Shree Warana Vibhag Shikshan Mandal's

WARANA UNIVERSITY,

WARANANAGAR

(A State Public University established under Section 3 (6) of MPUA, 2016)

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Warana University

Established:2025

Structure & Syllabus For

First Year of M. Tech. in Structural Engineering

Semester- I and II

Department of Civil Engineering

UNDER

Faculty of Science & Technology

(As Per National Education Policy – 2020)

With Effect from Academic Year 2025-26 Onwards

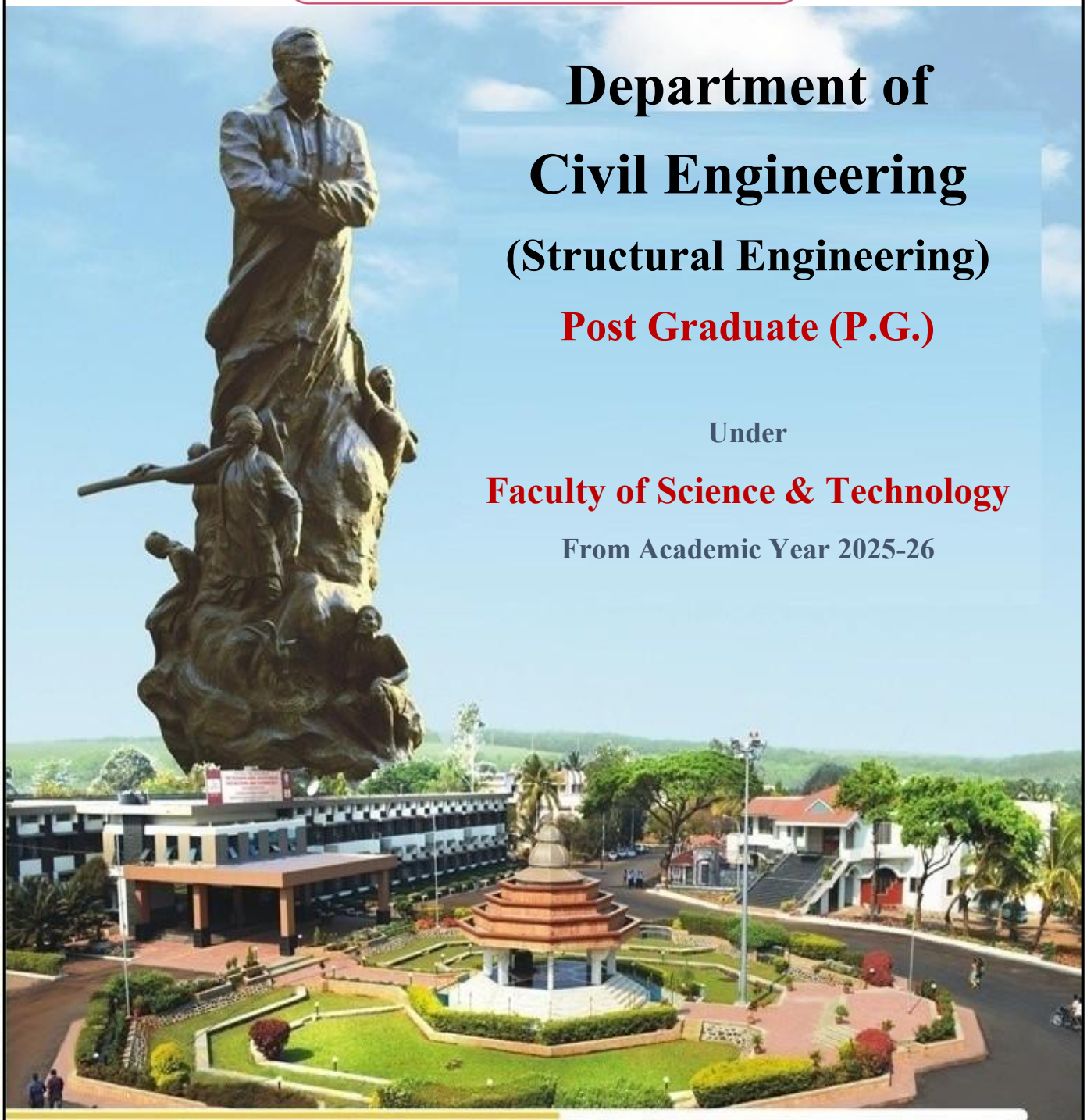
Shree Warana Vibhag Shikshan Mandal's

TATYASAHEB KORE INSTITUTE OF ENGINEERING AND TECHNOLOGY
(AUTONOMOUS), WARANANAGAR, KOLHAPUR

TKIET
Estd. 1983

Lead Institute of

WARANA UNIVERSITY, WARANANAGAR
(A State Public University)



Department of Civil Engineering

(Structural Engineering)

Post Graduate (P.G.)

Under

Faculty of Science & Technology

From Academic Year 2025-26

M. Tech. in Civil (Structural Engineering)

Structure and Syllabus under Autonomy as per NEP Policy 2020

Contents

Preface

The National Education Policy (NEP) 2020 has introduced significant reforms in India's higher education system, emphasizing multidisciplinary learning, flexibility, innovation, skill development, and industry-oriented education. In alignment with these progressive reforms, Tatyasaheb Kore Institute of Engineering & Technology (TKIET), Warana University, Warananagar, is committed to implementing NEP 2020 in its true spirit to develop technically proficient, ethically responsible, and industry-ready professionals.

The Department of Civil Engineering is pleased to present the syllabus for the First Year M. Tech. in Structural Engineering, carefully designed in accordance with NEP 2020 guidelines and evolving industry requirements. The first-year curriculum is structured to build a strong theoretical and analytical foundation in structural engineering through core subjects such as Mechanics of Structures, Structural Dynamics and Earthquake Engineering, Theory of Elasticity and Plasticity, and Finite Element Methods. These courses aim to strengthen the understanding of structural behaviour under various loading conditions and enhance analytical and problem-solving capabilities.

The programme emphasizes advanced analysis and design concepts essential for modern infrastructure development. It integrates engineering fundamentals with computational tools and software applications through laboratory practice and software labs, enabling students to address complex structural engineering challenges. The inclusion of seminars and comprehensive viva further enhances students' research aptitude, technical communication, and presentation skills.

This syllabus provides detailed information regarding the course structure, credit distribution, and evaluation scheme to facilitate systematic and effective implementation. The Department gratefully acknowledges the valuable contributions of the Board of Studies members, faculty experts, and industry professionals whose insights and expertise have significantly contributed to the development of this curriculum.

We are confident that this programme in Structural Engineering will equip students with advanced technical knowledge, analytical proficiency, and innovative thinking required to design safe, sustainable, and resilient structures, thereby contributing effectively to the engineering profession and society.

Program Outcomes

Program Outcomes (POs) are clear, measurable statements that describe what students are expected to know, understand, and be able to do by the time they complete an academic program. They define the competencies, skills, and professional abilities that graduates should possess at the end of the program. In India, POs for Engineering Programs are formally prescribed and monitored by the National Board of Accreditation (NBA). NBA has defined the following three POs for a graduate of PG Engineering Program:

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

Duration

- The full time M. Tech Program is a **2 years post graduate program**.
- The program is divided into **4 semesters**.

Eligibility

1. The Candidate should be an Indian National.

2. Passed Bachelor's Degree in the relevant field of Engineering & Technology from AICTE or Central or State Government approved institutions or equivalent, with at least 50% marks (at least 45% marks in case of candidates of Backward Class categories, EWS and PWD).

3. Obtained Qualified score or non-qualified score in GATE conducted by the IIT for the current academic year.

OR

3. For sponsored candidates (Proforma P and Q), a minimum of two years of full-time work experience in a registered firm/ company/ industry/ educational and/ or research institute/ any Government Department or Government Autonomous Organization in the relevant field in which admission is being required.

Medium of Instruction

- The medium of instruction, examinations, assignments, and project reports is English.

Abbreviations

Acronym	Full Form
ISE	In-Semester Examination
ISE -I	In-Semester Examination I
ISE-II	In-Semester Examination II
ESE	End Semester Examination
ISA	In Semester Assessment
POE	Practical Oral Examination
TH	Theory Lecture
Tut	Tutorial
PH	Practical Hours
P	Practical
O	Oral
TW	Term Work
CH	Contact Hours
C	Credit
PCC	Professional Core Course
PE	Program Elective
OEC	Open Elective Course
LC	Laboratory Course
MC	Mandatory Course
SW	Seminar work
II	Industrial Internship
PC	Dissertation
SLC/AC	Self Learning Course/Audit course

Examination & Evaluation Pattern

Evaluation tools used for the evaluation of a student for each course is as follows:

For Theory Courses	In-Semester Examination (ISE) And End Semester Examination (ESE)
For Lab / Tutorial Courses	In-Semester Assessment (ISA) And / Or Practical and Oral Examination (POE)

Refer course structure for specific evaluation tools used for each course.

In-Semester Examination (ISE)

The In-Semester Examination (ISE) will be conducted at the departmental level. There will be two tests in each semester for every theory course: ISE-I and ISE-II.

- Each test will be of 40 marks.
- The duration of each test will be 1 hour and 30 minutes.

The total ISE marks will be calculated as the average of ISE-I and ISE-II. These rules may be modified from time to time as per the guidelines of the concerned regulatory authorities.

- ISE-I will cover Unit I and Unit II.
- ISE-II will cover Unit III and Unit IV.

  - **Minimum Passing Criteria**

    Students must score a minimum of 40% marks in the ISE. If a student fails to secure the minimum required marks, he/she must appear for a Make-up Examination.

    The Make-up Examination will be conducted in the same semester for:

    - Students who fail to secure minimum passing marks.
    - Students who were absent due to valid reasons such as medical issues, natural calamities, or participation in NSS, NCC, or similar activities (subject to verification of absence and recommendation from the Head of Department).

- **Special Provision**

  If a failed student appears for three tests (including the Make-up test) and scores more than 16 marks when calculating the average of the best two out of the three tests, the student will be awarded the minimum passing marks of 16 only.

  For students absent with valid reasons:

  - If absent in one test, the average of the attempted test and the Make-up test will be considered.
  - If absent in two tests, the decision will be taken after reviewing the reasons and based on the recommendation of the Head of Department.

End Semester Examination (ESE):

The End Semester Examination (ESE) will be conducted for 60 marks and will be based on the entire syllabus. The duration of each examination will be 2 hours.

Weightage of Units

The weightage of units in the ESE question paper will be as follows:

a) Units that are not covered in ISE-I or ISE-II will carry 30% weightage each.

b) Units that are covered in ISE-I and ISE-II will carry 10% weightage each.

Backlog Examination

Students who fail in the End Semester Examination (ESE) of either the odd or even semester within an academic year will be allowed to appear for the Backlog Examination, which will be conducted along with the regular ESE of the respective semester.

- **Re-Examination of ESE**

  A Re-Examination (Make-up Examination) for all courses (UG and PG), including both theory and laboratory courses, will be conducted once a year before the commencement of the odd semester of the next academic year.

  - A one-grade penalty will be applied to students appearing for the Make-up/Re-Examination.
  - However, no grade penalty will be applied if a student secures a 'P' grade in the Make-up/Re-Examination.
  - Grace marks will not be awarded for the Make-up/Re-Examination.
  - Exception: Grace marks may be considered if the student is appearing for the ESE for the first time.

- **Eligibility Criteria for ESE**

  To be eligible for the End Semester Examination (ESE), a student must:

  - Secure at least 40% marks in ISE and ISA of the concerned course.

- Fulfil the attendance requirements as per the norms of Warana University, Warananagar.

If a student does not meet these requirements, he/she will not be eligible to appear for the ESE.

Nature of Question Paper for ESE

Q. No.			Marks	BL	CO
1	**Attempt the following.**		**24**		
	a	**Unit -1**		II	1
	b	**Unit -2**		III	2
	c	**Unit -3**		IV	1
	d	**Unit -4**		I	1
2	**Attempt any Two of the following.**		**18**		
	a	**Unit -5**		VI	2
	b	**Unit -5**		II	3
	c	**Unit -5**		IV	3
3	**Attempt any Two of the following.**		**18**		
	a	**Unit -6**		IV	4
	b	**Unit -6**		III	4
	c	**Unit -6**		III	4

In Semester Assessment (ISA):

ISA for laboratory courses will be conducted as a continuous assessment throughout the semester. The assessment will be based on the following:

1. Performance in laboratory work.
2. Submission of experiments in the form of a properly maintained journal or report.
3. Timely completion of assigned experiments.
4. Attendance in laboratory sessions.
5. Understanding of the experiments conducted, evaluated through methods such as quizzes, oral examinations, case studies, field work, surveys, open-book tests, model preparation, programming, projects, or any other criteria specified by the course teacher.

Practical Oral Examination (POE):

POE for laboratory courses will be conducted immediately after the end of the semester. The duration of the practical examination will be as specified in the curriculum structure. The POE will be conducted jointly by an Internal Examiner and an External Examiner.

The examination may be conducted in any one of the following ways:

1. **Oral Examination Only**

   Both the Internal and External Examiners will ask questions based on the practical content of the course to assess the student's practical knowledge.

2. **Practical Examination Only**

   Students will be required to perform a given experiment, complete a workshop task, prepare a drawing, or develop a computer program, as applicable. In this case, the student's performance will be evaluated by the External Examiner only.

3. **Practical and Oral Examination**

   Students will first perform a given practical task. This will be followed by an oral examination (viva voce) based on the practical content of the course. The student's performance will be evaluated jointly by both the Internal and External Examiners.

Grading System

The University follows a **10-Point Grading System** to evaluate student performance.

- **Conversion of Marks into Grades**
  In every semester, the marks you get in each subject (out of 100) are converted into **grade points** as per the table below. You need at least **40% marks** to pass a subject.

Marks Obtained (Out of 100)	Grade Point	Letter Grade	Meaning
Absent	0	AB	Absent
0 – 39	0	F	Fail
40 – 44	4	P	Pass
45 – 49	5	C	Average
50 – 59	6	B	Above Average
60 – 69	7	B+	Good
70 – 79	8	A	Very Good
80 – 89	9	A+	Excellent
90 – 100	10	O	Outstanding

Note:

1. If decimal marks are 0.5 or more, they will be rounded off to the next higher number. (Example: 59.5 will become 60)
2. For courses of 50 marks or 200 marks, marks will be converted proportionally to 100 marks before assigning grade points.

- **Calculation of Semester Grade Point Average (SGPA)**
  SGPA is calculated at the end of each semester**.** It shows your average performance in one semester.

$$SGPA = \frac{\sum(Credit \times Grade\ Point)\ for\ each\ course\ of\ a\ Semester}{\sum(Credits)\ for\ a\ Semester}$$

- **Calculation of Cumulative Grade Point Average (CGPA)**
  CGPA is calculated after completing multiple semesters. CGPA reflects the overall academic performance of the student in the program.

$$CGPA = \frac{\sum(Total\ Credits\ of\ a\ Semester \times SGPA\ of\ Respective\ Sememster)\ of\ all\ semesters}{\sum(Course\ Credits)\ of\ all\ Semesters}$$

Note: The SGPA & CGPA shall be rounded off to 2 decimal points.

First Year M. Tech Structural Engineering

Curriculum Structure & Evaluation Scheme for Semester-I

Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
			L	T	P	C	CH	Component	Marks	Min for Passing	
PCC	2501PCST PCC101	Mechanics of Structures	3	-	-	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PCC101T	Mechanics of Structures (Tutorial)	-	1	-	1	1	ISA	25	10	10
	2501PCST PCC102	Structural Dynamics & Earthquake Engineering	3	-	-	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PCC102T	Structural Dynamics & Earthquake Engineering (Tutorial)	-	1	-	1	1	ISA	25	10	10
PE	2501PCST PE103X	Program Elective-I	3	-	-	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PE104X	Program Elective-II	3	-	-	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PE105X	Program Elective-III	3	-	-	3	3	ESE	60	24	40
								ISE	40	16	
LC	2501PCST LC106P	Laboratory Practice.	-	-	4	2	4	POE	25	10	20
								ISA	25	10	
SW	2501PCST SW107T	Seminar-I	-	-	2	1	2	ISA	50	20	20
Total			**15**	**2**	**6**	**20**	**23**		**650**	**260**	**260**

Note : 'X' indicates the sequence number of PE/OE offered by the respective department.

First Year M. Tech Structural Engineering

List of Program Electives for Semester-I

	Course Code	Course Title
Program Elective-I	2501PCSTPE1031	Advance Design of Concrete Structures
	2501PCSTPE1032	Advances in Concrete Composite
	2501PCSTPE1033	Advanced Design of Prestressed Concrete Structures
Program Elective-II	2501PCSTPE1041	Design of RC Bridges
	2501PCSTPE1042	Structural Health Monitoring
	2501PCSTPE1043	Repairs and Rehabilitations of Structures
Program Elective-III	2501PCSTPE1051	Advanced Structural Analysis
	2501PCSTE1052	Stability of Structures
	2501PCSTPE1053	Dynamics of Structure

First Year M. Tech Structural Engineering

Curriculum Structure & Evaluation Scheme for Semester-II

Course Category	Course Code	Course Title	Teaching and Credit Scheme					Examination and Evaluation Scheme			
			L	T	P	C	CH	Component	Marks	Min for Passing	
PCC	2501PCST PCC201	Theory of Elasticity and Plasticity	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PCC201T	Theory of Elasticity and Plasticity Tutorial	--	1	--	1	1	ISA	25	10	10
	2501PCST PCC202	Finite Element Methods	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PCC202T	Finite Element Methods Tutorial	--	1	--	1	1	ISA	25	10	10
PE	2501PCST PE203X	Program Elective-IV	3		--	3	3	ESE	60	24	40
								ISE	40	16	
	2501PCST PE204X	Program Elective-V	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
OE	2501PCST OE205X	Open Elective Course	3	--	--	3	3	ESE	60	24	40
								ISE	40	16	
LC	2501PCST LC206T	Software Lab	--	--	2	1	2	ISA	25	10	10
SW	2501PCST SW207T	Seminar-II	--	--	2	1	2	ISA	50	20	20
CV	2501PCST CV208P	Comprehensive Viva	--	--	2	1	2	OE	25	10	10
Total			**15**	**2**	**6**	**20**	**23**	**--**	**650**	**260**	**260**

Note: 'X' indicates the sequence number of Program Elective (PE) offered by Computer Science and Engineering Program. Students should opt for the Open Elective (OE) course from other departments. The list of OE courses offered by other departments is available in the structure. Although the OE course code is defined by the respective program in the structure, the actual opted OE course will appear on the mark card.

First Year M. Tech Structural Engineering

List of Program Electives for Semester-II

	Course Code	Course Title
Program Elective-IV	2501PCSTPE2031	Advanced Design of Structural Foundations
	2501PCSTPE2032	Theory of Plates and Shells
	2501PCSTPE2033	Advanced Design of Reinforced Concrete Structures
Program Elective-V	2501PCSTPE2041	Advanced Design of Steel Structures
	2501PCSTPE2042	Soil Structure Interaction
	2501PCSTPE2043	Design of High-Rise Buildings

First Year M. Tech. First Year M. Tech Structural Engineering

List of Open Electives Offered by All Programs

Sr. No.	OE Offered by Program	Course Code	Open Elective Course
1	Chemical Engineering	2501PCHEOE2051	Project Management
2		2501PCHEOE2052	Operations Research
3		2501PCHEOE2053	Energy Technology
4	Electronics & Telecommunication Engineering	2501PETCOE2051	Advanced Operating Systems
5		2501PETCOE2052	Cyber Security
6		2501PETCOE2053	Artificial Intelligence and Machine Learning
7	Construction Management (Civil Engineering)	2501PCCMOE2051	Water Power Engineering
8		2501PCCMOE2052	Waste to Energy
9		2501PCCMOE2053	Contracts & Tenders
10	Mechanical Design (Mechanical Engineering)	2501PMDEOE2051	Cryogenics
11		2501PMDEOE2052	Design for Manufacture & Assembly
12		2501PMDEOE2053	Enterprise Resource Planning
13	Structural Engineering (Civil Engineering)	2501PCSTOE2051	Cost Management of Engineering Projects
14		2501PCSTOE2052	Optimization Techniques in Civil Engineering
15		2501PCSTOE2053	Industrial Safety
16	Computer Science and Engineering	2501PCSEOE2051	Ethical AI & Explainability
17		2501PCSEOE2052	Computer Vision
18		2501PCSEOE2053	High Performance Computing for Multidisciplinary Research

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPCC101 Course Name: Mechanics of Structure

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have basic knowledge of structural analysis and strength of materials, including determinate and indeterminate structures, shear force and bending moment diagrams, stress–strain relationships, bending theory, and deflection of beams and columns. Familiarity with matrix algebra and classical structural analysis methods such as slope deflection, moment distribution, and basic frame analysis is also essential

Course Objectives: The objective of the course is to

1) To develop advanced understanding of influence lines, beam-columns, and analysis of determinate and indeterminate structures
2) To apply stiffness and flexibility methods for analysis of continuous beams, trusses, frames, and curved beams.
3) To integrate computational techniques for structural analysis using matrix and member-oriented stiffness methods.
4) To prepare students for research, practical problem-solving, and design of complex structures under varied loading conditions.

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

CO1	Draw and interpret influence line diagrams for continuous beams, portal frames, and two-hinged arches
CO2	Analyze determinate and indeterminate curved beams subjected to various loads.
CO3	Solve beam-on-elastic-foundation problems for infinite, semi-infinite, and finite beams.
CO4	Analyze beam-columns considering geometric and material nonlinearity under different support conditions.
CO5	Apply structure-oriented stiffness method to analyse continuous beams, trusses, and plane frames.
CO6	Utilize member-oriented stiffness method frames, including transformation and assembly of stiffness matrices.

Course Description:
This course focuses on advanced methods of structural analysis including influence line diagrams for indeterminate structures, curved beams, beams on elastic foundations, and beam-columns considering geometric and material nonlinearity. It also introduces the stiffness method in both structure-oriented and member-oriented approaches for analysing beams, trusses, frames, and space structures

Course Content

Unit-1	Influence Lines and Moment Distribution	08
Influence Line Diagrams for Indeterminate Structures: Continuous beams, portal frames & two hinged arches. Muller-Breslau's Principle & Moment distribution method		
Unit-2	**Curved Beams**	**08**
Beams Curved in Plan: Determinate & Indeterminate beams curved in plan.		

Unit-3	**Beams on Elastic Foundations**	**06**
Beams on Elastic Foundations: Analysis or infinite, semi-infinite & finite beam		
Unit-4	**Beam columns**	**06**
Concept of geometric & material nonlinearity. Governing differential equation, Analysis of beam-columns subjected to different loadings and support conditions. Stiffness and carry-over factors for beam-columns, fixed end actions due to various loads.		
Unit-5	**Stiffness Method – Structure Oriented**	**06**
Stiffness method of structural analysis, flexibility and stiffness matrices, Analysis of continuous beams, trusses and plane frames by Structure oriented stiffness approach.		
Unit-6	**Member Oriented Stiffness Method**	**06**
Stiffness matrices of beam, truss, plane frame grid, pin & rigid jointed space frame elements on member axes. Transformation of matrices on Structure axes. Over- all joint stiffness matrix and nodal load vector, assembly rules. Calculation of member end forces, Bandwidth.		

Learning Resources:

Text Books

1) Elements of Strength of Materials – Timoshenko and Young, East-West Press.
2) Intermediate Structural Analysis – Wang C.K., McGraw Hill Education
3) Mechanics of Materials – Gere and Timoshenko, PWS Publishing Company
4) Structural Analysis – Vol I and II – S.S. Bhavikatti, Vikas Publishing House.
5) Theory of Structures – S. Ramamrutham, Dhanpat Rai Publishing Company.

Reference Books

1) Advanced Mechanics of Solids – L.S. Srinath, McGraw Hill Education
2) Theory and Analysis of Elastic Plates and Shells – J.N. Reddy, CRC Press
3) Theory of Elasticity – S.P. Timoshenko and J.N. Goodier, McGraw Hill Education
4) Advanced Structural Analysis – Devdas Menon, Narosa Publishing House
5) Solid Mechanics – Kazimi S.M.A., Tata McGraw Hill Publishing Co. Ltd.
6) Analysis of Structures – Vol I & II – Vazirani and Ratwani, Khanna Publishers.

e-Books

1) https://theconstructor.org – Examples and solved problems on indeterminate structures.
2) https://sciencedirect.com – Articles on beam-columns, curved beams, and elastic foundation problems.

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – Lectures on advanced structural analysis, stiffness & flexibility methods
2) https://ascelibrary.org – Research papers on matrix analysis and structural mechanics.
3) https://structurae.net – Case studies and database for continuous beams, portal frames, and arches

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPCC101T Course Name: Mechanics of Structure

Teaching Scheme	Credit	Evaluation Scheme
Tutorial/Practical: 01 Hours/Week	01	ISA: 25 Marks

Prerequisites, if any:
Students should have prior knowledge of Engineering Mechanics, Strength of Materials, and basic Structural Analysis. Understanding of equilibrium conditions, bending moment and shear force in beams, deflection of structures, and analysis of determinate and indeterminate structures is necessary for studying advanced structural behaviour.

Course Objectives: The objective of the course is to

1) To understand advanced analytical methods used in structural mechanics
2) To study the behaviour of special structural systems such as curved beams and beams on elastic foundations.
3) To analyse beam-columns considering nonlinear effects
4) To apply stiffness matrix methods for analysis of complex structural structures

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

CO1	Explain the concept and application of influence lines for indeterminate structure
CO2	Analyse structural systems such as curved beams and beams on elastic foundations
CO3	Evaluate the behaviour of beam-columns considering nonlinear structural effects
CO4	Apply stiffness matrix methods for analysis of beams, trusses, and frames
CO5	Formulate stiffness matrices and assemble global matrices for structural systems
CO6	Interpret structural responses obtained from matrix-based structural analysis

Course Description:
This course focuses on advanced concepts in the mechanics and analysis of structures. It covers influence line diagrams for indeterminate structures, analysis of curved beams, and behaviour of beams on elastic foundations. The course also introduces beam-column behaviour considering geometric and material nonlinearity. Matrix methods of structural analysis using stiffness approaches are studied for analysing beams, trusses, and frames. The subject helps students understand advanced analytical techniques required for complex structural systems.

Course Content

Sr. No.	Topic of Practical / Experiment / Tutorial	Assigned Hours
1	**Assignment Title** - Influence Line Analysis of Indeterminate Structures **Description:** Students will draw Influence Line Diagrams (ILD) for reactions, shear forces, and bending moments in continuous beams and portal frames using Muller–Breslau's principle. Problems using the moment distribution method will also be solved for indeterminate structures.	**02**

2	**Assignment Title**-Structural Analysis of Beams Curved in Plan **Description:** Students will analyse determinate and indeterminate beams curved in plan, determine internal forces and bending moments, and study the structural behaviour caused by curvature.	**02**
3	**Assignment Title**-Analysis of Beams Resting on Elastic Foundations **Description:** Students will analyse infinite, semi-infinite, and finite beams resting on elastic foundations and determine deflection, bending moment, and shear force using theoretical methods.	**02**
4	**Assignment Title-** Analysis of Beam-Columns under Combined Loading **Description:** Students will study beam-column behaviour considering geometric and material nonlinearity, determine stiffness factors and carry-over factors, and analyse beam-columns under different support conditions.	**02**
5	**Assignment Title**-Matrix Analysis of Structures using Structure-Oriented Stiffness Method **Description:** Students will formulate flexibility and stiffness matrices and apply the stiffness method to analyse continuous beams, trusses, and plane frames.	**02**
6	**Assignment Title**-Member-Oriented Matrix Analysis of Structural Systems **Description:** Students will develop element stiffness matrices for beams, trusses, frames, grids, and space frames, perform matrix transformation, assemble global stiffness matrices, and calculate member end forces.	**02**

Learning Resources:

Text Books

1) Advanced Structural Analysis – C.S. Reddy – Tata McGraw Hill
2) Matrix Analysis of Structures – Aslam Kassimali – Cengage Learning
3) Structural Analysis – S.S. Bhavikatti – Vikas Publishing
4) Advanced Structural Analysis – Devdas Menon – Narosa Publishing

Reference Books

1) Matrix Structural Analysis – McGuire, Gallagher & Ziemian – Wiley
2) Structural Analysis – Hibbeler – Pearson Education
3) Theory of Structures – Timoshenko & Gere – McGraw Hill
4) Advanced Theory of Structures – Bansal – Laxmi Publications

e-Books

1) Advanced Structural Analysis – C.S. Reddy
   https://archive.org/details/advanced-structural-analysis
2) Matrix Structural Analysis – McGuire
   https://civilnode.com/download-book/10287769934128/matrix-structural-analysis
3) Structural Analysis – Hibbeler
   https://archive.org/details/structural-analysis-hibbeler

MOOC / NPTEL/YouTube Links

1) NPTEL – Advanced Structural Analysis (IIT Madras)
   https://nptel.ac.in/courses/105106050
2) NPTEL – Matrix Methods of Structural Analysis
   https://nptel.ac.in/courses/105106049
3) Structural Analysis Lecture Series – IIT Delhi
   https://www.youtube.com/playlist?list=PLbRMhDVUMngdWkYl9w9d4FZ3VAb9YSEux

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPCC102 Course Name: Structural Dynamics and Earthquake Engineering

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have basic knowledge of structural analysis and strength of materials, including vibration of simple systems, stiffness and mass concepts, and analysis of beams and frames. Familiarity with matrix methods, differential equations, and fundamental concepts of engineering mechanics is essential for understanding dynamic response and seismic behaviour of structures.

Course Objectives: The objective of the course is to

1) Understand dynamic Behavior of structures and the effects of various types of loading including seismic
2) Formulate and solve differential equations governing single and multi-degree freedom systems
3) Analyze structural response to earthquakes using different methods.
4) Learn design philosophies and codal provisions for earthquake-resistant structures.

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

CO1	Understand the behaviour of structures subjected to dynamic loading
CO2	Analyze SDOF and MDOF systems for free and forced vibration
CO3	Apply principles of vibration to continuous structural elements
CO4	Interpret and construct response spectra for earthquake ground motions.
CO5	Perform seismic analysis using IS codes and advanced methods
CO6	Apply codal provisions to design earthquake-resistant structures effectively.

Course Description:
This course covers the fundamentals of structural dynamics and earthquake engineering, including analysis of SDOF and MDOF systems, vibrations of continuous systems, and response to various dynamic loads. It also focuses on earthquake ground motion, response spectrum, seismic analysis methods, and earthquake-resistant design principles as per relevant IS codes, including modern concepts such as base isolation and performance-based design.

Course Content

Unit-1	Fundamentals of Structural Dynamics	08

Difference between static and dynamic loading, Types of dynamic loads, Equation of motion for SDOF systems, D'Alembert's principle, Free and forced vibration (with and without damping), Response to harmonic, periodic and impulsive loads

Unit-2	Multi-Degree Freedom Systems	08

Equation of motion for MDOF systems, Matrix formulation, Eigenvalue problem, Natural frequencies and mode shapes, Modal superposition method, Orthogonality of modes

Unit-3	Continuous Systems	06

Introduction to dynamics of continuous systems, Vibrations of strings, bars and beams, Longitudinal and transverse vibration, Application of Rayleigh and Rayleigh-Ritz methods

Unit-4	Earthquake Ground Motion and Response	06

Seismic waves and strong ground motion, Characteristics of ground motion, Response spectrum, Construction and interpretation of response spectra, Concept of seismic zoning

Unit-5	Seismic Analysis of Structures	06

Idealization of structures, Linear and nonlinear behaviour, Response history and modal analysis, Time history and frequency domain analysis, Equivalent static analysis and response spectrum method (IS 1893)

Unit-6	Earthquake Resistant Design	06

Ductility, overstrength, and redundancy, Codal provisions (IS 1893, IS 13920), Design of RC and steel structures, Base isolation and energy dissipation systems, Performance-based design concepts

Learning Resources:

Text Books

1) Dynamics of Structures – Theory and Applications to Earthquake Engineering – Anil K. Chopra, *Pearson*
2) Structural Dynamics – Mario Paz and William Leigh, Springer
3) Earthquake Resistant Design of Structures – Pankaj Agarwal and Manish Shrikhande, *PHI Learning*
4) Structural Dynamics – Theory and Computation – Mario Paz, *Springer*
5) Structural Dynamics: Vibrations and Systems – Madhujit Mukhopadhyay, *Ane Books Pvt. Ltd*
6) Vibration Problems in Engineering – S.P. Timoshenko, D.H. Young and W. Weaver, *John Wiley & Sons*

Reference Books

1) Earthquake Engineering for Structural Design – W.H. Robinson and D.J. Dowrick, *Oxford*
2) Structural Dynamics: Concepts and Applications – Joseph W. Tedesco, William G. McDougal, C. Allen Ross, *Pearson Education*
3) Introduction to Structural Dynamics and Aeroelasticity – Dewey H. Hodges and G. Alvin Pierce, *Cambridge University Press*
4) Fundamentals of Structural Dynamics – Roy R. Craig Jr., Andrew J. Kurdila, *John Wiley & Sons*
5) Earthquake Engineering: From Engineering Seismology to Performance-Based Engineering – Yousef Bozorgnia and Vitelmo V. Bertero, *CRC Press*
6) Seismic Design of Reinforced Concrete and Masonry Buildings – T. Paulay and M.J.N. Priestley, *John Wiley & Son*

e-Books

1) https://ascelibrary.org – ASCE Library for latest earthquake engineering research
2) https://www.eqclearinghouse.org – Earthquake Engineering Research Institute (EERI) resources

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – NPTEL video lectures on Structural Dynamics and Earthquake Engineering
2) https://www.iitk.ac.in/nicee – National Information Centre of Earthquake Engineering (NICEE)
3) https://www.usgs.gov – U.S. Geological Survey for seismic data

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPCC102T Course Name: Structural Dynamics and Earthquake Engineering

Teaching Scheme	Credit	Evaluation Scheme
Tutorial/Practical: 01 Hours/Week	01	ISA: 25 Marks

Prerequisites, if any:
Students should have basic knowledge of Engineering Mechanics, Strength of Materials, Structural Analysis, and basic mathematics such as differential equations and matrices. Understanding structural behaviour under static loads and fundamental vibration concepts will help students understand the dynamic response of structures.

Course Objectives: The objective of the course is to

1) To understand the fundamentals of structural dynamics and vibration behaviour of structures.
2) To analyse single and multi-degree-of-freedom structural systems subjected to dynamic loads.
3) To study earthquake ground motion and seismic response of structures.
4) To understand seismic analysis and earthquake-resistant design concepts as per relevant codes.

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

CO1	Explain the fundamentals of structural dynamics and vibration behaviour of structures
CO2	Analyse single-degree and multi-degree freedom systems subjected to dynamic loading
CO3	Evaluate dynamic response of continuous structural systems.
CO4	Interpret earthquake ground motion characteristics and response spectra
CO5	Perform seismic analysis of structures using codal provisions.
CO6	Apply earthquake-resistant design principles for safe structural design

Course Description:
This course introduces the dynamic behaviour of structures subjected to time-dependent loads such as earthquakes, wind, and machine vibrations. It covers the formulation of equations of motion for single and multi-degree freedom systems and the analysis of continuous structural systems. The course also explains earthquake ground motion characteristics and response spectrum concepts. Students learn seismic analysis methods and earthquake-resistant design principles as per relevant codes. The course helps develop an understanding of structural safety and performance under dynamic loading conditions.

Course Content

Sr. No.	Topic of Practical / Experiment / Tutorial	Assigned Hours
1	**Assignment Title** - Dynamic Response of Single Degree of Freedom Systems **Description:** Students will derive the equation of motion for SDOF systems using D'Alembert's principle and analyse free and forced vibration cases with and without damping. Numerical problems on harmonic and impulsive loading will be solved.	**02**

2	**Assignment Title** - Dynamic Analysis of Multi-Degree Freedom Systems **Description:** Students will formulate equations of motion for MDOF systems using matrix methods, determine natural frequencies and mode shapes, and apply the modal superposition method for dynamic analysis.	**02**
3	**Assignment Title** - Dynamic Behaviour of Continuous Structural Systems **Description:** Students will analyse vibration of strings, bars, and beams and determine natural frequencies using Rayleigh and Rayleigh–Ritz methods.	**02**
4	**Assignment Title** - Study of Earthquake Ground Motion and Response Spectrum **Description:** Students will study seismic waves, characteristics of ground motion, and response spectrum analysis. Construction and interpretation of response spectra for earthquake records will be performed.	**02**
5	**Assignment Title** - Seismic Analysis of Building Structures **Description:** Students will perform seismic analysis of building frames using equivalent static analysis and response spectrum methods as per IS 1893.	**02**
6	**Assignment Title** - Earthquake Resistant Design and Retrofitting Strategies **Description:** Students will study ductility, overstrength, redundancy, and codal provisions for earthquake-resistant design. Case studies on base isolation and energy dissipation systems will also be analysed.	**02**

Learning Resources:

Text Books

1) Dynamics of Structures – Anil K. Chopra – Pearson Education
2) Structural Dynamics: Theory and Computation – Mario Paz – Springer
3) Structural Dynamics – Clough & Penzien – McGraw Hil
4) Earthquake Resistant Design of Structures – Pankaj Agarwal & Manish Shrikhande – PHI Learning

Reference Books

1) Dynamics of Structures – Humar – CRC Press
2) Theory of Vibrations with Applications – William T. Thomson – CRC Press
3) Earthquake Engineering – S.K. Duggal – Oxford University Press
4) Seismic Design of Reinforced Concrete and Masonry Buildings – T. Paulay & M.J.N. Priestley – Wiley

e-Books

1) Dynamics of Structures – Anil K. Chopra
   https://archive.org/details/dynamics-of-structures-chopra
2) Structural Dynamics – Clough and Penzien
   https://archive.org/details/structural-dynamics
3) Earthquake Resistant Design of Structures – Pankaj Agarwal
   https://archive.org/details/earthquake-resistant-design

MOOC / NPTEL/YouTube Links

1) NPTEL – Structural Dynamics (IIT Madras)
   https://nptel.ac.in/courses/105106046
2) NPTEL – Earthquake Engineering (IIT Kanpur)
   https://nptel.ac.in/courses/105104043
3) IIT Roorkee – Structural Dynamics Lecture Series
   https://www.youtube.com/playlist?list=PLLy_2iUCG87DVeRKuF2P8s3HdWu3U

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1031 Course Name: Advanced Design of Concrete Structures

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have basic knowledge of reinforced concrete design and structural analysis, including analysis and design of beams, slabs, columns, and footings. Familiarity with strength of materials, load calculations, and basic concepts of prestressed concrete is essential.

Course Objectives: The objective of the course is to

1) Develop an advanced understanding of analysis and design principles of special reinforced concrete elements.
2) Provide knowledge of the design of foundations, water retaining structures, and staging systems under various loading conditions.
3) Introduce the fundamental concepts, mechanics, and design methodologies of prestressed concrete.
4) Equip students with the ability to analyse, design, and evaluate prestressed concrete members and special structural sections as per IS codes

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

CO1	Analyze and design flat slabs, grid slabs, and circular slabs using advanced methods.
CO2	Design combined footings and raft foundations considering soil–structure interaction
CO3	Analyze and design overhead water tanks and staging under wind and seismic loads.
CO4	Explain stress, strength, load balancing concepts and evaluate prestress losses.
CO5	Design prestressed concrete beams, box, T & I sections, shear, deflection and end blocks as per IS codes.
CO6	Apply advanced concepts to design continuous beams, partially prestressed members, and circular prestressed pipes.

Course Description:
This course focuses on the analysis and design of special reinforced and prestressed concrete structures, including flat, grid, and circular slabs, combined footings, raft foundations, and water tanks with staging. It also covers the fundamentals and design of prestressed concrete members and special prestressed sections as per IS code provisions

Course Content

Unit-1	**Analysis and Design of Special Slabs**	**08**
Design of flat slab, grid slab, circular slab.		
Unit-2	**Design of Footings & Rafts**	**08**
Analysis and design of combined footing & raft foundation		
Unit-3	**Analysis and Design of Water Tanks & Staging**	**06**
Analysis and design of overhead water tank – Rectangular & circular with flat bottom Design of staging for wind & seismic loads		
Unit-4	**Mechanics of Prestressed Concrete**	**06**

Mechanics of pre-stressed concrete, stress concept, strength concept & load balancing concept, high strength material, systems of prestressing, losses of prestress		
Unit-5	**Design of Prestressed Concrete Members**	**06**
Design of Prestressed Concrete, beams, box, T& I Sections, Shear, Deflection, Design of End Block, IS code method		
Unit-6	**Analysis and Design of Special Prestressed Sections**	**06**
Analysis & design of continuous beams, partial prestressing, circular prestressing – pipes.		

Learning Resources:

Text Books

1) Advanced Reinforced Concrete Design – P.C. Varghese, 2nd Edition, Prentice Hall of India, 2012.
2) Design of Reinforced Concrete Structures – N. Subramanian, Oxford University Press, 2014
3) Limit State Design of Reinforced Concrete – P. Dayaratnam, 3rd Edition, Oxford & IBH Publishing, 2013
4) Prestressed Concrete – N. Krishna Raju, 5th Edition, Tata McGraw Hill Education, 2012
5) Prestressed Concrete Structures – P. Dayaratnam & R. Narayan, Oxford & IBH Publishing, 2011.
6) Design of Reinforced Concrete Structures – S. Ramamrutham & R. Narayan, 16th Edition, Dhanpat Rai Publications, 2018

Reference Books

1) Reinforced Concrete Design – S. Unnikrishnan Pillai & Devdas Menon, 4th Edition, Tata McGraw Hill,2017
2) Design of Concrete Structures – Arthur H. Nilson, David Darwin & Charles W. Dolan, 14th Edition, McGraw Hill International Edition, 2010.
3) Structural Design of Tall Buildings – Bungale S. Taranath, 2nd Edition, McGraw Hill, 2011
4) Prestressed Concrete Analysis and Design – M.K. Hurst, 2nd Edition, CRC Press, 2017
5) Fundamentals of Prestressed Concrete – Y. Guyon, Contractors Record Ltd., London, Reprint 2010
6) Design of Prestressed Concrete Structures – T.Y. Lin and Ned H. Burns, 3rd Edition, John Wiley & Sons, 1991.

e-Books

1) https://www.services.bis.gov.in – Bureau of Indian Standards (IS 456, IS 1343, IS 3370, IS 875, IS 1893 etc.)
2) ttps://icidcbc.org – Indian Concrete Institute (ICI) for journals, technical papers, and concrete design resources
3) https://structville.com – Struct Ville articles and solved examples on advanced reinforced and prestressed concrete design

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in/courses/105101087– NPTEL lectures on Design of Reinforced Concrete Structures (IIT Madras)
2) https://nptel.ac.in/courses/105106118– NPTEL lectures on Prestressed Concrete Structures (IIT Madras)

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1032 Course Name: Advances in Concrete Composite

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have basic knowledge of concrete technology and strength of materials, including properties of cement, aggregates, and conventional concrete. Familiarity with mix design, testing of concrete, and basic reinforced concrete behaviour is essential.

Course Objectives: The objective of the course is to

1) Understand the properties, types, and applications of fibre reinforced, ferrocement, silica fume, and polymer concrete
2) Evaluate the fresh and hardened properties of advanced concrete materials using standard tests
3) Analyze and design concrete structures incorporating fibres, ferrocement, and polymer-based materials
4) Develop skills for selecting and applying advanced concrete materials in sustainable and durable structural solutions.

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

CO1	Explain the types, properties, and applications of fibres in fibre reinforced concrete.
CO2	Evaluate the fresh and hardened properties of fibre reinforced concrete using standard tests.
CO3	Analyze and design fibre reinforced concrete members under compression, flexure, and shear.
CO4	Understand ferrocement materials, mechanical properties, construction techniques, and design applications.
CO5	Examine the properties, mechanical performance, and durability aspects of silica fume concrete
CO6	Describe polymer concrete, polymer impregnated concrete, and their structural applications.

Course Description:
This course deals with advanced cementitious materials including fibre reinforced concrete, ferrocement, silica fume concrete, and polymer concrete. It covers their materials, properties, testing methods, and design considerations, along with their applications in improving strength, durability, and performance of concrete structures.

Course Content

Unit-1	**Fiber Reinforced Concrete**	**08**

Fiber reinforced composites: Introduction to Fiber Reinforced Concrete, types of fibres, properties of fibres. Properties of constituent materials. Mix proportion, fixing, casting.

Unit-2	**Properties of Fresh and Hardened Fiber Concrete**	**08**

Properties of freshly mixed reinforced concrete (fibre concrete), workability tests, mechanical properties, Mechanics and mechanism of Fiber Reinforced Concrete.

Unit-3	Testing and Design of Fiber Reinforced Concrete	06
Testing of fibre reinforced under compression, flexure, and shear and bending. Various toughness indices. Stress-strain behaviour. Design aspects of reinforced concrete structures with fibres.		
Unit-4	**Ferrocement: Materials, Construction, and Design**	**06**
Ferro cement - Introduction, materials used mechanical properties, construction techniques, design in direct tension, and applications merits as structural materials.		
Unit-5	**Silica Fume Concrete: Properties and Durability**	**06**
Silica Fume Concrete - Introduction, physical and chemical properties of silica physical and chemical properties of silica fume concrete in fresh state, mechanical properties and durability of silica concrete.		
Unit-6	**Polymer Concrete: Types, Properties, and Applications**	**06**
Polymer Concrete: Introduction, Classification, properties of constituent materials, polymer impregnated concrete, polymer concrete, application.		

Learning Resources:

Text Books

1) Fiber Reinforced Cement Composites – P. K. Mehta & Paulo J. M. Monteiro, 2nd Edition, McGraw Hill Education, 2014.
2) Fiber Reinforced Concrete: Properties and Applications – M. R. K. Rao, 1st Edition, Alpha Science International, 2012
3) Ferrocement and Laminated Cementitious Composites – P. S. R. Prasad, 1st Edition, CRC Press, 2010.
4) High Performance Concrete – P. Kumar Mehta, 2nd Edition, McGraw Hill, 2013.
5) Polymer Concrete: Structure and Applications – R. N. Swamy, 1st Edition, Elsevier, 2003

Reference Books

1) Properties of Concrete – A. M. Neville, 5th Edition, Pearson Education, 2012
2) Fiber Reinforced Concrete: An Overview – P. K. Mehta & Paulo J. M. Monteiro, 2nd Edition, Prentice Hall, 2014
3) Ferrocement: Properties, Construction and Applications – P. S. R. Prasad, CRC Press, 2011
4) High Strength Concrete: Materials and Technology – F. H. Wittmann, 2nd Edition, E & FN Spon, 2008
5) Advanced Concrete Technology – John Newman & Ban Seng Choo, 1st Edition, Elsevier, 2003

e-Books

1) https://icidcbc.org – Indian Concrete Institute for research papers, journals, and technical reports
2) https://structville.com – Struct Ville blog for practical insights, solved examples, and design applications

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in/courses/105101087– NPTEL lectures on concrete technology and fiber reinforced concrete
2) https://www.concrete.org – American Concrete Institute (ACI) for technical resources on advanced concrete materials

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1033 Course Name: Advanced Design of Prestressed Concrete Structures

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have a basic understanding of Strength of Materials, Structural Analysis, Reinforced Concrete Design, Concrete Technology, and Engineering Mechanics. Knowledge of stress–strain behaviour, bending and shear in beams, analysis of determinate and indeterminate structures, properties of concrete and steel, and limit state design concepts will help students understand the behaviour and design of prestressed concrete members

Course Objectives: The objective of the course is to

1) Introduce the fundamental principles, types, systems, and material requirements of prestressed concrete
2) Develop analytical and design skills for prestressed flexural members, beams, slabs, and indeterminate structures as per codal provisions
3) Enable students to apply design methodologies for anchorage zones, composite construction, pipes, and columns considering serviceability and ultimate limit states
4) Foster understanding of advanced topics such as partial prestressing, creep, shrinkage, and crack width control for practical applications

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

CO1	Explain the principles of prestressing, types, devices, and analyse losses in prestress.
CO2	Analyze and design statically determinate prestressed beams for flexure, shear, torsion as per IS Code
CO3	Evaluate transmission and anchorage zone stresses in pretensioned and post-tensioned members.
CO4	Analyze and design statically indeterminate prestressed concrete structures including continuous beams and frames.
CO5	Apply concepts of composite construction, creep, shrinkage, partial prestressing, and crack width calculations in design.
CO6	Design special prestressed concrete elements such as pipes and columns under axial load and moments.

Course Description:
This course introduces the principles and applications of prestressed concrete structures. It covers types and systems of prestressing, materials, losses of prestress, and analysis and design of prestressed members for flexure, shear, and torsion as per code provisions. The course also includes topics such as statically indeterminate prestressed structures, anchorage zone stresses, composite construction, and partial prestressing concepts.

Course Content

Unit-1	Introduction to prestressed concrete	08

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

Unit-2	Statically determinate PSC beams	08
design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions.		
Unit-3	**Transmission of prestressing pretensioned member**	**06**
Anchorage zone stresses for posttensioned members.		
Unit-4	**Statically indeterminate structures**	**06**
Analysis and design - continuous beams and frames, choice of cable profile, linear transformation and concordance		
Unit-5	**Composite construction**	**06**
Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage effects. Partial prestressing - principles, analysis and design concepts, crack width calculations		
Unit-6	**Analysis and design**	**06**
Analysis and design of prestressed concrete pipes, columns with moments.		

Learning Resources:

Text Books

1) Prestressed Concrete – N. Krishna Raju, Tata McGraw-Hill, 6th Edition, 2018.
2) Prestressed Concrete Structures – P. Dayaratnam & P. Sarah, Oxford & IBH, 7th Edition, 2017.
3) Design of Prestressed Concrete Structures – T.Y. Lin & Ned H. Burns, Wiley, 3rd Edition, 1981
4) Limit State Design of Prestressed Concrete – Y. Guyon, Applied Science Publishers, 1972.
5) Prestressed Concrete – N. Rajagopalan, Narosa Publishing House, 2002

Reference Books

1) Prestressed Concrete: Design and Construction – Fritz Leonhardt, Wilhelm Ernst & Sohn, 1977
2) Prestressed Concrete Structures – Collins & Mitchell, Prentice Hall, 1991
3) Design of Prestressed Concrete – Arthur H. Nilson, John Wiley & Sons, 2nd Edition, 1987
4) Design of Prestressed Concrete to AS3600 – Gilbert & Mickleburgh, Longman, 1988
5) Design of Prestressed Concrete to AS3600-2009 – R.I. Gilbert, N.C. Mickleburgh, G. Ranzi, CRC Press, 2016.

e-Books

1) Engineering Civil Resource Hub: https://www.engineeringcivil.com
2) Concrete Centre (UK): https://www.concretecentre.com

MOOC / NPTEL/YouTube Links

1) NPTEL – Prestressed Concrete Structures: https://nptel.ac.in
2) BIS Standards (IS Codes Online): https://www.services.bis.gov.in
3) ScienceDirect – Prestressed Concrete Research Papers: https://www.sciencedirect.com

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1041 Course Name: Design of RC Bridges

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have prior knowledge of Structural Analysis, Reinforced Concrete Design, Strength of Materials, and Engineering Mechanics. Basic understanding of structural behaviour under different loads, design principles of RCC members, and foundation engineering concepts will help students understand bridge components, load transfer mechanisms, and structural design procedures used in bridge engineering.

Course Objectives: The objective of the course is to

1) Understand the fundamental concepts, forms, and types of bridges along with selection criteria and foundations
2) Learn about various design loads, forces, and their impact on bridge structural systems as per IRC
3) Develop the ability to design different types of R.C.C. bridge decks, substructures, and special components
4) Gain knowledge of construction techniques, erection methods, bearings, expansion joints, and bridge maintenance practices

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

CO1	Classify different types of bridges and select appropriate forms with economic span lengths.
CO2	Identify and evaluate design loads and forces acting on bridges as per IRC specifications.
CO3	Apply design methods for R.C.C. deck slabs, T-beams, box culverts, and balanced cantilever bridges.
CO4	Demonstrate knowledge of construction techniques for substructures, abutments, retaining walls, and erection of superstructures.
CO5	Design abutments, piers, approach slabs, bearings, and expansion joints for various bridge systems.
CO6	Assess inspection, maintenance, and repair methods to ensure safety and serviceability of bridges.

Course Description:
This course provides an understanding of the planning, analysis, design, construction, and maintenance of bridges. It introduces various bridge forms and the criteria for selecting suitable bridge types and span lengths. The course covers different loads and forces acting on bridges as per IRC provisions and the analysis and design of RCC bridge decks such as slab bridges, T-beam bridges, and box culverts. It also includes construction techniques for bridge substructures and superstructures, inspection and maintenance practices, and the design of important bridge components such as abutments, piers, bearings, and expansion joints

Course Content

Unit-1	Introduction to Bridges	08

General Basic bridge forms –beam, arch, suspension, various types of bridges, selection of type of Bridge and economic span length, super structure -philosophy, geometric alignment, drainage, road curb, wall foundation, pile foundation, open well foundation.

Unit-2	Design Loads and Forces on Bridges	08
loads for bridges –dead load, vertical live load, IRC loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces, deformation and horizontal forces.		
Unit-3	**Design of R.C.C. Bridge Decks**	**06**
Design of R. C. deck slab, beam and slab, T beam, Pigeaud's theory, Courbon's theory, balanced cantilever bridge, box culvert.		
Unit-4	**Construction Techniques, Inspection, Maintenance, and Repair of Bridges**	**06**
Construction techniques -construction of sub structure footing, piles, caissons, construction of reinforced earth retaining wall and reinforced earth abutments, super structure erection method bridge deck construction, by cantilever method, Inspection maintenance and repair of bridges.		
Unit-5	**Design of Bridge Substructures**	**06**
Analysis and design of sub structure abutments, Piers, approach slab.		
Unit-6	**Bridge Bearings and Expansion Joints**	**06**
Bearing and expansion joints forces on bearings Types of bearings, design of unreinforced elastomeric bearings, expansion joints.		

Learning Resources:

Text Books

1) Design of Bridges – N. Krishna Raju, Oxford & IBH Publishing, 4th Ed., 2019
2) Bridge Engineering – S.P. Bindra, Dhanpat Rai Publications
3) Concrete Bridge Practice by Dr. V.K. Raina Tata McGraw Hill Pub. Co
4) Design of Bridge Structures – T.R. Jagadeesh & M.A. Jayaram, PHI Learning, 2nd Ed., 2012
5) Design of Highway Bridges – R.M. Barker & J.A. Puckett, Wiley, 3rd Ed., 2013

Reference Books

1) Bridge Engineering Handbook – Wai-Fah Chen & Lian Duan, CRC Press
2) Bridge Management – M.J. Ryall, G.A.R. Parke & J.E. Harding, CRC Press, 2nd Ed., 2010
3) Prestressed Concrete Bridges – Nigel R. Hewson, Thomas Telford
4) Structural Design of Bridges – W.F. Chen & L. Duan, CRC Press
5) Bridge Design Manual – Ministry of Road Transport and Highways (MORTH)

e-Books

1) https://www.irc.nic.in – Indian Roads Congress codes and publication
2) https://ascelibrary.org – ASCE research papers on bridge design and construction
3) https://www.fhwa.dot.gov/bridge – U.S. Federal Highway Administration bridge resources

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – NPTEL Bridge Engineering courses
2) https://theconstructor.org – Bridge design concepts and case studies

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1042 Course Name: Structural Health Monitoring

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have basic knowledge of Structural Analysis, Reinforced Concrete Design, Strength of Materials, and Construction Materials. Understanding of structural behaviour under different loads, deterioration mechanisms in concrete structures, and basic concepts of instrumentation and testing methods will help students learn techniques used for evaluating and monitoring the health of structures

Course Objectives: The objective of the course is to

1) To understand factors influencing structural health and causes of structural distress
2) To study concepts and methods of structural health monitoring and auditing
3) To learn field testing techniques for evaluating structural performance under static and dynamic conditions
4) To gain knowledge of repair, rehabilitation, and smart material applications in structural health assessment

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

CO1	Identify causes of structural distress and importance of regular maintenance.
CO2	Apply concepts of structural health monitoring for assessing safety of altered structures
CO3	Conduct structural audit and evaluate procedures for collapse investigations.
CO4	Perform static and dynamic field tests with appropriate sensors and data acquisition systems.
CO5	Analyze stress history and dynamic response data for structural performance evaluation.
CO6	Suggest suitable repair, rehabilitation techniques, and smart material applications in structural health monitoring.

Course Description:
This course introduces the concept of structural health monitoring and assessment of existing structures. It covers factors affecting the health of structures, causes of structural distress, and the importance of regular maintenance. The course also discusses structural audit procedures, investigation of structural failures, and methods for assessing the safety of structures during alterations. Various static and dynamic field testing techniques, sensor systems, and remote monitoring technologies are included for evaluating structural performance. The course also introduces modern repair and rehabilitation techniques along with smart materials and electro-mechanical impedance methods used in structural health monitoring.

Course Content

Unit-1	**Structural Health**	**08**
Factors affecting Health of Structures, Causes of Distress, Regular Maintenance.		
Unit-2	**Structural Health Monitoring**	**08**
Concepts Various Measures, Structural Safety in Alteration.		

Unit-3	Structural Audit	06
Assessment of Health of Structure, Collapse and Investigation, Investigation, Management, SHM Procedures.		
Unit-4	**Static Field Testing**	**06**
Types of Static Tests, Simulation and Loading Methods, sensor systems and hardware requirements, Static Response Measurement.		
Unit-5	**Dynamic Field Testing**	**06**
Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Hardware for Remote Data Acquisition Systems, Remote Structural Health Monitoring.		
Unit-6	**Introduction to Repairs and Rehabilitations of Structures**	**06**
Case Studies (Site Visits), piezo– electric material and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique.		

Learning Resources:

Text Books

1) Structural Health Monitoring – Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Wiley, 1st Edition, 2006
2) Structural Health Monitoring: A Machine Learning Perspective – Charles R. Farrar, Keith Worden, Wiley, 1st Edition, 2012.
3) Maintenance and Repair of Civil Structures – B.L. Gupta, Standard Publishers, 3rd Edition, 2015
4) Health Monitoring of Structural Materials and Components – Douglas E. Adams, Wiley, 1st Ed, 2007
5) Repair and Rehabilitation of Concrete Structures – Poonam I. Modi, Jaypee Brothers, 2nd Ed, 2018

Reference Books

1) Structural Condition Assessment – Robert T. Ratay, Wiley, 2nd Edition, 2009
2) Structural Assessment: The Role of Large and Full-Scale Testing – F.K. Garas, K. M. Holford, S.S. Suraya, CRC Press, 1st Edition, 2008
3) Handbook on Repair and Rehabilitation of RCC Buildings – CPWD, Government of India, 1st Edition, 2002
4) Reinforced Concrete: Repair and Rehabilitation – R. Dodge Woodson, Butterworth-Heinemann, 1st Edition, 2009
5) Durability of Concrete and Cement Composites – C.L. Page, M.M. Page, Woodhead Publishing, 2nd Edition, 2007

e-Books

1) https://theconstructor.org – Articles and examples on SHM, structural audit, and repairs
2) https://www.shmii.org – International Society for SHM of Intelligent Infrastructure
3) https://civilengineeringnotes.com – Notes and tutorials on repair, retrofitting, and SHM

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – Free online lectures on structural health monitoring and rehabilitation
2) https://theconstructor.org – SHM, NDT methods, and practical engineering articles

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1043 Course Name: Repairs and Rehabilitation of Structure

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have prior knowledge of Reinforced Concrete Design, Strength of Materials, Structural Analysis, and Concrete Technology. Understanding of behaviour of concrete and steel structures, cracking mechanisms, durability issues, and structural loading will help students identify structural distress and apply suitable repair and rehabilitation techniques.

Course Objectives: The objective of the course is to

1) To understand the causes of deterioration and distress in concrete and steel structures
2) To develop knowledge of damage assessment, inspection, and evaluation procedures
3) To study repair, rehabilitation, and retrofitting techniques for concrete structures.
4) To familiarize with modern materials, innovative methods, and seismic retrofitting approaches

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

CO1	Identify various causes of deterioration in structures and the importance of maintenance.
CO2	Analyze types of distress, damages, and their effects in concrete and steel structures.
CO3	Evaluate structures using non-destructive testing and assessment models.
CO4	Apply advanced repair and rehabilitation techniques for different structural problems.
CO5	Select suitable materials and innovative concretes for rehabilitation projects.
CO6	Propose and design seismic retrofitting strategies for RC buildings.

Course Description:
This course focuses on the maintenance, repair, rehabilitation, and retrofitting of damaged structures. It introduces the causes of structural deterioration, inspection techniques, and procedures for assessing the condition of existing structures. The course covers different types of distress in concrete and steel structures, crack formation, corrosion effects, and methods for damage evaluation using non-destructive testing techniques. Various repair and strengthening methods such as grouting, shotcreting, epoxy injection, and advanced concrete materials are also discussed. The course further addresses rehabilitation strategies, engineered demolition methods, and seismic retrofitting techniques for reinforced concrete buildings through practical case studies.

Course Content

Unit-1	Introduction to deterioration of structures	08

Introduction to deterioration of structures with aging; Need for rehabilitation. Maintenance, Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance, Various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

Unit-2	Distress in concrete /steel structures	08
Types of damages; Sources or causes for damages; effects of damages; Case studies, Quality assurance for concrete – Strength, Durability and Thermal properties, of concrete – Cracks, different types, causes – Effects due to climate, temperature, Sustained elevated temperature, Corrosion – Effects of cover thickness.		
Unit-3	**Damage assessment and evaluation models**	**06**
Damage testing methods; Non-destructive Testing Techniques, Epoxy injection, Shoring, Underpinning, Corrosion protection techniques Corrosion inhibitors, Corrosion resistant steels, Coatings to reinforcement, cathodic protection.		
Unit-4	**Rehabilitation methods**	**06**
Grouting; Detailing; Imbalance of structural stability; Polymer concrete, Sulphur infiltrated concrete, Fiber reinforced concrete, High strength concrete, High performance concrete, Vacuum concrete, Self-compacting concrete, Geopolymer concrete, Reactive powder concrete, Concrete made with industrial wastes. Case studies.		
Unit-5	**Methods of Repair Shortcreting; Grouting**	**06**
Epoxy-cement mortar injection; Crack ceiling Strengthening of Structural elements, Repair of structures distressed due to corrosion, fire, Leakage, earthquake – DEMOLITION TECHNIQUES – Engineered demolition methods Case studies.		
Unit-6	**Seismic Retrofitting of reinforced concrete buildings**	**06**
Introduction; Considerations in retrofitting of structures; Source of weakness in RC frame building – Structural damage due to discontinuous load path; Structural damage due to lack of deformation; Quality of workmanship and materials; Classification of retrofitting techniques; Retrofitting strategies for RC buildings – Structural level (global) retrofit methods; Member level (local) retrofit methods; Comparative analysis of methods of retrofitting.		

Learning Resources:

Text Books

1) Concrete Structures – Repair, Rehabilitation and Retrofitting – P.C. Varghese, PHI Learning, 2nd Edition
2) Retrofitting of Structures – A.K. Jain, Khanna Publishers
3) Repair and Rehabilitation of Concrete Structures – P. I. Modi & C. N. Patel, PHI Learning
4) Maintenance, Repair and Rehabilitation of Concrete Structures – B.L. Gupta & Amit Gupta, Standard Publishers, 2nd Edition, 2014
5) Repair and Rehabilitation of Concrete Structures – R.D. Patel, CBS Publishers, 1st Edition, 2016

Reference Books

1) Handbook on Repair and Rehabilitation of RCC Buildings – CPWD, Government of India, 2002
2) Concrete Repair: A Practical Guide – Michael Raupach & Carola Forster, CRC Press, 1st Ed.2014
3) Structural Rehabilitation in Seismic Zones – S.K. Duggal, Oxford University Press, 1st Edition, 2013
4) IS 15988:2013 – Seismic Evaluation and Strengthening of Existing RCC Buildings – Guidelines

e-Books

1) https://civilnote.com – Structural rehabilitation and repair materials
2) https://theconstructor.org – Technical articles and case studies

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – NPTEL lectures on repair, retrofitting, and NDT
2) https://www.bis.gov.in – BIS codes (IS 13920, IS 1893, IS 456, repair & retrofitting codes).

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1051 Course Name: Advanced Structural Analysis

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have prior knowledge of Engineering Mechanics, Strength of Materials, and Structural Analysis. Understanding of equilibrium of structures, shear force and bending moment diagrams, analysis of determinate and indeterminate structures, and basic concepts of deflection and structural behaviour will help students learn advanced analytical methods used in structural engineering.

Course Objectives: The objective of the course is to

1) Understand the advanced methods for analysing indeterminate structures
2) Apply matrix and energy methods to determine internal forces and deformations
3) Analyze structures under various static and dynamic loads
4) Use computational tools and software in structural analysis problems

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

CO1	Apply classical methods to analyse indeterminate structures
CO2	Formulate and solve structural problems using stiffness and flexibility methods
CO3	Develop matrix-based models for analysing different types of structures
CO4	Utilize energy principles and approximate methods in analysing complex structures
CO5	Construct and interpret influence line diagrams for different structural elements
CO6	Analyze and verify structural systems using commercial software tools

Course Description:
This course introduces advanced methods of structural analysis used for solving complex structures. It reviews classical force and displacement methods and their application to beams, frames, and trusses. The course covers flexibility and stiffness methods and their matrix formulations for structural analysis. Energy methods such as the principle of virtual work, Castigliano's theorem, and unit load method are also discussed. Influence line diagrams for indeterminate structures and moving load analysis are included for bridge applications. The course also introduces computer-aided structural analysis and the use of software tools for modelling and analysis of structural systems.

Course Content

Unit-1	Review of Classical Methods	08

Review of force and displacement methods, Application to beams, frames, and trusses, Analysis of statically indeterminate structures, Influence lines for indeterminate structures, Rolling loads and Muller–Breslau principle.

Unit-2	Flexibility and Stiffness Methods	08

Concept of flexibility and stiffness matrices, Development of flexibility method, Development of stiffness method, Comparison of flexibility and stiffness approaches, Application to simple structures.

Unit-3	Matrix Method of Structural Analysis	06
Introduction to matrix formulation, Element stiffness matrix and global stiffness matrix, Assembly process, Boundary conditions and solution, Application to continuous beams, trusses, and portal frames.		
Unit-4	**Energy Methods and Approximate Analysis**	**06**
Principle of virtual work, Castigliano's theorems, Unit load method for deflection, Approximate methods for tall buildings and multi-storey frames, Portal and cantilever methods.		
Unit-5	**Influence Line Diagrams and Moving Loads**	**06**
Influence line diagrams (ILDs) for statically indeterminate structures, ILDs using Muller–Breslau principle, moving loads on girders and trusses, Maximum shear and moment envelopes, Application to bridge structures.		
Unit-6	**Computer Aided Structural Analysis**	**06**
Introduction to structural analysis software**,** Pre-processing and post-processing techniques**,** Modelling beams, trusses, and frames**,** Interpretation of software outputs**,** Limitations and verification with manual calculations.		

Learning Resources:

Text Books

1) Advanced Structural Analysis – Devdas Menon, Narosa Publishing House
2) Matrix Methods of Structural Analysis – Meghre & Deshmukh, Charotar Publishing House
3) Advanced Structural Analysis – C.K. Wang, McGraw Hill Education
4) Matrix Analysis of Structures – Aslam Kassimali, Cengage Learning
5) Theory of Structures – Vol. II – B.C. Punmia et al., Laxmi Publications

Reference Books

1) Structural Analysis – R.C. Hibbeler, Pearson Education
2) Matrix Structural Analysis – William Weaver Jr. & James Gere, Van Nostrand Reinhold
3) Matrix Analysis of Framed Structures – William McGuire et al., Wiley
4) Finite Element Analysis: Theory and Programming – C.S. Krishnamoorthy, Tata McGraw Hill
5) Computer Methods of Structural Analysis – F.C. Filippou, Springer

e-Books

1) https://www.civilera.com – Tutorials and case studies on advanced structural analysis
2) https://ascelibrary.org – Research articles on structural analysis

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – NPTEL structural analysis video courses
2) https://theconstructor.org – Theory, examples, and software tutorials

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1052 Course Name: Stability of Structures

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have a strong foundation in Strength of Materials, Structural Analysis, and Theory of Structures. Understanding of column behaviour, bending of beams, elastic stability concepts, and analysis of indeterminate structures is essential. Knowledge of energy methods and basic differential equations will also help students understand the stability behaviour of structural members and systems.

Course Objectives: The objective of the course is to

1) To understand concepts, criteria, and behaviour related to structural stability.
2) To analyse stability of columns, beams, and frames under various loading and boundary conditions
3) To study inelastic and dynamic stability behaviour of structural members
4) To apply theoretical methods to predict stability and prevent failure in structures

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

CO1	Explain stability criteria and post-buckling behaviour of structures.
CO2	Determine critical loads and stability behaviour of columns with various end conditions.
CO3	Analyze continuous beams and frames for stability using moment distribution and stiffness methods.
CO4	Solve lateral buckling problems for beams under different loading conditions.
CO5	Apply inelastic buckling theories to predict column behaviour beyond elastic limits
CO6	Evaluate dynamic stability of discrete and continuous systems using Lagrange-Hamilton methods.

Course Description:
This course deals with the stability behaviour of structural members and systems under different loading conditions. It introduces the basic concepts and criteria of structural stability, including static, dynamic, and energy approaches. The course covers buckling behaviour of columns considering various boundary conditions, imperfections, and eccentric loading. Stability analysis of continuous beams and frames is also discussed using classical methods. Additional topics include lateral buckling of beams, inelastic buckling of columns, and advanced concepts of dynamic stability of structures. The course helps students understand the behaviour of structures near buckling conditions and provides analytical tools for evaluating structural stability.

Course Content

Unit-1	**Introduction to Structural Stability**	**08**
Introduction- concept of stability, static dynamic and energy criterion of stability. Flexibility and stiffness criteria. Snap through & post buckling behaviour.		
Unit-2	**Stability of Column**	**08**

Stability of columns Critical load for standard boundary conditions, elastically restrained perfect column, effect of transverse shear in buckling, column with geometric imperfections, eccentrically loaded columns, orthogonality of buckling modes, large deformation theory for columns.		
Unit-3	**Stability of continuous beams and frames**	**06**
Moment distribution and stiffness method for stability analysis of continuous beams and frames.		
Unit-4	**Lateral Buckling of Beams**	**06**
Lateral buckling of beam Differential equations for lateral buckling, lateral buckling of beam in pure bending, lateral buckling of beam subjected to concentrated and uniformly distributed force.		
Unit-5	**Inelastic stability of columns**	**06**
Inelastic buckling, double modulus theory, tangent modulus theory, Shanley's theory of inelastic buckling, eccentrically loaded inelastic column.		
Unit-6	**Dynamic stability of structure**	**06**
Discrete system, Lagrange-Hamilton formulation for continuous system, stability of continuous system, general method for conservative and non-conservative system		

Learning Resources:

Text Books

1) Theory of Elastic Stability – Stephen Timoshenko & James Gere, McGraw Hill, 2nd Edition, 1961
2) Structural Stability of Steel: Concepts and Applications for Structural Engineers – Theodore V. Galambos, Wiley, 2nd Edition, 1998
3) Stability of Structures: Principles & Applications – Z. P. Bažant & L. Cedolin, Springer, 2nd Ed, 2010
4) Advanced Structural Analysis – Devdas Menon, Narosa Publishing, 1st Edition, 2010
5) Structural Analysis and Stability – R. Narayanan, PHI Learning, 1st Edition, 2012

Reference Books

1) Structural Stability of Steel and Composite Structures – R.C. Sharma & S.S. Pande, CRC Press, 1st Edition
2) Stability Theory of Structures – W. Prager & P.G. Hodge, Dover, 1st Edition, 1972
3) Elastic and Inelastic Stability of Structures – A.K. Chopra, Pearson, 2nd Edition, 2012
4) Structural Analysis and Design – C.S. Reddy, McGraw Hill, 3rd Edition, 2011
5) Structural Stability and Nonlinear Analysis – G. P. Timoshenko, D.H. Young, Van Nostrand, 2nd Edition

e-Books

1) https://theconstructor.org – Articles and examples on buckling, column and beam stability
2) https://sciencedirect.com – Research papers on elastic and inelastic stability of structures

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – Free lectures on structural stability and advanced structural analysis
2) https://ascelibrary.org – ASCE papers on structural stability and dynamic buckling
3) https://structurae.net – Database of structures with stability and buckling case studies

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTPE1053 Course Name: Dynamic of Structures

Teaching Scheme	Credit	Evaluation Scheme
Lectures: 03 Hours/Week	03	ISE: 40 Marks ESE: 60 Marks

Prerequisites, if any:
Students should have prior knowledge of Engineering Mechanics, Strength of Materials, Structural Analysis, and basic differential equations. Understanding of structural behaviour under static loads, vibration concepts, and analysis of beams and frames will help students understand the dynamic response of structures subjected to time-dependent loads

Course Objectives: The objective of the course is to

1) Understand the basic concepts and principles of structural dynamics
2) Formulate and solve dynamic equations of motion for various structures
3) Analyze the response of structures subjected to different types of dynamic loads
4) Apply the concepts of damping, resonance, and vibration control in design

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

CO1	Understand the fundamentals of structural dynamics and vibration principles
CO2	Formulate and solve equations of motion for SDOF and MDOF systems
CO3	Analyze the dynamic response of structures to various types of loading
CO4	Evaluate modal parameters and apply modal analysis techniques
CO5	Interpret earthquake ground motion and assess structural behaviour under seismic loading
CO6	Apply structural dynamics principles using software tools for real-life analysis

Course Description:
This course introduces the fundamental principles of structural dynamics and vibration analysis of structures. It covers the formulation of equations of motion and the response of single-degree-of-freedom and multi-degree-of-freedom systems under various dynamic loads. The course also discusses the dynamic behaviour of continuous systems such as beams and frames. Special emphasis is given to earthquake ground motion, seismic response of structures, and response spectrum analysis. The course further introduces vibration control techniques, damping devices, and the application of structural analysis software for dynamic analysis of structures.

Course Content

Unit-1	Introduction to Structural Dynamics	08

Importance of dynamic analysis, Types of dynamic loads: wind, earthquake, machine-induced, Free and forced vibrations, Equation of motion: single-degree-of-freedom (SDOF) systems, Damping concepts and types.

Unit-2	Response of SDOF Systems	08

Free vibration with and without damping, Forced vibration under harmonic loading, Response to periodic and non-periodic loads, Duhamel's integral, Response spectrum.

Unit-3	Multi-Degree-of-Freedom (MDOF) Systems	06
Formulation of equations of motion, Evaluation of natural frequencies and mode shapes, Orthogonality of modes, Modal superposition method, Lumped and consistent mass matrices.		
Unit-4	**Continuous Systems**	**06**
Dynamic behaviour of beams and frames, Derivation of wave equation, Mode shapes and natural frequencies, Application of Rayleigh and Dunkerley methods, Introduction to finite element approach for dynamic problems.		
Unit-5	**Earthquake Ground Motion and Structural Response**	**06**
Characteristics of ground motion, Seismic parameters and design spectra, Seismic analysis of structures, Base shear calculation, Time history and response spectrum methods.		
Unit-6	**Applications and Advanced Topics**	**06**
Vibration control and isolation, tuned mass dampers (TMDs), Active and passive damping devices, Structural dynamics using software (e.g., ETABS, SAP2000), Case studies on earthquake response of buildings.		

Learning Resources:

Text Books

1) Dynamics of Structures: Theory and Applications to Earthquake Engineering – Anil K. Chopra, *Pearson Education*
2) Structural Dynamics: Theory and Computation – Mario Paz & William Leigh, *Springer*
3) Dynamics of Structures – R.W. Clough & J. Penzien, *McGraw Hill Education*
4) Fundamentals of Structural Dynamics – Roy R. Craig & Andrew J. Kurdila, *Wiley*
5) Structural Dynamics – M. Mukhopadhyay, *ANE Books*

Reference Books

1) Structural Dynamics – P. Dayaratnam, *Wiley Eastern Limited*
2) Seismic Analysis of Structures – T.K. Datta, *John Wiley & Sons*
3) Earthquake Resistant Design of Structures – Pankaj Agarwal & Manish Shrikhande, *PHI Learning*
4) Vibration of Continuous Systems – Singiresu S. Rao, *Wiley*
5) Earthquake Engineering for Structural Design – W.H. Robinson & D.J. Thambiratnam, *Spon Press*

e-Books

1) https://ascelibrary.org – Research and case studies related to structural dynamics
2) https://www.fema.gov – Resources on seismic and disaster-resilient structural design

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – NPTEL video lectures on structural dynamics and earthquake engineering
2) https://theconstructor.org – Articles and tutorials on vibration and dynamic analysis
3) https://etabs.com – Structural software for vibration and dynamic response analysis

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTLC106P Course Name: Laboratory Practices

Teaching Scheme	Credit	Evaluation Scheme
Tutorial/Practical: 04 Hours/Week	02	ISA: 25 Marks POE: 25 Marks

Prerequisites, if any:
Students should have basic knowledge of Concrete Technology, Strength of Materials, Structural Analysis, and Reinforced Concrete Design. Understanding of material properties, behaviour of structural elements under loading, and basic laboratory testing procedures will help students perform experiments and interpret results related to structural materials and elements.

Course Objectives: The objective of the course is to

1) To develop a practical understanding of material behaviour and structural responses.
2) To expose students to advanced testing equipment and analytical procedures
3) Testing of high-strength concrete using compressive testing machine (CTM)
4) Microstructural analysis using SEM or petrographic analysis (demo-based)

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

CO1	Understand experimental procedures for testing structural materials and elements.
CO2	Evaluate the mechanical properties of construction materials under different loading
CO3	Analyze structural behaviour through lab-scale element testing
CO4	Apply advanced instrumentation and monitoring techniques in structural experiments
CO5	Use computer software for structural modelling and analysis
CO6	Interpret and document test results with logical conclusions and reports

Course Description:
This laboratory course provides practical exposure to testing and analysis of structural materials and elements. It includes experiments on concrete mix design, strength testing, and evaluation of concrete properties. The course also involves testing of structural components such as beams, columns, and slabs to study load–deflection behaviour and failure patterns. Students are introduced to advanced instrumentation techniques such as strain gauges, accelerometers, and structural health monitoring tools. In addition, software-based analysis using finite element and structural analysis programs is included to help students understand modern computational methods used in structural engineering.

Course Content

Sr. No.	Topic of Practical / Experiment / Tutorial	Assigned Hours
A	**Material Characterization (Any 2)** 1. Concrete mix design (M30/M40) and testing of workability &	**08**

	strength 2. Flexural and split tensile strength test of hardened concrete 3. Testing of high-strength concrete using compressive testing machine (CTM) 4. Microstructural analysis using SEM or petrographic analysis (demo-based)	
B	**Structural Element Testing (Any 2)** 1. Testing of RC beam for flexure and shear – load vs deflection behaviour 2. Load testing of column model to study failure pattern and crushing load 3. Model testing of slab panel (two-way) – deflection and cracking pattern 4. Testing of beam retrofitted with FRP or jacketing	**08**
C	**Advanced Instrumentation (Any 1)** 1. Strain measurement using strain gauges and data acquisition 2. Dynamic testing of structure models using accelerometers or vibration meter 3. Health monitoring demo using smart sensors or NDT tools	**08**
D	**Software-based Laboratory (Any 1)** 1. Finite Element Analysis of beam/column using ANSYS, MIDAS, SAP2000, or STAAD Pro 2. Modal analysis or dynamic response using software tools 3. Use of MATLAB or Python for solving numerical structural problems	**08**

Learning Resources:

Text Books

1) Concrete Technology – M.S. Shetty, *S. Chand Publishers*
2) Advanced Reinforced Concrete Design – P.C. Varghese, *PHI Learning*
3) Experimental Stress Analysis – Sadhu Singh, *Khanna Publishers*
4) Laboratory Manual in Structural Engineering – S.K. Bhattacharya, *New Age International*

Reference Books

1) Handbook on Experimental Mechanics – Prasad & Kumar, *CRC Press*
2) Experimental Methods for Engineers – J.P. Holman, *McGraw-Hill*
3) Design and Control of Concrete Mixtures – PCA, *Portland Cement Association*

e-Books

1) https://theconstructor.org – Practical guides and test methods
2) https://icivilengineer.com – Lab manuals and tutorials

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – Structural engineering and lab demo lectures

Tatyasaheb Kore Institute of Engineering and Technology
First Year of Master of Technology Structural Engineering

Course Code: 2501PCSTSW107T Course Name: Seminar-I

Teaching Scheme	Credit	Evaluation Scheme
Tutorial/Practical: 02 Hours/Week	01	ISA: 50 Marks

Prerequisites, if any:
Students should have a basic understanding of structural engineering subjects, research methodology, and engineering communication skills. Familiarity with technical literature, structural design concepts, and use of software tools will help students effectively study recent developments and present technical findings.

Course Objectives: The objective of the course is to

1) To enhance the student's ability to research, understand, and present technical content
2) To develop confidence in public speaking and technical communication
3) To promote critical thinking and literature analysis on recent advancements in structural engineering
4) To prepare students for effective technical writing and report documentation

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

CO1	Identify and explore emerging research areas in structural engineering
CO2	Perform comprehensive literature reviews from journals and technical sources
CO3	Analyze and interpret existing work to identify research gaps
CO4	Prepare a structured seminar report using academic writing conventions
CO5	Deliver an effective oral presentation with confidence and clarity
CO6	Participate in discussions, respond to questions, and defend presented work.

Course Description:
This course aims to develop students' research, analytical, and presentation skills through a technical seminar on recent topics in structural engineering. Students are required to select topics related to emerging structural materials, advanced design codes, sustainable construction, structural health monitoring, artificial intelligence applications, or case studies of structural failures and retrofitting. The course involves conducting a literature survey of technical papers, preparing a structured seminar report, and delivering a technical presentation followed by a discussion and viva. This helps students improve their ability to review research, organize technical information, and communicate engineering ideas effectively.

Course Content

Sr. No.	Topic of Practical / Experiment / Tutorial	Assigned Hours
A	Topic Selection & Approval • Emerging trends in structural materials • Recent codes & standards in earthquake/bridge/high-rise design	**06**

	• Sustainable construction techniques • Applications of AI/ML or software tools in structural engineering • Structural failures, retrofitting case studies • Smart materials, sensors, or structural health monitoring	
B	**Literature Survey** • Minimum of 8–10 technical papers (journal/conference) • Review of standards, textbooks, and web resources	**06**
C	**Seminar Report Preparation** • Introduction, literature review, methodology, results/discussion, conclusion • Report must be prepared as per standard format (typed, spiral-bound, 20–25 pages)	**06**
D	**Presentation & Viva** • 10–15-minute PowerPoint presentation • Q&A session by faculty panel • Peer review & feedback	**06**

Learning Resources:

Text Books

1) Technical Communication: Principles and Practice – Meenakshi Raman & Sangeeta Sharma, *Oxford University Press*
2) Scientific Writing: A Reader and Writer's Guide – Jean-Luc Lebrun, *Springer*
3) Presentation Skills for Engineers – Mark Wiskup, *Career Press*
4) Engineering Communication – Charles W. Knisely & Karin I. Knisely, *Cengage Learning*

Reference Books

1) Research Methodology: Methods and Techniques – C.R. Kothari, *New Age International*
2) Technical Writing for Engineers & Scientists – Leo Finkelstein, *McGraw-Hill*
3) Engineering Research Methodology – R. Venkatraman, *PHI Learning*
4) Communication Skills for Engineers – Sunita Mishra & C. Muralikrishna, *Pearson Education*

e-Books

1) https://ascelibrary.org – Research articles from ASCE journals
2) https://sciencedirect.com – Access to technical literature
3) https://researchgate.net – Free access to technical papers and discussion

MOOC / NPTEL/YouTube Links

1) https://nptel.ac.in – Research methodology and technical presentation courses
2) https://slideshare.net – Sample seminar presentations