K.S. Rangasamy College of Technology

(Autonomous Institution affiliated to Anna University, Chennai)

CURRICULUM & SYLLABI

FOR

M.E. Structural Engineering

(For the batch admitted in 2023– 2024)

R 2022

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.

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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

Department of Civil Engineering

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.

PROGRAMME 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs):

Engineering Graduates will be able to:

PSO1: Acquire in-depth knowledge of the Structural Engineering discipline, with an ability to evaluate, ana synthesize existing and new knowledge in structural design.

PSO2: Critically analyze complex Structural Engineering problems, apply independent judgment for synthesizing information and make innovative advances in a theoretical, practical and policy context.

PSO3: Conceptualize and solve Structural Engineering problems, evaluate potential solutions and arrive at technically feasible, economically viable and environmentally sound solutions with due consideration of health, safety, and socio-cultural factors.

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES (PEOs) WITH PROGRAMMEOUTCOMES (POs)

The M.E. Strucutural Programme outcomes leading to the achievement of the objectives are summarized in the following Table.

Programme Educational Objectives	Programme Outcomes					
	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

Contributions: 1- low, 2- medium, 3- high

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Year	Sem.	Course Name	PO					
			1	2	3	4	5	6
I	I	Applied Mathematics for Structural Engineering	3	3	2	1	2	
		Theory of Elasticity and Plasticity	3	3	3	2	3	3
		Structural Dynamics and Earthquake Engineering	2	2	3	2	2	3
		Research Methodology and IPR	3	3	2	2	2	2
		Advanced Construction Engineering and Experimental Techniques Laboratory	3	3	3	3	3	3
		Technical Seminar	3	3	3	2	2	2
	II	Advanced Steel Structures	3	3	3	3	3	3
		Advanced Concrete Structures	3	3	3	3	2	2
		Finite Element Analysis in Structural Engineering	3	3	3	3	2	2
		Advanced Structural Engineering Laboratory	3	2	3	2	2	2
		Computer Aided analysis and Design laboratory	3	3	2	2	2	2
II	III	Project Work - Phase I	3	3	3	2	3	2
		Inplant Training	3	3	3	2	3	2
	IV	Project Work - Phase II	3	3	3	2	3	2

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K.S. RANGASAMY COLLEGE OF TECHNOLOGY

Credit Distribution for M.E (SE)Programme–2022 –2023 Batch

S. No.	Category	Credits Per Semester				Total Credits	Percentage %
		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.	60 PSE 101	Applied Mathematics for Structural Engineering	PC	3	3	2	0	4	Engineering Mathematics, Probability and Statistics
2.	60 PSE 102	Theory of Elasticity and Plasticity	PC	3	3	0	0	3	Fundamentals of Mathematics, Strength of Material
3.	60 PSE 103	Structural Dynamics and Earthquake Engineering	PC	3	3	0	0	3	Fundamentals of Mathematics
4.	60 PED 001\ 60 PDB E26	Research Methodology and IPR	PC	3	3	0	0	3	Nil
5.	60 PSE 1P1	Advanced Construction Engineering and Experimental Techniques Laboratory	PC	4	0	0	4	2	Concrete Technology
6.	60 PSE 201	Advanced Steel Structures	PC	3	3	0	0	3	Steel member design and foundation design
7.	60 PSE 202	Advanced Concrete Structures	PC	3	3	0	0	3	Design of RC elements
8.	60 PSE 203	Finite Element Analysis in Structural Engineering	PC	3	3	0	0	3	Knowledge of forces and resolution and equilibrium concepts.
9.	60 PSE 2P1	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2	Basic RC and steel design theory and design
10.	60 PSE 2P2	Computer Aided analysis and Design laboratory	PC	4	0	0	4	2	CAD for structures

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PROFESSIONAL ELECTIVES (PE)

SEMESTER I, PROFESSIONAL ELECTIVE I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60PSE E11	Theory of Structural Stability	PE	3	3	0	0	3	Foundation Engineering
2.	60PSE E12	Theory of Plates and Shells	PE	3	3	0	0	3	Strength of materials and its mechanics
3.	60PSE E13	Design of Tall Buildings	PE	3	3	0	0	3	Industrial Structures
4.	60PSE E14	Design of Structures for Dynamic Loads	PE	3	3	0	0	3	Structural Dynamics
5.	60PSE E15	Fracture Mechanics of Concrete Structures	PE	3	3	0	0	3	Basic Strength of material
6.	60PSE E16	Advanced Groundwater Hydrology	PE	3	3	0	0	3	-
7.	60PSE E17	Groundwater Modeling and Management	PE	3	3	0	0	3	-

SEMESTER II, PROFESSIONAL ELECTIVE II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60PSE E21	Structural Health Monitoring	PE	3	3	0	0	3	Nil
2.	60PSE E22	Design of Sub Structures	PE	3	3	0	0	3	Foundation design
3.	60PSE E23	Structural Optimization	PE	3	3	0	0	3	Nil
4.	60PSE E24	Bridge Engineering	PE	3	3	0	0	3	Design concepts of RCC, prestressed concrete and steel structures.
5.	60PSE E25	Non-linear Analysis of Structures	PE	3	3	0	0	3	Finite element methods
6.	60PSE E26	Environmental Monitoring Instruments	PE	3	3	0	0	3	-
7.	60PSE E27	Municipal Solid Waste Management	PE	3	3	0	0	3	-

SEMESTER II, PROFESSIONAL ELECTIVE III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60PSE E31	Soil Structure Interaction	PE	3	3	0	0	3	Geotechnical Engineering
2.	60PSE E32	Design of Shell and Spatial Structures	PE	3	3	0	0	3	Theory of elasticity and plasticity.
3.	60PSE E33	Off Shore Structures	PE	3	3	0	0	3	Nil
4.	60PSE E34	Experimental Techniques and Instrumentation	PE	3	3	0	0	3	Fundamentals of Mathematics
5.	60PSE E35	Matrix Method of	PE	3	3	0	0	3	Mechanics of structures and

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		Structural Analysis							structural analysis.
6.	60PSE E36	Secondary Treatment of Wastewater	PE	3	3	0	0	3	-
7.	60PSE E37	Industrial Wastewater Pollution - Prevention and Control	PE	3	3	0	0	3	-

SEMESTER III, PROFESSIONAL ELECTIVE IV

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60PSE E41	CADD for Structures	PE	3	3	0	0	3	Nil
2.	60PSE E42	Design of Industrial Structure	PE	3	3	0	0	3	Steel Structures
3.	60PSE E43	Disaster Resistant Structures	PE	3	3	0	0	3	Nil
4.	60PSE E44	Industrial Steel Structures	PE	3	3	0	0	3	Steel Structures
5.	60 PSE E45	Corrosion Engineering	PE	3	3	0	0	3	RCC and Steel Structures
6.	60PSE E46	Principles and Design of Biological Treatment System	PE	3	3	0	0	3	-
7.	60PSE E47	Transportation of Water and Wastewater	PE	3	3	0	0	3	-

SEMESTER III, PROFESSIONAL ELECTIVE V

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60PSE E51	Prestressed Concrete Structures	PE	3	3	0	0	3	Nil
2.	60PSE E52	Advanced Concrete Technology	PE	3	3	0	0	3	Concrete Technology
3.	60PSE E53	Aseismic Design of Structures	PE	3	3	0	0	3	Dynamics of Structures
4.	60PSE E54	Maintenance and Rehabilitation of Structures	PE	3	3	0	0	3	RCC and Steel Structures
5.	60PSE E55	Modern Construction Materials	PE	3	3	0	0	3	Concrete Technology
6.	60PSE E56	Remote Sensing and GIS for Hydrology and Water Resources	PE	3	3	0	0	3	-
7.	60PSE E57	Principles and Design of Physico Chemical Treatment Systems	PE	3	3	0	0	3	-

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AUDIT COURSES (AC)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 PAC 001	English For Research Paper Writing	AC	2	2	0	0	0	-NIL-
2.	60 PAC 002	Disaster Management	AC	2	2	0	0	0	-NIL-
3.	60 PAC 003	Constitution Of India	AC	2	2	0	0	0	-NIL-

CAREER GUIDANCECOURSES (CG)

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C	Pre-requisite
1.	60 PSE 1P2	Technical Seminar	CG	2	0	0	2	1	Nil
2.	60 PSE3P1	Project Work - Phase I	CG	16	0	0	16	08	Nil
3.	60 PSE3P2	Inplant Training	CG	0	0	0	0	2	Nil
4.	60 PSE4P1	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)

COURSES OF STUDY

(For the candidates admitted from 2022-2023 onwards)

SEMESTER I

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 PSE 101	Applied Mathematics for Structural Engineering	PC	5	3	2	0	4
2.	60 PSE 102	Theory of Elasticity and Plasticity	PC	5	3	2	0	4
3.	60 PSE 103	Structural Dynamics and Earthquake Engineering	PC	5	3	2	0	4
4.	60 PED 001\ 60 PDB E26	Research Methodology and IPR	PC	3	3	0	0	3
5.	60 PSE E1*	Professional Elective I	PE	3	3	0	0	3
6.	60 PAC 001	English for Research Paper Writing	AC	2	2	0	0	0
PRACTICALS								
7.	60 PSE 1P1	Advanced Construction Engineering and Experimental Techniques Laboratory	PC	4	0	0	4	2
8.	60 PSE 1P2	Technical Seminar	CG	2	0	0	2	1
			Total	**29**	**17**	**6**	**6**	**21**

SEMESTER II

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 PSE 201	Advanced Steel Structures	PC	3	3	0	0	3
2.	60 PSE 202	Advanced Concrete Structures	PC	3	3	0	0	3
3.	60 PSE 203	Finite Element Analysis in Structural Engineering	PC	5	3	2	0	4
4.	60 PSE E2*	Professional Elective II	PE	3	3	0	0	3
5.	60 PSE E3*	Professional Elective III	PE	3	3	0	0	3
6.	60 PAC 002	Disaster Management	AC	2	2	0	0	0
PRACTICALS								
7.	60 PSE 2P1	Advanced Structural Engineering Laboratory	PC	4	0	0	4	2
8.	60 PSE 2P2	Computer Aided analysis and Design laboratory	PC	4	0	0	4	2
			Total	**27**	**17**	**2**	**8**	**20**

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SEMESTER III

S.No.	Course Code	Course Title	Category	Contact Periods	L	T	P	C
THEORY								
1.	60 PSE E4*	Professional Elective IV	PE	3	3	0	0	3
2.	60 PSE E5*	Professional Elective V	PE	3	3	0	0	3
PRACTICALS								
3.	60 PSE3P1	Project Work - Phase I	CG	16	0	0	16	8
4.	60 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.	60 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
2 Hours tutorial = 1 credit
2 Hours practical = 1 credit

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M.E. / M.Tech. Degree Programme

SCHEME OF EXAMINATIONS

(For the candidates admitted from 2022-2023 onwards)

FIRSTSEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1	60 PSE 101	Applied Mathematics for Structural Engineering	2	40	60	100	45	100
2	60 PSE 102	Theory of Elasticity and Plasticity	2	40	60	100	45	100
3	60 PSE 103	Structural Dynamics and Earthquake Engineering	2	40	60	100	45	100
4	60 PED 001\ 60 PDB E26	Research Methodology and IPR	2	40	60	100	45	100
5	60 PSE E1*	Professional Elective I	2	40	60	100	45	100
6	60 PAC 001	English for Research Paper Writing	2	100	-	100		
PRACTICAL								
7	60 PSE 1P1	Advanced Construction Engineering and Experimental Techniques Laboratory	3	60	40	100	45	100
8	60 PSE 1P2	Technical Seminar	3	100	-	100	-	100

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to60marksfortheawardofterminalexamination marks.

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60 PSE101	APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING	Category	L	T	P	Credit
		PC	3	2	0	4

Objective

- To describe the concepts of solving system of equations.
- 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 basic concepts on Fourier transform.

Prerequisite

NIL

Course Outcomes

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

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	1	2
CO2	3	3	2	1	2
CO3		3	2	1	2
CO4	3	3	2	1	2
CO5	3	3	2	1	2
3- Strong; 2-Medium; 1-Low					

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember (Re)	10	10	10
Understand (Un)	10	10	10
Apply (Ap)	20	40	60
Analyze (An)	20	0	20
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0

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60 PSE101 - APPLIED MATHEMATICS FOR STRUCTURAL ENGINEERING

M.E. STRUCTURAL ENGINEERING

Semester	Hours/Week			Total Hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	2	0	60	4	40	60	100

Eigenvalue Problems Matrix operations – 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**

Textbook(s):

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

Reference(s):

1. B.S.Grewal, "Numerical methods in Engineering and Science, 11th Edition, Khanna Publishers, New Delhi, 2013.
2. A.S. Gupta, "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi 1999.
3. S.Rajasekaran, "Numerical Methods in Science and Engineering: A Practical Approach", S.Chand& Co., New Delhi, 1st Edition, 1999 (Reprint 2012).
4. G. James, "Advanced Modern Engineering Mathematics", 3rdEdition,Pearson Education, 2004.
5. Prof. AdrijitGoswami, "Transform Calculus and its applications in Differential Equations" – NPTEL Video Course.

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Course Contents and Lecture Schedule

S.No.	Topic	No.of Hours
1	**Eigenvalue Problems**	
1.1	Matrix operations	1
1.2	Solution of system of linear equation by Gauss Seidal iterative method	1
1.3	Eigen value and eigen vector by iterative methods: Power method	1
1.4	Tutorial	2
1.5	Jacobi method	1
1.6	Given's method	2
1.7	House holder method	2
1.8	Tutorial	2
2	**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	Tutorial	2
2.4	Interpolation: polynomial approximation	1
2.5	Lagrange's method	1
2.6	Newton's method	2
2.7	Tutorial	2
3	**Calculus of Variations**	
3.1	Concept of variation and its properties	1
3.2	Euler's equation	1
3.3	Functional dependent on first andhigher order derivatives	2
3.4	Functionals dependent on functions of several independent variables	1
3.5	Tutorial	2
3.6	Variational problems with moving boundaries	1
3.7	Isoperimetric problems	1
3.8	Ritz method	1
3.9	Tutorial	2
4	**Laplace Transform Techniques for Partial Differential Equations**	
4.1	Laplace transform: Definitions – Properties	1
4.2	Dirac delta function – Unit step functions	1
4.3	Convolution theorem	1
4.4	Tutorial	2
4.5	Inverse Laplace transform: Complex inversion formula	1
4.6	Solutions to partial differential equations: Heat equation	2

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4.7	Solutions to partial differential equations: Wave equation	2
4.8	Tutorial	2
5	**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	Tutorial	2
5.5	Solutions to partial differential equations: Heat equation	1
5.6	Solutions to partial differential equations: Wave equation	1
5.7	Laplace's equation	2
5.8	Poisson's equation	1
5.9	Tutorial	2
	Total	**60**

CourseDesigners

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60 PSE 102	THEORY OF ELASTICITY AND PLASTICITY	Category	L	T	P	Credit
		PC	3	2	0	4

Objective

- 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.

Prerequisite

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.	Remember, Understand, Apply
CO2	Analyze the problem with bi-harmonic equations.	Remember, Understand, Analyze
CO3	Identify the different approaches for solving the torsional problems and thin walled open and closed sections	Remember, Understand, Apply, Analyze
CO4	Analyze the elasticity problems with various energy methods.	Analyze
CO5	State the assumptions of plasticity and solve plastic problems.	Understand and Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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-Low						

Assessment Pattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	20	10	30
Analyse	20	30	50
Evaluate	-	-	-

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Create	-	-	-

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60 PSE 102 - THEORY OF ELASTICITY AND PLASTICITY								
M.E. STRUCTURAL ENGINEERING								
Semester	**` Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**	60	**C**	**CA**	**ES**	**Total**
I	3	2	0		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(Tutorial) = 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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.8	Specification of stress and strain –2D & 3D & Problems	1
1.9	Generalized Hook's law, Stress-Strain relationship- Mohr Circle	2
2	**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	**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	**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
4.8	Finite difference method	1
4.9	Engesser's theorem & Castingliano's theorem	1
4.10	Problems in energy method	2
5	**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
	Total	**60**

Course Designers

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R1/ w.e.f. 12.07.2023
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60 PSE 103	STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING	Category	L	T	P	Credit
		PC	3	2	0	4

Objective

- 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

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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-Low						

AssessmentPattern

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

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60 PSE 103- STRUCTURAL DYNAMICS AND EARTHQUAKE ENGINEERING								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	2	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	**[12]**
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	**[12]**
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	**[12]**
Dynamic Analysis of Continuous Systems Free and forced vibration of continuous system –Rayleigh Ritz method – formulation using conservation of energy- formulation using virtual work.	**[12]**
Practical Applications Idealization of multi-storeyed frames – Impact loading - blast loading - aerodynamics, gust phenomenon principles of analysis..	**[12]**
TotalHours	**60**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.8	Damped SDOFs- underdamped, overdamped and critically damped	1
1.9	Logarithmic decrement ,method of determining damping	1
1.10	Tutorial	2
2	**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	**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	**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
4.8	Tutorial	2
5	**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 Analysis	1
5.6	Tschebotarioff's reduced frequency method- design problems	2
	Total	**60**

CourseDesigners

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60 PED 001\ 60 PDB E26	RESEARCH METHODOLOGY AND IPR	Category	L	T	P	Credit
		PC	3	0	0	3

Objective(s)

- 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-requisite

Nil

Course Outcomes

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

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

Mapping with Programme Outcomes

COURSE NAME	CO	PO						PSO		
		1	2	3	4	5	6	1	2	3
Research Methodology and IPR	CO1	3	3	2	2	2	2	3	1	3
	CO2	3	3	2	2	2	2	3	1	3
	CO3	3	3	2	2	2	2	3	1	3
	CO4	3	3	2	2	2	2	3	1	3
	CO5	3	3	2	2	2	2	3	1	3

Note: 3 – Strong Contribution; 2 – Average Contribution; 1 – Some Contribution

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AssessmentPattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		Model Exam (Marks)	End Semester Examination (Marks)
	1	2		
Remember	10	10	20	30
Understand	20	20	40	30
Apply	30	30	40	30
Analyse	0	0	0	10
Evaluate	0	0	0	0
Create	0	0	0	0

Syllabus

K.S.Rangasamy College of Technology – Autonomous R2022

60 PED 001\ 60 PDB E26 - Research Methodology and IPR

Common to all Branches

Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	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.

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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.

Course Content 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	3
3.0	**Data Analysis and Reporting**	
3.1	Overview of Multivariate analysis	1
3.2	Hypotheses testing and Measures of Association	2
3.3	Presenting Insights	1
3.4	Findings using written reports and oral presentation	2
3.5	Checks for Plagiarism	1
3.6	Falsification	1
3.7	Fabrication, and Misrepresentation	1
4.0	**Intellectual Property Rights**	

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4.1	Intellectual Property – The concept of IPR	1
4.2	Evolution and development of concept of IPR, IPR development process	2
4.3	Trade secrets, utility Models, IPR & Bio diversity	2
4.4	Role of WIPO and WTO in IPR establishments	1
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	2
5.2	Inventive step, Specification, Types of patent application	2
5.3	Process E-filling, Examination of patent	1
5.4	Grant of patent, Revocation	1
5.5	Equitable Assignments, Licences, Licensing of related patents	2
5.6	Patent agents, Registration of patent agents	1
	Total Hrs	**45**

CourseDesigner

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R1/ w.e.f. 12.07.2023
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60 PSE 1P1	ADVANCED CONSTRUCTION ENGINEERING AND EXPERIMENTAL TECHNIQUES LABORATORY

Category	L	T	P	Credit
PC	0	0	4	2

Objectives

- To impart knowledge on various test of concrete making materials
- To perform mix design using IS and ACI method
- To learn the various test for self-compacting & hardened concrete
- To acquire skills on non- destructive test of concrete
- To conduct various durability test available for concrete

Pre-requisite

Courses – Construction Materials & Concrete Technology

Course Outcomes

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

CO1	Identify the suitable test available for concrete making materials	Apply
CO2	Execute mix design for manufacturing the concrete	Apply
CO3	Perform various test for self - compacting & hardened concrete	Apply
CO4	Examine the strength of existing structure by non - destructive testing methods	Apply
CO5	Analyze the durability performance of concrete	Analyse

Mapping with Programme outcomes

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

List of Experiments

1. Tests on concrete making materials
   a) Test on cement - Specific gravity, Setting time, Soundness, Fineness & Compressive strength
   b) Test on aggregate - Flakiness & Elongation, Density and Fineness modulus
2. Concrete Mix Design as per IS 10262 - 2019 method & ACI Method
3. Tests on self-compacting concrete
4. Tests on hardened concrete
   a) Mechanical properties of concrete & their relationship
   b) Stress strain behavior of concrete
5. Non-Destructive testing Methods

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a) Ultra sonic Pulse Velocity Meter

b) Rebound hammer

6. Durability test on hardened concrete

a) Water absorption test

b) Sulphate attack

c) Chloride attack

d) RCPT Test

Text book(s):	
1.	A R Santhakumar, “Concrete Technology, Oxford Higher Education, New Delhi, 2018
2.	P. Kumar Mehta, Paulo J. M. Monteiro, Concrete: Microstructure, Properties, and Materials, McGraw Hill Education, 2014
Reference(s)	
1.	IS 383 – 2016, Coarse and Fine Aggregate for Concrete - Specification (Third Revision)
2.	IS: 10262 – 2019, Concrete Mix Proportioning - Guidelines (Second Revision)
3.	IS 456 – 2000, Code of Practice - Plain and reinforced concrete (Fourth Revision)
4.	IS: 516 – 1959, (Reaffirmed 2018) - Methods of Tests for Strength of Concrete

Course Designer

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60 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.	Apply
CO2	Organize a detailed literature survey and build a document with respect to technical presentations.	Apply
CO3	Analysis and comprehension of proof-of-concept and related data.	Analyze
CO4	Effective presentation and improve soft skills.	Apply
CO5	Make use of new and recent technology (e.g. graphical abstract) for creating technical reports.	Analyze

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
TIRUCHENGODE - 637 215

K.S.Rangasamy College of Technology–Autonomous R2022								
60 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	45	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	**45**

Course Designers

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

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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

M.E. / M.Tech. Degree Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2022-2023 onwards)
SECOND SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1	60 PSE 201	Advanced Steel Structures	2	40	60	100	45	100
2	60 PSE 202	Advanced Concrete Structures	2	40	60	100	45	100
3	60 PSE 203	Finite Element Analysis in Structural Engineering	2	40	60	100	45	100
4	60 PSE E2*	Professional Elective II	2	40	60	100	45	100
5	60 PSE E3*	Professional Elective III	2	40	60	100	45	100
6	60 PAC 002	Disaster Management	2	100	-	100	-	100
PRACTICAL								
7	60 PSE 2P1	Advanced Structural Engineering Laboratory	3	60	40	100	45	100
8	60 PSE 2P2	Computer Aided analysis and Design laboratory	3	60	40	100	45	100

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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60 PSE 201	ADVANCED STEEL STRUCTURES	Category	L	T	P	Credit
		PC	3	0	0	3

Objective

- 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.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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(Re)	05	05	10
Understand(Un)	05	05	20
Apply (Ap)	15	20	30
Analyse (An)	35	30	40
Create (Cr)	-	-	-

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K.S.Rangasamy College of Technology–Autonomous R2022								
60 PSE 201- ADVANCED STEEL STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Analysis and Design of Beam Column**	
1.1	Introduction-General Behaviour of beam column	1

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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	**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	**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	**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	**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
	Total	**45**

CourseDesigner

1. Dr.M.VELUMANI - velumani@ksrct.ac.in

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60 PSE 202	ADVANCED CONCRETE STRUCTURES	Category	L	T	P	Credit
		PC	3	0	0	3

Objective

- 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

Prerequisite

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	Remember/ Understand/ Analyse/Apply
CO2	Perform the design of special RC elements	Remember/ Understand/ Analyse/Apply
CO3	Learn the design of flat slabs and grid floors	Remember/ Understand/ Analyse/Apply
CO4	Analyze the inelastic behavior of RC beams	Remember/ Understand/ Analyse/Apply
CO5	Draw the reinforcement detailing of structural elements	Remember/ Understand/ Analyse/Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember(Re)	05	10	10
Understand(Un)	05	10	20
Apply (Ap)	30	20	40
Analyse (An)	20	20	30
Create (Cr)	-	-	-

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K.S.Rangasamy College of Technology–Autonomous R2022								
60 PSE 202 - ADVANCED CONCRETE STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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**

Textbook(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	Topic	No.of Hours
1	**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	**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	**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	**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	**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
	Total	**45**

Course Designer

1. Mr.K.ANGU SENTHIL - angusenthil@ksrct.ac.in

R1/ w.e.f. 12.07.2023
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60 PSE 203	FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	Category	L	T	P	Credit
		PC	3	2	0	4

Objective

- 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.

Prerequisite

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.	Remember, Understand, Apply
CO2	Describe the concept of two dimensional elements.	Remember, Understand, Analyze
CO3	Analyze the 2D problems using isoparametric quadrilateral elements and Implement the Gaussian Quadrature expression for numerical integration.	Remember, Understand, Apply, Analyze
CO4	Identify the concepts of Non-linear Analysis of the structures.	Understand and Analyze
CO5	Apply the knowledge on application of Finite Element method	Remember, Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	5	5	10
Understand	5	5	10
Apply	35	35	30
Analyse	15	15	50
Evaluate	-	-	-
Create	-	-	-

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K.S.Rangasamy College of Technology - Autonomous R2022								
60 PSE 203- FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING								
M.E. STRUCTURAL ENGINEERING								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	3	2	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 (Tutorial) = 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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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 methods and 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

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2	**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	**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	**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
4.8	Software for inelastic behaviour	1
4.9	Iteration methods and iterative methods, Newtons Raphson Method	1
4.10	Tutorials on Non-linear analysis problems	2
5	**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
	Total	**60**

Course Designers

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60 PSE 2P1	ADVANCED STRUCTURAL ENGINEERING LABORATORY	Category	L	T	P	Credit
		PC	0	0	4	2

Objective

- 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

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

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60 PSE 2P1 -ADVANCED STRUCTURAL ENGINEERING LABORATORY								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
II	0	0	4	45	2	60	40	100

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

TotalHours	**45**

Textbook(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

1. Dr.R.JAGADEESAN - jagadeesan@ksrct.ac.in

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60 PSE 2P2	COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY	Category	L	T	P	Credit
		PC	0	0	4	2

Objective

- 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.

Prerequisite

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

Assessment Pattern

Bloom's Category	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Understand (U)	-	-	20
Apply (Ap)	-	-	50
Analyse (An)	-	-	30
Create (Cr)	-	-	0

R1/ w.e.f. 12.07.2023
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K.S.Rangasamy College of Technology–Autonomous R2022								
60 PSE 2P2 -COMPUTER AIDED ANALYSIS AND DESIGN LABORATORY								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	0	0	4	45	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.

Textbook(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 Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Model - I**	
1.1	Drafting – 2D & 3D	4
1.2	Design of Buildings	6
1.3	Analysis of loads on Buildings	6
2	**Model - II**	
2.1	Programming – Basic	4
2.2	Programming with MATLAB	6
2.3	Programming with MATLAB	6
3	**Model - III**	
3.1	Finite Element Analysis - Introduction	4
3.2	Finite Element Analysis – Software Application	4
3.3	Finite Element Analysis – Software Application	5

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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

M.E. / M.Tech. Degree Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2022-2023 onwards)
THIRD SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
THEORY								
1	60 PSE E4*	Professional Elective IV	2	40	60	100	45	100
2	60 PSE E5*	Professional Elective V	2	40	60	100	45	100
PRACTICAL								
7	60 PSE3P1	Project Work - Phase I	3	100	-	100	-	100
8	60 PSE3P2	Inplant Training	3	100	-	100	-	100

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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K.S.Rangasamy College of Technology – Autonomous R2022								
60 PSE 3P1 PROJECT WORK PHASE I								
M.E. STRUCTURAL ENGINEERING								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
III	0	0	16	60	08	100	0	100
Objective(s)	• 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.							
Course Outcomes	**At the end of the course, the students will be able to** 1. Survey the relevant literature such as books, national/international refereed journals and contact resource persons for the selected topic of research. 2. Use different experimental techniques/different software/ computational/analytical tools. 3. Design and develop an experimental set up/ equipment/test rig. 4. Conduct tests on existing set ups/equipments and draw logical conclusions from the results after analyzing them. 5. Work in a research environment or in an industrial environment.							

The Project Work will start in semester III and should preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution. 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. The examination shall consist of the preparation of 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 Head and PG coordinator. The candidate has to be in regular contact with his guide and the topic of dissertation must be mutually decided by the guide and student.

K.S.Rangasamy College of Technology – Autonomous R2022								
60 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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(An Autonomous Institution affiliated to Anna University)

M.E. / M.Tech. Degree Programme
SCHEME OF EXAMINATIONS
(For the candidates admitted from 2022-2023 onwards)
FOURTH SEMESTER

S.No.	Course Code	Name of the Course	Duration of Internal Exam	Weightage of Marks			Minimum Marks for Pass in End Semester Exam	
				Continuous Assessment *	End Semester Exam **	Max. Marks	End Semester Exam	Total
PRACTICAL								
1	60 PSE4P1	Project Work - Phase II	3	60	40	100	45	100

*CA evaluation pattern will differ from course to course and for different tests. This will have to be declared in advance to students. The department wills put a process in place to ensure that the actual test paper follow the declared pattern.

**End Semester Examination will be conducted for maximum marks of 100 and subsequently be reduced to 60 marks for the award of terminal examination marks.

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K.S.Rangasamy College of Technology – Autonomous R2022								
60 PSE 4P1 PROJECT WORK – PHASE II								
M.E. STRUCTURAL ENGINEERING								
Semester	**Hours / Week**			**Total hrs**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
IV	0	0	32	60	16	60	40	100
Objective(s)	• 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							
Course Outcomes	**At the end of the course, the students will be able to** 1. Develop attitude of lifelong learning and will develop interpersonal skills to deal with people working in diversified field will. 2. Write technical reports and research papers to publish at national and international level. 3. Develop strong communication skills to defend their work in front of technically qualified audience. 4. Learn about Patent filing and IPR 5. Gain knowledge about new business ideas and product development							

It is a continuation of Project work started in semester III. He has to submit the report in prescribed format and also present a seminar. The dissertation should be presented in standard format as provided by the department. The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion. The report must bring out the conclusions of the work and future scope for the study. . The work has to be presented in front of the examiners panel consisting of an approved external examiner, an internal examiner and a guide, co-guide etc. as decided by the Head and PG coordinator. The candidate has to be in regular contact with his guide.

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60PSE E11	THEORY OF STRUCTURAL STABILITY	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember (Re)	10	10	10
Apply (Ap)	40	40	60
Analyse (An)	10	10	30
Create (Cr)	0	0	0

R1/ w.e.f. 12.07.2023
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K.S.Rangasamy College of Technology - Autonomous R2022								
60PSE E11- THEORY OF STRUCTURAL STABILITY								
M.E. STRUCTURAL ENGINEERING								
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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**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	**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	**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	**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
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E12	THEORY OF PLATES AND SHELLS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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 analyze 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.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	Continuous AssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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K.S.Rangasamy College of Technology–Autonomous R2022								
60PSE E12 -THEORY OF PLATES AND SHELLS								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
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	**[09]**
Circular Plates Symmetrical bending of circular plates, plates on elastic foundation.	**[09]**
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.	**[09]**
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	**[09]**
Total Hours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**Rectangular Plates**	
2.1	Small deflections of laterally loaded plates – Differential equation	1

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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	**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	**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
4.8	Energy methods - Principle of virtual work- Principle of minimum potential energy	1
5	**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
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60PSE E13	DESIGN OF TALL BUILDINGS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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K.S.Rangasamy College of Technology–Autonomous R2022								
60PSE E13 -DESIGN OF TALL BUILDINGS								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Totalhrs	Credit	MaximumMarks		
	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.	**[09]**
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	**[09]**
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.	**[09]**
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.	**[09]**
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.	**[09]**
TotalHours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.5	Light weight concrete	2
1.6	Self Compacting Concrete.	2
2	**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	**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	**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
4.8	Creep and Shrinkage effects, Temperature Effects and Fire Resistance.	1
5	**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
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
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Approved in Academic Council Meeting held on 03/06/2023

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60PSE E14	DESIGN OF STRUCTURES FOR DYNAMIC LOADS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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	Analyze
CO3	Perform ductile detailing	Understand
CO4	Design against wind load as per BIS Code	Apply
CO5	Ductility Detailing should be considering for vibrations structures	Analyze

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember (Re)	10	10	10
Apply (Ap)	40	40	60
Analyse (An)	10	10	30
Create (Cr)	0	0	0

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60PSE E14 - DESIGN OF STRUCTURES FOR DYNAMIC LOADS								
M.E. STRUCTURAL ENGINEERING								
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	Damodarasamy S.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

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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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	**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	**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	**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	**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
	Total	**45**

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60PSE E15	FRACTURE MECHANICS OF CONCRETE STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60PSE E15- FRACTURE MECHANICS OF CONCRETE STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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..	**[09]**
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.	**[09]**
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..	**[09]**
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	**[09]**
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.	**[09]**
TotalHours	**45**

Textbook(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 L–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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.5	Crack tip Plasticity	2
1.6	Fracture toughness	2
2	**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	**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	**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	**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
	Total	**45**

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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		Category	L	T	P	Credit
60PSE E16	**ADVANCED GROUNDWATER HYDROLOGY**	PE	3	0	0	3

Objective

- The basic knowledge of groundwater hydrogeology, hydrometeorology, aquifers and it parameter.
- Understand various theories and equations related to groundwater hydraulics.
- Locating the hydro geological boundaries through conducting pumping tests and analysis.
- Understanding the concepts well design criteria.
- Acquire knowledge about problem identification and also providing suitable remedy in terms of maintaining the local groundwater table.

Pre requisite

Basic knowledge of Environmental Engineering courses

Course Outcomes

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

CO1	Study the ground water hydrologic cycle and types of acquifiers.	Remember/ Analyse/ Apply
CO2	Understand the ground water movement and principles of ground water flow and equation.	Remember / Analyse/ Apply
CO3	Analyze the aquifer parameters and well characteristics.	Remember / Analyse/ Apply
CO4	Discuss the construction of wells and design of wells.	Remember / Analyse/ Apply
CO5	Explain the methods of ground water recharge and assessment	Remember / Analyse/ Apply

Mapping with Programme Outcomes

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

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60PSE E16- ADVANCED GROUNDWATER HYDROLOGY								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Totalhrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Introduction to Groundwater Groundwater in Hydrologic Cycle – Occurrence of groundwater– Hydrogeology – Hydrometeorology – soil sample analysis - Water bearing materials - Types of aquifers – parameters of Aquifers – Determination of specific yield and permeability.	**[09]**
Groundwater Hydraulics Groundwater Movement - Darcy's law and its limitations - Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit – Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of wells – Interference of wells – Collector wells and Infiltration galleries	**[09]**
Pumping Test Analysis Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells.	**[09]**
Well Design and Construction Well design criteria – Construction of wells – Well drilling methods – Filter design – Artificial and natural packing – Well castings and screens – Production test – Maintenance of production wells	**[09]**
Special Topics Methods of artificial groundwater recharge – Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence - Wells in hard rock areas.	**[09]**
TotalHours	**45**

Textbook(s):

1. D K Todd, "Groundwater Hydrology", John Wiley & Sons, Inc, New York, 2005.
2. H M Raghunath, "Groundwater" New Age International,1987.

Reference(s):

1. Bear J, "Hydraulics of Groundwater", McGraw-Hill, New York,1979.
2. Bouwer H, "Groundwater Hydrology", McGraw-Hill, NewYork,1978.
3. Driscoll, "Groundwater and Wells", Johnson Filtration Systems, Inc., 1986.
4. M S Hantush, "Hydraulics of wells in Advances in Hydro science", Academic Press, 1964.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction to Groundwater**	
1.1	Groundwater in Hydrologic Cycle	1
1.2	Occurrence of groundwater	1
1.3	Hydrogeology and Hydrometeorology	2

1.4	Soil sample analysis and Water bearing materials	2
1.5	Types of aquifers and parameters of Aquifers	2
1.6	Determination of specific yield and permeability	1
2	**Groundwater Hydraulics**	
2.1	Groundwater Movement and Darcy's law and its limitations	1
2.2	Stream lines and flow net analysis	1
2.3	Discharge and draw down for various condition of groundwater flow	2
2.4	Principles of groundwater flow and its equation	2
2.5	Evaluation of well loss parameters and Partial penetration of wells, Interference of wells	1
2.6	Collector wells and Infiltration galleries	2
3	**Pumping Test Analysis**	
3.1	Determining aquifer parameters for unconfined, leaky and non-leaky aquifers	3
3.2	Steady and Transient conditions and Slug test	2
3.3	Locating hydro geological boundaries	2
3.4	Determination of well characteristics and specific capacity of wells	1
3.5	Well characteristics of large diameter wells.	1
4	**Well Design and Construction**	
4.1	Well design criteria	1
4.2	Construction of wells and Well drilling methods	2
4.3	Filter design – Artificial and natural packing	2
4.4	Well castings and screens	1
4.5	Production test	1
4.6	Maintenance of production wells.	2
5	**Special Topics**	
5.1	Methods of artificial groundwater recharge	2
5.2	Groundwater assessment and balancing	2
5.3	Seawater intrusion in coastal aquifers	1
5.4	Land Subsidence	2
5.5	Wells in hard rock areas	2
	Total	**45**

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60PSE E17	GROUNDWATER MODELING AND MANAGEMENT	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- Understand the groundwater exploration techniques both surface and subsurface by remote sensing and geophysical methods.
- Acquire preliminary idea about different methods of groundwater modeling techniques.
- Understand the different equations and model formulation methods.
- Acquire knowledge about data required for design and run the model.
- Understand about the influence of modeling for attaining the effective groundwater management.

Pre requisite

Basic knowledge of Environmental Engineering courses

Course Outcomes

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

CO1	Acquired knowledge on ground water exploration through various geophysical methods by surface and substance investigation.	Remember/ Analyse/ Apply
CO2	Understand about the term model and it's types.	Remember / Apply
CO3	Gain knowledge about different equations related to ground water modeling.	Remember / Analyse/ Apply
CO4	Acquired knowledge on groundwater model design and development	Remember / Analyse/ Apply
CO5	Familiar to create the need based model and its development.	Remember / Analyse/ Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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K.S.Rangasamy College ofTechnology–Autonomous R2022								
60PSE E17- GROUNDWATER MODELING AND MANAGEMENT								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Totalhrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
I	3	0	0	45	3	40	60	100

Groundwater Prospecting Investigation and evaluation – Geophysical methods- Electrical Resistivity methods – Interpretation of data – Seismic method – Subsurface investigation – Test drilling – Resistivity logging – Application of remote sensing techniques .	**[09]**
Groundwater Flow Model Physical models – Analog models – Mathematical modeling – Unsaturated flow models Numerical modeling of groundwater flow – Finite Differential equations - Finite difference solution – Successive over Relaxation, Alternating direction implicit procedure – Crank Nicolson equation – Iterative methods -Direct methods - Inverse problem – Finite element method	**[09]**
Contaminant Transport Model Contaminant transport theory – Advection, dispersion equation – Longitudinal and transverse dispersivity – Hydrodynamic dispersion – Analytical models – Numerical simulation of solute transport – Solution methods - Sorption model – Subsurface mass transport through the vadose zone - Density driven flow - Heat transport.	**[09]**
Model Development Data requirements – Conceptual model design : Conceptualization of aquifer system – Parameters, Input-output stresses, Initial and Boundary conditions - Model design and execution : Grid design, Setting boundaries, Time discretization and Transient simulation – Model calibration : steady state and unsteady state – sensitivity analysis – Model validation and prediction – Uncertainty in the model prediction	**[09]**
Groundwater Management Model Optimal groundwater development – Indian GEC norms – Conjunctive use models Modeling multilayer groundwater flow system -Modeling contaminant migration – Modeling fracture flow system – Artificial recharge feasibility through modeling – Simulation of movements of solutes in unsaturated zone – Stochastic modeling of groundwater flow - Groundwater contamination, restoration and management	**[09]**
TotalHours	**45**

Textbook(s):

1. L Elango and R Jayakumar, “Modelling in Hydrology”, Allied Publishers Ltd., 2001.
2. Randall, J Charbeneau, “ Groundwater Hydraulics and Pollutant Transport”,, Printice Hall, 2000.

Reference(s):

1. K R Rushton, “Groundwater Hydrology : Conceptual and Computational Models”, Wiley, 1st Edition,2003.
2. C W Fetter, “Contaminant Hydrogeology”, Prentice Hall,1999.
3. I Remson, G M Hornberger and F J, Moltz, “Numerical Methods in Subsurface Hydrology”, Wiley, New York, 1971.
4. Robert Willis and William W G Yenth, “Groundwater System Planning and Management”, Prentice Hall, Englewood Cliffs,New Jersey, 1987.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Groundwater Prospecting**	
1.1	Investigation and evaluation	1
1.2	Geophysical methods	1
1.3	Electrical Resistivity methods	2
1.4	Interpretation of data	2
1.5	Seismic method and Subsurface investigation	2
1.6	Application of remote sensing techniques	1
2	**Groundwater Flow Model**	
2.1	Physical models, Analog models and Mathematical modeling	1
2.2	Unsaturated flow models and Numerical modeling of groundwater flow	1
2.3	Finite Differential equations and Finite difference solution	2
2.4	Alternating direction implicit procedure	2
2.5	Crank Nicolson equation, Iterative methods and Direct methods	1
2.6	Finite element method	2
3	**Contaminant Transport Model**	
3.1	Contaminant transport theory, Advection, dispersion equation	3
3.2	Longitudinal and transverse dispersivity	2
3.3	Hydrodynamic dispersion and Analytical models	2
3.4	Solution methods - Sorption model, Subsurface mass transport through the vadose zone	1
3.5	Density driven flow - Heat transport.	1
4	**Model Development**	
4.1	Conceptual model design	1
4.2	Conceptualization of aquifer system its Parameters, Input-output stresses, Initial and Boundary conditions	2
4.3	Model design and execution	2
4.4	Time discretization and Transient simulation	1
4.5	Sensitivity analysis	1
4.6	Model validation and prediction	2
5	**Groundwater Management Model**	
5.1	Optimal groundwater development	2
5.2	Modeling multilayer groundwater flow system	2
5.3	Artificial recharge feasibility through modeling	1
5.4	Simulation of movements of solutes in unsaturated zone	2
5.5	Stochastic modeling of groundwater flow	2
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E21	STRUCTURAL HEALTH MONITORING	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

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	Remember/ Understand/ Analyse/Apply
CO2	Investigate the health of structure using SHM procedures	Remember/ Understand/ Analyse/Apply
CO3	Examine the health of structure using static field test	Remember/ Understand/ Analyse/Apply
CO4	Assess the health of structure using dynamic field test	Remember/ Understand/ Analyse/Apply
CO5	Apply suitable repair and rehabilitation techniques	Remember/ Understand/ Analyse/Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember(Re)	05	05	10
Understand(Un)	05	05	20
Apply (Ap)	25	30	50
Analyse (An)	25	20	20
Create (Cr)	-	-	-

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60PSE E21 - STRUCTURAL HEALTH MONITORING								
M.E -STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
Structural Audit Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures	**[09]**
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.	**[09]**
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.	**[09]**
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.	**[09]**
TotalHours	**45**

Textbook(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

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.5	Concepts in Structural monitoring	1
1.6	Various measures in structural monitoring	2
1.7	Structural Safety in Alteration.	1
2	**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	**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	**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	**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
	Total	**45**

Course Designer

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60PSE E22	DESIGN OF SUB STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

Basic knowledge of Soil Mechanics, Geology & Mathematical

CourseOutcomes

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	Apply, Analyze
CO3	Explain pile foundation and their types	Understand
CO4	Estimation the well foundations and sheet pile wall	Apply
CO5	Identify the general analysis of machine foundation and soil dynamics	Analyze

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	
Knowledge (Kn)	10	10	10
Apply (Ap)	40	40	60
Analyse (An)	10	10	30
Create (Cr)	0	0	0

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60PSE E22 -DESIGN OF SUB STRUCTURES								
M.E. STRUCTURAL 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

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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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2	**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	**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	**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	**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	2
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
		2
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60PSE E23	STRUCTRUAL OPTIMIZATION	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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.	Remember, Understand, Apply
CO2	Write algorithm for Geometric and Dynamic programming.	Remember, Understand, Analyze
CO3	To know the basis of univariate and multivariate minimization.	Remember, Understand, Apply, Analyze
CO4	Understand the concepts of optimization structural theorems.	Analyze
CO5	Understand the concepts of optimization problems in the Structural Engineering	Understand and Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	10
Understand	10	10	10
Apply	20	10	30
Analyse	20	30	50
Evaluate	-	-	-
Create	-	-	-

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60PSE E23 -STRUCTRUAL OPTIMIZATION								
M.E. STRUCTURAL ENGINEERING								
Elective II								
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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**Optimization Techniques And Algorithms**	
2.1	Basics of Optimization Techniques	1

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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	**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	**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	**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
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60PSE E24	BRIDGE ENGINEERING	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

CourseOutcomes

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

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	3	2							3
CO2	2	3	3	2	2							1
CO3	3	3		3	2							2
CO4	3	3	2	2	2							2
CO5	3	3	2	1	3							2
3- Strong;2-Medium;1-Some												

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Knowledge (Kn)	10	10	10
Apply (Ap)	40	40	60
Analyse (An)	10	10	30
Create (Cr)	0	0	0

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60PSE E24 -BRIDGE ENGINEERING								
M.E. STRUCTURAL 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	Topic	No.of Hours
1	**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	**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	**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	**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

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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	**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
	Total	**45**

Course Designers

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60PSE E25	NON LINEAR ANALYSIS OF STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- Analyze 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.

Prerequisite

Basic knowledge of Soil Mechanics, Geology & Mathematical

CourseOutcomes

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

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	10
Understand	10	10	10
Apply	20	10	30
Analyse	20	30	50
Evaluate	-	-	-
Create	-	-	-

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60PSE E25 -NON LINEAR ANALYSIS OF STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Elective II								
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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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2	**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	**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	**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	**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
	Total	**45**

Course Designers

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60PSE E26	ENVIRONMENTAL MONITORING INSTRUMENTS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To understand the chemical analysis of water
- To know the analysis of pollutants.
- To find the methods for toxic organics estimation.
- To learn the non-destructive methods of analysis.
- To provide knowledge about monitoring analyzers.

Pre requisite

Basic knowledge of Environmental Engineering courses

Course Outcomes

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

CO1	Able to select appropriate instrumental method for chemical analysis.	Knowledge/ Analyse/ Apply
CO2	Explore spectroscopic methods of analysis of pollutants	Knowledge/ Analyse/ Apply
CO3	Select the correct method for toxic organics estimation using chromatography methods	Knowledge/ Analyse/ Apply
CO4	Understand electro and nondestructive methods of analysis	Knowledge/ Analyse/ Apply
CO5	Identify the continuous monitoring instruments	Knowledge/ Analyse/ Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Knowledge (Kn)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60PSE E26 – ENVIRONMENTAL MONITORING INSTRUMENTS								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Fundamentals Wet chemistry methods and their limitations-instrumental methods, selection of method- precision and accuracy, error in measuring signals- quality control & assurance- sample preservation, sample preparation and analyte isolation.	**[09]**
Spectroscopic Methods Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace, cold vapour and hydride generation), Atomic Emission Spectrometry (AES), flame photometry and Inducted Coupled Plasma (ICP) – TOC Analyzer	**[12]**
Chromatrographic Methods Principles, techniques and applications of GC, GC-MS, high performance liquid chromatography (HPLC) and Ion Chromatography (IC)-hyphenated techniques for environmental contaminant (trace organics) analysis, ICP-MS	**[08]**
Electro and Radio Analytical Methods Principles, techniques and applications of conductometry, potentiometry, coulometry, AOX Analyzer. amperometry, polarography, electro-capillary analysis, Neutron Activation Analysis (NAA), X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods.	**[08]**
Continuous Monitoring Instruments Principles, techniques and applications of NDIR analyzer for CO, chemiluminescent analyzer for NOx, fluorescent analyzer for SO2- particulates analysis- auto analyzer for water quality using flow injection analysis. LIMS.	**[08]**
Total Hours	**45**

Textbook(s):

1. Bruce Wiersma G, “Environmental Monitoring” CRC Press, 2004
2. Paul R. Loconto Trace Environmental Quantitative Analysis: Principles, Techniques, and Applications, Marcel Dekker; 2nd Edition , 2005,

Reference(s):

1. Willard H. Merritt, L. Dean, D.A. and Settle, F.A. ‘Instrumental methods of analysis Edn. Words Worth, New York, 2004.
2. Ewing Instrumental Methods of Chemical Analysis, 5th Edition, McGraw Hill, New York.1985
3. Reeve, R.N., “Introduction to Environmental Analysis”, Analytical Techniques in the Sciences, John Wiley & Sons, Chichester, UK, 2002.
4. Barcelo, D.(editor), “Environmental analysis. Techniques, Applications and Quality Assurance”, Elsevier, The Netherlands, 1996

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Fundamentals**	
1.1	Wet chemistry methods	1
1.2	instrumental methods	2
1.3	error in measuring signals	2
1.4	quality control & assurance	2
1.5	sample preparation and analyte isolation	2
2	**Spectroscopic Methods**	
2.1	techniques and applications of spectrophotometry	2
2.2	fluorimetry, nephelometry and turbidimetry	2
2.3	Atomic Absorption Spectrometry	2
2.4	Atomic Emission Spectrometry	2
2.5	flame photometry and Inducted Coupled Plasma (ICP)	2
2.6	TOC Analyzer	2
3	**Chromatrographic Methods**	
3.1	Principles, techniques and applications of GC,	2
3.2	high performance liquid chromatography	2
3.3	Ion Chromatography	2
3.4	hyphenated techniques for environmental contaminant analysis	2
4	**Electro and Radio Analytical Methods**	
4.1	Introduction to Electro and Radio Analytical Methods	1
4.2	Principles, techniques and applications of conductometry, potentiometry, coulometry,	2
4.3	AOX Analyzer. amperometry, polarography	2
4.4	electro-capillary analysis	1
4.5	Neutron Activation Analysis	1
4.6	X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods.	1
5	**Continuous Monitoring Instruments**	
5.1	Principles, techniques and applications of NDIR analyzer for CO	2
5.2	chemiluminescent analyzer for NOx	2
5.3	fluorescent analyzer for SO2	1
5.4	particulates analysis	1
5.5	auto analyzer for water quality using flow injection analysis	2
	Total	**45**

Course Designers

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60PSE E27	MUNICIPAL SOLID WASTE MANAGEMENT	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To know the types, sources, generation of municipal solid waste
- To understand the Storage, collection, transport, of municipal solid waste.
- To learn the design and operation aspects of sanitary landfills.
- To acquire knowledge on waste processing
- To study the source reduction and onsite storage methods.

Pre requisite

Basic knowledge of properties learnt in waste management courses

Course Outcomes

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

CO1	. Identify the sources, types and characteristics of solid wastes. .	Knowledge/ Analyse/ Apply
CO2	Describe the health, environmental effects and solid waste management strategies	Knowledge/ Analyse/ Apply
CO3	Choose the on-site storage methods and segregation of municipal solid wastes	Knowledge/ Analyse/ Apply
CO4	Summaries the methods of collection and operating, maintenance of transfer station	Knowledge/ Analyse/ Apply
CO5	Explain the off-site processing techniques and equipments.	Knowledge/ Analyse/ Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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

Assessment Pattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Knowledge (Kn)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60PSE E27 – MUNICIPAL SOLID WASTE MANAGEMENT								
M.E – Structural Engineering								
Semester	Hours/Week			Total hrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
II	3	0	0	45	3	40	60	100

Sources and Types Sources and types of municipal solid wastes-Waste generation rates-factors affecting generation, characteristics-methods of sampling and characterization; Effects of improper disposal of solid wastes-Public health and environmental effects. Elements of solid waste management – Municipal solid waste (M&H) rules- Integrated management.- Social and Financial aspects; Public awareness; Role of NGO's	**[09]**
Source Reduction and On-Site Storage Source reduction of waste- Reduction, Reuse and Recycling - On-site storage methods- Effect of storage, materials used for containers- segregation of solid wastes – Public health and economic aspects of open storage – waste segregation and storage – case studies under Indian conditions.	**[09]**
Collection and Transfer Methods of Residential and commercial waste collection – Collection vehicles – Manpower – Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems – solving.	
Processing of Wastes Objectives of waste processing – Physical Processing techniques and Equipments; Resource recovery from solid waste composting and biomethanation; Thermal processing options- case Studies under Indian conditions.	**[09]**
Disposal Land disposal of solid waste; Sanitary landfills – site selection, design and operation of sanitary landfills –Landfill liners - Management of leach ate and landfill gas – Land fill Bioreactor.-Dumpsite Rehabilitation	**[09]**
TotalHours	**45**

Textbook(s):

1.	T.V Ramachandra, "Management of Municipal solid waste" TERI Press, 2010
2.	George Tchobanoglous and Frank Kreith, "Handbook of Solid waste Management", Mc Graw Hill, Newyork, 2002.

Reference(s):

1.	Handbook of Solid Waste Management (McGraw-Hill Handbooks), 2002
2.	Paul T Williams, "Waste Treatment and Disposal", John Wiley and Sons, 2000.
3.	Manual on Municipal Solid Waste Management, CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 2000.
4.	Manser A.G.R and Keeling A.A, "Practical Handbook of Processing and Recycling of Municipal solid Wastes", Lewis Publishers, CRC Press, 1996.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Sources and Types**	
1.1	Sources and types of municipal solid wastes	1
1.2	Waste generation rates	1
1.3	factors affecting generation	1
1.4	methods of sampling	1
1.5	Effects of improper disposal of solid wastes	1
1.6	Public health and environmental effects	1
1.7	Elements of solid waste management	1
1.8	Municipal solid waste (M&H) rules	1
1.9	Public awareness; Role of NGO's	1
2	**Source Reduction and On-Site Storage**	
2.1	Source reduction of waste	1
2.2	Reuse and Recycling	1
2.3	On-site storage methods-	2
2.4	Effect of storage on material	1
2.5	materials used for containers	1
2.6	segregation of solid wastes	1
2.7	Public health and economic aspects of open storage	1
2.8	waste segregation and storage	1
3	**Collection and Transfer** vehicles – Manpower –Collection routes – Analysis of collection systems; Transfer stations – Selection of location, operation & maintenance; options under Indian conditions – Field problems – solving. Me	
3.1	Methods of Residential and commercial waste collection	1
3.2	Collection vehicles	2
3.3	Collection routes	1
3.4	Analysis of collection systems	2
3.5	Transfer stations	1
3.6	Selection of location for transfer stations	1
3.7	operation & maintenance transfer stations	1
4	**Processing of Wastes**	
4.1	Objectives of waste processing	1
4.2	Physical Processing techniques and Equipments	2
4.3	Resource recovery from solid waste	2
4.4	composting and biomethanation	1

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4.5	biomethanation	1
4.6	Thermal processing options	1
4.7	case Studies	1
5	**Disposal**	
5.1	Land disposal of solid waste	1
5.2	Sanitary landfills site selection	1
5.3	design and operation of sanitary landfills	2
5.4	Landfill liners	1
5.5	Management of leach ate and landfill gas	2
5.6	Land fill Bioreactor	1
5.7	Dumpsite Rehabilitation	1
	Total	**45**

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60PSE E31	SOIL STRUCTURE INTERACTION	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

Basic knowledge of Soil Mechanics, Foundation Design & Geology.

CourseOutcomes

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	Apply
CO3	Formulate winkler foundation model for elastic continum	Understand
CO4	Calculate elastic medium for rectangular and circular plates	Apply
CO5	Estimate the load distribution in pile.	Analyze

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						

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Knowledge (Kn)	10	10	10
Apply (Ap)	40	40	60
Analyse (An)	10	10	30
Create (Cr)	0	0	0

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60PSE E31 -SOIL STRUCTURE INTERACTION								
M.E. STRUCTURAL ENGINEERING								
Elective III								
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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.7	Elastic continuum, two parameter elastic models	1
1.8	Elastic plastic behaviour	1
1.9	Time dependent behaviour	1
2	**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	**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	**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	**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
	Total	**45**

Course Designers

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		Category	L	T	P	Credit
60PSE E32	**DESIGN OF SHELL STRUCTURES**	**PE**	**3**	**0**	**0**	**3**

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Objective

- 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.

Prerequisite

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

Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60PSE E32 - DESIGN OF SHELL STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
Design of Folded Plates Folded Plate structures – structural behaviour – Types – Design by ACI – ASCE Task Committee method.	**[09]**
Space Frame - Design Philosophy Space frames – configuration – types of nodes – general principles of design Philosophy – Behaviour	**[09]**
Analysis of Space Frames Analysis of space frames – Formex Algebra, Formian – Detailed design of Space frames	**[09]**
Optimization Optimization by structural theorems – Maxwell, Mirchell and Heyman's Theorems for trusses and frames – Fully stressed design with deflection constraints – Genetic Algorithm.	**[09]**
TotalHours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Membrane Theory of Shells**	
1.1	Shell surfaces	1
1.2	Classification of shell surfaces	1
1.3	Surfaces of revolution	1
1.4	∆-forms of surfaces	2
1.5	Folded plates	2
1.6	Characteristics of shell surfaces.	2
2	**Design of Folded Plates**	

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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	**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	**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
4.8	Cylindrical shells – Equilibrium equations – Jenkin's theory	1
5	**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
	Total	**45**

Course Designers

1. Dr.K.VIJAYA SUNDRAVEL - vijayasundravel@ksrct.ac.in

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60PSE E33	OFF SHORE STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

CourseOutcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60PSE E33 -OFF SHORE STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
FORCES OF OFFSHORE STRUCTURES Wind forces, wave forces on small bodies and large bodies - current forces - Morison equation.	**[09]**
OFFSHORE SOIL AND STRUCTURE MODELLING Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.	**[09]**
ANALYSIS OF OFFSHORE STRUCTURES Static method of analysis, foundation analysis and dynamics of offshore structures.	**[09]**
DESIGN OF OFFSHORE STRUCTURES Design of platforms, helipads, Jacket tower, analysis and design of mooring cables and pipelines.	**[09]**
TotalHours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**FORCES OF OFFSHORE STRUCTURES**	
2.1	Design specification of API, DNV, Lloyd's and other classification societies	1

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2.2	Construction of jacket and gravity platforms 28102 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	**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	**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	**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
	Total	**45**

Course Designers

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60PSE E34	EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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 performnondestructive testing methods in structures

Prerequisite

Courses - Engineering Mathematics and Basic Science

CourseOutcomes

Onthesuccessful completion ofthecourse,studentswill beable to

CO1	Demonstrate the strain measuring equipment	Remember/ Understand/ Analyse/Apply
CO2	Understand various vibration measuring equipment	Remember/ Understand/ Analyse/Apply
CO3	Choose various data indicating and recording instrument.	Remember/ Understand/ Analyse/Apply
CO4	Outline the concept of photoelasticity	Remember/ Understand/ Analyse/Apply
CO5	Apply suitable non-destructive testing methods.	Remember/ Understand/ Analyse/Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		End SemExamination (Marks)
	1	2	
Remember(Re)	10	05	15
Understand(Un)	10	15	15
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)	-	-	-

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60PSE E34 -EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION								
M.E - STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[11]**
Vibration Measurements Linear Variable Differential Transducers (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs.	**[07]**
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.	**[09]**
Photoelasticity Photoelasticity – Optics of photoelasticity – Polariscope – Isoclinics and Isochromatics– Methods of stress separation	**[07]**
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).	**[11]**
TotalHours	**45**

Textbook(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.

CourseContentsandLectureSchedule

S.No	Topic	No.of Hours
1	**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

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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	**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	**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	**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	**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
	Total	**45**

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60PSE E35	MATRIX METHOD OF STRUCTURAL ANALYSIS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To learn the basic concepts of structural analysis.
- To know about the matrix analysis of structures by using flexibility method.
- To understand about the matrix analysis of structures by using stiffness method.
- To learn about matrix analysis of axial elements.
- To learn about matrix analysis of beams and frames

Prerequisite

Fundamentals of Mathematics, knowledge of basic Science

CourseOutcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	Continuous Assessment Tests (Marks)		End Sem Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	20	10	30
Analyse	20	30	50
Evaluate	-	-	-
Create	-	-	-

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K.S.Rangasamy College of Technology – Autonomous R2022								
60PSE E35 -MATRIX METHOD OF STRUCTURAL ANALYSIS								
M.E. STRUCTURAL 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

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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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1.7	Energy methods	1
1.8	Energy concepts based on displacement field	1
1.9	Energy concepts based on force field	1
2	**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	**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	**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
4.8	Analysis for the flexibility matrix	1
4.9	Problems in Flexibility matrix	1
5	**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
	Total	**45**

Course Designers

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Approved in Academic Council Meeting held on 03/06/2023

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60PSE E36	SECONDARY TREATMENT OF WASTEWATER	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- Process analysis and kinetics of secondary treatment
- To understand the process kinetics
- Suspended and attached growth treatment of wastewater
- To study the digestion process
- To find the attached growth treatment process.

Prerequisite

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

Course Outcomes

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

CO1	Identify the biological treatment process and analysis	Create
CO2	Evaluate the bio kinetic coefficients	Apply
CO3	Recognize the common physical, chemical and biological unit operations encountered in treatment process	Understand
CO4	Characterize the treatment process	Understand
CO5	Formulate the application of the attached growth treatment process.	Apply

Mapping with Programme Outcomes

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

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End Sem. Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60PSE E36- SECONDARY TREATMENT OF WASTEWATER								
M.E. STRUCTURAL ENGINEERING								
Elective III								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	3	0	0	45	3	40	60	100

Objective(s)	• Process analysis and kinetics of secondary treatment • To understand the process kinetics • Suspended and attached growth treatment of wastewater • To study the digestion process • To find the attached growth treatment process.
Course Outcomes	**At the end of the course, the students will be able to** 1. Identify the biological treatment process and analysis 2. Evaluate the biokinetic coefficients 3. Recognize the common physical, chemical and biological unit operations encountered in treatment process 4. Characterize the treatment process 5. Formulate the application of the attached growth treatment process

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Introduction, Process Analysis and Selection

Biological treatment processes – objectives - Choice of treatment method – Environmental impact and other considerations in planning the treatment – Cost of Wastewater treatment – Reactors used for the treatment – mass balance analysis – Reactions, Reaction rates – Enzyme reaction. Modeling of ideal flow and non ideal flow reactors – Reactors in parallel – Reactors in series – Tracer tests – Estimation of dispersion coefficient. [9]

Fundamentals of Process Kinetics

Role of microorganisms – Microbial growth kinetics - Biological oxidation process - loading – MCRT - F/ M ratio - Determination of biokinetic coefficients – Modelling of suspended growth treatment process – Description, Design and operating parameters – Modelling of plug flow reactors. [9]

Suspended Growth Treatment Process - Activated Sludge Process and Ponds

Treatment Process Loading – Biological & solids retention time – F/M ratio – Determination of Bio-kinetic constants – application of kinetics to Biological Treatment - Suspended Growth Treatment Process – Modelling of Suspended Growth Treatment Process – CFSTR – PFR - Design of Activated Sludge Process – Modifications (only theory) – Oxidation pond – Aerated lagoons – Oxygen requirements – arrangement for transfer of oxygen – Secondary clarifier - design features.

Stabilization ponds – Classification – Application – Process design, flow pattern and analysis of Aerobic ponds – Facultative ponds – Anaerobic ponds – maturation ponds – Construction and performance. [9]

Suspended Growth Treatment Process - Digestion Process

Sludge Digestion – Sources of sludge – Characteristics – Quantities – Anaerobic digestion – Process – Kinetic relationship – gas production – design considerations. Anaerobic treatment of liquid wastes – Anaerobic sludge blanket process – design considerations. Aerobic Digestion – Kinetics – Oxygen requirements – Design considerations [9]

Attached Growth Treatment Process

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Trickling Filter – Process – Classification - design based on popular design equations – NRC, Rankine's and Eckenfelder equation - Rotating Biological contactors – Anaerobic attached growth treatment processes – up flow packed bed – up flow expanded bed – Fluidized bed – Down flow bed. (Only theory) [9]

Total Hours: 45

Text book :

1	Garg, S.K., "Environmental Engineering" Vol. II, Khanna Publishers, New Delhi, 2003.

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2	Karia G L & Christian R A, “Wastewater Treatment”, Prentice Hall of India, New Delhi, 2013.
Reference(s) :	
1	Metcalf and Eddy, “Waste Water Engineering – Treatment and reuse”, Tata McGraw-Hill, New Delhi, 2003.
2	Arceivala S. J., “Waste Water Treatment and disposal, Marceldekker publishers, 1981.
3	Larry D. Benefield and Clifford W. Randall, “Biological process design for Wastewater Treatment”, 1980.
4	Howard S. Peavy, Donald R. Rowe and George Techobanoglous, “Environmental Engineering”, McGraw – Hill co., 1987.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction, Process Analysis and Selection**	
1.1	Biological treatment processes	1
1.2	Choice of treatment method	1
1.3	Environmental impact and other considerations in planning the treatment	1
1.4	Cost of Wastewater treatment	2
1.5	Reactors used for the treatment	2
1.6	Estimation of dispersion coefficient.	2
2	**Fundamentals of Process Kinetics**	
2.1	Role of microorganisms	1
2.2	Microbial growth kinetics	1
2.3	Biological oxidation process	2
2.4	Determination of biokinetic coefficients	1
2.5	Modelling of suspended growth treatment process	1
2.6	Design and operating parameters	1
2.7	Modelling of plug flow reactors.	1
2.8	Biological & solids retention time	1
2.9	Determination of Bio-kinetic constants	1
2.10	Determination of Bio-kinetic constants	1
3	**Suspended Growth Treatment Process - Activated Sludge Process and Ponds**	
3.1	Suspended Growth Treatment Process	2
3.2	Modelling of Suspended Growth Treatment Process	2
3.3	Design of Activated Sludge Process	1
3.4	Oxidation pond	1
3.5	Oxygen requirements	1
3.6	Arrangement For Transfer Of Oxygen	1
3.7	Secondary clarifier	1
4	**Suspended Growth Treatment Process - Digestion Process**	
4.1	Sludge Digestion	2
4.2	Sources of sludge	1

4.3	Anaerobic digestion	1
4.4	Kinetic relationship	1
4.5	Anaerobic treatment of liquid wastes	1
4.6	Anaerobic sludge blanket process	1
4.8	Design considerations. Aerobic Digestion	1
5	**Attached Growth Treatment Process**	
5.1	Attached Growth Treatment Process	2
5.2	Substrate Removal in Attached Growth Treatment Process	1
5.3	Trickling Filter	1
5.4	Design based on popular design equations	1
5.5	NRC, Rankine's and Eckenfelder equation	1
5.6	Rotating Biological contactors	1
5.7	Anaerobic attached growth treatment processes	1
5.8	Up flow packed bed	1
	Total	**45**

CourseDesigners

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60PSE E37	INDUSTRIAL WASTEWATER POLLUTION - PREVENTION AND CONTROL	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To know the industrial wastewater and laws
- To identify techniques and approaches for minimizing the generation.
- To find the treatment of physio chemical and biological treatment methods.
- To identify an Application of physio chemical and biological treatment methods for recovery, reuse and disposal.
- To know the supported with case studies under Indian situations.

Prerequisite

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

Course Outcomes

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

CO1	Discuss about the source and environmental impact of industrial waste water	Create
CO2	Able to develop the methods for prevention and control of industrial pollution	Apply
CO3	Formulate the various methods for industrial waste water treatment	Understand
CO4	Know about the design of effluent treatment plant	Understand
CO5	Identify the various case studies associated in industrial wastewater treatment	Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End Sem. Examination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60PSE E37- INDUSTRIAL WASTEWATER POLLUTION - PREVENTION AND CONTROL								
M.E. STRUCTURAL ENGINEERING								
Elective III								
Semester	**Hours / Week**			**Total Hours**	**Credit**	**Maximum Marks**		
	L	**T**	**P**		**C**	**CA**	**ES**	**Total**
II	3	0	0	45	3	40	60	100

Objective(s)	• To know the industrial wastewater and laws • To identify techniques and approaches for minimizing the generation . • To find the treatment of physio chemical and biological treatment methods. • To identify an Application of physio chemical and biological treatment methods for recovery, reuse and disposal. • To know the supported with case studies under Indian situations.
Course Outcomes	**At the end of the course, the students will be able to** 1. Discuss about the source and environmental impact of industrial waste water 2. Able to develop the methods for prevention and control of industrial pollution 3. Formulate the various methods for industrial waste water treatment 4. Know about the design of effluent treatment plant 5. Identify the various case studies associated in industrial wastewater treatment

Note: The hours given against each topic are of indicative. The faculty have the freedom to decide the hours required for each topic based on importance and depth of coverage required. The marks allotted for questions in the examinations shall not depend on the number of hours indicated.

Introduction

Industrial scenario in India– Industrial activity and Environment - Uses of Water by industry – Sources and types of industrial wastewater – Nature and Origin of Pollutants - Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Industrial waste survey – Industrial wastewater monitoring and sampling -generation rates, characterization and variables –Toxicity of industrial effluents and Bioassay tests – Major issues on water quality management [9]

Industrial Pollution Prevention

Prevention and Control of Industrial Pollution – Benefits and Barriers – Waste management Hierarchy - Source reduction techniques – Pollution Prevention of Assessment - Material balance - Evaluation of Pollution prevention options –Cost benefit analysis – payback period - Waste minimization Circles [9]

Industrial Wastewater Treatment

Equalisation - Neutralisation – Oil separation – Flotation – Precipitation – Heavy metal Removal– Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – carbon adsorption - Photocatalysis – Wet Air Oxidation – Evaporation – Ion Exchange – Membrane Technologies – Nutrient removal.- Treatability studies. [9]

Wastewater Reuse And Residual Management

Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse – Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and disposal of sludge – Management of RO rejects. [9]

Case Studies

Attached Growth Treatment Process – Substrate Removal in Attached Growth Treatment Process - Industrial manufacturing process description, wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil Refining – Pharmaceuticals – Sugar and Distilleries [9]

Total Hours: 45

Text book :

1	Bishop.P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International Edn. McGraw Hill Book Co., Singapore, 2000.
2	James. G. Mann and Liu.Y.A, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 1999

Reference(s) :

1	Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 2000.
2	Nelson Leonard Nemerow, "Industrial waste treatment – contemporary practice and vision for the future", Elsevier, Singapore, 2007
3	Frank Woodard, "Industrial waste treatment Handbook", Butterworth Heinemann, New Delhi, 2001.
4	Paul L. Bishop, "Pollution Prevention: - Fundamentals and Practice', Mc-Graw Hill International, Boston, 2000.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Introduction**	
1.1	Industrial scenario in India	1
1.2	Industrial activity and Environment	1
1.3	Uses of Water by industry	1
1.4	Sources and types of industrial wastewater	2
1.5	Nature and Origin of Pollutants	2
1.6	Toxicity of industrial effluents and Bioassay tests	2
2	**Industrial Pollution Prevention**	
2.1	Prevention and Control of Industrial Pollution	1
2.2	Benefits and Barriers	1
2.3	Waste management Hierarchy	2
2.4	Source reduction techniques	1
2.5	Pollution Prevention of Assessment	1
2.6	Material balance	1
2.7	Evaluation of Pollution prevention options	1
2.8	Cost benefit analysis	1
2.9	Payback period	1
2.10	Waste minimization Circles	1
3	**Industrial Wastewater Treatment**	
3.1	Aerobic and anaerobic biological treatment	2
3.2	carbon adsorption	2
3.3	Wet Air Oxidation	1
3.4	Ion Exchange	1
3.5	Oxygen requirements	1
3.6	Membrane Technologies	1
3.7	Treatability studies.	1
4	**Wastewater Reuse And Residual Management**	
4.1	Joint treatment of industrial and domestic wastewater	2
4.2	Industrial reuse , Present status and issues	1
4.3	Disposal on water and land	1
4.4	Residuals of industrial wastewater treatment	1
4.5	Quantification and characteristics of Sludge	1
4.6	Thickening, digestion, conditioning, dewatering and disposal of sludge	1
4.8	Management of RO rejects.	1
5	**Case Studies**	
5.1	Attached Growth Treatment Process	2
5.2	Substrate Removal in Attached Growth Treatment Process	1

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5.3	Industrial manufacturing process description	1
5.4	wastewater characteristics, source reduction options and waste treatment flow sheet for Textiles	1
5.5	Tanneries	1
5.6	Pulp and paper	1
5.7	Metal finishing	1
5.8	Sugar and Distilleries	1
	Total	**45**

CourseDesigners

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		Category	L	T	P	Credit
60PSE E41	**CADD for Structures**	**PE**	**3**	**0**	**0**	**3**

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Objective

- To gain knowledge on Computer graphics and drafting software packages
- To analyze 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

Prerequisite

Courses –Structural Analysis, RCC and Steel Design

CourseOutcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember(Re)	05	10	10
Understand(Un)	05	10	20
Apply (Ap)	30	20	40
Analyse (An)	20	20	30
Create (Cr)	-	-	-

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K.S.Rangasamy College of Technology–Autonomous R2022								
60PSE E41 - CADD FOR STRUCTURES								
M.E STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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	**[09]**
Structural Analysis Computer methods of structural analysis - Finite Element programming – Analysis through application packages	**[09]**
Structural Design Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials	**[09]**
Optimization Linear programming - Simplex algorithm - Post-optimality analysis – Project scheduling - CPM and PERT applications Genetic algorithm and applications	**[09]**
Artificial Intelligence Introduction - Heuristic search - knowledge based expert systems - Architecture and applications of KBES - Expert system shells - Principles of neural network.	**[09]**
TotalHours	**45**

Textbook(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

CourseContentsandLectureSchedule

S.No	Topic	No.of Hours
1	**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

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2	**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	**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	**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	**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
	Total	**45**

CourseDesigner

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60PSE E42	DESIGN OF INDUSTRIAL STRUCTURE	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember	10	10	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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K.S.Rangasamy College of Technology–Autonomous R2022								
60PSE E42 - DESIGN OF INDUSTRIAL STRUCTURE								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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	**[09]**
Portal Frames Design of portal frame with hinge base, design of portal frame with fixed base – Gable Structures – Lightweight Structures	**[09]**
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..	**[09]**
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.	**[09]**
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	**[09]**
TotalHours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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

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2	**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	**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	**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	**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
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E43	DISASTER RESISTANT STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	3	3	2	3	3	3	2	2	3
CO2	3	3	3	3	3	3	3	3	3	3	2	2
CO3	3	2	3	2	3	3	2	2	3	3	2	3
CO4	2	2	3	3	2	2	2	2	3	3	2	3
CO5	3	3	3	3	3	3	3	3	2	2	2	3
3- Strong;2-Medium;1-Some												

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Remember(Re)	10	10	20
Understand(Un)	10	15	20
Apply (Ap)	35	30	50
Analyse (An)	05	05	10
Create (Cr)	-	-	-

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60PSE E43- DISASTER RESISTANT STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
Community Structures Response of dams, bridges, buildings ,Strengthening measures , Safety analysis and rating – Reliability assessment	**[09]**
Rehabilitation and Retrofitting Testing and evaluation - Classification of structures for safety point of view – methods of strengthening for different disasters - qualification test – different techniques	**[09]**
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.	**[09]**
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.	**[09]**
TotalHours	**45**

Textbook(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

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**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	**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	**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	**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 foundationimpact on safety	2
5.6	Ground improvement techniques.	2
	Total	**45**

Course Designer

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E44	INDUSTRIAL STEEL STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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(Re)	10	10	20
Understand(Un)	10	15	20
Apply (Ap)	35	30	50
Analyse (An)	05	05	10
Create (Cr)	-	-	-

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60PSE E44- INDUSTRIAL STEEL STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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.	**[09]**
Industrial Building Roofs for Industrial Buildings- Steel shell roofs- Gantry Girders- Design of gantry columns	**[09]**
Industrial Appurtenances Bunkers and Silos - Chimney and cooling Towers – Design of steel storage tanks	**[09]**
Design of Lattice Towers Micro wave towers - Transmission Line Towers – pipe track structures- Tower Foundations – Testing towers.	**[09]**
Design of Pre Engineered Structures Introduction-section specification-Types of assemblies –analysis and design of pre engineered structure- connection details	**[09]**
TotalHours	**45**

Textbook(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.

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**Industrial Building**	

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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	**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	**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	**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
	Total	**45**

Course Designer

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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60 PSE E45	CORROSION ENGINEERING	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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(Re)	10	10	20
Understand(Un)	10	15	20
Apply (Ap)	35	30	50
Analyse (An)	05	05	10
Create (Cr)	-	-	-

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60 PSE E45 - CORROSION ENGINEERING								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Totalhrs	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.	**[09]**
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.	**[09]**
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.	**[09]**
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.	**[09]**
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.	**[09]**
TotalHours	**45**

Textbook(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.

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**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	**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	**CORROSION TESTING**	
4.1	Introduction – Classification – Purpose – Materials and specimens	1
4.2	surface preparation – Measuring & Weighing – Exposure Techniques	1

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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	**CORROSION PREVENTION**	
5.1	Materials Selection: Metals & Alloys	1
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
	Total	**45**

Course Designer

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E46	PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM

Category	L	T	P	Credit
PE	3	0	0	3

Objective

- To know the Principles of Aerobic and anaerobic treatment of waste water.
- To design the Aerobic treatment of waste water.
- To identify the anaerobic treatment of waste water.
- To find out the solution of sludge treatment.
- To Know the Construction, operation and maintenance of waste water treatment units

Pre requisite

Basic knowledge of properties learnt in basics of Biological treatment system

Course Outcomes

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

CO1	Able to develop conceptual schematics required for biological treatment of wastewater	Knowledge/ Analyse/ Apply
CO2	Ability to translate pertinent criteria into system requirements	Knowledge/ Analyse/ Apply
CO3	Analyze the and best solution for anaerobic treatment of wastewater	Knowledge/ Analyse/ Apply
CO4	Design the sludge digestion process.	Knowledge/ Analyse/ Apply
CO5	Identify the construction operation and maintenance aspects	Knowledge/ Analyse/ Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Knowledge (Kn)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60PSE E46- PRINCIPLES AND DESIGN OF BIOLOGICAL TREATMENT SYSTEM

M.E. STRUCTURAL ENGINEERING

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

Principles **[09]**

Objectives of biological treatment – significance – aerobic and anaerobic treatment kinetics of biological growth – Factors affecting growth – attached and suspended growth Determination of Kinetic coefficients for organics removal – Biodegradability assessment -selection of process-reactors-batch-continuous type-kinetics

Design of Aerobic Treatment Systems **[09]**

Design of sewage treatment plant units –Activated Sludge process and variations, Sequencing Batch reactors, Membrane Biological Reactors-Trickling Filters-Bio Tower-RBC-Moving Bed Reactors-fluidized bed reactors, aerated lagoons, waste stabilization ponds – nutrient removal systems – natural treatment systems, constructed wet land – Disinfectant – disposal options – reclamation and reuse – Flow charts, layout, hydraulic profile, recent trends

Anaerobic Treatment of Wastewater

Attached and suspended growth, Design of units – UASB, up flow filters, Fluidized beds septic tank and disposal – Nutrient removal systems – Flow chart Layout and Hydraulic profile – Recent trends.

Sludge Treatment and Disposal **[09]**

Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout PID hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

Construction Operations and Maintenance Aspects **[09]**

Construction and Operational Maintenance problems – Trouble shooting – Planning, Organizing and Controlling of plant operations – capacity building, Case studies – sewage treatment plants – sludge management facilities

TotalHours **45**

Textbook(s):

1. Arceivala, S.J., “Wastewater Treatment for Pollution Control”, TMH, New Delhi, Second Edition, 2000.
2. Garg, S.K., “Environmental Engineering” Vol. II, Khanna Publishers, New Delhi, 2003.

Reference(s):

1. Manual on “Sewerage and Sewage Treatment” CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2. Metcalf & Eddy, INC, ‘Wastewater Engineering – Treatment and Reuse”, Fourth Edition, Tata Mc Graw-Hill Publishing Company Limited, New Delhi, 2003.
3. Qasim, S.R. “Wastewater Treatment Plant, Planning, Design & Operation”, Technomic Publications, Newyork, 1994.
4. Karia G L & Christian R A, “Wastewater Treatment”, Prentice Hall of India, New Delhi, 2013.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Principles**	
1.1	Objectives of biological treatment	1
1.2	aerobic and anaerobic treatment kinetics of biological growth	2
1.3	Factors affecting growth	1
1.4	attached and suspended growth	1
1.5	Determination of Kinetic coefficients for organics removal	1
1.6	Biodegradability assessment	1
1.7	Classification of reactors	1
1.8	batch-continuous type	1
2	**Design of Aerobic Treatment Systems**	
2.1	Design of sewage treatment plant units	1
2.2	Activated Sludge process	1
2.3	Sequencing Batch reactors	1
2.4	Membrane Biological Reactors	1
2.5	Trickling Filters	1
2.6	Moving Bed Reactors and fluidized bed reactors	1
2.7	aerated lagoons and waste stabilization ponds	1
2.8	constructed wet land	1
2.9	reclamation and reuse	
3	**Anaerobic Treatment of Wastewater**	
3.1	Attached and suspended growth	2
3.2	Design of units - UASB	2
3.3	Nutrient removal systems	1
3.4	septic tank and disposal	1
3.5	septic tank and disposal	1
3.6	Flow chart Layout and Hydraulic profile	2
4	**Sludge Treatment and Disposal**	
4.1	Design of sludge management facilities,	1
4.2	sludge thickening, sludge digestion	2
4.3	biogas generation	2
4.4	sludge dewatering	1
4.5	Layout PID hydraulics profile	1
4.6	upgrading existing plants	1
4.7	ultimate residue disposal	1
5	**Construction Operations and Maintenance Aspects**	
5.1	Construction and Operational Maintenance problems	2
5.2	Trouble shooting	1
5.3	Planning, Organizing and Controlling of plant operations	1

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5.4	capacity building	1
5.5	sewage treatment plants	2
5.6	sludge management facilities	1
5.7	Case studies	1
	Total	**45**

CourseDesigners

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R1/ w.e.f. 12.07.2023
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60PSE E47	TRANSPORT OF WATER AND WASTE WATER	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To understand the fluid characteristics
- To know concepts related to water transmission mains
- To find the water distribution system, sewer networks and
- To design the storm water drain, with emphasis on computer application.
- To know the Case studies on transportation of water and waste water

Pre requisite

Basic knowledge of Environmental Engineering courses

Course Outcomes

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

CO1	Understand the general hydraulics and principles of flow measurements.	Knowledge/ Analyse/ Apply
CO2	Describe the components of water transmission system.	Knowledge/ Analyse/ Apply
CO3	Analyze the water distribution networks plan the wastewater collection from various sources	Knowledge/ Analyse/ Apply
CO4	Evaluate the conveyance of wastewater and various appurtenances	Knowledge/ Analyse/ Apply
CO5	Estimate the storm water drainage quantity by various methods.	Knowledge/ Analyse/ Apply

Mapping with Programme Outcomes

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

Assessment Pattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		End SemExamination (Marks)
	1	2	
Knowledge (Kn)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60PSE E47 - TRANSPORT OF WATER AND WASTE WATER								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	Credit	Maximum Marks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

General Hydraulics and Flow Measurement Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.	**[09]**
Water Transmission and Distribution Need for Transport of water and waste water-Planning of water system-Selection of pipe materials-Water transmission main design-gravity and pumping main, selection of pumps-characteristics-economics; specials, jointing and maintenance, water hammer analysis, water distribution pipe network design, analysis and optimization-appurtenances-corrosion prevention-minimization of water losses-leak detection, storage reservoir.	**[09]**
Wastewater Collection and Conveyance Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.	**[09]**
Storm Water Drainage Necessity- combined and separate system; Estimation of storm water run off Formulation of rainfall intensity duration and frequency relationships- Rational methods.	**[09]**
Case Studies and Software Applications Use of computer software in water transmission, water distribution and sewer design – LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based soft ware's.	**[09]**
TotalHours	**45**

Textbook(s):

1.	Bajwa, G.S. "Practical Handbook on Public Health Engineering", Deep Publishers, Shimla, 2003
2.	M.J.Hammer, "Water and Wastewater Technology", Regents / Prentice Hall, New Jercy, 2001.

Reference(s):

1.	"Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
2.	"Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.
3.	Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications.
4.	Syed R Qasim, "Wastewater Treatment Plants – Planning, Design and Operations, CRC Press Additional Learning Source

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**General Hydraulics and Flow Measurement**	
1.1	Fluid properties	1
1.2	fluid flow – continuity principle, energy principle and momentum principle	2
1.3	frictional head loss in free and pressure flow	2
1.4	minor heads losses	2
1.5	Flow measurement	2
2	**Water Transmission and Distribution** .	

2.1	Need for Transport of water and waste water	1
2.2	Planning of water system	1
2.3	Selection of pipe materials	1
2.4	Water transmission	1
2.5	selection of pumps	1
2.6	jointing and maintenance	1
2.7	water distribution pipe network design	1
2.8	appurtenances	1
2.9	minimization of water losses	1
3	**Wastewater Collection and Conveyance**	
3.1	Design of sanitary sewer	1
3.2	partial flow in sewers	2
3.3	Wastewater pumps and pumping stations	1
3.4	sewer appurtenances	1
3.5	inspection and maintenance of sewers	1
3.6	Design of sewer outfalls	2
3.7	Conveyance of corrosive wastewaters.	1
4	**Storm Water Drainage**	
4.1	Necessity of storm water drainage	1
4.2	combined and separate system	2
4.3	Estimation of storm water run off	2
4.4	Formulation of rainfall intensity duration	2
4.5	Frequency Analysis	1
4.6	Rational methods.	1
5	**Case Studies and Software Applications**	
5.1	Use of computer software in water transmission	2
5.2	water distribution and sewer design	2
5.3	LOOP version 4.0	1
5.4	SEWER -BRANCH	1
5.5	Canal ++	1
5.6	GIS based soft wares	2
	Total	**45**

Course Designers

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60 PSE E51	PRESTRESSED CONCRETE STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- Understand the principles and general mechanical behavior of prestressed concrete
- To analyze 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.
- Analyze and design of composite members and special structural elements like water tank, poles, pipes.

Prerequisite

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

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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60 PSE E51 - PRESTRESSED CONCRETE STRUCTURES								
M.E. STRUCTURAL ENGINEERING								
Elective V								
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

Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**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	**Design of Flexural Members**	
2.1	Behaviour of flexural members	1
2.2	Determination Of Ultimate Flexural Strength	1

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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	**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	**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	**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
	Total	**45**

CourseDesigners

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60PSE E52	ADVANCED CONCRETE TECHNOLOGY	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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 requisite

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	Analyse/ Apply
CO2	Describe the special concretes	Remember
CO3	Outline the durability of concrete.	Remember/ Analyse/
CO4	Identify the concepts form work and quality control	Remember
CO5	Illustrate the behavior of concreting under special circumstances.	Remember

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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 (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

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60 PSE E52 - ADVANCED CONCRETE TECHNOLOGY								
M.E. STRUCTURAL 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 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	Topic	No.of Hours
1	**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	**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	**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	**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

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4.7	Quality Management.	1
5	**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
	Total	**45**

CourseDesigners

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Passed in BoS Meeting held on 19.05.2023
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60 PSE E53	ASEISMIC DESIGN OF STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

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.	Remember, Understand, Apply
CO2	Define the basic concepts of elements of vibration and behavior of structures under cyclic loading.	Remember, Understand, Analyze
CO3	Practice the codal provisions for design and detailing of earthquake resistant structures.	Remember, Understand, Apply, Analyze
CO4	Formulate the design principles for Non-engineered buildings and design provisions for bridges and dams.	Analyze
CO5	Categorize the new concepts on different types of base isolation techniques.	Understand and Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	10
Understand	10	10	10
Apply	20	10	30
Analyse	20	30	50
Evaluate	-	-	-
Create	-	-	-

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K.S.Rangasamy College of Technology – Autonomous R2022

60 PSE E53 - ASEISMIC DESIGN OF STRUCTURES

M.E. STRUCTURAL ENGINEERING

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

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Course Contents and Lecture Schedule

S.No	Topic	No. of Hours
1	**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	**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	**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	**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	**Base Isolation Techniques**	
5.1	Modern Concepts	1
5.2	Base Isolation	3
5.3	Adoptive systems	3
5.4	Case studies	2
	Total	**45**

Course Designers

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

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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TIRUCHENGODE - 637 215

60 PSE E54	MAINTENANCE AND REHABILITATION OF STRUCTURES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- 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

Prerequisite

Fundamentals of Mathematics, knowledge of properties of construction materials and its mechanics 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.	Understand
CO2	Evaluate the basic concepts of the corrosion.	Evaluate
CO3	Point out various types of techniques to repair crack, wear, fire and leakage.	Create
CO4	Study the various types and properties of repair materials.	Remember
CO5	Describe the various demolition techniques and demolition methods	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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	10
Understand	10	10	10
Apply	10	10	20
Analyse	10	10	20
Evaluate	10	10	10
Create	10	10	30

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Passed in BoS Meeting held on 19.05.2023
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K.S.Rangasamy College of Technology - Autonomous R2022

60PSE E54 MAINTENANCE AND REHABILITATION OF STRUCTURES

M.E. STRUCTURAL ENGINEERING

Elective V

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 [9]

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.

Durability of Structures [9]

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.

Maintenance and Repair Strategies [9]

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.

Materials for Repair [9]

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, ferro cement concrete, fibre reinforced concrete, eliminators and polymers coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete.

Techniques for Repair and rehabilitation of structures [9]

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

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	Topic	No.of Hours
1	**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	**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	**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	**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
4.8	Foamed Concrete, Mortar and Dry Pack, Vacuum Concrete	1
5	**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

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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
	Total	**45**

CourseDesigners

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60 PSE E55	MODERN CONSTRUCTION MATERIALS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To gain knowledge of modern construction materials to be used in the field.
- To study about special concrete commonly used in civil engineering construction.
- To understand the properties of metals and its applications.
- To study about the properties of various water proofing materials.
- To adopt smart materials for smart structures.

Pre requisite

Basic knowledge of properties of construction materials.

Course Outcomes

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

CO1	Understand the properties of special concrete and its applications.	Analyse/ Apply
CO2	Learn about various types of metals and its properties.	Knowledge
CO3	Gain knowledge about various composite materials and its applications in concrete construction.	Knowledge/ Analyse/
CO4	Learn about various water proofing materials and its functions.	Knowledge
CO5	Study about types of smart materials and its applications.	Knowledge

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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 (Marks)		End Sem Examination (Marks)
	1	2	
Remember (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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K.S.Rangasamy College of Technology - Autonomous							R2022
60PSEE55 - MODERN CONSTRUCTION MATERIALS							
M.E. STRUCTURAL 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

Special Concretes Concretes, Behaviour of concretes - High Strength and High Performance Concrete – Fibre Reinforced Concrete, Self compacting concrete, Alternate Materials to concrete.	[9]
Metals Steels - New Alloy Steels – Aluminum and its Products –Coatings to reinforcement – Applications.	[9]
Composites Plastics –Reinforced Polymers – FRP – Applications	[9]
Other Materials Water Proofing Compounds – Non-weathering Materials – Flooring and Facade Materials	[9]
Smart and Intelligent Materials Smart and Intelligent Materials for intelligent buildings - Special features	[9]
	Total Hours:45

Text book(s):	
1	Ganapathy, C., Modern Construction Materials, Eswar Press, 2015.
2	Shetty M.S, “Concrete Technology: Theory and Practice”, S.Chand & Company Ltd., 2005.
Reference(s) :	
1	Shan Somayaji, “Civil Engineering Materials”, Prentice Hall Inc., 2001.
2	Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi, 2005.
3	S K Sharma, "Civil Engineering and construction material," Khanna Publuishing House, 2016.
4	ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2002.

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Special Concretes**	
1.1	Concretes – introduction	1
1.2	Types of concrete	1
1.3	Behaviour of concretes	1
1.4	Behaviour of concretes	1
1.5	High Strength and High Performance Concrete	1
1.6	High Strength and High Performance Concrete	1
1.7	Fibre Reinforced Concrete	1
1.8	Self-compacting concrete	1
1.9	Alternate Materials to concrete	1
2	**Metals**	
2.1	Steels – Introduction and Manufacturing	1
2.2	New Alloy Steels	2
2.3	Aluminum and its Products	2
2.4	Coatings to reinforcement	2
2.5	Applications	2
3	**Composites**	
3.1	Plastics - Introduction	2
3.2	Plastics - Applications and Types	2
3.3	Reinforced Polymers	2
3.4	FRP	2
3.5	Applications	1
4	**Other Materials**	
4.1	Water Proofing Compounds	1
4.2	Non-weathering Materials	3
4.3	Flooring Materials	3
4.4	Facade Materials	2
5	**Smart and Intelligent Materials**	
5.1	Smart Materials - Introduction	1
5.2	Smart and Intelligent Materials for intelligent buildings	3
5.3	Smart and Intelligent Materials for intelligent buildings	3
5.4	Special features	2
	Total	**45**

CourseDesigners

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60PSE E56	REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- The fact related to hydrology
- Acquired the knowledge about important terms and definitions related to drainage basin.
- Familiar to use the remote sensing and GIS as a tool in the field of assessing the water resources.
- Groundwater quality and potential can be studied through modeling.
- Knowledge on effective management over the surface groundwater by mapping and modeling.

Pre requisite

Basic knowledge of Remote Sensing and GIS courses

Course Outcomes

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

CO1	Understand about hydrological cycle and its various stages.	Knowledge/ Analyse/ Apply
CO2	Acquired knowledge on remote sensing and GIS techniques effective usage in water resources application oriented data interpretation model creation.	Knowledge/ Analyse/ Apply
CO3	Understand the fundamental procedure which are most necessary for water shed management	Knowledge/ Analyse/ Apply
CO4	Familiar to GIS mapping concept through which multiple levels of assessment could be done in the field of natural disasters.	Knowledge/ Analyse/ Apply
CO5	Understand about thematic mapping preparation for groundwater related GIS analysis of spatial and temporal distribution	Knowledge/ Analyse/ Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	3	3
CO2	3	2	2	3	3	2
CO3	2	3			3	2
CO4	3	2		2	3	1
CO5	3	2	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 (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

R1/ w.e.f. 12.07.2023
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60PSE E56 – REMOTE SENSING AND GIS FOR HYDROLOGY AND WATER RESOURCES.

M.E. STRUCTURAL ENGINEERING

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

.**Basics of Hydrology** Hydrological cycle – estimation of various components of hydrology cycle – clouds –rainfall – runoff – evaporation – transpiration – evapo–transpiration – interception – depression storage – spectral properties of water – GIS application in surface water modeling – case studies.	**[09]**
Drainage Basin Watershed divide – stream networks – Delineation and codification of watersheds morphometric analysis – linear – areal –relief aspects – Rainfall- runoff modeling – urbanhydrology – case studies.	**[09]**
Areal Assessment Mapping of snow covered area – snow melt runoff – flood forecasting, risk mapping and flood damage assessment soil moisture area – drought forecasting and damage assessment – GIS application in aerial assessment – case studies	**[09]**
Ground Water and Water Quality Ground water prospects – surface water indicators – vegetation , geology, soil aquifer – aquifer parameters – well hydraulics – estimation of ground water potential – hydrologic budgeting – mathematical models – GIS application in ground water modeling – study on sea water intrusion – modeling of sea water intrusion – water quality parameters – physical, chemical, biological properties. Water quality mapping and monitoring – correlation model for pollution detection and suspended sediment concentration– case studies.	**[09]**
Irrigation and Watershed Management Project investigation, implementation, maintenance stage- location of storage/ diversion works – canal alignment –depth-area capacity curve generation, - conjunctive use of surface and ground water – Mapping and monitoring the catchment command area – artificial recharge of groundwater – water harvesting structures – sediment yield – modeling of reservoir siltation – prioritization of watershed –modeling of sustainable development – Development of information system for Natural resource management – case studies.	**[09]**
TotalHours	**45**

Textbook(s):

1. U M Shamsi, “GIS Applications for Water, Wastewater”, and Storm water Systems,CRC, 1st Edition 2005.
2. Andy D Ward and Stanley W Trimble, “Environmental Hydrology”, Lewis Publishers, 2004.

Reference(s):

1. David Maidment, Dean Djokic, “Hydrologic and Hydraulic Modeling Support with Geographic Information Systems”, Esri Press, 2000.
2. Wilfried Brutsaert, “Hydrology: An Introduction”, Cambridge University Press, 2005.
3. C Eri, Barrett, Clare H Power, “Satellite Remote Sensing for Hydrology and Water Management”, Gordon @ Breach Science publications, Newyork 1990.
4. Yangbo Chen, Christopher Neale, Ian Cluckie, Z Su Jianzhong, Zhou Qiang Huang and Zongxue Xu “Remote Sensing and GIS for Hydrology and Water Resources” IAHS Proceedings & Reports, Paperback – Import, 2015.

R1/ w.e.f. 12.07.2023
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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Basics of Hydrology**	
1.1	Hydrological cycle	1
1.2	estimation of various components of hydrology cycle	2
1.3	Rainfall and runoff	1
1.4	evaporation & transpiration	1
1.5	Evapo-transpiration and interception	1
1.6	spectral properties of water	1
1.7	GIS application in surface water modeling	2
2	**Drainage Basin**	
2.1	Introduction to watershed management	1
2.2	Delineation and codification of watersheds morphometric analysis	4
2.3	relief aspects	1
2.4	runoff modeling	2
2.5	urban hydrology	1
3	**Areal Assessment**	
3.1	Mapping of snow covered area	2
3.2	snow melt runoff	1
3.3	flood forecasting	1
3.4	flood damage assessment	1
3.5	drought forecasting and damage assessment	2
3.6	GIS application in aerial assessment	2
4	**Ground Water and Water Quality**	
4.1	surface water indicators	1
4.2	aquifer parameters	1
4.3	estimation of ground water potential	1
4.4	hydrologic budgeting	1
4.5	GIS application in ground water modeling	2
4.6	water quality parameters	1
4.7	correlation model for pollution detection and suspended sediment concentration	2
5	**Irrigation and Watershed Management**	
5.1	Project investigation	1
5.2	location of storage/ diversion works	1
5.3	canal alignment	2
5.4	Mapping and monitoring the catchment command area	1
5.5	artificial recharge of groundwater	1
5.6	modeling of reservoir siltation	2

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5.7	Development of information system for Natural resource management	1
	Total	**45**

CourseDesigners

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60PSE E57	PRINCIPLES AND DESIGN OF PHYSiCO-CHEMICAL TREATMENT SYSTEMS	Category	L	T	P	Credit
		PE	3	0	0	3

Objective

- To know the working principles and characteristics of physio-chemical treatment.
- To design of various physical treatment systems for water and wastewater.
- To find the chemical treatment systems for water and wastewater.
- To understand and design of municipal water treatment plant
- **To design the wastewater treatment plant**

Pre requisite

Basic knowledge of Environmental Engineering courses

Course Outcomes

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

CO1	Know about pollutant in water and wastewater	Remember / Analyse/ Apply
CO2	Able to develop conceptual schematics required for the physical treatment of water and wastewater	Remember / Analyse/ Apply
CO3	Ability to create the principles and applications of chemical treatment	Remember /Analyse/ Apply
CO4	Formulate the preliminary design of municipal water treatment plant	Remember / Analyse/ Apply
CO5	To gain knowledge about design of wastewater treatment plant	Remember / Analyse/ Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	3	3	2
CO2	3	2	3	3	3	3
CO3	3	3	2		2	2
CO4	3	3		3	3	2
CO5	2	2		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 (Re)	20	20	30
Apply (Ap)	30	20	50
Analyse (An)	10	20	20
Create (Cr)		-	-

R1/ w.e.f. 12.07.2023
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60PSE E57 - PRINCIPLES AND DESIGN OF PHYSICO-CHEMICAL TREATMENT SYSTEMS								
M.E. STRUCTURAL ENGINEERING								
Semester	Hours/Week			Totalhrs	Credit	MaximumMarks		
	L	T	P		C	CA	ES	Total
III	3	0	0	45	3	40	60	100

Classification of Pollutants Pollutants in water and wastewater – characteristics, Standards for performance Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type-kinetics.	**[09]**
Physical Treatment Principles Principles of Screening – Mixing, Equalization – Sedimentation – Filtration – Modeling back washing – Evaporation – Incineration – gas transfer – mass transfer coefficient Adsorption – Isotherms – Principles, kinetics, regeneration membrane separation, Reverse Osmosis, nano filtration, ultra filtration and hyper filtration electrodialysis, distillation – stripping and crystallization – Recent Advances.	**[09]**
Chemical Treatment Principles Principles of Chemical treatment – Coagulation flocculation – Precipitation – flotation solidification and stabilization – Disinfection, Ion exchange, Electrolytic methods, Solvent extraction – advanced oxidation /reduction – Recent Trends	**[09]**
Design of Municipal Water Treatment Plant Selection of Treatment – Design of municipal water treatment plant units – Aerators – chemical feeding – Flocculation – clarifies – tube settling – filters – Rapid sand filters slow sand filter, pressure filter, Dual media inlets Displacement and gaseous type. Design of Industrial Water Treatment Units- Selection of process – Design of softeners – Demineralisers –Reverse osmosis plants –flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends – Software application.	**[09]**
Design of Wastewater Treatment Plants Design of municipal wastewater treatment units-screens-detritors-grit chamber-settling tanks-sludge thickening-sludge dewatering systems-sludge drying beds - Design of Industrial Wastewater Treatment Units-Equalization- Neutralization-Chemical Feeding Devices-mixers-floatation units-oil skimmer- flow charts – Layouts –Hydraulic Profile PID construction and O&M aspects – case studies, Residue management – Upgradation of existing plants – Recent Trends – Software application.	**[09]**
TotalHours	**45**

Textbook(s):

1. Metcalf and Eddy, “Wastewater Engineering”, Treatment and Reuse, Tata McGraw Hill, New Delhi, 2003.
2. Sincero and Sincero, Environmental Engineering: A Design Approach, Prentice Hall India Learning, 2009

Reference(s):

1. Qasim, S.R., Motley, E.M. and Zhu.G. “Water works Engineering – Planning, Design and Operation”, Prentice Hall, New Delhi, 2002.
2. Lee, C.C. and Shun dar Lin, “Handbook of Environmental Engineering Calculations”, Mc Graw Hill, Newyork, 1999.
3. Hendricks, D. ‘Water Treatment Unit Processes – Physical and Chemical’ CRC Press, Newyork, 2006.
4. Larry D Benefield, “Process Chemistry for water and wastewater Treatment”, Prentice Hall Publications

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Course Contents and Lecture Schedule

S.No	Topic	No.of Hours
1	**Classification of Pollutants**	
1.1	Pollutants in water and wastewater	1
1.2	Characteristics, standards for performance	2
1.3	Significance of physico-chemical treatment	2
1.4	Selection criteria and types of reactor	2
1.5	Batch-continuous type	2
2	**Physical Treatment Principles**	
2.1	Principles of Screening	1
2.2	Sedimentation	2
2.3	Filtration	2
2.4	Evaporation and Incineration	1
2.5	Mass transfer coefficient Adsorption	1
2.6	Principles and kinetics	1
2.7	Reverse Osmosis	1
2.8	Nano filtration, ultra filtration and hyper filtration	1
2.9	Electrodialysis and distillation	1
3	**Chemical Treatment Principles**	
3.1	Principles of Chemical treatment	1
3.2	Coagulation flocculation	2
3.3	Precipitation	1
3.4	Flotation solidification and stabilization	2
3.5	Disinfection	1
3.6	Electrolytic methods	2
3.7	Advanced oxidation /reduction	1
4	**Design of Municipal Water Treatment Plant**	
4.1	Selection of Treatment	1
4.2	Design of municipal water treatment plant units	2
4.3	Aerators	1
4.4	Flocculation	1
4.5	Rapid sand filter and slow sand filter	2
4.6	O&M aspects	1
4.7	Residue management	1
5	**Design of Wastewater Treatment Plants**	
5.1	Screens	1
5.2	Grit chamber	1
5.3	Settling tanks	2
5.4	Sludge thickening	1

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5.5	Dewatering systems	1
5.6	Design of Industrial Wastewater Treatment Units	1
5.7	Equalization and Neutralization	1
5.8	Chemical Feeding Devices	1
	Total	**45**

Course Designers

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60 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-requisite

-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	Remember, Understand &Apply
CO2	Learn about what to write in each section	Remember, Understand &Apply
CO3	Understand the skills needed when writing a Title	Remember, Understand &Apply
CO4	Understand the skills needed when writing the Conclusion	Remember, Understand &Apply
CO5	Ensure the good quality of paper at very first-time submission	Remember, Understand &Apply

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

R1/ w.e.f. 12.07.2023
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AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		Model Exam (Marks)
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100

Syllabus

K.S. Rangasamy College of Technology – Autonomous R 2022

60 PAC 001 - ENGLISH FOR RESEARCH PAPER WRITING

M.E. STRUCTURAL ENGINEERING

Semester	Hours/Week			Total hrs	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**

TextBook(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.

R1/ w.e.f. 12.07.2023
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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

R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60 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-requisite

-NIL-

Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable to

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

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		Model Exam (Marks)
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100

Syllabus

K.S. Rangasamy College of Technology – Autonomous R 2022								
60 PAC 002 – DISASTER MANAGEMENT								
M.E STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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]

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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**

TextBook(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.

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

CourseDesigner

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
Approved in Academic Council Meeting held on 03/06/2023

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60 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-requisite

-NIL-

Course Outcomes

Onthesuccessful completion ofthecourse,studentswill beable 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.	Remember, Understand &Apply
CO2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India	Remember, Understand &Apply
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.	Remember,Underst and &Apply
CO4	Discuss the passage of the Hindu Code Bill of 1956.	Remember, Understand &Apply
CO5	Discuss the role and functioning of election commission of India.	Remember, Understand &Apply

MappingwithProgrammeOutcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6
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						

AssessmentPattern

Bloom'sCategory	ContinuousAssessmentTests (Marks)		Model Exam (Marks)
	1	2	
Remember (R)	10	10	20
Understand (U)	20	20	30
Apply (Ap)	30	30	50
Analyze (An)	0	0	0
Evaluate (Ev)	0	0	0
Create (Cr)	0	0	0
Total	60	60	100

Syllabus

K.S. Rangasamy College of Technology – Autonomous R 2022								
60 PAC 003 – CONSTITUTION OF INDIA								
M.E STRUCTURAL ENGINEERING								
Semester	Hours/Week			Total hrs	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)	[3]
Philosophy of The Indian Constitution Preamble, Salient Features	[3]
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 Election Commissioners - Institute and Bodies for the welfare of SC/ST/OBC and women.	[6]
Total Hours:	**30**

TextBook(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.

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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

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 democracy	2

Course Designer

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R1/ w.e.f. 12.07.2023
Passed in BoS Meeting held on 19.05.2023
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