Curriculum Structure for M. Tech. Programmes
M. Tech. (Structural Engineering)

(In light of NEP2020)

NCrF Level 7

For students admitted in 2023-24 onwards

Govt. College of Engineering, Amravati

(*An Autonomous Institute of Govt. of Maharashtra*)

Near Kathora Naka, Amravati, Maharashtra

PIN 444604

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Member Secretary | BoS Chairperson | Dean (Academics) | Principal

Govt. College of Engineering, Amravati

(An Autonomous Institute of Govt. of Maharashtra)

Curriculum Structure for M. Tech. Structural Engineering (In light of NEP 2020)

Category wise credit distribution:

Semester	PC	PE	OE	RM	OJT / FP	ISS	RP / DI	Total
I	15	03	---	---	---	02	---	20
II	12	03	---	02	---	02	---	19
III	---	03	03	---	04	---	13	23
IV	---	---	---	---	---	---	18	18
Total	**27**	**09**	**03**	**02**	**04**	**04**	**31**	**80**

SN	Abbreviation	Meaning	Credits	Percentage
01	PC	Programme Core	27	33.75
02	PE	Programme Elective	09	11.25
03	OE	Open Elective	03	03.75
04	RM	Research Methodology	02	02.50
05	OJT	On-Job Training/ Internship	04	05.00
06	FP	Field Projects		
07	ISS	Independent Study & Seminar	04	05.00
08	RP	Research Project	31	38.75
09	DI	Dissertation		
		Total	80	100.00

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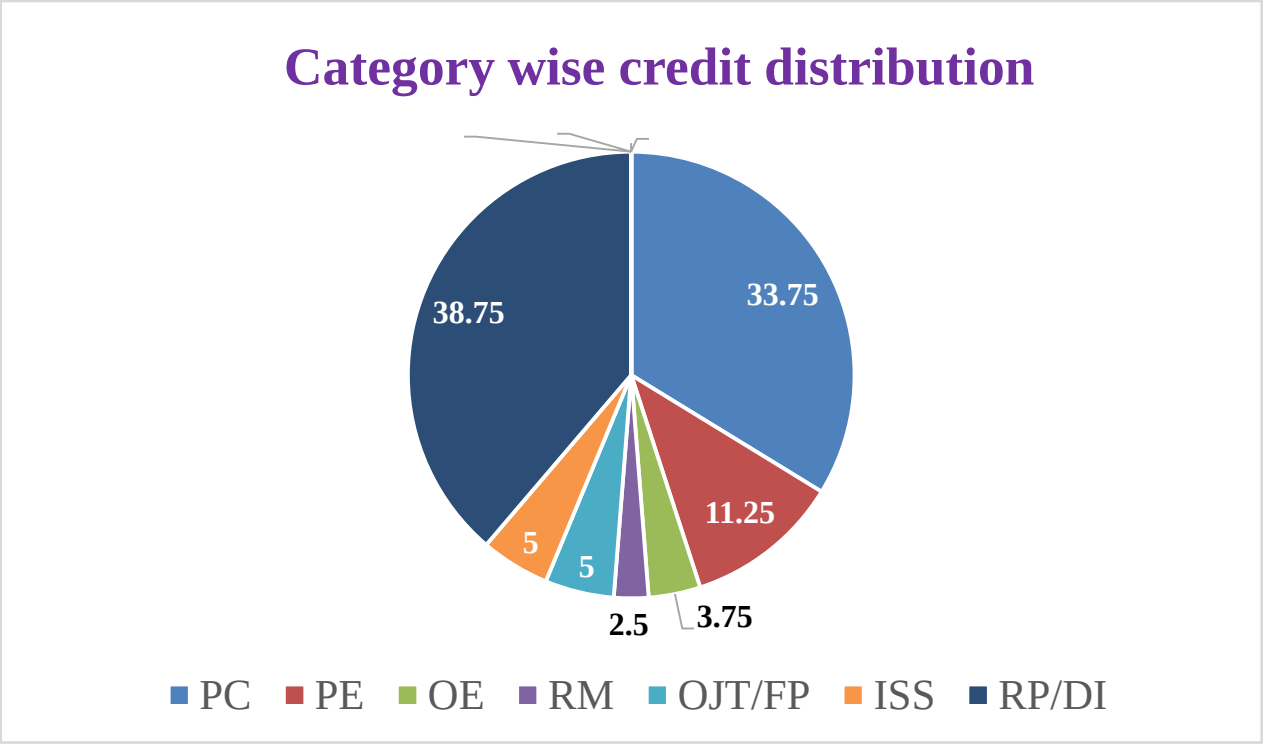
Category wise credit distribution
33.75
11.25
3.75
2.5
5
5
38.75
PC
PE
OE
RM
OJT/FP
ISS
RP/DI

General Instructions:

1) 10% content of syllabus of each theory course of first, second and third semesters shall be completed by the students with self-study. The 10% portion of each course (for self-study) shall be declared by the concerned course-coordinator at the beginning of teaching of the course.

2) Student can complete any two theory courses of second semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of second semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

3) Student can complete the two theory courses of third semester, if desired, in "online" mode, offered through SWAYAM/ NPTEL. In this case –

i) Students can register and complete these online courses any time after beginning of first semester, however, the student must successfully complete and pass the course, and submit the score card/ certificate before declaration of result of third semester.

ii) In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

4) Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject. The assessment of the same shall be done in third semester. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB

5) Students going for industrial project or going for dissertation at some other institute (approved by DFB), during third and fourth semester, shall complete the courses Programme Elective – III and Open Elective in any one of the two modes –

i) Online courses offered through SWAYAM/ NPTEL: In this case the student must complete the course and submit the score card/ certificate before commencement of fourth semester. Students can register and complete these courses any time after beginning of first semester

In case if a student registers for a course in online mode but fails in the course the student will have to register for the course in the institute whenever it is offered. In this case, the student will have to attend the classes of the course (in order to satisfy the minimum attendance criteria), appear for all the examinations (MSE, TA, ICA, ESE etc) of the course, and successfully complete the course with at least D grade.

ii) Self-study mode: In this case the student will have to study the course of his/her own. The student shall appear for all the college assessments/ examinations (MSE, TA and ESE) personally as per the schedule declared by the institute.

6) Maximum period for completion of M. Tech. programme:

The maximum duration for completion of the PG full time programme is eight semesters from the date of initial registration. The maximum duration of the programme includes the period of withdrawal, absence and different kinds of leaves permissible to a student but it shall exclude the period of rustication of the student from the institute and it shall also exclude the period lapsed between exit after first year (second semester) and reentry at second year (third semester). However, genuine cases on confirmation of valid reasons may be referred to Academic Council for extending this limit by additional one year.

M. Tech. (Structural Engineering) Semester I

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	CE2101	Advanced Structural Analysis	03	1	--	04	30	10	60	---	---	100	04
PC	CE2102	Structural Dynamics	04	--	--	04	30	10	60	---	---	100	04
PC	CE2103	Earthquake Resistant Structures	04	--	--	04	30	10	60	---	---	100	04
PE	CE2104	Programme Elective – I	03	--	--	03	30	10	60	---	---	100	03
PC	CE2105	Laboratory Practice – I	--	--	06	06	--	--	--	50	50	100	03
ISS	CE2106	Seminar – I	--	--	01	01	--	--	--	50	---	50	02
		Total	15	--	07	22	120	40	240	100	50	550	20

LIST OF PROGRAMME ELECTIVE-I (CE2104)

CE2104: Program Elective - I	
A	Computer Methods for Structural Analysis
B	Theory of Plates and Shell
C	Design of Pre-stressed Concrete Structures
D	Design of Masonry Structures

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – I shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar I are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar I.

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M. Tech. (Structural Engineering) Semester II

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PC	CE2201	FEM in Structural Engineering	03	--	--	03	30	10	60	--	--	100	03
PC	CE2202	Adv. Design of Steel Structures	03	--	--	03	30	10	60	--	--	100	03
PC	CE2203	Adv, Design of RCC Structures	03	--	--	03	30	10	60	--	--	100	03
PE	CE2204	Programme Elective – II	03	--	--	03	30	10	60	--	--	100	03
RM	SH2201	Research Methodology	02	--	--	02	30	20	--	--	--	50	02
PC	CE2206	Laboratory Practice – II	--	--	06	06	--	--	--	50	50	100	03
ISS	CE2207	Seminar – II	--	--	01	01	--	--	--	50	--	50	02
OJT/FP	CE2302	On-job training/ Internship/Field work	--	--	--	--	--	--	--	50	--	50	04
		Total	14	--	07	21	150	60	240	150	50	650	23

List of Programme Electives II (CE2204)

CE2204: Program Elective - II	
A	Structural Health Monitoring
B	Advanced Concrete Technology
C	Design High-rise Structures
D	Design of Plates and Shell

Note:

i) The contact hours for the students (with concerned supervisor) for Seminar – II, shall be one hour per week per student, subject to maximum of four hours per week.

ii) The hours shown in the teaching scheme for Seminar II are the contact hours for the students with concerned supervisor. Each student is expected to devote at least four hours per week for Seminar II.

iii) Individual students are required to choose a topic of their interest for Seminar II. They shall acquire state-of-the art knowledge in that area and shall define the grey area related to topic (gap analysis) so as to carry dissertation in that area. The students are required to review literature on the topic and deliver seminar.

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Exit option:

- The exit option at the end of one year of the Master's degree program willcommence from AY 2024-25.
- Students who have joined a two-year Master's degree program may opt for exit at the end of the first year and he/ she shall be eligible for M. Voc. Degree (Level 6.5)
- The M. Voc. Degree may be awarded to a student provided they have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- Even if, a student exits after third semester, the M. Voc. Degree may be awarded to him/ her provided he/ she have earned all 43 credits of first year (first and second semester) including 04 credits of On-job training / Internship/ Field work. The On-job training / Internship/ Field work shall be completed during summer break, after completion of the second semester of the first year in the respective Major Subject.
- The student must submit the report of On-job training / Internship/ Field work, in the format prescribed by the institute, as partial fulfilment of award of M. Voc. degree.
- Re-entry to complete the PG degree, after taking the exit option, will be permissible up to 05 years from the date of admission to the PG programme. Such students, shall have to surrender the M. Voc. Degree, at the time of re-entry. There shall be a gap of at least six months between exit after first year and re-entry to PG degree at third semester

M. Tech. (Structural Engineering) Semester III

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
PE	CE2301	Programme Elective – III	03	--	--	03	30	10	60	--	--	100	03
OE	SH2301	Open Elective	03	--	--	03	30	10	60	--	--	100	03
RP/DI	CE2303	Dissertation Stage – I	--	--	04	04	--	--	--	150	--	150	13
		Total	06	--	04	10	60	20	120	200	--	400	23

Note: The hours shown in the teaching scheme for Dissertation Stage I are the contact hours for the students with concerned supervisor. The student is expected to devote at least twenty-six hours per week for Dissertation Stage I.

List of Programme Electives and Open Electives

CE2301: Program Elective III		**SH2301: Open Elective**	
A	Artificial Intelligence & Machine Learning	A	Industrial Safety
B	Adv. Theory of Elasticity and Plasticity	B	Operation Research
C	Analysis and Design of Form Work	C	Project Management
D	Design of Bridge Structure	D	Data Structure and Algorithms
E	Adv. Design of Foundations	E	Nano-Technology

M. Tech. (Structural Engineering) Semester IV

Category	Course Code	Name of the course	Teaching Scheme				Examination Scheme						Credits
							Theory			Practical		Total	
			Theory	Tut	Pract	Total	MSE	TA	ESE	ICA	ESE		
RP/DI	CE2401	Dissertation Stage – II	--	--	04	04	--	--	--	100	200	300	18
		Total	--	--	04	04	--	--	--	100	200	300	18

Note:

i) Dissertation Stage – I is pre-requisite for Dissertation Stage – II

ii) The hours shown in the teaching scheme for Dissertation Stage II are the contact hours for the students with concerned supervisor. The student is expected to devote at least thirty-six hours per week for Dissertation Stage II.

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Comparison of existing and new programme structure:

i) On the basis of Marks and Credit:

Semester	Marks		Credits	
	Existing	**New**	**Existing**	**New**
I	610	550	17	20
II	600	600	19	19
III	300	400	16	23
IV	400	300	16	18
Total	**1910**	**1850**	**68**	**80**

ii) On the basis of semester wise number of courses:

	Number of courses									
	Semester I		Semester II		Semester III		Semester IV		Total	
	Existing	New	Existing	New	Existing	New	Existing	New	Existing	New
Theory	05	04	05	05	02	02	---	---	12	11
Practical	01	01	01	01	---	---	---	---	02	02
Seminar	01	01	01	01	---	---	---	---	02	02
Internship	---	---	---	---	---	01	---	---	---	01
Dissertation	---	---	---	---	01	01	01	01	02	02

iii) On the basis of course category:

Course category	Number of courses		Credits	
	Existing	**New**	**Existing**	**New**
PC	08	08	24	27
PE	03	03	09	09
OE	02	01	03	03
RM	01	01	02	02
OJT / FP	---	01	---	04
ISS	02	02	04	04
RP / DI	02	02	26	31
Total	**18**	**18**	**68**	**80**

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Equivalence Scheme

M. Tech (Structural Engineering) as per new NEP

Course in old Scheme				Equivalence course in new scheme (NEP)		
Sr. No.	Course code with Name of course(old)		Credit	Course code with Name of course (new)		Credit
1.	CEP131	Advanced Structural Analysis	3	CE2101	Advanced Structural Analysis	4
2.	CEP132	Advanced Solid Mechanics	3	CE2301 (A)	Programme Elective – III Advanced Theory of Elasticity and Plasticity	3
3.	SHP111	Numerical Methods For Structural Engineering	3	----	No Equivalence	---
4.	CEP134 (A)	Program Elective I Theory and Applications of Cement Composites	3	----	No Equivalence	---
5.	CEP134 (B)	Program Elective I Theory of Structural Stability	3	----	No Equivalence	---
6.	CEP134 (C)	Program Elective I Computer Methods for Structural Analysis	3	CE2104 (A)	Program Elective I- Computer Methods of Structural Analysis	3
7.	CEP134 (D)	Program Elective I Structural Health Monitoring	3	CE2204 (A)	Programme Elective – II Structural Health Monitoring	03
8.	CEP134 (E)	Program Elective I Structural Optimization	3	----	No Equivalence	---
9.	CEP134 (F)	Program Elective I Theory of Plates & Shells	3	CE2104 (B)	Program Elective I - Theory of Plates & Shells	3
10.	CEP135	Lab Practice-I	3	----	No Equivalence	---
12	CEP136	Seminar I	2	CE2106	Seminar – I	2
13	CEP231	FEM in Structural Engineering	3	CE2201	FEM in Structural Engineering	3
14	CEP232	Structural Dynamics	3	CE2102	Structural Dynamics	4
15	CEP233	Earthquake Resistant Structures	3	CE2103	Earthquake Resistant Structures	4
16	CEP234	Program elective II	3	----	No Equivalence	---

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	(A)	Advanced Steel Design				
17	CEP234 (B)	Program elective II Design of Formwork	3	CE2301 (B)	Programme Elective – III Analysis and Design of Form Work	3
18	CEP234 (C)	Program elective II Design of High Rise Structures	3	CE2204 (C)	Programme Elective – II Design of High Rise Structures	03
19	CEP234 (D)	Program elective II Design of Masonry Structures	3	CE2104 (D)	Programme Elective – I Design of Masonry Structures	03
20	CEP234 (E)	Program elective II Design of Advanced Structures	3	----	No Equivalence	---
21	CEP234 (F)	Program elective II Advanced Design of Foundations	3	CE2301 (D)	Programme Elective – III Adv. Design of Foundations	3
22	CEP234 (G)	Program elective II Soil Structure Interaction	3	----	No Equivalence	---
23	CEP234 (H)	Program elective II Design of Industrial Structure	3	----	No Equivalence	---
24	SHP221	Research Methodology	2	SH2201	Research Methodology	02
25	CEP235	Lab Practice-II	3	----	No Equivalence	---
26	CEP236	Seminar II	2	CE2207	Seminar – II	2
27	CEP331 (A)	Program Elective III Design of Prestreesed Concrete structures	3	CE2104 (C)	Programme Elective – I Design of Prestressed Concrete Structures	03
28	CEP331 (B)	Program Elective III Analysis of Laminated Composite Plates	3	----	No Equivalence	---
29	CEP331 (C)	Program Elective III Fracture Mechanics of Concrete Structures	3	----	No Equivalence	---
30	CEP331 (D)	Program Elective III Design of Plates and Shells	3	CE2204 (D)	Programme Elective – II Design of Plates & Shells	03
31	CEP332	Dissertation Stage I	10	CE2303	Dissertation Stage – I	13
32	CEP432	Dissertation Stage II	10	CE2401	Dissertation Stage – II	18
33	----	No Equivalence	---	CE 2105	Laboratory Practice-I	3
34	----	No Equivalence	---	CE2202	Adv. Design of Steel	3

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					Structures	
35	----	No Equivalence	---	CE2203	Adv. Design of RC Structures	3
36	----	No Equivalence	---	CE 2204 (B)	Adv. Concrete Technology	3
37	----	No Equivalence	---	CE 2206	Laboratory Practice-II	3
38	----	No Equivalence	---	CE2301 (C)	Design of Bridge Structures	3
39	SHP321	**Open Elective** (B). Industrial Safety (C) Operations Research (H) Project Management (I) Data Structure & Algorithms	3	SH2301	**Open Elective** (A) Industrial Safety A) Operation Research B) Project Management C) Data Structure & Algorithms	3
40	SHP321	**Open Elective** (A) Business Analytics (D) Cost Management of Engineering Projects (E) Composite Materials (F) Waste to Energy (G) Finance Management	3	----	No Equivalence	---
41	----	No Equivalence	---	CE 2302	On Job training/Internship/Field Work	
42	SHP 121	Audit courses	--	----	No Equivalence	---

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Course Code	CE2101							Course category			PC
Course Name	ADVANCED STRUCTURAL ANALYSIS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	01	-	04	30	10	60	2 hrs 30 min	-	-	100	04

Course Objectives

To make the students aware and understand:

1. Various advanced methods to solve structural analysis problems
2. Necessity and analysis of frames using approximate methods
3. Analysis of beams curved in plan and subjected to unsymmetrical bending

Course Contents

Approximate methods of analysis

(a) Portal Method, b) Cantilever Method, c) Factored Method

Kani's Method (Rotation Contribution Method)

Analysis of single storey frames (Non-Sway and Sway), Analysis of symmetric non sway multistory frames

Influence Line Diagram for Indeterminate Beams

Application of Muller's Breslau's Principle for ILD of continuous two span beam resting on simple supports, ILD for reactions, shear force and bending moment at any section/supports.

Beams curved in plan

Analysis of beams curved in plan with different support conditions, Shear Force Diagram, Bending Moment Diagram and Twisting Moment Diagram

Rayleigh-Ritz approach

Energy and complementary energy, total potential energy of structures, minimum potential energy theorem, Rayleigh's method, Rayleigh-Ritz method, Application to beams using power series and trigonometric series

Theory of elasticity

State of stress at point, stress equilibrium equations, strain components, stress-strain relation, generalized Hooke's law, plane stress and plane strain conditions, stress and strain compatibility for 2 D Treatment in

Cartesian Coordinates, Introduction to Polar Coordinates stress distribution symmetrical about axis, Strain components in polar coordinates

Reference Books and Websites

1. Basic Structural Analysis, Reddy C. S., 2nd edition, Tata McGraw Hill, New Delhi, 2004.
2. Energy Principles of Structural Mechanics, T. R. Taucher, 2nd edition., McGraw- Hill, 1974
3. Intermediate Structural Analysis, Wang, C. K., International Edition, McGraw Hill Inc, 1983
4. Elementary Structural Analysis, Utku, Norris and Wilbur, 4th edition, McGraw Hill Inc, 1991
5. Structural Analysis, R. C. Hibbler, 4th edition, Prentice Hall of India Pvt., Ltd. Publications,1999
6.Theory of Elasticity, Timoshenko and Goodier, 3rd edition, McGraw-Hill International Book Company, 1995
7. Applied Elasticity, Chi Teh Wang, McGraw-Hill Book Company, 1953
8. Elasticity in Engineering, Ernest E Sechler, Dover Publications, 1952
9. http://www.nptelvideos.com/discipline.php?name=civil-engineering
10. https://www.youtube.com/channel/UCmE0iFn9Hk8sxMBsOz4EnyQ

Course Outcomes

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

CE2101.1 Analyze frames using approximate methods and Kani's method

CE2101.2 Analyze beams curved in plan with different support conditions

CE2101.3 Draw ILD of indeterminate beams for various functions

CE2101.4 Apply Energy Theorems and Rayleigh-Ritz Method for structural analysis

CE2101.5 Solve 2-D state of Stress and strain problems in Elasticity

CO – PO -Mapping

CO	PO1	PO2	PO3	PO4	PO5
CE2101.1	2	3	-	-	-
CE2101.2	2	3	-	-	--
CE2101.3	2	3	-	-	--
CE2101.4	2	3	-	-	-
CE2101.5	2	3	-	-	-

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

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Course Code	CE2102							Course category			PC
Course Name	STRUCTURAL DYNAMICS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	---	---	04	30	10	60	2 hrs 30 min	---	---	100	04

Course Objectives:

To make the students aware and understand:

1. Single Degree of Freedom (SDoF) System, Multi Degree of Freedom (MDoF) System and associated terms.
2. Analysis of Damped and Un-damped Single Degree of Freedom system using numerical and classical methods.
3. Behavior of Damped and Un-damped Multi Degree Freedom System and derive its response in frequency and time domain.
4. Response of continuum system

COURSE CONTENTS:

Single degree freedom system:

Free vibrations, damped free vibrations, critical damping, and response, periodic loading expressed in harmonics, dynamic load factor

Single degree freedom system:

Response to impulsive loading, rectangular, triangular pulses, Duhamel Integral, Response to general dynamic loading, Numerical schemes such as Wilson-Theta, Newmark-Beta, constant linear acceleration, time domain and frequency domain analysis

Multi-degree freedom system:

Stiffness and flexibility approaches, Lumped-mass matrix, free vibrations fundamental Frequencies and mode shapes, orthogonality of modes, numerical schemes to find mode shapes and frequencies

Multi degree freedom systems:

Response to dynamic loading, Formulations of equations of motion, normal coordinates mode superposition method, modal matrix, numerical scheme of Wilson and Newmark

Distributed systems:

Free vibrations of uniform beams, differential equation and Solution, boundary conditions, finite difference solution, finite element, Ritz approach, free vibrations of simply supported plate (Transverse vibrations)

Reference Books:

1. Dynamics of Structures, Clough R. W. and Penzien J., Mc Graw Hill.
2. Structural Dynamics and Introduction to Earthquake Engineering, Chopra A. K.
3. Vibration of Structures - Application in Civil Engineering Design, Smith J. W., Chapman and Hall.
4. Dynamics of Structures, Humar J. L., Prentice Hall.
5. Structural Dynamics - Theory and Computation, Paz Mario, CBS Publication.
6. Dynamics of Structures, Hart and Wong.

Course Outcomes:

On successful completion of this course students will be able to:

CEP2102.1: Understand basics of Single Degree of Freedom (SDoF) System, Multi Degree of Freedom (MDoF) System and associated terms.

CEP2102.2: Analysis the response of Damped and Un-damped Single Degree of Freedom system using numerical and classical methods.

CEP2102.3: Analysis of behavior of Damped and Un-damped Multi Degree Freedom System and derive its response in frequency and time domain.

CEP2102.4: Analysis of response of continuum system

CEP2102.5: Solve the problems of distributed systems

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CEP2102.1	2	3	-	-	-
CEP2102.2	2	3	-	-	--
CEP2102.3	2	3	-	-	--
CEP2102.4	2	3	-	-	-
CEP2102.5	2	3	-	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2103							Course category -			PC
Course Name	EARTHQUAKE RESISTANT STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
04	--	---	04	30	10	60	2 hrs 30 min	--	---	100	04

Course Objectives:

To make the students aware and understand

1. Seismology and seismic codes for analysis & design
2. Earthquake resistant analysis &design of structures.
3. Detailing of earthquake resistant reinforced concrete buildings.

Course Contents:

Seismology:

Causes of Earthquake, the Earth and its interior, Circulations, plate tectonics, faults, seismic waves, Strong ground motions, characteristics of strong ground motions. Measurement of Earthquake: Magnitude, Intensity, Richter scale measurement of earthquake, accelerograph, accelerogram wave measuring instruments, other modern methods of earthquake measurement. Recording and analysis of earthquake records, Numerical Problems

Indian Seismic Codes:

Seismic zones in India, Seismic design philosophy for buildings, I.S. – 1893: 2016 (Part I), Structural response to earthquake, methods of analysis, Seismic analysis of multistoried building frames by equivalent static analysis, response spectrum analysis and elastic time history analysis with Numerical Problems, basic load combinations, Study of I.S. – 1893: 2016 (Part II): Introduction to Seismic Analysis of Water Tanks (No numerical example)

Conceptual Earthquake Resistant Design:

Concept, Earthquake Resistant Planning of structures, Guidelines for achieving efficient earthquake resistant building, I.S. selection of sites, importance of architectural features in earthquake resistant building, twisting of building, geotechnical design considerations, framing systems, strong column-weak beam concept, base isolation and devices, Energy dissipating devices (dampers), bracing systems.

Reinforced Concrete Buildings:

Seismic effects on RCC building, Basic assumptions, concrete detailing general requirements, resistance and

design considerations for RC building elements with numerical problems: Beams, Columns, Beam-Column joints, Footing, Shear Walls, Seismic design considerations (no mathematical treatment) for open ground storey, soft and weak storey, short column effect. Special aspects in multistoried buildings, structural response of multistory building to earthquake

Ductile detailing using IS-13920: Design strategy, strength, ductility of reinforced concrete members, ductile detailing in RC building elements: Slabs, Beams, Columns, Beam-Column joints, special confining reinforcement, Footing, Staircases, Shear Walls

Reference Books:

1. IS 1893:2016, Criteria for Earthquake Resistant Design of Structures, Part I, Bureau of Indian Standards, New Delhi, 2016.
2. IS 13920: 2015, Ductile Detailing of Reinforced Concrete Structures subjected to Seismic forces - Code of practice, Bureau of Indian Standards, New Delhi, 1993.
3. Earthquake Design Practice for buildings, Davide Key, Thomas Telford Ltd., London, First edition, 1988.
4. Seismic Design of Reinforced Concrete and Masonry Buildings, Paulay, T., M.J.N. Priestley, John Willey and Son's Publications, First edition ,1992
5. Handbook of seismic analysis and design of structure, FarzadNaiem
6. National Information Centre for earthquake engineering, Indian Institute of Technology Kanpur, www.nicee.org
7. Earthquake resistant Design of Structures, S. K. Duggal, Oxford University Press Publications, First edition, 2007
8. Earthquake resistant design of structures, PankajAgrawal and Manish Shrikhande, Prentice Hall of India Pvt, Ltd. Publications, 2006.

Course Outcomes:

On successful completion of this course students will be able to

CE2203.1: Describe different seismology concepts

CE2203.2: Apply seismic codes for analysis & design

CE2203.3: Analyze & design earthquake resistant design of structures

CE2203.4: Apply special aspects ofstructural response of earthquakein multistoried buildings

CE2203.5: Design and detailing of earthquake resistant reinforced concrete buildings

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2203.1	2	3	3	--	-
CE 2203.2	2	3	3	-	--
CE 2203.3	2	3	3	--	--
CE 2203.4	2	3	3	--	-
CE 2203.5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2- Moderately Correlated 3- Strongly Correlated

Member Secretary BoS Chairperson Dean (Academics) Principal

Course Code	CE2104(A)	Course category	PE
Course Name	COMPUTER METHODS OF STRUCTURAL ANALYSIS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	---	---	03	30	10	60	2 hrs 30 min	---	---	100	03

Course Objectives:

To make the students aware and understand

1. Analyze the skeleton structures using flexibility method.
2. Analyze the skeleton structures using stiffness method
3. Application of finite difference method to beam bending problems.

Course Content

Flexibility method (Structure approach):
Flexibility coefficients, physical Meaning, basic determinate or released structure, choice of redundant, Geometrical compatibility conditions, Matrix formulations, Hand Solution of simple problems on truss. beams, plane rigid jointed frames without axial deformation& grids

Stiffness methods (structure approach):
Stiffness co-efficient, restrained structure, Unknown displacements, Joint equilibrium conditions, Hand solution of simple problems on beam, plane rigid jointed frames without axial deformation.

Stiffness methods (member approach):
General strategy, stiffness matrix assembly process, structure stiffness matrices, hand solution of simple problems on beam, plane rigid jointed frames without axial deformation, trusses and grids.

Stiffness Method applied to Large Frames:
Local Coordinates and Global Coordinates, Forces and displacement referred to member and structure axes, Memory problems in large structural systems: In core and out core Techniques, half band storage and solution, SK line storage and solution. Tri-diagonalisation, partial and full block elimination, Tape operations, frontal technique, Sub-structure method

Finite Difference Method:

Operators for 1D & 2D problems, Application of finite difference method to beam bending problems& plate under static loads, different boundary conditions

Computer Programs: (FORTRAN/C Language)
Flow chart and computer programs for member based stiffness method – Data preparations, Various alternative, displacement code, half band width, calculation of forces.

Reference Books

1. Matrix Methods of Structural Analysis, Dr A.S. Meghre and S. K. Deshmukh, Charotar Publishing House, Anand, India, 2003.
2. Structural Analysis, A Matrix Approach: G. S. Pandit and S. P. Gupta, Tata McGrow Hill Publishing Company Limited, New Delhi, 1986.
3. Analysis of framed structures: James M. Gere and William Weaver Jr., D Van Nostrand Company Inc., Affiliated East West Press Pvt. Ltd., 1965.
4. Matrix, Finite Element, Computer and Structural Analysis: M. Mukhopadhyay, Third Edition, Oxford & IBH publishing Co. Pvt. Ltd. 1993.

Course Outcomes:

On successful completion of this course students will be able to

CE2104 (A).1: Analyze the skeleton structures using flexibility method.

CE2104(A).2:Analyze the skeleton structures using structure approach and member approach of stiffness method

CE2104(A). 3: Apply finite difference method to beam bending problems

CE2104(A). 4: Prepare computer program for CMSA problems

CE2104(A).5: Data preparation & Force calculations

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CEP2102.1	2	3	--	-	-
CEP2102.2	2	3	--	--	--
CEP2102.3	2	3	3	--	--
CEP2102.4	2	3	3	-	-
CEP2102.5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE2104(B)	Course category	PE
Course Name	THEORY OF PLATES & SHELLS		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	---	---	03	30	10	60	2 hrs 30 min	---	---	100	03

Course Objectives:

To make the students aware and understand:

1. Various analytical methods for the solution of thin plates and shells.
2. Numerical techniques and tools for solution of complex problems in thin plates.
3. Bending theory analysis & design procedures as applied to shell structures

Course Contents:

Plates:

Classification-Thin and thick plates, small and large deflections, Assumptions in theory of thin plates with small deflection, Governing Differential equation in Cartesian coordinates, moment curvature relations, stress resultants.

Rectangular plates:

Navier solution for plates with all edges simply supported, Distributed loads, Point loads, rectangular patch load, Green function, Levy's method, Distributed load, line load

Energy method:

Minimum potential theorem, Rayleigh-Ritz approach for simple cases

Circular Plates:

Governing differential equation in Polar coordinates, Axi-symmetric situation, moment curvature relations, simply supported and fixed edge, distributed load, line load, linearly varying load.

Shells:

Introduction to thin shell theory, classification on shell geometry, equation to shell surfaces, stress resultants, stress-displacement relations, compatibility Conditions, equilibrium equations.

Circular cylindrical shells:

Membrane theory

Bending theory for circular-cylindrical shell: Design procedure

Shell of revolution:

Membrane theory, spherical and conical shells with axisymmetric loading

Simple methods:

Analysis and design for conical and hyperbolic paraboloid shells

Reference Books

1. Theory of Plates and Shells, S. P. Timoshenko and W. Kriger, 2nd edition, TMH, 1987.
2. Elementary Theory of Plates, L. G. Jaeger, Macmillan, 1964.
3. Analysis of Plates, Szilard Rudolp, PHI, 1974
4. Design and Construction of Concrete Shell Roofs, G. S. Ramaswamy, CBS, 1986.

Course Outcomes:

On successful completion of this course students will be able to

CE2104(B).1: Analyze thin plates and shells.

CE2104(B).2: Apply analytical methods for the solution of shells.

CE2104(B).3: Apply the numerical techniques and tools for the complex problems in thin plates.

CE2104(B).4: Apply the numerical techniques and tools for the complex problems in shells.

CE2104(B).5: Solve bending theory problems in cylindrical shells .

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2104(B).1	2	3	--	-	-
CE 2104(B).2	2	3	--	--	--
CE 2104(B).3	2	3	3	--	--
CE 2104(B).4	2	3	3	-	-
CE 2104(B).5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE2104 (C)							Course category			PE
Course Name	DESIGN OF PRESTRESSED CONCRETE STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	---	---	03	30	10	60	2 hrs 30 min	---	---	100	03

Course Objectives:

To make the students aware and understand

1. Concept of losses in the prestressed concrete. Fundamentals of prestressing.
2. Analysis of prestressed concrete deck slab and beam/ girders.
3. Design of prestressed concrete deck slab and beam/ girders.
4. Design of end blocks for prestressed members.

Course Contents:

Introduction to prestressed concrete:

Types of prestressing, systems and devices, materials, losses in prestress, Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, code provisions.

Statically determinate PSC beams:

Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.

Transmission of pre-stressed in pre-tensioned members;

Anchorage zone stresses for post-tensioned members.

Statically indeterminate structures:

Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordancy.

Pre-stressed concrete pipes & poles:

Analysis and design of pre-stressed concrete pipes, poles

Pre-stressed Sleepers and water tanks:

Analysis and design of pre-stressed Sleepers and water tanks

Reference Books:

1. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 1955.
2. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 1981.
3. Limited State Design of Prestressed Concrete,GuyanY., Applied Science Publishers, 1972.
4. IS: 1343- Code of Practice for Prestressed Concrete

Course Outcomes:

On successful completion of this course students will be able to:

CE2104(C).1: Determine losses in the prestressed concrete. Conceptulize basic aspects of prestressed concrete

CE2104(C).2: Analyse prestressed concrete deck slab and beam/ girders.

CE2104(C).3: Design of end blocks for prestressed members.

CE2104(C).4:. Analyze and design prestressed inderminate beams and frames

CE2104(C).5: Analyze prestressed pipes, poles, sleepers and water tanks

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2104(C).1	2	3	3	-	-
CE 2104(C).2	2	3	3	--	--
CE 2104(C).3	2	3	3	--	--
CE 2104(C).4	2	3	3	-	-
CE 2104(C).5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE2104 (D)							Course category			PE
Course Name	DESIGN OF MASONRY STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	---	---	03	30	10	60	2 hrs 30 min	---	---	100	03

Course Objectives:

To make the students aware and understand

Course Objectives:

1. Properties of masonry units, their strengths and factors affecting strength.
2. Analysis of reinforced masonry members for various types of loadings.
3. Application of elastic and inelastic methods of analysis to masonry structures.

Course Contents:

Introduction: Historical Perspective, Masonry Materials, Masonry Design Approaches, Overview of Load Conditions, Compression Behavior of Masonry, Masonry Wall Configurations, Distribution of Lateral Forces.

Flexural Strength of Reinforced Masonry Members: In plane and Out-of-plane Loading

Interactions: Structural Wall, Columns and Pilasters, Retaining Wall, Pier and Foundation.

Shear Strength and Ductility of Reinforced Masonry Members.

Prestressed Masonry: Stability of Walls, Coupling of Masonry Walls, Openings, Columns, Beams.

Elastic and Inelastic Analysis: Modeling Techniques, Static Push Over Analysis and use of Capacity Design Spectra.

Reference Books:

1. Design of Reinforced Masonry Structures, NarendraTaly, ICC, 2nd Edn,
2. Masonry Structures: Behavior and Design, Hamid Ahmad A. and Drysdale Robert G., 1994.
3. Mechanics of Masonry Structures, Editor: Maurizio Angelillo, 2014.

Course Outcomes:

On successful completion of this course students will be able to:

CE2104(D).1: Describe properties of different masonry units, their strength and factors affecting strength.

CE2104(D).2:Analyze various types of reinforced masonry members, subjected to different loading systems.

CE2104(D).3:Design various types of reinforced masonry members, subjected to different loading systems.

CE2104(D). 4:Perform elastic and inelastic analysis for masonry walls

CE2104(D). 5:Describe stability concepts for prestressed walls

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2104(B).1	2	3	3	-	-
CE 2104(B).2	2	3	3	--	--
CE 2104(B).3	2	3	3	--	--
CE 2104(B).4	2	3	3	-	-
CE 2104(B).5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2105							Course category			PC
Course Name	LAB PRACTICE- I										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	06	06	-	-	-	---	50	50	100	03

Course Objectives:

To make the students aware and understand

1. Application of various software for analysis & design of civil engineering structures
2. Develop design charts for MS Excel for common structural elements
3. Application of seismic analysis to multistory buildings

List of Experiments/Assignments:

1 Modeling & analysis of structural components for various loading conditions (slabs, beams, columns , footings , trusses , girders etc) using different structural analysis software

2 Perform Analysis & Design of Multi-storied structure using software tools

3 Apply seismic analysis concept to civil engineering structures using SAP/STRAD PRO/ETAB/ etc. Software

4 Development of design charts for structural components using MS Excel

Course Outcomes:

On successful completion of this course students will be able to:

CE2105.1:Model & analyze different structural elements using different structural analysis softwares

CE2105.2: Perform Analysis & Design of Multi storied structure using software tools

CE2105.3: Analyze seismically civil Engineering structures

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CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2105.1	2	2	3	3	-
CE 2105.2	2	2	3	3	--
CE 2105.3	2	2	3	3	--

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2106							Course category			ISS
Course Name	SEMINAR I										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	01	01	-	-	-	-	50	-	50	02

Course Objectives:

1. To review the literature (research papers, relevant books and internet) to identify topic from structural engineering.
2. To develop technical report writing skills.
3. To improve the presentation skills on technical matters.
4. To enhance critical thinking abilities.

Individual students are required to choose a topic of their interest from related topics to the stream of specialization, preferably from outside the M. Tech. curriculum. The students are required to review literature on the topic and deliver seminar. A committee consisting of at least three faculty members (preferably specialized in the respective stream headed by HOD wherein guide should be one of the members) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a report of seminar. The seminar report shall not have any plagiarized content (all sources shall be properly cited or acknowledged). One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other shall be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. It is encouraged to do simulations/ experimentation related to the chosen topic and present the results at the end of the semester.

Course Outcomes:

On successful completion of this course students will be able to

CEP136.1: review the literature (research papers, relevant books and internet) to identify topic from structural engineering.

CEP136.2: develop technical report writing skills.

CEP136.3: improve the technical presentation skills.

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CO – PO Mapping:

Course Outcomes	Program Outcomes				
	PO1	PO2	PO3	PO4	PO5
CE2136.1	1	1	1	1	1
CE2136.2	1	1	1	1	1
CE2136.3	1	1	1	1	1

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2201							Course category			PC
Course Name	FEM IN STRUCTURAL ENGINEERING										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	---	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand

1. Fundamental concepts of finite element method.
2. Theory & Characteristics of finite elements that represents engineering structures.
3. Application of finite element solution to structural engineering problem.
4. Finite element analysis program/ software.

Course Contents:

Introduction:
History and Applications. Spring and Bar Elements, Minimum Potential Energy Principle, Direct Stiffness Method, Nodal Equilibrium equations, Assembly of Global Stiffness Matrix, Element Strain and Stress.

Beam Elements:
Flexure Element, Element Stiffness Matrix, Element Load Vector.

Method of Weighted Residuals:
Galerk in Finite Element Method, Application to Structural Elements, Interpolation Functions, Compatibility and Completeness Requirements, Polynomial Forms, Applications

Types of elements:
Triangu lar Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-Symmetric Elements, Numerical Integration, Gaussian Quadrature

Application to Solid Mechanics:
Plane Stress, CST Element, Plane Strain Rectangular Element, Isoparametric Formulation of the Plane Quadrilateral Element, Axi- Symmetric Stress Analysis, Strain and Stress Computations.

Computer Implementation of FEM procedure:

Pre-Processing, Solution, Post-Processing, Use of Commercial FEA Software

Reference Books:

Member Secretary BoS Chairperson Dean (Academics) Principal

1. Finite Element Analysis, Seshu P., Prentice-Hall of India,2005.
2. Concepts and Applications of Finite Element Analysis, Cook R. D., Wiley J., New York, 1995.
3. Fundamentals of Finite Element Analysis, Hutton David, Mc-Graw Hill, 2004.
4. Finite Element Analysis, Buchanan G.R., McGraw Hill Publications, New York, 1995.
5. Finite Element Method, Zienkiewicz O.C.& Taylor R.L. Vol. I, II & III, Elsevie

Course Outcomes:

On successful completion of this course students will be able to

CE2201.1: Describe the concepts behind the formulation method in FEM.

CE2202.2: Identify the application and characteristics of finite elements such as beam, bar, plane and isoparametric elements.

CE2203.3: Derive constitutive relations and solve structural engineering problem.

CE2204.4: Execute the finite element analysis program/ software.

CE2205.5: Apply FEM concepts to solid mechanics problems

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2201.1	2	3	-	3	-
CE 2201.2	2	3	1	3	--
CE 2201.3	3	2	1	3	--
CE 2201.4	3	2	1	3	-
CE 2201.5	2	3	1	3	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2202							Course category-			PC
Course Name	ADVANCED DESIGN OF STEEL STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand:

1. Design Procedures for structural elements of Gantry & Welded plate Girders using relevant codal provisions
2. Analysis and design of storage steel structures (water tanks , Bunkers & Cilos)
3. Analysis and design of Chimney

Course Contents:

Steel Gantry Girders:

Introduction, loads acting on gantry girder, permissible stress, types of gantry girders and crane rails, crane data, maximum moments and shears, construction detail, design procedure

Welded Plate Girders:

Design of different components parts of welded plate girder

Portal Frames:

Design of portal frame with hinge base, design of portal frame with fixed base -Gable Structures – Lightweight Structures

Steel Bunkers and Silos:

Design of square bunker – Jansen's andAiry's theories – IS Code provisions – Design of side plates – Stiffeners – Hooper – Longitudinal beams Design of cylindrical silo – Side plates – Ring girder – stiffeners.

Chimneys:

Introduction, dimensions of steel stacks, chimney lining, breech openings and access ladder, loading and load combinations, design considerations, stability consideration, design of base plate, design of foundation bolts, design of foundation.

Water Tanks:

Design of rectangular riveted steel water tank – Tee covers – Plates – Stays –Longitudinal and transverse beams –Design of staging – Base plates – Foundation and anchor bolts

Design of pressed steel water tank:

Design of stays – Joints – Design of hemispherical bottom water tank – side plates – Bottom plates – joints – Ring girder –Design of staging and foundation

Reference Books:

1. Design of Steel Structures - Vol. II, Ramchandra. Standard Book House, Delhi.
2. Design of Steel Structures - Arya A. S., Ajmani J. L., Nemchand and Bros., Roorkee.
3. The Steel Skeleton- Vol. II, Plastic Behaviour and Design - Baker J. F., Horne M. R., Heyman J., ELBS.
4. Plastic Methods of Structural Analysis, Neal B. G., Chapman and Hall London.
5. IS 800: 2007 – General Construction in Steel - Code of Practice, BIS, 2007.
6. SP – 6 - Handbook ofStructural Steel Detailing, BIS,1987
7. https://nptel.ac.in/courses/105/106/105106113/
8. https://www.youtube.com/watch?v=CNE4hk_SGTo&list=PLry0oTiKPxdWSdla5MeAGae69h6KMK1a3

Course Outcomes:

On successful completion of this course students will be able to

CE2202.1: Design gantry girder & welded plate girder

CE2202.2: Analyze and design steel portal frames.

CE2202.3: Analyze and design storage bins bunkers & silos

CE2202.4: Analyze and design steel & pressed steel water tanks

CE2202.5: Analyze and design steel chimney

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2201.1	2	3	3	--	-
CE 2201.2	2	3	3	-	--
CE 2201.3	3	2	3	--	--
CE 2201.4	3	2	3	--	-
CE 2201.5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE2203	Course category	PC
Course Name	ADVANCED DESIGN OF RCC STRUCTURES		

Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	---	---	03	30	10	60	2 hrs 30 min	---	---	100	03

Course Objectives:

To make the students aware and understand:

1. Design flat slabs
2. Analysis & design of building frames
3. Design of deep beams & beams curved in plans
4. Design storage structures 9 Water tanks, Bunkers & Silos)

COURSE CONTENTS:

Design of Flat slabs

Analysis of multi bay multi storey building frames by Substitute Frame Method of approximate methods

Design of portal frames (maximum up to two bay, two story)

Design and detailing of Deep beams

Design of beams curved in plan

Design of Circular & Rectangular Elevated Water tanks

Design of Storage structures, silos and bunkers.

Reference Books:

1. Reinforced Concrete Design, Pillai S. U. and MenonD., Tata McGraw-Hill, 3rd Ed, 1999.
2. Design of RC Structures, SubramaniamN., Oxford University Press, 2008.
3. Reinforced Concrete Structures, Park R.and PaulayT. , John Wiley & Sons, 1995.
4. Advanced Reinforced Concrete Design, Varghese P. C., Prentice Hall of India, New Delhi.

Course Outcomes:

On successful completion of this course students will be able to

CEP2103.1: Design of flat slabs

CEP2103.2: Analysis & design of building frames

CEP2103.3: Design of Deep beams & beams circular in plan

CEP2103.4: Design of rectangular & elevated water tanks

CEP2103.5: Design of storage structures viz bunkers & silos

CO – PO –Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CEP2102.1	2	3	3	3	-
CEP2102.2	2	3	3	3	--
CEP2102.3	2	3	3	3	--
CEP2102.4	2	3	3	3	-
CEP2102.5	2	3	3	3	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2204							Course category			PE
Course Name	(A) STRUCTURAL HEALTH MONITORING										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	---	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand

1. Concepts of diagnosis the distresses in the structure its causes and factors.
2. Assessment of the health of structure using static field methods, Structural audit concepts
3. Assessment of the the health of structure using dynamic field tests.
4. Repairs and rehabilitation measures of the structure

Course Contents:

Structural Health:

Factors affecting Health of Structures, Causes of Distress, Regular Maintenance

Structural Health Monitoring:

Concepts, Various Measures, Structural Safety in Alteration

Structural Audit:

Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures

Static Field Testing:

Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement

Dynamic Field Testing:

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

Introduction to Repairs and Rehabilitations of Structures:

Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique

Reference Books:

1. Structural Health Monitoring, Daniel Balageas, Claus_PeterFritzen, Alfredo Güemes, John Wiley and Sons, 2006.
2. Health Monitoring of Structural Materials and Components Methods with Applications, Douglas E Adams, John Wiley and Sons, 2007.
3. Structural Health Monitoring and Intelligent Infrastructure, Vol1, J. P. Ou, H. Li and Z. D. Duan, Taylor and Francis Group, London, UK, 2006.
4. Structural Health Monitoring with Wafer Active Sensors, Victor Giurglutiu, Academic Press Inc, 2007.

Course Outcomes:

On successful completion of this course students will be able to

CE2204 (A).1: Diagnose the distresses in the structures with its causes and factors.

CE2204 (A).2: Assess the health of structure using static field methods.

CE2204 (A).3: Assess the health of structure using dynamic field tests.

CE2204 (A).4: Suggest repairs and rehabilitation measures of the structure

CE2204 (A).5 Audit the structures technically

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2204(A).1	2	3	3	--	-
CE 2204(A).2	2	3	3	-	--
CE 2204(A).3	2	3	3	--	--
CE 2204(A).4	2	3	3	--	-
CE 2204(A).5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2204							Course category			PE
Course Name	(B) Advanced Concrete Technology										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	---	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand

1. Discuss the concrete ingredients and its influence at gaining strength.
2. Design of concrete mix and grade as per IS codes.
3. Summarise the concepts of conventional concrete and its differences with other concretes like no fines, light weight etc.
4. Describe the application and use of fiber reinforced concrete.
5. Design and develop the self-compacting and high performance concrete.

Course Contents:

Properties of cement, fine aggregate and coarse aggregates, Additives and Admixtures in Concrete, Rheology of Concrete

Manufacturing and methods of concreting, Properties of fresh and hardened concrete, Mix design by I.S. method

Design and manufacture of normal concrete, light weight concrete – Cellular concrete – No fines concrete – Aerated & foamed concrete

Design and manufacture of fiber reinforced concrete – Polymer concrete – Fly ash concrete

Design and manufacture of Self compacting concrete – High performance concrete – Very high strength concrete – High density concrete, Mass concrete, Roller compacted concrete, high early strength,

Reference Books:

1. Neville, A.M. and Brookes, J.J., "Concrete Technology", 2nd Edition, Pearson Education, 2010.
2. Gambhir, M.L., "Concrete Technology", 2nd Edition, Tata McGraw Hill Publishers, New Delhi, 2009.
3. Neville, A.M., "Properties of Concrete", 3rd Edition, Longman Scientific and General, 1992.
4. Shanta Kumar A.R., "Concrete Technology", 2nd Edition, Oxford University Press, New Delhi, 2000.
5. Krishna Raju. N, "Design of Concrete Mixes", 2nd Edition, CBS Publishers and Distributors, 2009.
6. Shetty, M.S., "Concrete Technology", 3rd Edition, S.Chand Publications, New Delhi

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Course Outcomes:

On successful completion of this course students will be able to:

CE2204 (B).1: Discuss the concrete ingredients and its influence at gaining strength.

CE2204 (B).2: Design of concrete mix and grade as per IS codes.

CE2204 (B).3: Summarize the concepts of conventional concrete and its differences with other concretes like no fines, light weight etc.

CE2204 (B).4: Describe the application and use of fiber reinforced concrete.

CE2204 (B).5 Design and develop the self-compacting and high performance concrete

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2204(B).1	--	--	--	--	-
CE 2204(B).2	1	3	2	3	--
CE 2204(B).3	--	--	--	--	--
CE 2204(B).4	--	--	--	3	-
CE 2204(B).5	1	3	2	3	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

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Course Code	CE 2204							Course category			PE
Course Name	(C) DESIGN OF HIGH RISE STRUCTURES										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand

1. Concepts of analysis &design of Transmission/ TV tower, Mast and Trestles with different loading conditions.
2. Analysis of design and detail the RC and Steel Chimney.
3. Analysis, designing &detailing the tall buildings subjected to different loading conditions using relevant codes.

Course Contents:

Design of transmission/ TV tower, Mast and trestles:

Configuration, bracing system, analysis and design for vertical transverse and longitudinal loads

Analysis and Design of RC and Steel Chimney:

Analysis and Design of RC and Steel Chimney, Foundation design for varied soil strata

Tall Buildings:

Structural Concept, Configurations, various load resisting systems, Wind and Seismic loads, Dynamic approach, structural design considerations and IS code provisions. Firefighting design provisions

Application of software in analysis and design: (In the form of TA Assignments)

Reference Books:

1. Structural Design of Multi-storied Buildings, Varyani U. H., 2nd Ed., SouthAsianPublishers,New Delhi, 2002.
2. Structural Analysis and Design of Tall Buildings, Taranath B. S., McGraw Hill, 1988.
3. Illustrated Design of Reinforced ConcreteBuildings(GF+3storeyed), Shah V. L. &Karve S. R., Structures Publications, Pune, 2013.

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4. Design of Multi Storied Buildings, Vol. 1 & 2, CPWD Publications, 1976.
5. Tall Building Structures, Smith Byran S. and Coull Alex, Wiley India. 1991.
6. High Rise Building Structures, Wolfgang Schueller, Wiley., 1971.
7. Tall Chimneys, Manohar S. N., Tata McGraw Hill Publishing Company, New Delhi

Course Outcomes:

On successful completion of this course students will be able to:

CE2204(C).1: Analyze&design Transmission/ TV tower, Mast and Trestles with different loading conditions.

CE2204(C).2: Analyze, design, and detail the RC Chimney.

CE2204(C).3: Analyze, design, and detail the Steel Chimney

CE2204(C).4: Analyse &design tall buildings subjected to different loading conditions using relevant codes

CE2204(C).5: Detailing of tall buildings subjected to different loading conditions using relevant codes

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2205(C).1	2	3	3	--	-
CE 2205(C).2	2	3	3		--
CE 2205(C).3	2	3	3		--
CE 2205(C).4	2	3	3		-
CE 2205(C).5	2	3	3		-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2204							Course category-			PE
Course Name	(D) DESIGN OF PLATES & SHELLS										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
03	--	--	03	30	10	60	2 hrs 30 min	--	---	100	03

Course Objectives:

To make the students aware and understand

1. Analyse and design ofprismatic folded plate systems.
2. Analyse and design shells using approximate solutions
3. Analyse and design cylindrical shells
4. Design ofdoubly curved shells using approximate Solutions.

Course Contents:

Prismatic folded Plate Systems

Shell Equations

Approximate Solutions

Analysis and Design of Cylindrical Shells

Approximate Design methods for Doubly Curved Shells

Reference Books:

1. Theory of Plates and Shells, Timoshenko and Woinowsky-Krieger S., Tata Mc Graw Hill Edition, 2010.
2. Design and Construction of Concrete Shell Roofs, Ramaswamy G. S., 1st Edition, 2005.
3. Design of Reinforced Concrete Shells & Folded Plate, Varghese P. C., 1st Edition, PHI.
4. Design of Plate and Shell Structures, Jawad Maan H., Springer Science.

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Course Outcomes:

On successful completion of this course students will be able to

CE2204 (D).1: Analyze and design prismatic folded plate systems

CE2204 (D).2: Analyze and design shells using approximate solutions

CE2204 (D).3: Analyze and design cylindrical shells

CE2204 (D).4: Design doubly curved shells using approximate Solutions.

CE2205 (D).5: Solve the problems of plates & shells

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2205(D).1	2	3	3	-	-
CE 2205(D).2	2	3	3	--	--
CE 2205(D).3	2	3	3	--	--
CE 2205(D).4	2	3	3	-	-
CE 2205(D).5	2	3	3	-	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	SH2201							Course category-			RM
Course Name	RESEARCH METHODOLOGY										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
02	--	--	02	30	20	--	-	--	---	50	02

Course Objectives:

To make the students aware and understand:

1. Research problem formulation and methods
2. Data collection methods and analyze research related information
3. Research reports, and thesis writing
4. Research Ethics and Intellectual Property Right
5. Research paper writing and publishing

Course Contents:

Introduction to Research: Definition of research, Characteristics of research, Types of research- Descriptive *vs.* Analytical, Applied *vs.* Fundamental, Quantitative *vs.* Qualitative, Conceptual *vs.* Empirical, Steps of research methodology

Research Problem Formulation and Methods:

Literature review, sources of literature, various referencing procedures, maintain literature data using Endnote2, Identifying the research areas from the literature review and research database, Problem Formulation, Identifying variables to be studied, determining the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution. Important steps in research methods: Observation and Facts, Laws and Theories, Development of Models. Developing a research plan: Exploration, Description, Diagnosis and Experimentation

Data collection:

Sampling methods, methods of data collection, Basic Concepts concerning testing of hypotheses, procedures of hypothesis testing, generalization and interpretation Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modeling, Simulation and analysis.

Research reports and Thesis writing

Introduction: Structure and components of scientific reports, types of report, Thesis writing: different steps and software tools in the design andpreparation of thesis, layout, structure and language of typical reports, Illustrations and tables, bibliography, referencing and footnotes, Oral presentation: planning, software tools, creating and making effective presentation, use of visual aids, importance of effective communication.

Research Ethics, IPR and Publishing:

Ethics: Ethical issues.

IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual propertyrights,

Publishing: design of research paper, citation and acknowledgement, plagiarism tools, reproducibility and accountability.

Reference Books and websites:

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners", SAGE Publications Ltd., 2011
2. C.R. Kothari ,"Research Methodology: Methods and Trends", New Age International,2004
3. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction" JUTA and Company Ltd,2004.
4. S.D. Sharma , "Operational Research", Kedar Nath Ram Nath &Co.,1972
5. B.L. Wadehra, "Law Relating to Patents, Trademarks, Copyright Designs and Geographical Indications", Universal Law Publishing,2014.

Course Outcomes:

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

SH2201.1 Differentiate between various methods / types of research.

SH2201.2 Formulate research problem

SH2201.3 Collect and analyze research related information

SH2201.4 Describe ethics and IPR and its significance.

SH2201.5 Describe thesis report and research paper writing and publishing

CO – PO Mapping:

Course Outcomes	Program Outcomes					
	PO1	PO2	PO3	PO4	PO5	PO6
SH2201.1	-	-	-	-	-	3
SH2201.2	-	-	-	-	-	3
SH2201.3	-	-	-	-	-	3
SH2201.4	-	-	-	-	-	3
SH2201.5	-	-	-	-	-	3

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2206							Course category			PC
Course Name	LAB PRACTICE- II										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	---	06	06	--	--	--	---	50	50	100	03

Course Objectives:

To make the students aware and understand

1. Principles & application of different ND Testing methods
2. Analysis & design of different civil engineering structures with relevant codal provisions

Course Contents:

Non-Destructive testing of concrete members/structural elements

Design of Bridges (RC/ Prestressed/ Steel) for different loading & boundary conditions

Design of Portal frames (RC/ Prestressed/ Steel)

Design of water tanks (RC/ Prestressed/ Steel)

Design of Storage bins (RC/ Steel)

Course Outcomes:

On successful completion of this course students will be able to

CE2206.1: Perform & interpret Nondestructive testing methods on concrete structures

CE2206.2: Analysis & design of bridges (RC/ Prestressed/ Steel) for different loading & boundary conditions

CE2206.3: Analysis & design of Portal frames (RC/ Prestressed/ Steel)

CE2206.4: Analysis & design water tanks (RC/ Prestressed/ Steel)

CE2206.5: Analysis & Design of Storage bins (RC/ Steel)

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CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE2206.1	2	3	3	2	-
CE2206.2	2	3	3	2	--
CE2206.3	2	3	3	2	--
CE2206.4	2	3	3	2	-
CE2206.5	2	3	3	2	-

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code	CE 2207							Course category –			ISS
Course Name	SEMINAR-II										
Teaching Scheme				Examination Scheme							Credits
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
--	---	01	01	--	---	---	-	50	---	50	02

Course Objectives:

1. To review the literature (research papers, relevant books and internet) to identify expected potential dissertation topic from structural engineering.
2. To develop technical report writing skills.
3. To improve the technical presentation skills.
4. To enhance critical thinking abilities.

Course Contents:

Individual students are required to choose a topic of their interest. They will acquire state-of-the art knowledge in that area and to define the gray area related to topic (gap analysis) so as to carry dissertation in that area. The students are required to review literature on the topic and deliver seminar. A committee consisting of at least three faculty members (preferably specialized in the respective stream headed by HOD wherein guide should be one of the members) shall assess the presentation of the seminar and award marks to the students based on merits of topic of presentation. Each student shall submit two copies of a report of seminar. The seminar report shall not have any plagiarized content (all sources shall be properly cited or acknowledged). One copy shall be returned to the student after duly certifying it by the chairman of the assessing committee and the other shall be kept in the departmental library. Internal continuous assessment marks are awarded based on the relevance of the topic, presentation skill, quality of the report and participation. It is encouraged to do simulations/ experimentation related to the chosen topic and presents the results at the end of the semester.

Course Outcomes:

On successful completion of this course students will be able to

CE2207.1: Review the literature (research papers, relevant books and internet) to identify expected potential dissertation topic from structural engineering.

CE2207.2: Develop technical report writing skills.

CE2207.3: Improve the technical presentation skills.

CO – PO – Mapping:

CO	PO1	PO2	PO3	PO4	PO5
CE 2207.1	2	3	3	2	-
CE 2207.2	2	3	3	2	--
CE 2207.3	2	3	3	2	--

0 - Not correlated 1 - Weakly Correlated 2 - Moderately Correlated 3 - Strongly Correlated

Course Code								**CATEGORY**			**OJT/FP**
Course Name	**ON JOB TRAINING / FIELD PRACTICE**										
Teaching Scheme				**Examination Scheme**							**Credits**
Th	Tu	Pr	Total	Theory				Practical		Total	
				MSE	TA	ESE	ESE Duration	ICA	ESE		
-	-	-	-	-	-	-	-	50	-	50	04

Students must complete On-the-job training/ Internship/ Field work for a duration of minimum four weeks during summer break, after completion of second semester of first year in the respective major subject. The company/ organization for On-job training/ Internship/ Field work must be approved by the DFB.

The student must submit the report of On-job training / Internship / Field Work , in the format prescribed by the Institute.