rumian Publishers, 2018
4.	Sudhir S. Pandhye, English Grammar and Writing Skills, Notion Press, 2017.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction to Research Paper Writing**	
1.1	Planning and Preparation, Word Order	2
1.2	Breaking up long sentences, Structuring Paragraphs and Sentences	1
1.3	Being Concise and Removing Redundancy	2
1.4	Avoiding Ambiguity and Vagueness	1
2.0	**Presentation Skills**	
2.1	Clarifying Who Did What, Highlighting Your Findings	2
2.2	Hedging and Criticizing	2
2.3	Paraphrasing and Plagiarism, Sections of a Paper	1
2.4	Abstracts, Introduction	1
3.0	**Title Writing Skills**	
3.1	Key skills are needed when writing a Title	1
3.2	Key skills are needed when writing an Abstract, key skills are needed when writing an Introduction	2
3.3	Skills needed when writing a Review of the Literature	2
3.4	Methods, results, discussion, conclusions, the final check	1
4.0	**Result Writing Skills**	
4.1	Skills are needed when writing the Methods	2
4.2	Skills needed when writing the Results	1
4.3	Skills are needed when writing the Discussion	1
4.4	Skills are needed when writing the Conclusions	2
5.0	**Verification Skills**	
5.1	Useful phrases	2
5.2	Checking Plagiarism	2
5.3	How to ensure paper is as good as it could possibly be the first time submission	2

Course Designer

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R2/ w.e.f. 01.08.2025
Passed in the BOS Meeting Held on 17.06.2025
Approved in Academic Council Meeting held on 19.07.2025

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70 PAC 002	Disaster Management	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

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

Pre-requisites

-NIL-

Course Outcomes

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

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

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30

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Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PAC 002 – Disaster Management

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	0	30	0	40	60	100

Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.	[6]
Repercussions of Disasters and Hazards 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.	[6]
Disaster Prone Areas In India 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	[6]
Disaster Preparedness and Management 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.	[6]
Risk Assessment Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	[6]
Total Hours	30

Text Book(s):	
1.	Goel S. L., Disaster Administration and Management Text And Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi,2009.
2.	NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company,2007.
Reference(s):	
1.	Sahni, Pardeepet.al.," Disaster Mitigation Experiences and Reflections", Prentice Hall of India, 2001.
2.	Subramanian R,"Disaster Management", Vikas publishing Housing Pvt. Ltd., 2018.
3.	Chu-huaKuei, Christian N Madu, Handbook of Disaster Management Risk Reduction & Management: Climate change and Natural Disaster, world scientific, 2017.
4.	JankiAndharia, Disaster studies: Exploring Intersectional ties in Disaster Discourse, Springer, 2020.

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**Introduction**	
1.1	Disaster: Definition, Factors and Significance	2
1.2	Difference between Hazard and Disaster	2
1.3	Natural and Manmade Disasters	2
1.4	Difference, Nature	2
1.5	Types and Magnitude	1
2.0	**Repercussions of Disasters and Hazards**	
2.1	Economic Damage, Loss of Human and Animal Life	2
2.2	Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones	2
2.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
2.4	Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents	1
2.5	Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts	2
3.0	**Disaster Prone Areas In India**	
3.1	Study of Seismic Zones	1
3.2	Areas Prone to Floods and Droughts	2
3.3	Landslides and Avalanches	2
3.4	Areas Prone to Cyclonic and Coastal Hazards with Special Reference To Tsunami	2
3.5	Post-Disaster Diseases and Epidemics	2
4.0	**Disaster Preparedness and Management**	
4.1	Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard	2
4.2	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.3	Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches	2
4.4	Application of Remote Sensing, Data from Meteorological and other Agencies	2
4.5	Media Reports: Governmental and Community Preparedness	1
5.0	**Risk Assessment**	
5.1	Disaster Risk: Concept and Elements	2
5.2	Disaster Risk Reduction, Global and National Disaster Risk Situation	2
5.3	Techniques of Risk Assessment	2
5.4	Global Co-Operation in Risk Assessment and Warning	2
5.5	People's Participation in Risk Assessment. Strategies for Survival	1

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Course Designer

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70 PAC 003	Constitution of India	Category	L	T	P	Credit
		PC	2	0	0	0

Objectives

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

Pre-requisites

-NIL-

Course Outcomes

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

CO1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.	Apply
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India	Analyse
CO3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.	Understand
CO4	Discuss the passage of the Hindu Code Bill of 1956.	Analyse
CO5	Discuss the role and functioning of election commission of India.	Apply

Mapping with Programme Outcomes

Cos	Pos					
	1	2	3	4	5	6
CO1	3	3	2	2	3	1
CO2	3	3	2	2	3	1
CO3	3	3	2	2	3	1
CO4	3	3	2	3	2	1
CO5	3	3	2	3	2	1
3 - Strong; 2 - Medium; 1 – Some						

Assessment Pattern

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Bloom's Category	Continuous Assessment Tests (Marks)	
	1	2
Remember	30	30
Understand	30	30
Apply	40	40
Analyse	-	-
Evaluate	-	-
Create	-	-
Total	100	100

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

M.E - Structural Engineering

70 PAC 003 – Constitution of India

Semester	Hours/Week			Total Hours	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	2	0	0	30	0	40	60	100

History of Making of The Indian Constitution History, Drafting Committee, (Composition & Working)	[6]
Philosophy of The Indian Constitution Preamble, Salient Features	[6]
Contours of Constitutional Rights and Duties Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.	[6]
Organs of Governance Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.	[6]
Local Administration District's Administration head: Role and Importance Municipalities: Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation. Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles, CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.	[6]
Election Commission Election Commission: Role and Functioning. Chief Election Commissioner and ElectionCommissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	30
Text Book(s):	

1.	The Constitution of India,1950 (Bare Act),Government Publication.
2.	Busi S N, Ambedkar B R, "Framing of Indian Constitution",1st Edition, 2015.
Reference(s):	
1.	Jain, M P, "Indian Constitution Law", 7th Edition, Lexis Nexis,2014
2.	Basu, D D, "Introduction to the Constitution of India", Lexis Nexis, 2015.
3.	Bhansali S R., "Textbook on The Constitution of India", Universal Publishers, 2015
4.	Jain, M P., "Outlines of Indian Legal and Constitutional History", Lexis Nexis, 2014

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Course Contents and Lecture Schedule

S. No.	Topics	No. of hours
1.0	**History of Making of The Indian Constitution**	
1.1	History	1
1.2	Drafting Committee, (Composition & Working)	2
2.0	**Philosophy of The Indian Constitution**	
2.1	Preamble, Salient Features	3
3.0	**Contours of Constitutional Rights and Duties**	
3.1	Fundamental Rights, Right to Equality, Right to Freedom	1
3.2	Right against Exploitation, Right to Freedom of Religion	1
3.3	Cultural and Educational Rights	1
3.4	Right to Constitutional Remedies	1
3.5	Directive Principles of State Policy, Fundamental Duties	2
4.0	**Organs of Governance**	
4.1	Parliament, Composition, Qualifications and Disqualifications	2
4.2	Powers and Functions, Executive	1
4.3	President, Governor, Council of Ministers	1
4.4	Judiciary, Appointment and Transfer of Judges	1
4.5	Qualifications, Powers and Functions	1
5.0	**Local Administration**	
5.1	District's Administration head: Role and Importance Municipalities	1
5.2	Introduction, Mayor and role of Elected Representative, CEO, Municipal Corporation	1
5.3	Panchayat raj: Introduction, PRI: ZilaPanchayat. Elected officials and their roles	1
5.4	CEO ZilaPanchayat: Position and role. Block level: Organizational Hierarchy (Different departments)	1
5.5	Village level: Role of Elected and Appointed officials, Importance of grass root	2

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	democracy	

Course Designer

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