KPRIET
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M.E.–Structural Engineering

Curriculum and Syllabi

Regulations 2019

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I. Vision and Mission of the Institute

Vision

To become a premier institute of academic excellence by imparting technical, intellectual and professional skills to students for meeting the diverse needs of the industry, society, the nation and the world at large.

Mission

- Commitment to offer value-based education and enhancement of practical skills
- Continuous assessment of teaching and learning process through scholarly activities
- Enriching research and innovative activities in collaboration with industry and institute of repute
- Ensuring the academic process to uphold culture, ethics and social responsibility

II. Vision and Mission of the Department

Vision

To develop competent Civil Engineers to create infrastructure with technology in demand that leads to nation building

Mission

The Mission of the Department is to

- Provide holistic education to students to enhance technical knowledge and skills
- Indoctrinate augmented contents to meet the requirements of stakeholders
- Promote research and consultancy activities in collaboration with industries
- Foster ethical and moral values with leadership qualities

III. Program Educational Objectives (PEOs)

The Program Educational Objectives (PEOs) of the Civil Engineering (CE) represent major accomplishments that the graduates are expected to achieve after three to five years of graduation.

PEO1: Graduates will attain adequate knowledge in the core areas of Civil Engineering with good communication and presentation skills and excel in their chosen profession

PEO2: Graduates will become successful Civil Engineers by applying their technical and managerial skills and disseminate the knowledge with confidence in various disciplines of Civil Engineering as a responsible citizen

PEO3:Graduates will initiate an active programme for life long professional achievement and expertise through continuous development

IV. Program Outcomes (POs)

Graduates of Civil Engineering will be able to

PO1Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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PO 2 Problem analysis: Identify, formulate, review research literature, and analyze complex civil engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3 Design/ development of solutions: Design solutions for complex civil engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4 Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5 Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex civil engineering activities with an understanding of the limitations.

PO 6 The engineer and society: Apply reasoning informed by the contextual knowledge to access societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7 Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8 Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9 Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10 Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11 Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12 Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

V. Program Specific Outcomes (PSOs)

Graduates of Civil Engineering will be able to

PSO 1: Design, construct and provide sustainable solutions through consultancy service.

PSO 2: Execute projects, prepare reports and practice professional licensure.

VI. PEO/PO Mapping

Following three levels of correlation should be used:

1: Low

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2: Medium

3: High

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
PEO1	3	3	3	3	2	2	2	2	2	3	3	2
PEO2	3	3	3	3	3	2	1	2	2	3	3	3
PEO3	3	3	3	3	3	2	2	2	1	3	3	3

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VII. MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

Year	SEM	Subject	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
I Year	SEM I	Advanced Mathematical Methods	✓	✓	-	-	-	-	-	-	✓	-	-	✓	-	✓
		Advanced Concrete Structures	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓
		Theory of Elasticity and Plasticity	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓
		Research Methodology	✓	✓	✓	✓	✓	-	-	-	-	-	-	-	✓	✓
	SEM II	Finite Element Analysis	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓
		Prestressed Concrete	✓	✓	✓	✓	-	-	-	-	✓	-	✓	✓	✓	✓
		Advanced Steel Structures	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Stability of Structures	✓	✓	-	✓	-	-	-	-	-	-	-	-	✓	✓
		Advanced Structural Engineering Laboratory	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
II Year	SEM III	Aseismic Design of Structures	✓	✓	✓	✓	-	-	-	-	-	-	-	-	✓	✓
		Technical Seminar	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	✓
		Project Work (Phase-I)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	SEM IV	Project Work (Phase-II)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
PROFESSIONAL ELECTIVES (PE)																
I Year	SEM I	Repair and Rehabilitation of Structures	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-		✓	✓
		Prefabricated Structures	✓	✓	✓	✓	✓	✓	-	-	✓	✓	✓	✓	✓	✓
		Offshore Structures	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
		Matrix Methods for Structural Analysis	✓	✓	✓	-	✓	-	-	-	-	-	-	-	✓	-

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		Theory of Plates	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	-
	SEM II	Mechanics of Composite Materials	✓	✓	✓	✓	✓	✓	✓	-	-	✓	-	✓	✓	✓
		Analysis and Design of Tall Building	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	-	✓	✓	✓
		Industrial Structures	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	✓
		Experimental Techniques	✓	✓	✓	✓	✓	✓	✓	✓	✓	—	✓	—	✓	✓
		Wind and Cyclone Effects on Structures	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	-	✓	✓	✓
II Year	SEM III	Nonlinear Analysis of Structures	✓	✓	✓	✓	✓	✓	✓	✓	-	✓	✓	✓	✓	✓
		Design of Sub Structures	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	✓
		Optimization of Structures	✓	✓	✓	-	-	-	-	-	-	-	-	-	✓	✓
		Design of Steel Concrete Composite Structures	✓	✓	-	-	-	✓	✓	✓	✓	✓	✓	-	✓	✓
		Design of Bridges	✓	✓	✓	✓	-	-	-	-	-	-	✓	-	✓	✓
		Design of Shell and Spatial Structures	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	✓
		Computer Aided Analysis and Design	✓	✓	✓	✓	-	-	-	✓	-	-	-	-	✓	✓

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M.E. STRUCTURAL ENGINEERING

REGULATIONS – 2019

CHOICE BASED CREDIT SYSTEM

CURRICULUM FOR I TO IV SEMESTERS

SEMESTER I

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P19MA101	Advanced Mathematical Methods	BS	3	1	0	4
2	P19ST101	Advanced Concrete Structures	PC	3	0	0	3
3	P19ST102	Theory of Elasticity and Plasticity	PC	3	0	0	3
4	P19ST103	Research Methodology	PC	3	0	0	3
5	-	Professional Elective I	PE	3	0	0	3
6	-	Professional Elective II	PE	3	0	0	3
			TOTAL	18	1	0	19

SEMESTER II

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
THEORY							
1	P19ST201	Finite Element Analysis	PC	3	0	0	3
2	P19ST202	Prestressed Concrete	PC	3	0	0	3
3	P19ST203	Advanced Steel Structures	PC	3	0	0	3
4	P19ST204	Stability of Structures	PC	3	0	0	3
5	-	Professional Elective III	PE	3	0	0	3
6	-	Professional Elective IV	PE	3	0	0	3
PRACTICALS							
7	P19ST205	Advanced Structural Engineering Laboratory	PC	0	0	4	2
			TOTAL	18	0	4	20

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SEMESTER III

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	P19ST301	Aseismic Design of Structures	PC	3	0	0	3
2	-	Professional Elective V	PE	3	0	0	3
3	-	Professional Elective VI	PE	3	0	0	3
		PRACTICALS					
4	P19ST302	Technical Seminar	EEC	0	0	2	1
5	P19ST303	Project Work (Phase-I)	EEC	0	0	12	6
			TOTAL	9	0	14	16

SEMESTER IV

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	P19ST401	Project Work (Phase-II)	EEC	0	0	24	12
			TOTAL	0	0	24	12

INDUSTRIAL INTERNSHIP

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	P19STI01	Industrial Training / Internship (4 weeks)	EEC	0	0	0	2
2	P19STI02	Industrial Training / Internship (2 weeks)	EEC	0	0	0	1
			TOTAL	0	0	0	3

PROFESSIONAL ELECTIVES I & II (PE)

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19STP01	Repair and Rehabilitation of Structures	3	0	0	3
2	P19STP02	Prefabricated Structures	3	0	0	3
3	P19STP03	Offshore Structures	3	0	0	3
4	P19STP04	Matrix Methods for Structural Analysis	3	0	0	3
5	P19STP05	Theory of Plates	3	0	0	3

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PROFESSIONAL ELECTIVES III & IV (PE)

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19STP06	Mechanics of Composite Materials	3	0	0	3
2	P19STP07	Analysis and Design of Tall Building	3	0	0	3
3	P19STP08	Industrial Structures	3	0	0	3
4	P19STP09	Experimental Techniques	3	0	0	3
5	P19STP10	Wind and Cyclone Effects on Structures	3	0	0	3

PROFESSIONAL ELECTIVES V & VI (PE)

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19STP11	Nonlinear Analysis of Structures	3	0	0	3
2	P19STP12	Design of Sub Structures	3	0	0	3
3	P19STP13	Optimization of Structures	3	0	0	3
4	P19STP14	Design of Steel Concrete Composite Structures	3	0	0	3
5	P19STP15	Design of Bridges	3	0	0	3
6	P19STP16	Design of Shell and Spatial Structures	3	0	0	3
7	P19STP17	Computer Aided Analysis and Design	2	0	2	3

SUMMERY OF CREDITS SEMESTER-WISE

S.NO.	SEMESTER	L	T	P	CREDITS
1.	Semester I	18	1	0	19
2.	Semester II	18	0	4	20
3.	Semester III	9	0	14	16
4.	Semester IV	0	0	24	12
5.	Industrial Internship	0	0	0	3
				TOTAL	70

PROFESSIONAL CORE (PC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
		THEORY					
1	P19ST101	Advanced Concrete Structures	PC	3	0	0	3
2	P19ST102	Theory of Elasticity and Plasticity	PC	3	0	0	3
3	P19ST103	Research Methodology	PC	3	0	0	3
4	P19ST201	Finite Element Analysis	PC	3	0	0	3
5	P19ST202	Prestressed Concrete	PC	3	0	0	3
6	P19ST203	Advanced Steel Structures	PC	3	0	0	3

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7	P19ST204	Stability of Structures	PC	3	0	0	3
8	P19ST205	Advanced Structural Engineering Laboratory	PC	0	0	4	2
9	P19ST301	Aseismic Design of Structures	PC	3	0	0	3

PROFESSIONAL ELECTIVES (PE)

S.NO.	COURSE CODE	COURSE TITLE	L	T	P	C
1	P19STP01	Repair and Rehabilitation of Structures	3	0	0	3
2	P19STP02	Prefabricated Structures	3	0	0	3
3	P19STP03	Offshore Structures	3	0	0	3
4	P19STP04	Matrix Methods for Structural Analysis	3	0	0	3
5	P19STP05	Theory of Plates	3	0	0	3
6	P19STP06	Mechanics of Composite Materials	3	0	0	3
7	P19STP07	Analysis and Design of Tall Building	3	0	0	3
8	P19STP08	Industrial Structures	3	0	0	3
9	P19STP09	Experimental Techniques	3	0	0	3
10	P19STP10	Wind and Cyclone Effects on Structures	3	0	0	3
11	P19STP11	Nonlinear Analysis of Structures	3	0	0	3
12	P19STP12	Design of Sub Structures	3	0	0	3
13	P19STP13	Optimization of Structures	3	0	0	3
14	P19STP14	Design of Steel Concrete Composite Structures	3	0	0	3
15	P19STP15	Design of Bridges	3	0	0	3
16	P19STP16	Design of Shell and Spatial Structures	3	0	0	3
17	P19STP17	Computer Aided Analysis and Design	2	0	2	3

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.NO.	COURSE CODE	COURSE TITLE	CATEGORY	L	T	P	C
1	P19ST302	Technical Seminar	EEC	0	0	2	1
2	P19ST303	Project Work (Phase-I)	EEC	0	0	12	6
3	P19ST401	Project Work (Phase-II)	EEC	0	0	24	12
4	P19STI01	Industrial Training / Internship (4 weeks)	EEC	0	0	0	2
5	P19STI02	Industrial Training / Internship (2 weeks)	EEC	0	0	0	1

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COMPONEMTS OF CURRICULUM AND CREDIT STRUCTURES

S. No.	Course Component	Suggested credits by AICTE	Total number of credits in each component	Curriculum Content (% of total number of credits of the program)
1	Basic Sciences (BS)	-	4	6
2	Professional Core (PC)	-	26	37
3	Professional Elective (PE)	-	18	26
4	Employability Enhancement Courses (EEC)	-	22	31
			Total number of credits	**70**

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SEMESTER I

P19MA101	ADVANCED MATHEMATICAL METHODS	Category: BS			
		L	T	P	C
		3	1	0	4

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To provide the student with a repertoire of mathematical methods that are essential to the solution of advanced problems encountered in the fields of applied physics and engineering
- It covers a broad spectrum of mathematical techniques such as Laplace Transform, Fourier Transform, Calculus of variations, conformal mapping and numerical methods.
- Application of these topics to the solution of problems in physics and engineering is stressed

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PATIAL DIFFERENTIAL EQUATIONS **9 + 3**

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

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS **9 + 3**

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

UNIT III CALCULUS OF VARIATIONS **9 + 3**

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

UNIT IV CONFORMAL MAPPING AND APPLICATIONS **9 + 3**

Introduction to conformal mappings and bilinear transformations – Schwarz Christoffel transformation – Transformation of boundaries in parametric form – Physical applications – Fluid flow and heat flow problems

UNIT V NUMERICAL METHODS **9 + 3**

Linear simultaneous equation–Gauss elimination–Gauss Jordan and Crouts method–Gauss Seidal iterative method–Gauss Jacobian method–Solutions of Algebraic and Transcendental equations–Newton method and Adams Method

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 60 Periods

TEXT BOOKS:

1. Jain R.K, Iyengar, SRK, 'Advanced Engineering Mathematics', Fourth Edition, Alpha Science Publications,2014
2. Gerald W. Recktenwald, 'Introduction to Numerical Methods', Pearson Publications(US)second edition, 2019

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REFERENCES:

1. JVasishtha A.K, Gupta R.K 'Integral Transforms', Krishna's Educational Publishers, 2016
2. Sastry, S.S, "Introductory Methods of Numerical Analysis", PHI Learning Pvt. Ltd, 5th Edition, 2015
3. NPTEL Web link: http://nptel.ac.in/courses/105105043/12

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Solve IVP and BVP's using Laplace Transform techniques	Apply
CO2	Apply Fourier Transforms to IVP and BVP in PDE's	Apply
CO3	Determine Maximizing and minimizing the functional that occurs in Engineering fields.	Apply
CO4	Construct conformal mapping and apply it in Engineering fields.	Apply
CO5	Solve Linear System of linear equations and nonlinear equations in practical engineering problems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	-	-	-	-	-	1	-	-	2	-	1
CO2	3	2	-	-	-	-	-	-	1	-	-	2	-	1
CO3	3	2	-	-	-	-	-	-	1	-	-	2	-	1
CO4	3	2	-	-	-	-	-	-	1	-	-	2	-	1
CO5	3	2	-	-	-	-	-	-	1	-	-	2	-	1
CO	3	2	-	-	-	-	-	-	1	-	-	2	-	1
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

12/1/17

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SEMESTER I

P19ST101	ADVANCED CONCRETE STRUCTURES	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Concrete Technology

COURSE OBJECTIVES:

- To design special RC elements such as Corbels, Deep beams, Grid floors
- To design of flat slab and yield line-based design of RC elements
- To understand the ductile detailing beams and frames

UNIT I BASIC DESIGN CONCEPTS 9

Limit state method – Design of beams– Design of columns according to IS Codes. Short-term and long-term deflection of reinforced concrete beams–Estimation of crack width in reinforced concrete

UNIT II DESIGN OF SPECIAL RC ELEMENTS 9

Strut and tie method of analysis for corbels and deep beams–Design of corbels–Design of Deep beams–Design of Grid floors–Design of slender columns subjected to combined bending moment and axial force using IS 456-2000

UNIT III FLAT SLABS AND YIELD LINE BASED DESIGN 9

Design of flat slabs according to IS method–Check for shear– Design of spandrel beams–Yield line theory and Hillerborg's strip method of design of slabs

UNIT IV INELASTIC BEHAVIOUR OF CONCRETE BEAMS AND COLUMNS 9

Inelastic behaviour of concrete beams, MomentRotation curves, ductility definitions, evaluation

UNIT V DUCTILE DETAILING 9

Concept of Ductility–Detailing for ductility–Design of beams, columns for ductility–Design of cast-in-situ joints in frames

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Subramanian. N., (2013), "Design of Reinforced Concrete Structures", Oxford University Press, New Delhi
2. Dr. H. J. Shah, "Reinforced Concrete", Vol-1 and Vol-2, Charotar, 8th Edition – 2009 and 6th Edition

REFERENCES:

1. Gambhir.M.L., (2012)," Design of Reinforced Concrete Structures, Prentice Hall of India, New Delhi
2. Varghese. P.C., (2011), Advanced Reinforced Concrete Design, PHI Learning Pvt. Ltd., New Delhi

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Design the columns and examine short term and long-term deflection of beams.	Apply
CO2	Design the deep beams, corbels, and slender columns	Apply
CO3	Design the flat slabs with various methods	Apply
CO4	Analyse inelastic behaviour of concrete beams and columns	Apply
CO5	Design the ductility and cast-in-situ joints in frames	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO2	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO3	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO4	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO5	3	2	2	3	2	-	-	-	-	-	-	-	2	2
CO	3	2	2	3	2	-	-	-	-	-	-	-	2	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER I

P19ST102	THEORY OF ELASTICITY AND PLASTICITY	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand elastic properties of different types of materials
- To study 2D stress strain relationship of materials
- To gain knowledge on elastic plastic problems in bending

UNIT I ELASTICITY 9

Analysis of stress and strain, Equilibrium equations – Compatibility equations – Stress strain relationship. Generalized Hooke's law

UNIT II 2D STRESS STRAIN PROBLEMS 9

Plane stress and plane strain – Simple two-dimensional problems in Cartesian and Polar coordinates

UNIT III TORSION OF NON-CIRCULAR SECTION 9

St. Venant's approach Prandtl's approach – Membrane analogy – Torsion of thin walled open and closed sections

UNIT IV ENERGY METHODS 9

Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems

UNIT V PLASTICITY 9

Physical Assumptions – Yield criteria – Plastic stress strain relationship. Elastic plastic problems in bending –torsion and thick cylinder

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Timoshenko, S. and GoodierJ.N ."Theory of Elasticity", McGraw Hill Book Co., New York, 2010
2. Sadhu Singh., (2004), Theory of Elasticity, Dhanpat Rai sons Private Limited, New Delhi

REFERENCES:

1. Ansel C Ugural and Saul.K. Fenster," Advanced Strength and Applied Elasticity," Fourth Edition, Prentice,1998
2. Hall Professional technical Reference, New Jersy, 2003.
3. Chakrabarty.J, "Theory of Plasticity", Third Edition, Elsevier Butterworth - Heinmann – UK, 2007

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Analysis of stress strain relationship and compatibility equations	Analyze
CO2	Study plane stress and strain problems	Understand
CO3	Learn torsion on non- circular section	Understand
CO4	Gain sufficient knowledge in various energy theories	Understand
CO5	Analyze plastic stress strain relationship and elastic plastic problems	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO3	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO4	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO5	3	3	2	2	-	-	-	-	-	-	-	-	2	2
CO	3	3	2	2	-	-	-	-	-	-	-	-	2	2
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)						

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SEMESTER I

P19ST103	RESEARCH METHODOLOGY	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To design Understand the scope and objective of the Research Problem
- To explore the literature studies in the chosen field of study
- To understand the process of Intellectual Property Rights

UNIT I RESEARCH PROBLEMS 9

Meaning of research problem – Sources of research problem – Criteria Characteristics of a good research problem – Errors in selecting a research problem – Scope and objectives of research problem – Approaches of investigation of solutions for research problem – data collection – Analysis – Interpretation – Necessary instrumentations

UNIT II LITERATURE STUDIES 9

Effective literature studies approach – Analysis Plagiarism – Research ethics

UNIT III RESEARCH PROPOSAL 9

Effective technical writing – How to write report – Paper Developing a Research Proposal – Format of research proposal – Presentation and assessment by a review committee

UNIT IV INTELUTUAL PROPERTY RIGHTS 9

Patents – Designs, Trade and Copyright – Process of Patenting and Development: technological research – Innovation – Patenting – Development – International Scenario: International cooperation on Intellectual Property – Procedure for grants of patents – Patenting under PCT

UNIT V PATENT RIGHTS 9

Scope of Patent Rights – Licensing and transfer of technology – Patent information and databases – Geographical Indications

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007
2. Mayall, "Industrial Design", McGraw Hill, 1992
3. Asimov, "Introduction to Design", Prentice Hall, 1962

REFERENCES:

1. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016
2. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Investigate the solutions for research problem, data collection, analysis, interpretation	Analyze
CO2	Understand the approaches for literature studies	Understand
CO3	Understand the procedure for report writing	Understand
CO4	Explore the process of patent and grant of patent	Apply
CO5	Understand the licensing and transfer of technology	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	3	-	-	-	-	-	-	-	2	2
CO2	3	2	2	3	3	-	-	-	-	-	-	-	2	2
CO3	3	2	2	3	3	-	-	-	-	-	-	-	2	2
CO4	3	2	2	3	3	-	-	-	-	-	-	-	2	2
CO5	3	2	2	3	3	-	-	-	-	-	-	-	2	2
CO	3	2	2	3	3	-	-	-	-	-	-	-	2	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

P19ST201	FINITE ELEMENT ANALYSIS	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the basics of the Finite Element Technique, a numerical tool for the solution of different classes of problems
- To generate the governing Finite Element equations for system governed by partial differential equations
- To understand the use of the basic finite elements for structural applications using truss, beam, frame

UNIT I INTRODUCTION 9

Approximate solutions of boundary value problems – Methods of weighted residuals, approximate solution using variational method, Boundary conditions and general comments-continuity, compatibility, convergence aspects. Basic finite element concepts – Basic ideas in a finite element solution, Finite element equations using modified Galerkin method

UNIT II AXIAL DEFORMATION OF BAR AND SPRING ELEMENT 9

Natural Coordinates – Triangular Elements – Rectangular Elements – Lagrange and Serendipity Elements -Solid Elements – Isoparametric Formulation – Stiffness Matrix of Isoparametric Elements – Numerical Integration: One, Two and Three Dimensional - Examples

UNIT III ANALYSIS OF FRAMED STRUCTURES 9

Stiffness of Truss Member – Analysis of Truss -Stiffness of Beam Member – Plane Frame Analysis – Analysis of Grid and Space Frame – Two Dimensional Solids – Constant Strain Triangle –Linear Strain Triangle – Rectangular Elements – Numerical Evaluation of Element Stiffness –Computation of Stresses, Geometric Nonlinearity and Static Condensation – Axisymmetric Element – Finite Element Formulation of Axisymmetric Element –Finite Element Formulation for 3 Dimensional Elements

UNIT IV PLATES AND SHELLS 9

Introduction to Plate Bending Problems – Finite Element Analysis of Thin Plate – Finite Element Analysis of Thick Plate -Introduction to Finite Strip Method -Finite Element Analysis of Shell

UNIT V APPLICATIONS OF FEM 9

Finite Elements for Elastic Stability – Dynamic Analysis – Solution techniques to Dynamic Problem-Nonlinear, Vibration and Thermal Problems – Meshing and Solution Problems – Modeling and analysis using recent analysis software's

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Bhavikatti.S.S, "Finite Element Analysis", New Age International Publishers, 2007
2. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007

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REFERENCES:

1. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007
2. Rao.S.S, "Finite Element Method in Engineering", Butterworth – Heinmann, UK, 2008
3. Logan D. L., A First Course in the Finite Element Method, Thomson Learning, 2007
4. R.D.Cook, Concepts and Applications of Finite Element Analysis, John Wiley &Sons
5. David Hutton,"Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the energy principles and finite element concepts.	Understand
CO2	Formulate shape functions for various elements.	Understand
CO3	Determine the stresses and strains for 2d and 3d problems.	Understand
CO4	Apply finite element method for the analysis of framed structures, plates and shells using finite element method.	Apply
CO5	Analyze and understand the applications of finite element method using recent analysis software	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO2	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO3	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO4	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO5	3	2	2	2	-	-	-	-	-	-	-	-	1	1
CO	3	2	2	2	-	-	-	-	-	-	-	-	1	1
Correlation levels:	1: Slight (Low)				2: Moderate (Medium)						3: Substantial (High)			

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SEMESTER II

P19ST202	PRESTRESSED CONCRETE	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the basic Principle of prestressing
- To know the methods used for analysing prestressed concrete structures
- To design the various prestressed concrete structures

UNIT I PRINCIPLES OF PRESTRESSING 9

Basic concepts of Prestressing – Types and systems of prestressing – Need for High Strength materials – Analysis methods – Losses of prestress – Short and Long-term deflection – Cable layouts

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behaviour of flexural members – Determination of ultimate flexural strength – Design of flexural members – Design for shear – Bond and torsion – Transfer of prestress

UNIT III DESIGN OF CONTINUOUS AND CANTILEVER BEAMS 9

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

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members – Application in the design of prestressed pipes and prestressed concrete – Cylindrical water tanks – Design of compression members with and without flexure

UNIT V DESIGN OF COMPOSITE MEMBERS 9

Composite beams – Analysis and design – Ultimate strength – Composite members applications – Partial prestressing – Advantages and applications

Contact Periods:

Lecture: 45 Periods Tutorial: 15 Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Krishna Raju, "Prestressed Concrete", Tata McGraw Hill Publishing Co., New Delhi, 2008
2. Rajagopalan.N, "Prestressed Concrete", Narosa Publications, New Delhi, 2008

REFERENCES:

1. Arthur H. Nilson, "Design of Prestressed Concrete", John Wiley and Sons Inc, New York, 2004.
2. Lin.T.Y., andBurns.H "Design of Prestressed Concrete Structures", John Wiley and Sons Inc, New York, 2009.
3. Sinha.N.C.and.Roy.S.K, "Fundamentals of Prestressed Concrete", S.Chand and Co., 1998

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Able to calculate the losses and analyze for deflection of prestressed concrete members	Analyze
CO2	Design the prestressed concrete members for flexure and shear as per the relevant design code	Apply
CO3	Analyze and design of continuous and cantilever beams	Apply
CO4	Design of prestressed concrete structures - sleepers, tanks, pipes and poles	Apply
CO5	Analyze and design of composite beams and students will have sufficient knowledge on partial pre-stressing	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	2	-	2	1	3	3
CO2	3	3	3	-	2	-	-	-	-	-	-	-	3	3
CO3	3	3	3	-		-	1	-	-	1	-	-	3	3
CO4	3	3	3	-	2	-	-		2	-		1	3	3
CO5	3	3	3	-	-	2	-	1		-	2		3	3
CO	3	3	3	2	-	-	-	-	2	-	2	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

P19ST203	ADVANCED STEEL STRUCTURE	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the behaviour of members and connections
- To analyse and design the Industrial buildings of roofs and chimneys
- To study the design of light gauge steel structure

UNIT I JOINTS IN STEEL CONSTRUCTION 9

Shear connections–Fin plate connection–End plate connection–Framed connections–Moment connections–Bolted end plate connection–Welded beam to column connection– Splices–Column base Connection

UNIT II LIGHT GAUGE STEEL DESIGN 9

Concepts– Local buckling and Effective width– Design of beams– Stiffened flange–Multiple stiffened flange– Unstiffened flange– Design of beams for lateral buckling– Design of columns– Design of members under combined stresses– Design of connections

UNIT III INDUSTRIAL MATERIAL HANDLING SYSTEMS 9

Types of cranes–Basic requirements for crane running beams–Design of jib crane foundations – Design of Monorail–Gantry girder for under slung cranes–Gantry girders for overhead cranes – Plated and Braced Gantry girder–Gantry columns

UNIT IV INDUSTRIAL APPURTENANCES 9

Self-supporting chimney–Chimney foundations– Guyed steel chimney– Design of silos– Design of Bunkers–Design of self-Standing towers

UNIT V INDUSTRIAL ROOF SYSTEMS 9

Components– Cladding–Purlins– Primary load carrying systems – Beams– Trusses– Frames – Loads and load combinations for design– Design of Purlins and side cladding girts – Antisag rods – Planning and design of trusses– Planning and design of North light roof system–Design of lattice girders – Planning and design of bracings – Panel bracing– Roof bracing

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. L.S.Jayagopal and D. Tensing "Design of Steel Structures" Vikas Publishing House, Delhi, 2015
2. L.S.Jayagopal and D. Tensing "Advanced Design of Steel Structures"Vikas Publishing House, Delhi, 2019

REFERENCES:

1. Joseph A. Edminister, Mahmood Nahvi, "Electric Circuits", 5th edition,Schaum's outline series, McGraw Hill Education, New Delhi,2017
2. Allan H. Robbins, Wilhelm C. Miller, "Circuits Analysis Theory and Practice", 5th edition, Cengage Learning,India,2013

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Study the behaviour of different connections in steel structures	Understand
CO2	Analyse and design of light gauge steel members	Analyze
CO3	Understand the design concept of crane foundations, monorail, gantry girders	Understand
CO4	Analyze and design of steel towers	Analyze
CO5	Design of industrial roof systems	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	2	-	-	-	-	2	2
CO2	3	-	-	-	-		-	-	1	-	-	-	2	2
CO3	3	3	-	-	-	2	1	-	-	-	1	-	-	2
CO4	3	3	-	-	-		-	-	-	-	-	2	2	2
CO5	3	-	-	-	-	2	-	-	-	2	-	-	2	2
CO	3	3	3	-	-	2	1	2	1	2	1	2	2	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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SEMESTER II

P19ST204	STABILITY OF STRUCTURES	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the basic concept of buckling
- To study about torsional and lateral buckling
- To design the various models in structural elements

UNIT I BUCKLING OF COLUMNS 9

Classification of buckling problems–Eigen value problem–Elastic and Inelastic Buckling–Governing equation for columns–Analysis for various boundary conditions– Using Equilibrium, Energy methods–Approximate methods–Rayleigh Ritz–Galerkins approach–Non prismatic and built up columns–Buckling modes–Numerical Techniques–Finite difference method– Effect of shear on buckling

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

Theory of beam column–Stability analysis of beam column with single–concentrated loads–distributed load and end couples–Analysis of rigid jointed frames with and without sway–Use of stability function to determine the critical load

UNIT III TORSIONAL AND LATERAL BUCKLING 9

Torsional buckling – Combined torsional and flexural buckling – Local buckling uniform and non-uniform torsion on open section – Lateral buckling of beams –Pure bending of simply supported and cantilever beams

UNIT IV BUCKLING OF PLATES 9

Governing differential equation – Buckling of thin plates various edge conditions – Analysis by equilibrium and energy approach – Finite difference method

UNIT V INELASTIC BUCKLING 9

Double modulus theory – Tangent modulus theory – Shanley's model – Eccentrically loaded inelastic column – Inelastic buckling of plates – Post buckling behaviour of plates

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Chajes A, "Principles of Structures Stability Theory", Prentice Hall, 1974
2. Ashwini Kumar, "Stability Theory of Structures", Allied publishers Ltd., New Delhi, 2003
3. Gambhir, "Stability Analysis and Design of Structures", Springer, New York, 2004

REFERENCES:

1. Timoshenko.S.P, and Gere.J.M, "Theory of Elastic Stability", McGraw Hill Book Company, 1963
2. Manikaselvam V K, "Elements of Matrix and Stability Analysis of Structures",Khanna Publishers,1999
3. Simitser.G.J and Hodges D.H, "Fundamentals of Structural Stability", Elsevier Ltd., 2006

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the fundamental concepts of structural stability.	Understand
CO2	Analyze the beam column joints with single and multiple loads.	Analyze
CO3	Understand the lateral buckling of beams.	Understand
CO4	Analyze the buckling of plates with equilibrium and energy approach.	Analyze
CO5	Understand the buckling behaviour of plates	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	2	-	-	-	-	-	-	-	-	3	3
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	2	-	2	-	-	-	-	-	-	-	-	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO	3	2	-	2	-	-	-	-	-	-	-	-	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER II

P19ST205	ADVANCED STRUCTURAL ENGINEERING LABORATORY	Category: PC			
		L	T	P	C
		0	0	4	2

PRE–REQUISITES:

- Concrete Technology, Design of RC Elements, Design of Steel Structures

COURSE OBJECTIVES:

- To understand the various parameters of the concrete mix design and various testing on concrete

LIST OF EXPERIMENTS

1. Concrete mix design for M30, M60 grade
   a. Indian Standard Method
   b. ACI Method
2. Flow characteristics of self-compacting concrete
3. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour
4. Testing of simply supported steel beam for strength and deflection behaviour
5. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading
6. Dynamic Response of cantilever steel beam
   a. To determine the damping coefficients from free vibrations
   b. To evaluate the mode shapes
7. Static cyclic testing of single bay two storied steel frames and evaluate
   a. Drift of the frame.
   b. Stiffness of the frame.
   c. Energy dissipation capacity of the frame
8. Non-Destructive Test on concrete
   a. Rebound hammer
   b. Ultrasonic Pulse Velocity Tester

Contact Periods:

Lecture: - Periods Tutorial: – Periods Practical: 60 Periods Total: 60 Periods

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Identify the functional role of ingredients of concrete and apply this knowledge to mix design philosophy	Remember
CO2	Design and develop the self-compacting concrete and its fresh properties	Apply
CO3	Apply engineering principles to understand behaviour of structural/ elements	Apply
CO4	Understand the dynamic testing on steel beams and to know about the method of static cyclic testing of single bay two storied steel frames	Remember
CO5	Conduct Non-Destructive Tests on existing concrete structures	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	-	-	3	-	-	-	-	-	-	-	-	3	3
CO2	2	-	1	3	1	-	-	2	2	1	1	-	3	3
CO3	2	2	-	3	-	2	-	-	-	-	-	1	3	3
CO4	2	2	-	3	-	-	2	-	-	-	-	-	3	3
CO5	2	-	-	3	-	-	-	-	-	-	-	-	3	3
CO	2	2	1	3	1	2	2	2	2	1	1	1	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER III

P19ST301	ASEISMIC DESIGN OF STRUCTURES	Category: PC			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the effect of earthquakes on structures
- To study the modern concepts used for earthquake resistant design
- To design the earthquake resistant Structures

UNIT I INTRODUCTION 9

Basic Seismology – General features of Tectonics of Seismic Regions– Earthquake Terminology – Definitions –Earthquake History – Behaviour of Buildings, Dams and Bridges in Earthquakes – Seismographs – Accelerographs – Theory of Vibrations – Damped and undamped system – free and forced vibrations – SDOF and MDOF systems

UNIT II EARTHQUAKE RESPONSE 9

Earthquake Response to Elastic and Inelastic Buildings – Application to Response Spectrum Theory – base exited motion - ground motion parameters – Modal response contribution – modal participation factor – response history – spectral analysis – multiple support excitation – earthquake response to continuous systems on rigid base

UNIT III EARTHQUAKE RESISTANT DESIGN OF MASONRY STRUCTURES 9

Structural Systems – Types of Buildings – Causes of damage – Planning Considerations– Philosophy and Principle of Earthquake Resistant Design – Guidelines for Earthquake Resistant Design - Earthquake Resistant Masonry Buildings – Design consideration – Guidelines

UNIT IV EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

Earthquake Resistant Design of R.C.C. Buildings – Material properties – Lateral load analysis – Capacity based Design and detailing – Strong Column Weak Beam concept– Rigid Frames – Shear Walls-Liquefaction of soil

UNIT V MODERN CONCEPTS 9

Modern Concepts – Base Isolation– Passive Control and Active Control Systems – Computer Analysis and Design of Buildings for Earthquake Loads using Software Packages

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Pankaj Agarwal, 'Earthquake Resistant Design of Structures', Prentice – Hall of India pvt.ltd., New Delhi,2002
2. Anil K. Chopra, 'Dynamics of Structures – Theory and applications to Earthquake Engineering', Prentice – Hall of India pvt.ltd., New Delhi,2002
3. Ambrose &Vergun, ' Simplified Building Design for wind and Earthquake Forces', John Wiley, 1985

REFERENCES:

1. Berg, 'Seismic, Design Codes and Procedures, Earthquake Engineering Research Institute, 2000
2. Newmark&Rosenbluenth, 'Fundamentals of Earthquake Engineering', Prentice Hall, 1971

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3. Rosenblueth (Ed.), 'Design of Earthquake Resistance Structures', Prentech Press, London, 1980

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Explain behavior of structures subjected to earthquake.	Understand
CO2	Utilize various IS codal provisions for seismic design.	Apply
CO3	Design masonry and RC structures to the earthquake forces.	Apply
CO4	Design and detailing of framed and shear wall structure.	Apply
CO5	Design buildings for seismic forces using various software packages.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	2	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO	3	2	2	1	-	-	-	-	-	-	-	-	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER III

P19ST302	TECHNICAL SEMINAR	Category: EEC			
		L	T	P	C
		0	0	2	1

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To work on a specific technical topic in Structural Engineering and acquire the skills of written and oral presentation.
- To acquire writing abilities for seminars and conferences

STRATEGY

The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Structural Engineering and to engage in discussion with the audience. A brief copy of their presentation 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 defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 30 Periods Total: 30 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Face an audience and to tackle any problem during group discussion in the Interviews	Apply
CO2	Acquire writing abilities for seminars and conferences	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	2	2	-	3	3	3	-	3	2	2
CO2	3	1	1	1	2	2	-	3	3	3	-	3	2	2
CO	3	1	1	1	2	2	-	3	3	3	-	3	2	2
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

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SEMESTER III

P19ST303	PROJECT WORK (PHASE - I)	Category: EEC			
		L	T	P	C
		0	0	12	6

PRE–REQUISITES:

- NIL

COURSE OBJECTIVES:

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

STRATEGY

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

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 180 Periods Total: 180 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Involve in individual and team work with good oral, written and Graphical communications	Apply
CO2	Apply the principles in structural Engineering	Apply
CO3	Gain practical professional experience in structural Engineering	Analyze
CO4	Investigate the leading problems related to structural Engineering	Evaluate
CO5	Develop the solution for the problem identified in structural Engineering	Create

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COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO2	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO3	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO4	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO5	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO	3	2	2	3	2	2	2	2	3	3	2	3	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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SEMESTER IV

P19ST401	PROJECT WORK (PHASE - II)	Category: EEC			
		L	T	P	C
		0	0	24	12

PRE–REQUISITES:

- Project work (Phase - I)

COURSE OBJECTIVES:

- To solve the identified problem based on the formulated methodology
- To develop skills to analyse and discuss the test results, and make conclusions

STRATEGY

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner

Contact Periods:

Lecture: 0 Periods Tutorial: 0 Periods Practical: 360Periods Total: 360 Periods

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Involve in individual and team work with good oral, written and Graphical communications	Apply
CO2	Apply the principles in Civil & Structural Engineering	Apply
CO3	Gain practical professional experience in Structural Engineering	Analyze
CO4	Investigate the leading problems related to structural Engineering	Evaluate
CO5	Develop the solution for the problem identified in structural Engineering	Create

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO2	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO3	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO4	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO5	3	2	2	3	2	2	2	2	3	3	2	3	3	3
CO	3	2	2	3	2	2	2	2	3	3	2	3	3	3

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE - SEMESTER I

		Category: PE			
		L	T	P	C
P19STP01	REPAIR AND REHABILITATION OF STRUCTURES	3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the maintenance and repair strategies of concrete structures
- To study the properties of properties of repair materials
- To investigate the techniques for repair and demolition of structures

UNIT I MAINTENANCE AND REPAIR STRATEGIES 9

Maintenance – Repair and rehabilitation –Facets of Maintenance – Importance of Maintenance – Various aspects of Inspection – Assessment procedure for evaluating a damaged structure – Causes of deterioration

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE 9

Quality assurance for concrete– Construction concrete properties – Strength – Permeability– Thermal properties and cracking–Effects due to climate–temperature–chemicals–corrosion– Design and construction errors–Effects of cover thickness and cracking

UNIT III MATERIALS FOR REPAIR 9

Special concretes and mortar – Concrete chemicals– Special elements for accelerated strength gain – Expansive cement – Polymer concrete – Sulphur infiltrated concrete – Ferro cement – Fiber reinforced concrete

UNIT IV TECHNIQUES FOR REPAIR AND DEMOLITION 9

Rust eliminators and polymers coating for rebar during repair – Foamed concrete–mortar and dry pack– Vacuum concrete– Gunite and Shotcrete– Epoxy injection– Mortar repair for cracks– Shoring and underpinning–Methods of corrosion protection– Corrosion inhibitors– Corrosion resistant steels– Coatings and cathodic protection– Engineered demolition techniques for dilapidated structures– Case studies

UNIT V REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Repairs to overcome low member strength–Deflection–Cracking–Chemical disruption– weathering corrosion– Wear– Fire– Leakage and marine exposure

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Modi, P.I., Patel, C.N. (2016). Repair and Rehabilitation of Concrete Structures, PHI India, New Delhi
2. Bhattacharjee, J., Concrete Structures Repair Rehabilitation and Retrofitting, CBS Publishers& Distributors, New Delhi 2017
3. Varghese, P.C., Maintenance, Repair & Rehabilitation and Minor Works of Buildings, PHI India, New Delhi,2014

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REFERENCES:

1. IABSE, Case Studies of Rehabilitation, Repair, Retrofitting, and Strengthening of Structures, Volume 12, Structural Engineering Documents (SED), Switzerland,2010
2. Santhakumar, A.R., Training Course notes on Damage Assessment and repair in Low Cost Housing, "RHDC-NBO" Anna University, July1992
3. Lakshmipathy, M. etal Lecture notes of Workshop on "Repairs and Rehabilitation of Structures", 29 - 30th October 1999

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Procure the accurate idea about the maintenance and repair strategies of building	Remember
CO2	Understand the cracking, thermal and chemical disruption	Understand
CO3	Comprehend the basic concepts related to materials available for repair	Understand
CO4	Articulate with the recent suitable techniques for repair and demolition process	Analyze
CO5	Ability to prepare repair and rehabilitation method for various deteriorated structure	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	3	-	2	3	-	2	-	1	-	-	-	2
CO2	2	2	-	2	2	3	2	2	-	-	-	-	-	2
CO3	2	2	3	-	2	3	2	-	-	-	-	-	3	2
CO4	2	2	3	2	2	3	2	-	-	1	-	-	3	2
CO5	2	2	3	-	2	3	-	-	-	-	-	-	3	2
CO	2	2	3	2	2	3	2	2	-	1	-		3	2
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE - SEMESTER I

P19STP02	PREFABRICATED STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the design principles of prefabricated structures
- To analyse the RC prefabricated floors, stairs and roofs
- To design Industrial building and shell roofs

UNIT I DESIGN PRINCIPLES 9

General: Civil Engineering requirements– Specific requirements for planning and layout of prefabrication plant– IS Code specifications Modular co-ordination– Standardization– Disuniting of Prefabricates– Production– Transportation– Erection– Stages of loading and code provisions– Safety factors– Material properties– Deflection control– Lateral load resistance– Location and types of shear walls

UNIT II REINFORCED CONCRETE 9

Prefabricated structures–Long wall and cross-wall large panel buildings– One way and two-way prefabricated slabs–Framed buildings with partial and curtain walls–Connections–Beam to column and column to column

UNIT III FLOORS, STAIRS AND ROOFS 9

Types of floor slabs– Analysis– Design example of cored and panel types– Two-way systems– Staircase: slab design– Types of roof slabs and insulation requirements–Description of joints–their behaviour and reinforcement requirements–Deflection control for short term and long-term loads– Ultimate strength calculations in shear and flexure

UNIT IV WALLS 9

Types of wall panels–Blocks and large panels–Curtain–Partition and load bearing walls–load transfer from floor to wall panels– Vertical loads–Eccentricity and stability of wall panels–Design Curves– Types of wall joints– Curve behaviour and design–Leak prevention– Joint sealants– Sandwich wall panels– Approximate design of shear walls

UNIT V INDUSTRIAL BUILDINGS AND SHELL ROOFS 9

Components of single storey – Industrial sheds with crane gantry systems – R.C. Roof Trusses – Roof Panels – Corbels and Columns – Wind bracing design – Cylindrical – Folded plate and Hyper-prefabricated shells – Erection and jointing – Joint design – Hand book-based design

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Kims S. Elliot, "Precast Concrete Structures", CRC Press, Taylor & Francis,2017
2. Hubert Bachmann, Alfred Steinle, Precast Concrete Structures, Ernst &Sohn, Wiley Publication, 2011

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REFERENCES:

1. Ryan E. Smith, Prefab Architecture: A Guide to Modular Design and Construction, John Wiley and Sons. Inc. London,2010
2. Handbook of Precast Concrete Buildings, ICI publications, 2016

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Appreciate modular construction of prefabricated and classify the components of prefabrication	Understand
CO2	Design of disuniting structures elements	Apply
CO3	Analyze the joints in structural detailing of prefabricated structures	Analyze
CO4	Refer the codal provisions for abnormal load of prefabricated structure	Understand
CO5	Identify the components of typical structures	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	1	1	-	-	1	-	1	1	2	2
CO2	3	-	-	-	-	-	-	-	-	-	-	1	2	-
CO3	3	3	-	-	1	-	-	-	-	1	-	-	-	2
CO4	3	-	-	2	-	-	-	-	-	-	-	-	-	2
CO5	3	-	-	-	-	1	-	-	1	-	-	1	2	-
CO	3	3	3	2	1	1	-	-	1	1	1	1	2	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE - SEMESTER I

P19STP03	OFFSHORE STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the wave theories of offshore structures
- To analyse the offshore structures by static method of analysis
- To design offshore structures as per Indian codal provisions

UNIT I WAVE THEORIES 9

Wave generation process– Small– Finite amplitude and nonlinear wave theories

UNIT II FORCES OF OFFSHORE STRUCTURES 9

Wind forces – Wave forces on small bodies and large bodies – Current forces – Morison equation

UNIT III OFFSHORE SOIL AND STRUCTURE MODELLING 9

Different types of offshore structure – Foundation modelling – Fixed jacket platform – Structural modeling

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9

Static method of analysis – Foundation analysis and dynamics of offshore structures

UNIT V DESIGN OF OFFSHORE STRUCTURES 9

Design of platforms – Helipads – Jacket tower – Analysis and design of mooring cables – Pipelines

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Reddy.D.V and SwamidasA.S.J.,"Essential of offshore structures", CRC Press,2014
2. Mohamed A. El-Reedy, Offshore Structure, Design, Construction and Maintenance, Gulf Professional Publishing,2012
3. Gunther Clauss, Eike Lehmann, Carsten Ostergaard, M.J. Shields Offshore Structures: Volume I: Conceptual Design and Hydromechanics: 1, Springer- Verlag,2012

REFERENCES:

1. Turgut Sarpkaya, Wave Forces on Offshore Structures, Cambridge University Press, 2010
2. Eugenio Fortaleza, Active Control of Offshore Structures, Lambert Academic Publication.2012
3. API, Recommended Practice for Planning, designing and Construction, Fixed offshore platform, American Petroleum Institute publication, RP2A, Dallas, Texas,2010

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the wave generation process and wave theories	Understand
CO2	Know the different types of offshore structures and foundation modelling	Understand
CO3	Analysis of offshore structures by static method of analysis	Analyze
CO4	Analysis of offshore structures by dynamic method of analysis	Analyze
CO5	Design offshore structures like platform, helipads, jackets, towers	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	-	-	2	-		1	-	2	3	3
CO2	3	3	3	-	-	1		-	1	-	2	-	3	3
CO3	3	3	3	1	1	-	2	-	-	1	-	2	3	3
CO4	3	3	3	-	-	1	-	1	-	-	2	-	3	3
CO5	3	3	3	-	1	-	2	-	1	1	-	2	3	3
CO	3	3	3	1	1	1	2	1	1	1	2	2	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE - SEMESTER I

P19STP04	MATRIX METHODS FOR STRUCTURAL ANALYSIS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To Understand the Energy concepts in structures
- To study the transformation of information in structures
- To analyse the structures by Flexibility and stiffness method

UNIT I ENERGY CONCEPTS IN STRUCTURES 9

Introduction – Strain Energy – Symmetry of The Stiffness and Flexibility Matrices–Strain Energy in Terms of Stiffness and Flexibility Matrices – Stiffness and Flexibility Coefficients in Terms of Strain Energy – Additional properties of [a] and [k] – another Interpretation of coefficients a_{ij} and k_{ij}– Betti's law – Applications of Betti's law: Forces not at the coordinates – Strain energy in systems and in Elements

UNIT II CHARACTERSTICS OF STRUCTURES – STIFFNESS AND FLEXIBILITY 9

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

UNIT III TRANSFORMATION OF INFORMATION IN STRUTURES 9

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

UNIT IV FLEXIBILITY METHOD 9

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

UNIT V STIFFNESS METHOD 9

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

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

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TEXT BOOKS:

1. Bhavikatti S S, (2011), Matrix Methods of Structural Analysis, IK Publishing, India

REFERENCES:

1. Natarajan C and Revathi P., "Matrix Methods of Structural Analysis", PHI Learning Private Limited, New Delhi, 2014
2. Godbole P. N., Sonparote R. S., Dhote S. U., (2014), Matrix Methods of Structural Analysis, PHI Learning Pvt. Ltd., New Delhi

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the structures with energy concepts	Understand
CO2	Gain knowledge on characteristics of structures by evaluation of its flexibility and stiffness	Understand
CO3	Learn the transformation of system forces to element forces and element flexibility to system flexibility	Understand
CO4	Impart knowledge about analysis of system through direct and element approach of flexibility method	Analyze
CO5	Develop stiffness matrix for structures with zero force at some coordinates	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	-	3	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	3	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	3	-	-	-	-	-	-	-	-	-
CO5	3	-	2	-	3	-	-	-	-	-	-	-	2	-
CO	3	3	2	-	3	-	-	-	-	-	-	-	2	-
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)						3: Substantial (High)				

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PROFESSIONAL ELECTIVE - SEMESTER I

P19STP05	THEORY OF PLATES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To understand the behaviour of rectangular plates with different edge conditions
- To analyse the circular plates with symmetrical bending
- To analyse the anisotropic plates and thick plates

UNIT I INTRODUCTION TO PLATES THEORY 9

Deflection of thin Plates–Laterally loaded thin plates– Governing differential equation– Various boundary conditions

UNIT II RECTANGULAR PLATES 9

Rectangular plates–Simply supported rectangular plates–Navier solution and Levy's method– Rectangular plates with various edge conditions– Plates on elastic foundation–Moody's chart for analysis of plates with various boundary conditions/loading

UNIT III CIRCULAR PLATES 9

Symmetrical bending of circular plates

UNIT IV NUMERICAL AND APPROXIMATE METHODS 9

Energy methods – Finite difference and Finite element methods

UNIT V RESONANCE AND COUPLED CIRCUITS 9

Orthotropic plates and grids – Moderately thick plates

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Timoshenko. S., 'Theory of Plates and Shells', McGraw Hill Education (India) Private Limited, 2nd edition, New York, 2010

REFERENCES:

1. Bhavikatti. S.S., 'Theory of Plates and Shells', New Age International Publisher, First edition, New Delhi, 2012
2. Chandrashekhara, K., 'Theory of Plates', University Press (India) Ltd., Hyderabad, 2012

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Gain knowledge about introduction to plate theory.	Understand
CO2	Analysis plates with various boundary conditions/loading	Analyze
CO3	Learn symmetrical bending of circular plates	Understand
CO4	Impart knowledge on special ad appropriate method in finite element methods.	Understand
CO5	Analyze orthotropic plates and grids.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	2	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	2	-
CO5	3	3	-	-	-	-	-	-	-	-	-	-	2	-
CO	3	3	2	-	-	-	-	-	-	-	-	-	2	-

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE - SEMESTER II

P19STP06	MECHANICS OF COMPOSITE MATERIALS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the behaviour of composite materials and to investigate the failure and fracture characteristics
- To analyze the stress and strain component
- To analyze the design concepts of the composite structures

UNIT I INTRODUCTION 9

Introduction to Composites– Classifying composite materials– commonly used fiber and matrix constituents– Composite Construction– Properties of Unidirectional Long Fiber Composites and Short Fiber Composites

UNIT II STRESS STRAIN RELATIONS 9

Concepts in solid mechanics– Hooke's law for orthotropic and anisotropic materials– Linear Elasticity for Anisotropic Materials– Rotations of Stresses – Strains – Residual Stresses

UNIT III ANALYSIS OF LAMINATED COMPOSITES 9

Governing equations for anisotropic and orthotropic plates. Angle– ply and cross ply laminates – Static– Dynamic and Stability analysis for Simpler cases of composite plates– Interlaminar stresses

UNIT IV FAILURE AND FRACTURE OF COMPOSITES 9

Netting Analysis– Failure Criterion– Maximum Stress– Maximum Strain– Fracture Mechanics of Composites– Sandwich Construction.

UNIT V APPLICATIONS AND DESIGN 9

Metal and Ceramic Matrix Composites, Applications of Composites– Composite Joints– Design with Composites– Review– Environmental Issues

Contact Periods:

Lecture: 45 Periods Tutorial: –Period Practical: – Period Total: 45 Periods

TEXT BOOKS:

1. Vasiliev,V.V. "Mechanics of Composite Structures", CRC Press, 2017

REFERENCES:

1. Ronald F. Gibson, "Principles of Composite Material Mechanics", CRC Press; 4 edition ,2015
2. Daniel, "Engineering Mechanics of Composite Material", OUP; 2nd edition, 2013
3. Valery V. Vasiliev, "Advanced Mechanics of Composite Materials and Structures", Elsevier; 4 edition 2018
4. Robert M. Jones, "Mechanics of Composite Materials"-International Edition, CRC Press, 2016

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Discuss the general behaviour of steel concrete composite structure and its types	Understand
CO2	Analyse the stress and strain for the composite structure	Analyze
CO3	Explain design concepts of members	Understand
CO4	Estimate the failure mode and design the joints	Analyze
CO5	Analyse the composite member and identify applications	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	2	1	-	-	-	2	-	-	3	1
CO2	3	3	-	2	2	1	1	-	-	-	-	-	3	1
CO3	3	3	3	2	2	1	1	-	-	2	-	2	3	1
CO4	3	3	3	2	2	1	1	-	-	2	-	2	3	1
CO5	3	3	3	2	2	1	1	-	-	2	-	2	3	1
CO	3	3	3	2	2	1	1	-	-	2	-	2	3	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE - SEMESTER II

P19STP07	ANALYSIS AND DESIGN OF TALL BUILDINGS	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To study the behavior, analysis and design of tall structures
- To design the various types of structures
- To analyze the stability of structural elements

UNIT I INTRODUCTION 9

Tall building in the urban context – the tall building and its support structure – development of high-rise building structures – general planning considerations. dead loads – live load –construction loads -snow, rain, and ice loads – wind loads-seismic loading – water and earth pressure loads – loads – loads due to restrained volume changes of material – impact and dynamic loads – blast loads -combination of loads

UNIT II BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

Factors affecting growth– height and structural form–High rise behavior– Rigid frames– braced frames–In filled frames–shear walls– coupled shear walls– wall-frames–tubular–cores–outrigger braced and hybrid mega systems

UNIT III ANALYSIS AND DESIGN 9

Modeling for approximate analysis–Accurate analysis and reduction techniques– Analysis of buildings as total structural system considering overall integrity – major subsystem interaction, Analysis for member forces–drift and twist –Computerized three–dimensional analysis – Assumptions in 3D analysis – Simplified 2D analysis

UNIT IV STRUCTURAL ELEMENTS 9

Sectional shapes– properties and resisting capacity– design– deflection–cracking–prestressing, shear flow– Design for differential movement– creep and shrinkage effects–temperature effects and fire resistance

UNIT V STABILITY OF TALL BUILDING 9

Overall buckling analysis of frames– wall-frames– Approximate methods– second order effects of gravity of loading– P-Delta analysis– simultaneous first–order and P-Delta analysis– Translational, Torsional instability–out of plumb effects– stiffness of member in stability– effect of foundation rotation

Contact Periods:

Lecture: 45 Periods Tutorial: –Period Practical: – Period Total: 45 Periods

TEXT BOOKS:

1. B.S. Taranath, Structural analysis and design of tall building, CRC Press.,2011

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REFERENCES:

1. Michael Yit Lin Chew,"Construction Technology for Tall Building", World Scientific Publishing Company; 5th Edition edition, 2017
2. Alberto Lago, "Damping Technologies for Tall Buildings: Theory, Design Guidance and Case Studies", Butterworth-Heinemann; 1st edition, 2018
3. Nigel Clark, "Tall Buildings: A Strategic Design Guide", RIBA Publishing; 2nd edition, 2016

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Know tall building and their combination of loads.	Understand
CO2	Understand the behavior of various structural systems under gravity and lateral loading.	Understand
CO3	Utilize structural engineering software for analysis of high-rise structure.	Analyze
CO4	Utilize structural engineering software for design of high-rise structure	Analyze
CO5	Analyse the problems to be raised under various exposure of the building.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	3	-	-	1	-	2	-	-	-	-	1	-
CO2	3	2	-	-	2	-	-	-	-	1	-	-	-	-
CO3	3	-	3	-	-	-	1	-	-	-	-	2	-	1
CO4	3	-	3	-	-	-	1	-	-	-	-	-	-	-
CO5	3	2		3	-	-	-	-	-	-	-	-	-	-
CO	3	2	3	3	2	1	1	2	-	1	-	2	1	1
Correlation levels:			1: Slight (Low)		2: Moderate (Medium)					3: Substantial (High)				

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PROFESSIONAL ELECTIVE - SEMESTER II

P19STP08	INDUSTRIAL STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Design of Steel Structures, Structural Analysis I

COURSE OBJECTIVES:

- To study the requirements, planning and design of Industrial structures
- To design the industrial buildings
- To analyse and design of foundation, Chimneys and Cooling towers

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

Classification of Industries and Industrial structures - Planning for Layout Requirements regarding Lighting–Ventilation and Fire Safety - Protection against noise and vibration

UNIT II INDUSTRIAL BUILDINGS 9

Steel and RCC – Design of Corbels and Nibs – Design of Staircase– Design of gantry girders

UNIT III POWER PLANT STRUCTURES 9

Types of power plants – Containment structures – Cooling Towers – Bunkers and Silos – Pipe supporting structures

UNIT IV TRANSMISSION LINE STRUCTURES AND CHIMNEYS 9

Analysis and design of steel monopoles– transmission line towers – Sag and Tension calculations– Methods of tower testing – Design of self –supporting and guyed chimney

UNIT V FOUNDATION 9

Design of foundation for Towers– Chimneys –Cooling Towers – Machine Foundation –Design of Turbo Generator Foundation

Contact Periods:

Lecture: 45 Periods Tutorial: –Period Practical: – Period Total: 45 Periods

TEXT BOOKS:

1. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill,1992.

REFERENCES:

1. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers, 2004.
2. Manohar S.N, "Tall Chimneys - Design and Construction", Tata McGraw Hill, 1985.
3. Srinivasulu P and Vaidyanathan.C, "Handbook of Machine Foundations", Tata McGraw Hill, 1976.

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the classification of industries.	Understand
CO2	Analyse and design of corbel,nibs and staircase.	Analyze
CO3	Understand the types of power plants and containment structures.	Understand
CO4	Analyse and design transmission tower lines and chimneys.	Analyze
CO5	Analyse and design of foundation for towers.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	3
CO4	3	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	-	-	-	-	-	1	-	-	-	-	3	3
CO	3	2	2	1	-	-	-	1	-	-	-	-	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE - SEMESTER II

P19STP09	EXPERIMENTAL TECHNIQUES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Strength of Materials I & II

COURSE OBJECTIVES:

- To study the strain, vibration, wind flow and Non-Destructive methods
- To determine the acoustics and wind flow
- To apply non-destructive testing on structures, buildings, bridges and towers

UNIT I STRAIN MEASUREMENT 9

Methods of measurement, errors in measurements– calibration – load calibration of testing machines – i.s. code provisions – measurement system– mechanical, optical and acoustical extensometers – strain measurement electrical resistance strain gauges – principle, types, performance, uses – strain rosettes Wheatstone bridge – photo elasticity – principle and applications – hydraulic jacks and pressure gauges electronic load cells–proving rings

UNIT II VIBRATION MEASUREMENTS 9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements–Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT III ACOUSTICS AND WIND FLOW MEASURES 9

Principles of Pressure and flow measurements – pressure transducers – sound level meter – Venturimeter– flow meters – wind tunnel and its use in structural analysis – structural modelling – direct and indirect model analysis.

UNIT IV DISTRESS MEASUREMENT AND CONTROL 9

Diagnosis of distress in structures – Crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements – Structural Health Monitoring

UNIT V NON DESTRUCTIVE TESTING METHODS 9

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission– ultrasonic testing principles and application – Holography – use of laser for structural testing –Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo– impulse radar techniques, GECOR , Ground penetrating radar (GPR).

Contact Periods:

Lecture: 45 Periods Tutorial: – Period Practical: – Period Total: 45 Periods

TEXT BOOKS:

1. Jindal U.C., Experimental Stress Analysis, Pearson, New Delhi, 2013

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REFERENCES:

1. Dalley .J. W and Riley. W. F, "Experimental Stress Analysis", McGraw Hill Book Company,NewYork, 2005.
2. Ganesan.T.P, "Model Analysis of Structures", University Press, India, 2007
3. Ravisankar.K.andChellappan.A., "Advanced course on Non–Destructive Testing and Evaluation of Concrete Structures", SERC, Chennai, 2010.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K–Level
CO1	Describe the methodology of measuring errors and strains and calibrate the machineries and equipment used in the laboratory.	Understand
CO2	Describe the mechanical, optical, pneumatic and electrical strain gauges for strain measurement.	Understand
CO3	Understand the vibration measuring systems and wind flow measurements.	Understand
CO4	Gain knowledge about diagnose the distress in structures.	Understand
CO5	Apply non-destructive testing methods on structures.	Apply

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	3	3	2	2	1	2	–	2	–	3	1
CO2	3	1	3	3	3	2	2	1	2	–	2	–	3	1
CO3	3	1	3	3	3	2	2	1	2	–	2	–	3	1
CO4	3	1	3	3	3	2	2	1	2	–	2	–	3	1
CO5	3	1	3	3	3	2	2	1	2	–	2	–	3	1
CO	3	1	3	3	3	2	2	1	2	–	2	–	3	1
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

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PROFESSIONAL ELECTIVE - SEMESTER II

P19STP10	WIND AND CYCLONE EFFECTS ON STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Strength of Materials I & II

COURSE OBJECTIVES:

- To study the concept of wind and cyclone effects for the analysis and design of structures
- To design the special structures
- To determine the wind and cycloneeffects

UNIT I INTRODUCTION 9

Introduction – Spectral studies – Gust factor – Wind velocity– Methods of measurements – variation of speed with height – shape factor – aspect ratio – drag effects

UNIT II WIND TUNNEL STUDIES 9

Wind Tunnel Studies – Types of tunnels – Modeling requirements – Interpretation of results – Aero-elastic models

UNIT III EFFECT OF WIND ON STRUCTURES 9

Windon structures – Rigid structures – Flexible structures – Static and Dynamic effects –Tall buildings – chimneys

UNIT IV DESIGN OF SPECIAL STRUCTURES 9

Application to design – IS 875 (Part III) code method – Chimneys – Cooling towers – Cyclone Shelters

UNIT V CYCLONE EFFECTS 9

Cyclone effect on – low rise structures – sloped roof structures - Tall buildings. Effect of cyclone on claddings – design of cladding – use of code provisions in cladding design – Analytical procedure and modeling of cladding

Contact Periods:

Lecture: 45 Periods Tutorial: – Period Practical: – Period Total: 45 Periods

TEXT BOOKS:

1. Cook.N.J., "The Designer's Guide to Wind Loading of Building Structures", Butterworths, 1989.

REFERENCES:

1. Lawson T.V., "Wind Effects on Building Vol. I and II", Applied Science Publishers, London, 1980.
2. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York, 1978.

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the importance of wind properties and basic parameters.	Understand
CO2	Understand the static and dynamics response of tall buildings and chimneys due to wind.	Understand
CO3	Know the code provisions for the design of special structures for wind loading.	Understand
CO4	Understand the cyclone effect on low rise, sloped roof and tall building structures.	Understand
CO5	Know the design, analytical procedure and modeling of claddings.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	-	1	-	2	-	-	2	2	-	-	1	1
CO2	3	-	-	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	2	-	1	-	-	2	-	-	-	-	-	1
CO4	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	-	-	-	-	-	-	-	-	2	-	-	-	-
CO	3	2	2	1	1	2	-	2	2	2	-	2	1	1
Correlation levels:	1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)													

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP11	NON-LINEAR ANALYSIS OF STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To give an overview about the concept of nonlinear behaviour of beams and vibrations of beams
- To know the elastic analysis of statically determinate and indeterminate flexural members
- To study the non linear vibration and instabilities of elastically supported beams

UNIT I INTRODUCTION TO NONLINEAR ANALYSIS 9

Types of nonlinearities – Geometric nonlinearity, material nonlinearity, nonlinear governing equation for beams: moment – Curvature nonlinearity, geometric nonlinearity due to stretching, material nonlinearity, geometrically nonlinear beam problems – Moment-curvature nonlinearity – Cantilever beam, centrally loaded beam with two supports, cantilever beam subjected to tip load

UNIT II INELASTIC ANALYSIS OF COLUMNS 9

Nonlinear Analysis of Columns – Post buckling of cantilever column, Large deflection of column with both ends hinged

UNIT III VIBRATION THEORY AND ANALYSIS OF FLEXURAL MEMBERS 9

Vibration theory and analysis of flexural members; hysteretic models and analysis of uniform andvariable stiffness members under cyclic loading

UNIT IV ELASTIC AND INELASTIC ANALYSIS OF PLATES 9

Nonlinear Static Analysis of Plates – Geometric and Material Nonlinearities, Governing Nonlinear equations of Plates: Stress Function Approach, Displacement Equations Approach. Nonlinear Static Analysis of Plates – Boundary Conditions and method of solution, Large Deflection of Rectangular Plates

UNIT V NONLINEAR VIBRATION AND INSTABILITY 9

Nonlinear vibration and Instabilities of elastically supported beams

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Reddy.J.N, "Non linear Finite Element Analysis", Oxford University Press, 2008
2. Iyengar N G R, "Elastic Stability of Structural elements", Macmillan India Ltd, 2007
3. Fertis, D. G.,"Nonlinear Mechanics", CRC Press, Boca Raton, Florida, 1998

REFERENCES:

1. Sathyamoorthy, M, "Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida, 1997

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the concept of geometrically nonlinear beam problems	Understand
CO2	Apply the basic ideas inelastic analysis of columns	Apply
CO3	Apply the basic ideas in vibration theory and analysis of flexural members	Apply
CO4	Perform inelastic analysis of plates.	Apply
CO5	Perform nonlinear vibration and instability.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	-	-	1	-	2	-	-	-	-	1	-
CO2	3	2	2	-	-	-	2	-	-	-	-	2	-	1
CO3	3	2	3	-	-	-	1	-	-	-	-	-	-	-
CO4	3	2	1	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	1	-	2	-	-	-	-	2	1	-	-	-
CO	3	2	3	3	2	1	2	2	-	2	1	2	1	1
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)				

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP12	DESIGN OF SUB STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

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

UNIT I SHALLOW FOUNDATIONS 9

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

UNIT II PILE FOUNDATIONS 9

Introduction – Types of pile foundations – Load carrying capacity– Pile load test – Structural design of straight piles – Configuration of piles – Different shapes of piles cap – Structural design of pile cap

UNIT III WELL FOUNDATIONS 9

Types of well foundation – Grip length – Load carrying capacity – Construction of wells – Failures and Remedies – Design of well foundation – Lateral stability

UNIT IV MACHINE FOUNDATIONS 9

Introduction – Types of machine foundation – Basic principles of design of machine foundation – Dynamic properties of soil – vibration analysis of machine foundation – Design of foundation for Reciprocating machines and Impact machines – Reinforcement and construction details – vibration isolation

UNIT V SPECIAL FOUNDATIONS 9

Foundation on expansive soils – Choice of foundation – Under-reamed pile foundation–Foundation for concrete Towers, chimneys – Design of anchors–Reinforced earth retailing walls

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Swamy Saran, 'Analysis and Design of substructures', Oxford and IBH Publishing Co. Pvt. Ltd., 2006
2. Bowles .J.E., "Foundation Analysis and Design", McGraw Hill Publishing co., New York, 1997
3. Tomlinson.M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995

REFERENCES:

1. Varghese.P.C, "Design of Reinforced Concrete Foundations" – PHI learning private limited, New Delhi, 2009
2. W.F. Chen, Lian Duan "Bridge Engineering: Substructure Design", CRC press.2001

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Select appropriate foundation type based on available soil conditions	Understand
CO2	Determine the load carrying capacityand to design thepile foundation	Apply
CO3	Design well foundation	Apply
CO4	Understand the design of machine foundations	Understand
CO5	Design the under reamed pile foundation, concrete towers, chimneys	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	-	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	-	-	-	-	-	-	-	-	-	-	-	3	3
CO4	2	-	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	-	-	-	-	-	-	1	-	-	-	-	3	3
CO	3	-	2	1	-	-	-	1	-	-	-	-	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP13	OPTIMIZATION OF STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Nil

COURSE OBJECTIVES:

- To introduce the fundamentals of optimization concepts and their applications in the structural engineering field
- To study the linear programming methods of the optimization
- To apply various optimization techniques to solve structural engineering problems

UNIT I BASIC PRINCIPLES AND CLASSICAL OPTIMIZATION TECHNIQUES 9

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

UNIT II LINEAR PROGRAMMING 9

Formulation of problems –Graphical solution – Analytical methods – Standard form –Slack, surplus and artificial variables –Canonical form – Basic feasible solution – Simplex method –Two phase method - Penalty method – Duality theory –Primal –Dual algorithm

UNIT III NON LINEAR PROGRAMMING 9

Introduction to non-linear problems –One Dimensional minimization methods: Unidimensional – Unimodal function –Exhaustive and unrestricted search –Dichotomous search – Fibonacci Method - Golden section method - Interpolation methods, Unconstrained optimization Techniques

UNIT IV GEOMETRIC PROGRAMMING AND DYNAMIC PROGRAMMING 9

Geometric Programming- Polynomial – Degree of difficulty –Reducing G.P.P. to a set of simultaneous equations – Concepts of solving problems with zero difficulty and one degree of difficulty – Dynamic Programming–Bellman's principle of optimality –Representation of a multi stage decision problem –Concept of optimization problems – Truss optimization

UNIT V STRUCTURAL ENGINEERING OPTIMIZATION 9

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory – Minimum weight design for truss members – Fully stressed design– Optimization principles to design of R.C. structures such as multi-storey buildings, water tanks and bridges. Structural optimization for transient (dynamic) problems

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Belegundu,A.D. and Chandrapatla,T.R., "Optimisation Concepts and Applications in Engineering", Pearson Education, 2011
2. Arora J.S., "Introduction to Optimum Design", McGraw –Hill Book Company, 2011

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3. Deb K., "Optimisation for Engineering Design", Algorithms and examples, Prentice Hall, New Delhi, 2012.

REFERENCES:

1. Rao,S.S. "Optimization theory and applications", Wiley Eastern (P) Ltd., 1984
2. Spunt, "Optimization in Structural Design", Civil Engineering and Engineering Mechanics Services, Prentice-Hall, New Jersey 1971
3. Uri Krish, "Optimum Structural Design", McGraw Hill Book Co. 1981

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Apply the basic ideas in optimization to make the structures as lightly as possible.	Apply
CO2	Apply the linear programming techniques in engineering optimization.	Apply
CO3	Solve the unconstrained and constrained optimization problems in structural design.	Understand
CO4	Understand the methods in solving the problems related to geometric programming and dynamic programming..	Understand
CO5	Have knowledge in advanced techniques of optimization such as genetic algorithm and artificial neural networks.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO2	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO3	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO4	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO5	3	3	3	-	-	-	-	-	-	-	-	-	2	2
CO	3	3	3	-	-	-	-	-	-	-	-	-	2	2

Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP14	DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Design of Steel Structures

COURSE OBJECTIVES:

- To understand the behaviour and design of concrete composite elementsand structures
- To know the in-depth overview for the design of various steel concrete composite structures having applications in construction.
- To gain knowledge about seismic behavior of composite structures

UNIT I INTRODUCTION 9

Introduction to steel – Concrete composite construction – Theory of composite structures – Codes – Composite action – Failure Modes – Serviceability and Construction issues in design

UNIT II DESIGN OF COMPOSITE MEMBERS 9

Behaviour of composite beams – Applications of Composite beams – Design of composite beams – Design of Composite columns

UNIT III DESIGN OF CONNECTIONS 9

Shear Connectors – Types–Behaviour of shear connectors – Design of shear connectors–Degree of shear connection –Partial shear interaction

UNIT IV COMPOSITE BOX GIRDER BRIDGES 9

Introduction – Behaviour of box girder bridges – Design concepts

UNIT V CASE STUDIES AND SEISMIC BEHAVIOR 9

Case studies on steel – Concrete composite construction in buildings – Seismic behaviour ofcomposite structures

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Johnson R.P., 'Composite Structures of steel and concrete', Blackwell Scientific Publications (Second Edition), UK, 2004
2. Johnson R.P., "Composite Structures of Steel and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Blackwell Scientific Publications, 2004
3. Owens, G.W. and Knowels. P. Steel Designers manual (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992

REFERENCES:

1. Proceedings of "Workshop on Steel Concrete Composite Structures", conducted at Anna University, 2000
2. IS 11384 - 1985, Code of Practice for Steel concrete Composite structures

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the concept of steel-concrete composite construction	Understand
CO2	Design the composite members	Apply
CO3	Design the connections for composite members	Apply
CO4	Learn the design concepts for composite box girder bridge	Understand
CO5	Understand the seismic behaviour of composite structures	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	2	-	-	-	-	-	-	2	2
CO2	3	-	-	-	-	-	-	-	1		1	-	2	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	-	2
CO4	3	3	-	-	-	2	1	-	-	-	1	-	2	2
CO5	3	-	-	-	-	2	-	-	-	2	-	-	-	2
CO	3	3	-	-	-	2	1	2	1	2	1	-	2	2
Correlation levels:	1: Slight (Low)					2: Moderate (Medium)					3: Substantial (High)			

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP15	DESIGN OF BRIDGES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE–REQUISITES:

- Design of RC Elements, Design of Steel Structures, Prestressed Concrete

COURSE OBJECTIVES:

- To study the loads, forces on bridges and design of several types of bridges
- To learn and understand the design of various elements of the bridge structure
- To gain knowledge about analyze and design of substructure

UNIT I INTRODUCTION AND SHORT SPAN RC BRIDGES 9

Types of bridges and loading standards – Choice of type – IRC Specifications for road bridges – Design of RCC solid slab bridges – analysis and design of box culverts, Tee beam and slab bridges

UNIT II LONG SPAN RC BRIDGES 9

Design principles of continuous girder bridges, box girder bridges and balanced cantilever bridges – segmental construction and launching of girders

UNIT III PLATE GIRDER BRIDGES 9

Elements of plate girder – Design of plate girder – Intermediate Structure – Design Problem

UNIT IV PRESTRESSED CONCRETE BRIDGES 9

Flexural and torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – maximum and minimum prestressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – check for stresses at various sections – check for diagonal tension – Diaphragms – End block – short term and long term deflection

UNIT V BEARINGS AND SUBSTRUCTURES 9

Different types of bearings – Design of bearings – Design of piers and abutments of different types – design of Earth retaining structures–Types of bridge foundations – Design of foundations

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Jagadeesh.T.R. and Jayaram.M.A., "Design of Bridge Structures", Prentice Hall of India Pvt. Ltd. 2004
2. Ponnuswamy, S., "Bridge Engineering", Tata McGraw Hill, 2008
3. Krishnaraju.N, "Design of Bridges" Oxford & IBH publishing Co. Pvt Ltd, 4th Edition, 2008

REFERENCES:

1. Johnson Victor, D. "Essentials of Bridge Engineering", Oxford and IBH Publishing Co. New Delhi, 6th Edition, 2008
2. Jagadeesh.T.R. and Jayaram.M.A. "Design of Bridge Structures", Prentice Hall o f India Pvt Ltd. 2nd Edition, 2009
3. Raina. V.K. "Concrete Bridge Practice" Shroff Pub & Dist. Pvt. Ltd 2007

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Understand the fundamentals and codes of practice of bridge design	Understand
CO2	Learn about the design principles of bridges and culverts	Understand
CO3	Analyze and design of plate girders	Analyze
CO4	Analyze and design of prestressed concrete bridges	Analyze
CO5	Design of component of bridges and foundations.	Analyze

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	1	-	3	3
CO2	3	2	2	-	-	-	-	-	-	-	1	-	3	3
CO3	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	-	-	-	-	-	-	-	-	1	-	3	3
CO	3	2	2	1	-	-	-	-	-	-	1	-	3	3
Correlation levels:	1: Slight (Low)		2: Moderate (Medium)				3: Substantial (High)							

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP16	DESIGN OF SHELL AND SPATIAL STRUCTURES	Category: PE			
		L	T	P	C
		3	0	0	3

PRE– REQUISITES:

- Strength of Materials, Theory of Elasticity and Plasticity

COURSE OBJECTIVES:

- To study the behaviour and design of shells and folded plates
- To understand the basic concepts and behaviour of space frames
- To impart the concepts and application of FORMIAN software

UNIT I CLASSIFICATION OF SHELLS 9

Classification of shells, types of shells, structural action, - Design of circular domes, conical roofs, circular cylindrical shells by ASCE Manual No.31. application to design of shell roofs of water tanks(membrane analysis)

UNIT II FOLDED PLATES 9

Folded Plate structures, structural behaviour, types, design by ACI - ASCE Task Committee method – pyramidal roof

UNIT III INTRODUCTION TO SPACE FRAME 9

Space frames - configuration - types of nodes -Design Philosophy - Behaviour

UNIT IV ANALYSIS AND DESIGN 9

Analysis of space frames – Design of Nodes – Pipes - Space frames – Introduction to Computer Aided Design

UNIT V SPECIAL METHODS 9

Application of FORMEX Algebra, FORMIAN for generation of configuration

Contact Periods:

Lecture: 45 Periods Tutorial: – Periods Practical: – Periods Total: 45 Periods

TEXT BOOKS:

1. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010
2. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982
3. Ramasamy, G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 1986

REFERENCES:

1. ASCE Manual No.31, Design of Cylindrical Shells
2. Subramanian.N ,"Principles of Space Structures", Wheeler Publishing Co. 1999
3. M. Y. H. Bangash, T. Bangash "Elements of spatial structures: analysis and design" , Thomas Telford, 2003

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COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Know about classification of shells, types of shells, structural action, analyze and design of various types of shells	Understand
CO2	Know the structural behavior of folded plates and to design various types of folded plates	Understand
CO3	Know configuration and behavior of space frame	Understand
CO4	Analyze and design of space frame	Analyze
CO5	Know application of formex algebra, formian for generation of configuration.	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	-	-	-	-	-	1	-	-	-	-	3	3
CO	3	2	2	1	-	-	-	1	-	-	-	-	3	3
Correlation levels:	1: Slight (Low)			2: Moderate (Medium)				3: Substantial (High)						

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PROFESSIONAL ELECTIVE - SEMESTER III

P19STP17	COMPUTER AIDED ANALYSIS AND DESIGN	Category: PE			
		L	T	P	C
		2	0	2	3

PRE–REQUISITES:

- Design of RC Elements, Prestressed Concrete structures

COURSE OBJECTIVES:

- To learn the principles of computer graphics, structural analysis, structural design, FiniteElement Analysis
- To impart the parametric fundamentals to create and stimulate analysis of steel sections using suitable software
- To understand basic principles of optimization and Artificial Intelligence supported by software tools

UNIT I COMPUTER GRAPHICS 6

Graphic primitives – Transformations – Basics of 2D drafting – Modelling of curves and surfaces – Wire frame modelling –Solid Modelling – Graphic standards – Drafting Software packages

UNIT II STRUCTURAL ANALYSIS I 6

Computer method of structural analysis – Simulation and Analysis of steel sections I, channel and Angle

UNIT III STRUCTURAL ANALYSIS II 6

PEB Elements – RCC and Composite members – Nonlinear Analysis through software packages

UNIT IV STRUCTURAL DESIGN 6

Computer Aided Design of Steel and RC structural elements – Detailing of reinforcement – Detailed Drawing

UNIT V OPTIMIZATION 6

Introduction to Optimization – Applications of Linear programming – Simplex Algorithm – Post Optimality Analysis

LIST OF EXPERIMENTS

1. 2D Frame Modelling and Analysis.
2. 3D Frame Modelling and Analysis.
3. Non Linear Analysis using Design software.
4. Design and Detailing of Structural Elements.
5. Simulation and Analysis of steel beam using FEA software.
6. Simulation and Analysis of RCBeam using FEA software.
7. Simulation and Analysis of Composite elements using FEA software.
8. Eigen Value Buckling analysis using FEA software.

Contact Periods: 30

Lecture: 30 Periods Tutorial: – Periods Practical: 30 Periods Total: 60 Periods

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TEXT BOOKS:

1. Krishnamoorthy C.S and Rajeev S., "Computer Aided Design", Narosa Publishing House, New Delhi.
2. Groovern M.P. and Zimmers E.W. Jr.," CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, New Delhi, 1993.

REFERENCES:

1. Harrison H.B., "Structural Analysis and Design Vol.I and II", Pergamon Press, 1991
2. Rao. S.S., "Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009.
3. Richard Forsyth (Ed.), "Expert System Principles and Case Studies", Chapman and Hall, 1996.
4. Shah V.L. "Computer Aided Design in Reinforced Concrete" Structural Publishers, 2014

COURSE OUTCOMES:

Upon completion of the course, the student will be able to

COs	Statements	K-Level
CO1	Know basics of 2D drafting and drafting software packages	Understand
CO2	Do computer method of structural analysis	Understand
CO3	Know about Simulation and Analysis of steel sections I, channel and Angle	Understand
CO4	Do computer aided design of steel and RC structural elements	Understand
CO5	Know optimization techniques and to familiar with Post Optimality Analysis and knowledge based expert systems	Understand

COURSE ARTICULATION MATRIX:

POs / COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3
CO3	2	2	-	-	-	-	-	-	-	-	-	-	3	3
CO4	2	2	2	1	-	-	-	-	-	-	-	-	3	3
CO5	3	2	-	-	-	-	-	1	-	-	-	-	3	3
CO	3	2	2	1	-	-	-	1	-	-	-	-	3	3
Correlation levels:			1: Slight (Low)			2: Moderate (Medium)					3: Substantial (High)			

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