

DEPARTMENT OF APPLIED MECHANICS

NEP-2020 CURRICULUM

M. Tech. (STRUCTURAL ENGINEERING)

FULL –TIME PROGRAMME (Academic Year: 2026-27 Onwards)



**GOVERNMENT COLLEGE OF ENGINEERING
CH. SAMBAJI NAGAR**

Vision of the Department

To be center of Excellence in Structural Engineering

Mission of the Department

To create globally competitive Structural Engineers with ethics and social binding

Programme Educational Objectives of the Department**Graduates**

1. Will provide solutions to wide range of structural engineering problems to fulfill needs of industry.
2. Will have successful career in industry, entrepreneurship, academia and research.
3. Will be executives in government, semi-government public and private sectors.

Programme Outcomes of the Department Graduates

- 1) Will be able to discriminate, evaluate, and synthesize existing and new knowledge in structural engineering
- 2) Will be able to analyze and solve complex structural engineering problems with critical engineering judgement and evaluate alternative solutions considering safety, economy & finance factors, environmental and societal needs.
- 3) Will be able to model, analyze and design structural engineering problems using software
- 4) Will be able to explore new domains of knowledge in structural engineering through literature survey, formulate problem, and apply appropriate research methodology to advance the knowledge in structural engineering
- 5) Will be able to work in team for achieving common goal and share the learning experience with peers.
- 6) Will be able to prepare effective technical reports and document technical findings by adhering to appropriate standards, and make effective presentation, participate in technical discussion amongst peers.

GENERAL COURSE STRUCTURE & THEME**A. Definition of Credit:**

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
1 Hr. Laboratory (P) per week	0.5 Credit
2 Hours Laboratory (P) per week	1 Credit

B. Range of Credits: The total number of credits proposed for the two-year full time M. Tech. in Structural Engineering is kept as 62.

C. Semester wise Credit Distribution Structure for Two-Year Full-Time PG Program in Structural Engineering:

Semester		I	II	III	IV	Total Credits
Programme Core Course (PCC)	Program Courses	08	12	-	-	20
Programme Elective Course (PEC)		04	06			10
Open Elective (OE) Other than a particular program	Multidisciplinary Courses	-	02		-	02
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	02	-	-	-	02
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	-	02	-	-	02
Entrepreneurship/Economics/Management Courses		-	-	02	-	02
Indian Knowledge System				02		02
Research Methodology	Experiential Learning Courses	02	-	-	-	02
Dissertation/ Project/ Internship		-	-	08	12	20
Co-curricular Courses (CC)	Liberal Learning Courses	-	-	-	-	Audit
Total Credits (Major)		16	22	12	12	62

D. Category-wise Courses**1. VOCATIONAL AND SKILL ENHANCEMENT COURSE (VSEC)**

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	VSEC	Mini Project	I	0	0	4	02
Total Credits							02

2. HUMANITIES & SOCIAL SCIENCES COURSES [HSSM]

S. N	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Ability Enhancement Course (AEC)	Technical Presentation/ Communication	II	2	0	0	02
		Communication Skills & Report Writing					
2	Entrepreneurship/ Economics/ Management Courses	Economics/ Management Courses	III	02	0	0	02
3	Indian Knowledge System	Vedic Approach to Mathematics	III	02	-	-	02
Total Credits							06

3. EXPERIENTIAL LEARNING COURSES (ELC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	Research Methodology	Research Methodology	I	2	0	0	02
2	Project	Dissertation - I	III	0	0	8	08
3	Project	Dissertation - II	IV	0	0	12	12
Total Credits							22

4. LIBERAL LEARNING COURSES (CO-CURRICULAR COURSES (CC))

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
1	CC	Yoga	I	0	0	4	Audit
Total Credits							-



**Government College of Engineering,
Ch. Sambhaji Nagar
(An Autonomous Institute of Government of Maharashtra)**

Department of Applied Mechanics
NEP -2020: M. Tech. Program in Structural Engineering
Teaching and Evaluation Scheme w.e.f. Academic Year 2026-27

Semester – I

Sr. No.	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	AMPCC5001	Theory of Elasticity & Plasticity	3	0	0	3	20	20	60	100
2.	PCC	AMPCC5002	Structural Dynamics & Earthquake Engineering	4	0	0	4	20	20	60	100
3.	PCC	AMPCC5003	Lab- Structural Dynamics & Earthquake Engineering	0	0	2	1	-	25	-	25
4.	PEC	AMPEC5004-5007	Programme Elective Course - I	4	0	0	4	20	20	60	100
5.	VSEC	AMVSEC5012	Mini Project	0	0	4	2	-	25	25	50
6.	ELC	AMRMC5001	Research Methodology	2	0	0	2	20	20	60	100
7.	CC	INCCC5001#	Stress Management by Yoga/Club Activity)	-	-	2	-	-	-	-	-
Total				13	0	08	16	80	130	265	475
Programme Elective Course– I 1) AMPEC5004: Prestressed Concrete Design 2) AMPEC5005: Advance Concrete Technology 3) AMPEC5006: Numerical Methods & Optimization Techniques 4) AMPEC5007: Project Planning & Management											

Audit Course

Semester – II

Sr. No.	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	PCC	AMPCC5101	Finite Element Method	4	0	0	4	20	20	60	100
2.	PCC	AMPCC5102	Theory of Plates & Shells	4	0	0	4	20	20	60	100
3.	PCC	AMPCC5103	Design of Advance RC Structures	4	0	0	4	20	20	60	100
4.	PEC	AMPEC 5104-5108	Programme Elective Course - II	3	0	0	3	20	20	60	100
5.	PEC	AMPEC5109-5113	Programme Elective Course - III	3	0	0	3	20	20	60	100
6.	OE	AMOEC5001, CSOEC5002, CEOEC5003, MEOEC5004, EEOEC5005, ECOEC5006	OE-I	2	0	0	2	20	20	60	100
7.	AEC	AMAEC5001	Communication Skills and Report writing	2	0	0	2	20	20	60	100
Total				22	0	0	22	140	140	420	700
Programme Elective Course – II 1) AMPEC5104-Advance Seismic Analysis & Design 2) AMPEC5105-Mechanics of Composite Materials 3) AMPEC5106-Design of Advance Steel Structure 4) AMPEC5107-Soil Structure Interaction 5) AMPEC5108- Advance Structural Analysis				Programme Elective Course – III 1) AMPEC5109-Fracture Mechanics 2) AMPEC5110-Design of High-rise Structures 3) AMPEC5111- Structural Assessments & Rehabilitations 4) APMEC5112- Design of Bridge 5) AMPEC5113- Stability of Structures							

List of Open Electives I to be offered in PG Semester II (First Year)

Sr. No.	Course Code	Open Elective Course	Course offering Department
1	AMOEC5001	Basics of Finite Element Analysis	Applied Mechanics
2	CSOEC5002	Professional Ethics & Cyber Law	CSE
3	CEOEC5003	Engineering Optimization	Civil
4	MEOEC5004	Robotics(Not for Mechanical PG Students)	Mechanical
5	EEOEC5005	Electric Vehicles (Not for Electrical PG Students)	Electrical
6	ECOEC5006	IoT for Smart Systems	E&TC

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be approved by BoS Chairman**
Semester – III

Sr. No.	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	HSSM	MEEEM6001, ECEEM6002, MEEEM6003, CEIKS6001	HS	2	0	0	2	20	20	60	100
2.	ELC	AMDIS 6003	Dissertation – I	0	0	16	8	-	100	100	200
3	IKS	INIKS6001	Vedic approach to Mathematics	2	-	-	2	50	-	-	50
Total				4	0	16	12	70	120	160	350

*** Equivalent online courses (NPTEL/SWAYAM/MOOC/COURSERA/OTHERS) will be approved by BoS Chairman**

List of Humanities I to be offered in PG Semester II (First Year)

Sr. No.	Course code	Humanities Course	Course offering Department
1	EEAEC5001	Technical Communication	Electrical
2	AMAEC5001	Communication Skills & Report Writing	Applied Mechanics

List of Humanities II to be offered in PG Semester III (Second Year)

Sr. No.	Course code	Humanities Course	Course offering Department
1	MEEEM6001	Entrepreneurship Development	Mechanical
2	ECEEM6002	Engineering Economics	E&TC
3	MEEEM6003	Industrial Management	Mechanical
4	CEIKS6001	Ancient Water Management Practices	Civil

Semester – IV

Sr. No.	Category	Course Code	Course Title	Teaching Scheme			Credits	Continuous Evaluation in terms of Marks			
				L	T	P		ISE I	ISE II	ESE	Total
1.	ELC	AMDIS6101	Dissertation – II	-	-	24	12	150		150	150
Total				0	0	24	12	150		150	300





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SEMESTER-I

AMPCC5001: Theory of Elasticity & Plasticity (NEP- 2020 Model Course)

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test(ISE-I)	20 Marks
Tutorial	-	Teacher Assessment(ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course intends to provide students a comprehensive knowledge on the theory of elasticity and plasticity. The course focuses on the five topics shown in detailed syllabus.

Course Outcomes:

After successful completion of the course, students will be able:

1. To formulate/establish the basic equations of elasticity & plasticity in Cartesian & polar coordinate system.
2. To discriminate plain stress and plain strain problems of elasticity & plasticity in Cartesian coordinate system.
3. To solve two dimensional problem of elasticity & plasticity in Cartesian & polar coordinate system.
4. To apply principles to the stress analysis under various loading conditions such as torsion and bending.
5. To comprehend failure mechanisms in materials and differentiate yielding of materials by various yielding criteria.

Detailed Syllabus:

Unit -1	Basics of Elasticity Concept of stress at a point, the state of strain at a point, stress components on a rectangular parallelepiped in Cartesian coordinate system, derivation of stress equilibrium equations, strain displacement relations, strain compatibility condition and stress compatibility conditions, plane stress and plane strain problems of elasticity.	06 Hrs
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Unit -2	Two-Dimensional Problems in Cartesian Co-ordinates Introduction, Airy's Stress Function, Biharmonic equation, Solution by polynomials, Bending of a cantilever loaded at the end; Bending of a beam by uniform load, Direct method for determining Airy polynomial, Cantilever having Udl and concentrated load of the free end; Simply supported rectangular beam under a triangular load, Fourier Series, Complex Potentials, Cauchy Integral Method, Fourier Transform Method, Real Potential Methods.	06Hrs
Unit -3	Two-Dimensional Problems in Polar Co-Ordinates Introduction, Differential equations in polar coordinates such as equilibrium equation, Strain Displacement relations, Hooke's law, Stress function relations, compatibility equation, Stress-strain relations. Airy's stress function, Biharmonic equation, Axisymmetric problem, Thick-walled cylinder subjected, internal and external pressure, Rotating disk of uniform thickness, Circular disc with hole, Stress concentration, The effect of circular holes on stress	06Hrs
Unit -4	Torsion of Prismatic Bars and Bending of Prismatic Beams Torsion Assumptions and Torsion equation for general prismatic solid bars, Warping of Non-circular sections and St. Venant's theory, Prandtl's stress function approach, Torsion of Circular, Elliptical and Triangular cross-section, Torsion of thin-walled structures by membrane analogy, Torsion of rolled sections and shear flow Simple Bending, Unsymmetrical Bending, Shear Centre, Solution of Bending of Bars by Harmonic Functions, Solution of Bending Problems by Soap-Film Method	06 Hrs
Unit -5	Theory of Plasticity Introduction, Basic Concepts, , Physical assumptions, Failure theories, Yield Criteria (Tresca, Von-Mises), Yield Surface, equivalent stress and equivalent strain, Plastic work, Flow Rule-Plastic Potential, Elastic-Plastic and plastic stress-strain relations, Plastic Flow of anisotropic materials Viscoelasticity and Discrete plasticity: Introduction, Viscoelastic models (Maxwell, Kelvin-Voigt, Generalized Maxwell and Kelvin models), Viscoelastic stress-strain relationships, Viscoplasticity	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Reference Books:

- 1) Timoshenko. S and Goodier. J. N., " Theory of Elasticity", Mc Graw Hill Book Co., New York, Latest Edition
- 2) Sadhu Singh., " Theory of Elasticity", Khanna Publishers, New Delhi. Latest Edition

- 3) Sadhu Singh., "Theory of Plasticity", Khanna Publishers, New Delhi. Latest Edition
- 4) Helena H. J., "Theory of Elasticity and Plasticity", Kindle Edition
- 5) Popov. E., "Mechanics of Materials", Prentice Hall reprinted Pearson education, Latest Edition
- 6) Ansel. C. Ugural and Saul. K. Fenster, "Advanced Strength and Applied Elasticity," Fourth Edition, Prentice Hall Professional technical Reference, New Jersey.
- 6) Chakrabarty. J., "Theory of Plasticity", Third Edition, Elsevier Butterworth -Heinmann – UK

Evaluation Pattern

Table 1: Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	6
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPPC5002: Structural Dynamics & Earthquake Engineering
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Lectures	4 Hrs./Week	Class Test(ISE-I)	20 Marks
Tutorials		Teacher Assessment(ISE-II)	20 Marks
Total Credits	4	End-Semester Examination	60 Marks
		Total	100 Marks

Prerequisites: Not required

Course Description:

This is a fundamental core subject wherein the students will be exposed to the concepts of structural dynamics subjected to dynamic loadings and extend the principles to earthquake loading. This is a fundamental course which is required for analyzing and designing structures for earthquake loads.

Course Outcomes:

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

1. To compute the dynamic parameters of SDOF systems and analyse for given external loading.
2. Construct and use response spectrum of an earthquake and correlate to the construction of design spectra.
3. To compute the frequencies and mode shapes of MDOF systems.
4. Formulate analytical model of MDOF systems subjected to earthquake loading for a given time history and analyze using response spectrum methods.
5. Apply the code procedures for seismic analysis, design and detailing of symmetrical buildings.

UNIT-1	Characteristics of dynamic loading, Lumped and continuous mass models, Single-Degree-of Freedom (SDOF) systems, Free vibrations, Harmonic loading, Harmonic base motion, Resonance, Dynamic Amplification Factor, Transmissibility, Vibration Isolation. Response to general dynamic loading, Duhamel's Integral	06Hrs
UNIT-2	Introduction to seismology, Strong motion and their measurement, characteristics of earthquake ground motion, response spectrum, displacement, pseudo-velocity and pseudo-acceleration spectra, tripartite spectra, characteristics of earthquake spectra, MCE and DBE, Construction of site Design spectra	06 Hrs
UNIT-3	Multi-Degree-of-Freedom (MDOF) systems, Formulation of equations of motion, Free-vibrations, Frequencies and mode shapes, Orthogonality of normal modes, Mode-superposition method, Modal participation, Extension to earthquake loading	06 Hrs
UNIT-4	Earthquake resistant design philosophy, Provisions of IS:1893-2016-Part-I, Estimation of earthquake forces using the code, Seismic coefficient and response spectrum analysis, asymmetrical structures, accidental eccentricity,	06Hrs
UNIT-5	Earthquake resistant design principles, ductility, inelastic behavior, ductile detailing of RC members as per IS:13920-2016, design of beams and columns, Vibration control techniques.	06 Hrs

TEXT AND REFERENCE BOOKS

1. Ray W. Clough and Joseph Penziene, "Dynamics of Structures", Mc-Graw Hill, 3rd Edition, 1975.
2. Anil K. Chopra, "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, 3rd Edition, 2007.
3. Roy R. Craig, "Structural Dynamics: An Introduction to Computer Methods", Wiley, 1981.
4. Mario Paz, "Structural Dynamics", Springer, 1997.
5. J.L.Humar, "Dynamics of Structures", Balkema, 2002.
6. Hans Anton Buchholdt, "Structural Dynamics for Engineers", Thomas Telford, 1997.
7. Dowrick D.J., "Earthquake Resistant Design for Engineers", John Wiley Publishers, Latest Edition
8. Duggal S.K., "Earthquake Resistant Design of Structures", Oxford University press, Latest Edition
9. Hosur Vinod, "Earthquake Resistant Design of Building Structures", Wiley, Latest Edition
10. IS: 1893 (Part-I) -2016, "Criteria for earthquake resistant design of structures" Bureau of Indian Standards, New Delhi
11. IS:13920-2016, "Ductile Detailing of Reinforced Concrete Structures subjected to seismic forces-code of practice" Bureau of Indian Standards, New Delhi

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1 : Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20Marks	Teachers Assessment/ Assignment 20 Marks	End Semester Examination
K1	Remember	02	03	6
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4,	K3,K4
Class Test Marks	08	12			
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPC5003: Lab Structural Dynamics and Earthquake Engineering
(NEP- 2020 Model Course)**

Scheme of Teaching		Scheme of Evaluation	
Practical	2Hrs/Week	Term Work (ISE-II)	25
Total Credits	1	Total Marks	25

Prerequisite: In conjunction with theory courses Dynamics of Structures and Earthquake Resistant Design of Structures

Course Description: This is a Lab course in support to the theory courses Dynamics of Structures and Earthquake Resistant Design of Structures

Course Outcomes:

After successful completion of the course, students will be able to:

1. Determine dynamic properties of MDOF systems and explain the behaviour
2. Determine dynamic properties of asymmetrical buildings
3. Examine the behavior of structures under base motion and correlate to behavior of structures under earthquake loading

Detailed Syllabus:

At least six experiments out of the following

1. Dynamics of a three storied building frame subjected to harmonic base motion.
2. Dynamics of a one-storied building frame with planar asymmetry subjected to harmonic base motions.
3. Dynamics of a three storied building frame subjected to periodic (non-harmonic) base motion.
4. Vibration isolation of a secondary system.
5. Dynamics of a vibration absorber.
6. Dynamics of a four storied building frame with and without an open ground floor
7. Dynamics of one-span and two-span beams.
8. Earthquake induced waves in rectangular water tanks
9. Dynamics of free-standing rigid bodies under base motions
10. Seismic wave amplification, liquefaction and soil-structure interactions.

ISE-II (Term Work) :

The term work shall consist of a comprehensive journal consisting of records of experiments as detailed under the syllabus above.

Table 1: Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2	3	2	
CO2		1	2	2		3
CO3	1	2			2	2

3– High 2 – Medium 1 – Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Skill Level	Term Work Assessment (25 Marks)
S1	Imitation	05
S2	Manipulation	10
S3	Precision	10
S4	Articulation	
S5	Naturalization	
Total Marks		25

Table 3: Assessment Table

Course Outcomes	CO1	CO2	CO3
Assessment Tool	(Skill level S1 to S3 as applicable)	(Skill level S1 to S3 as applicable)	(Skill level S1 to S3 as applicable)
Term Work (25 Marks)	10	10	05
Total (25 Marks)	10	10	05

**AMPEC5004: Programme Elective Course -I-Pre-Stressed Concrete Design
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This course equips the students to understand the mechanism of prestressing and behavior of pre-stressed concrete element. Students will be exposed to analysis of strength and behavior of prestressed concrete structures. The course will deal with limit state of design of prestressed concrete structures like beams, axially loaded members, slabs, composite sections, liquid tanks, pipes, sleepers etc. in relevance to codal provisions.

Course Outcomes:

After successful completion of the course, students will be able:

1. To analyze the stresses and determine the behavior of determinate prestressed concrete beams.
2. To design Prestressed concrete slabs.
3. To appreciate the composite behavior and design composite sections.
4. To analyze the stresses and determine the behavior of indeterminate prestressed concrete beams
5. To apply prestressed concrete design concepts to various members like pipes, tanks, poles and sleepers.

Detailed Syllabus:

Unit -1:	Analysis and Design of Determinate Prestressed Concrete Beams Review of fundamentals of prestressing, Analysis of ultimate strengths of rectangular and flanged beams, Limit state design of rectangular and flanged beams (Type-I, Type-II, Type-III) for flexure, shear, torsion; Limit state of serviceability, Design of end block, Anchorage zone stresses in post-tensioned member.	06 Hrs
Unit -2:	Design of Prestressed Concrete Slabs; Axially loaded members Design of one way and two way prestressed concrete slabs, flat slab, Analysis and design of sections for axial tension, Design of compression member.	06 Hrs
Unit -3:	Analysis of Composite section Analysis of composite sections with precast PSC beams and cast-in-situ RC slab Stresses, Shrinkage, Deflection, and Flexural and shear strength of composite member, Design of composite member.	06 Hrs

Unit -4:	Analysis and Design of Indeterminate Prestressed Concrete Elements Analysis of continuous beams, primary and secondary moments, stresses, cable profile, line of prestress, linear transformation of cables, concordant cable profile, Analysis of ultimate load, Design of continuous beam and portal frames.	06 Hrs
Unit -5:	Analysis and Design of Tanks, Pipes, Pole, and Sleepers Analysis and design of circular tanks, pipes, Pole and railway sleepers.	06 Hrs

References:

1. Krishna Raju N., "Prestressed Concrete", Tata McGraw Hill Company, New Delhi, Latest Edition.
2. Mallic S. K. and Gupta A. P., "Prestressed Concrete", Oxford and IBH publishing Co. Pvt. Ltd. Latest Edition.
3. Dayaratnam P., "Prestressed Concrete", Oxford and IBH, Latest Edition.
4. Rajagopalan N., "Prestressed Concrete", Alpha Science, Latest Edition.
5. Ramaswamy G. S., "Modern Prestressed Concrete Design", Arnold Heinimen, New Delhi, Latest Edition.
6. Lin T. Y., "Design of Prestressed Concrete Structures", Third Edition, Wiley India Pvt. Ltd., New Delhi, Latest Edition.
7. David A. Sheppard, William R. and Phillips, "Plant Cast Precast and Prestressed Concrete-A Design Guide", McGraw Hill, New Delhi, Latest Edition.
8. IS 1343: 2012, Code of Practice for Prestressed Concrete, Bureau of Indian Standard, New Delhi, 2012.

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1 : Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20	Teachers Assessment/ Assignment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5005: Programme Elective- I Advanced Concrete Technology
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisites:

Knowledge about interaction of concrete making materials and their influence on the properties of concrete.

Course Description:

The Unit 1 and 2 provide the fundamentals of concrete technology and mix proportioning of concrete of desired properties. Unit 3 and 4 on High Performance Concrete and Special Concretes provide the information about selection of ingredients based on the performance requirements. Unit 5 deals with non-destructive evaluation and concrete repairs

Course Outcomes:

After successful completion of this course, the student will be able to

1. Select the ingredients judiciously for making concrete
2. Classify various types of concrete
3. Design concrete mixes with desired properties
4. Evaluate the properties of concrete in the structure and investigate the causes of damage of concrete
5. Propose the methods for concrete repair

Detailed Syllabus:

Unit-1:	Fundamentals of Concrete Technology Review of various constituents of concrete Properties of concrete: workability, rheology, permeability, strength , elasticity, shrinkage, creep, durability	06Hrs
Unit -2:	Fundamentals of Concrete Mix Proportioning: Abram's Law, Lyse's Rule, Glianville's work, Exposure conditions Comparative study of various concrete mix proportioning methods, Quality control.	06 Hrs
Unit -3:	High Performance Concrete High performance concrete (HPC): performance requirements, materials, cement-superplasticizer compatibility, methods of mix proportioning, concept of particle packing, properties in fresh and hardened state, durability of HPC	06 Hrs

Unit -4:	Special Concretes Self-compacting concrete, High density concrete, Aerated concrete, Lightweight concrete, Concrete with recycled waste: Constituent materials, mix proportioning, properties and applications, hot weather and cold weather concreting Fibre Reinforced Concrete (FRC): Types and properties of fibers, mix proportioning and behavior in fresh and hardened state. Ferro cement.	06 Hrs
Unit -5:	Non Destructive Evaluation and Concrete Repairs: Non-Destructive Evaluation of Concrete: Rebound hammer test- Ultrasonic pulse velocity tests, penetration resistance, pull out tests, elastic properties Chemical tests: Carbonation tests and chloride content, Corrosion potential assessment- cover meter survey, half-cell potentiometer test, resistivity measurement Concrete Repairs: Types and causes of damages of concrete, Materials and technology for repairing damaged concrete	06Hrs

TEXT AND REFERENCE BOOKS

1. A M Neville, Properties of Concrete, 4th edition, 2006, ELBS with Longman, UK
2. M L Gambhir, Concrete Technology, 3rd edition, 2006, Tata McGraw Hill, New Delhi
3. M S Shetty, Concrete Technology, 2008, S. Chand & Co., New Delhi
4. R. N. Raikar, Diagnosis and treatment of structures in distress, Published by R&D Centre of Structural Designers & Consultants Pvt. Ltd., Mumbai, 1994.
5. Raikar, R.N., "Learning from failures - Deficiencies in Design", Construction and Service - R and D Centre (SDCPL), Raikar Bhavan, 1987
6. Handbook on Repair and Rehabilitation of RCC buildings, Published by CPWD, Delhi, 2002.
7. Balaguru P.N. and Shah S.P., Fibre Reinforced Cement Composites, McGraw Hill, New Delhi
8. Hannant D.J., Fibre Cements and Fibre Concretes, John Wiley and Sons, New York
9. Naaman, A.E., Ferro cement and Laminated Cementitious Composites, Techno Press, USA

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1: Mapping of Course Outcomes with Program Outcomes:

Course Outcome	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO1	3		3	1	1	
CO2	2	1		1	1	3
CO3	3	3		2	2	
CO4	2		3	3		1
CO5		2	2		1	1

3-High, 2-Medium, 1-Low**Table 2: Recommended Assessment Pattern**

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total Marks 100		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)
Class Test	04	04	04	04	04
Teacher's Assessment	04	04	04	04	04
ESE	12	12	12	12	12

**AMPEC5006: Programme Elective -I: Numerical Methods and Optimization Techniques
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: The course content mainly focuses on different numerical techniques, finding solutions to real-time problems, apply the optimization techniques in the engineering field and applying optimization techniques for solving multi task applications.

Course Outcomes:

After successful completion of this course, students will be able:

1. To solve engineering problems using various computational methods.
2. To select appropriate techniques for tackling problems in structural engineering and building science.
3. To apply various optimization methods.
4. To develop capabilities of optimization programs.

Detailed Syllabus:

Unit -1:	Calculus of variation: Concepts of maxima and minima of functions, Constraints and Lagrange multipliers, extreme value of functional, Euler's Equations, solutions of Euler's equation, Lagrange equations generalized dynamic Excitations- constraints in dynamical systems	06 Hrs
Unit -2:	Numerical solution of ordinary differential equations: Taylor series method, Picard's method, Euler's method modified Euler's method & R.K. Method. Elliptical equations standard five point formula, diagonal five point formula –Solution of Laplace equation by Leibmann's iteration method, Poisson's equation	06 Hrs
Unit -3:	Numerical solution of partial differential equations: Parabolic equations bender – Schmidt method – bender – Schmidt recurrence Equation, crank – Nicholson difference method, Eigen values and Eigen vectors – general method – power method, spectral method	06 Hrs

Unit -4:	A. Finite difference solution: Weighted residual methods for initial value problems and boundary value problems- collocation method- sub domain method- method of least Squares-Equations in two dimensions- parabolic equations- explicit finite difference method- Crank-Nicholson, Implicit method- ellipse equations- finite difference method- problems with irregular boundaries. B. Introduction to finite element method: Weighted Residual methods, least square method, Galerkin's method – finite elements – Interpolating over the whole domain – one dimensional case, two dimensional Case – application to boundary value problems.	06 Hrs
Unit -5:	Problem formulation with examples: Single variable unconstrained optimization techniques,– Optimality criteria - interpolation methods - gradient based methods Multi variable unconstrained optimization techniques – optimality criteria Unidirectional search - direct search methods - simplex method - gradient based methods -Constrained optimization techniques –classical methods - linear programming problem.	06 Hrs

TEXT/REFERENCE BOOKS:

1. Curtis. F. Gerald, Applied Numerical Analysis, Addeson Wesley Publishing Company, Latest Edition.
2. Grewal B. S., Higher Engineering Mathematics Khanna Publishers, Latest Edition, Latest Edition.
3. Xavier C., C – Language and numerical methods by, New Age International Publishers, Latest Edition.
4. Jain M.K., S.K.R. Lyengar, R. K. Jain., Computational methods for partial differential equations, Latest Edition.
5. Chopra S.C. and Canale R.P. Numerical Methods for Engineers Mc Graw Hill, Latest Edition.
6. Smith G.D. Numerical solutions for Differential Equations Mc Graw Hill, Latest Edition.
7. Ketter and Prawel Modern Methods for Engineering Computations” Mc Graw Hill, Latest Edition.
8. Rajasekharan S. Numerical Methods in Science and Engineering, S. Chand & company, Latest Edition.
9. Rajasekharan S., Numerical Methods for Initial and Boundary value problems,” Khanna Publishers, Latest Edition.
10. Terrence J. Akai, Applied Numerical Methods for Engineers, Wiley publishers, Latest Edition.
11. Rao S. S., Engineering Optimization– Theory and Practice, New Age International, Latest Edition.
12. Deb K., Optimization for Engineering Design – Algorithms and examples, Prentice Hall, Latest Edition.
13. Kirsch U., Optimum Structural Design, McGraw Hill, Latest Edition.
14. Arora J S. Introduction to Optimum Design, McGraw Hill, Latest Edition.

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 7) Technical quizzes
- 8) Application development
- 9) Question & answer / Numerical solution
- 10) Group discussion
- 11) Assignments on course content
- 12) Other if any

Table 1: Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		2		3	3
CO2	2	2	1	1		1
CO3		3	3	1		
CO4	2	3		1	1	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20	Teachers Assessment/ Assignment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4	K1, K2, K3, K4
Class Test Marks	02	06	04	08
Teachers Assessment Marks	03	03	06	08
ESE Marks	06	18	18	18

**AMPEC5007: Programme Elective -I: Project Planning and Management
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4 Hrs/Week	Class Test (ISE-I)	20Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End Semester Examination	60 Marks
		Total	100 Marks

Pre-requisites: Not Applicable

Course Objectives: The objective of the course to know the students' basics of project management and planning.

Course Outcomes: On successful completion of this course, students will be able to-

1. Understand basics of project planning
2. Apply management methodology, monitoring and control techniques.
3. Understand environmental dimensions of a project and stresses on environment.
4. Understand project management, process management and project organization
5. Know Progress, Performance and Risk Measurement

Detailed Syllabus:

Unit -1:	The Basics of Project Planning Introduction, what is Project Planning? Why do we need project planning? Elements of project plan,. Project Scope Planning, Triangular Constraints (TQR), Delivery Schedule Planning, Project Resources Planning, Project Cost Planning, Project Quality Planning, Supporting Plans- Risk Management Plan, Communication Plan, Procurement Plan,	06 Hrs
Unit -2:	Project Management Methodology, Monitoring &Control Management methodology, Control and Risk, Balancing the Control System, Progress Reporting System, Five Types of Status Reports, Variances, How & When To Collect Data?, How and What Information to Update, Displaying Status, Charting the Work Break down Structure(WBS) to Report Project Status	06 Hrs
Unit -3:	Environmental Appraisal of Projects Objective, Introduction, Types and Environmental Dimensions of a Project , Stresses on Environment, Environmental Impact Assessment Methodologies	06 Hrs
Unit -4:	Project Management. & Project Organization Introduction, project management and process management, Project organization and responsibilities, Organizational models, Choosing the project organization, Developing a project network plan, Time Calculations.	06 Hrs
Unit -5:	Progress, Performance and Risk Measurement Introduction, The project control process, Performance Indicators, Project monitoring ,Evaluation, and Control, Risk management and Risk Identification, Risk Analysis, Risk Response andRisk control.	06 Hrs

References:

- 1) Prasana Chandra: Projects-Planning Analysis, Selection, Implementation & Review, Tata McGraw Hill, New Delhi.
- 2) M. Shaghil and M. Mushtaque: Project Planning and Management Vol. 1
- 3) C. Choudhury: Project Management, Tata McGraw Hill, New Delhi – 1995
- 4) Desai, Vasant: Project Management
- 5) P. Gopala Krishnan and V. Rama Moorthy: Project Management

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1: Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low**Table 2: Recommended Assessment Pattern**

Assessment Pattern Level No.	Knowledge Level	Class Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

VSEC- AMVSE5012: Mini Project

Teaching Scheme		Evaluation Scheme	
Practical	4 Hrs/Week	Class Test (ISE-I)	---
Tutorial	-	TW (ISE-II)	25 Marks
Total Credits	2	End Semester Examination (Viva Voce Examination)	25 Marks
		Total	50 Marks

Prerequisites:

Students should know the general use of computers.

Course Outcomes:

After successful completion of the course, students will be able:

1. To compile and prepare a technical report from the collected literature.
2. To present the literature in a comprehensive manner.
3. To identify the problem for the dissertation

Term Work:

The Mini Project with Seminar shall consist of collection of literature from a chosen field of Structural Engineering from various sources such as refereed journals, proceedings of national international conferences, PG/PhD theses etc. Based on the literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical/Experimental modeling, etc., as necessary the candidate shall define the problem for the dissertation.

The candidate shall prepare a technical report in a prescribed format and present before a panel of examiners consisting of guide and at least one faculty member of the department.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation: A mid-term evaluation shall be done as per the schedule given in the institute academic calendar. Student should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and one faculty members appointed by the DCoE as external examiners. The panel of examiner will assess the contents and presentation and give the suggestions, if any. In this phase student is expected to collect and present substantial literature.

Part-II: End Semester Evaluation for 25 Marks: Student should prepare technical report in prescribed format duly incorporating suggestions of Part-I and present power point presentation before the panel of examiners and class students. The student should be able to answer the questions asked. The panel of examiner will assess the seminar contents and seminar presentation and assigns the marks out of 25. In this phase the students is expected to define the problem for dissertation through further literature survey, case studies, data collection, surveys, pilot studies, mathematical/analytical modeling, etc., as necessary.

Table 1: Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	1	1	2
CO2		2	2		1	3
CO3	2		2	1		

3-High, 2-Medium, 1-Low**Table 2: Recommended Assessment Pattern**

Assessment Pattern Level No.	Knowledge Level	Term Work Assessment	Viva-voce Examination
K1	Remember	03	02
K2	Understand	08	05
K3	Apply	06	06
K4	Analyze	08	12
K5	Evaluate		
K6	Create	--	--
Total Marks		25	25

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3
	K1,K2,K3, K4	K1,K2,K3, K4	K1,K2,K3, K4
Term Work- 25 Marks	08	08	09
Viva-voce Assessment-25 Marks	05	10	10

AMELC 5001: Research Methodology

Teaching Scheme		Evaluation Scheme	
Theory	2 hrs/week	ISE I	20 marks
Tutorial	-	ISE II	20 marks
Total Credits	2	ISE III	-
		ESE	60 marks
		Total	100 Marks

Prerequisite: Nil

Course Description: The objective of this course is to expose the prospective researchers to basic methodologies and techniques of carrying out research work. The course provides detailed knowledge of developing a research plan and research design. Various statistical methods, optimization techniques, soft computing techniques are included in the course which will be needed for research work.

Course Outcome: After successful completion of the course, students will be able to

	Course Outcomes
CO1	Develop a research plan and define the research problem
CO2	Analyse the data required for research
CO3	Solve the mathematical model developed with the help of optimization techniques

Unit-I : Objectives of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Defining the Research Problem, Selecting the Problem, Technique Involved in Defining a Problem, Research Design, Important Concepts Relating to Research Design, Developing a Research Plan, Literature review.

Unit-II: Data analysis, Types of data, process of data analysis: sampling, cleaning etc. Classification and Presentation of data, Basic Concepts of Probability, Probability Axioms, Analysis and Treatment of Data, smoothening of Data, Population and Samples, Measures of Central Tendency, Measures of Dispersions, Measures of Symmetry, Measures of Peakedness. Regression Analysis – Simple Linear Regression, Multiple linear Regression, Correlation.

Unit-III: Optimization Techniques: Linear Programming, Simplex Method, Dual Simplex, Sensitivity Analysis. Artificial Variable Technique, Dynamic Programming, Introductory concepts of non-linear programming.

Unit-IV: Fuzzy logic: Introduction, Concepts, Basic Fuzzy Mathematical Operations, Fuzzy databases, Membership Functions, Fuzzy Linear Programming, Neural Networks: Artificial Neural Networks, architectures and algorithms, Basic neuron models, Neural network models, Learning algorithms, Genetic Algorithms: Introduction to genetic algorithm, Operators, Applications.

Recommended Books:

1. Research Methodology, C. R Kothari & Gaurav Garg, 5th Edition Book, New Age International Publishers, New Delhi
2. Research Methodology: A Step by Step Guide for Beginners, Ranjit Kumar, 2nd edition, Pearson's publication
3. Engineering Optimization, Theory and Practice, Rao S. S., *New Age International Publishers, New Delhi*
4. Statistical Methods, S P Gupta, S Chand & Sons, New Delhi

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1		3	
CO2	1		1			
CO3	1		3	1	2	2

1 – Low 2 – Medium 3 – High

Assessment: ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects on First and Second unit

ISE II: Shall be based on class test on third and fourth units

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	10			20
K2	Understand	10	10		20
K3	Apply		10		20
K4	Analyze				
K5	Evaluate				
K6	Create				
Total Marks 100		20	20		60

Assessment table

Assessment Tool	K1	K2	K3
	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3
ISE I (10 Marks)	10	10	
ISE II(10 Marks)		10	10
ISE III (0 Marks)			
ESE Assessment (30 Marks)	20	20	20
Total	30	40	30

**INCC5001: CC-YOGA/CLUB
(NEP 2020 MODEL COURSE)**

Teaching Scheme		Evaluation Scheme	
Theory		Audit Course	
Practical's	2 Hrs/Week		
Total Credits	00		

Course Description:

Co-curricular activities are activities that take place outside of a course's curriculum but are related to academics in some way. Although involvement is not part of classroom instruction, it does supplement and enhance a student's academic experience.

Yoga –

In today's stressful life, there is much more need to experience relaxation and remain focused. The inner connect is very much needed to retain stability. Beyond physical exercise there is much more to do in the field of Yoga. The content of this course includes Yoga, Pranayam, Meditation, Relaxation, rejuvenation and connection with our own self. The introduction of such an experiential course helps to boost self-confidence and with regulation of mind through meditation improves concentration. Meditation is basically training of mind and helps to regulate it. Along with experiential learning, the students are also exposed to learnings contained in the supported literature.

The student shall perform: a) Perfection in at least 3 types of Yoga-asanas (Trikonasan, Konasan and Ushtrasan) b) Perfection in at least 3 types of Pranayama (Anulom-Vilom, Bhramari and Kapalbhathi) c) Regular practice of Yoga-asanas, Pranayam and Meditation for 10 minutes during the allotted periods as per the time table and daily at home.

The evaluation is based on participating and performing Yoga, Pranayam and meditation regularly and perfectly under the guidance by Yoga Teachers. Meditation trainers will observe intrinsic goodness, right attitude and happy and joyous way of doing things.

Club activities:

Government Engineering College Aurangabad has various clubs that focus on specific interests such as robotics, coding, literature, environment, etc. These clubs often organize events, workshops, and competitions that provide students with opportunities to learn new skills and showcase their talents. Students will participate in Club Activities throughout semester. Faculty coordinators will coordinate along with student's bodies the activities of club.

The faculty coordinators will certify at the end of semester about participation of students

SEMESTER-II**AMPCC5101: PCC- Finite Element Method
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not Applicable**Course Description:** This course offers a numerical method good for solving complex structural problems based on finite element method.**Course Outcomes:**

After successful completion of the course, students will be able:

1. To identify structural behavior of various types of finite elements used in structural analysis.
2. To analyze typical structural engineering problems using basic mathematical methods relevant to finite element analysis of structures.
3. To define and use various iso-parametric finite elements in structural analysis.
4. To compute error estimates in finite element analysis of structures.
5. To apply appropriate modeling considerations for solving various structural problems.

Detailed Syllabus:

Unit -1:	Introduction to Finite Element Analysis Introduction to finite element method, Types of finite elements, Properties of various finite elements	06 Hrs
Unit -2:	Variational Methods of Formulation Principle of stationary potential energy, Rayleigh-Ritz method, formulation by weighted residual methods: Galerkin and other methods, Mixed formulation	06 Hrs
Unit -3:	Isoperimetric Elements: Triangular, quadrilateral, tetrahedral, hexahedral, etc; Numerical integrations, Static condensation, Load considerations and stress calculations, Patch test	06 Hrs
Unit -4:	Error Estimation and Convergence: Sources of error, ill-conditioning, discretization error, convergence rate, mesh revision methods	06 Hrs
Unit -5:	Modeling Considerations: Physical behavior vs element behavior, element shapes and interconnection, material properties, loads and reactions, connections in structures, boundary conditions, stress concentrations	08 Hrs

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

References:

1. Cook R D, Malkus D S, M E Plesha and R J Witt, Concepts and applications of finite element analysis, 4th edition, John Wiley & Sons, Inc., Singapore, Latest Edition.
2. Chandrupatla T R and Belegundu A D, Introduction to finite elements in engineering, 3rd edition, Pearson Prentice Hall, India, Latest Edition.
3. Reddy J N, An introduction to the finite element method, 3rd edition, Tata McGraw Hill, India, Latest Edition.
4. Bathe K J, Finite element procedures, Phi Learning Private Limited, New Delhi, Latest Edition.
5. Desai Y M, Eldho T I and Shah A H, Finite element method with applications in engineering, Pearson, Delhi, Latest Edition.
6. Olgierd C. Zienkiewicz, R. L. Taylor, The Finite Element Method: Basic Formulation and Linear Problems, Volume 1, McGraw-Hill College, Latest Edition.
7. Desai / Abel, Introduction to Finite Element Method, Paperback, Latest edition.

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPCC5102: PCC-II: Theory of Plates and Shells
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	4Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	4	End-Semester Examination	60 Marks
		Total	100 Marks

Prerequisites: Not Applicable

Fundamentals of strength of materials, theory of elasticity and analytical and numerical methods of solving higher order partial differential equations.

Course Description:

The course provides analysis of thin plates, shells and folded plates. Students are exposed to classical theories and their applications. The content can be applied for the design of structures such as slabs, retaining walls, domes, silos, folded staircase, etc.

Course Outcomes:

After successful completion of this course, the student will be able:

- 1) To classify types of plates, shells and folded plates.
- 2) To apply methods of analysis of plates and shells.
- 3) To compare the results of analysis by various methods.
- 4) To appreciate the structural behavior of plates, shells and folded plates.

Detailed Syllabus

Unit-1	Fundamentals of analysis of plates Review of plane stress and plane strain problems of elasticity, moment curvature relationships, Classification of plates with reference to deflection, Long rectangular thin plate with small deflections	06 Hrs
Unit -2	Analysis of rectangular plates Kirchhoff's small deflection theory of thin plates, Navier and Levy's method, boundary conditions, lateral and in plane loading, Finite difference solution	06 Hrs
Unit -3	Analysis of circular plates Symmetrical bending of plate, differential equation in polar coordinates, uniformly loaded and concentrically loaded plates with various boundary conditions, circular plate with a hole.	06 Hrs
Unit -4	Membrane theory of analysis of shells Classification of shells, assumptions, analysis of shells of revolutions: circular, cylindrical, elliptical, hyperbolic and paraboloid shells	06 Hrs
Unit -5	Analysis of shell and Folded plate Bending theory of analysis of shells Folded plate: structural behavior, three shear equation, Simpson and Whitney's methods	06 Hrs

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

TEXT AND REFERENCE BOOKS

1. Timoshenko and Kreiger, "Theory of Plates and Shells", Tata McGraw Hill Company, New Delhi, Latest Edition.
2. Szillard R., "Theory and analysis of plates", Prentice Hall, Latest Edition.
3. Szillard R., "Theories and applications of plate analysis: classical, numerical and engineering methods", John Wiley and Sons, Latest Edition.
4. Chandrashekhara K., "Theory of plates", University press India Ltd., Hyderabad Latest Edition.
5. Ramaswamy G.S., "Design and construction of concrete shell roofs", CBS Publishers and Distributors, India, Latest Edition.
6. Reddy J.N., "Theory and analysis of elastic plates and shells", CRC, Latest Edition.

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1		2	3
CO2	1	1			3	3
CO3		1	2		2	1
CO4	2	3		1	2	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4
Class Test Marks	05	05	05	05
Teachers Assessment Marks	04	04	06	06
ESE Marks	15	15	15	

**AMPC5103: PCC II- Design of Advanced RC Structures
(NEP- 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Lectures	4Hrs/Week	Test (ISE-I)	20 Marks
Tutorials	-	Teacher Assessment(ISE-II)	20 Marks
Total Credits	4	End-Semester Examination	60 Marks
		Total	100 Marks

Prerequisites: Usual undergraduate course in elementary theory and design of RCC structures should have been studied earlier.

Course Description:

Objectives:

1. To make the students aware of the code provisions for design of advanced structures
2. To expose students to analysis of and design of advanced RCC structures.
3. To expose students to analysis and design of various steel structures.

Course Outcomes expected

After successful completion of the course, students will be able to:

1. Design various industrial structures using relevant codes and standards
2. Design and Detailing of RCC structures as per current Practice Design and detailing of industrial steel structures as per current practice
3. Associate the design concept with overall design of advanced structures.

Detailed Syllabus:

Unit-1	Analysis and design of structures for storage of liquids: Provisions of IS 3370; Durability requirements, crack width, deflection and strength analyses; various methods of analysis and design of sections. Analysis and design of liquid retaining overhead structures like water tanks circular and rectangular in plan and design of staging.	06 Hrs
Unit-2	A. Design and detailing of deep beams by IS 456. B. Analysis and design of reinforced shear walls: Classification, Loads on shear walls, Design of rectangular and flanged shear walls, Moment of resistance of rectangular shear walls.	06 Hrs
Unit-3	A. Analysis and design of storage bins Analysis and design of industrial square/circular bunkers and silos B. Analysis and design of chimneys	06 Hrs
Unit-4	Analysis and design of industrial steel structure buildings	06 Hrs
Unit-5	Plastic analysis and design for rectangular frames, gable frames. Beams columns.	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

References:

1. Punmia B. C., A K Jain and A K Jain, Comprehensive Design of RCC Structures, Laxmi Publications (P) Ltd, New Delhi
2. Varghese P. C., Advanced Reinforced Concrete Design, 2nd Edition, Prentice-Hall of India Pvt Ltd, New Delhi, 2005
3. Ramamrutham S., Design of Reinforced Concrete Structures, Dhanpat Rai Publishing Company, New Delhi, 2007
4. Krishna Raju N., Advanced Reinforced Concrete Design, CBS Publishers & Distributors, Delhi
5. IS 456: 2000 Plain and Reinforced Concrete- Code of Practice, Bureau of Indian Standards, New Delhi.
6. Handbook on Concrete Reinforcement and detailing, Special Publication SP 34, Bureau of Indian Standards, New Delhi, 1987
7. IS: 800 – 2007 Code of Practice for General Construction in Steel
8. Comprehensive Design of Steel Structures, Punmia B. C., Jain A. K., Laxmi Publications(P)Ltd, New Delhi Subramanian N., “Design of Steel Structure “Oxford University Press, New Delhi.
9. Duggal S.K., “Limit state Design of steel structures by Limit State Method “ as per IS: 800- 2007 by Tata McGraw Hill Education Private limited New Delhi

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	3	3	
CO2	2	2		3	3	1
CO3	2	2	3		1	1

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4,
Class Test Marks	05	05	05	05
Teachers Assessment Marks	04	04	06	06
ESE Marks	15	15	15	

**AMPEC5104: Programme Elective - II – Advance Seismic Analysis & Design
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial		Teacher's Assessment(ISE-II)	20 Marks
Total Credits	03	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Must have undergone course AM-51002- Structural Dynamics & Earthquake Engineering

Course Description: Earthquake resistant design is an essential requirement in the analysis and design of structures. This is a course in continuation of the course in Structural Dynamics & Earthquake Engineering. This course is intended to give an insight into the advanced aspects of earthquake analysis and design after undergoing the basic course. The course aims to expose the students to numerical solutions of equations of motion, performance based design principles. The students are also exposed to the basics base isolation systems and various vibration control techniques. At the end of the course students will be able to contribute towards research in the area during their dissertation work.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Formulate analysis algorithm of MDOF structures using numerical integration methods.
2. Compute the forces in an unsymmetrical building
3. Explain the principles of performance based seismic design and obtain performance point for a given seismic demand.
4. Apply linear theory of base isolation to structures to find out the dynamic properties of a base isolated structure
5. Enlist different vibration control techniques and explain their behavior under seismic loading.

Detailed Syllabus:

Unit 1	Numerical Integration of Equations of Motion Reduction of DOF, static condensation, modeling of MDOF systems, Rayleigh-Ritz method, selection of Ritz vectors, numerical evaluation of response, time-stepping methods, Newmark-Beta method	6 Hrs
Unit 2	Seismic analysis of unsymmetrical buildings Seismic analysis of unsymmetrical structures, Centre of Mass and Centre of Stiffness, Eccentricity, Torsion, Modelling and Formulation of unsymmetrical buildings, Accidental eccentricity, Distribution of forces in buildings due to torsion	6 Hrs
Unit -3:	Performance Based Design Approach Performance based design, Performance criteria, Push-over analysis, capacity spectrum method, performance point, Different types of hinges	06 Hrs

Unit -4	Linear theory of base isolation Vibration control systems, passive, active, hybrid and semi-active systems, base-isolation, base-isolation principles and systems, linear theory of base-isolation	06 Hrs
Unit -5	Passive vibration control techniques Tuned mass dampers, Tuned Liquid dampers, Viscous dampers, Friction dampers, basic formulations	06 Hrs

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

References:

1. Clough R. W. and Penziene J., "Dynamics of Structures", Mc-Graw Hill, Latest Edition
2. Chopra A. K., "Dynamics of Structures: Theory and Applications to Earthquake Engineering", Pearson Education, Latest Edition.
3. Paz Mario, "Structural Dynamics", Springer, Latest Edition.
4. Kramer Steven, "Geotechnical Earthquake Engineering", Pearson Education, Latest Edition
5. Dowrick D.J., "Earthquake Resistant Design for Engineers", John Wiley Publishers, Latest Edition
6. Duggal S.K., "Earthquake Resistant Design of Structures", Oxford University press, Latest Edition
7. Hosur Vinod, "Earthquake Resistant Design of Building Structures", Wiley, Latest Edition
8. IS: 1893 (Part-I) -2016, "Criteria for earthquake resistant design of structures" Bureau of Indian Standards, New Delhi
9. IS:13920-2016, "Ductile Detailing of Reinforced Concrete Structures subjected to seismic forces-code of practice" Bureau of Indian Standards, New Delhi

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5105: Programme Elective II – Mechanics of Composite Materials
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End-Semester Examination	60 Marks

Prerequisites:

Knowledge about Solid Mechanics

Course Description:

The course provides the information about mechanics of various types of composite materials.

Course Outcomes:

After successful completion of this course, the student will be able to

1. Understand the basic aspects of the mechanics of fiber-reinforced composite materials and failure theories of a lamina.
2. Analyze the lamina and laminates.
3. Evaluate mechanical properties of composite materials
4. Able to pursue research work in the field of laminated composites.

Unit-1	Introduction: Definition of Fiber reinforced Composites, Applications and Various reinforcement and matrix materials.	06 Hrs
Unit -2	Mechanics of a Lamina: Linear elastic stress-strain relations, Elastic constants based on micromechanics, Plane stress constitutive relations, Transformation of stresses, strains and material coefficients, thermal stresses and strains.	06 Hrs
Unit -3	Laminated Composites: Types of laminated composites, Displacement field approximations for Classical Laminate theory, Laminate Strains, Stress resultants, Stiffness matrices, stresses and strains due to applied loads. Introduction to First Order Shear Deformation Theory.	06 Hrs
Unit -4	Failure Theories of a Lamina: Maximum Stress Failure Theory, Maximum Strain Failure Theory, Tsai-Hill Failure Theory, Tsai-Wu Failure Theory.	06 Hrs
Unit -5	Mechanical Properties Determination: Tensile properties, Compressive properties, Flexure properties, In-plane shear properties, Inter-laminar shear strength.	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

TEXT AND REFERENCE BOOKS

1. R. M. Jones, Mechanics of Composite Materials, Taylor and Francis Group 1999
2. K. Kaw. Springer: Mechanics of Composite Materials: CRC Press
3. P. K. Mallick: Fiber Reinforced Composites: CRC Press.
4. Agarwal. B. D., Broutman. L.J., and Chandrashekhara. Performance of Fiber Composites", John-Wiley and Sons, 2006

5. Daniel. I.M., and Ishai. O, “Engineering Mechanics of Composite Materials”, Oxford University Press, 2005
6. Hyer M.W., and White S.R., “Stress Analysis of Fiber-Reinforced Composite Materials”,
7. Mukhopadhyay. M, “Mechanics of Composite Materials and Structures”, Universities Press, India, 2005.

Evaluation Pattern

Table 1: Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	3	3	
CO2	3	3	1	1	2	2
CO3	2	2		2	2	3
CO4	3	3	2	1	2	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4
Class Test Marks	05	05	05	05
Teachers Assessment Marks	04	04	06	06
ESE Marks	15	15	15	15

**AMPEC5106: Programme Elective II Advance Steel Structure
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End-Semester Examination	60 Marks

Prerequisite: In conjunction with theory of courses Design of steel structure

Course Description: This course intends to provide students comprehensive knowledge on the design of steel structure. The course focuses on the five topics shown in detail syllabus.

Course Outcomes

After successful completion of this course, the student will be able to

- 1) analyze and design knee braced steel frame
- 2) understand the Concept of design gable portal steel frame
- 3) understand the Concept of design Open web frames for industrial shed
- 4) design and Select various types of plate girders
- 5) possess knowledge of design of steel structures, steel code provisions and behavior of structural steel.

Detailed syllabus

UNIT-1	Analysis and design of knee braced trussed bent with hinged, fixed and partially fixed bases without gantry. Design of knee brace, roof column and its base. Various types of column configurations in case of knee braced trussed bent with gantry loads. Design of stepped columns and bases under various load combinations.	06 Hrs
UNIT-2	Analysis and design of gable portal frame with and without gantry loads. Design of bracket supporting gantry loads.	06 Hrs
UNIT-3	Open web frames for industrial shed, trussed purlins, analysis and design of two storey building.	06 Hrs
UNIT-4	Design in light gauge steel –forms of light-gauge sections, local buckling of thin elements, multiple stiffened compression elements, axially loaded column, laterally supported beams.	06 Hrs
UNIT-5	Plate Girder Bridges - Types of floor systems, design of deck type plate Girder bridges for broad gauge railway, horizontal truss bracings and end cross frames.	06 Hrs

References Books

1. Ramachandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
2. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand & Bros., Roorkee
3. Teaching Resource for Structural Steel Design – INSDAG Kolkata
4. IS: 800 – 1984 Code of Practice for General Construction in Steel
5. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards (Revised)
6. IS: 4137 – 1967 Code of practice for Heavy Duty Electric Overhead Traveling Crane
7. Steel Designers Manual – ELBS
8. John E. Lothares – Advanced Design in Structural Steel, Prentice Hall
9. D. Johnson Victor - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
10. T.R. Jagadeesh, M.A. Jayaram - Design of Bridge Structures, Prentice-Hall of India
11. N. Krishna Raju - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
12. IS: 800 – 1984 Code of Practice for General Construction in Steel
13. IS: 875 – 1964 Code of Practice for Structural Safety of Building: Loading Standards (Revised)
14. IS: 1915 – 1961 Code of Practice for Steel Bridges
15. IS: 800 – 2007 Code of Practice for General Construction in Steel
16. Comprehensive Design of Steel Structures, B. C. Punmia, A. K. Jain, Laxmi Publications(P)Ltd, New Delhi.

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1: Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18

K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5107: Programme Elective -Elective II – Soil Structure Interaction
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	04Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: In this course focus is on idealization of soil response to closely represent continuum behavior and interaction analysis between the soil-structure with reference to relative stiffness of beams, slabs and piles under different loading conditions.

Course Outcomes:

After successful completion of the course, students will be able:

1. To explain concept of nature and complexities of soil structure interaction.
2. To analyse soil structure interaction for different types of structural elements under various conditions of loading and subsoil characteristics.
3. To determine the pile capacities for different loading.
4. To carry out linear and non-linear analysis.
5. To solve structural interaction problems under earthquake loading.

Detailed Syllabus:

Unit -1	Soil Response Interaction Analysis: Soil–foundation interaction problems, Soil behavior, Foundation behavior, Interface behavior, soil-foundation interaction analysis, soil response models, Elastic continuum, Winkler model.	06 Hrs
Unit -2	Soil Structure Interaction: Interaction problems based on theory of sub grade reaction on beams, footings, rafts.	06 Hrs
Unit -3	Analysis of Pile and Pile Groups: Determination of pile capacities and negative skin friction, group action of piles, Anchor piles, laterally loaded piles and pullout resistance, well foundation	06 Hrs
Unit -4	Linear and Non-Linear Analysis: Analysis of different types of frame structure founded on stratified natural deposits with linear and non-linear stress-strain characteristics.	06 Hrs
Unit -5	Engineering Applications of Dynamic Soil-Structure Interaction: Low rise residential buildings, multistory buildings, bridges, dams, nuclear power plants, offshore structures, soil-pile-structure interactions.	06 Hrs

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes

- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

References:

1. Bowels J.E., "Analytical and Computer Methods in Foundation", McGraw Co. New York, Latest Edition.
2. Desai C.S. and Christian J.T. "Numerical Methods in Geotechnical Engineering" McGraw Hill Book Co. New York, Latest Edition.
3. Soil Structure Interaction, The real behavior of structures, Institution of Structural Engineers, Latest Edition.
5. Elastic Analysis of Soil Foundation Interaction, Developments in Geotechnical Engg.vol-17, Elsevier Scientific Publishing Co., Latest Edition.
6. Selvadurai A.P.S. "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific Publishing Company, Latest Edition.
7. Swami Saran "Analysis& Design of substructures", Oxford& IB Publishing Co. Pvt. Ltd., Latest Edition.
8. Kurian Nainan P. "Design of Foundation System- Principles & Practices", Narosa Publishing House, Latest Edition.
9. Salgado, R., "The Engineering of Foundations", Tata McGraw Hill Education Private Limited, New Delhi, Latest Edition.
10. Saran, S, "Analysis and Design of Substructures", Taylor & Francis Publishers, Latest Edition.
11. Hemsley, J.A, "Elastic Analysis of Raft Foundations", Thomas Telford, Latest Edition.
12. Poulos, H.G., and Davis, E.H., "Pile Foundation Analysis and Design", John Wiley, Latest Edition.
13. Selvadurai, A.P.S., "Elastic Analysis of Soil Foundation Interaction", Elsevier, Latest Edition.
14. Kurien, N.P., "Design of Foundation Systems: Principles and Practices Narosa Publishing House, New Delhi, Latest Edition.
15. Wolf, J. P., "Dynamic Soil-Structure Interaction", Prentice-Hall, Latest Edition.
16. Cakmak, A.S. – Editor, "Soil-Structure Interaction", Developments in Geotechnical Engineering 43, Elsevier and Computational Mechanics Publications, Latest Edition.
17. Wolf, J.P., "Soil-Structure Interaction in the Time-Domain", Prentice Hall, Latest Edition.
18. Wolf, J.P. and Song C. "Finite Element Modelling of Unbounded Media", John Wiley & Sons, Latest Edition.

Table 1: Mapping of Course Outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low**Table 2: Recommended Assessment Pattern**

Assessment	Knowledge Level	Class Test	Teachers	End Semester
Pattern Level No.		20 Marks	Assessment 20 Marks	Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5108: Programme Elective II – Advanced Structural Analysis
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	04 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisites:

Fundamentals of Structural Analysis, Matrix algebra, Solution of equations,

Course objectives:

- 1) To make the students to understand matrix methods of analysis.
- 2) To make the students apply these methods for analysis using software's.
- 3) To make the student to analyze various types of structures.

Course Outcomes:

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

1. To differentiate between various methods of analysis for multistory frames.
2. To categorize and choose appropriate structural analysis method.
3. To analyze the structure using software.
4. To prepare algorithm and flowchart for analysis of structure.
5. To formulate and analyze beams on elastic foundation.

UNIT-1	Flexibility method: Review of basics of flexibility method. Analysis of frames, trusses, space frames, grids (programme/ software).	08 Hrs
UNIT-2	Stiffness methods: Review of basics of Stiffness method, Analysis of frames, trusses, space frames and grid structures. Substructure analysis techniques. computer oriented direct stiffness method.(programme/ software)	08 Hrs
UNIT-3	Principle of multiple and substitute frame method	05 Hrs
UNIT-4	Beams on elastic foundation: Governing differential equation, solution for finite and infinite beams, energy methods	05 Hrs
UNIT-5	Secondary stresses in frames and trusses.	04 Hrs

TEXT AND REFERENCE BOOKS

1. J.M. Gere & W. Weaver, Analysis of Framed Structures, 2nd edition, 2004, CBS, New Delhi
2. F.W. Beaufait, Basic concept of Structural Analysis ,1977, Prentice Hall, Englewood cliffs, N.J.
3. T. R. Taucher, Energy Principles of Structural Mechanics, 2nd edition, 2006, Tata McGraw Hill, New Delhi
4. Harold C. Martin, Introduction to Matrix Methods Of Structural Analysis, 15th edition, 1966, Tata McGraw Hill, New Delhi
5. M. Heteny, Beams on Elastic Foundation, 2nd edition, 1946, university of Michigan Press, USA
6. M. F. Rubinstein, Matrix computer Analysis of structure, 2nd edition, 1966,

- Prentice Hall, Engle-wood cliffs, N.J.
 7 Dr. A.S. Meghre & S.K. Deshmukh, Matrix Method of Structural Analysis 1st edition, 2003, Charotar Publication, Anand-Gujrat

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

Table 1: Mapping of Course Outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5109: Programme Elective III – Fracture Mechanics
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Lectures	3 Hrs/Week	Class Test(ISE-I)	20 Marks
Tutorials	-----	Teacher Assessment(ISE-II)	20 Marks
Total Credits	3	End-Semester Examination	60 Marks

Prerequisites:

Usual undergraduate courses strength of materials / mechanics of solids or materials should have been studied earlier.

Course Objectives:

The course on fracture mechanics is usually not taught at undergraduate level. The postgraduate students would learn the peculiar ways of structural failures due to fracture.

Course Outcomes

After successful completion of this course, the student will be able to

- 1) understand the various fracture modes
- 2) understand the concept of yield criteria and fracture mechanisms
- 3) understand the relations between K and G
- 4) to study plastic deformations and Mixed mode fracture
- 5) explain fracture toughness testing, crack arrest and repairing techniques

UNIT-1 Overview of fracture mechanics: Historical cases of failures by fracture, fracture modes	06 Hrs
UNIT-2 Yield criteria, crack initiation, growth and fracture mechanisms, LEFM, EPFM, life estimation	06 Hrs
UNIT-3 Fracture strength, Energy release rate (G), crack-tip stresses and displacements, stress-intensity-factor (K) for different geometries and loadings, relation between K and G	06 Hrs
UNIT-4 Plastic deformations near crack-tip, J-integral, Irwin's model, Dugdale's approach, Mixed mode fracture	06 Hrs
UNIT-5 Fracture toughness testing, crack arrest and repairing techniques	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution

- 4) Group discussion
- 5) Assignments on course content

TEXT AND REFERENCE BOOKS

1. K Ramesh, Engineering Fracture Mechanics, e-book, IIT Madras, 2007
2. D Broek, Elementary Engineering Fracture Mechanics, Martinus Nijhoff Publishers, The Hague, 1982
3. T L Anderson, Fracture Mechanics: Fundamentals and Applications, CRC Press Book, 2004
4. Prashant Kumar, Elements of Fracture Mechanics, Tata McGraw-Hill, New Delhi, 2009
5. Meguid S A, Engineering Fracture Mechanics, Elsevier Applied Science, London, 1989
6. Kanninen M F and Popelar C H, Advanced Fracture Mechanics, Oxford University Press, New York, 1985
7. Gdoutos E E , Fracture Mechanics-An Introduction, Kluwer Academic Publishers, Dordrecht, 1993

Evaluation Pattern

Table 1: Mapping of Course outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5110: Programme Elective III – Design of High Rise Structures
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3Hrs/Week	Class Test(ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisites: Not Applicable

This subject introduces students to the special requirements necessary for the successful design of high rise buildings. The student should know the basic knowledge of structural floor, framing and foundation systems, wind and earthquake loading, structural analysis techniques including computer-aided analysis.

Course Description: This course intends to provide students a comprehensive knowledge on the high-rise structures. The course is necessary for civil engineers because now a day's many high rise structures are getting constructed due to high land cost and to accommodate more population in lesser area. The various structural systems and the methods of analysis and design will be taught in this course. The behavior of building for wind and earthquake loading and how it affects the design of structural systems and the building services will be focused in this course.

Course Outcomes:

After successful completion of the course, students should be able to:

1. describe nature of designing a tall building and the role of a structural engineer in the design of tall buildings
2. differentiate various structural systems for high-rise buildings
3. Develop conceptual designs of floors using different floor systems
4. Analyze various structural systems in buildings
5. Analyze and designs foundation systems for different buildings and soil types

Detailed Syllabus:

Unit -1	General Considerations Introduction; Definition of a tall building; Lateral load design philosophy; Concept of premium for height; Factors responsible for slimming down the weight of structural frame; Development of high-rise architecture; structural concepts	06 Hrs
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Unit -2	Gravity and Lateral Load Resisting Structural Systems High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall-frames, tubular, cores, Steel-Concrete Composite Floor Systems Aluminum Facades, Modeling for approximate analysis, accurate analysis, subsystem interaction, differential movement, creep and shrinkage effects, temperature effects and fire.	06 Hrs
Unit -3	Design Criteria Design philosophy, static and dynamic approach, Structural systems and concepts, Effect of openings. Large panel construction. Foundation superstructure interaction. Wind effects, Nature of wind; Extreme wind conditions; Characteristics of wind; Provisions of IS875(Part3); Wind tunnel engineering – Introduction, Description, of wind tunnels; Objectives of wind tunnel tests, Rigid model studies, Aero elastic Tall building behavior during earthquakes; Philosophy of earthquake design; Provisions of IS1893(Part1).	06 Hrs
Unit -4	Stability of Tall Buildings Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity loading, simultaneous first order and P-Delta analysis, translational, Torsional instability. Lateral Systems for Steel Buildings, Lateral Systems for Concrete Buildings, Lateral Systems for Composite Construction	06 Hrs
Unit -5	Foundations Introduction, bearing capacity: Shallow and deep foundations; Settlement analysis, Different types of foundations and their designs: Raft, Piles, and Well foundation; Foundations subjected to dynamic loads.	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

Reference Books:

- 1) Taranath B. S., "Structural Analysis and Design of Tall Buildings", McGraw-Hill, latest edition.
- 2) Taranath B. S., "Steel, Concrete and Composite design of tall buildings", McGraw-Hill, latest edition.
- 3) Hill, latest edition.
- 4) Smith B. S. and A. Coull, "Tall Building Structures," John Wiley & Sons, latest edition
- 5) Schuellar, W, "High Rise Building Structures", John Wiley and Sons
- 6) Lynn S. Beedle, "Advances in Tall Buildings", CBS Publishers and Distributors, Delhi, 1996.
- 7) Gupta Y. P., "High Rise Structures: Design and Construction Practices in middle level cities"

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1		2	3
CO2	3	2		1	2	
CO3	2	1		3		1
CO4	2		2		3	3
CO5	3	3	3	3	2	--

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMPEC5111: Programme Elective III- Structural Assessment and Rehabilitation
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test(ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End-Semester Examination	60 Marks

Prerequisites:

Knowledge about Concrete Technology, Structural analysis and design

Course Description:

The course provides the information about condition assessment of the structure and its rehabilitation.

Course Outcomes:

After successful completion of this course, the student will be able to

- 1) Estimate the causes for distress and deterioration of structures
- 2) Apply NDT for condition assessment of structures and identify damages in RC structures
- 3) Select material and rehabilitation/retrofitting strategy suitable for distress
- 4) Formulate guidelines for repair management of deteriorated structures

Detailed Syllabus

Unit-1	Introduction and Condition Survey: Importance of structural assessment, Preliminary assessment through visual inspection methods, Various formats, Structural scores and interpretation	06Hrs
Unit -2	Material Condition Evaluation: Non-Destructive evaluation tests-Concrete strength assessment-Rebound hammer test-Ultrasonic pulse velocity tests, penetration resistance, pull out tests, core sampling and testing - Chemical tests-Carbonation tests and chloride content, Corrosion potential assessment-cover meter survey, half-cell potentiometer test, resistivity measurement, Load Test, Acceptance Criteria	06 Hrs
Unit -3	Structural Analysis and Assessment: Evaluation of reserve strength of existing structures, analysis necessary to identify critical sections, detailed structural assessment for seismic loads based on IS 1893-2016 Discussion of case studies of RCC buildings subjected to distress-Identification and estimation of damage - Fire damage assessment, structural integrity and soundness assessment, interpretation and evaluation of results	06 Hrs

Unit -4	Repair Materials: Selection of repair materials for concrete-Essential parameters for repair materials-Strength and durability aspects, cost and suitability aspects - Materials for repair-Premixed cement concrete and mortars, polymer modified mortars and concrete, epoxy and epoxy systems including epoxy mortars and concrete, polyester resins, coatings – FRP composites	06 Hrs
Unit -5	Rehabilitation and Retrofitting Methods: Identifying a suitable repair/retrofitting option for certain damage in a structure, guniting, shotcreting, polymer concrete system, reinforcement replacement, strengthening concrete by surface impregnation, polymer and epoxy overlays, plate bonding technique, Ferro cement jacketing, RCC jacketing, propping and supporting, fiber wrap technique, foundation rehabilitation methods etc.	06Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

TEXT AND REFERENCE BOOKS

1. R.N. Raikar, Learning from failures - Deficiencies in Design, Construction and Service, R and D Centre, Structural Designers and Consultants Pvt. Ltd. (SDCPL), Raikar Bhavan, Mumbai, 1987
2. Ravi Shankar. K., Krishnamurthy. T.S, "Structural Health Monitoring, Repair and Rehabilitation of Concrete Structures", Allied Publishers, 2004
3. CPWD Handbook on Repair and Rehabilitation of RCC buildings, Govt. of India Press, New Delhi, 2002.
4. Santhakumar A.R., "Concrete Technology" Oxford University Press, New Delhi, 2007.

Evaluation Pattern**Table 1: Mapping of Course outcome with Program Outcomes**

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		3	3	2	2
CO2		3	2		1	1
CO3	3	3	2	1		
CO4	2		3	2	1	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4
Class Test Marks	05	05	05	05
Teachers Assessment Marks	04	04	06	06
ESE Marks	15	15	15	15

AMPEC5112: Programme Elective III – Design of Bridges
(NEP-2020 Model Course)

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test(ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment (ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable.

Course Description: The contents of the course include analysis, design and detailing of various types of reinforced and prestressed concrete bridges.

Course Outcomes:

After successful completion of the course, students will be able:

1. To identify various structural forms of concrete bridges.
2. To define standard loads specified by IRC for bridges.
3. To analyze and design reinforced and prestressed concrete bridges.
4. To illustrate functioning of bearings and other structural elements in bridges.

Detailed Syllabus:

Unit -1	General forms of various types of bridges: Arch type, slab type, slab and beam type, plate girder type, open-web girder, suspension type, cable stayed type, etc.	06 Hrs
Unit -2	Live loads on Bridges: Loading standards for road bridges conforming to IRC, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, etc;	06 Hrs
Unit -3	Reinforced Concrete Bridges: Solid slab type, slab-girder type, skew type, curved type, continuous type, balanced cantilever type, arch type	06 Hrs
Unit -4	Prestressed Concrete Bridges: Advantages, systems of prestressing, prestress losses, preliminary dimensions, design principles, T-beams, box girders	06 Hrs
Unit -5	Substructure in Bridges: Piers, abutments, bearings, wing walls, and foundations	06 Hrs

ISE-I: Class test on first two Units

ISE-II : Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

References:

1. Hambly E. C, Bridge Deck Behaviors, E & FN SPON Publications, Latest Edition.
2. Raina V.K., Concrete Bridge Practice, Analysis, Design and Economics, Tata McGraw- Hills Publishing Company Limited, Latest Edition.
3. Ryall M. J., Parke G. A. R, Harding J.E., The Manual of Bridge Engineering, Thomas Telford Publishers, Latest Edition.
4. Rajagopalan R., Bridge Superstructure, Tata McGraw- Hills Publishing Company Limited, Latest Edition.
5. Ponnuswamy S., Bridge Engineering, Tata McGraw – Hills Publishing Company Limited, Latest Edition.
6. Aswani M. G., Vazirani V. N., Ratwani M.M., Design of Concrete Bridges, Khanna Publishers, Latest Edition.
7. Rakshit K. S., Design and Construction of Highway Bridges, New Central Book Agency (P) Ltd, Pune, Latest Edition.
8. Johnson Victor D. - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Latest Edition.
9. Jagadeesh T. R., Jayaram M. A. - Design of Bridge Structures, Prentice-Hall of India, Latest Edition.
10. Krishna Raju N. - Design of Bridges, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Latest Edition.
11. David Lee – Bridge Bearings and Expansion Joints, E& FN Spon, Latest Edition.
12. Joseph E. Bowles – Foundation Analysis and Design, McGraw-Hill International Edition, Latest Edition.
13. Nainan P. Kurian – Design of Foundation Systems, Narosa Publishing House, Latest Edition.
14. IRC:6-1966, Standard Specifications and Code of Practice for Road Bridges, Section II- Loads and Stresses (3rd Revision), Indian Road Congress, New Delhi
15. IRC:18-1985, Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned Concrete) (2nd Revision), Indian Road Congress, New Delhi
16. IRC:21-1987, Standard Specifications and Code of Practice for Road Bridges, Section III- Cement Concrete (plain and Reinforced) (2nd Revision), Indian Road Congress, New Delhi
17. IRC:112-2011,
15. IS456-2000, Code of Practice for Plain and Reinforced Concrete, 4th Revision, Indian Standards Institution, New Delhi

Table 1: Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	3	1
CO2	3	2	1	2	3	
CO3	2	2	1	2		2
CO4		3	3	1	1	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4
Class Test Marks	04	04	04	04
Teachers Assessment Marks	04	02	06	06
ESE Marks	12	12	12	12

**AMPEC5113: Programme Elective III- Stability of Structure
(NEP-2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	3 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-	Teacher's Assessment(ISE-II)	20 Marks
Total Credits	3	End Semester Examination	60 Marks
		Total	100 Marks

Pre-requisites: Not Applicable

Course Description:

1. Learn the buckling of columns, analysis using equilibrium, energy and approximate methods.
2. Know the stability analysis of beam-columns and frames with different loads.
3. Analyse for torsional, flexural and lateral buckling of beams.
4. Perform the buckling analysis of thin plates using different approaches.
5. Study the inelastic buckling analysis of plates.

Course Outcomes:

On successful completion of this course, students will be able to-

1. Understand the analysis of buckling of columns using appropriate method.
2. Analyse the practical problems of beam-columns and frames.
3. Analyse the beams for torsional, flexural and lateral buckling.
4. Perform buckling analysis of thin plates.
5. Analyse the plates for inelastic buckling and understand the post-buckling behavior of plates.

Detailed Syllabus:

Unit -1	Buckling of Columns: Buckling of columns: States of equilibrium - Classification of buckling problems - concept of equilibrium, energy, imperfection and vibration approaches to stability analysis - Eigen value problem. Governing equation for columns - Analysis for various boundary conditions - using Equilibrium, Energy methods. Approximate methods - Rayleigh Ritz, Galerkin's approach - Numerical Techniques - Finite difference method - Effect of shear on buckling	06 Hrs
Unit -2	Buckling of Beam-columns and Frames Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method	06 Hrs
Unit -3	Torsional and Lateral Buckling: Torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections. Numerical solutions. Lateral buckling of beams, pure bending of simply supported beam and cantilever beam,	06 Hrs
Unit -4	Buckling of Plates Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques	06 Hrs
Unit -5	Inelastic Buckling Double modulus theory - Tangent modulus theory - Shanley's model – Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behavior of plates	06 Hrs

ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content
- 6) Other if any

References:

1. Timoshenko, S., and Gere., —Theory of Elastic Stability, McGraw Hill Book Company, 1963.
2. Chajes, A. —Principles of Structures Stability Theory, Prentice Hall, 1974.
3. Ashwini Kumar, —Stability Theory of Structures, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.
4. Iyenger. N. G. R., —Structural stability of columns and plates, Affiliated East West Press, 1986.
5. Gambhir, —Stability Analysis and Design of Structures, Springer, New York, 2004.

Table 1: Mapping of Course Outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test 20 Marks	Teachers Assessment 20 Marks	End Semester Examination
K1	Remember	02	03	06
K2	Understand	06	03	18
K3	Apply	04	06	18
K4	Analyze	08	08	18
K5	Evaluate			
K6	Create			
Total		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1, K2, K3	K2, K3, K4	K2, K3, K4	K2, K3, K4	K4, K3
Class Test Marks	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

**AMOECS001: Open Elective – Basics of Finite Element Analysis
(NEP 2020 Model Course)**

Teaching Scheme		Evaluation Scheme	
Theory	2 Hrs/Week	Class Test (ISE-I)	20 Marks
Tutorial	-----	Teacher's Assessment (ISE-II)	20 Marks
Total Credits	2	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite:

The UG level courses like Solid/Fluid Mechanics, Theory of Elasticity and Plasticity, Theory of Structures/Machines, Heat Transfer, Calculus, Differential Equations, Linear Algebra, etc should have been studied earlier respectively by students of different branches of engineering.

Course Description:

This course is designed to introduce FEM as a numerical technique that employs a philosophy of piecewise approximations of solutions to problems described by differential equations. Since this method uses a mathematical structure common to various physical theories, it is intended to make students aware of the generality of the method irrespective of students' branch of engineering.

Course Outcomes:

After successful completion of the course, students will be able to:

1. Recognize basic mathematical concepts used in finite element analysis like procedures used in solution of engineering problems
2. Enumerate mathematical procedure followed for analysis of 1-D, 2-d and 3-D problems in engineering
3. Estimate errors in attempted finite element analysis of given problems
4. Solve various engineering problems using finite element method.

Detailed Syllabus:

Unit -1	Preliminaries: Basic concept of FEM, Some mathematical concepts and formulae, weak formulation of boundary value problems, variational methods of approximation	06 Hrs
Unit -2	Finite element analysis of 1D problems-Part I: Basic steps of FEA, Applications to heat transfer, fluid mechanics, solid mechanics problems; analysis of bending of beam by Euler-Bernoulli and Timoshenko theories, analysis of plane frames;	06 Hrs
Unit -3	Finite element analysis of 1D Problems-Part II: Approximation errors, various measures of errors, convergence and accuracy of solution; isoperimetric formulations and numerical integration, Computer implementation	06 Hrs

Unit -4	Finite element analysis of 2D Problems Boundary value problems, mesh generation and imposition of boundary conditions, Applications to heat transfer, fluid mechanics, solid mechanics problems; library of elements and interpolation functions, numerical integration and modeling considerations	06 Hrs
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ISE-I: Class test on first two Units

ISE-II: Teacher's Assessment- Teachers Assessment of 20 marks may be based on one or more of the following

- 1) Technical quizzes
- 2) Application development
- 3) Question & answer / Numerical solution
- 4) Group discussion
- 5) Assignments on course content

References:

1. J N Reddy, An Introduction to the Finite Element Method, Mc-Graw-Hill, Inc., New Delhi, 1993
2. Bathe K J, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1982
3. Cook R D, D S Malkus, and M E Plesha, Concepts and Applications of Finite Element Analysis, John Wiley, New York, 1989
4. Zienkiewicz O C and R L Taylor, The Finite Element Method, Vol. I, Basic Formulation and Linear Problems, McGraw-Hill, London, 1989
5. Hughes T J R, The Finite Element Method (Linear, Static and Dynamic Finite Element Analysis), Prentice-Hall, Englewood Cliffs, NJ, 1987
6. Desai C S and J F Abel, Introduction to the Finite Element Method, Van Nostrand-Reinhold, New York, 1972
7. Chandropatla T R and A D Belegundu, Introduction to Finite Elements in Engineering, Prentice-Hall, Englewood Cliffs, NJ, 1991
8. Shames I H, Mechanics of Fluids, McGraw-Hill, New York, 1962
9. Holoman J P, Heat Transfer, McGraw-Hill, New York, 1986
10. Nagotov E P, Applications of Numeric Methods to Heat Transfer, McGraw-Hill, New York, 1978
11. Kreyszig E, Advanced Engineering Mathematics, John Wiley, New York, 1988
12. Dym C L and I H shames, Solid Mechanics: A Variational approach, McGraw-Hill, New York, 1973
13. Timoshenko S P and J N Goodier, Theory of Elasticity, McGraw-Hill, New York, 1970
14. Willems N and W M Lucas, Jr., Structural Analysis for Engineers, McGraw-Hill, New York, 1978
15. Szilard R, Theory and Analysis of Plates, Prentice-Hall, Englewood Cliffs, NJ, 1974

16. Timoshenko S P and S Woinowsky-Krieger, Theory of Plates and Shells, McGraw- Hill, New York, 1959
17. Stroud A H and D Secrest, Gaussian Quadrature Formulas, Prentice-Hall, Englewood Cliffs, NJ, 1966

Table 1: Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2		3
CO2	2	3	1	2		3
CO3	2	2	3	2	2	
CO4	2	2	1	3	2	

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	04	05	15
K2	Understand	05	05	15
K3	Apply	06	05	15
K4	Analyze	05	05	15
K5	Evaluate			
K6	Create			
Total Marks 100		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)
Class Test	5	5	5	5
Teachers Assessment	4	4	06	06
ESE	15	15	15	15

AMAEC 5101 Communication Skills & Report Writing

Teaching Scheme	Examination Scheme	
Lectures: 02 hrs/ week	ISE I	20 Marks
Tutorial: 00 hrs/ week	ISE II	20 Marks
Credits:02	ISE III	00 Marks
	End Semester Examination	60 Marks

Prerequisites: Nil

Course description: In view of growing importance of English as a tool for global communication and the consequent emphasis on training the students to acquire communicative competence, the syllabus has been designed to develop the linguistic and communicative competence of the students of engineering. The goal of the course is to improve listening, speaking, reading and writing skills. Thus the stress in the syllabus is primarily on the development of communicative skills and fostering of ideas.

Course Outcomes:

After completing the course, students will able to:

	Course Outcomes
CO1	Develop their personality through corporate etiquettes and take active participation in discussion and other academic activities as well.
CO2	press them through oral as well as written communication and develop written communication for professional and business purpose.
CO3	rite dissertation report and paper scientifically

Detailed Syllabus:

Unit 1	Basic Concept, Factors, Process and Types of Communication, Principles of Effective Communication, Barriers of Communication. And how to overcome these barriers.
Unit 2	Body Language and its different aspects, Voice Dynamics & Voice Modulation, Professional Appearance, Clothing Etiquettes and Corporate Dressing. Letter
Unit 3	Basic of Soft skills. Parts of Speech, Types of Tense, Use of Articles, Synonyms and Antonyms, Find out the Grammatical Errors in the given sentences. Writing, Office documents like Circulars, Notices, Minutes, Agenda And Memos, Report Writings. Resume Writing
Unit 4	Interpretation and Report Writing: Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report

Text and Reference Books

1. "Business Communication" By Urmila Rai & S. M. Rai, Himalaya Publishing House, Mumbai
2. "Communication Skills" By Leena Sen, Second Edition, PHI Learning Publishers, Delhi
3. "Technical communication" By William Sanborn (Pearson publications.)
4. "Presentation Skills for Managers", McGraw Hills brief case books.

5. Professional Communication Skill, Pravil S.R. Bhatia, S. Bhatia, S Chand Publishing, Delhi
 6. Technical Report Writing Today: Daniel G. Riordan, Steven E. Pauley
 7. 8. English Grammar Composition & Effective Business Communication, M. A Pink, S. E. Thomas.

Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		2	1		2
CO2		2	1	1	1	
CO3	2		2		2	

1 – Low 2 – Medium 3 – High

Assessment: ISE I: Shall be on the basis of Class Tests/ Assignments/ Quizzes/ Field visits/ Presentations/ Course Projects on First unit
 ISE II: Shall be based on class test on second & third units

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember	10	10		20
K2	Understand	10	10		20
K3	Apply				20
K4	Analyze				
K5	Evaluate				
K6	Create				
Total Marks 100		20	20		60

Assessment table

Assessment Tool	K1	K2	K3
	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3
ISE I (10 Marks)	10	10	
ISE II (10 Marks)	10	10	
ISE III (0 Marks)			
ESE Assessment (30 Marks)	20	20	20
Total	40	40	20

SEMESTER-III**AMDIS6003: Dissertation-I
(NEP 2020 Model Course)**

Scheme of Teaching		Scheme of Evaluation	
Dissertation-	16 Hrs/Week	Term Work (ISE - II)	100 Marks
Total Credits	8	Viva Voce (ESE - II)	100 Marks
		Total	200 Marks

Prerequisites: Not applicable.

Course Description:

The Dissertation work is one of the important aspects of PG education incorporating the research component in the curriculum. The student is required to study the existing literature from various sources such as refereed journals, proceedings of National/International conferences, PG, PhD theses reference book etc. of Structural Engineering. The student would identify the problem and provide solution/s through experimental/Analytical/comparative study as partial fulfillment of PG degree.

The Dissertation-I mainly focuses on literature survey, identification of problem and action plan with possible outcomes for the completion of Dissertation-II

Course Outcomes: After successful completion of the course, students will be able:

1. To appraise the state-of-the-art in the chosen field through exhaustive literature survey.
2. To formulate/define the problem for dissertation
3. To compile and prepare a technical report of the collected literature and present.

Term Work:

The Dissertation-I shall consist of collection of literature from a chosen field of Structural Engineering from various sources. The candidate shall formulate/define analytical and/or experimental problem for carrying out dissertation work. The candidate shall prepare a technical report in a prescribed format. The evaluation of the term work shall be through submission of monthly progress report of the student in prescribed format.

Viva Voce Examination: It consists of two parts.

Part-I: Mid-Term Evaluation: A mid-term evaluation for shall be done as per the schedule given in the institute academic calendar. Students should prepare a power point presentation and present before the panel of examiners and class students and should be able to answer questions asked by the panel of examiners and class students. Panel of examiner consists of guide as internal examiner and at least one faculty member appointed by the Head of the Department as external examiner. The panel of examiner will assess the contents and presentation and gives the suggestions, if any.

Part-II: End Semester Evaluation for 100 Marks: Students shall prepare a comprehensive report incorporating the suggestions of part-I, if any and make a power point presentation before the panel of examiners as above and class students and should be able to

answer questions asked by the panel of examiners and class students. The panel of examiner will assess the contents and presentation and assigns the marks out of 100 marks.

Table-I Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3	2	3
CO2				3	2	3
CO3				3	2	3

3-High, 2-Medium, 1-Low

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember			25	25
K2	Understand			25	25
K3	Apply			25	25
K4	Analyze			25	25
K5	Evaluate				
K6	Create				
Total Marks 200				100	100

Assessment table

Assessment Tool	K1	K2	K3	K4
	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3
ISE I				
ISE II				
ISE III (Total 100)	25	25	25	25
ESE Assessment (Total 100)	25	25	25	25
Total (Total 200)	50	50	50	50

SEMESTER-IV
AMDIS6101: ELC: Dissertation-II
(NEP 2020 Model Course)

Scheme of Teaching		Scheme of Evaluation	
Practical	24 Hrs/Week	Term Work (ISE II)	150 Marks
Total Credits	12	Viva Voce (ESE)	150 Marks
		Total	300 Marks

Prerequisites: Students should have completed AM 61003: Dissertation-I satisfactorily.

Course Description:

The dissertation-II is a continuation of Dissertation-I and mainly focuses on solution of the defined problem through experimental/analytical/comparative study as planned.

Course Outcomes: After successful completion of the course, students will be able:

1. To appraise the additional literature in the chosen field of structural engineering.
2. To refine the formulated problem in the chosen field of structural engineering.
3. To find solution to the identified problem using appropriate methodology.
4. To interpret, discuss, debate the solution and draw conclusions.
5. To write the thesis and present before panel of examiner and peers.

Term Work:

The Dissertation-II shall consist of a complete analytical and/or experimental work in Structural Engineering containing literature survey, problem formulation, solution, results, interpretations, discussions and conclusions certified by guide and an internal evaluation committee. The candidate shall prepare a technical report in a prescribed format and submit soft bound 3-hard copies signed by the guide and submit it to the CoE for viva-voce examination. After the viva-voce examination, student shall submit 3-hard bound copies after the corrections, if any, suggested by the panel of examiners along with program exit survey in prescribed format. The evaluation of the term work shall be based on monthly progress report of the student in prescribed format and final submission.

Paper Publications:

A proof of uploading paper to SCI, Web of Science, Scopus, Indian Citation Index journal or filling patent is mandatory requirement for submission of dissertation. However, if the dissertation work is in collaboration with industry/organization/research agency, the uploading of paper/filling a patent shall not be mandatory but desirable.

Pre submission presentation:

There shall be a pre submission presentation before a panel of experts/faculty consisting of guide and faculty/experts and all PG students of the concerned class.

Viva Voce Examination:

Students should prepare a power point presentation and present it before the panel of examiners consisting of guide and the external examiner appointed by the CoE. The candidate should be able to defend his work in front of the panel of examiners and class students. The panel of examiners will assess the dissertation contents and presentation and assigns the marks out of 150.

Table-1 Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3	2	3
CO2				3	2	3
CO3				3	2	3
CO4				3	2	3
CO5				3	2	3

3-High, 2-Medium, 1-Low.

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	ISE III	End Semester Examination
K1	Remember			25	20
K2	Understand			25	20
K3	Apply			25	20
K4	Analyze			25	20
K5	Evaluate				20
K6	Create				
Total Marks 200				100	100

Assessment table

Assessment Tool	K1	K2	K3	K4	K5
	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3	CO1, CO2, CO3
ISE I					
ISE II					
ISE III (Total 100)	25	25	25	25	
ESE Assessment (Total 100)	20	20	20	20	20
Total (Total 200)	45	45	45	45	20