DEPARTMENT OF APPLIED MECHANICS

NEP-2020 CURRICULUM

M. Tech. (STRUCTURAL ENGINEERING)

FULL –TIME & PART TIME PROGRAMME

(Academic Year: 2023-24 Onwards)

GOVERNMENT COLLEGE OF ENGINEERING
CH. SAMBHAJI NAGAR

Visionof the Department
To be centre 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.

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

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. Practical (P) per week	0.5 Credit
2 Hours Practical (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 **80.**

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)		**08**	**06**			**14**
Open Elective (OE) Other than a particular program	Multidisciplinary Courses	**-**	**03**	**03**	**-**	**06**
Vocational and Skill Enhancement Course (VSEC)	Skill Courses	**02**	**02**	**-**	**-**	**04**
Ability Enhancement Course (AEC)	Humanities Social Science and Management (HSSM)	**-**	**03**	**-**	**-**	**03**
Entrepreneurship/Economics/ Management Courses		**-**	**-**	**03**	**-**	**03**
Research Methodology	Experiential Learning Courses	**04**	**-**	**-**	**-**	**04**
Project		**-**	**-**	**10**	**16**	**26**
Indian Knowledge System				**02**		**02**
Co-curricular Courses (CC)	Liberal Learning Courses	**-**	**-**	**-**	**-**	**Audit**
Total Credits (Major)		**22**	**26**	**18**	**16**	**82**

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	I	0	0	4	**02**
2	VSEC	Mini Project – II	II	0	0	4	**02**
Total Credits							**04**

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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	II	3	0	0	**03**
2	Entrepreneurship/Economics/ Management Courses	Economics/ Management Courses	III	3	0	0	**03**
						Total Credits	**06**

3. EXPERIENTIAL LEARNING COURSES (ELC)

S. No	Category	Course Title	Semester	Hours per week			Total Credits
				Lecture	Tutorial	Practical	
	Research Methodology	Research Methodology	I	4	0	0	**04**
2	Project	Dissertation - I	III	0	0	20	**10**
3	Project	Dissertation - II	IV	0	0	32	**16**
						Total Credits	**30**

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	**-**

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Dated: 23rd Nov 2023

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 2023-24

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.	PEC	AMPEC5008-5011	Programme Elective Course - II	4	0	0	**4**	20	20	60	**100**
6.	VSEC	AMVSEC5012	Mini Project – I	0	0	4	**2**	-	25	25	**50**
7.	ELC	MERMC5001	Research Methodology	4	0	0	**4**	20	20	60	**100**
8.	CC	INCCC5001#	Stress Management by Yoga/Club Activity)	-	-	2	-	-	-	-	-
Total				**18**	**0**	**10**	**22**	**100**	**150**	**325**	**575**

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

Programme Elective Course – II

1) AMPEC5008:Design of Bridges
2) AMPEC5009:Stability of Structure
3) AMPEC5010:Soil Structure Interaction
4) AMPEC5011:Advance Structural Analysis

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 # 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 5104-5106	Programme Elective Course - III	3	0	0	**3**	20	20	60	**100**
5.	PEC	AMPEC5107-5109	Programme Elective Course - IV	3	0	0	**3**	20	20	60	**100**
6.	OE	AMOEC5110	Basics of Finite Element Analysis	3	0	0	**3**	20	20	60	**100**
7.	VSEC	AMVSEC5111	Mini Project – II	0	0	4	**2**	-	25	25	**50**
8.	AEC	EEAEC5001	Technical Presentation	3	0	0	**3**	20	20	60	**100**
			Total	**24**	**0**	**4**	**26**	**140**	**165**	**445**	**750**

Programme Elective Course – III

1) AMPEC5104-Advance Seismic Analysis & Design
2) AMPEC5105-Mechanics of Composite Materials
3) AMPEC5106-Design of Advance Steel Structure

Programme Elective Course – IV

1) AMPEC5107:Fracture Mechanics
2) AMPEC5108:Design of High-rise Structures
3) AMPEC5109:Structural Assessments & Rehabilitations

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List of Open Electives I to be offered in PGSemesterII (FirstYear)

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	ElectricVehicles (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.	OE	AMOEC 6001	Indian Constitution	3	0	0	**3**	20	20	60	**100**
2.	HSSM	MEEE M6001	Entrepreneurship Development	3	0	0	**3**	20	20	60	**100**
3.	ELC	AMDIS 6003	Dissertation – I	0	0	20	**10**	-	100	100	**200**
4	IKS	AMIKS 6004		2	-	-	**02**	50	-		
Total				**6**	**0**	**20**	**18**	**40**	**140**	**220**	**400**

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

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

Sr. No.	Course Code	Open Elective Course	Course offering Department
1	AMOEC6001	Indian Constitution	Applied Mechanics
2	CSOEC6002	Data Science(Not for CSE PG Students)	CSE
3	CEOEC6003	Disaster Management	Civil
4	MEOEC6004	Additive manufacturing	Mechanical
5	EEOEC6005	Smart Grid Systems	Electrical
6	ECOEC6006	Soft Computing	E&TC

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

Sr.No.	Course code	Humanities Course	Course offering Department
1	EEAEC5001	Technical Communication	Electrical

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	-	-	32	**16**	-	-	150	150
			Total	**0**	**0**	**32**	**16**	**0**	**0**	**150**	**150**

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

GOVERNMENT COLLEGE OF ENGINEERING, CH. SAMBHAJI NAGAR

(An Autonomous Institute of Government of Maharashtra)

Department of Applied Mechanics

M. Tech. (Structural Engineering -Full-Time & Part Time) Programme

NEP-2020 Model-2023-24 Onwards

Detailed Syllabi of All Courses

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, Prandtle'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 Viscoplasticity: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,NewDelhi.Latest Edition

3) Sadhu Singh.," Theory of Plasticity", Khanna Publishers,NewDelhi.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 Jersy.
7) 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	3	3	3	-	-	-
CO2	3	3	2	-	--	-
CO3	3	3	3	-	-	-
CO4	3	3	3	-	-	-
CO5	3	3	3	-	-	-

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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	04	04	04	04	04
Teachers Assessment Marks	04	02	06	06	02
ESE Marks	12	12	12	12	12

AMPCC5002: 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 analysing 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	2	3	3	--	----	----
CO2	3	3	2	--	----	----
CO3	2	3	3	--	----	----
CO4	3	3	3	--	----	----
CO5	2	3	3	--	----	----

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 AssessmentMarks	04	02	06	06	02
ESE Marks	12	12	12	12	12

AMPCC5003: 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	3	2			
CO2	3	3	2			
CO3	2	3	3			
CO4	2	2	3			

3– High 2 – Medium 1 – Low

Table 2: Recommended Assessment Pattern

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

Table 3: Assessment Table

Course Outcomes	CO1	CO2	CO3
Assessment Tool	**(Skill level S1 to S5 as applicable)**	**(Skill level S1 to S5 as applicable)**	**(Skill level S1 to S5 as applicable)**
Term Work (25 Marks)	10	10	05
Total (25 Marks)	20	15	15

AMPEC5004:ProggrameElective Course -I-Pre-Stressed Concrete Design (NEP- 2020Model 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 equips the studentsto 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, liquidtanks, 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 indeterminae 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 andDesign 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", ArnoldHeinimen, 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	2	3	3	--	----	----
CO2	3	3	2	--	----	----
CO3	2	3	3	--	----	----
CO4	3	3	3	--	----	----
CO5	2	3	3	--	----	----

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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	04	04	04	04	04
Teachers AssessmentMarks	04	02	06	06	02
ESE Marks	12	12	12	12	12

AMPEC5005:Programme Elective Course- 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
03)Design concrete mixes with desired properties

1) Evaluate the properties of concrete in the structure and investigate the causes of damage of concrete
2) 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-superplasticiser compatibility,methods of mix proportioning, concept of particle packing, properties in fresh and hardened state, durability of HPC	06 Hrs

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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.Ferrocement.	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), RaikarBhavan, 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 Willey and Sons, New York
9. Naaman, A.E., Ferrocement 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	2	2			
CO2	3	2	3			
CO3	3	3	3			
CO4	2	3	2			
CO5	2	2	3			

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	02	07
K2	Understand	03	03	08
K3	Apply	05	05	15
K4	Analyze	06	06	20
K5	Evaluate	04	04	10
K6	Create	00	00	00
Total Marks 100		20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	(Knowledge level K1 to K5 as applicable)	(Knowledge level K1 to K5 as applicable)	(Knowledge level K1 to K5 as applicable)	(Knowledge level K1 to K5 as applicable)	(Knowledge level K1 to K5 as applicable)
Class Test	04	04	04	04	04
Teacher's Assessment	04	04	04	04	04
ESE	12	12	12	12	12

AMPEC5006: Proggrame Elective Course-I : Numerical Methods and Optimization Techniques
(NEP-2020 ModelCourse)

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 PublishingCompany, 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 InternationalPublishers, 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 PrawelModern 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," KhannaPublishers, 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., Optimisation 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	3	3	--	----	----
CO2	3	3	2	--	----	----
CO3	2	3	3	--	----	----
CO4	3	3	3	--	----	----
CO5	2	3	3	--	----	----

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

AMPEC5007:Programme Elective Course-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, Organisational 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 and Risk control.	**06 Hrs**

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Dated: 23rd Nov 2023

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	3	3	--	----	----
CO2	3	3	2	--	----	----
CO3	2	3	3	--	----	----
CO4	3	3	3	--	----	----
CO5	2	3	3	--	----	----

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 AssessmentMarks	04	02	06	06	02
ESE Marks	12	12	12	12	12

AMPEC5008:ProggrameElective Course :Elective II – Design of Bridges (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 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. HamblyE.C, Bridge Deck Behaviour, 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. RyallM.J., ParkeG.A.R, HardingJ.E., The Manual of Bridge Engineering, Thomas Telford Publishers, Latest Edition.
4. RajagopalanR., Bridge Superstructure, Tata McGraw- Hills Publishing Company Limited, Latest Edition.
5. Ponnuswamy S., Bridge Engineering, Tata McGraw – Hills Publishing Company Limited, Latest Edition.
6. AswaniIM. G., VaziraniV.N.,Ratwani M.M., Design of Concrete Bridges, Khanna Publishers, Latest Edition.
7. RakshitK. S., Design and Construction of Highway Bridges, New Central Book Agency (P) Ltd, Pune, Latest Edition.
8. Johnson VictorD. - Essentials of Bridge Engineering Fifth Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi, Latest Edition.
9. JagadeeshT.R., JayaramM.A. - Design of Bridge Structures, Prentice-Hall of India, Latest Edition.
10. Krishna RajuN. - 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	3			
CO2	--	2	2			
CO3	3	3	3			
CO4	--	3	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

AMPEC5009: Programme Elective Course -II-Elective II – Stability of Structure
(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**

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, Galerkins 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 behaviour 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	2	2	3			
CO2	--	2	2			
CO3	3	3	3			
CO4	--	3	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

AMPEC5010: Programme Elective Course -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	4	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 HillBook Co. New York, Latest Edition.
2. Desai C.S. and Christian J.T. "Numerical Methods in GeotechnicalEngineering" McGraw Hill Book Co. NewYork, Latest Edition.
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6. Selvadurai A.P.S. "Elastic Analysis of Soil-Foundation Interaction", Elsevier Scientific PublishingCompany, 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", NarosaPublishingHouse, 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", PrenticeHall, 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	2	2	3			
CO2	--	2	2			
CO3	3	3	3			
CO4	--	3	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

AMPEC5011 :Programme Elective Course -II – Advanced Structural Analysis (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	4	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/ softwares).	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 ,Engle-wood 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

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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
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			
CO2	--	2	2			
CO3	3	3	3			
CO4	--	3	2			

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment	Knowledge Level	Class Test	Teachers	End Semester

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

Pattern Level No.		20 Marks	Assessment 20 Marks	Examination
K1	Remember	02	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 AssessmentMarks	04	02	06	06	02
ESE Marks	12	12	12	12	12

VSEC- AMVSE5012: Mini Project I

Teaching Scheme		Evaluation Scheme	
Practical	4Hrs/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 to

1) use software for analysis and design of structures.
2) Understand concrete mix proportioning and behavior of concrete under shear, flexure and tension
3) Understand standard procedure of testing of properties of concrete in the hardened state.
4) Apply NDT methods for evaluation of strength of existing concrete.

Detailed Syllabus

No. 1	Unit:1	No. of

	Application Software	Hrs
1.1	Introduction to application Software: STAAD/ ETAB/ SAP etc with simple example	**10Hrs**
1.2	Analysis and design of RCC structures and Steel Structures: RCC building/ Retaining walls and Trusses for roofs/ bridges/Space frames	**10Hrs**
2	**Unit:2** **List of laboratory experiments**	**20Hrs**
2.1	Comparative study of ACI 211.1.91, DOE(1988) and IS 10262-1982 methods of concrete mix proportioning for high strength and high performance concrete.	
2.2	Study of the effect of w/c ratio on workability and strength of concrete slump cone test, compaction factor test, flow table test, kelly ball test etc.	
2.3	Study of the effect of aggregate cement ratio on workability and strength of concrete Study of the effect of fine to coarse aggregate ratio on workability, cohesiveness and permeability of concrete	
2.4	Durability test-shrinkage test ,Acid attack est and water permeability test on Hardend concrete.	
2.5	Determination of Young's Modulus and poisons ratio on hardend concrete. Testing of reinforced concrete beams and slabs for shear flecural and Impact behavior	
2.6	A Study of correlation between concrete cube compressive strength,concrete core test, cylindrical compressive and split tensile strength and modulus of rupture of concrete of standard grades.	
2.7	NDT Test on hardened concrete- Ultrasonic pulse velocity test, Rebound hammer Test, corrosion/ half Cell potentiometer test, video gauge test to determine quality of concrete,	

Term Work:

Term work shall consist of analysis and design of RCC structures and Steel Structures: such as RCC building/ Retaining walls and Trusses for roofs/ bridges/Space frames by using STAAD/ ETAB/ SAP etc and suitable exercises done in the laboratory based on the syllabus in various groups.

Viva Voce Examination:

Viva-voce examination, based on the record of term work submitted by the candidate, shall be conducted by the internal and external examiners appointed by the Head of the department

Table 1: Mapping of Course Outcome with Program Outcomes

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

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

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

Table 3: Assessment Table

Course Outcomes	CO1	CO2	CO3 & CO4
Assessment Tool	**(Skill level S1 to S5 as applicable)**	**(Skill level S1 to S5 as applicable)**	**(Skill level S1 to S5 as applicable)**
Term Work (25 Marks)	05	10	10
ESE (25 Marks)	05	10	10

MERMC5001:ResearchMethodology		
Teaching Scheme	**Examination Scheme**	
Lectures: 04 Hrs. / Week	**ISEI**	**20Marks**
Credits: 04	**ISEII**	**20Marks**
	End Semester Examination	**60Marks**

Course Objectives:

1. To guide students from understanding foundational research concepts to critically formulating research problems, culminating in the adept creation of comprehensive research plans and literature reviews.
2. To develop comprehensive understanding of various research methods, both qualitative and quantitative
3. To facilitate students in analyzing, evaluating, and creating research proposals.
4. To attain mastery in data collection methods, sampling, data analysis techniques, and result interpretation for robust research outcomes.
5. To Equip students with the skills to proficiently create and present diverse research reports, encompassing various formats or a delivery, technical writing, and ethical awareness regarding plagiarism.

Course Outcomes:

After completing the course students will able to

Course Outcomes	
CO1	Develop the abilitytocomprehendcoreresearchconcepts,definekeyelementslike variables and hypotheses, and critically evaluate literature to identify research gaps.
CO2	Justify their chosen research methods and explain their advantages and limitations.
CO3	Create well-structured research proposals that include clear research objectives, methods, and expected outcomes.
CO4	Proficientinusingdataanalysistechniquesrelevanttotheirchosenresearchmethods, suchasstatisticalanalysisforquantitativeresearchorthematicanalysisforqualitative research.
CO5	Createcomprehensiveresearchreportsindiverseformats,suchasacademicpapers, presentations, and technical reports.

Detailed Syllabus:

Unit 1	**Introduction to RM:** Meaning of Research, 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 DefiningaProblem,ResearchDesign,ImportantConceptsRelatingtoResearch Design, Developing a Research Plan, Literature review.
Unit 2	**Methods of Research:** Qualitative and quantitative methods of research like Historical, case study, ethnography, exposit facto, documentary and content analysis, survey(Normative, descriptive, evaluative etc.) field and laboratory experimentalstudies.Characteristicsofmethodsandtheirimplicationsin research area.
Unit 3	**Development of research proposal:** Research proposal and its elements Formulation of research problem-criteria of sources and definition Development of objectives and characteristics of objectives. Development hypotheses and applications.

Unit 4	**Methods of data collection:** Concept of sampling and other concepts related to sampling. Probability and non-probability samples, their characteristics and implications.Toolsofdatacollections,theirtypes,attributesanduses.Redesigning, research tools-like questionnaire, opinionative, observation, interviews, scales and tests etc. **Methods of data analysis:** Analysis of qualitative data based on various tools. Analysis of quantitative data and its presentation with tables, graphse tc. Statistical tools and techniques of data analysis-measures of central tendency, dispersion. Decision making with hypothesis testing through parametric and non-parametric tests. Validity and delimitations of research findings.
Unit 5	**Interpretation and Report Writing:** Meaning of Interpretation, Techniques of Interpretation, Significance of Report Writing, Steps in Writing Report, Layout of theResearchReport,TypesofReports,OralPresentation,MechanicsofWritinga Research Report, Writing a technical paper, plagiarism and its implications.

Text and Reference Books

1. GargB. L.,KaradiaR., Agarwal F. and AgarwalU. K., An introduction to Research Methodology, RBSA Publishers, 2002
2. Kothari C. R., Research Methodology: Methods and Techniques. New Age International, 1990.
3. Merriam S. B., TisdellE. J., Qualitative Research: A Guide to Design and Implementation, 4th edition, John Wiley &Sons, 2016.
4. CreswellJ.W.,ResearchDesign:Qualitative,QuantitativeandMixedMethods Approaches, 4th edition,SAGE Publications, Inc,2014.
5. OlsenC.,DevoreJ.,PeckR.,IntroductiontoStatisticsandDataAnalysis,5th edition, Brooks/Cole, 2015.
6. Panneerselvam R., Research Methodology, 2nd edition, PHI Learning, 2014.

Assessment: ISEI(Class Test), ISEII (TA)& ESE

TA: Students will perform one or more of the following activities

1. Surprise Test
2. Assignment
3. Quiz
4. Any other activity suggested by course coordinator

Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	ISE I	ISE II	End Semester Examination
K1	Remember	05	02	06
K2	Understand	10	08	24
K3	Apply	00	03	09
K4	Analyze	05	04	12
K5	Evaluate	00	03	09
K6	Create	00	00	00
Total		20	20	60

Mapping of Course Outcomes with Program Outcomes:

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

3 – High , 2 – Medium, 1– Low

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 ofclassroom 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 Kapalbhati) c) Regular practice of Yoga-asanas, Pranayam and Meditation for10 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 students 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:	**Isoparametric 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. CookR D, MalkusD 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. ChandrupatlaT R and BelegunduA D, Introduction to finite elements in engineering, 3rd edition, Pearson Prentice Hall, India, Latest Edition.
3. ReddyJ N, An introduction to the finite element method, 3rd edition, Tata McGraw Hill, India, Latest Edition.
4. BatheK J, Finite element procedures, Phi Learning Private Limited, New Delhi, Latest Edition.
5. DesaiY M, EldhoT I and ShahA 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
K6	Create			
Total		**20**	**20**	**60**

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

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 andanalytical 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** Kirchoff's small deflection theory of thin plates, Navier and Lavy'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 paraboloidal 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	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 AssessmentMarks	04	04	06	06
ESE Marks	15	15	15	15

AMPCC5103:PCC III- 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

3. Design and detailing of industrial steel structures as per current practice
4. 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. Beamcolumns.	**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. PunmiaB. 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. RamamruthamS., 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, PunmiaB.C., Jain A.K.,Laxmi Publications(P)Ltd, New Delhi

9. Subramanian N., “Design of Steel Structure “Oxford University Press, New Delhi.
10. 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test 20 Mraks**	**Teachers Assessment 20 Marks**	**End Semester Examination**
K1	Remember	02	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 AssessmentMarks	04	04	06	06
ESE Marks	15	15	15	15

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

AMPEC5104:Programme Elective Course- III – 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 propertiers 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 Course -III – 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 Chandrashekara.K. "Analysis and 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

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AMPEC5106 :Programme Elective Course –III: Design of 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 behaviour 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

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Dated: 23rd Nov 2023

References Books

1. Ramchandra – 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 Kolkatta
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. Lotheres – 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 Course -IV – 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, MartinusNijhoff 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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

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AMPEC5108:Programme Elective Course -IV – 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

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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**
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-
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	3	3	3			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	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	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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 Course -: 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

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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, ferrocement 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), RaikarBhavan, Mumbai, 1987
2. Ravishankar.K., Krishnamoorthy.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			
CO2	3	3	2			
CO3	3	3	3			
CO4	3	3	3			
CO5	3	3	3			

3-High, 2-Medium, 1-Low

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	**Knowledge Level**	**Test 20 Mraks**	**Teachers Assessment 20 Marks**	**End Semester Examination**
K1	Remember	02	-	06
K2	Understand	06	03	12
K3	Apply	04	03	18
K4	Analyze	08	06	16
K5	Evaluate		08	08
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

AMOEC5110:Open Elective – Basics Of Finite Element Analysis (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**

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	**08 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;	**08 Hrs**
Unit -3:	**Finite element analysis of 1D problems-Part II:** Approximation errors, various measures of errors, convergence and accuracy of solution; isoparametric formulations and numerical integration, Computer implementation	**08 Hrs**

Unit -4:	**Finite element analysis of 2D problems-Part I:** 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	**08 Hrs**
Unit -5:	**Finite element analysis of 2D problems-Part II & 3D problems :** Analysis of plane elasticity; flows of viscous incompressible fluids, bending of elastic plates**;** Computer implementation; FEA of 3D problems	**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:

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Table 1: Mapping of Course Outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1			
CO2	3	2	2			
CO3	3	3	3			
CO4	3	2	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	12
K2	Understand	05	05	12
K3	Apply	06	05	12
K4	Analyze	05	05	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
Total Marks 100		**20**	**20**	**60**

Table 3: Assessment Table

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

AMVSEC5111:Mini Project-II
(NEP 2020 Model Course)

Teaching Scheme		Evaluation Scheme	
Theory	0 Hrs/Week	Term Work	25 Marks
Tutorial/Practicals	4 Hrs/Week	Viva-voce	25 Marks
Total Credits	**2**		
		Total	50 Marks

Prerequisite: Not applicable

Course Description: The student shall collect, review, compile, comprehend, present research literature and identify the problem for the dissertation in the field of Structural Engineering.

Course Outcomes:

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

1. To search literature from different sources to appraise the state-of-the-art.
2. To compile and prepare a technical report from the collected literature.
3. To present the literature in a comprehensive manner.
4. 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 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 for 10 Marks: A mid-term evaluations for 10 marks out of 25 marks 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 and assigns the marks out of 10. In this phase student is expected to collect and present substantial literature.

Part-II: End Semester Evaluation for 15 Marks: Student should prepare technical report in prescribed format duly incorporating suggestions of Part-I and present power point presentation before the panel of examinersand 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 15. 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	3
CO2	--	----	----	2	2	3
CO3	------	-------	-----	2	2	3

3-High, 2-Medium,1-Low

Table 2: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2,K4	K2,K3,K4	K2,K3,K4	K3,K4
Term Work- 25 Marks	4	5	08	08
Viva-voce Assessment-25 Marks	5	5	08	07

Table 3: Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Term Work Assessment	Viva-voce Examination
K1	Remember	02	02
K2	Understand	08	05
K3	Apply	04	04
K4	Analyze	08	09
K5	Evaluate	03	05
K6	Create	--	--
Total Marks		**25**	**25**

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

EEAEC5001 : Technical Presentation

Teaching Scheme		**Evaluation Scheme**	
Theory	3 Hrs/Week	Class Test	20 Marks
Tutorial		Teacher's Assessment	20 Marks
Total Credits	**3**	End Semester Examination	60 Marks
		Total	100 Marks

Prerequisite: Not applicable

Course Description: This workshop is designed to help participants develop effective technical presentation skills. Whether you are an engineer, scientist, or a technical professional, the ability to communicate complex ideas clearly and persuasively is essential. Through a combination of theory and practical exercises, you will learn to create and deliver compelling technical presentations.

Course Outcomes:

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

1. Understand the principles of effective technical presentations.
2. Develop and structure technical content for presentations.
3. Enhance speaking and delivery skills.
4. Use visual aids and technology effectively.
5. Manage Q&A sessions and handle audience questions.
6. Gain confidence in presenting technical information**.**

Detailed Syllabus:

Session 1: Introduction to Technical: PresentationsCourse overview and expectations Importance of technical presentationsElements of a successful presentation

Session 2: Audience Analysis Understanding your audience Tailoring your content to the audience
Identifying audience needs and interests

Session 3: Content Development Creating clear objectives Organizing technical content Using effective transitions.

Session 4: Visual Aids and Technology Designing effective slides Using multimedia and visuals Avoiding common design mistakes.

Session 5: Speaking and Delivery SkillsTechniques for effective speaking Body language and non-verbal communicationManaging nerves and anxiety

Session 6: Rehearsal and Feedback The importance of practice Peer and self-assessment Receiving constructive feedback

Session 7: Handling Q&A Sessions Preparing for questions Strategies for answering questionsDealing with challenging questions

Session 8: Final Presentations

Each participant delivers a technical presentationPeer and instructor feedback Reflection and improvement plans

Session 9-16: Repeat Sessions 1-8 with in-depth practice, refining skills, and incorporating feedback.

Assessment and Grading:

Attendance and participation: 20% Presentation content and structure: 20%Delivery and speaking skills: 20%

Visual aids and technology usage: 15%Handling Q&A sessions: 15% Improvement over the course: 10%

Table 1: Mapping of Course Outcome with Program Outcomes

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

3-High, 2-Medium,1-Low

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of thefollowing

1. Technical quizzes
2. Application development
3. Question & answer / Numerical solution
4. Group discussion
5. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Approved in XXV IIth Academic Council
Dated: 23rd Nov 2023

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4
	K1,K2	K2,K3	K2,K3	K3,K4
Class Test (20 Marks)	10	10		
Teachers Assessment (20 Marks)		4	10	6
ESE (60 Marks)	18	18	12	12

SEMESTER-III

AMOEC6001: Indian Constitution
(NEP- 2020Model 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**

Preamble:

The study of their own country constitution and studying the importance environment as well as understanding their own human rights help the students to concentrate on their day to day discipline. It also gives the knowledge and strength to face the society and people.

Prerequisite: Nil

Course Outcomes:

After the completion of the course the student will be able to

1) Explain the background of the present constitution of India and features
2) Utilize the fundamental rights and duties
3) Understand the working of the union executive, parliament and judiciary
4) Understand the working of the state executive, legislature and judiciary.
5) Utilize the special provisions and statutory institutions and show national and patriotic spirit as responsible citizens of the country

Detailed Syllabus

No.	Topic	No. of Lectures
1	**Unit : 1**	
1.1	Definition of constitution, historical back ground, salient features of the constitution.	1
1.2	Preamble of the constitution, union and its territory	1
1.3	Meaning of citizenship, types, termination of citizenship	2
2	**Unit:2**	

Approved in XXV IIth Academic Council
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2.1	Definition of state, fundamental rights, general nature, classification, right to equality ,right to freedom , right against exploitation	2
2.2	Right to freedom of religion, cultural and educational rights, right to constitutional remedies. Protection in respect of conviction for offences	2
2.3	Directive principles of state policy, classification of directives, fundamental duties.	2
3	**Unit:3**	
3.1	The Union executive, the President, the vice President, the council of ministers, the Prime minister, Attorney-General, functions.	2
3.2	The parliament, composition, Rajya sabha, Lok sabha, qualification and disqualification of membership, functions of parliament.	2
3.3	Union judiciary, the supreme court, jurisdiction, appeal by special leave.	1
4	**Unit:4**	
4.1	The State executive, the Governor, the council of ministers, the Chief minister, advocate general, union Territories.	2
4.2	The State Legislature, composition, qualification and disqualification of membership, functions.	2
4.3	The state judiciary, the high court, jurisdiction, writs jurisdiction	1
5	**Unit:5**	
5.1	Relations between the Union and the States, legislative relation, administrative relation, financial Relations, Inter State council, finance commission	2
5.2	Emergency provision, freedom of trade commerce and inter course, comptroller and auditor general of India, public Services, public service commission, administrative Tribunals.	2
5.3	Official language, elections, special provisions relating to certain classes, amendment of the Constitution.	2

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
	1	1	1	3	2	2
CO1	2	2	1	3	2	2
CO2	1	1	1	3	2	2
CO3		2	1	3	2	2
CO4	1	1	1	3	2	2

3-High, 2-Medium,1-Low

Teacher's Assessment: Teachers Assessment of 20 marks may be based on one or more of thefollowing

1. Technical quizzes
2. Application development
3. Question & answer / Numerical solution
4. Group discussion
5. Other if any

Table 2: Recommended Assessment Pattern

Assessment Pattern Level No.	Knowledge Level	Class Test	Teacher's Assessment	End Semester Examination
K1	Remember	6		18
K2	Understand	7	4	18
K3	Apply	7	10	12
K4	Analyze		6	12
K5	Evaluate			
K6	Create			
	Total Marks	20	20	60

Table 3: Assessment Table

Assessment Tool	CO1	CO2	CO3	CO4	CO5
	K1,K2	K2,K3	K2,K3	K3,K4	K3,K4
Class Test (20 Marks)	04	04	04	04	04
Teachers Assessment (20 Marks)	04	04	04	04	04
ESE (60 Marks)	12	12	12	12	12

Text Books

1 D D Basu, Introduction to the constitution of India, Lexis Nexis, New Delhi,
2 PM Bhakshi, The constitution of India, Universal Law

Reference Books

1 Ministry of law and justice, The constitution of India, Govt of India, New Delhi, .
2 JN Pandey, The constitutional law of India, Central Law agency, Allahabad,
3 MV Pylee, India's Constitution, S Chand and company, New Delhi,

AMEEM6002:HSSM: Economics and Entrepreneurship for Engineers

(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

Prerequisite: Not Applicable

Course Description : For any construction project to be successful, it must be technically sound and the resulting benefits must exceed the cost associated with the project. This course "Economics and Finance for Engineers" basically aims at describing various aspects of engineering economics. The field of construction economics and finance deals with the systematic evaluation of cost and benefit associated with different projects. The topics in this course cover principles of engineering economy followed by basic methods for carrying out economic studies considering the time value of money. The other topics include the demonstration of different methods namely present, future and annual worth method, rate of return, break-even comparison, capitalized-cost and cost-benefit analysis for the comparison of alternatives. In addition, other topics those will be covered are different methods of depreciation, taxes, and cost analysis of construction equipments followed by cost estimating. Further, topics on financial management namely construction accounting, financial statements, financial ratios and working capital management are also included in this course. The topics will be developed in a logical sequence. For clear illustration of concepts, a number of problems will be solved. This course will definitely help the students and teachers in understanding the underlying principles and concepts in economics and finance

Course Outcomes:

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

1) Fundamental understanding of the concepts of Economics, namely Micro and Macro Economics.
2) Apply the Basic concepts of principle Cash flow using various Interest calculation Formulae
3) Understanding of Project planning with a specific view on project Financing.
4) Know decision making techniques based on financial guidelines.
5) Understanding how projects are framed and planned and executed

Detailed Syllabus:

Unit -1:	**Engineering Economics** Basic principles – Time value of money, Quantifying alternatives for decision making, Cash flow diagrams,Equivalence- Single payment in the future (P/F, F/P), Present payment compared to uniform series payments (P/A,A/P), Future payment compared to uniform series payments (F/A,A/F),Arithmetic gradient, Geometric gradient.	**06 Hrs**
Unit -2:	**Comparison of Alternatives** Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return,Break-even comparisons, Capitalized cost analysis,Benefit-cost analysis.	**06 Hrs**
Unit -3:	**Depreciation and Replacement Analysis** Depreciation - methods and calculation, Inflation, Taxes, Equipment costs, Ownership and operating costs, Buy/Rent/Lease options, Replacement analysis	**06 Hrs**
Unit -4:	**Cost Estimating** Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes, Parametric estimate, Life cycle cost.	**06 Hrs**
Unit -5:	**Financial Management:** Construction accounting, Chart of Accounts, Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management.	**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:

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2. Bose, D. C.,"Fundamentals of Financial management", 2nd ed.,PHI, New Delhi, 2010.
3. Boyer, C.B. and Merzbach, U. C.,"A History of Mathematics", 2nd ed., John Wiley & Sons, New York, 1989.
4. Gould, F.E.,"Managing the Construction Process", 2nd ed.,Prentice Hall, Upper Saddle River, New Jersey, 2002.
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Delhi, 2011.
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14. Sullivan, W. G.,Bontadelli, J.A. and Wicks,E. M.,"Engineering Economy", 11th ed., Prentice Hall, Upper Saddle River, New Jersey, 2001.

Evaluation Pattern

Table 1: Mapping of Course outcome with Program Outcomes

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	3	3		----	----
CO2	2	3	2		----	----
CO3	2	3	3		----	----
CO4	3	3	2		----	----
CO5	2	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	12
K2	Understand	05	05	12
K3	Apply	06	05	12
K4	Analyze	05	05	12
K5	Evaluate	00	00	12
K6	Create	00	00	00
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 K4as applicable)	(Knowledge level K1 to K4 as applicable)	(Knowledge level K1 to K4 as applicable)
Class Test	4	4	4	4	4
Teachers	4	4	4	4	4

Assessment					
ESE	12	12	12	12	12

AMDIS6003:ELC: Dissertation-I
(NEP 2020 Model Course)

Scheme of Teaching		Scheme of Evaluation	
Dissertation-	20 Hrs/Week	Term Work (ISE - II)	100 Marks
Total Credits	**10**	Viva Voce (ESE - II)	100 Marks
		Total	**200Marks**

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 for 25 Marks: A mid-term evaluations for 25 marks out of 50 marks 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 and assigns the marks out of 25marks.

Part-II: End Semester Evaluation for 25 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 25 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

SEMESTER-IV

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

Scheme of Teaching		Scheme of Evaluation	
Practical	32Hrs/Week	Term Work (ISE II)	150 Marks
Total Credits	16	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.