Tulsiramji Gaikwad-Patil College of Engineering and Technology
Wardha Road, Nagpur-441 108
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Approved by AICTE, New Delhi, Govt. of Maharashtra
(An Autonomous Institute Affiliated to RTM, Nagpur University)

Department of Civil Engineering

DEPARTMENT OF CIVIL ENGINEERING

M.Tech (Structural Engineering)

Structure & Curriculum

From

Academic Year 2021-22

Vision and Mission of Institute

Vision:

"To emerge as a learning Center of Excellence in the National Ethos in domains of Science, Technology and Management"

Mission

[M1] To strive for rearing standard and stature of the students by practicing high standards of Professional ethics, transparency and accountability

[M2] To provide facilities and services to meet the challenges of Industry and Society

[M3] To facilitate socially responsive research, innovation and entrepreneurship

[M4] To ascertain holistic development of student and staff members by inculcating knowledge and profession as work practices

Vision of the Department

To enhance and empower the capability of youth in education, research and entrepreneurship, capable of offering the innovative solution to the challenges faced in the Civil Engineering domain

Mission of the Department

- To develop capable civil engineering graduates by imparting quality education and training.
- To nurture youth to face challenges and offer solutions in the research domain of civil engineering.
- To promote overall development of the students by enhancing their skills to become self-sufficient by offering industrial exposure.
- To develop leadership skills and engage in the process of lifelong learning.
- To create infrastructure and human services in a sustainable way, to achieve social and environmental needs.

Program Education Objectives (PEO)

- The graduates will be able to apply principles of advanced Mathematics and Engineering sciences to analyze and solve civil engineering problems.
- Create sustainable environment to plan infrastructure for social needs.
- Design and execute civil engineering projects.
- Develop as a leader and to inculcate team spirit to execute ethically the projects.
- Adopt emerging technologies for lifelong learning.

Program Outcomes (PO)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

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Scheme of Instructions

Scheme of Instructions for First Year M. Tech. Programme in Structural Engineering

Semester – I (w.e.f.: AY 2021-22)

Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	CT - 1	CT - 2	TA / CA	ESE	TOTAL
									Exam Scheme				
1.	PCC	MSE1101	Theory of Elasticity and Plasticity	3	1	-	4	4	15	15	10	60	100
2.	PCC	MSE1102	Structural Dynamics	3	-	-	3	3	15	15	10	60	100
3.	PEC	MSE1103-06	Professional Elective - I	3	-	-	3	3	15	15	10	60	100
4.	PEC	MSE1107-10	Professional Elective - II	3	-	-	3	3	15	15	10	60	100
5.	PCC	MSE1111	Matrix Analysis of Structures	3	-	-	3	3	15	15	10	60	100
6.	PCC	MSE1112	Structural Dynamics Lab	-	-	2	2	1	-	-	25	25	50
7.	PCC	MSE1113	Matrix Analysis of Structures Lab			2	2	1	-	-	25	25	50
8.	MCC	MAU1114	Disaster Management of Infrastructure	2	-	-	2	Audit	-	-	-	-	-
			Total	17	1	4	22	18	75	75	100	350	600

L- Lecture   T-Tutorial   P-Practical   CT1- Class Test 1   CT2- Class Test 2   TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Professional Elective / Audit Course / Open Elective (list is provided at the end of structure)

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Scheme of Instructions

Scheme of Instructions for First Year M. Tech. Programme in Structural Engineering

Semester – II (w.e.f.: AY 2021-22)

| Sr. No.	Course Category	Course Code	Course Title	L	T	P	Contact Hrs / week	Credits	CT - 1	CT - 2	TA / CA	ESE	TOTAL
1.	PCC	MSE1201	Finite Element Analysis	3	1	-	4	4	15	15	10	60	100
2.	PCC	MSE1202	Theory of Plates & Shell	3	1	-	4	4	15	15	10	60	100
3.	PEC	MSE1203-06	Professional Elective - III	3	-	-	3	3	15	15	10	60	100
4.	PEC	MSE1207-10	Professional Elective – IV	3	-	-	3	3	15	15	10	60	100
5.	PCC	MSE1211	Advanced R.C.C. Lab	-	-	2	2	1	-	-	25	25	50
6.	PCC	MSE1212	Advanced Steel Lab	-	-	2	2	1	-	-	25	25	50
7.	FC	MSE1213	Research Methodology#	2	-	-	2	2	-	-	25	25	50
8.	MCC	MAU1214	Presentation & Research Paper Writing	2	-	-	2	Audit	-	-	-	-	-
			Total	16	2	04	22	18	60	60	115	315	550

L- Lecture   T-Tutorial   P-Practical   CT1- Class Test 1   CT2- Class Test 2   TA/CA- Teacher Assessment / Continuous Assessment

ESE- End Semester Examination (For Laboratory: End Semester Performance)

*- Professional Elective / Audit Course / Open Elective (list is provided at the end of structure)

Students are expected to complete it online by appearing NPTEL/Swayam Certification for 03 credits. Weekly 02 Hrs Theory in which students are expected to work on mathematical modeling, Seminar on IPR, Patent filing, Removing Plagiarisms, etc. will be done.

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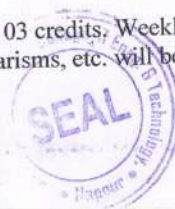
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Scheme of Instructions

Scheme of Instructions for First Year/Second Year M. Tech. Programme in Structural Engineering

List of Professional Elective Courses

Semester - I		Semester-II	
Professional Elective - I	**Professional Elective - II**	**Professional Elective- III**	**Professional Elective - IV**
Theory of Structural Stability	Advanced Design of Steel Structures	New Engineering Materials and Technology	Design of Advanced Concrete Structures
Theory of Thin Plates and Shells	Design of Composite Construction	Design of Formwork	Advanced Design of Foundations
Structural Optimization	Structural Health Monitoring and Rehabilitations of Structures	Design of High-Rise Structures	Soil Structure Interaction
Design of Environmental Structures	Design of Earthquake Resistant Structures	Earth Retaining Structures	Design of Industrial Structure

List of Open Electives and Audit Courses

Semester - I		Semester - II
Open Electives	**Audit Course - I**	**Audit Course - II**
MCSXX01: Business Analytics	MAU1119: Constitution of India	MAU1219: Constitution of India
MIPXX05: Industrial Safety	**MAU1114: Disaster Management of Infrastructure**	**MAU1214: Presentation & Research Paper Writing**
MMBXX06: Operation Research	MAU1139: Sanskrit for Technical Knowledge	MAU1239: Stress Management by Yoga
MSEXX02: Cost Management of Engineering Projects	MAU1149: Value Education	MAU1249: Personality Development through Life Enlightenment Skills
MSEXX03: Composite Materials		
MIPXX04: Waste to Energy		

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Program: M. Tech. Structural Engineering

Semester-I	MSE1101: Theory of Elasticity and Plasticity

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	1 Hrs/week		CT-II	15 Marks
Total Credits	4		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks
Pre-Requisites: Structural Analysis, Steel structures, steel design			**Total Marks**	**100 Marks**

Course Objectives:

1.	To introduce to the student the analysis of linear elastic solids under mechanical and thermal loads
2.	To expose the students to the principles of elastic stability and introduce to the student the analysis of linear elastic solids under mechanical and thermal loads
3.	To explain the principles of dynamic analysis of stability.
4.	To develop the fundamental understanding of elasticity and elastic stability
5.	To identify the dynamics analysis of system with distributed property

Course Contents

Unit I	Analysis of Stress and strain in 2 dimensions: Introduction, Types of forces, Components of Stresses and strains, Stress-strain relation, Plane stress and plane strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress function
Unit II	Analysis of stress and strain in 3 dimensions: Components of stress, principal stresses, stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.
Unit III	Bending of cantilever of narrow rectangular section loaded at end, bending of simply supported beam with uniform load, torsion of non-circular sections, Elliptical cross-section.
Unit IV	Differential equation for beam, columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral bucking of beams. Buckling of simply supported rectangular plates uniformly compresses in middle plane.
Unit V	Energy method for elastic buckling of columns, Approximate method, buckling of columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load Elastic stability of columns --- eigenvalue problem; buckling modes and critical load; beam columns; beam-columns with elastic restraints; effect of initial curvature; buckling of bar on elastic foundation; buckling of frames; inelastic stability; lateral buckling of beams in pure bending; torsional buckling; combined flexural-torsional buckling.

	Text Books	
T.1	Theory of Elasticity, 3rd Edition, Authored by Timoshenko, S.P. and Goodier, J.N Mc-Graw Hill Publication, New Delhi, 1999	
T.2	Theory of Elastic Stability, 2nd Edition, Authored by S.P. and Gere J. M., Mc-Graw Hill Company, New Delhi,200	
T.3	Computational Elasticity-Theory of Elasticity, Authored by Ameen,M. First Addition Hill Publication, New Delhi, 1999	

	Reference Books	
R.1	A General theory of elastic stability Authored by Michael Thompson Hill Publication 2007	
R.2	Theory of Stability of Continuous Elastic Structures Authored by Antonio Grimaldi and Mario Como Hill Publication – 2001	
R.3	Theory of Elastic Stability (Civil Engineering) 2ndKindle Edition Authored by Stephen P. Timoshenko, James M. Gere Hill Publication 2002	

	Useful Links	
1	https://nptel.ac.in/courses/105/105/105105177/	
2	https://nptel.ac.in/courses/105/105/105105173/	
3	https://nptel.ac.in/courses/105/105/105105173/	

	Course Outcomes	PO/PSO	CL	Class Sessions
MSE1101.1	**Apply** the concept of plane stress and plane strain at a point	PO1, PO2	3	9
MSE1101.2	**Analysis** of stress and strain in 2 and 3 dimensions	PO1, PO2, PO3	4	9
MSE1101.3	**Solve** differential equation for analysis of beam and column	PO1, PO2	3	9
MSE1101.4	**Compare** bending concept for narrow rectangular section	PO1, PO2, PO3	4	9
MSE1101.5	**Integrate** compressive forces and distributed axial load	PO1, PO2, PO3,	6	9

Program: M. Tech. Structural Engineering

Semester-I	MSE1102 Structural Dynamics

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: RCC Structures, Advanced Steel Design.			**Total Marks**	**100 Marks**

Course Objectives:

1.	To understand the behavior of structure especially building to various dynamic loads
2.	To provide the fundamental understanding of the structural dynamics and the problem-solving ability for dynamic response in civil engineering design, analysis and research
3.	To apply the structural dynamics theory to real-world problems like seismic analysis and design of structures
4.	To Introduce students to analytical and numerical methods in structural dynamics with emphasis on vibration and to opportunities to optimize system for desired dynamic response.
5.	To analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses.

Course Contents

Unit I	Analysis of undamped and viscously damped, single degree freedom systems. Fundamentals of Rigid/Deformable body dynamics
Unit II	Introduction to vibrations due to earthquake, Study of IS 1893-1984 and 2000 applicable to buildings and water tanks.
Unit III	Response of single degree freedom systems to harmonic loading support motion and transmissibility Duhamel's integral.
Unit IV	Free vibrations of lumped mass multi degree freedom systems, shear buildings orthogonality criteria Rayleigh's method.
Unit V	Dynamic analysis of systems with distributed properties, Approximate design method Transformation factors. Liquification, Response of continuous systems to dynamic loads. Energy Principle.

Text Books	
T.1	Structural Dynamics: Theory and Computation 6th edition Authored by Mario Paz springer - 2008.
T.2	Fundamentals of structural dynamics Authored by Roy R Craig Wiley publication -2006
T.3	Structural Dynamics Authored by Yong Bai and Zhao-Dong Xu Wiley publication -2019

Reference Books	
R.1	Structural dynamics Authored by Joseph W. Tedesco Cambridge University Press-2018
R.2	Dynamics of Structures Authored by Anil Kumar CRC Press -2009
R.3	Dynamics of Structures, Authored by S. Chopra – Person Publication -2020

Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/105/1051051778/
3	https://nptel.ac.in/courses/105/105/1051051778/

	Course Outcomes	PO/PSO	CL	Class Sessions
MSE1102.1	**Apply** the concept of Multiple degree of freedom to damped and undamped oscillating conditions.	PO1, PO2	3	9
MSE1102.2	**Analyse** the Vibration analysis technics to R.C.C Structures with IS code study.	PO1, PO2, PO3	4	9
MSE1102.3	**Formulate** the structural dynamics theory to analyse the response of single degree freedom systems and design of structure.	PO1, PO2, PO3	5	9
MSE1102.4	**Develop** the equation of motion for vibratory systems and solving for the free and forced response.	PO1, PO2, PO3	6	9
MSE1102.5	**Solve** problem on Dynamic analysis with distributed properties & loading by Energy Principle, Rayleigh-Ritz method.	PO1, PO2, PO3,	5	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1103: (PE-I) Theory of Structural Stability

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks
Pre-Requisites: Solid Mechanics. Reinforced Cement Concrete Structures			**Total Marks**	**100 Marks**

Course Objectives:

1.	To achieve fundamental understanding of the subject of stability of structures and apply it to diverse problems in civil engineering.
2.	To understand the mechanisms to provide stability to the structures with respect to torsion buckling
3.	To impart knowledge about methods involved in the analysis of structures.
4.	To determine response of structures by classical concept of stability
5.	To enable the student, get a feeling of how real-life structures behave, and apply the diverse problem in civil engineering

Course Contents

Unit I	Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behavior
Unit II	Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling
Unit III	Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of Frame Members
Unit IV	Stability of Beams: lateral torsion buckling.
Unit V	Stability of Plates: axial flexural buckling, shear flexural buckling, buckling under combined loads.

Text Books

T.1	Theory of Plates and Shells Authored by Timoshenko, McGraw Publication New York. -2004
T.2	Theory and Analysis of Plates Authored by P. Szilard, Prentice Hall publication -2001
T.3	Theory of Plates Authored by K. Chandrasekhara, University Press Publication 2003

	Reference Books
R.1	Manual of Principles of Structural Stability Theory, Authored by Alexander Chafes, Prentice Hall, New Jersey-2000
R.2	Numerical Methods for Engineering Problems, Authored by N. Krishna Raju & K. U Muthu, Mac-Millan publishers -2009
R.3	Theory of Elasticity Stability Authored by Timoshenko and Gere. Dover Publications-2008

	Useful Links
1	https://nptel.ac.in/courses/127/105/127105018/
2	https://nptel.ac.in/courses/105/108/105108124/
3	https://nptel.ac.in/courses/105/108/105108122/

		Course Outcomes	PO/PSO	CL	Class Sessions
MSE1103.1		Apply the concept of stability of discrete and continuous system	PO1, PO2	3	9
MSE1103.2		Design the stability of columns by considering the buckling and torsion effect	PO1, PO2, PO3	6	9
MSE1103.3		Examine the stability of various frame	PO1, PO2,PO3	4	9
MSE1103.4		Judge the stability of beam and plate	PO1, PO2, PO3	5	9
MSE1103.5		Evaluate the buckling and dynamic stability for inelastic materials	PO1, PO2, PO3,	5	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1104: (PE-I) Theory of Thin Plate and Shell

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: Advanced Steel Design, Structural Analysis-I			**Total Marks**	**100 Marks**

Course Objectives:

1.	To enable the student analyze and design thin shell structures including domes and cylindrical shell
2.	To study the behavior of thin plates, simply supported plate and sinusoidal load
3.	To study the behavior of rectangular plates and circular plates with clamped and simply supported edges
4.	To demonstrate the foundations of the classical theory of shells
5.	To analyze the plate with/without Central Hole and design thin shell structures including domes and cylindrical shell

Course Contents

Unit I	**Introduction:** Space Curves, Surfaces, Shell Co-ordinates, Strain Displacement Relations, Assumptions in Shell Theory, Displacement Field Approximations, Stress Resultants, Equation of Equilibrium using Principle of Virtual Work, Boundary Conditions
Unit II	**Small Deflection Theory of Thin Rectangular Plates:** Assumptions, Derivation of governing differential equation for thin plates, Boundary conditions, simply supported plate and sinusoidal load, Navier's solution, Application to different cases, Levy's solution for various boundary conditions subjected to different loadings
Unit III	**Circular Plates:** Symmetrical loading, Relations between slope, deflection, moments and curvature – Governing differential equation, uniformly loaded plates with clamped and simply supported edges, Central hole, bending by moments and shearing forces uniformly distributed
Unit IV	**Plates on Elastic Foundations:** Governing differential equation, deflection of uniformly loaded simply supported rectangular plate, Navier and Levy type solutions, large plate loaded at equidistant points by concentrated forces P.
Unit V	**Introduction to the shells of Double curvatures:** Geometry, analysis and design of elliptic paraboloid, conoid and hyperbolic parabolic shapes, inverted umbrella type. Axi-Symmetrical shells: General equation - Analysis and axi-symmetrical by membrane theory. Application spherical shell and hyperboloid of revolution cooling towers

	Text Books	
T.1	Theory of Plates and Shells Authored by Timoshenko, McGraw Publication NewYork. -2004	
T.2	Theory and Analysis of Plates Authored by P. Szilard, Prentice Hall publication -2001	
T.3	Theory of Plates Authored by K. Chandrasekhara, University Press Publication 2003	

	Reference Books	
R.1	Manual of Principles of Structural Stability Theory, Authored by Alexander Chafes, Prentice Hall, New Jersey-2000	
R.2	Numerical Methods for Engineering Problems, Authored by N. Krishna Raju & K. U Muthu, Mac-Millan publishers -2009	
R.3	Theory of Elasticity Stability Authored by Timoshenko and Gere. Dover Publications-2008	
Useful Links		
1	https://nptel.ac.in/courses/105/108/105108122/	
2	https://nptel.ac.in/courses/127/105/127105018/	
3	https://nptel.ac.in/courses/105/108/105108122/	

		Course Outcomes	PO/PSO	CL	Class Sessions
MSE1104.1		Apply the concept of cylindrical bending and slope in slightly bent plate	PO1, PO2	3	9
MSE1104.2		Judge the boundary condition subjected to structural loadings	PO1, PO2, PO3	5	9
MSE1104.3		Evaluate the moments and shearing forces for circular section	PO1, PO2	5	9
MSE1104.4		Analyze the problems pertaining to beams on elastic foundation	PO1, PO2, PO3	4	9
MSE1104.5		Design the Governing equation for buckling plate	PO1, PO2, PO3,	6	9

Program: M. Tech. Structural Engineering

Semester-I	MSE1105: (PE-I) Structural Optimization

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks
Pre-Requisites: Analysis -I, RCC Structures, Concrete Technology			Total Marks	100 Marks

Course Objectives:

1.	To Understand how to formulate a structural optimization problem, including defining appropriate design variables, constraints, and objective functions.
2.	To apply approximation methods to construct a sequence of approximate structural design problems
3.	To evaluate the results of a structural optimization using optimality criteria to determine the nature of the solution.
4.	To understand how structural analysis methods are integrated with optimization methods to synthesize a structural design.
5.	To solve structural design problems according to the described method including defining appropriate design variables, constraints, and objective functions.

Course Contents

Unit I	Introduction: Simultaneous Failure Mode and Design, Classical External Problems
Unit II	Calculus of Variation: Variational Principles with Constraints,
Unit III	Linear Programming, Integer Programming, Nonlinear Programming, Dynamic Programming,
Unit IV	Geometric Programming and Stochastic Programming.
Unit V	Applications: Structural Steel and Concrete Members, Trusses and Frames. Design: Frequency Constraint, Design of Layouts.

Text Books

T.1	Evolutionary Structural Optimization Authored by Grant P. Steven and Y. M. Xia Wiley Publication 2000
T.2	Theory of Plates, 1st Edition, Authored by Chandrasekhara K, Universities Press (India) Ltd, Hyderabad,2001
T.3	Theory of Plates and Shells, 2nd Edition,Authored by S.W Timoshenko S.P and Krieger, McGraw-Hill Book Company, New Delhi, 1970.

	Reference Books	
R.1	An Introduction to Structural Optimization Authored by Anders Klarbring and Peter W. Hill Publication 2010	
R.2	Structural Optimization Authored by Keith M. MacBain and William CRC Press – 2003	
R.3	Elements of Structural Optimization Authored by Manohar P. Kamat and Raphael T. Haftka CRC Press Publication -2000	
Useful Links		
1	https://nptel.ac.in/courses/105/108/105108127/	
2	https://nptel.ac.in/courses/127/105/127105018/	
3	https://nptel.ac.in/courses/105/108/105108122/	

	Course Outcomes	**PO/PSO**	**CL**	**Class Sessions**
MSE1105.1	Execute Variational principle for optimization	PO1, PO2	3	9
MSE1105.2	Apply optimization techniques to structural steel and concrete members.	PO1, PO2, PO3	3	9
MSE1105.3	Analyze liner programming concept with respect structural optimization	PO1, PO2, PO3	4	9
MSE1105.4	Compare the Geometric programming and stochastic programming	PO1, PO2, PO3	4	9
MSE1105.5	Design of concrete members by using frequency constraint.	PO1, PO2, PO3,	6	9

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Semester-I	MSE1106 (PE-I) Design of Environmental Structures

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: Structural Dynamics, RCC Structures, Concrete Technology			**Total Marks**	**100 Marks**

Course Objectives:

1.	To understand the concept of environmental structures and hydraulics structures
2.	To relate the method of analysis of hydraulics structures
3.	To list out the application of environmental structures
4.	To design the structural members by considering environmental aspect
5.	To interpret the result in comparison with public health considerations and standards.

Course Contents

Unit I	Analysis and Design of Over Head Water Tanks.
Unit II	Design of Under Ground Tanks.
Unit III	Design of jack well/Pump house / approach bridges. / Box culvert, Application of box culvert
Unit IV	Design of pretreatment units - aerators, flash mixer, sand filters.
Unit V	Design considerations including loads such as traffic load, backfill load, live load etc. for Appurtenances like man-holes, concrete bedding and thrust blocks for sewers, rising mains etc.

Text Books

T.1	A Circular Storage Tanks and Silos, Authored by GhaliE & F N Spon, publication -2000)
T.2	Introduction and Design of Environmental structures authored by David A Cornwell and Mackenzie L Davis CRC Press-2007
T.3	R.D.,Designof liquidretaining concretestructure, authored by S Anchor,Published by CRC (2000)

Reference Books	
R.1	Jain, S.K. & Jaiswal, O.R., GuidelinesManual for seismic design of liquid storage tanks, NICEE, IITK, 2004
R.2	Guidelines Manuals for seismic design of liquid storage tanks, PublishedNICEE, 2010
R.3	Introduction and Design of Environmental structures Authored by David A Cornwell and Mackenzie L Davis AP Publication -2009
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/127/105/127105018/
3	https://nptel.ac.in/noc/courses/105/#ongoing

		Course Outcomes	PO/PSO	CL	Class Sessions
MSE1106.1		Apply the design concept of tanks	PO1, PO2	3	9
MSE1106.2		Evaluate the methods for design of underground tank	PO1, PO2, PO3	5	9
MSE1106.3		Examine the effects of jack well pump	PO1, PO2, PO3	4	9
MSE1106.4		Defend the units of aerators	PO1, PO2, PO3	5	9
MSE1106.5		Modify the design consideration including traffic loads and backfill loads	PO1, PO2, PO3,	6	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1107: (PE-II) Advanced Design of Steel Structures

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: Structural analysis, Steel Design			**Total Marks**	**100 Marks**

Course Objectives:

1.	To impart knowledge on behavior and design of various connections.
2.	To design the tabular structures including connection and supports.
3.	To enable students to analyze bridge superstructure.
4.	To evaluate and design forces acting, bending moments & stress on chimney.
5.	To design and check the industrial shed as per IS code

Course Contents	
Unit I	Eccentric and Moment connections: Beams – Column Connections- Connections Subjected to Eccentric Shear – Bolted Framed Connections- Bolted Seat Connections – Bolted Bracket Connections. Bolted Moment Connections – Welded Framed Connections – Welded Bracket Connections – Moment Resistant Connections.
Unit II	Tabular Structures: Properties of steel tubes, design of tension member and compression members, design of welded connections, design of flexural members, analysis and design of tabular trusses including purlins and supports.
Unit III	Bridges: Introduction, steel used in bridges, classification of steel bridges load & load combination, Analysis and design of girder bridge, plate girder bridges, truss bridges, gusseted connection
Unit IV	Forces acting on chimney, design of self-supporting welded and bolted chimney and components including design of foundation.
Unit V	Design of industrial shed considering gravity and wind load/ gantry Girders.

Text Books	
T.1	RamChandra Design of Steel structures Vol-I & Vol-II Std. book house / Rajsons Publication Pvt. Ltd.,, Delhi, 2006
T.2	Gaylords, E.H. & Gaylords, C. N., Design of Steel Structures, Blackwell, 1994.
T.3	Dayaratnam P., Design of Steel Structures, Wheeler Publications, Allahabad, 1992

Reference Books

R.1	Ghosh, ― Analysis and Design practice of Steel Structure‖, (Forthcoming), Phi Publisher, New Delhi
R.2	Design of Steel Structures, Wheeler Publications, Allahabad, 1994
R.3	Design of Eccentric Connection Raj Publication Pvt. Ltd.,, Delhi, 2009

Useful Links

1	https://nptel.ac.in/courses/105/105/105105162/
2	http://www.digimat.in/nptel/courses/video/105105162/L45.html
3	https://nptel.ac.in/noc/courses/105/#ongoing

	Course Outcomes	PO/PSO	CL	Class Sessions
MSE1107.1	Modify the design concept of eccentric connection	PO1, PO2	6	9
MSE1107.2	Create tabular structures with supports and connections	PO1, PO2, PO3	6	9
MSE1107.3	Design the various components of bridges	PO1, PO2, PO3	6	9
MSE1107.4	Classify the design consideration including loads and storage vessels	PO1, PO2, PO3	6	9
MSE1107.5	Compose the various concept related to industrial sheds	PO1, PO2, PO3,	6	9

Program: M. Tech. Structural Engineering

Semester-I	MSE1108 (PE-II) Design of Composite Construction

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: Steel Structures, Reinforced Cement Concrete Structures. Advanced Concrete Structures.			**Total Marks**	**100 Marks**

Course Objectives:	
1.	To develop the student's skills in understanding the different manufacturing methods available for composite material
2.	To predict an understanding of the behavior, analysis and design of Steel concrete composite elements and structures
3.	To explain the behavior of constituents in the composite materials, shear connectors
4.	To familiarize with the design and analysis procedure of steel and concrete composite elements
5.	To Enlighten the students in different types of reinforcement and seismic behavior of composite materials

Course Contents		
Unit I	**Introduction** Classification and Characteristics of Composite Materials- Basic Terminology, Advantages. Stress-Strain Relations- Orthotropic and Anisotropic Materials, Engineering Constants for Orthotropic Materials, Introduction to steel, concrete composite construction, Codes, Composite action, Serviceability and Construction issues in design.	
Unit II	**Design of composite Members** Analysis and Design of Cement Composite Structural Elements - Ferrocement, SIFCON And Fibre Reinforced Concrete. Design of composite beams, slabs, columns, beam and columns, Design of composite trusses.	
Unit III	**Design of connection** Shear connectors – Types – Design of connections in composite structures – Design of shear connectors – Partial shear interaction.	
Unit IV	**Composite Box Girder Bridge** Introduction - behavior of box girder bridges - design concepts	
Unit V	**Case Studies** Case studies on steel - concrete composite construction in buildings - seismic behavior of composite structures	

Text Books	
T.1	Composite Structures of Steel and ConcreteBeams, Slabs, Columns and Frames for Buildings Authored by Roger P. Johnson, Yong C. Wang Fourth Edition Wiley Publication 2018
T.2	Composites for Construction: Structural Design with FRP Materials Authored by C Bank Wily Publication -2001
T.3	Composite Structures: Design, Mechanics, Analysis, Manufacturing, and Testing Authored by Manoj Kumar Buragohain CRC Publication -2000

Reference Books	
R.1	"Shear Connection and Concrete Beams, Slabs, Columns and Frames for Buildings", Vol.I, Authored by Johnson R.P. Blackwell Scientific Publications, 2002
R.2	Composite Steel and Concrete Structural Members, Fundamental behavior", Manual Authored by Bradford M.A. "Pergamon press, Oxford, 1999
R.3	Introduction to the Design and Analysis of Composite Structures: An Engineers Practical Guide published in 2014

Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/105/105105164/
3	https://nptel.ac.in/courses/105/105/1051051228/

	Course Outcomes	PO/PSO	CL	Class Sessions
MSE1108.1	Apply the concept of serviceability and construction issue in design	PO1, PO2	3	9
MSE1108.2	Design the composite members for structures	PO1, PO2, PO3	6	9
MSE1108.3	Compare the shear connection required in structures	PO1, PO2, PO3	4	9
MSE1108.4	Analyses the composite box girder bridge	PO1, PO2, PO3	4	9
MSE1108.5	Evaluate the seismic behavior of composite structures	PO1, PO2, PO3,	5	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1109: (PE-II) Structural Health Monitoring		

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks
Pre-Requisites: Concrete Technology, RCC Structures, Advanced steel design			Total Marks	100 Marks

Course Objectives:

1.	To Implement fundamental concepts in structural health monitoring
2.	To do the Assessment of post-earthquake structural integrity and identify the performance-based design philosophy
3.	To Provide Performance enhancement of an existing structure
4.	To understand the remote structural health monitoring
5.	To classify a damage detection and characterization strategy for engineering structure

Course Contents

Unit I	Structural Health: Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.
Unit II	Structural Health Monitoring: Concepts, Various Measures, Structural Safety in Alteration. Structural Audit: Assessment of Health of Structure, Collapse and Investigation, Investigation Management, SHM Procedures.
Unit III	Static Field Testing: Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.
Unit IV	Dynamic Field Testing: Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.
Unit V	Introduction to Repairs and Rehabilitations of Structures: Case Studies (Site Visits), piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.

Text Books

T.1	Structural Health Monitoring: A Machine Learning Perspective Authored by Charles R. Farrar and Keith Worden Wiley Publication 2012

| T.2 | Structural Health Monitoring: A Non-Deterministic Framework Authored by Ranjan Ganguli Springer-2020 |
| T.3 | New Trends in Structural Health Monitoring Authored by K. Alfredo Wiley publication 2012 |

Reference Books

R.1	Structural Health Monitoring of Aerospace CompositesAuthored by Victor Giurgiutiu AP Publication -2015
R.2	Structural Health Monitoring authored by Daniel Balagieswiley publication - 2006
R.3	Structural Health Monitoring of Large Civil Engineering StructuresAuthored by Hua-Peng Chen Wiley Blackwell publication -2018

Useful Links

1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/105/105105173/
3	https://nptel.ac.in/courses/105/105/105105177/

		Course Outcomes	**PO/PSO**	**CL**	**Class Sessions**
MSE1109.1		Evaluate the factor affecting the Health of Structures	PO1, PO2	5	9
MSE1109.2		Compare the structural audit for existing building	PO1, PO2, PO3	4	9
MSE1109.3		Analyze the simulations and loading method	PO1, PO2, PO3	4	9
MSE1109.4		Demonstrate the stress history data	PO1, PO2, PO3	3	9
MSE1109.5		Modify on the repair and rehabilitation of structures	PO1, PO2, PO3,	6	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1110: (PE-II) Design of Earthquake Resistant Structures

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		CT-I	15 Marks
Tutorial	-		CT-II	15 Marks
Total Credits	3		CA	10 Marks
Duration of ESE: 3Hrs			ESE	60 Marks
Pre-Requisites: RCC Structures, Steel Structures.			**Total Marks**	**100 Marks**

Course Objectives:

1.	To give an exposure to earthquake engineering, earthquake, faults and propagation of earthquake waves
2.	To introduce fundamentals of structural dynamics relevant to earthquake resistant design
3.	To understand the behavior of concrete structures during earthquakes
4.	To provide a rational basis for the design of earthquake-resistant structures.
5.	To design earthquake resistant structures as per IS guidelines and to study IS:1893, IS 13920 for analysis of ductile RCC Structures

Course Contents

Unit I	**Engineering geology of earthquakes:** Faults, Propagation of earthquake waves, quantification of earthquake, magnitude, energy intensity of earthquake, accelerograph, scalogram, recording and analysis of earthquake records, seismicity of the world, Analysis and interpretation of earthquake data, determination of magnitude, epicenter, epicenter distances focal depth, focal mechanism, seismic zoning
Unit II	**Causes or sources of earthquake damage:** Damage due to ground failure, History of apast earthquakes, generation of response spectrum from available earthquake records, Evolution of seismic risk, Concept of response spectra, generation of site-specific spectrum, characteristics of earthquake ground motion.
Unit III	**Strength, ductility and energy absorption:** Ductility of reinforced members subjected to flexure. Axial loads & shear detailing of RCC members beam column, Beam-column joints for ductile behaviours, IS code previsions
Unit IV	**Guideline for achieving efficient seismic resistant design:** Special aspects in multi-story buildings, effect of torsion, flexible first story, P-delta effect, soil-structure, interaction on building response. Drift limitation.
Unit V	**Seismic design principles of retaining walls** – Concept of Seismic design of bridges – Seismic design of bearings Seismic Control of Structures: Base isolation- Tuned mass dampers Study of IS: 1893, IS:13920 for analysis and ductile design of RCC structures and other related code

Text Books

T.1	Earth quake Engineering –Authored by S K Duggal Oxford University Press Publication 2007

T.2	Seismic Architecture: The architecture of earthquake resistant structures- Authored by Prof Lunge. Pearson Education Press Publication-2009	
T.3	Earthquake Resistance design of Structures authored by Pankaj Agrawal Raj Publication -2006	

Reference Books

R.1	Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2nd Edition., Pearson Education Publication Pvt. Ltd, New Delhi, 1995
R.2	Basic Elements of Earthquake Engineering -Authored by Asadour H. HadjianWiley Publication -2019
R.3	Advanced Soil Dynamics and Earthquake Engineering Authored by Bharat Bhushan Prasad PHI Publication – 2009

Useful Links

1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/105/1051051778/
3	https://nptel.ac.in/courses/105/105/1051051775/

	Course Outcomes		**PO/PSO**	**CL**	**Class Sessions**
MSE1110.1	Apply the concept of Propagation of earthquake waves		PO1, PO2	3	9
MSE1110.2	Examine the causes and sources of earth quake		PO1, PO2, PO3	4	9
MSE1110.3	Evaluate the moments and shear detailing of RCC member		PO1, PO2, PO3	5	9
MSE1110.4	Design the special aspect in multistoried building		PO1, PO2, PO3	6	9
MSE1110.5	Design the structure by using IS 1893		PO1, PO2, PO3,	6	9

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Program: M. Tech. Structural Engineering

Semester-I	MSE1111: Matrix Analysis of Structures

Teaching Scheme			Examination Scheme	
Theory	3 Hrs/week		**CT-I**	15 Marks
Tutorial	-		**CT-II**	15 Marks
Total Credits	**3**		**CA**	10 Marks
Duration of ESE: 3Hrs			**ESE**	60 Marks
Pre-Requisites: Structural Analysis, RCC Structures, Advance concrete structures			**Total Marks**	**100 Marks**

Course Objectives:

| 1.	To make the student to analyze various types of structures with respect to imposed load
2.	To expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses.
3.	To determine deflections and forces in statically determinate and indeterminate structures using force and stiffness methods
4.	To use a physical interpretation of stiffness matrices to assemble stiffness matrices analytically
5.	To Combine classical methods of Structural Analysis with programming and commercial software

Course Contents

Unit I	Stiffness method for plane truss, beams and plane frames
Unit II	Stiffness method for plane grid and space frames
Unit III	Effect of shear deformation. Internal member end releases
Unit IV	Analysis for member loading (self, temperature & imposed), inclined supports, lack of fit, initial joints displacements, Boundary Value Problems (BVP): Approximate Solution of Boundary Value Problems
Unit V	Solution technique with banded & skyline technique, band minimization, frontal techniques

Text Books

T.1	J. M. Matrix Method of Structural Analysis 3rd Edition Authored by Gere, W. and Weaver New York Wiley Publication 2000
T.2	Matrix Method of Structural Analysis, 1st edition, Authored by Meghre A.S. & Deshmukh S.K. Charotar publishing house, Anand, 2003
T.3	Matrix Method of Structural Analysis, 2nd Edition; Authored by Kanchi, M. B., John Willey & Sons, Publication 2006

	Reference Books	
R.1	Matrix Analysis of Structures 2nd Edition Authored by Aslam Kassimali AP Publication 2006	
R.2	Matrix Method of Structural Analysis, 1stedition, Authored by A.S. & Deshmukh CharotarPublishing house, Anand, 2007	
R.3	Matrix Analysis of Structures Authored by Robert E. Sennett Wiley publication -2007	
Useful Links		
1	https://nptel.ac.in/courses/105/108/105108122/	
2	https://nptel.ac.in/courses/127/105/127105018/	
3	https://nptel.ac.in/courses/105/108/105108122/	

		Course Outcomes	PO/PSO	CL	Class Sessions	Lab Sessions
MSE1111.1		Apply the concept of stiffness method for plane truss	PO1, PO2	3	9	2
MSE1111.2		Evaluate the method for analysis of space frame	PO1, PO2, PO3	5	9	2
MSE1111.3		Analyze the effect of shear deformation internal member and end release	PO1, PO2,PO3	4	9	4
MSE1111.4		Judge dynamics analysis of system with distributed properties	PO1, PO2, PO3	5	9	2
MSE1111.5		Design the solution techniques with banded sky line technique	PO1, PO2, PO3,	6	9	2
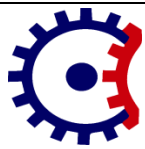
Program: M. Tech Structural Engineering

Semester	Course Code	Name of Course	L	T	P	Credits
I	MSE1112	Structural Dynamics Laboratory	-	-	2	1

Pre-Requisites: Structural Dynamics, RCC Structures, Advanced Steel Design

Course Objectives:

|	
1.	To understand the behaviors of structure especially building to various dynamic loads
2.	To provide the fundamental understanding of the structural dynamics and the problem-solving ability for dynamic response in civil engineering design, analysis and research
3.	To apply the structural dynamics theory to real-world problems like seismic analysis and design of structures
4.	To Introduce students to analytical and numerical methods in structural dynamics with emphasis on vibration and to opportunities to optimize system for desired dynamic response.
5.	To analyze structures subjected to any kind of dynamic excitation and computing quantities like displacements, forces, stresses,
6.	To understand the behaviors of structure especially building to various dynamic loads

	List of Experiment	CO
1	Study the concept of undamped and viscous damped	**CO1**
2	Calculation of horizontal seismic force of building using IS 1893-1984	**CO2**
3	Dynamic of two-story building frame subjected to harmonic base motion	**CO3**
4	Dynamic response of four-story building frame using base harmonic motion	**CO3**
5	To determine the damp natural frequency	**CO4**
6	To calculate the lateral water force of a water tank due to earth quake shock	**CO5**
7	To observe liquefaction of soil	**CO5**

Text Books

T.1	Earthquake Resistant Design for Engineers and Architects‖, 3rdEdition 1989
T.2	Earth quake resistance design of Structure – S K Duggal
T.3	Seismic Architecture: The architecture of earthquake resistant structures- Book by Mentor Lunge.
T.4	Experimental Structural Dynamics: An Introduction toBook by Robert Emerson Coleman

	Reference Books
R.1	Computational Dynamics —Theory of Elasticity, First Addition 2007
R.2	Penzien, —Dynamics of Structures‖, McGraw Hill, 1994
R.3	Structural Dynamics of Earthquake Engineering: Theory and Application Book by Sagathevan Rajasekhara
R.4	Experimental Structural Dynamics: An Introduction toBook by Robert Emerson Coleman
Useful Links	
1	https://nptel.ac.in/courses/105/105/105105162/
2	https://nptel.ac.in/courses/105/105/1051051778/
3	https://nptel.ac.in/noc/courses/105/#ongoing

	Course Outcomes	**PO/PSO**	**CL**	**Lab Sessions**
MSE1112.1	Apply the concept of Propagation of earthquake waves	PO1, PO2	3	2
MSE1112.2	Examine the causes and sources of earth quake	PO1, PO2, PO3	4	2
MSE1112.3	Evaluate the moments and shear detailing of RCC member	PO1, PO2, PO3	5	4
MSE1112.4	Design the special aspect in multistoried building	PO1, PO2, PO3	6	2
MSE1112.5	Design the structure by using IS 1893	PO1, PO2, PO3,	6	2
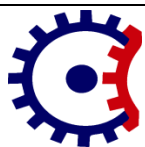
Program: M. Tech Structural Engineering

Semester	Course Code	Name of Course	L	T	P	Credits
I	MSE1113	Matrix Analysis of Structures Laboratory	-	-	2	1

Pre-Requisites: Structural Dynamics, RCC Structures, Advanced Steel Design

Course Objectives:

1.	To make the student to analyze various types of structures.
2.	To expand the student knowledge of the stiffness and flexibility methods studied in the basic structural analysis courses.
3.	To determine deflections and forces in statically determinate and indeterminate structures using force and stiffness methods
4.	To use a physical interpretation of stiffness matrices to assemble stiffness matrices analytically
5.	To Combine classical methods of Structural Analysis with programming and commercial software

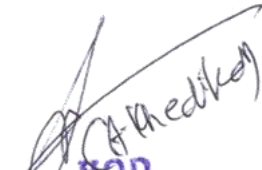| List of Experiments		CO
1	Analysis and Design of plane Truss	CO1
2	Evaluation in various methods of space frame	CO2
3	Analysis of plane Beam and shear deformation	CO3
4	Testing of beams for deflection, flexure and shear	CO3
5	Analysis and design of plane Frame	CO4
6	Demonstrate the various methods of analysis of Plane Grid	CO4
7	Study of sky line technique	CO5

Text Books

T.1	Gere, W. and Weaver; J. M., Matrix Method of Structural Analysis 3rd Edition, Van Nostrand Reinhold; New York; 1990
T.2	Meghre A.S. & Deshmukh S.K. ; Matrix Method of Structural Analysis, 1st edition, Charotar publishing house, Anand, 2003
T.3	Kanchi, M. B., Matrix Method of Structural Analysis, 2nd Edition; John Willey & Sons, 1999
T.4	Matrix Method of Structural Analysis, 3rd Edition; John Willey & Sons, 2000

Reference Books

R.1	Matrix Method of Structural Analysis, 3rd Edition; John Willey & Sons, 2000
R.2	A.S. & Deshmukh S.K. ; Matrix Method of Structural Analysis, 1st edition, Charotar publishing house, Anand, 2005
R.3	Integrated matrix analysis of structuresBook by Mario Paz
R.4	Matrix Analysis of Structures, SI EditionBook by Aslam Kassiani

Useful Links		
1	https://onlinecourses.nptel.ac.in/noc21_ce59/preview	
2	https://nptel.ac.in/courses/127/105/127105018/	
3	https://nptel.ac.in/courses/105/108/105108122/	

	Course Outcomes	PO/PSO	CL	Lab Sessions
MSE1113.1	Apply the concept of stiffness method for plane truss	PO1, PO2	3	2
MSE1113.2	Evaluate the method for analysis of space frame	PO1, PO2, PO3	5	2
MSE1113.3	Analyze the effect of shear deformation internal member and end release	PO1, PO2,PO3	4	2
MSE1113.4	Judge dynamics analysis of system with distributed properties	PO1, PO2, PO3	5	4
MSE1113.5	Design the solution techniques with banded sky line technique	PO1, PO2, PO3,	6	2

H.O.D.
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T.G.P.C.E.T.Nagpur.

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Tulsiramji Gaikwad-Patil
College Of Engineering
and Technology, Nagpur

Principal
Tulsiramji Gaikwad - Patil College Of
Engineering & Technology
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