SENGUNTHAR ENGINEERING COLLEGE

(AUTONOMOUS)

(Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai)
Recognized Under Section 2(f) & 12(B) of the UGC Act, 1956
NAAC Accredited with 'A' Grade
TIRUCHENGODE - 637 205 NAMAKKAL (Dt) TAMILNADU

ESTD 2001

ISO 9001 REGISTERED

CURRICULUM & SYLLABI

M.E. STRUCTURAL ENGINEERING

(CHOICE BASED CREDIT SYSTEM)

REGULATIONS – 2023

(For the Students Admitted in the Academic Year 2023-2024 onwards)

Estd : 2001

Note: The regulations hereunder are subject to amendments as may be decided by the Academic Council of the Sengunthar Engineering College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the program under the same Regulation as may be decided by the Academic Council.

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DEPARTMENT

OF

CIVIL ENGINEERING

REGULATION 2023

CURRICULUM AND SYLLABI

FOR M.E. – STRUCTURAL ENGINEERING

(For the Students admitted in the Academic Year 2023-2024 onwards)

FIRST SEMESTER

TO

FOURTH SEMESTER

Estd : 2001

INDEX

SCHEME FOR CURRICULUM

M.E. – Structural Engineering

REGULATIONS 2023

CHOICE BASED CREDIT SYSTEM

M.E. STRUCTURAL ENGINEERING

VISION

- To be a premier Civil Engineering Department to provide quality education and to enrich research and professional service to the society in all areas of civil engineering.

MISSION

- To impart knowledge in Civil Engineering and allied fields through a dynamic curriculum and best teaching methodologies.
- To produce quality engineers with moral values who are capable of meeting the demands and challenges of the profession by focusing on latest practices.
- To inspire and nurture innovative leaders and entrepreneurs.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Graduates can

- ✓ Be competent in Structural Engineering to apply in-depth technical knowledge, effective design skills and sustainability principles to address evolving engineering challenges of the industry and society with professional ethics.
- ✓ Exhibit attitude, professionalism, ability to communicate with team members and adapt to the latest technology by engaging themselves in life-long learning.
- ✓ Engage in continual learning by pursuing advanced research.

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

PO1	**Engineering knowledge**	Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	**Problem analysis**	Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**Design / development of solutions**	Design solutions for complex 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.

PO4	**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.
PO5	**Modern tool usage**	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO6	**The engineer and society**	Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7	**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.
PO8	**Ethics**	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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.

PROGRAM SPECIFIC OUTCOME (PSOs)

PSO1	Execute innovation and excellence in Structural Engineering problem solving and design in global and societal contexts.
PSO2	Applying an analytical approach for the practical problems in the field of Structural Engineering.
PSO3	Commit to lifelong learning and professional development in the Structural Engineering.

MAPPING OF COURSE OUTCOME AND PROGRAM OUTCOME

Year	Sem	Course Name	PO												PSO		
			1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
I	I	23PSM101 - Advanced Mathematics for Structural Engineering	3.0	3.0	-	2.0	-	-	-	-	-	-	-	2.0	-	-	-
		23PGT101 - Research Methodology and IPR	3.0	2.0	1.6	1.6	1.6	1.0	-	-	-	-	2.0	1.0	2.0	1.0	1.4
		23PST101 - Applied Elasticity and Plasticity	3.0	3.0	2.0	2.0	1.0	-	-	-	-	-	1.0	1.0	3.0	2.0	1.0
		23PST102 - Finite Element Analysis and Methods	3.0	2.80	2.0	2.0	-	-	2.60	1.0	-	2.0	-	1.0	3.0	2.0	1.0
		23PSE101 - Experimental Techniques	2.83	2.83	1.67	2.50	1.0	-	-	-	-	1.0	1.0	1.0	2.83	1.33	1.0
		Professional Elective – I	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23PEE101 - Research Paper Writing and Seminar	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	II	23PST201 - Advances in Steel Structures	3.0	2.0	2.6	1.8	1.0	1.0	1.8	-	-	-	1.0	1.0	3.0	2.0	1.0
		23PST202 - Structural Dynamics and Seismic Design	3.0	3.0	2.0	1.4	1.0	1.0	1.0	-	-	-	1.0	1.0	3.0	2.0	1.0
		23PSE201 - Advances in Concrete Technology	2.83	2.83	1.67	2.33	1.0	-	-	-	-	1.0	1.0	1.0	2.83	1.33	1.0
		Professional Elective – II	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Professional Elective – III	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Open Elective	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23PEE201 - Mini Project	3.0	3.0	2.0	2.0	1.0	1.0	-	-	-	-	-	1.0	3.0	2.0	2.0
II	III	Professional Elective – IV	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Professional Elective – V	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		Professional Elective – VI	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		23PEE301 - Project work (Phase – I)	3.0	3.0	2.0	2.0	1.0	1.0	-	-	-	1.0	1.0	1.0	3.0	2.0	2.0
	IV	23PEE401 - Project work (Phase – II)	3.0	3.0	2.0	2.0	1.0	1.0	-	-	-	1.0	1.0	1.0	3.0	2.0	2.0

PROFESSIONAL ELECTIVE COURSES

S.No.	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	23PSP101 - Disaster Resistant Structures	3.0	2.6	2.0	2.0	2.0	1.0	1.0	-	-	-	-	1.0	3.0	2.6	1.0
2	23PSP102 - Theory of Structural Stability	3.0	3.0	2.6	2.0	1.4	1.0	1.0	-	-	-	-	1.0	3.0	2.6	1.4
3	23PSP103 - Advances in Concrete Structures	2.6	1.8	2.0	1.8	1.0	1.4	1.6	-	-	-	1.0	1.0	2.8	2.2	1.0
4	23PSP104 - Smart Materials for Construction	3.0	2.2	2.0	2.0	2.0	1.0	2.0	-	-	-	1.0	1.0	3.0	2.4	2.0
5	23PSP105 - Cracks and Crack Control in Concrete Structures	2.6	1.8	2.0	1.8	1.0	1.4	1.6	-	-	-	1.0	1.0	2.8	2.2	1.0
6	23PSP201 - Formwork Engineering	3.0	2.4	3.0	2.0	2.0	1.6	2.0	-	1.0	1.0	1.6	1.0	3.0	2.4	1.6
7	23PSP202 - Design of Industrial Structures	3.0	3.0	3.0	3.0	2.0	1.6	2.0	-	1.0	-	1.0	1.0	3.0	2.6	1.8
8	23PSP203 - Structural Health Monitoring	3.0	3.0	3.0	3.0	2.8	1.8	2.0	-	-	1.0	1.0	1.0	2.8	2.6	1.6
9	23PSP204 - Fracture Mechanics	3.0	3.0	3.0	3.0	2.8	1.6	1.8	-	-	1.0	1.0	1.0	2.8	2.4	1.4
10	23PSP205 - Pre-Stressed Concrete Structures	3.0	2.0	2.0	2.0	1.4	1.4	1.4	-	-	-	1.4	1.4	3.0	2.0	1.4
11	23PSP206 - Structural Optimization	3.0	3.0	3.0	3.0	2.0	1.8	1.8	-	-	-	1.4	1.4	3.0	2.8	1.4
12	23PSP207 - Energy Efficient Structures	3.0	3.0	3.0	2.8	2.2	1.8	1.8	-	1.0	1.0	1.8	1.8	3.0	2.2	1.8
13	23PSP208 - Wind and Cyclone Effects on Structures	3.0	3.0	3.0	3.0	2.0	1.6	2.0	-	1.0	-	1.0	1.0	3.0	2.6	1.8
14	23PSP209 - Computer Aided Design of Structures	2.6	2.0	2.0	2.0	1.6	1.6	1.6	-	-	-	1.6	1.6	3.0	2.0	1.6
15	23PSP210 - Mechanics of Composite Materials	3.0	2.4	3.0	2.0	2.0	1.6	2.0	-	1.0	1.0	1.6	1.0	3.0	2.4	1.6
16	23PSP301 - Design of Offshore Structures	3.0	3.0	3.0	3.0	2.8	1.6	1.8	-	-	1.0	1.0	1.0	2.8	2.4	1.4
17	23PSP302 - Design of Steel Concrete Composite Structures	3.0	3.0	3.0	3.0	2.8	1.8	2.0	-	-	1.0	1.0	1.0	2.8	2.6	1.6
18	23PSP303 - Design of Masonry Structures	3.0	3.0	3.0	3.0	2.0	1.6	2.0	-	1.0	-	1.0	1.0	3.0	2.6	1.8
19	23PSP304 - Non-Linear Analysis	3.0	3.0	3.0	3.0	2.0	1.8	1.8	-	-	-	1.4	1.4	3.0	2.8	1.4
20	23PSP305 - Bridge Structures	3.0	3.0	3.0	2.8	2.0	1.6	2.0	-	1.0	1.0	1.6	1.0	3.0	2.6	1.6

21	23PSP306 - Design of Structures for Dynamic Load	3.0	3.0	3.0	3.0	2.0	1.6	2.0	-	1.0	-	1.0	1.0	3.0	2.6	1.8
22	23PSP307 - Design of Shell and Spatial Structures	3.0	3.0	3.0	3.0	2.0	1.8	1.0	-	1.0	-	1.6	1.6	3.0	2.8	1.8
23	23PSP308 - Design of Sub-Structures	3.0	3.0	3.0	3.0	2.8	1.8	2.0	-	-	1.0	1.0	1.0	2.8	2.6	1.6
24	23PSP309 - Structural Analysis by Matrix Methods	3.0	3.0	3.0	3.0	2.0	1.8	1.8	-	-	-	1.6	1.6	3.0	2.6	1.6
25	23PSP310 - Cold Formed Steel Structures	3.0	3.0	3.0	3.0	1.8	1.6	1.6	-	1.0	-	1.6	1.6	3.0	2.6	1.4
26	23PSP311 - Theory of Plates	2.6	2.0	2.0	2.0	1.6	1.6	1.6	-	-	-	1.6	1.6	3.0	2.0	1.6
27	23PSP312 - Soil Structure Interaction	3.0	3.0	2.0	2.0	1.0	1.4	1.6	-	-	-	1.0	1.0	3.0	2.2	1.6
28	23PSP313 - Corrosion Engineering	3.0	3.0	3.0	3.0	1.0	2.0	2.0	-	-	-	1.0	1.0	2.8	2.2	1.4
29	23PSP314 - Maintenance and Rehabilitation of Structures	3.0	3.0	1.8	2.6	1.0	1.0	1.0	-	-	1.0	1.0	1.0	3.0	1.4	1.0
30	23PSP315 - Smart Structures	3.0	2.0	2.0	2.0	2.0	1.0	2.0	-	-	-	1.0	1.0	3.0	2.0	2.0

OPEN ELECTIVE COURSES

S.No.	Course Name	PO												PSO		
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	23PGO201 - Disaster Management	3.0	2.0	2.0	2.0	1.0	1.0	1.0	-	-	1.0	1.0	1.0	3.0	2.0	1.0
2	23PGO202 - Cost Management of Engineering Projects	3.0	3.0	3.0	3.0	2.0	1.0	1.0	1.0	1.0	1.0	3.0	1.0	2.0	2.0	1.0
3	23PGO203 - Constitution of India	3.0	2.0	2.0	1.0	-	1.0	-	1.0	1.0	1.0	-	1.0	2.0	1.0	1.0
4	23PGO204 - Business Analytics	3.0	3.0	3.0	3.0	2.0	1.0	-	1.0	1.0	1.0	2.0	1.0	3.0	2.0	1.0
5	23PGO205 - Digital Marketing	3.0	3.0	3.0	3.0	2.0	1.0	-	1.0	1.0	1.0	1.0	1.0	3.0	2.0	1.0

CURRICULUM AND SYLLABI

FOR M.E. / M.Tech. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023-2024 onwards)

M.E. - STRUCTURAL ENGINEERING - FIRST SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23PSM101	Advanced Mathematics for Structural Engineering	FC	3	1	0	4	40	60	100
23PGT101	Research Methodology and IPR	FC	3	0	0	3	40	60	100
23PST101	Applied Elasticity and Plasticity	PC	3	0	0	3	40	60	100
23PST102	Finite Element Analysis and Methods	PC	3	0	2	4	40	60	100
	Professional Elective – I	PE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23PSE101	Experimental Techniques	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23PEE101	Research Paper Writing and Seminar	EEC	1	0	0	0	100	–	100
TOTAL CREDITS IN SEMESTER - I			21						

FC	:	Foundation Courses
PC	:	Professional Core
PE	:	Professional Elective
OE	:	Open Elective
EEC	:	Employability Enhancement Courses
L	:	Lecture
T	:	Tutorial
P	:	Practical
C	:	Credit Point
CIA	:	Continuous Internal Assessment
ESE	:	End Semester Examination
TOT	:	Total

M.E. - STRUCTURAL ENGINEERING – SECOND SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
23PST201	Advances in Steel Structures	PC	3	0	0	3	40	60	100
23PST202	Structural Dynamics and Seismic Design	PC	3	0	0	3	40	60	100
	Professional Elective – II	PE	3	0	0	3	40	60	100
	Professional Elective – III	PE	3	0	0	3	40	60	100
	Open Elective	OE	3	0	0	3	40	60	100
EMBEDDED COURSE									
23PSE201	Advances in Concrete Technology	PC	3	0	2	4	50	50	100
EMPLOYABILITY ENHANCEMENT COURSE									
23PEE201	Mini Project	EEC	0	0	2	1	100	–	100
TOTAL CREDITS IN SEMESTER - II			20						

FC : Foundation Courses
PC : Professional Core
PE : Professional Elective
OE : Open Elective
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

M.E. - STRUCTURAL ENGINEERING - THIRD SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
THEORY									
	Professional Elective – IV	PE	3	1	0	4	40	60	100
	Professional Elective – V	PE	3	1	0	4	40	60	100
	Professional Elective – VI	PE	3	0	0	3	40	60	100
EMPLOYABILITY ENHANCEMENT COURSE									
23PEE301	Project work (Phase – I)	EEC	0	0	12	6	40	60	100
TOTAL CREDITS IN SEMESTER - III			17						

FC : Foundation Courses
PC : Professional Core
PE : Professional Elective
OE : Open Elective
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

M.E. - STRUCTURAL ENGINEERING - FOURTH SEMESTER

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
EMPLOYABILITY ENHANCEMENT COURSE									
23PEE401	Project work (Phase – II)	EEC	0	0	24	12	40	60	100
TOTAL CREDITS IN SEMESTER - IV			12						

FC : Foundation Courses
PC : Professional Core
PE : Professional Elective
OE : Open Elective
EEC : Employability Enhancement Courses
L : Lecture
T : Tutorial
P : Practical
C : Credit Point
CIA : Continuous Internal Assessment
ESE : End Semester Examination
TOT : Total

LIST OF FOUNDATION COURSE

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSM101	Advanced Mathematics for Structural Engineering	FC	3	1	0	4	40	60	100
23PGT101	Research Methodology and IPR	FC	3	0	0	3	40	60	100

LIST OF PROFESSIONAL CORE

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PST101	Applied Elasticity and Plasticity	PC	3	0	0	3	40	60	100
23PST102	Finite Element Analysis and Methods	PC	3	0	2	4	40	60	100
23PSE101	Experimental Techniques	PC	3	0	2	4	50	50	100
23PST201	Advances in Steel Structures	PC	3	0	0	3	40	60	100
23PST202	Structural Dynamics and Seismic Design	PC	3	0	0	3	40	60	100
23PSE201	Advances in Concrete Technology	PC	3	0	2	4	50	50	100

LIST OF PROFESSIONAL ELECTIVE COURSES

Professional Elective - I

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSP101	Disaster Resistant Structures	PE	3	0	0	3	40	60	100
23PSP102	Theory of Structural Stability	PE	3	0	0	3	40	60	100
23PSP103	Advances in Concrete Structures	PE	3	0	0	3	40	60	100
23PSP104	Smart Materials for Construction	PE	3	0	0	3	40	60	100
23PSP105	Cracks and Crack Control in Concrete Structures	PE	3	0	0	3	40	60	100

Professional Elective - II

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSP201	Formwork Engineering	PE	3	0	0	3	40	60	100
23PSP202	Design of Industrial Structures	PE	3	0	0	3	40	60	100
23PSP203	Structural Health Monitoring	PE	3	0	0	3	40	60	100
23PSP204	Fracture Mechanics	PE	3	0	0	3	40	60	100
23PSP205	Pre-stressed Concrete Structures	PE	3	0	0	3	40	60	100

Professional Elective - III

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSP206	Structural Optimization	PE	3	0	0	3	40	60	100
23PSP207	Energy Efficient Structures	PE	3	0	0	3	40	60	100
23PSP208	Wind and Cyclone Effects on Structures	PE	3	0	0	3	40	60	100
23PSP209	Computer Aided Design of Structures	PE	3	0	0	3	40	60	100
23PSP210	Mechanics of Composite Materials	PE	3	0	0	3	40	60	100

Professional Elective - IV

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	**T**	**P**	**C**	**CIA**	**ESE**	**TOT**
23PSP301	Design of Offshore Structures	PE	3	1	0	4	40	60	100
23PSP302	Design of Steel Concrete Composite Structures	PE	3	1	0	4	40	60	100
23PSP303	Design of Masonry Structures	PE	3	1	0	4	40	60	100
23PSP304	Non–Linear Analysis	PE	3	1	0	4	40	60	100
23PSP305	Bridge Structures	PE	3	1	0	4	40	60	100

Professional Elective -V

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSP306	Design of structures for Dynamic Loads	PE	3	1	0	4	40	60	100
23PSP307	Design of Shell and Spatial Structures	PE	3	1	0	4	40	60	100
23PSP308	Design of Sub–Structures	PE	3	1	0	4	40	60	100
23PSP309	Structural Analysis by Matrix Methods	PE	3	1	0	4	40	60	100
23PSP310	Cold Formed Steel Structures	PE	3	1	0	4	40	60	100

Professional Elective - VI

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PSP311	Theory of Plates	PE	3	0	0	3	40	60	100
23PSP312	Soil Structure Interaction	PE	3	0	0	3	40	60	100
23PSP313	Corrosion Engineering	PE	3	0	0	3	40	60	100
23PSP314	Maintenance and Rehabilitation of Structures	PE	3	0	0	3	40	60	100
23PSP315	Smart Structures	PE	3	0	0	3	40	60	100

LIST OF OPEN ELECTIVE COURSES

OPEN ELECTIVES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PGO201	Disaster Management	OE	3	0	0	3	40	60	100
23PGO202	Cost Management of Engineering Projects	OE	3	0	0	3	40	60	100
23PGO203	Constitution of India	OE	3	0	0	3	40	60	100
23PGO204	Business Analytics	OE	3	0	0	3	40	60	100
23PGO205	Digital Marketing	OE	3	0	0	3	40	60	100

LIST OF EMPLOYABILITY ENHANCEMENT COURSES

Course Code	Name of the Subject	Category	Periods / Week			Credit	Maximum Marks		
			L	T	P	C	CIA	ESE	TOT
23PEE101	Research Paper Writing and Seminar	EEC	1	0	0	0	100	–	100
23PEE201	Mini Project	EEC	0	0	2	1	100	–	100
23PEE301	Project work (Phase – I)	EEC	0	0	12	6	40	60	100
23PEE401	Project work (Phase – II)	EEC	0	0	24	12	40	60	100

SCHEME FOR SYLLABI

M.E. – Structural Engineering

SEMESTER I

23PSM101 ADVANCED MATHEMATICS FOR STRUCTURAL ENGINEERING L T P C
3 1 0 4

OBJECTIVES

- To learn the basic concepts about Laplace series and Laplace transforms.
- To study the boundary value problems associated with engineering applications using transform methods.
- To understand the concepts of calculus of variations.
- To gain knowledge in conformal mappings and their applications to fluid flows and heat flows.
- To know the various tensors that occurs in engineering problems.

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9+3

Analysis Laplace transform properties – Transform of Error function, Bessel's function, Dirac delta function and Unit step function – Complex inversion formula – Solution of Diffusion equation – Solution of Wave equation.

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

Fourier transform pairs – Properties of Fourier transform – Transform of elementary functions – Convolution theorem – Parseval's relation – Transform of Dirac delta function – Solution of Diffusion equation – Solution of Wave equation – Solution of Laplace equation.

UNIT III CALCULUS OF VARIATIONS 9+3

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functionals dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems – Direct methods – Ritz 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 INTEGRATION AND TENSOR ANALYSIS 9+3

Gaussian quadrature – Gauss-Hermite quadrature – Gaussian quadrature for double integral approximation – Summation convention – Contravariant and covariant vectors – Christoffel symbols.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply Laplace and Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
- Analyze boundary value problems using Fourier transform techniques.
- Interpret the concepts of calculus of variations in solving various boundary value problems.
- Construct conformal mappings between various domains and apply conformal mappings in fluid flows and heat flow problems..
- Apply Numerical integration and tensor analysis as a tool in the field of applied sciences and related fields.

TEXT BOOKS

1. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., 3rd Edition, 2015.
2. Filip Rindler, "Calculus of Variations", Springer, 1st Edition, New York, 2018.

REFERENCES

1. Lokenath Debnath & Dambaru Bhatta, "Integral Transforms and Their Applications", Chapman & Hall/CRC, 2nd Edition, 2016.
2. Taha Sochi, " Principles of Tensor Calculus", Create Space Independent Publishing Platform, 1st Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/111/105/111105123/ (Transform Calculus and its applications in Differential Equations)
2. https://nptel.ac.in/courses/111/104/111104025/ (Calculus of variations and Integral Equations)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	-	2	-	-	-	-	-	-	-	2	-	-	-
2	3	3	-	2	-	-	-	-	-	-	-	2	-	-	-
3	3	3	-	2	-	-	-	-	-	-	-	2	-	-	-
4	3	3	-	2	-	-	-	-	-	-	-	2	-	-	-
5	3	3	-	2	-	-	-	-	-	-	-	2	-	-	-
AVG	**3.0**	**3.0**	**-**	**2.0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2.0**	**-**	**-**	**-**

1-Low 2-Medium 3-High '-' – No Correlation

23PGT101	RESEARCH METHODOLOGY AND IPR (Common to all PG Engineering Courses)	L T P C 3 0 0 3

OBJECTIVES

- To learn the problem formulation, analysis and solutions.
- To know the effective literature study approaches.
- To write Technical papers / presentations without violating professional ethics.
- To understand the process of process and procedure of patenting.
- To gain basic knowledge on intellectual property rights.

UNIT I RESEARCH PROBLEM **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 REVIEW **9**

Effective literature studies approaches – Analysis – Plagiarism and research ethics.

UNIT III TECHNICAL WRITING /PRESENTATION **9**

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee**.**

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) **9**

Nature of Intellectual Property – 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 INTELLECTUAL PROPERTY RIGHTS (IPR) **9**

Patent Rights: Scope of Patent Rights – Licensing and transfer of technology – Patent information and databases – Geographical Indications – New Developments in IPR: Administration of Patent System – IPR of Biological Systems, Computer Software etc – Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Identify research problems.
- Apply effective literature studies in research work.
- Develop effective technical papers/presentations.
- Describe that today's world is controlled by Computer, Information Technology, but tomorrow the world will be ruled by ideas, concepts, and creativity.
- Explain about IPR and filing patents in R & D.

TEXT BOOKS

1. Ranjith Kumar, "Research Methodology: A step–by–step guide for beginners", SAGE Publications, 4th Edition, 2014.
2. Neeraj Pandey, Khushdeep Dhrani, "Intellectual Property Rights", PHI Learning Private Limited, 2014.

REFERENCES

1. Heather Silyn–Roberts, "Writing for Science and Engineering: Papers, Presentations and Reports", Elsevier, 2nd Edition, 2013.
2. Douglas C. Montgomery, "Design and Analysis of Experiments", 9th Edition, Wiley Publishers, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/121/106/121106007/ (Introduction to Research)
2. https://nptel.ac.in/courses/109/106/109106137/ (IPR)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	-	-	-	-	**2**	1	2	1	2
2	3	2	2	2	2	1	-	-	-	-	2	1	2	1	2
3	3	2	1	1	1	1	-	-	-	-	2	1	2	1	1
4	3	2	2	2	2	1	-	-	-	-	2	1	2	1	1
5	3	2	1	1	1	1	-	-	-	-	2	1	2	1	1
AVG	**3.0**	**2.0**	**1.6**	**1.6**	**1.6**	**1.0**	**-**	**-**	**-**	**-**	**2.0**	**1.0**	**2.0**	**1.0**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PST101 **APPLIED ELASTICITY AND PLASTICITY** **L T P C**
3 0 0 3

OBJECTIVES

- To study the classical theory of linear elasticity for two and three dimensional state of stress.
- To learn the two dimensional problems in Cartesian coordinates.
- To understand the solutions for elasticity problems in polar coordinates.
- To introduce the energy principles and energy method of solution of solid continuum mechanics.
- To understand the plastic stress strain relations and criteria of yielding.

UNIT I ELASTICITY **9**

Analysis of stress and strain, Equilibrium equations – Compatibility equations – Principal strain – Principle of superposition – Stress strain relationship – Generalized Hooke's law – Lame's constants – Differential equations of equilibrium in two and three dimensions in Cartesian coordinates.

UNIT II TWO DIMENSIONAL PROBLEMS IN CARTESIAN COORDINATES **9**

Plane stress and plane strain – Methods of formulation of elasticity problems – Methods of solution of elasticity problems – Airy's Stress Function – Polynomials – Direct method of determining Airy's Stress Function – Simple two-dimensional problems in Cartesian coordinates.

UNIT III TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES **9**

General equations in polar coordinates – Stress distribution symmetrical about an axis – Pure bending of curved bars – Strain components in polar coordinates – Displacements for symmetrical stress distribution – Rotating Disc – Thick Cylinder under Uniform Pressure.

UNIT IV TORSION AND ENERGY METHODS **9**

Torsion of Prismatic bars – St.venant's approach – Prandtl's approach: Membrane analogy – Torsion of thin walled open and closed sections – Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

UNIT V PLASTIC DEFORMATION **9**

Physical Assumptions – Yield Criteria – Von Misses Yield Criterion – Tresca Yield Criterion – Failure Theories – Applications of Thick Cylinder – Plastic Stress Strain Relationship (Flow Rule) – Strain hardening – Elasto-Plastic Problems in Bending and Torsion.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the stresses and strains.
- Derive the solutions for elasticity problems in Cartesian coordinates.
- Derive the solutions for two dimensional problems in polar coordinates.
- Analyze the beams and columns using energy methods.
- Determine deformations by applying plasticity theory.

TEXT BOOKS

- Chandramouli P.N., "Theory of Elasticity", Yesdee Publishing Pvt. Ltd., 1st Edition, 2017.
- Jane Helena H., "Theory of Elasticity and Plasticity", Prentice Hall Publication, 1st Edition, 2017.

REFERENCES

1. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, 10th Edition, 2018.
2. Timoshenko, S. and Goodier J.N., "Theory of Elasticity", McGraw Hill Book Co, 3rd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/105/105105177/ (Theory of Elasticity)
2. https://nptel.ac.in/courses/105/108/105108070/ (Applied Elasticity for Engineers)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	-	-	-	-	-	1	1	3	2	1
2	3	3	2	2	1	-	-	-	-	-	1	1	3	2	1
3	3	3	2	2	1	-	-	-	-	-	1	1	3	2	1
4	3	3	2	2	1	-	-	-	-	-	1	1	3	2	1
5	3	3	2	2	1	-	-	-	-	-	1	1	3	2	1
AVG	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**-**	**-**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PST102	FINITE ELEMENT ANALYSIS AND METHODS (Lab Component Theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To learn the skills in finite element method.
- To study the properties of various elements.
- To gain knowledge in one dimensional element properties.
- To acquire knowledge in two and three dimensional element problems.
- To understand the analysis of frames by finite element method.

UNIT I INTRODUCTION **9**

Finite Element method – History and Applications – Basic steps in finite element analysis – Boundary value problems – Approximate solutions – Variational and weighed residual methods – Rayleigh Ritz and Galerkin formulations – Spring and Bar Elements – Minimum Potential Energy Principle – Weak formulation.

UNIT II ELEMENT PROPERTIES **9**

Discretization – Displacement model – Element properties – Lagrange and Serendipity Elements – Solid Elements – Iso-parametric Formulation – Stiffness Matrix of Iso-parametric Elements –Triangular Elements – Rectangular Elements – 3D Brick Elements – Elements for Fracture Analysis – Plate bending elements – Thick plate elements.

UNIT III ONE DIMENSIONAL PROBLEMS **9**

One dimensional problems – Coordinate systems – Global, local and natural coordinate systems – Shape functions – Bar, beam and truss element – Generation of Stiffness Matrix and Load Vector – Application to trusses, beams and plane frames – Convergence requirements, P and H methods.

UNIT IV FEM FOR TWO AND THREE–DIMENSIONAL SOLIDS **9**

Constant Strain Triangle – Linear Strain Triangle – Numerical Evaluation of Element Stiffness – Computation of Stresses, Geometric Nonlinearity and Static Condensation – Axisymmetric Element – Finite Element Formulation of Axisymmetric Element – Finite Element Formulation for 3 Dimensional Elements – Problems.

UNIT V ANALYSIS OF FRAMED STRUCTURES **9**

Stiffness of Truss Member – Analysis of Truss – Stiffness of Beam Member – Finite Element Analysis of Continuous Beam – Plane Frame Analysis – Analysis of Grid and Space Frame – Solution for simple frames.

LIST OF EXPERIMENTS

1. Introduction of structural Analysis software Programming in Excel for model analysis.
2. Modeling using STAAD and dynamic analysis.
3. RCC and Steel design.
4. Finite element modeling.
5. Stability analysis using FEM.
6. Finite Element Analysis of thin and thick plates.

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the energy principles and finite element concepts.
- Find out the solutions for various problems by applying the knowledge of element properties.
- Apply finite element analysis concept in one dimensional element problems.
- Apply the finite element analysis concept in two and three dimensional element problems.
- Analyze the framed structures.

TEXT BOOKS

1. Nam H Kim, bhavani V.Sankar & Ashok V.Kumar, "Introduction to Finite Element Analysis", 2nd Edition, Wiley Publishers, 2018.
2. Chandrupatla.R.T. and Belegundu.A.D., "Introduction to Finite Elements in Engineering", Pearson Education, 4th Edition, 2016.

REFERENCES

1. Ioannis Koutromanos, "Fundamentals of Finite Element Analysis", 1st Edition, Wiley Publishers, 2018.
2. Reddy, J.N, "An Introduction to the finite element method", McGraw Hill International Edition, 3rd Edition 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/112/104/112104193/ (Basics of Finite Element Analysis – I)
2. https://nptel.ac.in/courses/112/104/112104116/ (Finite Element Method)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	-	-	3	1	-	2	-	1	3	2	1
2	3	3	2	2	-	-	3	1	-	2	-	1	3	2	1
3	3	2	2	2	-	-	2	1	-	2	-	1	3	2	1
4	3	3	2	2	-	-	2	1	-	2	-	1	3	2	1
5	3	3	2	2	-	-	3	1	-	2	-	1	3	2	1
AVG	**3.0**	**2.80**	**2.0**	**2.0**	**-**	**-**	**2.60**	**1.0**	**-**	**2.0**	**-**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSE101	EXPERIMENTAL TECHNIQUES (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To learn the errors in measurement and learn the principles of measurement.
- To know about vibrating measuring instruments and digital and electronic display.
- To study the wind flow measurement and pressure measurement and scale different models.
- To learn the damage assessment.
- To understand about the NDT methods.
- To provide a detailed account of modern experimental techniques in construction Engineering research.

UNIT I FORCE AND STRAIN MEASUREMENTS **9**

Basic Choice of Experimental stress analysis methods, errors in measurements – Strain gauge – Principle – Types, performance and uses – Hydraulic jacks and pressure gauges – Electronic load cells and Proving Rings – Calibration of Testing Machines – Long–term monitoring – Vibrating wire sensors – Fibre optic sensors.

UNIT II MEASUREMENT OF VIBRATION **9**

Characteristics of structural vibration – Linear variable differential transformer (LVDT) – Transducers for Velocity and acceleration measurements – Vibration meter – Seismographs – Vibration analyzer – Display of recording of signals – Cathode ray oscilloscope – XY plotter – Chart plotters – Digital data acquisition systems

UNIT III ACOUSTICS AND WIND FLOW MEASUREMENTS **9**

Principles of pressure and flow measurements – Pressure transducer – Sound level meter – Wind tunnel and its use in structural analysis – Structural modeling – Direct and indirect model analysis – Application to structural problems – Testing of Transmission line towers – Acoustic emission

UNIT IV DISTRESS MEASUREMENTS & 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.

UNIT V NON–DESTRUCTIVE TESTING TECHNIQUES **9**

Load testing of structures, Buildings, bridges and towers – Rebound Hammer – Ultrasonic Testing, Principles and applications – Moire fringes – Brittle coatings – Holography – Use of Lasers for structural testing – GECOR and GPR.

LIST OF EXPERIMENTS

1. Strain gauge meter – Determination of Young's modulus of a metallic wire
2. Ultrasonic interferometer – ultrasonic velocity in liquids
3. Electrical conductivity of metals and alloys with temperature–four probe method
4. Resistivity measurements
5. NDT – Ultrasonic flaw detector
6. Calibration of Proving Ring

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain force and strain measurement by selecting appropriate tools and technique.
- Analyze the structures using various vibration measuring instruments.
- Apply model analysis as an effective experimental technique.
- Determine distress in the structures using various electronic equipments.
- Describe advanced NDT methods in accessing the load testing of structures.
- Apply the analytical techniques and graphical analysis to interpret the experimental data.

TEXT BOOKS

1. Karthik Selva Kumar Karuppasamy, "Applications and Techniques for Experimental Stress Analysis", IGI Global, 1st Edition, 2019.
2. Dally J.W. and Riley W.F., "Experimental Analysis", McGraw Hill Inc., 1st Edition, 2018.

REFERENCES

1. D.E.Bray and R.K.Stanley, "Non–Destructive Evaluation", McGraw Hill Publishing Co., 1st Edition, 2018.
2. Ganesan.T.P, "Model Analysis of Structures", Universities Press, 2nd Edition, 2015.

E–RESOURCES

1. https://nptel.ac.in/courses/112/107/112107242/ (Mechanical Measurement System)
2. https://nptel.ac.in/courses/112/106/112106068/ (Experimental Stress Analysis)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	3	1	-	-	-	-	1	1	1	3	1	1
2	3	3	2	2	1	-	-	-	-	1	1	1	3	2	1
3	3	3	2	3	1	-	-	-	-	1	1	1	3	2	1
4	3	3	2	2	1	-	-	-	-	1	1	1	3	1	1
5	3	3	1	3	1	-	-	-	-	1	1	1	3	1	1
6	2	2	1	2	1	-	-	-	-	1	1	1	2	1	1
AVG	**2.83**	**2.83**	**1.67**	**2.50**	**1.0**	-	-	-	-	**1.0**	**1.0**	**1.0**	**2.83**	**1.33**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PEE101 **RESEARCH PAPER WRITING AND SEMINAR** **L T P C**
1 0 0 0

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers).
4. Preparing a draft outline of research work.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Linking the papers and preparing a draft of the paper.
7. Preparing conclusions based on the reading of all the papers.
8. Writing the Final Paper and giving final Presentation.
9. Maintaining a file for records of activities.

Activities to be carried out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic Stating an Objective	You are requested to select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society. 2. List 2 journals 3. List 2 conferences, symposia or workshops. 4. List 1 thesis title 5. List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from your area.	3rd week	**3%** (the selected information must be area specific and of international and national standard)

Collection of Journal papers in the topic in the context of the objective - collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read – try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour—first ǁor—foundational papers in the field (as indicated in other people's survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization). • Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered/sections of the paper are being considered	4th week	**6%** (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other's work, in the author's opinion? • What simplifying assumptions does the	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next 5 papers	Repeat Reading Paper Process	6th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for final 5 papers	Repeat Reading Paper Process	7th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	**8%** (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	**6%** (Clarity, purpose and conclusion) **6%** Presentation & Viva Voce

Introduction Background	Write an introduction and background sections	10th week	**5%** (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions – clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**10%** (formatting, English, Clarity and linking) **4%** Plagiarism Check Report
Seminar	A brief 15 slides on your paper.	14th & 15th week	**10%** (based on presentation and viva-voce)

TOTAL: 30 PERIODS

SEMESTER II

23PST201 ADVANCES IN STEEL STRUCTURES L T P C
3 0 0 3

(IS 800:2007, IS 801:1975, IS805:1995, IS811:1987, IS875:1987 & SP 06 are to be permitted)

OBJECTIVES

- To study the general principle in the design of steel structures.
- To understand the design of purlins and girders.
- To know the suitable types of connections under various conditions.
- To learn the design of steel transmission line towers.
- To gain knowledge in response of steel structures for fire, fatigue and understand the principles of earthquake resistant design.

UNIT I DESIGN PHILOSOPHIES 9

Philosophies of Limits State Design, WSD and LRFD Concepts of Plastic design – Local Buckling of thin plate elements – Section Classification – Limit State Design – Comparison of BIS and other International codes – Behaviour and Limit state design of beam columns.

UNIT II DESIGN OF PURLINS AND GIRDERS 9

Beams subjected to biaxial bending – Built-up Purlins – Various types and design – Design of Wind girders – Beam-columns – With various support conditions – Design of foundations with lateral forces.

UNIT III DESIGN OF CONNECTIONS 9

Types of connections – Welded, bolted and riveted – Throat and root stresses in Fillet welds – Seated connections – Un-stiffened and stiffened seated connections – Moment resistant connections – Clip angle connections – Split beam connections – Framed connections.

UNIT IV ANALYSIS AND DESIGN OF STEEL TOWERS 9

Micro Wave Towers – Transmission line towers – Loads on towers – Shape, Sag and Tension in Uniformly loaded conductors – Analysis of towers – Design of member in towers.

UNIT V SPECIAL REQUIREMENTS OF DESIGN AND CONSTRUCTION 9

Fire resisting properties of steel – Principles of fire-resistant Design – Fatigue failures of steel structures – Principle of Fatigue-resistant Design As per IS code – Seismic Behaviour and advantages of steel – Principles of Earthquake resistant design of Steel Structures.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe various design philosophies as per various international codes.
- Design the steel members such as purlins, gable wind girders, base plates subjected to combined forces.
- Explain and design the different types of steel connections such as welded, bolted and moment resisting connections.
- Analyze the high rise steel structures subjected to wind load.
- Design the steel structures for resisting fire, fatigue and earthquakes.

TEXT BOOKS

1. Duggal.S.K., "Limit State Design of Steel Structures", McGraw Hill Private Limited, 3rd Edition, 2019.
2. Subramanian N, "Design of Steel Structures", Oxford University Press, 2nd Edition, 2015.

REFERENCES

1. Dayaratnam P, "Design of Steel Structures", S. Chand & Company, 3rd Edition, 2017.
2. Ramchandra & Virendra Gehlot, "Design of Steel Structures"- 1 & 2, Scientific Publishers, 13th Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/105/105/105105162/ (Design of Steel Structures)
2. https://nptel.ac.in/courses/105/106/105106113/ (Design of Steel Structures – II)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	3	2	1	1	2	-	-	-	1	1	3	2	1
2	3	2	3	2	1	1	2	-	-	-	1	1	3	2	1
3	3	2	2	1	1	1	1	-	-	-	1	1	3	2	1
4	3	2	2	2	1	1	2	-	-	-	1	1	3	2	1
5	3	2	3	2	1	1	2	-	-	-	1	1	3	2	1
AVG	**3.0**	**2.0**	**2.6**	**1.8**	**1.0**	**1.0**	**1.8**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PST202 STRUCTURAL DYNAMICS AND SEISMIC DESIGN L T P C
3 0 0 3

(IS13920: 2016, IS13935: 2009, IS 1893: 2002 & IS 4326:1993 are to be permitted)

OBJECTIVES

- To understand the principles and methods of dynamic analysis.
- To learn the damped and Un–damped techniques.
- To study the various direct integration methods.
- To gain knowledge in earthquake monitoring with seismic instrumentation and estimation of earthquake parameters.
- To know the design of earthquake resistant buildings.

UNIT I VIBRATION ANALYSIS 9

Vibration and its importance to structural engineering problems – Elements of vibratory systems and simple harmonic motion – Generalized mass – D'Alembert's principle – Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems – Effect of damping – Transmissibility.

UNIT II TWO DEGREE OF FREEDOM SYSTEMS 9

Formulation of Structure – Equations of Motion of Two degree of freedom systems – Damped and un-damped free vibrations – Un-damped forced vibration – Normal modes of vibration – Applications.

UNIT III DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 9

Introduction – Damping in MDOF systems – Non-linear MDOF systems – Direct integration methods – Wilson 'φ' method – New 'β' method – Measurement of damping and vibration techniques – Application of structural dynamics in the design of block and frame foundations.

UNIT IV EARTHQUAKES AND GROUND MOTION 9

Engineering Seismology (Definitions, Introduction to Seismic hazard, Earthquake Phenomenon) – Seismo–tectonics and Seismic Zoning of India – Earthquake Monitoring and Seismic Instrumentation – Characteristics of Strong Earthquake Motion – Estimation of Earthquake Parameters – Microzonation.

UNIT V EARTHQUAKE RESISTANT DESIGN OF RC STRUCTURES 9

Earthquake Resistant Design of R.C.C. Buildings – Material properties – Lateral load analysis – Design and detailing – Rigid Frames – Shear wall – Coupled Shear wall

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the elements of vibratory systems and its importance in analysis.
- Apply the equation of motion to two degree of freedom systems.
- Analyze dynamic response by direct integration method.
- Describe ground motion and its relationship to seismic design of structures.
- Apply the basic principles of conceptual design for earthquake resistant RC building.

TEXT BOOKS

1. Anil K. Chopra, "Dynamics of Structures", Pearson Education, 3rd Edition, 2016.
2. H. R. Wason, M. L. Sharma, Manish Shrikhande. "Advances in Indian Earthquake Engineering and Seismology", Springer, 1st Edition, 2018.

REFERENCES

1. Martin Williams, "Structural Dynamics", CRC Press, 1st Edition, 2016.
2. S K Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 3rd Edition, 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106151/ (Structural Dynamics)
2. https://nptel.ac.in/courses/105/102/105102016/ (Seismic Analysis of Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	1	1	1	1	-	-	-	1	1	3	2	1
2	3	3	2	2	1	1	1	-	-	-	1	1	3	2	1
3	3	3	2	1	1	1	1	-	-	-	1	1	3	2	1
4	3	3	2	2	1	1	1	-	-	-	1	1	3	2	1
5	3	3	2	1	1	1	1	-	-	-	1	1	3	2	1
AVG	**3.0**	**3.0**	**2.0**	**1.4**	**1.0**	**1.0**	**1.0**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSE201	ADVANCES IN CONCRETE TECHNOLOGY (Lab Embedded Theory Course)	L T P C 3 0 2 4

OBJECTIVES

- To study the properties of concrete.
- To learn the design of concrete mixes as per ACI and IS methods.
- To know the quality of concrete and stress strain characteristics as per IS provision.
- To understand various concrete manufacturing processes and concreting methods.
- To learn about special concretes and their applications in the diverse construction field.
- To cast and test the structural beams and columns.

UNIT I INTRODUCTION **9**

Concrete: Past, Present and Future – Constituent Materials — Strength of Concrete – Dimensional Stability of Concrete – Chemical and Mineral Admixtures – Properties of fresh and hardened Concrete – Mineral additives.

UNIT II MIX DESIGN **9**

Principles of Concrete Mix Design – Factors in the choice of mix proportions – Mix design methods – A.C.I Methods – I.S. Methods – Mix proportion – Correction for moisture content – Bulking – Yield of concrete – Design of High strength concrete and Self compacting concrete – EFNARC Specifications – Design of concrete mix with Fly ash and silica fume.

UNIT III TESTING OF CONCRETE **9**

Workability – Compression – Tension – Flexure – Bond strength – Factors affecting the results – Accelerated strength results – Stress strain characteristics – Modulus of Elasticity – In situ strength determination – Variation in results – Distribution of strength – Standard deviation – Non destructive tests – I.S. code provision.

UNIT IV CONCRETING METHODS **9**

Concrete manufacturing process – Stages of manufacturing – Transportation, placing and curing methods – Extreme weather concreting – Special concreting methods – Vacuum dewatering concrete – Underwater concreting – Special form work types.

UNIT V SPECIAL CONCRETES **9**

Lightweight and Heavy Weight Concrete – High Strength Concrete – High Performance Concrete – Polymers in Concrete – Steel fiber Reinforced Concrete – Ferro cement Concrete – Vaccum Concrete – Shotcrete – Ready Mixed Concrete – Self compacting concrete – Geopolymer concrete.

LIST OF EXPERIMENTS

1. Casting and Testing of Simply Supported Reinforced Concrete beams for flexure.
2. Casting and Testing of Simply Supported Reinforced Concrete beams for shear.
3. Testing of Simply Supported Steel beams for flexure.
4. Casting and Testing of Reinforced Concrete columns.
5. Accelerated Corrosion Test on concrete.
6. Rapid Chloride Penetration Test.

TOTAL: 45 + 15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Find out the properties of fresh and hardened concrete.
- Design the concrete mix by various methods.
- Investigate various testing of concrete and stress strain characteristics as per IS Code.
- Choose the correct concrete methods in the field depending upon the requirement and site conditions.
- Apply suitable concrete for different structures considering the prevailing weathering conditions.
- Perform casting and testing in structural members.

TEXT BOOKS

1. Shetty M.S., Concrete Technology, S.Chand and Company Ltd., 8th Edition, 2019.
2. Krishnaraju, N., Advanced Concrete Technology, CBS Publishers, 4th Edition, 2018.

REFERENCES

1. Gambir,M.L. "Concrete Technology", Tata McGraw Hill, Publishing Co,Ltd, 6th Edition, 2017.
2. Santhakumar,A.R., Concrete Technology, Oxford University Press, 10th Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/105/102/105102012/ (Concrete Technology)
2. https://nptel.ac.in/courses/105/106/105106176/ (Advanced Concrete Technology)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	**3**	1	-	-	-	-	1	1	1	3	1	1
2	3	3	2	2	1	-	-	-	-	1	1	1	3	2	1
3	3	3	2	3	1	-	-	-	-	1	1	1	3	2	1
4	3	3	2	2	1	-	-	-	-	1	1	1	3	1	1
5	3	3	1	3	1	-	-	-	-	1	1	1	3	1	1
6	2	2	1	1	1	-	-	-	-	1	1	1	2	1	1
AVG	**2.83**	**2.83**	**1.67**	**2.33**	**1.0**	-	-	-	-	**1.0**	**1.0**	**1.0**	**2.83**	**1.33**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PEE201 **MINI PROJECT** **L T P C**
0 0 2 1

OBJECTIVES

- To design a structure using modern software tools available like ETABS, STAAD, STRAP etc. and present it in the form of complete detail drawing.

GUIDELINES

Students have to work individually with standard codes, computational tools and software packages for analyzing, designing and detailing a structure. A detailed report on the work done shall be submitted by individual student in the form of a report and presentation.

TOTAL: 30 PERIODS

OUTCOMES

- At the end of the course project the students will have a clear idea of his/her area of work in Plan a layout of a structure, calculate loads using IS codes and various computational tools, Analyze the structure for various loads and load combination according to the relevant IS codes, design and detail structures using computer software/tools and check the correctness using manual approximate methods and prepare the complete structural drawings using computer software.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	1	-	-	-	-	-	1	3	2	2
AVG	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**1.0**	-	-	-	-	-	**1.0**	**3.0**	**2.0**	**2.0**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER III

23PEE301	**PROJECT WORK (PHASE–I)**	**L T P C** **0 0 12 6**

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.

GUIDELINES

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.

TOTAL: 180 PERIODS

OUTCOMES

- At the end of the course project the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	1	-	-	-	1	1	1	3	2	2
AVG	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**1.0**	-	-	-	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**2.0**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER IV

23PEE401 **PROJECT WORK (PHASE – II)** **L T P C**
0 0 24 12

OBJECTIVES

- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.
- To train the students in preparing project reports and to face reviews and viva– voce examination.

GUIDELINES

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.

TOTAL: 360 PERIODS

OUTCOMES

- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	1	-	-	-	1	1	1	3	2	2
AVG	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**1.0**	-	-	-	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**2.0**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER I

PROFESSIONAL ELECTIVE I

23PSP101	**DISASTER RESISTANT STRUCTURES**	**L T P C** **3 0 0 3**

OBJECTIVES

- To understand the design philosophy for loads, earthquake and wind.
- To acquire knowledge in safety and risk assessment in structures.
- To study the damage assessment and retrofitting.
- To understand the materials, design and detailing for life line structures.
- To learn the advanced techniques for damage assessment.

UNIT I BEHAVIOUR OF LIFE LINE STRUCTURES **9**

Design philosophy to resist flood, cyclone, and earthquake and fire disasters – National and International Codes of practice – By-laws of urban and semi-urban areas – Past history and lessons from disasters – Approach to traditional and Modern Structures.

UNIT II RISK ASSESSMENT OF STRUCTURES **9**

Safety analysis and rating – Reliability assessment repairs and Retrofitting techniques of Community Structures – Protection of Nuclear Structures – Dams, bridges and buildings..

UNIT III REHABILITATION AND RETROFITTING **9**

Testing and evaluation – Classification according to safety level – Methods and materials for strengthening for different disasters – Qualification test – Dynamic impact analysis.

UNIT IV MATERIALS, DESIGN AND DETAILING **9**

Modern Materials for disasters reduction – Detailing aspects of structures subject to probable disasters – Construction techniques – Analysis methodology – Techniques for optimal performance – Provisions for artificial disasters – Blast and impact.

UNIT V TECHNIQUES OF DAMAGE ASSESSMENT **9**

Damage surveys – Maintenance and modification to improve hazard resistance – Application GIS in disaster management – Foundation improvement techniques.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the design philosophy of Disaster Resistant Structures.
- Demonstrate risk assessment in disaster resistant structures.
- Analyze retrofitting methods to resist disasters.
- Examine the uses of modern materials in disaster reduction.
- Apply GIS in disaster management.

TEXT BOOKS

1. D. N. Shaw, R T L Allen, S C Edwards, "Repair of Concrete Structures", Taylor & Francis Group, 2nd Edition, 2019.
2. M. M. Sulphey, "Disaster Management", Prentice Hall India Pvt., Limited, 1st Edition, 2016.

REFERENCES

1. Poonam I. Modi, Chirag N. Patel, "Repair and Rehabilitation of Concrete Structures", Prentice Hall India Pvt. Limited, 1st Edition, 2016.
2. Sekhar Chandra Dutta, Parthasarathi Mukhopadhyay, "Improving Earthquake and Cyclone Resistance of Structures", Energy and Resources Institute, 2nd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/107/105107204/ (Introduction to DRS)
2. https://nptel.ac.in/courses/105/101/105101004/ (Introduction to Earthquake Engineering)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	2	1	1	-	-	-	-	1	3	3	1
2	3	2	2	2	2	1	1	-	-	-	-	1	3	2	1
3	3	3	2	2	2	1	1	-	-	-	-	1	3	3	1
4	3	3	2	2	2	1	1	-	-	-	-	1	3	3	1
5	3	2	2	2	2	1	1	-	-	-	-	1	3	2	1
AVG	**3.0**	**2.6**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**-**	**-**	**-**	**-**	**1.0**	**3.0**	**2.6**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP102 **THEORY OF STRUCTURAL STABILITY** **L T P C**
3 0 0 3

OBJECTIVES

- To study the stability of columns using theoretical and numerical methods.
- To understand the approximate methods and numerical methods of inelastic buckling.
- To learn the beam column behavior and that of frames.
- To gain knowledge in the buckling of columns.
- To understand energy methods.

UNIT I STABILITY OF COLUMNS **9**

Fundamental concepts – Elastic structural stability – Structural instability – Analytical methods for the stability Analysis, equilibrium, imperfections and energy methods – Non-prismatic columns – Built up columns – Buckling modes Effect of shear on buckling load – Large deflection theory.

UNIT II METHODS OF ANALYSIS AND INELASTIC BUCKLING **9**

Approximate methods – Rayleigh and Galerkin methods – Numerical methods – Finite difference and Finite Element – Analysis of columns – Experimental study of column behavior – South well plot – Column curves

UNIT III BEAM COLUMNS AND FRAMES **9**

Beam-column behavior – Standard cases – Continuous columns and beam-columns – Columns on elastic foundation – Buckling of frames – Single storey portal frames with and without side sway – Classical and stiffness methods – Use of Wood's charts.

UNIT IV BUCKLING OF BEAMS **9**

Lateral buckling of beams – Energy method – Application to symmetric and single symmetric I beams – Simply supported and cantilever beams – Narrow rectangular cross sections – Numerical solutions – Torsional buckling.

UNIT V BUCKLING OF THIN PLATES **9**

Isotropic rectangular plates – Governing Differential equations – Simply supported on all edges – Use of energy methods – Numerical techniques.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply structural stability and instability concepts for designing column.
- Examine the appropriate methods for analyzing columns.
- Explain the behavior of beam, column and frames.
- Determine the lateral buckling of beams.
- Apply the various numerical techniques and energy methods for buckling of thin plates.

TEXT BOOKS

1. Timoshenko, S.P. and Gere J.M., "Theory of Elastic Stability", McGraw Hill Book Company, 2nd Edition, 2016.
2. Sukhvarsh Jerath, "Structural Stability Theory and Practice", Wiley Publishers, 1st Edition, 2021.

REFERENCES

1. Shanmugam N.E. & Wang C.M., "Analysis and Design of Plated Structures Vol 1: Stability", Elsevier, 2nd Edition, 2021.
2. Galambos T.V, "Structural members and frames", Dover Publications Inc, 1st Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/105/108/105108141/ (FEM for Vibration and Stability analyses)
2. https://nptel.ac.in/courses/112/103/112103251/ (Theory of Rectangular Plates – Part – I)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	1	1	-	-	-	-	1	3	3	2
2	3	3	2	2	1	1	1	-	-	-	-	1	3	2	1
3	3	3	3	2	2	1	1	-	-	-	-	1	3	3	2
4	3	3	2	2	1	1	1	-	-	-	-	1	3	2	1
5	3	3	3	2	1	1	1	-	-	-	-	1	3	3	1
AVG	**3.0**	**3.0**	**2.6**	**2.0**	**1.4**	**1.0**	**1.0**	**-**	**-**	**-**	**-**	**1.0**	**3.0**	**2.6**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP103 **ADVANCES IN CONCRETE STRUCTURES** **L T P C**
3 0 0 3

(IS456: 2000, IS 1893: 2002, IS5525: 1969 & SP34 are to be permitted)

OBJECTIVES

- To understand the basic concepts of reinforced concrete members.
- To learn about slender columns, R.C walls and Corbels
- To study the concept of shear reinforcement and edge beams.
- To gain knowledge in moment redistribution.
- To understand the design and detailing of the structures.

UNIT I INTRODUCTION **9**

Review of Basic Concepts – Behavior and Design of Reinforced Concrete members considering flexure, Torsion, combined with flexure and flexural shear, axial compression deflection and crack width as per IS 456: 2000.

UNIT II DESIGN OF SPECIAL R.C. ELEMENTS **9**

Behavior and Design of Slender Columns – Design of R.C.Walls – Ordinary and Shear walls – Design of Corbels – Deep beams and grid floors

UNIT III FLAT SLABS AND FLAT PLATES **9**

Design of flat slabs and flat plate according to ACI method – Design of shear – Reinforcement and Edge (Spandrel) beams – Yield line theory & Hiller borg method of design of slabs.

UNIT IV MOMENT REDISTRIBUTION **9**

Limit Analysis of Concrete beams – Moment rotation curves – Moment redistribution in continuous beams – Baker's method of plastic design – Design of cast in-situ frames.

UNIT V DESIGN AND DETAILING OF STRUCTURES **9**

Detailing for ductility – Fire Resistance of buildings – Field control of concrete – Strengthening of existing structures – Design and detailing of structures according to different codes

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the behavior and design concept of reinforced concrete members.
- Design slender columns, R.C. walls and corbels.
- Develop flat slab and flat plates according to ACI methods.
- Apply moment redistribution in continuous beams.
- Design and detail Fire Resistant buildings.

TEXT BOOKS

1. N. K. Raju, "Advanced Reinforced Concrete Design", CBS PUB & DIST PVT Limited INDIA, 1st Edition, 2016.
2. Pillai.S.V and Menon.D, "Reinforced Concrete Design", Tata McGraw Hill Book Co., first Edition, 2016.

REFERENCES

1. Macginley.T.J. and Choo B.S., Reinforced Concrete Design Theory and Examples, CRC Press, 1st Edition, 2018.
2. David A. Fanella, "Reinforced Concrete Structures: Analysis and Design", McGraw-Hill Education, 1st Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106176/ (Advanced Concrete Technology)
2. http://www.nptelvideos.in/2012/11/ (design of reinforced concrete structures.html)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	2	-	-	-	1	1	3	2	1
2	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
3	2	2	2	1	1	1	2	-	-	-	1	1	3	3	1
4	2	2	2	2	1	2	1	-	-	-	1	1	3	2	1
5	3	1	2	2	1	2	2	-	-	-	1	1	2	2	1
AVG	**2.6**	**1.8**	**2.0**	**1.8**	**1.0**	**1.4**	**1.6**	**-**	**-**	**-**	**1.0**	**1.0**	**2.8**	**2.2**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP104 **SMART MATERIALS FOR CONSTRUCTION** **L T P C**
3 0 0 3

OBJECTIVES

- To know the suitable concrete admixture.
- To learn about steel concrete composite elements.
- To understand the fiber reinforced concrete mix as per ACI standards.
- To study the structure and characteristics of geo-polymer concrete.
- To acquire knowledge in the mechanical properties of ferro cement.

UNIT I CONCRETE ADMIXTURES **9**

Mineral (pozzolanic materials and fillers) – Chemical (accelerators, retarders, plasticizers, super plasticizers, air entraining agent, viscosity modifier, corrosion inhibitors and water repellent) – Dosage – Compatibility.

UNIT II STEEL CONCRETE COMPOSITE **9**

Introduction to steel-concrete composite structures – Anatomy of a composite building – Construction of composite structures – Design of composite beam and column – Shear connectors – Design strength of shear connectors – Load resisting systems connections – Analysis procedures of buildings for gravity and lateral loads.

UNIT III FIBER REINFORCED CONCRETE **9**

Fibre materials – Mix proportioning – Distribution and orientation – Interfacial bond – Properties in fresh state – Strength and behaviour in tension, compression and flexure of steel fibre reinforced concrete – Mechanical properties – Crack arrest and toughening mechanism – Applications of FRC – Design as per ACI 544.4R-18 Case study.

UNIT IV GEO–POLYMER CONCRETE **9**

Characterisation – Activating solution – Structure of geopolymers – Accelerated curing – Durability – Design – Engineering properties – Applications – Case study.

UNIT V FERROCEMENT **9**

Ferro cement: ferrocement materials – Mechanical properties – Cracking of ferrocement – Strength and behaviour in tension – Compression and flexure – Design of ferrocement in tension – Ferrocement constructions, durability and applications.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply suitable admixtures for concrete.
- Design steel concrete composite structures.
- Develop fibre reinforced concrete as per ACI 544.
- Analyze the importance of Geo-polymer Concrete in fields.
- Examine the behavior and design of ferrocement.

TEXT BOOKS

1. A.M Paillere, "Applications of Admixtures in Concrete", CRC Press, 1st Edition, 2019.
2. Johnson R.P. and Wang Y.C., "Composite Structures of Steel and Concrete", Wiley Publishers, 1st Edition, 2018.

REFERENCES

1. Harvinder Singh, "Steel Fiber Reinforced Concrete", Springer, 1st Edition, 2017.
2. Stanley Abercrombie, "Ferrocement: Building with cement, sand, and wire mesh", Hill Family Books, 1st Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/112/104/112104251/ (Smart materials intelligence system)
2. https://nptel.ac.in/courses/105/102/105102195/ (Sustainable Materials and Green Buildings)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
2	3	3	2	2	2	1	2	-	-	-	1	1	3	3	2
3	3	2	2	2	2	1	2	-	-	-	1	1	3	3	2
4	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
5	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
AVG	**3.0**	**2.2**	**2.0**	**2.0**	**2.0**	**1.0**	**2.0**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.4**	**2.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP105 CRACKS AND CRACK CONTROL IN CONCRETE STRUCTURES **L T P C**
3 0 0 3

OBJECTIVES

- To learn the properties and microstructure of concrete.
- To study the various durability and corrosion behavior of concrete.
- To know the different types of cracks due to any type of force including earthquake force and other factors.
- To understand the long term effects of cracking.
- To gain knowledge in advanced crack control and repair techniques.

UNIT I PROPERTIES OF CONCRETE **9**

Historical note on Portland Cement Concrete – Basic properties of plain concrete – Microstructure – Shrinkage, creep and strength of concrete – Temperature effect on concrete – Transport properties of concrete – Tensile, shear, bend and torsional strength of plain and reinforced concrete.

UNIT II DURABILITY OF CONCRETE **9**

Durability of concrete causes for inadequate durability of concrete chloride diffusion – Carbonation of concrete – Sulphate attack – Acid attack on concrete – Alkali-Silica reaction – Abrasion resistance – Fire resistance – Erosion resistance – Cavitations' – Flame resistance – Corrosion resistance – Chemical resistance of concrete and other durability tests methods on concrete.

UNIT III THEORY OF CRACKS **9**

Heat gain and loss phenomenon in buildings – Thermal performance parameters – Role of building enclosures – Openings and materials in thermal environment – Basic principles of light and daylight – Energy efficient light design of buildings – Daylight design of buildings.

UNIT IV PROPERTIES OF CRACKS **9**

Long term effects of cracking – Material and loading effects – Creep effect – Bond – Slip theory – Straight line theory – Flexural stiffness – Effective moment of inertia – Computation of deflection due to short term and long term – Computation of crack width and crack spacing – Limiting crack width – Pressure grouting methods and procedures.

UNIT V CRACK DETECTION AND CONTROL **9**

Crack detection – Crack measuring techniques – Control of cracking in plain and reinforced concrete beams and columns – Crack control by material selection – Crack reduction designs and construction practices – Advanced crack control and repair techniques – Crack detection devices.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the properties and micro structure of concrete.
- Explain the durability of concrete and corrosion behavior.
- Apply the heat gain and loss phenomenon for identification of cracks.
- Describe the long term effects of cracking.
- Analyze the Crack measuring techniques.

TEXT BOOKS

1. Sandor Popovics, "Concrete Materials: Properties, Specifications, and Testing", Noyes Publications, 2nd Edition, 2017.
2. Prashanth kumar., "Elements of Fracture Mechanics", by Wheeler Publishing Company, New Delhi, 3rd Edition, 2017.

REFERENCES

1. Srinath L.S., "Advanced mechanics of Solids", Tata Mcgraw–hill Publishing Company Ltd, New Delhi, 3rd Edition, 2017.
2. Francis Barre, Philippe Bisch, "Control of Cracking in Reinforced Concrete Structures", Wiley Publishers, 1st Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/112/106/112106065/ (Engineering Fracture Mechanics)
2. https://nptel.ac.in/courses/105/106/105106202/ (Maintenance and Repair of Concrete Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	2	-	-	-	1	1	3	2	1
2	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
3	2	2	2	1	1	1	2	-	-	-	1	1	3	3	1
4	2	2	2	2	1	2	1	-	-	-	1	1	3	2	1
5	3	1	2	2	1	2	2	-	-	-	1	1	2	2	1
AVG	**2.6**	**1.8**	**2.0**	**1.8**	**1.0**	**1.4**	**1.6**	**-**	**-**	**-**	**1.0**	**1.0**	**2.8**	**2.2**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER II
PROFESSIONAL ELECTIVE II

23PSP201	**FORMWORK ENGINEERING** (IS 14687: 1999 are to be permitted)	**L T P C** **3 0 0 3**

OBJECTIVES

- To study the materials and behavior of formwork.
- To know the different loads acting on formwork and design foundation formwork.
- To learn formwork for wall and column.
- To understand the formwork for beam and slab.
- To gain knowledge in the flying formwork.

UNIT I INTRODUCTION **9**

Introduction – Formwork as a temporary structure – Requirements for Formwork – Selection of Formwork – Classification of Formwork – Formwork Materials – Timber – Plywood – Steel – Aluminium Form – Plastic Forms – Other Material – Form Coating and Mould Linings – Form Anchors – Tie System – Spreaders, Spacers – Form Linings Materials.

UNIT II FORMWORK DESIGN CONCEPTS & FOUNDATION FORMWORK **9**

Loads on Formwork – Dead or Permanent Loads – Imposed Loads – Environmental Loads – Design Basis (Assumption Made in Formwork Design) – Estimating Permissible Stress – Maximum Bending Moment, Shear Force, and Deflection – Formwork for Foundation – Conventional Formwork for Foundation – Foundation Formwork (All Steel) – Foundation Formwork Design – Illustration on Foundation Wall Design.

UNIT III WALL & COLUMN FORMWORK **9**

Wall Formwork – Conventional Wall Formwork – Proprietary Wall Formwork System – Large Area Wall Forms – Climbing Formwork Wall Formwork – Wall Form Design – Illustration of Wall Formwork Design Using Plywood and H-16 Beams – Column Formwork – Conventional Column Formwork – Proprietary Column Formwork – Column Formwork System.

UNIT IV SLAB AND BEAM FORMWORK **9**

Traditional Slab and Beam Formwork – Slab and Beam Formwork Solutions offered by L&T – Beam and Slab – Formwork Solution by PERI and Mivan – Achieving Economy In Slab Construction – Design of Slab and Beam Construction – Illustration of Slab and Beam Formwork Design – Illustration of Proprietary Slab Formwork.

UNIT V FLYING FORMWORK **9**

Some Examples of Flying Formwork – Flying Formwork Cycle – Advantages and Limitation of Flying Formwork – Design Issues In Flying Forms – Safety Issues in Flying Forms – Table Forms – Tunnel Formwork System – Column Mounted Shoring System – Gang Forms – Slip form.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the requirements and classification of formwork.
- Analyze the Bending Moment, Shear Force, and Deflection.
- Explain the wall and column formwork.
- Analyze the Slab and Beam Formwork Solutions offered by L&T.
- Design the Flying Formwork techniques as per codal provisions.

TEXT BOOKS

1. R. L. Peurifoy, "Formwork for Concrete Structures", McGraw Hill India, 6th Edition, 2016.
2. Kumar Neeraj Jha, "Formwork for Concrete Structures", Tata McGraw Hill Education, 2nd Edition, 2018.

REFERENCES

1. Janardan Jha, "Modern Practices in Formwork for Civil Engineering Construction Works", University Science Press, 2nd Edition, 2018.
2. P.S.McAdam and G.W.Lee, "Formwork: A Practical Guide", CRC Press, 1st Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/104/105104030/ (Concrete Engineering and Technology)
2. https://nptel.ac.in/courses/105/102/105102088/ (Formwork)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	2	-	1	1	2	1	3	3	2
2	3	2	3	2	2	1	2	-	1	1	1	1	3	2	1
3	3	2	3	2	2	2	2	-	1	1	2	1	3	2	2
4	3	2	3	2	2	2	2	-	1	1	2	1	3	2	2
5	3	3	3	2	2	1	2	-	1	1	1	1	3	3	1
AVG	**3.0**	**2.4**	**3.0**	**2.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**1.0**	**1.6**	**1.0**	**3.0**	**2.4**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP202 **DESIGN OF INDUSTRIAL STRUCTURES** **L T P C**
(IS 800: 2007, IS 801, IS 811 & SP06 are to be permitted) **3 0 0 3**

OBJECTIVES

- To understand the layout requirement regarding lighting and ventilation.
- To learn the design of various industrial buildings.
- To study the various types of power plant structures.
- To know the analysis of power transmission structures.
- To acquire knowledge in the auxiliary structures.

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS **9**

Classification of Industries and Industrial structures – Planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety – Protection against noise and vibration – Guidelines of Factories Act.

UNIT II INDUSTRIAL BUILDINGS **9**

Roofs for Industrial Buildings – Steel and RCC – Gantry Girders – Design of Corbels and Nibs – Machine foundations

UNIT III POWER PLANT STRUCTURES **9**

Introduction – Types of power plants – Design of Turbo generator foundation – Containment structures.

UNIT IV POWER TRANSMISSION STRUCTURES **9**

Introduction – Transmission Line Towers – Substation Structures – Tower Foundations – Testing Towers

UNIT V AUXILLIARY STRUCTURES **9**

Chimneys and cooling Towers – Bunkers and Silos – Pipe supporting structures

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the planning and functional requirements of various industries
- Design gantry girders, corbels and nibs for industrial buildings.
- Apply the basic concepts in the design of power plant structures.
- Design power transmission structures.
- Develop the chimneys and cooling Towers.

TEXT BOOKS

1. P.Srinivasulu and C.Vaidyanathan, "Handbook of Machine Foundations", Tata McGraw Hill, 3rd Edition, 2018.
2. Manohar S.N, "Tall Chimneys – Design and Construction", Tata McGraw Hill, 2nd Edition, 2018.

REFERENCES

1. Santhakumar A.R.and Murthy S.S., "Transmission Line Structures", Tata McGraw Hill, 4th Edition, 2017.
2. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings:A Design Manual", Birkhauser Publishers, 6th Edition, 2016.

E-RESOURCES

1. https://nptel.ac.in/courses/105/106/105106113/ (Design of Steel Structures II)
2. https://nptel.ac.in/courses/105/105/105105162/ (Design of Steel Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	2	2	-	1	-	1	1	3	2	2
2	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
3	3	3	3	3	2	1	2	-	1	-	1	1	3	2	1
4	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
5	3	3	3	3	2	1	2	-	1	-	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**-**	**1.0**	**1.0**	**3.0**	**2.6**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP203 **STRUCTURAL HEALTH MONITORING** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the fundamentals of health monitoring of structures.
- To know the structural audit for health assessment of structures.
- To learn the static field methods as tool of SHM.
- To study the dynamic field tests to assess the structure.
- To gain knowledge in advanced concepts for structural health monitoring.

UNIT I STRUCTURAL HEALTH MONITORING – OVERVIEW **9**

Structural Health – Factors affecting Health of Structures – Causes of Distress and Regular Maintenance – Structural Health Monitoring – Concepts, Various Measures and Structural Safety in Alteration.

UNIT II STRUCTURAL AUDIT **9**

Assessment of Health of Structure – Collapse and Investigation – Investigation Management – SHM Procedures – Report preparation.

UNIT III STATIC FIELD TESTING **9**

Types of Static Tests – Simulation and Loading Methods – Sensor systems and hardware requirements – Static Response Measurement – Optimal placement of sensors.

UNIT IV DYNAMIC FIELD TESTING **9**

Types of Dynamic Field Test – Stress History Data – Dynamic Response Methods – Hardware for Remote Data Acquisition Systems – Remote Structural Health Monitoring.

UNIT V ADVANCED CONCEPTS **9**

Case Studies /Site Visits – Piezo-electric material and other smart materials – Electro-mechanical impedance (EMI) technique and adaptations.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the fundamentals and need of health monitoring of structures.
- Describe the importance of structural audit for health assessment of structures.
- Analyze the health of structure using static field methods.
- Analyze the health of structure using dynamic field tests.
- Apply EMI technique for health monitoring of structure.

TEXT BOOKS

1. Daniel Balageas, Claus Peter Fritzen and Alfredo Güemes, "Structural Health Monitoring", John Wiley and Sons, 5th Edition, 2017.
2. Victor Giurglutiu, "Structural Health Monitoring with Wafer Active Sensors", Academic Press Inc, 3rd Edition, 2018.

REFERENCES

1. Douglas E Adams, "Health Monitoring of Structural Materials and Components Methods with Applications", John Wiley and Sons, 2nd Edition, 2016.
2. J. P. Ou, H. Li and Z.D.Duan, "Structural Health Monitoring and Intelligent Infrastructure", Vol 1, Taylor and Francis Group, London, 1st Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/114/106/114106046/ (Introduction to SHM)
2. https://nptel.ac.in/courses/112/104/112104160/ (SHM of Composites)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	2	-	-	1	1	1	2	2	1
2	3	3	3	3	3	2	2	-	-	1	1	1	3	3	1
3	3	3	3	3	3	2	2	-	-	1	1	1	3	2	2
4	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
5	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**1.8**	**2.0**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.6**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP204 **FRACTURE MECHANICS** **L T P C**
3 0 0 3

OBJECTIVES

- To learn the fracture mechanics principles.
- To understand the effect of scale in fracture mechanics.
- To know the numerical methods for analysis of concrete elements.
- To learn the importance of numerical modeling.
- To gain knowledge in steel fracture.

UNIT I ESSENTIALS OF CONCRETE FRACTURE **9**

Introduction – Blunt crack band theory – Finite element implementation – Energy considerations – Applications and practical analysis – Crack development – General model for progressive fracturing.

UNIT II SCALE EFFECTS **9**

Introduction – Dimensional analysis applied to plain and reinforced concrete structures – Fracture stability in plain and reinforced concrete elements – Hysteretic behavior of reinforced concrete elements.

UNIT III NUMERICAL METHODS **9**

The behavior of concrete in a tension test – Comparison between concrete and steel – Tensile fracture zones – A general model for the tensile fracture of concrete – Material properties – FEM analysis of a fracture zone: coincident with predetermined crack path – FEM analysis of a fracture zone: not coincident with predetermined crack path.

UNIT IV NUMERICAL MODELLING **9**

Discrete crack models for concrete – The linear model – The nonlinear model – Crack propagation modeling: the future.

UNIT V FRACTURE OF STEEL **9**

Fracture – Fracture under extreme conditions – Fatigue – Environment sensitive cracking.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the fundamentals of fracture mechanics to concrete structures.
- Demonstrate scale effects in crack analysis of concrete elements.
- Analyze cracked concrete members by using FEM concepts.
- Describe the pre cracked element numerically.
- Explain the fracture of steel.

TEXT BOOKS

1. David Broek, "The practical use of fracture mechanics", Kluwer Academic Publishers, 10th Edition, 2018.
2. Gdoutos.E.E, "Fracture Mechanics-An Introduction", Kluwer Academic publishers, 3rd Edition, 2020.

REFERENCES

1. George C. Sih, A. Ditomasso, "Fracture mechanics of concrete: Structural application and numerical calculation", 4th Edition, Springer Science & Business Media, 2016.
2. Anderson T.L, "Fracture mechanics: Fundamentals and Applications", CRC Press, 4th Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/112/106/112106065/ (Engineering Fracture Mechanics)
2. https://onlinecourses.nptel.ac.in/noc19_me42/preview (Introduction to Engineering Fracture Mechanics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	-	1	1	1	2	2	1
2	3	3	3	3	3	1	2	-	-	1	1	1	3	3	1
3	3	3	3	3	3	2	2	-	-	1	1	1	3	2	1
4	3	3	3	3	3	2	2	-	-	1	1	1	3	2	2
5	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**1.6**	**1.8**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.4**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP205 PRE–STRESSED CONCRETE STRUCTURES L T P C
3 0 0 3

(IS 1343: 1980, IS 784: 2001, IS 784: 1959 & IS 15916: 2010 are to be permitted)

OBJECTIVES

- To learn the various systems of pre–stressing.
- To understand the design of flexural members for shear, bond and torsion and end blocks.
- To study the concept of continuous beams and their design.
- To know the tension and compression members and the process of pre-stressing.
- To understand the design of pre–stressed concrete bridges.

UNIT I PRINCIPLES OF PRESTRESSING 9

Principles of Pre-stressing – Types and systems of pre-stressing – Constituent materials and their properties – Analysis methods – Losses – Deflection (short & long term) – Camber and cable layouts.

UNIT II DESIGN OF FLEXURAL MEMBERS 9

Behavior of flexural members – Determination of ultimate flexural strength – Codal provisions – Design of flexural members – Design for shear – Bond and torsion – Design of end blocks.

UNIT III DESIGN OF CONTINUOUS BEAMS 9

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

UNIT IV DESIGN OF TENSION AND COMPRESSION MEMBERS 9

Design of tension members – Application in the design of pre-stressed pipes and pre-stressed concrete cylindrical water tanks – Design of compression members with and without flexure – Application in the design of piles, flag masts and similar structures.

UNIT V DESIGN OF PRESTRESSED CONCRETE BRIDGES 9

Composite Beams – Analysis and design – Pre-stressed deck Slab Bridge – Composite sections – Ultimate strength – Application in pre-stressed concrete bridges – Design of pre-tensioned and post tensioned girder bridges – Partial pre-stressing – Advantages and applications.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the pre-stressed concrete element using various methods.
- Design pre-stressed concrete flexural members.
- Develop the profiles for pre-stressed continuous beams.
- Design pre-stressed tension and compression members as per codal recommendations.
- Analyze the pre-stressed concrete bridges as per IRC specifications.

TEXT BOOKS

1. Karuna Mho Ghosh, "Pre-stressed Concrete", PHI Learning Private Limited, 2nd Edition, 2018.
2. Rajagopalan.N, "Pre-stressed Concrete", Narosa Publications, 2nd Edition, 2017.

REFERENCES

1. Krishna Raju, "Pre-stressed Concrete", Tata McGraw-Hill Publishing Co, 6th Edition, 2018.
2. Muthu K.U and Azmi Ibrahim, "Pre-stressed Concrete", PHI Learning Private Limited, 1st Edition, 2011.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106118/ (Prestressing System)
2. https://www.digimat.in/nptel/courses/video/105106118/L05.html (Pre-Stressed Concrete Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
2	3	2	2	2	2	2	2	-	-	-	2	2	3	2	2
3	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
4	3	2	2	2	2	2	2	-	-	-	2	2	3	2	2
5	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
AVG	**3.0**	**2.0**	**2.0**	**2.0**	**1.4**	**1.4**	**1.4**	**-**	**-**	**-**	**1.4**	**1.4**	**3.0**	**2.0**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER II

PROFESSIONAL ELECTIVE III

23PSP206 **STRUCTURAL OPTIMIZATION** **L T P C**
3 0 0 3

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 know the suitable non-linear programming methods for structural optimization.
- To understand the various methods of optimality involving geometric and dynamic programming.
- To learn the various advanced techniques for optimization in water distribution and plumbing.

UNIT I OPTIMIZATION FUNDAMENTALS **9**

Optimization methods – Introduction, Problem formulation, Introduction to mathematical principles in optimization – Mathematical models – Activity – Design methodology – Civil engineering case study – Unconstrained functions – Single variable – Several variable – Equality constraints – Inequality constraints – Optimization – Design space – Feasible and Infeasible – Convex and concave – Active constraints – Local and Global optima – Differential Calculus – Optimality criteria – Lagrange multiplier method – Kuhntucker 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 – Uni-modal function – Exhaustive and unrestricted search – 116 Dichotomous search – Fibonacci method – Golden section method – Interpolation methods – Unconstrained multivariable function – Uni-variate method – Cauchy's steepest descent method – Conjugate gradient method (Fletcher Reeves) – Variable metric methods (Davison-Fletcher-Powell) – Direct and indirect methods – Interior Penalty function – External Penalty function method.

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 sub - optimization problems – Truss optimization.

UNIT V NON–TRADITIONAL METHODS **9**

Requirements of water distribution – Components – Service reservoirs – Functions and drawings – Network design – Economics – Computer applications – Analysis of distribution networks – Appurtenances – Operation and maintenance – Leak detection, Methods. Principles of design of water supply in buildings – House service connection – Fixtures and fittings – Systems of plumbing and drawings of types of plumbing.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the basic ideas in optimization to make the structures as lightly as possible.
- Explain the linear programming techniques in engineering optimization.
- Evaluate the non-linear programming methods for structural optimization.
- Describe the methods adopted in solving the problems related to geometric and dynamic Programming.
- Analyze the advanced techniques of optimization for water distribution and plumbing.

TEXT BOOKS

1. Belegundu. A.D.and Chandrapatla,T.R., "Optimisation Concepts and Applications in Engineering", Pearson Education, 3rd Edition, 2017.
2. Deb K., "Optimisation for Engineering Design", Algorithms and examples, Prentice Hall, 3rd Edition, 2016.

REFERENCE

1. Rao.S.S., "Engineering Optimization: Theory and Practice", Wiley Publishers, 5th Edition, 2020.
2. Jasbir Arora , "Introduction to Optimum Design", Elsevier, 4th Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/112/101/112101298/ (Optimization from fundamentals)
2. https://nptel.ac.in/courses/111/105/111105039/ (Optimization – Introduction)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	-	-	1	1	3	2	1
2	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
3	3	3	3	3	2	2	2	-	-	-	1	1	3	3	1
4	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
5	3	3	3	3	2	2	2	-	-	-	1	1	3	3	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.8**	**1.8**	**-**	**-**	**-**	**1.4**	**1.4**	**3.0**	**2.8**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP207	ENERGY EFFICIENT STRUCTURES	L T P C 3 0 0 3

OBJECTIVES

- To create awareness of the necessity of energy needed for structures.
- To study the different climate types and their influence in building design.
- To focus on the thermal environment of structures.
- To learn the major appliances and their utilization in buildings.
- To understand the energy audit systems in buildings.

UNIT I INTRODUCTION **9**

Need of energy in buildings – Assessment – Energy consumption pattern of various types of buildings – Factors influencing the energy use in building – Concepts of energy efficient building.

UNIT II CLIMATE **9**

Study of Climate types – their influence in building design – Environmental factors affecting building design – Analysis of thermal and visual environment.

UNIT III HEAT AND LIGHT **9**

Heat gain and loss phenomenon in buildings – Thermal performance parameters – Role of building enclosures, openings and materials in thermal environment – Basic principles of light and daylight – Energy efficient light design of buildings – Daylight design of buildings.

UNIT IV APPLIANCES IN BUILDINGS **9**

Major appliances in building and their energy consumptions – Principles of solar heating, cooling and power(PV) systems – Integration of energy efficient appliances with the buildings.

UNIT V ENERGY AUDIT **9**

Energy survey and energy audit of buildings – Calculation of energy inputs and utilization in buildings – Energy audit reports of buildings – Concepts of Green Buildings – Energy rating of buildings.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain various energy consumption patterns.
- Analyze the climate and environmental factors affecting building design.
- Design of buildings according to thermal Environment.
- Describe the integration of energy efficient appliances with buildings.
- Demonstrate energy audit in buildings.

TEXT BOOKS

1. Francesco Asdrubali, "Handbook of Energy Efficiency in Buildings", Elsevier, 1st Edition, 2019.
2. Threlkeld, J.L., "Thermal Environmental Engineering", Prentice–Hall, 3rd Edition, 2016.

REFERENCE

1. Lal Jayamaha, "Energy–Efficient Building Systems: Green Strategies for Operation and Maintenance", McGraw Hill, 6th Edition, 2016.
2. Krishnan, A., Baker, N., Yannas, S. and Szokolay, S.V., "Climate Responsive Architecture – A Design Hand Book for Energy Efficient Buildings", Tata McGraw Hill Publishing Company Ltd, 5th Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/102/105102175/ (Energy Efficiency, Acoustics and day lighting in building)
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18–me44/ (Energy conservation and waste heat recovery)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	1	1	-	1	1	1	1	3	2	1
2	3	3	3	3	2	2	2	-	1	1	2	2	3	2	2
3	3	3	3	3	2	2	2	-	1	1	2	2	3	2	2
4	3	3	3	3	2	2	2	-	1	1	2	2	3	2	2
5	3	3	3	3	3	2	2	-	1	1	2	2	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**2.8**	**2.2**	**1.8**	**1.8**	**-**	**1.0**	**1.0**	**1.8**	**1.8**	**3.0**	**2.2**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP208 **WIND AND CYCLONE EFFECTS ON STRUCTURES** **L T P C**
(IS 875:1987 PART I & III are to be permitted) **3 0 0 3**

OBJECTIVES

- To know the types and characteristics of wind loads on structures.
- To understand wind tunnel studies to model wind experimentally.
- To study the effect of wind on structures.
- To study codal provisions for design structures subjected to wind.
- To learn the behavior of cyclone on buildings.

UNIT I WIND LOADING ON STRUCTURES **9**

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

UNIT II WIND TUNNEL STUDIES **9**

Wind Tunnel Studies, Types of tunnels – Prediction of acceleration – Load combination factors – Wind tunnel data analysis – Calculation of Period and damping value for wind design – Modeling requirements, Aero dynamicand Aero-elastic models.

UNIT III EFFECT OF WIND ON STRUCTURES **9**

Classification of structures – Rigid and Flexible – Effect of wind on structures – Static and dynamic effects on tall buildings – Chimneys.

UNIT IV DESIGN OF SPECIAL STRUCTURES **9**

Design of Structures for wind loading as per IS/ASCE, BS and NBC provisions – design of Tall Buildings – Chimneys –Transmission towers and steel monopoles – Industrial sheds.

UNIT V CYCLONE EFFECTS **9**

Types – 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 – Codal provisions.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the concept of wind loadings to design structures.
- Explain the importance of wind tunnel studies.
- Analyze the effect of wind on structures.
- Design tall structures subjected to wind as per codal provisions.
- Analyze the behavior of cyclone on buildings.

TEXT BOOKS

1. Emil Simiu and Dong Hun Yeo, "Wind Effects on Structures", Wiley Publishers, 1st Edition, 2016.
2. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, 2nd Edition, 2016.

REFERENCE

1. Cook.N.J., "The Designer's Guide to Wind Loading of Building Structures", Butterworth's, 1st Edition, 2016.
2. John D Holmes, "Wind loading of structures" Taylor and Francis group, 4th Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/102/105102016/ (Seismic analysis of structures)
2. https://nptel.ac.in/content/storage2/courses/101106040/chapter%201.pdf (Wind Tunnel)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	2	2	-	1	-	1	1	3	2	2
2	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
3	3	3	3	3	2	1	2	-	1	-	1	1	3	2	1
4	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
5	3	3	3	3	2	1	2	-	1	-	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**-**	**1.0**	**1.0**	**3.0**	**2.6**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP209 **COMPUTER AIDED DESIGN OF STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the basics of graphic primitives, transformations and 2–D drafting of computer graphics.
- To learn the various computer methods of structural analysis.
- To understand the structural design concepts.
- To know the applications of linear programming and CPM and PERT.
- To acquire knowledge in Artificial Intelligence.

UNIT I COMPUTER GRAPHICS **9**

Graphic primitives – Transformations – Basics of 2-D drafting – Modeling of curves and surfaces – Wire frame modeling – Solid modeling – Graphic standards – Drafting software packages and usage.

UNIT II STRUCTURAL ANALYSIS **9**

Computer aided analysis of steel and RC Structural elements – Application of software**.**

UNIT III STRUCTURAL DESIGN **9**

Computer aided design of steel and RC Structural elements – Detailed drawing – Bill of materials.

UNIT IV OPTIMIZATION **9**

Application of linear programming – Simplex algorithm – Post–optimality analysis – Project scheduling – CPM and PERT applications.

UNIT V ARTIFICIAL INTELLIGENCE **9**

Introduction – Heuristic search – knowledge based expert systems – Rules and decision tables – Inference mechanisms– Simple applications – Genetic algorithm and applications – Principles of Neural network – Architecture and applications of KBES – Expert system shells.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Examine 2 D drawings using drafting software.
- Analyze the structures by using various softwares.
- Design the structures with computer methodologies.
- Analyze the structural design with various computer packages and graphics.
- Apply artificial intelligence to real life applications.

TEXT BOOKS

1. Rao. S.S., "Engineering Optimization", Wiley Publishers, 5th Edition, 2019.
2. Groover M.P. and Zimmers E.W.Jr.," CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India Ltd, 1st Edition, 2016.

REFERENCE

1. Krishnamoorthy C.S and Rajeev S, "Computer Aided Design", Narosa Publishing House, 2nd Edition, 2018.
2. Srinivasa Prakash Regalla, "Computer Aided Analysis and Design", I.K. International Publishing House Pvt. Limited, 3rd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/106/106/106106090/ (Computer Graphics)
2. https://nptel.ac.in/courses/106/102/106102220/ (An introduction to Artificial Intelligence)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
2	2	2	2	2	2	2	2	-	-	-	2	2	3	2	2
3	3	2	2	2	2	2	2	-	-	-	2	2	3	2	2
4	2	2	2	2	2	2	2	-	-	-	2	2	3	2	2
5	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
AVG	**2.6**	**2.0**	**2.0**	**2.0**	**1.6**	**1.6**	**1.6**	**-**	**-**	**-**	**1.6**	**1.6**	**3.0**	**2.0**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP210 MECHANICS OF COMPOSITE MATERIALS L T P C
3 0 0 3

OBJECTIVES

- To understand the composite materials and properties of composite fiber and matrix constituents.
- To learn stress strain relation of orthotropic and anisotropic materials.
- To know the static, dynamic and stability analysis for simpler cases of composite plates.
- To study the failure criterion and fracture mechanism of composites.
- To gain knowledge in the composite materials design and its applications.

UNIT I INTRODUCTION TO COMPOSITES 9

Introduction to Composites – Classifying composite materials and their properties – Commonly used fiber and matrix constituents – Composite Construction – Properties of Unidirectional Long Fiber Composites – 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 an isotropic and orthotropic plate – Angle-ply and cross ply laminates - Static, dynamic and stability analysis for simpler cases of composite plates – Inter laminar 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 – Environmental issues.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the fiber types and classify the composite material.
- Relate the stress - strain properties, longitudinal and transverse properties of composites lamina.
- Analyze the laminated composites and compute the lamina strength.
- Find the failure criterion and fracture mechanics of composites.
- Apply the load deformation relation, residual stresses for the design of composites.

TEXT BOOKS

1. Agarwal. B.D and Broutman.L.J, "Analysis and Performance of fiber composites", John-Wiley and Sons, 4th Edition, 2017.
2. Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill, 10th Edition, 2016.

REFERENCE

1. Ronald F. Gibson, "Principles of Composite Material Mechanics", CRC Press, 4th Edition, 2016.
2. Krishan K. Chawla, "Composite Materials Science and Engineering", Springer, 2nd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/112/104/112104229/ (Introduction to composites)
2. https://nptel.ac.in/courses/105/108/105108124/ (Composite Materials)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	2	-	1	1	2	1	3	3	2
2	3	2	3	2	2	1	2	-	1	1	1	1	3	2	1
3	3	2	3	2	2	2	2	-	1	1	2	1	3	2	2
4	3	2	3	2	2	2	2	-	1	1	2	1	3	2	2
5	3	3	3	2	2	1	2	-	1	1	1	1	3	3	1
AVG	**3.0**	**2.4**	**3.0**	**2.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**1.0**	**1.6**	**1.0**	**3.0**	**2.4**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER III

PROFESSIONAL ELECTIVE–IV

23PSP301 DESIGN OF OFFSHORE STRUCTURES L T P C
3 1 0 4

(IS 4561 Part 1, 2, 3, 4 & 5, IS 9527 Part 1, 3 & 4, IS 10020 Part 4: 1981 & SP 64 are to be permitted)

OBJECTIVES

- To understand the principles of wave theory.
- To know the various forces acting on offshore structures.
- To introduce the concepts of modeling of offshore structures.
- To learn the various methods offshore structures.
- To study the design of offshore structures like platform, helipads and jacket towers.

UNIT I WAVE THEORIES 9+3

Wave generation process, small, finite amplitude and nonlinear wave theories.

UNIT II FORCES OF OFFSHORE STRUCTURES 9+3

Wind forces, wave forces on small bodies and large bodies – Current forces – Morison equation.

UNIT III OFFSHORE STRUCTURE MODELLING 9+3

Different types of offshore structures, foundation modeling, fixed jacket platform structural modeling.

UNIT IV ANALYSIS OF OFFSHORE STRUCTURES 9+3

Static method of analysis – foundation analysis and dynamics of off shore structures.

UNIT V DESIGN OF OFFSHORE STRUCTURES 9+3

Design of platforms – Helipads, Jacket tower – Analysis and design of mooring cables and pipelines – Wind turbines.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the principles of wave theory.
- Evaluate the forces on offshore structures.
- Describe modeling of soil and offshore structures.
- Analyze the offshore structures.
- Design offshore structures such as platform, helipads and jacket towers.

TEXT BOOKS

1. Mohamed A El-Reedy, "Offshore Structures Design, Construction and Maintenance", Elsevier Science, 2nd Edition, 2019.
2. Chakrabarti Subrata, "Handbook of Offshore Engineering", Elsevier Science, 1st Edition, 2017.

REFERENCES

1. Reddy.D.V and Swamidas A.S.J, Essentials of Offshore Structures, CRC Press, 2nd Edition, 2016.
2. Yong Bai, Wei-Liang Jin, "Marine Structural Design", Elsevier Science, 2nd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/114/106/114106011/ (Design of Offshore structures)
2. https://nptel.ac.in/courses/114/106/114106015/ (Foundation of Offshore structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	-	1	1	1	2	2	1
2	3	3	3	3	3	1	2	-	-	1	1	1	3	3	1
3	3	3	3	3	3	2	2	-	-	1	1	1	3	2	1
4	3	3	3	3	3	2	2	-	-	1	1	1	3	2	2
5	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**1.6**	**1.8**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.4**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP302 DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES L T P C
3 1 0 4

OBJECTIVES

- To introduce the composite construction and composite behaviour of steel concrete composite structures.
- To study the composite beams, columns, floors, slabs and concrete filled steel tubes.
- To learn the composite floors and to analyze internal forces and moments.
- To acquire knowledge about the composite columns under compression and bending.
- To understand the design considerations for composite trusses.

UNIT I THEORY OF COMPOSITE STRUCTURES 9+3

Introduction to Steel-Concrete Composite Construction – Merits and demerits – Theory of composite structures – Introduction to IS and Euro codal provisions for steel concrete composites design – Local buckling and section classification – Limit states – Partial safety factors – Introduction to Steel - Concrete - Steel - Sandwich Construction.

UNIT II COMPOSITE BEAMS 9+3

Introduction to composite beams – Advantages – Elastic behavior of composite beams – No interaction and Full interaction – Shear connectors – Types and load bearing mechanism of shear connectors – Ultimate load behavior of composite beam – Serviceability limit states – Types, merits and behavior of profiled decking – Propped and un-propped conditions – Basic design considerations – Design of simply supported and continuous composite beam (with or without profile deck).

UNIT III COMPOSITE FLOORS 9+3

Introduction to composite floors – Benefits – Sheeting parallel to span – Sheeting perpendicular to span – Ponding effect – Structural elements – Bending resistance – Shear resistance – Serviceability criteria – Analysis of internal forces and moments – Design of Composite floors.

UNIT IV COMPOSITE COLUMNS 9+3

Introduction to composite columns and its types – Advantages – Materials – Proposed design method – Design parameters and checks for structural adequacy – Resistance of encased composite column cross section and in filled composite column cross section under compression – Effective elastic flexural stiffness – Design of both encased and in filled composite column under axial compression, uniaxial bending and biaxial bending.

UNIT V COMPOSITE TRUSSES **9+3**

Introduction – Loads and analysis of trusses – Configuration of trusses – Behaviour and application of composite truss – Truss members – Composite connections – Design consideration – Stud specifications – Design of composite truss – Case studies on steel-concrete composite construction in buildings.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the basic concepts of steel concrete composite construction.
- Analyze and design composite beams with or without profile decking sheet.
- Design composite floors with the provision of profile decking sheet.
- Design the encased and in–filled composite columns.
- Describe the design of composite trusses and case studies.

TEXT BOOKS

1. Johnson R.P., "Composite Structures of Steel and Concrete", Blackwell Publishing, 8th Edition, 2019.
2. David Collings, "Steel-concrete Composite Buildings", Thomas Telford, 4th Edition, 2017.

REFERENCES

1. Narayanan R, "Steel - Concrete Composite Structures', CRC Press, 1st Edition, 2019.
2. J.Y. Richard Liew, Ming–Xiang Xiong, Bing–Lin Lai, "Design of Steel–Concrete Composite Structures Using High–Strength Materials", Elsevier Science, 1st Edition, 2021.

E–RESOURCES

1. https://nptel.ac.in/courses/105/108/105108124/ (Composite materials)
2. https://nptel.ac.in/courses/105/105/105105162/ (Design of steel structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	2	-	-	1	1	1	2	2	1
2	3	3	3	3	3	2	2	-	-	1	1	1	3	3	1
3	3	3	3	3	3	2	2	-	-	1	1	1	3	2	2
4	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
5	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**1.8**	**2.0**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.6**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP303 **DESIGN OF MASONRY STRUCTURES** **L T P C**
3 1 0 4

(IS 1905: 1987, IS 13827: 1993 & IS 13828: 1993 are to be permitted)

OBJECTIVES

- To learn the basic principles of design of masonry elements.
- To understand the structural interactions between wall – columns.
- To gain knowledge in codal provisions to arrive strength of masonry.
- To introduce the concepts of pre-stressed masonry.
- To study elastic and inelastic analysis methods to predict masonry behaviour under failure.

UNIT I INTRODUCTION **9+3**

Historical Perspective – Masonry Materials - Masonry Design Approaches – Overview of Load Conditions – Compression Behavior of Masonry – Masonry Wall Configurations – Distribution of Lateral Forces.

UNIT II INTERACTIONS **9+3**

Structural Wall – Columns and Pilasters – Retaining Wall – Pier and Foundation.

UNIT III STRENGTH **9+3**

Flexural strength of reinforced masonry members – In plane and out-of-plane loading – Shear strength and ductility of reinforced masonry members.

UNIT IV PRESTRESSED MASONRY **9+3**

Stability of walls – Coupling of masonry walls, openings, columns and beams.

UNIT V ELASTIC AND INELASTIC ANALYSIS **9+3**

Modeling Techniques – Static Push over Analysis and use of Capacity Design Spectra.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the masonry design approaches.
- Analyze the interactions of reinforced masonry members.
- Determine shear strength and ductility of Reinforced Masonry members.
- Apply the concept of pre-stressed masonry in fields.
- Examine the stability of walls and Perform elastic and inelastic analysis of masonry walls.

TEXT BOOKS

1. A.W. henry, Sinha and S.R.Davies, "Design of masonry structures", Taylor and francis, 4th Edition, 2017.
2. Narendra Taly, "Design of reinforced masonry structures", The McGraw Hill, 5th Edition, 2016.

REFERENCES

1. R.S. Schneider and W.L. Dickey, "Reinforced Masonry Design", Prentice Hall, 4th Edition, 2016.
2. Drysdale, R. G. Hamid, A. H. and Baker, L. R, "Masonry Structures: Behaviour & Design", Prentice Hall Hendry, 1st Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106197/ (Design of masonry structures)
2. https://www.digimat.in/nptel/courses/video/105106197/L01.html (Design of masonry structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	2	2	-	1	-	1	1	3	2	2
2	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
3	3	3	3	3	2	1	2	-	1	-	1	1	3	2	1
4	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
5	3	3	3	3	2	1	2	-	1	-	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**-**	**1.0**	**1.0**	**3.0**	**2.6**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP304 **NON-LINEAR ANALYSIS** **L T P C**
3 1 0 4

OBJECTIVES

- To study the concept of non–linear behavior of beams and vibrations of beams.
- To understand the elastic analysis of statically determinate and indeterminate flexural members.
- To know the governing equation for static and dynamic analysis of composite plate.
- To study the inelastic analysis of statically determinate and indeterminate flexural members.
- To learn the non-linear analysis of plates and its governing equation.

UNIT I NON LINEAR BENDING AND VIBRATION OF BEAMS **9+3**

Introduction –Types of non-linearity – Non-linear governing equation for beams – Geometrically non-linear beam problems – Vibrations of beams with various boundary conditions – Forced vibration of beams – Post buckling cantilever column – Behavior of beams with material non-linearity – Non-linear vibration and instabilities of elastically supported beams.

UNIT II ELASTIC ANALYSIS OF FLEXURAL MEMBERS **9+3**

Flexural behavior – Statically determinate and statically – Indeterminate bars – Uniform and varying thickness.

UNIT III ANALYSIS OF LAMINATED COMPOSITES **9+3**

Governing equations for an isotropic and orthotropic plate – Angle-ply and cross ply laminates – Static, dynamic and stability analysis for simpler cases of composite plates – Inter laminar stresses.

UNIT IV IN ELASTIC ANALYSIS OF FLEXURAL MEMBERS **9+3**

Inelastic analysis of uniform and variable thickness members subjected to small deformations – Inelastic analysis of flexible bars of uniform and variable stiffness – Members with and without axial restraints.

UNIT V NON LINEAR STATIC AND DYNAMIC ANALYSIS OF PLATES **9+3**

Introduction – Governing non-linear equations for plates – Boundary conditions and methods of solutions – Large deflection analysis of rectangular and non-rectangular plates – Free and forced vibrations of rectangular and nonrectangular plates – Post buckling behaviour of plates – Effects of transverse shear deformations and material nonlinearity.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze the beam using basic concept of non–linearity and vibration.
- Differentiate statically determinate and indeterminate flexural members.
- Interpret the composite plates for static and dynamic condition.
- Examine the inelastic analysis with various boundary conditions of thin walled structural members.
- Demonstrate static and dynamic analysis of plates.

TEXT BOOKS

1. Sathyamoorthy. M, "Non-linear Analysis of Structures", CRC Press, 3rd Edition, 2017.
2. Fertis. D. G.,"Non-linear Mechanics", CRC Press, 2nd Edition, 2016.

REFERENCES

1. Reddy.J.N, "Non-linear Finite Element Analysis", Oxford University Press, 4th Edition, 2018.
2. Gang Li, Kevin Wong, "Theory of Nonlinear Structural Analysis", Wiley Publishers, 2nd Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/108/106/108106162/ (Non–Linear Analysis System)
2. https://nptel.ac.in/courses/112/104/112104161/ (Mechanics of Laminated Composite Strucutres)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	-	-	1	1	3	2	1
2	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
3	3	3	3	3	2	2	2	-	-	-	1	1	3	3	1
4	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
5	3	3	3	3	2	2	2	-	-	-	1	1	3	3	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.8**	**1.8**	**-**	**-**	**-**	**1.4**	**1.4**	**3.0**	**2.8**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP305 **BRIDGE STRUCTURES** **L T P C**
3 1 0 4

(IS 456:2000, IS 458: 1971, IRC 5: 1998, IRC 6: 2001, IRC 18: 2000, IRC 21: 2000, IRC 22: 1986, IRC 24: 2001, IRC 78: 2000,IRC 83 Part 1 & 2 are to be permitted)

OBJECTIVES

- To know the skills in designing various types of bridges.
- To understand the design of short span bridges.
- To learn the design of long span bridges.
- To study the design of pre-stressed bridges.
- To gain knowledge in the design of bearings & concrete piers.

UNIT I INTRODUCTION **9+3**

Classification, investigations and planning, choice of type, I.R.C. specifications for road bridges, standard live loads, other forces acting on bridges & general design considerations.

UNIT II SHORT SPAN BRIDGES **9+3**

Introduction – Design of culvert – Deck Slab Bridge – Load distribution theories – Pigeaud's Theory – T-beam and girder bridges.

UNIT III LONG SPAN GIRDER BRIDGES **9+3**

Introduction – Procedure & Design principles of continuous bridges – Box girder bridges – Balanced cantilever bridges

UNIT IV DESIGN OF PRESTRESSED BRIDGES **9+3**

Flexural and Torsional parameters – Courbon's theory – Distribution co-efficient by exact analysis – Design of girder section – Maximum and minimum pre-stressing forces – Eccentricity – Live load and dead load shear forces – Cable Zone in girder – Check for stresses at various sections – Check for diagonal tension – Diaphragms – End block – Short term and long term deflections.

UNIT V DESIGN OF BEARINGS AND SUBSTRUCTURES **9+3**

Different types of bearings – Design of bearings – Design of masonry and concrete piers and abutments – Types of bridge foundations – Design of foundations.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the design theories for super structure and sub structure of bridges.
- Design short span bridges.
- Explain the behaviors of continuous bridges, box girder bridges.
- Design pre-stressed concrete bridges.
- Analyze the Different types of bearings, abutments, piers and types of foundations for Bridges.

TEXT BOOKS

1. Krishna Raju.N "Design of Bridges", Oxford and IBH Publishing Company, 4th Edition, 2017.
2. T.R. Jagadeesh and M.A. Jayaram, "Design of Bridge Structures", Prentice Hall of India Pvt.Ltd, 2nd Edition 2018.

REFERENCES

1. Ponnuswamy S, "Bridge Engineering", Tata McGraw Hill, 2nd Edition, 2017.
2. D. Johnson Victor, "Essentials of Bridge Engineering", Oxford and IBH Publishing Co, 6th Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/105/105/105105165/ (Reinforced Concrete Road Bridge)
2. http://www.digimat.in/nptel/courses/video/105105165/L18.html (Reinforced Concrete Road Bridge)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	2	2	2	2	-	1	1	2	1	3	2	1
2	3	3	3	3	2	1	2	-	1	1	1	1	3	3	1
3	3	3	3	3	2	2	2	-	1	1	2	1	3	3	2
4	3	3	3	3	2	2	2	-	1	1	2	1	3	2	2
5	3	3	3	3	2	1	2	-	1	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**2.8**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**1.0**	**1.6**	**1.0**	**3.0**	**2.6**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER III

PROFESSIONAL ELECTIVE–V

23PSP306 DESIGN OF STRUCTURES FOR DYNAMIC LOAD L T P C
3 1 0 4

OBJECTIVES

- To study the behavior of R.C.C. under the action of impact and cyclic loads.
- To learn the characteristics of seismic loading and to design structures subjected to seismic loads.
- To understand the effects of blast loads on structure for analysis and design.
- To know the effects of wind on loading on structures, their analysis and design.
- To understand the response of dams, bridges and buildings against different disasters.

UNIT I GENERAL 9+3

Design philosophy to resist earthquake, cyclone, flood, blast and impact – National and International codes of practice – Behavior of concrete, steel, masonry and soil under impact and cyclic loads – Energy absorption capacity – Ductility of material and the structure – Design Against Cyclone And Flood: Effect of cyclones on buildings and special structures – Safety and precautionary steps in design.

UNIT II DESIGN AGAINST EARTHQUAKES 9+3

Earthquake characterization – Response spectrum – seismic coefficient and response spectra methods of estimating loads – Response of framed, braced frames and shear wall buildings – Design as per BIS codes practice – Ductility based design.

UNIT III DESIGN AGAINST BLAST AND IMPACT 9+3

Characteristics of internal and external blast – Impact and impulse loads – Explosions – Threats – wave scaling law – Fire loading – Restraints – Pressure distribution on buildings above ground due to external blast – Underground explosion – Design of buildings for blast , fire and impact as per BIS code of practice.

UNIT IV DESIGN AGAINST WIND 9+3

Characteristics of wind – Basic and design wind speeds Aero-elastic and Aerodynamic effect – Design as per BIS code of practice including Gust factor approach – Along wind and across wind response– effect on tall buildings, towers, chimneys, roofs, window glass, Cladding and slender structures – vibration of cable supported bridges and power lines due to wind effects – tornado effects.

UNIT V SPECIAL CONSIDERATIONS 9+3

Detailing for ductility – Passive and active control of vibrations – New and favorable materials – Response of dams, bridges, buildings – Strengthening measures – Safety analysis – Methods of strengthening for different disasters – Maintenance and modifications to improve hazard resistance.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the effects of dynamic loads like earthquake, blast and impact on structures.
- Describe the concepts of seismic resistant design as per BIS code.
- Design the structures against blast and impact loads.
- Analyze effect of wind on structures and design against wind load.
- Apply the concepts of favorable materials for ductility based designing of structure along with strengthening methods.

TEXT BOOKS

1. Daniel J Inman, "Vibration with Control", Wiley Publishers, 2nd Edition, 2018.
2. Bela Goschy, "Design of Buildings to withstand abnormal loading", Butterworhts, 1st Edition, 2017.

REFERENCES

1. Paulay.T and Priestly. M.N.J, "A seismic Design of Reinforced Concrete and Masonry Buildings", John Wiley and Sons, 2nd Edition, 2016.
2. Dowling C.H, "Blast Vibration – Monitoring and Control", Prentice Hall Inc, 1st Edition, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106151/ (Structural Dynamics)
2. https://nptel.ac.in/courses/105/101/105101006/ (Structural Dynamics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	2	2	-	1	-	1	1	3	2	2
2	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
3	3	3	3	3	2	1	2	-	1	-	1	1	3	2	1
4	3	3	3	3	2	2	2	-	1	-	1	1	3	3	2
5	3	3	3	3	2	1	2	-	1	-	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.6**	**2.0**	**-**	**1.0**	**-**	**1.0**	**1.0**	**3.0**	**2.6**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP307 DESIGN OF SHELL AND SPATIAL STRUCTURES L T P C
3 1 0 4

OBJECTIVES

- To know the different type of shell structures.
- To understand the design of circular domes, conical roofs and circular cylindrical shells.
- To study the behavior of space frames.
- To introduce the general design philosophy for designing space frames.
- To learn the finite element analysis of shell structures.

UNIT I SHELL CLASSIFICATION AND ANALYSIS 9+3

Classification of shells – Structural actions – Membrane theory – Analysis of spherical domes – Cylindrical shells – Folded plates.

UNIT II DESIGN OF SHELLS 9+3

Design of circular domes – Conical roofs – Circular cylindrical shells.

UNIT III FOLDED PLATES 9+3

Folded plate structures – Structural behavior – Types – Design – Pyramidal roof.

UNIT IV INTRODUCTION TO SPACE FRAME 9+3

Space frames – Configuration – Types of nodes – General principles of design Philosophy – Behavior.

UNIT V FINITE ELEMENT ANALYSIS 9+3

Finite element application on cylindrical shells – Introduction to shell elements – Flat elements – Axisymmetric elements – Degenerated elements – General shell elements.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Analyze and design various shell and spatial structures.
- Design different types of domes.
- Interpret the behavior of folded plates.
- Evaluate the structural behavior and philosophy of space frames.
- Develop the shell elements using finite element analysis.

TEXT BOOKS

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co, 6th Edition, 2017.
2. Avelino Samartin Quiroga, Edgard Backx, "Shell and Spatial Structures: Computational Aspects", Springer, 2nd Edition, 2016.

REFERENCES

1. Subramanian.N ,"Principles of Space Structures", Wheeler Publishing Co, 4th Edition, 2017.
2. Ramasamy. G.S., "Design and Construction of Concrete Shells Roofs", CBS Publishers, 1st Edition, 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/124/105/124105015/ (Shell structures)
2. https://nptel.ac.in/courses/105/103/105103209/ (Plates and Shells)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	1	-	1	1	3	2	1
2	3	3	3	3	2	2	1	-	1	-	2	2	3	3	2
3	3	3	3	3	2	2	1	-	1	-	1	1	3	3	2
4	3	3	3	3	2	2	1	-	1	-	2	2	3	3	2
5	3	3	3	3	2	2	1	-	1	-	2	2	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.8**	**1.0**	**-**	**1.0**	**-**	**1.6**	**1.6**	**3.0**	**2.8**	**1.8**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP308 **DESIGN OF SUB–STRUCTURES** **L T P C**
3 1 0 4

(IS 1904: 1986, IS 6403: 1981, IS 8009: 1976, IS 456: 2000, IS 2911 Part 1 to 4: 2010, IS 2974: 1992 Part 1 – 5 are to be permitted)

OBJECTIVES

- To learn the different types of shallow foundation.
- To study about pile caps and under-reamed pile foundations.
- To understand the concepts in designing well foundations.
- To introduce basic principles of design of machine foundation.
- To know the special foundation for concrete chimneys and towers.

UNIT I SHALLOW FOUNDATIONS **9+3**

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+3**

Introduction – Types of pile foundations – Load carrying capacity – Pile load test – Pile driving and construction – Configuration of piles – Different shapes of piles cap – Structural design of pile cap – Under-reamed pile foundation – Piles subjected to lateral loads – Combined raft foundation.

UNIT III WELL FOUNDATIONS **9+3**

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

UNIT IV MACHINE FOUNDATIONS **9+3**

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 – Construction aspects–vibration isolation.

UNIT V SPECIAL FOUNDATIONS **9+3**

Foundation on expansive soils – Choice of foundation – Foundation for concrete Towers and chimneys – Reinforced earth retaining walls – Marine Foundations.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Identify appropriate foundation type based on available soil conditions.
- Determine the load carrying capacity of pile foundation.
- Design the well foundations for construction engineering structures.
- Develop the foundation for Reciprocating machines and Impact machines.
- Analyze the soil foundation on expansive soils and to design foundation for special structures

TEXT BOOKS

1. Varghese.P.C, "Design of Reinforced Concrete Foundations ॥", PHI learning private limited, New Delhi, 1st Edition, 2018.
2. Michael J Tomlinson, John C Woodward, "Pile Design and Construction Practice", 6th Edition, CRC Press, 2018.

REFERENCES

1. Swamy Saran, "Analysis and Design of substructures ॥", Oxford and IBH Publishing Co. Pvt. Ltd, 1st Edition, 2018.
2. Tomlinson.M.J, "Foundation Design and Construction ॥", Longman, 6th Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/101/105101083/ (Foundation Engineering)
2. https://nptel.ac.in/courses/105/101/105101005/ (Soil Dynamics)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	2	-	-	1	1	1	2	2	1
2	3	3	3	3	3	2	2	-	-	1	1	1	3	3	1
3	3	3	3	3	3	2	2	-	-	1	1	1	3	2	2
4	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
5	3	3	3	3	3	2	2	-	-	1	1	1	3	3	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.8**	**1.8**	**2.0**	**-**	**-**	**1.0**	**1.0**	**1.0**	**2.8**	**2.6**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP309 STRUCTURAL ANALYSIS BY MATRIX METHODS L T P C
3 1 0 4

OBJECTIVES

- To introduce fundamental characteristics of elements and system by evaluation of its flexibility and stiffness matrices.
- To learn the concept of analysis of system through direct and element approach of flexibility method.
- To know the analysis of structures by direct and element approach of stiffness method is to be included.
- To understand the programming techniques for simple problems.
- To acquire knowledge in advanced techniques of matrix methods.

UNIT I ENERGY CONCEPTS IN STRUCTURES 9+3

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 FLEXIBILITY METHOD 9+3

Direct method applied to beams and frames – Relationship between element and system – Strain Energy in terms of flexibility coefficients – Approach to equivalent joint load concept through Betti's Law – Problems in beams, frames, trusses including effect of temperature and support sinking.

UNIT III STIFFNESS METHOD 9+3

Direct stiffness method to beams, frames and simple trusses – Strain energy in terms of stiffness coefficients – Relationship between element and systems – Static condensation techniques – Problems in beams, frames including secondary effects – Analysis of 3D structures – Grid and pin jointed trusses.

UNIT IV PROGRAMMING 9+3

Programming of solution techniques for simultaneous equation solution – Matrix operation – Simple program development for element stiffness matrix – Assemblage – Complete structure of a stiffness analysis program with subroutines – Use of GTSTRUDL / STAAD / SAP to solve problems in trusses, beams and frames.

UNIT V ADVANCED TOPICS 9+3

Sub structuring techniques – Force and displacements – Band width reduction – Tri-diagnolisation technique – Band solvers – Frontal solvers – Re-analysis technique – Transfer matrix method – Use of symmetry and anti symmetry.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the strain energy concepts in structures.
- Examine the matrix flexibility method for planar trusses, beams, and frames.
- Analyze the direct stiffness method for three dimensional framed structures.
- Develop the program for element stiffness matrix.
- Explain complex analysis procedures such as sub structuring and tri-diagonalization techniques.

TEXT BOOKS

1. William McGuire, Richard H. Gallagher, Ronald D. Ziemian, "Matrix structural Analysis", Wiley, 1st Edition, 2018.
2. Natarajan C and Revathi P.,"Matrix Methods of Structural Analysis ll", PHI Learning Private Limited, 1st Edition, 2016.

REFERENCES

1. Devdas Menon., "Advanced Structural Analysis ll", Narosa Publishing House, 1st Edition, 2019.
2. Jack. C, Mc Cormac, "Structural Analysis: Using Classical and Matrix Methods", John Wiley, 4th Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/105/105105180/ (Matrix Method of Structural Analysis)
2. http://www.digimat.in/nptel/courses/video/105105180/L05.html (Matrix Method of Structural Analysis)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	1	-	-	-	1	1	3	2	1
2	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
3	3	3	3	3	2	2	2	-	-	-	2	2	3	3	2
4	3	3	3	3	2	2	2	-	-	-	2	2	3	2	2
5	3	3	3	3	2	2	2	-	-	-	1	1	3	3	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.8**	**1.8**	**-**	**-**	**-**	**1.6**	**1.6**	**3.0**	**2.6**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP310 **COLD FORMED STEEL STRUCTURES** **L T P C**
3 1 0 4

OBJECTIVES

- To understand various cold formed steel structural elements.
- To introduce the thin elements in the design of cold formed steel.
- To study the design for web of beams, wide beam and short span beams.
- To know the design of flexural column buckling and wall studs.
- To learn about light gauge steel shear diaphragms and shell roof structures.

UNIT I INTRODUCTION **9+3**

General – Types of Cold Formed Steel Sections and their applications – Methods of Forming – Materials used in Cold Formed Steel Construction – Yield Point – Tensile Strength – Stress Strain Curve – Modulus of Elasticity and Tangent Modulus – Ductility – Weldability – Fatigue Strength and Toughness. Connections – Types of Connections – Welded Connections – Bolted Connections – Other Fasteners.

UNIT II STRENGTH OF THIN ELEMENTS AND DESIGN CRITERIA **9+3**

General – Definitions of General Terms – Basic Design Stress – Wind, Earthquake and Combined forces – Structural Behavior of Compression Elements and Design Criteria – Stiffeners for Compression Elements – Structural Behavior of Perforated Elements – Plate buckling of Columns – Behavior of Webs of Beams and Cylindrical Tubular Elements.

UNIT III DESIGN OF FLEXURAL MEMBERS **9+3**

General – Beam Strength and Deflection – Design of Webs of beams – Lateral Buckling of Beams – Bracing Requirements of Beams – Unusually Wide Beam Flanges and Unusually Short Span beams.

UNIT IV DESIGN OF COMPRESSION MEMBERS **9+3**

General – Yielding – Flexural Column Buckling – Effect of Cold Work on Column Buckling – Effect of Local Buckling on Column Strength – AISI Design Formula for Flexural Buckling – Effective Length factor K – Torsional Buckling and Torsional-Flexural Buckling – Bracing and Secondary Members – Maximum Slenderness Ratio – Wall Studs – Testing of Wall Material for Lateral Bracing Value.

UNIT V DESIGN OF BEAM COLUMNS **9+3**

General – Doubly symmetric shapes and shapes not subjected to torsional or torsional – Flexural buckling – Thin walled open Sections which may be subjected to Torsional-Flexural Buckling – Singly Symmetric Open Shapes – Unsymmetric Shapes – Light Gauge Steel Shear Diaphragms and shell Roof Structures – Light Gauge Steel Shear Diaphragms – Columns and Beams braced by Steel Diaphragms – Shell Roof Structures.

TOTAL: 45+15 = 60 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply the concepts on the behavior of Cold formed steel structure.
- Apply the concept of thin elements in the design of cold formed steel.
- Develop the cold formed steel flexural members as per codal provisions.
- Analyze the design of compression members as per codal provisions.
- Design the cold formed steel beam columns as per codal provisions.

TEXT BOOKS

1. Wie–Wen Yu, "Cold Formed Steel Structures", McGraw Hill Book Company, 3rd Edition, 2019.
2. Horne M.R. and Morris L.J., "Plastic Design of Low Rise Frames", Granada Publishing Ltd, 1st Edition, 2019.

REFERENCES

1. Salmon C.G. and Johnson J.E., "Steel Structures-Design and Behaviour", Harper and Row, 2nd Edition, 2019.
2. Dayaratnam P. "Design of Steel Structures", A.H. Wheeler, 4th Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106113/ (Design of Steel Structures II)
2. https://nptel.ac.in/courses/105/105/105105162/ (Design of Steel Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	1	1	-	1	-	1	1	3	2	1
2	3	3	3	3	2	1	1	-	1	-	2	2	3	3	1
3	3	3	3	3	2	2	2	-	1	-	2	2	3	3	2
4	3	3	3	3	2	2	2	-	1	-	2	2	3	2	2
5	3	3	3	3	2	2	2	-	1	-	1	1	3	3	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**1.8**	**1.6**	**1.6**	**-**	**1.0**	**-**	**1.6**	**1.6**	**3.0**	**2.6**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER III

PROFESSIONAL ELECTIVE–VI

23PSP311 **THEORY OF PLATES** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce various plate theories, governing equations for bending of plates and various boundary conditions.
- To know Navier's solution and Levy's solution to analyze rectangular plates.
- To study the bending of circular plates.
- To understand the concepts of finite difference method.
- To learn the engineering design approach to plates.

UNIT I INTRODUCTION TO PLATE THEORY **9**

Thin and thick plates – Small and large – Deflection theory of thin plate – Assumptions – Moment curvature relations – Stress resultants – Governing differential equation for bending of plates – Various boundary conditions.

UNIT II RECTANGULAR PLATES **9**

Classical solution for rectangular plates with different types of loads and boundary conditions – Navier's and Levy's solution methods – Continuous plates (introduction only).

UNIT III CIRCULAR PLATES **9**

Bending of circular plates with clamped and simply supported edges – Plate with central hole – Uniformly distributed and varying loads – Conical loads, Distributed couples – Ring loads – Semicircular plates – Asymmetrically loaded plates.

UNIT IV FINITE DIFFERENCE METHOD **9**

Finite Difference Methods – Improved finite difference Methods – Energy Methods – Variational Methods – Galerkin's Methods – Matrix displacement Methods – Lattice analogy – Finite Element Method (Introduction only) – Application to plates.

UNIT V ADVANCED TOPICS **9**

Large-Deflection Theory – Influence surface for plates – Skew plates – Orthotropic plate bending theory and bending of thick plates – Mindlin's Theory – Layered plates Engineering approach to design of plates and continuously supported floor slabs – Application of flat plate theory to design of flat slabs.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Apply various plate theories in design.
- Analyze rectangular plates using Navier's solution, Levy's solution.
- Evaluate the bending of circular plates for the given boundary conditions.
- Design the plates using finite difference method.
- Design the various types of orthotropic and thick plates under different loading conditions.

TEXT BOOKS

1. Reddy J N, "Theory and Analysis of Elastic Plates and Shells", McGraw Hill Book Company, 2nd Edition, 2016.
2. Szilard. R "Theory and Analysis of Plates-Classical and Numerical Methods", Wiley, 4th Edition, 2017.

REFERENCES

1. Ansel C. Ugural, " Plates and Shells Theory and Analysis ", CRC Press, 4th Edition, 2017.
2. Chandrashekhara K, Theory of Plates, University Press (India) Ltd., 3rd Edition, 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/112/103/112103251/ (Theory of Rectangular Plates)
2. https://nptel.ac.in/courses/105/103/105103209/ (Plates and Shells)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
2	2	2	2	2	2	2	2	-	-	-	2	2	3	2	2
3	3	2	2	2	2	2	2	-	-	-	2	2	3	2	2
4	2	2	2	2	2	2	2	-	-	-	2	2	3	2	2
5	3	2	2	2	1	1	1	-	-	-	1	1	3	2	1
AVG	**2.6**	**2.0**	**2.0**	**2.0**	**1.6**	**1.6**	**1.6**	**-**	**-**	**-**	**1.6**	**1.6**	**3.0**	**2.0**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP312 **SOIL STRUCTURE INTERACTION** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the idea about soil–foundation interaction.
- To understand the analysis of beams for finite length.
- To learn the analysis of finite plates by numerical method.
- To study the elastic analysis of pile.
- To study about retaining structures in soil structure interaction.

UNIT I INTRODUCTION **9**

Introduction to soil – Foundation interaction problems – soil behavior – Foundation behavior – Interface behavior – Scope of soil foundation interaction analysis – Soil response models – Winkler, Elastic continuum – Two parameter elastic models – Elastic plastic behaviour – Time dependent behaviour.

UNIT II BEAM ON ELASTIC FOUNDATION **9**

Infinite beam – Two parameters – Isotropic elastic half space – Analysis of beams of finite length – Classification of finite beams in relation to their stiffness.

UNIT III PLATES ON ELASTIC CHANNEL **9**

Thin and thick rafts – Analysis of finite plates – Numerical analysis of Pile – Analysis of finite plates.

UNIT IV ANLYSIS OF PILE **9**

Elastic analysis of single pile – Theoretical solutions for settlement and load distributions – Analysis of pile group – Interaction analysis – Load distribution in groups with rigid cap.

UNIT V SSI IN RETAINING STRUCTURES **9**

Curved failure surfaces, their utility and analytical / graphical predictions from Mohr-Coulomb envelope and circle of stress – Earth pressure computations by friction circle method – Earth pressure on wall with limited / restrained deformations – Earth pressure on sheet piles, braced excavations – Design of supporting system for excavations.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Illustrate the overview of soil – structure interactions.
- Analyze the behavior of the soil under elastic and plastic condition as beam element.
- Examine the behavior of the soil as plate element.
- Explain the behavior of the pile under static and dynamic loads.
- Develop the soil structure interaction involved in retaining structures.

TEXT BOOKS

1. Alexander Tyapin, "Soil-structure interaction in seismic analysis", Asv Publications, 1st Edition, 2019.
2. A.S. Cakmak, "Soil-Structure Interaction", Elsevier Science, 1st Edition, 2016.

REFERENCES

1. Chandrakant S. Desai, Musharraf Zaman. "Advanced Geotechnical Engineering – Soil–Structure Interaction using Computer and Material Models", CRC Press, 1st Edition, 2016.
2. Poulos, H.G., and Davis, E.H, "Pile Foundation Analysis and Design", John Wiley, 1st Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/105/105105200/ (Soil Structure Interaction)
2. https://nptel.ac.in/courses/105/106/105106052/ (Geo-synthetics and Reinforced Soil Structure)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	2	1	1	2	-	-	-	1	1	3	2	1
2	3	3	2	2	1	1	1	-	-	-	1	1	3	2	1
3	3	3	2	2	1	1	2	-	-	-	1	1	3	3	2
4	3	3	2	2	1	2	1	-	-	-	1	1	3	2	2
5	3	3	2	2	1	2	2	-	-	-	1	1	3	2	2
AVG	**3.0**	**3.0**	**2.0**	**2.0**	**1.0**	**1.4**	**1.6**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.2**	**1.6**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP313 **CORROSION ENGINEERING** **L T P C**
3 0 0 3

OBJECTIVES

- To learn electro chemical corrosion.
- To know the various types of testing in corrosion.
- To study about the prevention of corrosion.
- To understand the corrosion in selected environment.
- To gain knowledge in corrosion related issues in various industries.

UNIT I CORROSION **9**

General – Electrochemical corrosion of metals – Galvanic cells – Corrosion rates (kinetics) – Types of corrosion with properties and phenomenon – Oxidation metals.

UNIT II CORROSION TESTING **9**

Importance, classification – Materials and specimens – Surface preparation – Measuring and weighing – Exposure techniques – Duration, planned interval tests.

UNIT III CORROSION PREVENTION **9**

Material selection – Modification of metal – Alternate of environment – Design – Cathodic and anodic protection – Coatings (metallic, inorganic, non metallic and organic)

UNIT IV CORROSION IN SELECTED ENVIRONMENT **9**

Atmospheric Corrosion – Corrosion in Automobiles – Corrosion in Soils – Corrosion of Steel in Concrete – Corrosion in Water – Microbiologically Induced Corrosion – Corrosion in the Body.

UNIT V CORROSION IN INDUSTRIES **9**

Corrosion in the Petroleum Industry – Corrosion in the Aircraft Industry – Corrosion in the Microelectronics Industry.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the causes and mechanism of various types of corrosion.
- Examine the various tests for corrosion measurement.
- Apply suitable techniques for corrosion prevention.
- Identify the occurrence of corrosion under different environment.
- Investigate corrosion related issues in various industries.

TEXT BOOKS

1. Sadasivam, V. "Modern Engineering Chemistry – A Simplified Approach", Kamakya Publications, 1st Edition, 2017.
2. Jones D.A. "Principles and Prevention of Corrosion", Macmillan Publishing Co, 2nd Edition, 2020.

REFERENCES

1. Kuriakose, J.C. and Rajaram J. "Chemistry in Engineering and Technology", Vol. I and II, Tata McGraw–Hill Publications Co. Ltd, 2nd Edition, 2016.
2. Balasubramanian, M.R., Krishnamoorthy, S. and Murugesan, V., "Engineering Chemistry", Allied Publisher Limited, 2nd Edition, Chennai, 2016.

E–RESOURCES

1. https://nptel.ac.in/courses/113/104/113104082/(Corrosion Part–I)
2. https://nptel.ac.in/courses/113/104/113104089/(Corrosion Part–II)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	1	2	2	-	-	-	1	1	3	2	1
2	3	3	3	3	1	2	2	-	-	-	1	1	3	2	1
3	3	3	3	3	1	2	2	-	-	-	1	1	3	3	1
4	3	3	3	3	1	2	2	-	-	-	1	1	3	2	2
5	3	3	3	3	1	2	2	-	-	-	1	1	2	2	2
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**1.0**	**2.0**	**2.0**	**-**	**-**	**-**	**1.0**	**1.0**	**2.8**	**2.2**	**1.4**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP314 MAINTENANCE AND REHABILITATION OF STRUCTURES L T P C
3 0 0 3

OBJECTIVES

- To understand the causes of distress.
- To study the reasons of crack formations.
- To know the deterioration of concrete buildings.
- To learn the repair procedure for steel constructions.
- To understand the strengthening techniques for prevailing structures.

UNIT I DIAGNOSE OF DISTRESS **9**

General Consideration – Distresses monitoring – Causes of distresses – Quality assurance – Defects due to climate, chemicals, wear and erosion – Inspection – Structural appraisal – Economic appraisal.

UNIT II BUILDING CRACKS **9**

Building Cracks – Diagnosis, Causes and Remedial measures – Thermal and Shrinkage cracks – Unequal loading – Vegetation and trees – Chemical action – Foundation movements – Techniques for repair – NDT techniques, Grouting, Epoxy injection – Repair materials – Special concretes and mortar.

UNIT III REPAIR OF CONCRETE STRUCTURES **9**

Introduction – Causes of deterioration – Diagnosis of cracked structures – Methods of repair – Repairing, spalling and disintegration – Repairing of concrete floors and pavements.

UNIT IV REPAIR OF STEEL STRUCTURES **9**

Types and causes for deterioration – Preventive measures – Repair procedure – Brittle fracture – Lamellar tearing – Defects in welded joints – Mechanism of corrosion – Corrosion production methodologies – Design and fabrication errors – Distress during erection – Causes and remedies.

UNIT V STRENGTHENING OF EXISTING STRUCTURES **9**

General principles – Relieving loads – Strengthening super structures – Plating – Conversion to composite construction – Post stressing – Jacketing – Bonded overlays – Reinforcement addition – Strengthening substructures – Under pinning – Increasing load capacity of footing – Design for rehabilitation – Strength enhancement of steel structures.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the distress in civil engineering structures.
- Apply the theoretical concepts of crack repairing in the field.
- Identify suitable repair techniques for deterioration of concrete structures.
- Analyze the right techniques to eliminate distressing in steel arrangements.
- Apply strengthening concepts for existing structures.

TEXT BOOKS

1. Guha, P.K, "Maintenance and Repairs of Buildings", New Central Book Agency (P) Ltd, 1st Edition, 2016.
2. Modi, P.I., Patel, C.N., "Repair and Rehabilitation of Concrete Structures", PHI India, 1st Edition, 2016.

REFERENCES

1. Chudley R, "The Maintenance and Adaptation of Buildings", Longman Group Ltd, 2nd Edition, 2017.
2. Shetty, M.S, "Concrete Technology - Theory and Practice", S. Chand and Company Ltd, 8th Edition, 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106202/ (Maintenance and Repair of Concrete Structures)
2. https://www.digimat.in/nptel/courses/video/105106202/L31.html (Maintenance and Repair of Concrete Structures)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	2	**3**	1	1	1	-	-	1	1	1	3	1	1
2	3	3	2	2	1	1	1	-	-	1	1	1	3	2	1
3	3	3	2	3	1	1	1	-	-	1	1	1	3	2	1
4	3	3	2	2	1	1	1	-	-	1	1	1	3	1	1
5	3	3	1	3	1	1	1	-	-	1	1	1	3	1	1
AVG	**3.0**	**3.0**	**1.8**	**2.6**	**1.0**	**1.0**	**1.0**	**-**	**-**	**1.0**	**1.0**	**1.0**	**3.0**	**1.4**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PSP315 **SMART STRUCTURES** **L T P C**
3 0 0 3

OBJECTIVES

- To introduce the basic principles and mechanisms of smart materials and devices.
- To understand the parallel damped and gyroscopic vibration absorber.
- To learn the basic principles and mechanisms of measuring techniques.
- To know various control systems in structures.
- To study the applications of shape memory and smart bridges.

UNIT I PROPERTIES OF MATERIALS & ER AND MR FLUIDS **9**

Piezoelectric Materials and properties – Actuation of structural components – Shape Memory Alloys – Constitutive modeling of the shape memory effect, vibration control – Embedded actuators – Electro rheological and magneto rheological fluids – Mechanisms and Properties – Fiber Optics – Fibre characteristics – Fiber optic strain sensors.

UNIT II VIBRATION ABSORBERS **9**

Parallel damped vibration absorber – Gyroscopic vibration absorber – Active vibration absorber – Applications – Vibration Characteristics of mistuned systems – Analytical approach.

UNIT III MEASURING TECHNIQUES **9**

Strain measuring techniques using electrical strain gauges – Types – Resistance – Capacitance – Inductance – Wheatstone bridges – Pressure transducers – Load cells – Temperature Compensation – Strain Rosettes.

UNIT IV CONTROL OF STRUCTURES **9**

Control modeling of structures – Control strategies and limitations – Classification of control systems – Classical control, Modern control, optimal control and digital control – Active structures in practice.

UNIT V APPLICATIONS IN CIVIL ENGINEERING **9**

Application of shape memory – Alloys in bridges – Concept of smart bridges – Application of ER fluids – Application of MR dampers in different structures – Application of MR dampers in bridges and high rise structures – Structural health monitoring – Application of optical fibres – Concept of smart concrete.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe various smart materials and devices.
- Explain the analytical approach on vibration absorbers.
- Demonstrate strain measurement using smart materials.
- Develop control strategies for smart structures.
- Interpret the applications of smart structures.

TEXT BOOKS

1. Azfal Suleman, "Smart Structures Applications and Related Technologies", Springer, 1st Edition, 2018.
2. Srinivasan, A.V.,and Michael McFarland D, "Smart Structures - Analysis and Design", Cambridge University Press, 1st Edition, 2016.

REFERENCES

1. Brian Culshaw, "Smart Structures and Materials", Artech House, 3rd Edition, 2018.
2. Gandhi. M.V and Thompson. B.S., "Smart Materials and Structures", Chapman and Hall, 1st Edition, 2018.

E–RESOURCES

1. https://nptel.ac.in/courses/112/104/112104173/ (Smart Materials)
2. https://nptel.ac.in/courses/112/104/112104251/ (Smart Materials)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
2	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
3	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
4	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
5	3	2	2	2	2	1	2	-	-	-	1	1	3	2	2
AVG	**3.0**	**2.0**	**2.0**	**2.0**	**2.0**	**1.0**	**2.0**	**-**	**-**	**-**	**1.0**	**1.0**	**3.0**	**2.0**	**2.0**

1-Low 2-Medium 3-High '-' – No Correlation

SEMESTER II

OPEN ELECTIVE

23PGO201 **DISASTER MANAGEMENT** **L T P C**
3 0 0 3

OBJECTIVES

- To learn the basic conceptual understanding of disasters.
- To study different types of disasters.
- To learn about the disaster management techniques.
- To create awareness about disasters.
- To understand the concept of disaster risk assessment.

UNIT I INTRODUCTION **9**

Definition and types of disaster Hazards and Disasters – Risk and Vulnerability in Disasters – Natural and Man-made disasters – Earthquakes, floods drought, landside, land subsidence, cyclones, volcanoes, tsunami, avalanches, global climate extremes – Man-made disasters: Terrorism, gas and radiations leaks, toxic waste disposal, oil spills, forest fires.

UNIT II TYPES OF DISASTERS **9**

Study of important disasters Earthquakes and its types – Magnitude and intensity – Seismic zones of India – Major fault systems of India plate – Flood types and its management – Drought types and its management – Landside and its managements – Case studies of disasters in Sikkim (e.g) Earthquakes, Landside) – Social economics and environmental impact of disasters.

UNIT III DISASTER MANAGEMENT **9**

Mitigation and Management techniques of Disaster – Basic principles of disasters management – Disaster Management cycle – Disaster management policy – National and State Bodies for Disaster Management – Early Warming Systems – Building design and construction in highly seismic zones – Retrofitting of buildings.

UNIT IV DISASTER AWARENESS **9**

Training, awareness program and project on disaster management – Training and drills for disaster preparedness – Awareness generation program – Usages of GIS and Remote sensing techniques in disaster management.

UNIT V RISK ASSESSMENT **9**

Mini project on disaster risk assessment and preparedness for disasters with reference to disasters in Sikkim and its surrounding areas.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the basic conceptual understanding of disasters.
- Explain the different types of disasters.
- Analyze the disaster mitigation and management techniques.
- Discuss the importance of disaster awareness programs for disaster management.
- Analyze the risk behind the disasters.

TEXT BOOKS

1. Harsh K Gupta, Disaster Management, Universities Press Pvt. Limited, 9th edition, 2018.
2. Sulphey M.M., "Disaster Management", PHI Learning Private Limited, 4th Edition, 2017.
3. Damon P. Copola, "Introduction to International Disaster Management", Elsevier Inc, 1st Edition, 2016.

REFERENCES

1. Sharma S.C., "Disaster Management", Khanna Book Publishing Co. (P) Ltd., 5th Edition, 2018.
2. Gupta A.K., Nair S.S. and Chatterjee S. "Disaster Management and Risk Reduction: Role of Environmental Knowledge", Narosa Publishing House, 4th Edition, 2018.
3. Murthy D.B.N., "Disaster Management", Deep & Deep Publications, 3rd Edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/124/107/124107010/ (Disaster Management).
2. https://nptel.ac.in/courses/105/103/105103209/ (Plates and Shells)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	2	-	1	1	-	-	-	-	1	3	2	1
2	3	2	2	2	-	1	1	-	-	-	-	1	3	2	1
3	3	2	2	2	1	1	1	-	-	1	1	1	3	2	1
4	3	2	2	2	-	1	1	-	-	1	1	1	3	2	1
5	3	2	2	2	1	1	1	-	-	1	1	1	3	2	1
AVG	**3.0**	**2.0**	**2.0**	**2.0**	**1.0**	**1.0**	**1.0**	**-**	**-**	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PGO202 COST MANAGEMENT OF ENGINEERING PROJECTS L T P C
3 0 0 3

OBJECTIVES

- To understand the overview of cost management.
- To learn the different stages of project execution.
- To study the different analysis techniques adopted for project commissioning.
- To know the various pricing strategies followed in engineering projects.
- To study the different quantitative techniques used for cost management.

UNIT I INTRODUCTION **9**

Introduction and overview of the strategic cost management process – Cost concepts in decision making – Relevant cost, Differential cost, Incremental cost and Opportunity cost – Objectives of a Costing System – Inventory valuation – Creation of a database for operational control – Provision of data for decision making.

UNIT II PROJECT **9**

Meaning, different types, why to manage, cost overruns centres, various stages of project execution – Conception to commissioning – Project execution as conglomeration of technical and nontechnical activities – Detailed Engineering activities – Pre project execution main clearances and documents – Project team: Role of each member – Importance of project site – Data required with significance – Project contracts – Types and contents – Project execution – Project cost control – Bar charts and network diagram.

UNIT III PROJECT COMMISSIONING **9**

Mechanical and process – Cost Behavior and Profit Planning – Marginal Costing – Distinction between marginal costing and absorption costing – Break-even Analysis – Cost volume-Profit Analysis – Various decision-making problems – Standard Costing and Variance Analysis.

UNIT IV PRICING STRATEGIES **9**

Pareto Analysis – Target costing – Life cycle costing – Costing of service sector – Just-in-time approach – Material requirement planning – Enterprise resource planning – Total quality management and theory of constraints – Activity-based cost management – Bench marking – Balanced score card and value-chain analysis – Budgetary control – Flexible budgets – Performance budgets – Zero-based budgets – Measurement of divisional profitability pricing decisions including transfer pricing.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT **9**

Quantitative techniques for cost management – Linear programming – PERT/CPM – Transportation problems – Assignment problems – Simulation – Learning curve theory.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the basics of cost management process.
- Analyze the detailed engineering activities associated in project execution.
- Apply suiltable analysis techniques for project commissioning.
- Discuss the various pricing strategies followed in project implementation.
- Analyze the different quantitative techniques used for cost management.

TEXT BOOKS

1. Charles T. Horngren, Srikant M. Datar and Madhav V. Rajan, "Cost Accounting A Managerial Emphasis", Pearson Education, 14th Edition, 2023.
2. Charles T. Horngren and George Foster, "Advanced Management Accounting", Pearson Education, 13th Edition, 2018.
3. Qiu Guo Lin, Cost management of engineering project, China Electric Power Press, 7th edition, 2017.

REFERENCES

1. Robert S Kaplan, Anthony A. Alkinson, "Management Accounting", Pearson Education, 4th Edition, 2022.
2. Ashish K. Bhattacharya, "Principles & Practices of Cost Accounting", PHI Learning Private Limited, 6th Edition, 2020.
3. Kenneth K Humpheys, Project and cost engineers' handbook (cost management), CRC Press, 4th edition, 2017.

E–RESOURCES

1. https://nptel.ac.in/courses/105/106/105106149/ (Types of Projects)
2. https://nptel.ac.in/courses/110/104/110104073/ (Cost Management for Projects)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	-	1	1	-	-	1	-	1	2	2	1
2	3	3	3	3	-	1	1	1	-	1	3	1	2	2	1
3	3	3	3	3	2	1	1	1	-	1	3	1	2	2	1
4	3	3	3	3	2	1	1	1	1	1	3	1	2	2	1
5	3	3	3	3	2	1	1	1	1	1	3	1	2	2	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**3.0**	**1.0**	**2.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PGO203 **CONSTITUTION OF INDIA** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the basics of constitution law and constitutionalism.
- To learn the fundamental rights and duties.
- To know the constitution powers of union and state executives.
- To study the constitutional powers and procedures.
- To learn the powers and functions of public service commissions.

UNIT I INTRODUCTION **9**

Meaning of the constitution law and constitutionalism – Historical perspective of the constitution of India – Preamble – Salient features and characteristics of the constitution of India – Citizenship.

UNIT II FUNDAMENTAL RIGHTS **9**

Scheme of the fundamental rights – The scheme of the fundamental duties and its legal status – The directive principles of state policy – Its importance and implementation.

UNIT III UNION AND STATE EXECUTIVE **9**

Federal structure and distribution of legislative and financial powers between the union and the states – Parliamentary form of Government in India – The constitution powers and status of the President of India – Governor – Appointment, powers and functions.

UNIT IV CONSTITUTIONAL POWERS **9**

Amendment of the constitutional powers and procedure – The historical perspectives of the constitutional amendments in India – Emergency Provisions – National emergency – President Rule – Financial Emergency.

UNIT V OTHER CONSTITUIONAL FUNCTIONARIES **9**

Election commission of India – Organization – Powers and functions – Union public service commission – State public service commission – Local self government.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Describe the features and characteristics of the constitution of India.
- Explain the importance of fundamental rights and duties.
- Analyze the constitution power of union and state executives.
- Discuss the amendment of constitutional powers and procedure.
- Examine the powers and functions of union and state public service commission.

TEXT BOOKS

1. Durga Das Basu, "Introduction to the Constitution of India", Lexis Nexis Publishers, 24th Edition, 2019.
2. Subhash C. Kashyap," Our Constitution", National Book Trust, 5th Edition, 2021.
3. P M Bakshi, The constitution of India, Universal Law Publishing, 14th edition, 2017.

REFERENCES

1. M.Laxmikanth, "Indian Polity", McGraw Hill Publications, 7th Edition, 2023.
2. Granville Austin, "The Indian Constitution: Cornerstone of a Nation", OUP India, 8th Edition, 2017.
3. V N Shukla, Constitution of India, Eastern Book Company, 4th Edition, 2019.

E–RESOURCES

1. https://nptel.ac.in/courses/129/106/129106002/(Constitution of India)
2. https://nptel.ac.in/courses/129/106/129106003/(Constitutional Studies)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	2	2	1	-	1	-	1	1	1	-	1	2	1	1
2	3	2	2	1	-	1	-	1	1	1	-	1	2	1	1
3	3	2	2	1	-	1	-	1	1	1	-	1	2	1	1
4	3	2	2	1	-	1	-	1	1	1	-	1	2	1	1
5	3	2	2	1	-	1	-	1	1	1	-	1	2	1	1
AVG	**3.0**	**2.0**	**2.0**	**1.0**	**-**	**1.0**	**-**	**1.0**	**1.0**	**1.0**	**-**	**1.0**	**2.0**	**1.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PGO204 **BUSINESS ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES

- To learn the overview of business analysis.
- To know the importance of project life cycle and product life cycles.
- To understand the different types of requirements in business analytics.
- To study the various analysis techniques for transforming requirements.
- To learn about finalizing requirements.

UNIT I BUSINESS ANALYSIS **9**

Overview of business analysis – Overview of requirements – Role of the business analyst – Stakeholders: the project team, management, and the front line – Handling stakeholder conflicts.

UNIT II LIFE CYCLES **9**

Systems development life cycles – Project life cycles – Product life cycles – Requirement life cycles.

UNIT III FORMING REQUIREMENTS **9**

Overview of requirements – Attributes of good requirements – Types of requirements – Requirement sources – Gathering requirements from stakeholders – Common requirements documents.

UNIT IV TRANSFORMING REQUIREMENTS **9**

Stakeholder Needs Analysis – Decomposition Analysis – Additive/Subtractive Analysis – Gap Analysis – Notations (UML & BPMN) – Flowcharts – Swim Lane Flowcharts – Entity-Relationship Diagrams – State-Transition Diagrams – Data Flow Diagrams – Use Case Modeling – Business Process Modeling.

UNIT V FINALIZING REQUIREMENTS **9**

Presenting requirements – Socializing requirements and gaining acceptance – Prioritizing requirements – Managing requirements Assets – Change control – Requirement tools – Recent trends in embedded and collaborative business intelligence – Visual data recovery – Data storytelling and data journalism.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the role of business analyst in business proposals.
- Examine the necessity of product life cycle and requirement life cycle.
- Describe the overview of forming requirements.
- Analyze various transforming requirements used in business analytics.
- Apply requirement tools for finalizing requirements.

TEXT BOOKS

1. Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "Business analytics Principles, Concepts, and Applications", Pearson FT Press, 3rd Edition, 2019.
2. James R Evans, "Business Analytics", Pearson FT Press, 3rd Edition, 2020.
3. Wayne L. Winston, "Business Analytics: Data analysis & decision making", South Western College Publishing, 6th Edition, 2017.

REFERENCES

1. Swain Scheps , "Business Intelligence for Dummies", Dummies Publishers, 4th Edition, 2018.
2. Ger Koole, "An Introduction to Business Analytics", MG Books, 1st Edition, 2019.
3. Walter R. Paczkowski, "Business Analytics: Data Science for Business Problems", Springer International Publishing, 1st Edition, 2022.

E–RESOURCES

1. https://nptel.ac.in/courses/110/107/110107092/ (Business analytics and data mining modeling)
2. https://nptel.ac.in/courses/110/105/110105089/ (Business analytics for management decision)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	-	-	-	1	2	1	3	2	1
2	3	3	3	3	2	1	-	1	1	1	2	1	3	2	1
3	3	3	3	3	2	1	-	1	1	1	2	1	3	2	1
4	3	3	3	3	2	1	-	1	1	1	2	1	3	2	1
5	3	3	3	3	2	1	-	1	1	1	2	1	3	2	1
AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**	**-**	**1.0**	**1.0**	**1.0**	**2.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

23PGO205 **DIGITAL MARKETING** **L T P C**
3 0 0 3

OBJECTIVES

- To understand the origin of digital marketing.
- To learn the different types of social media marketing.
- To know the techniques adopted for search engine optimization.
- To study the importance of facebook marketing and mobile marketing in business.
- To learn the tools and methods of web analytics.

UNIT I INTRODUCTION & ORIGIN OF DIGITAL MARKETING **9**

Traditional v/s digital marketing – Digital marketing strategy – The P-O-E-M framework – Segmenting & customizing messages – The digital landscape – Digital advertising market in India – Skills required in digital marketing – Digital marketing plan.

UNIT II SOCIAL MEDIA MARKETING **9**

Meaning, purpose, types of social media websites – Blogging: types of blogs – Blogging platforms & recommendations – Social media engagement – Target audience – Sharing content on social media – Do's and don'ts of social media.

UNIT III SEARCH ENGINE OPTIMIZATION **9**

Meaning – Common SEO techniques – Understanding search engines – Basics of keyword search – Google rankings – Link building – Steps to optimize website – Basics of Email marketing: Types of Emails – Mailing list – Email marketing tools – Email deliverability & Email marketing automation.

UNIT IV FACEBOOK MARKETING **9**

Introduction – Facebook for business – Anatomy of an Ad campaign – Role of adverts – Types & targeting – Adverts budget & scheduling – Adverts objective & delivery – LinkedIn marketing-introduction & importance – LinkedIn strategies – Sales leads generation using LinkedIn – Content strategies – Mobile marketing – Introduction – Mobile usage – Mobile advertising – Mobile marketing tool kit – Mobile marketing features.

UNIT V UNDERSTANDING WEB ANALYTICS **9**

Purpose, history, goals & objectives – Web analytic tools & methods – Web analytics mistakes and pitfalls – Basics of content marketing: Introduction – Content marketing statistics – Types of content – Types of blog posts – Content creation – Content optimization – Content management & distribution – Content marketing strategy – Content creation tools and apps – Challenges of content marketing.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of the course, Students will be able to:

- Explain the strategy of digital marketing.
- Describe the purpose of social media marketing.
- Apply the suitable technique for search engine optimization.
- Examine the importance of facebook marketing and linkedin marketing in business.
- Analyze the mistakes and pitfalls of web analytics.

TEXT BOOKS

1. Rajendra Nargundkar and Romi Sainy "Digital Marketing: Cases from India", Notion Press, 1st Edition, 2018.
2. Damian Ryan, "Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation", Kogen Page Publishers, 3rd Edition, 2018.
3. Simon Kingsnorth, "Digital Marketing Strategy: An integrated approach to online marketing", Kogen Page Publishers, 2nd Edition, 2017.

REFERENCES

1. Hermawan Kartajaya, Philip Kotler and Iwan Setiawan , "Marketing 4.0 : Moving from Traditional to Digital", Wiley Publishers, 1st Edition, 2018.
2. Seema Gupta, "Digital Marketing", McGraw Hill Publications, 3rd Edition, 2022.
3. Prabir Rai Chaudhuri, "What is digital marketing: A comprehensive guide", WMG Publishing, 1st Edition, 2022.

E–RESOURCES

1. https://onlinecourses.swayam2.ac.in/cec19_mg23/preview (Basics of Digital Marketing)
2. https://onlinecourses.swayam2.ac.in/ugc19_hs26/preview (Digital Marketing)

Mapping of Cos-Pos & PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
1	3	3	3	3	2	1	-	1	1	1	1	1	3	2	1
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AVG	**3.0**	**3.0**	**3.0**	**3.0**	**2.0**	**1.0**	**-**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**3.0**	**2.0**	**1.0**

1-Low 2-Medium 3-High '-' – No Correlation

SCHEME

Credit Summary

CURRICULUM AND SYLLABI

FOR M.E. DEGREE PROGRAMMES

(For the Students Admitted in the Academic Year 2023 – 2024 onwards)

CREDIT SUMMARY

M.E. STRUCTURAL ENGINEERING

Category	Semester				Credit Total
	I	II	III	IV	
FC	7	-	-	-	7
PC	11	10	-	-	21
PE	3	6	11	-	20
OE	-	3	-	-	3
EEC	-	1	6	12	19
Total	21	20	17	12	70