School of Engineering and Technology

Programme Structure & Syllabus

M.Tech (Structural Engineering)

2023-24

K.K. University

Bihar Sharif, Nalanda - 803115

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School of Engineering & Technology
Department of Civil Engineering
M. Tech in Structural Engineering

Objective of the Program:

The M.Tech Program in Structural Engineering aims to equip students with advanced theoretical and practical knowledge to address complex engineering challenges. It fosters a strong foundation in research methodologies and innovation, enabling contributions to cutting-edge advancements in the field. The program develops technical skills for the design, analysis, and assessment of structural systems using modern engineering tools and techniques. Graduates are prepared to meet professional standards, emphasizing safety, sustainability, and ethical practices. An interdisciplinary approach enhances problem-solving capabilities by integrating knowledge from related fields.

Program Education Outcomes:

PEO-1: Graduates will be capable of conducting independent research and contributing to innovations in structural engineering, addressing current and future challenges in the field.

PEO-2: Graduates will possess advanced knowledge and technical proficiency in structural engineering, enabling them to design, analyze, and evaluate complex structural systems.

PEO-3: Graduates will be adept at applying advanced engineering principles and computational tools to solve real-world structural engineering problems.

PEO-4: Graduates will be equipped to collaborate effectively with professionals from related fields, integrating multidisciplinary knowledge to enhance engineering solutions.

PEO-5: To develop entrepreneurial abilities, ethical practices and lifelong independent learning abilities.

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Program Outcomes:

PO-1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes:

PSO-1: Design and analyze complex structural components and systems, including buildings, bridges, and infrastructure, using advanced techniques and software tools.

PSO-2: Utilize advanced knowledge of construction materials, including concrete, steel, composites, and new materials, to enhance the performance and durability of structures.

PSO-3: Apply principles of seismic and wind engineering to design structures that can withstand natural forces, ensuring safety and stability.

PSO-4: Design and execute strategies for the retrofitting and rehabilitation of existing structures to extend their lifespan and improve their performance.

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M. Tech in Structural Engineering Programme/Course Structure

FIRST SEMESTER

S. No	CODE	TITLE	CREDIT	L	T	P	Hours Per Week
1	EMST1101	Advance Mathematics and Numerical Analysis	**4**	3	1	0	4
2	EMST1102	Theory of Elasticity	**4**	3	1	0	4
3	EMST1103	Advance Structural Analysis	**4**	3	1	0	4
4	EMST1104	Advance Design of Concrete Structures	**5**	3	0	2	5
5	EMST1105	Advance Foundation Engineering	**5**	3	0	2	5
6	EMST1106	Computer Aided Design	**5**	3	0	2	5
Total			**27**	**18**	3	9	27

SECOND SEMESTER

S. No	CODE	COURSE TITLE	CREDIT	L	T	P	Hours Per Week
1	EMST1201	Structural Dynamics	**4**	3	1	0	4
2	EMST1202	FEM in Structural Engineering	**4**	3	1	0	4
3	EMST1203	Prestressed Concrete Design	**4**	3	1	0	4
4	EMST1204	Non-Destructive Testing of materials	**5**	3	0	2	5
5	EMST1205	Advanced Construction Materials and Concrete Technology	**5**	3	0	2	5
6	EMST1206	Design of steel Structures	**5**	3	0	2	5
Total			**27**	**18**	**3**	6	27

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THIRD SEMESTER

S. No	CODE	TITLE	CREDIT	L	T	P	Hours Per Week
1	EMST2101	Elective-I	**4**	3	1	0	4
2	EMST2102	Elective-II	**4**	3	1	0	4
3	EMST2103	STAAD-Pro	**4**	0	0	6	6
4	EMST2104	Project	**8**	0	2	9	11
TOTAL			**20**	**6**	**4**	**15**	**25**

FOURTH SEMESTER

S. No	CODE	TITLE	CREDIT	L	T	P	Hours Per Week
1	EMST2201	Project	16	0	4	18	22
TOTAL			**16**	**0**	**04**	**18**	**22**

Elective I:

1. **EMST2101A** Design of Earthquake Resistant Structures
2. **EMST2101B** Stability Theory in Structural Engineering
3. **EMST2101C** Design of Tall Structures

Elective II:

1. **EMST2102A** Design of Offshore Structures
2. **EMST2102B** Reliability Based Civil Engineering Design
3. **EMST2102C** Advanced FEM and programming

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DEPARTMENT OF CIVIL ENGINEERING

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Programme Structure	M. Tech in Structural Engineering
Semester	1ST
Subject Code	EMST 1101
Course Name	Advance Mathematics and Numerical Analysis
Course Credits	3 (L)+1(T) = 4
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview:**
   To learn about Advance Mathematics and Numerical Analysis that include the Elementary Concept of Fuzzy logic, Introduction to Linear Programming, Transportation and Assignment Problems, Laplace, Heat & Wave Equations and differential equations.
2. **Prerequisite:** To understand the fundamental of Engineering mathematics and fundamental Calculus and algebra with its applications.
3. **Objective of the Syllabus:**
   This course Advance Mathematics and Numerical Analysis is an essential part of any Higher engineering education. These objectives aim to provide students with a comprehensive understanding of higher mathematics which can help in research-oriented studies in different subjects and probabilistic approach. It also helps in designing point of view and for smaller programming in transportation design studies.
4. **Course Outcomes:**

S. No.	Course Outcomes (Cos)
CO1	Understands the objectives of Some Elementary Concepts of Fuzzy Set, Algebraic Operations on Fuzzy sets and use and application of Fuzzy Logic.
CO2	Know about Linear Programming, Solution by Graphical and Simplex Method, Concept of Degeneracy and Duality, Big-M Method, Two Phase Method, Revised simplex Method.
CO3	Understanding about Transportation and Assignment Problems, North-West

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	Corner Method, Mathematical Formulation of Assignment Problem, Job Sequencing.
CO4	Understanding about Numerical Solution of an Ordinary Differential Equations and Partial Differential Equations (Laplace, Heat & Wave Equations), Gauss's Quadrature Formula.
CO5	Know about Difference Equations as a relation among the value of Order, Degree, Solution, Linear Difference Equations, General Solution of Homogeneous Difference Equation of order n, Particular Sol. of the Complete Difference Equations.

5. Syllabus:

UNIT -I Elementary Concept of Fuzzy logic

Some Elementary Concepts, Fuzzy Set, and Basic Fuzzy set operations, some fundamental Properties of Fuzzy set; Algebraic Operations on Fuzzy sets, Use of Fuzzy Logic, Application of Fuzzy Logic.

UNIT -II Introduction to Linear Programming

Solution by Graphical and Simplex Method, Concept of Degeneracy and Duality, Artificial Variable Techniques: Big-M Method, Two Phase Method, Revised simplex Method.

UNIT -III Transportation and Assignment Problems

North-West Corner Method, Lowest Cost Entry Method, Vogel's Method, Non-Degenerate Basic Feasible Solution, Assignment Model, Mathematical Formulation of Assignment Problem, Hungarian Method for the Assignment Problem, Job Sequencing.

UNIT -IV Numerical Method

Numerical Solution of an Ordinary Differential Equations, Numerical solutions of Partial Differential Equations (Laplace, Heat & Wave Equations), Gauss's Quadrature Formula.

UNIT -V Difference Equations

Difference Equations as a relation among the value of yx, Order, Degree, Solution, Linear Difference Equations, Solution of the Eq. Yx+1=AYx+B, Solution as Sequences, Linear Homogeneous Equations with Constants Coefficients, Linearly Independent Solutions, General Solution of Second order homogeneous Difference Equations, General Solution of Homogeneous Difference Equation of order n, Particular Sol. of the Complete Difference Equations.

BOOKS AND REFERENCES:

1. Rammana, B.V., Higher Engineering Mathematics, Tata McGraw Hill Pub. Company.
2. Potter, Goldberg & Edward, Advanced Engineering Mathematics, Oxford University Press.
3. Shastry, S. S., Engineering Mathematics, PHI Learning
4. Gupta, C.B., Engineering Mathematics I & II, McGraw Hill India.
5. Dean G. Duffy, Advanced Engineering Mathematics with MATLAB, CRC Press.

Additional Learning Sources: -

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1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

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Program Structure	**M. Tech in Structural Engineering**
Semester	**1ST**
Subject Code	**EMST1102**
Course Name	**Theory of Elasticity**
Course Credits	**3 (L) + 1(T)= 4**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. Course Overview:

This course explores the fundamental principles and applications of the theory of elasticity, which describes how solid materials deform and return to their original shape when subjected to forces. It covers both linear and nonlinear elasticity, focusing on mathematical formulations, solution techniques, and practical applications in engineering.

2. Prerequisite:

A well founded understanding of undergraduate-level mechanics of materials and differential equations.

3. Objective of Syllabus:

- To understand the fundamental concepts and equations governing the theory of elasticity.
- To analyze stress, strain, and deformation in elastic materials.
- To solve elasticity problems using analytical and numerical methods.
- To apply elasticity theory to real-world engineering problems.

4. Course Outcome:

S. No.	Course Outcomes (Cos)

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CO1	Formulate and solve elasticity problems using analytical and numerical methods.
CO2	Formulate and solve boundary value problems in solid continua using stress and displacement-based solution Strategies.
CO3	Formulate and solve planar problems using Airy stress function in rectangular and polar co-ordinates.
CO4	Solve specific three-dimensional problems like torsion, bending of non-circular pri bar, membrane analogy and simple plate bending
CO5	To analyze the structural sections subjected to torsion.

5. Syllabus:

UNIT I: Plane Stress & Plane Strain

Plane Stress, Plane Strain, Stress and Strain at a point, Differential equations of equilibrium, constitutive relation: anisotropic materials Linear elasticity; Stress, strain, constitutive relations; Boundary conditions Compatibility equation, stress function.

UNIT II: Two Dimensional Problems in Rectangular Co-ordinates

Solutions by Polynomials Saint- Venant's Principle, Determination of displacements, bending of beams, solution of two-dimensional problems in Fourier series.

UNIT III: Two Dimensional Problems in Polar Coordinates

General equations in Polar coordinates, Pure bending of curved bars, displacements for symmetrical stress distributions, bending of curved bar, stress distribution in plates with circular holes stresses in a circular disc general solution.

UNIT IV: Analysis of stress and strain in Three Dimensions

Principal stress and strain shearing stress and strains, elementary equation of equilibrium, compatibility conditions, problems of elasticity involving pure bending of prismatic bars.

UNIT V: Torsion of Prismatic Bars

Torsion of prismatic bars, membrane analogy, torsion of a bar of narrow rectangular cross section, torsion of rectangular bars, solution of torsional problem, torsion of rolled section, torsion of hollow shafts and thin tubes torsion buckling torsional flexural buckling.

REFERENCE BOOKS

1. Timoshenko, S.P. Theory of Elasticity (7th Ed.). McGraw –Hill International.

2.Timoshenko, S. P. & Gere, James M. Theory of Elastic Stability (2nd. ed.). McGraw –Hill International Editions, Mechanical Engineering Series.

3. Iyenger, N.G.R. Structural Stability of Columns & Plates. Ellis Horwood Ltd, Publisher.

4. "Advanced Mechanics of Materials and Applied Elasticity" by Ansel C. Ugural and Saul K. Fenster

Additional Learning Sources: -

1.Web links to e-learning: NPTEL.

2.Web links to e-learning: NCTEL.

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Program Structure	**M. Tech in Structural Engineering**
Semester	**1ST**
Subject Code	**EMST1103**
Course Name	**Advance Structural Analysis**
Course Credits	**3 (L) + 1(T)= 4**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. Course Overview:

This course provides in-depth knowledge and advanced techniques for analyzing complex structures. It covers both theoretical and practical aspects of structural analysis, focusing on the behavior of structures under various loading conditions. The course includes modern computational methods and tools used in structural engineering.

2. Prerequisite:

A solid understanding of undergraduate-level structural analysis and mechanics.

3. Objective of Syllabus:

- To understand advanced concepts in structural analysis.
- To develop proficiency in analyzing complex structural systems.
- To apply computational methods for solving structural analysis problems.
- To enhance problem-solving skills using advanced structural analysis tools.

4. Course Outcome:

S. No.	Course Outcomes (Cos)
CO1	To understand the basis methods of structural analysis and basic concepts of matrix approach (Flexibility Method).

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CO2	To formulate flexibility matrix and analyze rigid jointed plane frames by force method.
CO3	To formulate displacement matrix and analyses continuous beams, rigid & pin jointed plane frames by displacement method.
CO4	To analyze rigid & pin jointed space frames & space using displacement method.
CO5	To analyze and determine the effects of rolling loads on beams and girders.

5. Syllabus:

UNIT I: Matrix Method (Flexibility Method)

Force methods, Basic Concepts, evaluation of flexibility, transformation, analysis of a single member of different types, transformation of single member.

UNIT II: Plane and space structures

Applications to plane and space structures with pin joints and rigid joints, energy approach in flexibility method, effect of support displacement and transformation.

UNIT III: Matrix Method (stiffness Method)

Displacement methods, Basic concepts, Evaluation of stiffness coefficients, direct stiffness method, energy approach in stiffness method Code No. approach for global stiffness matrix, effect of support displacement and temperature.

UNIT IV: Symmetrical & anti-symmetrical problems

Stiffness of plane & space frames solution of problems, Comparison of force and displacement methods of solution.

UNIT V: Rolling Loads and Influence Lines

Maximum SF and BM curves for various types of Rolling loads, focal length, EUDL, Influence Lines for Determinate Structures- Beams, Three Hinged Arches. Influence lines for intermediate structures, Muller Breslau principle, Analysis of Beam- Columns.

TEXTBOOKS / REFERENCES

1.Reddy, C.S. Basic Structural Analysis. Tata McGraw-Hill Publishing Company

2.Gere, J.M. & Weaver, W. Analysis of frame structures. Allied East West Pvt. Ltd. New Delhi

3.Rajsekeran & Sankarsubramanian, Computational structural Mechanics. Prentice-Hall of India

Learning Private Limited.

4. Kanchi. Matrix Structural Analysis. Wiley Eastern Ltd. New Delhi

5.Pandit & Gupta. Structural Analysis: a matrix approach. Tata McGraw-Hill Publishing Company.

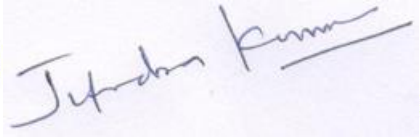
Additional Learning Sources: -

1.Web links to e-learning: NPTEL.

2.Web links to e-learning: NCTEL.

3.IES Master postal study material.

4.Made easy hand book.



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Programme Structure	M. Tech in Structural Engineering
Semester	1ST
Subject Code	EMST1104
Course Name	Advance Design of Concrete Structures
Course Credits	3 (L) +2(P) = 5
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview:** This course provides an in-depth study of advanced concepts and methodologies in the design of concrete structures. It covers both the theoretical and practical aspects of designing complex concrete structures, including buildings, bridges, and special structures. Emphasis is placed on modern design codes, sustainability, and innovative construction techniques.

2. **Prerequisite:** Basic knowledge of construction materials and structural behavior. A solid understanding of undergraduate-level concrete design and structural analysis.

3. **Objective of the Syllabus:**

   - To understand advanced principles and methods in the design of concrete structures.
   - To apply modern design codes and standards in concrete design.
   - To analyze and design complex concrete structures under various loading conditions.
   - To incorporate sustainability and innovative techniques in concrete construction.

4. **Course Outcomes:**

S.No.	Course Outcomes (Cos)
CO1	Analyze and design complex concrete structures for different loading condition.
CO2	To analyze and design the water tanks and bridge deck as per Indian standard specifications.
CO3	Analyze the behavior of prestressed concrete members under different types of loads, including dead loads, live loads, and dynamic loads.
CO4	To design the main components of silos and bunkers, including walls, roofs, hoppers, and foundations

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CO5	To design and detail reinforced concrete structures that can withstand seismic forces, enhancing their proficiency.

5.Syllabus:

UNIT I: Earthquake and wind effects on structures

Loads on structures, reinforced concrete design of flat slabs, grid floors, deep beams, design of building's load bearing and framed structures, design of pile and raft foundations, seismic analysis.

UNIT II: Design of Water Tank & Bridge

Design of ground and elevated water tanks, design of bridge decks.

UNIT III: Pre-stressed Concrete

Analysis and design of sections under flexure using limit state approach, anchorage zone and end block design, composite construction, introduction to statistically indeterminate pre-stressed concrete structures.

UNIT IV: Design of Bins

Silos and bunkers, Janseen's and Airy's theory, rectangular bunkers with sloping bottoms and with high side walls, battery of bunkers.

UNIT V: Earthquake resistant Design and detailing Ductility of reinforced concrete members

Design principles and code provisions, Detailing of reinforcement in slab, beams, columns foundations, walls and junctions.

TEXTBOOKS:

1. Chandrasekaran, Jai Krishna. Elements of earthquake engineering South Asian Publishers.
2. Shah & Karve, Text book of reinforced concrete. Structures publications
3. Punmia, B.C., Jain, Ashok Kumar & Jain, Arun Kumar. RCC designs. Laxmi Publications.

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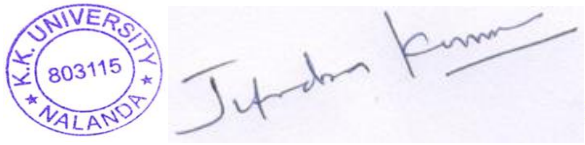
4. Krishna, Raju. Prestressed concrete (4th ed.). Tata McGraw-Hill Publishing Company.
5. Everard, Theory and problems of RCC design (Shaum's Outline Series Mcgraw-hill Professional.
6. Varghese, P.C.Advanced RCC Designs. Prentice-Hall of India Learning Private Limited.
7. P. Agrawal and M. shrikhande, earthquake resistance design of structures, practice all of india Pvt Ltd New Delhi

IS codes: latest versions: -

1. IS: 456 Code of practice for plain and reinforced concrete
2. IS: 875 (Part I, II, III,) Code of practice for design loads (other than earthquake) for buildings and structures
3. IS: 1893 Criteria for earthquake resistant design of structures
4. IS: 1343 Code for Prestressed concrete.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. Lab manual - KKU



Advance Design of Concrete Structures Lab SUBJECT CODE EMST1104P CREDIT: 02

LIST OF EXPERIMENTS:

Week 1: To determine the compressive strength of concrete.
Week 2: To analyze the behavior of prestressed concrete beams under loading.
Week 3: To demonstrate the compressive strength of concrete using a rebound hammer.
Week 4: Detailing of Water tanks.
Week 5: Design and detail of Bridge decks.
Week 6: Earthquake resistant Design and detailing Ductility of reinforced concrete members.
Week 7: To model and analyze concrete structures using finite element software.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.

2. Web links to e-learning: NCTEL.

3. Lab manual - KKU

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Program Structure	M. Tech in Structural Engineering
Semester	1ST
Subject Code	EMST1105
Course Name	Advance Foundation Engineering
Course Credits	3 (L) + 2(P)= 5
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. Course Overview:

To provide civil engineering students a detailed knowledge to carry out field investigation and to identify soil, so as to provide different types of foundation as per the properties of soil. This course focuses on the in-depth study of the analysis, design, and construction of foundations for various types of structures. The aim is to equip students with advanced knowledge and skills necessary for tackling complex foundation engineering problems in both theoretical and practical contexts.

2. Prerequisite:

Students must have Chemistry as a one subject at +2 levels.

3. Objective of Syllabus:

- To understand the principles of soil-structure interaction and its application in foundation engineering.
- To analyze and design different types of foundations including shallow and deep foundations.
- To gain knowledge on advanced topics like pile foundations, caissons, and retaining structures.
- To develop skills for assessing and improving foundation performance.

4. Course Outcome:

S. No.	Course Outcomes (Cos)
CO1	To design, analyze, and manage deep open cut projects, ensuring their stability and safety.
CO2	Analyze and calculate the bearing capacity of shallow foundations using various theoretical and empirical methods.
CO3	To calculate the load carrying capacity of single piles and pile groups using analytical and empirical methods.
CO4	To design coffer dam structures considering factors such as water depth, soil conditions, and construction sequence.

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CO5	Analyze dynamic loads generated by machinery, including rotating and reciprocating equipment, using principles of dynamics and structural analysis.

5. Syllabus:

UNIT- I: Deep Open Cuts

Introduction, Types of Coffer Dams, Design data for cellular cofferdam, Stability analysis of cofferdam, interlock stresses Soil Exploration: Introduction, Methods of exploration, Direct Methods and techniques of exploration, Methods of boring types of samples, Disturbance of soil sample, Soil samplers and sampling techniques, Ground water observations, Boring records, Spacing and depth of bore holes, Indirect methods of soil exploration, Penetration tests, Geophysical methods, Dynamics methods, Sequence of exploration programs

UNIT- II: Shallow Foundations

Introduction, General Requirements, Depth of foundation, bearing capacity, Eccentric Inclined loads, bearing capacity of stratified soils, Settlement of footings, Settlement of footings from constitutive laws, Settlement and tilt of eccentrically loaded footings, Allowable settlement, Plate bearing test, Standard penetration test Effect of water table, shallow foundation classification, Modulus of sub-grade reaction, Beams on elastic foundation, Raft foundation.

UNIT- III: Pile Foundation

Introduction, Uses of piles, Types of piles, pile drivers, bearing capacity of piles, Static analysis, Pile load test, Dynamic methods, other methods, Negative skin friction, Pile group, Ultimate bearing capacity of pile groups, Settlement of pile group, Influence of pile cap. Laterally loaded piles, Ultimate resistance, Elastic methods, Pile groups under lateral load, batter pile under lateral load, Batter pile groups under inclined loads, pile under dynamic loads.

UNIT- IV: Coffer Dams

Introduction, types of Coffer Dams, Design data for cellular cofferdam, Stability analysis of cofferdam, Interlock stresses.

UNIT- V: CORROSION AND LUBRICANT

Introduction, Criteria for satisfactory action of a machine foundation, Definitions, Degrees of freedom of a block foundation, Analysis of block foundation, Theory of linear weightless spring, Equivalent soil springs, Vertical vibration, Rocking vibration, Vibration in shear, Simultaneous rocking sliding and vertical vibrations for a foundation, India n standard on design and construction of foundations for reciprocating machines, Foundations for impact type machines, Indian Standard on design and construction of foundations for impact type machines, Analysis of block foundation based on elastic half space theory.

TEXT BOOKS:

1. Bowles, Foundation: Analysis and Design, McGraw Hill Book CO. Inc.
2. Peck, R.B., W.E. Hanson and T.H. Thornburn, Foundation Engineering, Wiley, New York.
3. Coduto, D. P., Yeung, M. R., & Kitch, W. A. (2010). "Foundation Design: Principles and Practices." Pearson.

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4. Prakash S.& Pun V.K, Soil Dynamics & Design foundation, McGraw Hill Co. 1998.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

Advance Foundation Engineering SUBJECT CODE EMST1105P CREDIT: 02

LIST OF EXPERIMENTS:

Week 1: To determine shear strength parameters of the given soil by direct shear test.
Week 2: To determine shear strength parameters of the given soil by triaxial test.
Week 3: To determine shear strength parameters of the given soil by vane shear test.
Week 4: To determine Bearing capacity by Plate load test.
Week 5: To determine Bearing capacity by SPT.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. Lab manual - KKU

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School of Engineering & Technology.
Department of Civil Engineering

Program Structure	**M. Tech in Structural Engineering**
Semester	**1ST**
Subject Code	**EMST1106**
Course Name	**Computer Aided Design**
Course Credits	**3 (L) + 2 (P) = 5**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

2. Course Overview:

To bring about an understanding of use of computers for solving designing, detailing of various structural members and other related problems by using computer-based programming. This course emphasizes both theoretical knowledge and practical skills necessary for utilizing CAD software effectively in structural engineering projects.

2. Prerequisite:

Basic Knowledge of computer programming and structure design.

3. Objective of Syllabus:

- Use CAD tools for structural analysis, design, and optimization of various types of structural systems.
- Introduce students to the fundamentals of software programming used in structural engineering, emphasizing their capabilities and applications.

4. Course Outcome:

S. No.	Course Outcomes (Cos)
CO1	To demonstrate a solid understanding of the fundamental concepts of C++ programming, including syntax, data types, operators, and control structures.
CO2	To develop strong problem-solving skills by analyzing, understanding, and breaking down complex problems into manageable components.
CO3	Gain proficiency in using industry-standard CAD software tools (e.g., AutoCAD) for creating technical drawings and designs.
CO4	To demonstrate a solid understanding of the fundamental concepts and principles of computer graphics, including rendering, and modeling.

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5. Syllabus:

UNIT- I: C++ programming language
Basics of programming, loops, decisions, structures, functions, objects/ classes, arrays.

UNIT- II: Programming problems
Overloading, inheritance, virtual functions and pointers, object-oriented programming Turbo Cpp features and programming, structure engineering problems programming.

UNIT- III: Computer Aided drafting
2-D and 3-D drawings, Introduction to CAD software drawing of buildings.

UNIT- IV: Introduction to computer graphics
3-D modeling software and analysis software.

TEXT BOOKS:

1. Lafore, Robert. (2006) *Object oriented programming in CPP.* Galgotia Publications Pvt. Ltd.
2. Balaguruswamy, E.(2011) *Programming in C(5th ed.).* Tata McGraw Hill Education Private Limited
3. Syal & Gupta. *Computer programming and engineering analysis*
4. AutoCAD, SolidEdge, Cadlab software and Manuals
5. Krishnamurthy, C.S. & Rajeev, S. & Rajaraman, A. *Computer Aided Design Software and Analytical tools* Narosa Publishing House New Delhi.

Additional Learning Sources: -

3. Web links to e-learning: NPTEL.
4. Web links to e-learning: NCTEL.

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Computer Aided Design SUBJECT CODE EMST1106P CREDIT: 02

LIST OF EXPERIMENTS

Week 1: Practice Exercises on Auto CAD Software.

Week 2: Drawing Plan of a building in Auto CAD

a) Plan of a Single Storeyed building in Auto CAD

b) Plan of a Multi Storeyed building in Auto CAD.

Week 3: Exercises on development of working drawings of buildings in Auto CAD.

Week 4: Create basic 3D objects using commands like extrude, revolve, and sweep

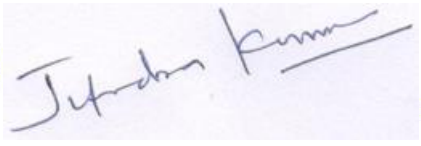
Week 5: Design and document a specific project such as a floor plan, mechanical part, or architectural elevation.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.

2. Web links to e-learning: NCTEL.

3. Lab manual - KKU



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Program Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1201
Course Name	Structural Dynamics
Course Credits	3 (L) + 1 (T)
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview:**

Structural Dynamics is a specialized course in the field of civil and structural engineering that focuses on the behavior of structures subjected to dynamic loads. This course covers the fundamental principles, analytical methods, and practical applications related to the dynamic response of structures. Students will learn how to analyze and design structures to withstand dynamic forces such as earthquakes, wind, and other time-varying loads.

2. **Prerequisite:**

Basic knowledge of structural analysis, engineering mechanics, mathematics, and basic vibration theory.

3. **Objective of Syllabus:**

- Learn the fundamental principles of structural dynamics, including the formulation of equations of motion and dynamic equilibrium.
- The objective of the course is to understand the behavior of structure to various dynamic loads: such as wind, earthquake, machine vibration and ambient vibration.
- Understand the principles of seismic design and analysis, including building codes and standards.

4. **Course Outcome:**

S. No.	Course Outcomes (Cos)
CO1	Understand the elements of single degrees of freedom, concept of damping and free and forced vibrations.
CO2	To formulate the solutions of the mathematical models of a vibrating system.
CO3	To apply the behaviour and response of linear and nonlinear two degree of freedom structures with various dynamic loading.
CO4	To study the behaviour and response of MDOF structures with various dynamic loading.
CO5	To introduce continuous systems and practical vibration analysis of structural systems.

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5. Syllabus:

UNIT I: Single Degree of Freedom System
Free and forced vibrations, Linear Viscous Damper, Coulomb Damper: Response to harmonic excitation, rotating unbalance and support excitations, Vibration isolation and transmissibility, single degree of freedom system as vibro-meter and accelerometer, response to periodic and arbitrary excitation.

UNIT II: Duhamel's integral & Impulse response function
Laplace transforms Fourier transform methods. Frequency response function. Phase-Plane Techniques. Critical Speed of rotors. Energy methods, Rayleigh's method, Equivalent viscous damping.

UNIT III: Two Degree of Freedom System
Matrix Formulation, Free Vibration, Beat phenomenon. Principle of Damped and un-damped vibration absorbers.

UNIT IV: Multi Degree of Freedom System
Matrix formulation, stiffness and flexibility influence coefficients, eigen value problem, normal modes and their properties. Matrix iteration technique for eigen value, and eigen vectors, Free and forced vibration by modal analysis.

UNIT V: Continuous System
Axial vibration of bar, torsion of shafts, transverse vibration of strings and bending vibration beams. Forced vibration. Normal mode method. Lagrangle's equation. Approximate methods of Rayleigh-Ritz, Galerkin etc.

REFERENCE BOOK:

1. Chopra A. K., Dynamics of Structures, Prentice Hall of India, New Delhi,
2. Clough R.W., Penzien J., Dynamics of structures, McGraw-Hill
3. Biggs J M, Introduction to Structural Dynamics
4. Mario Paz, Structural Dynamics, CBS publishers New Delhi.

Additional Learning Sources: -
1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

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Program Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1202
Course Name	FEM in Structural Engineering
Course Credits	3 (L) + 1 (T) = 4
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview:**

The Finite Element Method (FEM) in Structural Engineering course provides an in-depth understanding of the principles and applications of FEM for analyzing and solving complex structural engineering problems. The course covers the theoretical foundations, computational techniques, and practical implementations of FEM, emphasizing its role in modern structural analysis and design.

2. **Prerequisite:** Proficiency in structural analysis, engineering mechanics, differential equations, and basic knowledge of matrix algebra.
3. **Objective of the Syllabus:**
   - The finite element method is a numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems and some special topics.
   - Grasp the fundamental concepts and mathematical formulations underlying the Finite Element Method.
   - Gain proficiency in using FEM software for modeling and analyzing structural systems.
   - Apply FEM to solve real-world structural engineering problems involving various types of structures and materials.
4. **Course Outcomes:**

S. No.	Course Outcomes (Cos)
CO1	To learn the theory and characteristics of finite elements that represent engineering structures.
CO2	Develop element characteristic equation and generation of global equation.
CO3	Implement the formulation techniques to solve two-dimensional problems using triangle and quadrilateral elements.
CO4	Identify the application and characteristics of FEA elements such as bars, beams, plane and iso-parametric elements.

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CO5	Able to apply suitable boundary conditions to a global equation for bars, trusses, beams, axi symmetric and dynamic problems and solve them displacements, stress and strains induced.

5. Syllabus:

Unit I Introduction to Finite Element Method
General Applicability and Description of Finite Element Method Comparison with other methods.

Unit II Solution of finite Element Method
Solution of Equilibrium problems Eigen value problems, propagation problems, computer implementation of Gaussian eliminations Choleski's decomposition, Jocobi's and Ranga Kutta Method.

Unit III General Procedure of Finite Element Method
Descretization of the domain, Selection of Shapes, Types and Number of elements, node numbering technique, Interpolation Polynomials, their selection and derivation in terms of global and local coordinates, Convergence requirements. Formulation of Element Characteristic matrices and vectors, Variational approach. Assembly of Element matrices and Vectors and Derivation system equations, computation of element resultants

Unit IV Iso-parametric Formulation
Lagrange and Hermite interpolation functions, Iso parametric Elements, Numerical Integration.

Unit V Static Analysis
Formulation of equilibrium equation, Analysis of truss, Frames, Plane Stress and Plane Strain Problems Plates and Shells.

TEXT / REFERENCES BOOKS:

1. Weaver, Johnson, Finite element and structural analysis
2. H. C Martin, Matrix structural analysis
3. C.F. Abel, C.S. Desai, Finite element methods, CBS Publishers New Delhi
4. Buchanan, Finite element Analysis (Schaum Outline S), Tata McGraw Hill
5. Krishnamurthy, Finite element analysis, Tata McGraw Hill
6. Zinkiewicz, O.C. and Taylor, R.L., The Finite Element Method, McGraw-Hill
7. Reddy, J. N., An Introduction to Finite Element Method, McGraw-Hill, Singapore

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.

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2. Web links to e-learning: NCTEL.

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Program Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1203
Course Name	Prestressed Concrete Design
Course Credits	3 (L) + 1(T)= 4
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. Course Overview:

Prestressed Concrete Design is a specialized course in structural engineering focusing on the principles, methods, and applications of prestressed concrete. The course covers the design, analysis, and construction aspects of prestressed concrete structures, emphasizing the advantages of prestressing in improving performance and durability.

2. Prerequisite:

Understanding of Structural Analysis, Mechanics of Materials, Construction Materials and Reinforced Concrete Design.

3. Objective of Syllabus:

- Learn various prestressing techniques and their applications in structural design. •

Develop skills to analyze prestressed concrete members and systems.

- Understand and apply relevant design codes and standards.
- Explore innovative applications and recent advancements in prestressed concrete technology.

4. Course Outcome:

S. No.	Course Outcomes (Cos)
CO1	To learn the concepts of pre-stressing in concrete structures as well an able to formulate losses in prestressed concrete.
CO2	To understand behavior of prestressed continuous beams and able to design flexure member by using code provision for given conditions.
CO3	To understand behavior of prestressed flexure members and able to design flexure member by using code provision for given conditions.
CO4	To understand concepts of transmission length, bond, bearing and shear stress in prestressed members as well as able to design of prestress member for bond, bearing and shear requirement.

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CO5	To understand the behavior and design concept of full and partial prestressed slab members and able to design member for given requirements by following the guideline of Indian codes.

5. Syllabus:

UNIT I: Prestressing Systems and Losses of Prestressing

Introduction, various systems of prestressing, Types of loses and their analysis. Working Stress Design of Simple Beams: Critical load conditions: allowable stresses, Flexural design criteria; axially prestressed members; design of prestressing cable for a given cress-section; design procedure based on flexure, design by load balancing method and multiple stage prestressing.

UNIT II: Continuous Beams

Analysis of two span beam analysis of two span beam with eccentricities at outer supports; continuous beams with variable section design of continuous beam. Miscellaneous Structural Members: Compression Members: Columns subjected to combines bending and axial force, piles, poles, piers and abutments, Tension members-tie members, ring beams circular tanks and pipes pavement- sleepers, roads and runways.

UNIT III: **Limit State Design of Beams**

Limit state of strength in flexure, shear and torsion; permissible stresses limit state of serviceability against deflection, cracking and durability; design of simply supported and continuous beams.

UNIT IV: Bond and Anchorage of Prestressing cables

Bond in pre-tensioned and post- tensioned construction prestressing cable at Centroid axis; symmetric multiple cables causing axial thrust; cable with eccentricity; inclined prestressing cable, spanning stresses, end zone reinforcement.

UNIT V: STRUCTURE & POINTERS

One way slab tow way slabs, prestressed concrete beam slab construction; prestressed flat slab. Deflection and Crack Width: Factors influencing deflection, short term deflections of uncracked members, long term deflection deflections of cracked members, estimation of crack width using British code and FIP recommendations.

TEXTBOOKS / REFERENCES

1. N. Krishna Raju, Prestressd Concrete, Tata Mc Graw Hill Book Co.
2. P. Dayaratan, Prestressed Concrete Structures, Oxford & IBH CO., Delhi.
3. Jain & Jai Krishna, Plain & Reinforced Concrete Vol-II, Nem Chand & Bros, Roorkee.
4. IS 1343-1980 Code of Practice for Prestressed Concrete Bureau of Indian Standards New Delhi?

Additional Learning Sources: -

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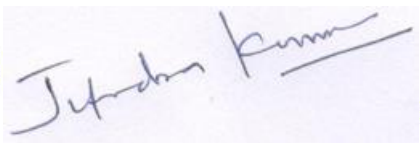
1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. IES Master postal study material.



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Programme Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1204
Course Name	Non-Destructive Testing of materials
Course Credits	3 (L) + 2 (P) = 5
Total Course Credit	

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview:**

The course typically covers a range of techniques and methodologies used to evaluate the properties of a material, component, or system without causing damage. This comprehensive overview ensures that students gain both theoretical knowledge and practical skills in Non-Destructive Testing, preparing them for careers in quality assurance, safety, and maintenance across various industries.

2. **Prerequisite:**

Basic understanding of materials science, physics, mathematics, and engineering principles, along with safety and laboratory skills.

3. **Objective of the Syllabus:**

To provide a basic understanding with the various non-destructive techniques and case studies on different members and apply them for inspecting materials in accordance with industry specifications and standards. Gain comprehensive knowledge of common NDT methods such as Visual Inspection (VI), Ultrasonic Testing (UT), Radiographic Testing (RT), Magnetic Particle Testing (MT), Eddy Current Testing (ET), and Liquid Penetrant Testing (PT).

4. **Course Outcomes:**

S.No.	Course Outcomes (Cos)
CO1	Apply the various NDT techniques to identify the defects.
CO2	Select the suitable NDT techniques for various defects.
CO3	Identifying the nature and quantifying the defects.
CO4	Understand the instruments and interpretation on techniques.

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CO5	Familiar with different applications of NDT.

5. Syllabus:

UNIT I Materials & Testing
Types of materials and tests.

UNIT II Variables of NDT
The variables involved destructive and non-destructive testing; correlation of properties obtained by NDT with the basic structure of matter.

UNIT III Other properties
NDT of different materials by various techniques such as radiographic, sonic and ultrasonic, electrical and magnetic.

UNIT IV Types of NDT
Oscilloscopic, microwave, eddy current penetration, thermal optical, holographic.

UNIT V Applications of NDT
Practical applications and advances in NDT.

BOOKS AND REFERENCES
Text Books

1. J.F. Hinslay, Non-Destructive Testing, MacDonald and Evants
2. H.B. Egerton, Non-Destructive Testing, Oxford University Press,
3. Krautkramer: Ultrasonic Testing of Materials, Springer Verlag,
4. M.A. Novgoresky, Testing of Building Materials and Structures, Mir Pub.
5. America Society of Metals: Handbook, Vol-II Destructive Inspection and Quality Control

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. IES Master postal study material.
4. Made easy hand book.
5. Lab manual - KKU

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Non-Destructive Testing of materials **SUB-CODE: EMST1204P** **CREDIT: 02**

Syllabus:

Week 1 Maturity test of Concrete.

Week 2 Pull out test on Hardened concrete.

Week 3 Ultra sonic test on Hardened concrete.

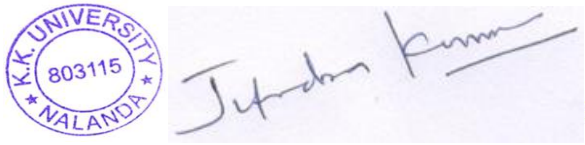
Week 4 Rebound Hammer test on Hardened concrete.

Week 5 Eddy Current Testing (ET) demonstration.

BOOKS AND REFERENCES

Text Books

1. Non-Destructive Evaluation of Materials" by J. Prasad and C. G. Krishnadas Nair.
2. "Practical Non-Destructive Testing" by Baldev Raj, T. Jayakumar, and M. Thavasimuthu.
3. Web links to e-learning: NPTEL.
4. Web links to e-learning: NCTEL.
5. Lab manual – KKU



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Programme Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1205
Course Name	Advanced Construction Materials and Concrete Technology
Course Credits	3 (L) + 2 (P)=5
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1. **Course Overview**:

This course explores the latest advancements in construction materials and concrete technology. It provides an in-depth understanding of innovative materials, their properties, applications, and the latest techniques in concrete technology. Students will learn about sustainability, durability, and the performance of various construction materials in modern construction projects.

2. **Prerequisite:**

A foundational course in materials science and basic concrete technology.

3. **Objective of the Syllabus**

- Gain knowledge about innovative materials like high-performance concrete, self-healing concrete, fiber-reinforced polymers, and more.
- Learn about the latest technologies and techniques in concrete production, placing, curing, and testing.
- Explore sustainable construction practices, including the use of recycled materials and green building techniques.
- Analyze real-world applications and case studies to understand the practical aspects of using advanced materials in construction projects.

4. **Course Outcomes:**

S.No.	Course Outcomes (Cos)
CO1	Will be able to study the physical properties like strength, durability, thermal effect, effect of chemicals, fire resistance and Radiation.

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CO2	Able to know about Thermo-plastic, Polymer concrete, Composite materials, Ferro cement, Building materials from Agricultural & Industrial wastes.
CO3	Ability to know about various steps of manufacture of concrete e.g. Mixing, Transportation, placing, compacting and curing. Properties of fresh concrete, Properties of hardened concrete.
CO4	Will be able to understand Admixture in concrete, Mix Design, Non-Destructive Testing of concrete.
CO5	Will be able to understand concrete at low & high temperature. Air entrained concrete, high performance concrete, Light weight and no fine concrete, Polymer concrete.

5.Syllabus:

UNIT I: Construction materials
physical properties like strength, durability, thermal effect, sound Insulation Environmental Influences: Thermal effects, Effect of Chemicals, Fire resistance, Corrosion and Oxidation, Radiation.

UNIT II: New construction materials
Thermo - Plastic, Polymer Concrete, Composite materials, Ferro cement, Building materials from Agricultural & Industrial wastes.

UNIT III: Cement & its properties
Detail of various steps of manufacture of concrete e.g. Mixing, transportation, placing, compacting and curing. Properties of fresh concrete, Properties of hardened concrete, strength characteristic, shrinkage, creep, durability, fattier.

UNIT IV: Permeability & durability of concrete
Admixtures in concrete, Mix Design, Non destructive Testing of Concrete.

UNIT V: Properties, Design and production of high strength and special concretes
Concrete at low & high temp. Air entrained concrete, high performance concrete. Light weight and no fine concrete, Ferro concrete, fiber reinforced concrete, Polymer concrete.

TEXT BOOKS:

1. Neville A.M., Properties of Concrete, ELBS, 4th Edition, Longman Ltd., London
2. Gambhir M.L., Concrete Technology, Tata Mc Graw Hill Book Co.
3. Peurifoy R.L., Construction Planning Equipment & Methods, TMH
4. Verma Mahesh, Construction Equipments and its Planning & Application, Metropoliton Book Company New Delhi.

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Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. IES Master postal study material.
4. Made easy hand book.

Advanced Construction Materials and Concrete Technology

SUB-CODE: EMST1205P CREDIT**: 02**

Syllabus:

List of Experiments: -

1. To determine the fineness of cement.
2. To determine the normal consistency of cement.
3. To determine the initial and final setting time of cement.
4. To determine compressive strength of cement.
5. To determine tensile strength of cement.
6. To determine the soundness of cement
7. To determine the fineness modulus of fine aggregate & coarse aggregate
8. Determining workability of concrete.
9. Compressing strength of concrete cube.
10. To determine the Workability of concrete by-
    - Slump cone test
    - Compaction factor
    - Vee Bee test

BOOKS AND REFERENCES

Text Books

1. Gambhir M.L., Concrete Technology, Tata Mc Graw Hill Book Co.
2. Laboratory Manual on Concrete Technology" by M. L. Gambhir.
3. Concrete Technology Lab Manual" by B.L. Gupta and Amit Gupta.
4. Web links to e-learning: NCTEL.
5. Lab manual – KKU

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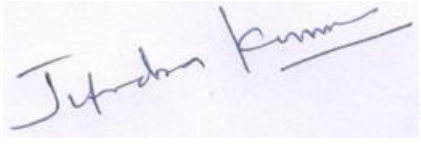

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Programme Structure	M. Tech in Structural Engineering
Semester	2nd
Subject Code	EMST1206
Course Name	Design of steel Structures
Course Credits	3(L)+ 2(P)= 5
Total Course Credit	90

Abbreviations: L-Lecture, T- Tutorial, P-Practical

1) **Course Overview:** This course focuses on the principles and methods used in the design of steel structures. It covers the fundamental concepts, design criteria, and practical techniques required for designing steel components and systems in compliance with relevant standards and codes. The course also emphasizes structural analysis, material behavior, and the integration of design with safety and serviceability considerations.

2) **Prerequisite:** A solid understanding of structural analysis and basic principles of mechanics, along with proficiency in engineering mathematics.

3) **Objectives of the Syllabus:** The course aims at learning of the design of steel structures and their utility depending on the requirement of the project. This course prepares students to tackle the challenges of designing safe, efficient, and innovative steel structures, equipping them with the knowledge and skills necessary for successful careers in structural engineering.

4) Course Outcomes: On successful completion of this course, the student will be able to

SL No.	Course Outcomes (Cos)
CO1	Understand material behavior, recognize various design philosophies in Steel structures and use limit state concepts to design general and eccentric connections in steel structures.
CO2	Use limit state method to design compression members with battened and laced column.
CO3	Understand plastic theory and analysis of structure and use limit state method to design beams in steel structures.
CO4	Analyze and design for buckling and stability issues in steel columns, including both global and local buckling considerations.

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CO5	To understand and design the steel beams subjected to Torsion and Bending

5) Syllabus:

UNIT I: Introduction to Limit States

Introduction, Standardization, allowable stress design, limit state design, partial safety factors, concept of section, classification; Plastic, compact semi- compact & slender.

UNIT II: Columns

Basic concepts, strength curve for an ideal strut, strength of column members in practice effect of eccentricity of applied loading. Effect of residual stresses, concept of effective lengths, no sway columns, torsional and torsion flexural buckling of columns, Robertson's de sign curve, modification to Robertson approach, design of columns using Robertson approach.

UNIT III: Laterally Restrained Beams

Flexural & shear behavior, web buckling & web crippling, effect of local buckling in laterally restrained plastic' or 'compact' beams, combined bending & shear, unsymmetrical bending. Unrestrained Beams: Similarity of column buckling of beams, lateral torsional buckling of symmetric section, factors affecting lateral stability, buckling of real beams design of cantilever beams, continuous beams.

UNIT IV: Beams Columns

Short & long beam columns, effects of slenderness ratio and axial force on modes of failure, beam column under biaxial bending, strength of beam columns, local section failure & overall member failure.

UNIT V: Beams Subjected to Torsion and Bending

Introduction, pure torsion and warping, combined bending torsion, capacity check, buckling check, design methods for lateral torsional buckling.

Suggested Reading: -

1. Morsis L.J. Plum, D.R., Structural Steel Work Design
2. Sinha D.A., Design of Steel Structures
3. Yu, W.W., Cold Formed Steel Structures Design
4. Design of Steel Structures" by N. Subramanian.
5. Limit State Design of Steel Structures" by S.K. Duggal.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.
3. IES Master postal study material.

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4. Made easy hand book.
5. Lab manual - KKU

Advanced Construction Materials and Concrete Technology

SUB-CODE: EMST1206P CREDIT**: 02**

Syllabus:

List of Experiments: -

1. Drawing of Steel Connections in Different Configurations.
2. Sectional Drawings and Details of Steel Members.
3. Preparation of Steel Fabrication Drawings.
4. Presentation of Steel Structure Drawings
5. Steel Structure Drafting Using CAD Software.
6. Presentation of Steel Structure Drawings.

BOOKS AND REFERENCES

Text Books

1. Structural Steelwork: Design to Limit State Theory" by Dennis Lam, Thien Cheong Ang, and Sing-Ping Chiew
2. Steel Structures: Design and Behavior" by Charles G. Salmon, John E. Johnson, and Faris A. Malhas.
3. Structural Steel Drafting and Design" by David MacLaughlin and Hector Estrada.
4. Web links to e-learning: NCTEL.
5. Lab manual – KKU

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Semester-III

Programme Structure	**M. Tech in Structural Engineering**
Semester	**3rd**
Subject Code	**EMST2101A**
Course Name	**Design of Earthquake Resistant Structures**
Course Credits	**3 (L) + 1 (T) = 4**
Total Course Credit	**172**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:

This course focuses on the principles, methods, and techniques used in the design of structures to resist earthquake forces. It covers seismic hazard assessment, structural dynamics, and seismic design codes. Emphasis is placed on understanding the behavior of structures under earthquake loading and applying advanced analysis and design approaches to ensure structural safety and resilience.

2.Prerequisite: Basic courses in the design of reinforced concrete and steel structures, covering design principles, codes, and standards.

3.Objective of the Syllabus:

The design of Earthquake Resistant Structures course is to equip students with a comprehensive understanding of seismic hazards and the behavior of structures under earthquake loading. Students will master the principles of structural dynamics, including natural frequencies, modes of vibration, and dynamic response analysis techniques such as response spectrum and time history analysis. They will learn to apply seismic design codes and standards, ensuring compliance with regulatory requirements and best practices in seismic design.

4.Course Outcomes:

S. No.	Course Outcomes (Cos)
CO1	Implement retrofitting techniques to enhance the seismic performance of existing structures.
CO2	Develop a comprehensive understanding of seismic design principles and practices.

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CO3	Study the behavior of different types of structures under earthquake forces, including ductility, strength, and stiffness considerations.
CO4	Analyze and evaluate the behavior of structures special structures under seismic forces.
CO5	Understand the principles of earthquake engineering, including seismicity, ground motion characteristics, and seismic hazard assessment.

5.Syllabus:

Unit I Seismic strengthening of Existing Buildings
Case history, Learning from earthquake, seismic Strengthening procedures.

Unit II Torsion & Rigidity
Rigid Diaphragms, Torsional moment, Center of mass and center of rigidity torsion effects. Lateral Analysis of Building Systems: Lateral load distribution with rigid floor diaphragms, moment resisting frames, shear walls, lateral stiffness of shear walls, shear wall-frame combination, examples.

Unit III Concept of Earthquake Resistant Design
Objectives of seismic design, Ductility, Hysteric response & energy dissipation, response modifications factor, design spectrum, capacity design,
classification of structural system, IS code provisions for seismic design of structures, multi-storied buildings, design criteria, P-A effects, storey drift, design examples ductile detailing of RCC structures.

Unit IV Seismic Design of Special Structures
Elevated liquid storage tanks, Hydrodynamic pressure in tanks, stack like structures, IS-1893 code provisions for bridges; Superstructures, sub- structures, submersible bridges, dams; Hydrodynamic effect due to reservoir, concrete gravity dams.

Unit V Engineering Seismology
Basic terms, seismic waves, earthquake magnitude and intensity, ground motion, dynamic response of structures, normalized response spectra, seismic coefficients and seismic zone coefficients.

BOOKS AND REFERENCES

Text Books

1. Chopra A.K., Dynamic s of Structures', Theory & Applications to Earthquake Engineering, Prentice Hall India, New Delhi
2. Clough & Penzien, Dynamics of Structures, McGraw Hill Book CO. Inc.
3. Pankaj Agarwal & Manish Shrikhande, “Earthquake Resistant Design of Structures”, Prentice Hall of India, New Delhi.
4. Paz, M, International Handbook of Earthquake Engineering, Chapman & Hall, New York.
5. IS-1893-1984, Indian Standard Criteria for Earthquake Resistant Design of Structures, B.I.S., New Delhi.

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6. IS-4326-1993, Indian Standard Code of Practice for Earthquake Resistant Design and Construction of Buildings, B.I.S., New Delhi.

Reference Books

1. S. K. Duggal, "Earthquake Resistant Design of Structures", Oxford university Press.
2. S. R. Damodarasamy and S. Kavitha, "Basics of Structural Dynamics and Aseismic Design", Prentice Hall of India, New Delhi.

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Programme Structure	M. Tech in Structural Engineering
Semester	3rd
Subject Code	EMST2101B
Course Name	Stability Theory in Structural Engineering
Course Credits	3 (L) + 1(T) = 4
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:

Stability Theory in Structural Engineering focuses on the fundamental concepts and methods related to the stability of structures. The course covers the theoretical aspects of stability, different types of instability phenomena, and practical applications in structural design. Emphasis is placed on understanding the behavior of structures under various loading conditions and developing skills to analyze and design stable structures.

2. Prerequisite:

Students should have completed introductory courses in geology, earth sciences, or geological engineering to understand fundamental geological concepts such as rock types, geological processes, and the geological timescale.

3.Objective of the Syllabus:

The course will cover the stability of columns, beams, frames, and complex structures such as multi-story buildings and bridges, emphasizing the effects of imperfections and non-linearities. Practical applications of stability theory will be explored, utilizing computer software for analysis and design. Students will appreciate the importance of stability in ensuring the safety and reliability of structures and learn to design stable structures under diverse conditions. The course will also keep students informed about current research and emerging trends, fostering the ability to critically evaluate recent advancements.

4.Course Outcomes:

S. No.	Course Outcomes (Cos)

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CO1	To understand and apply fundamental stability principles to analyze and ensure the stability of various structural systems.
CO2	To identify, analyze, and calculate buckling behavior in structural elements under various loading conditions.
CO3	To understand, analyze, and mitigate lateral instability in structural elements and systems.
CO4	To analyze and design thin plates to withstand buckling under diverse loading conditions, utilizing advanced mathematical techniques and practical engineering principles.
CO5	To apply energy principles and matrix algebra to efficiently analyze and solve complex structural problems, enhancing their capability in structural design and optimization

5.Syllabus:

UNIT-I Concepts of Stability

Euler Buckling Load, Critical Load of Laced, Battened and Tapped columns, Inelastic Buckling of column.

UNIT -II Concepts of Buckling

Fundamentals of mineralogy Study of common rock form minerals Ores and minerals of economic importance to civil engineering Elements of crystallography and introduction to crystal systems.

UNIT –III Concepts of Lateral Instability

Lateral Instability of Beams, Beam Columns.

UNIT –IV Concepts of Buckling of Plates

Local Buckling and post buckling behavior of plates.

UNIT –V Energy method and matrix method

Application of Energy method and matrix method in stability problems.

BOOKS AND REFERENCES

Text books/References:

1. Theory of Elastic Stability by Timoshenko, TMH Pub.

2. Structural Stability of Steel: Concepts and Applications for Structural Engineers" by Theodore V. Galambos, Andrea E. Surovek.

3. Structural Analysis: A Unified Classical and Matrix Approach" by Amin Ghali, Adam M. Neville, Tom G. Brown.

5. Advanced Structural Analysis" by Devdas Menon

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Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

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Programme Structure	**M. Tech in Structural Engineering**
Semester	**3rd**
Subject Code	**EMST2101C**
Course Name	**Design of Tall Structures**
Course Credits	**3 (L)+ 1(P) = 4**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:
This course provides a comprehensive examination of the design principles, analysis methods, and construction techniques essential for the engineering of tall buildings and skyscrapers. It is structured to equip students with the theoretical knowledge and practical skills required to address the unique challenges presented by tall structures, including stability, strength, and serviceability.

2.Prerequisite: Understanding of basic and advanced concepts in structural analysis, including the analysis of beams, frames, and trusses.

3.Objective of the Syllabus:

The course aims to equip students with comprehensive knowledge and skills necessary for the successful design and analysis of high-rise structures. Students will delve into various structural systems utilized in tall buildings, gaining an understanding of their advantages and limitations. They will learn to conduct rigorous load analyses, considering dead loads, live loads, wind loads, and seismic forces, and apply this knowledge to ensure structural stability and safety.

4.Course Outcomes:

S. No.	Course Outcomes (Cos)
CO1	Understand the unique challenges and considerations in the design of tall structures.

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CO2	To analyze and design structures to effectively withstand wind and earthquake forces, ensuring safety and stability.
CO3	To analyze and design shear walls and tubular structures, optimizing their use in enhancing the lateral stability and overall performance of buildings under various loads.
CO4	To design, analyze, and evaluate the performance of chimneys and other tall structures, considering factors such as wind and seismic loads, to ensure structural integrity and safety.
CO5	To develop accurate and efficient computational models for analyzing and designing tall buildings.

5.Syllabus:

UNIT –I Tall structures

Behavior of tall structures under static and dynamic loads, model analysis.

UNIT –II Wind and Earthquake Forces

Characteristics of Wind and Earthquake Forces. Gust Factor and Karman Vortices. Approximate and Regorlons Methods of analysis for wind and Earthquake Forces.

UNIT –III Shear walls & Tabular Structures

Shear walls, Frame Structures, Coupled shear walls, Tabular Structures, Ductility and reinforcement details at joint.

UNIT –IV Design of Chimneys & other Tall Structure

Criteria for design of Chimneys, T.V. Towers and other Tall Structure.

UNIT –V Modeling of tall structures

Modeling and case studies.

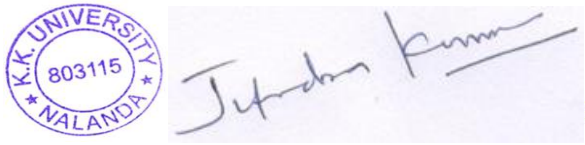
Text books/References:

1. Bryan Stafford Smith and Alex Coull, “Tall Building Structures - Analysis and Design”, John Wiley and Sons, Inc., 1991.

2. S.N. Manohar, “Tall Chimneys: Design and Construction”, McGraw-Hill, 1988.

3. Taranath B.S, “Structural Analysis and Design of Tall Buildings”, McGraw-Hill, 1988

4. Design of Reinforced Concrete Structures by Pillai and Devdas Menon.



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5. Pankaj Agarwal and Manish Shrikhande, Earthquake Resistant Design of Structures, 9th edition, PHI Learning Private Limited,New Delhi, 2011.

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Elective-II

Programme Structure	**M. Tech in Structural Engineering**
Semester	**3rd**
Subject Code	**EMST2102A**
Course Name	**Design of Offshore Structures**
Course Credits	**3 (L)+1(T) = 4**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:

Design of Offshore Structures typically covers various aspects related to the engineering and construction of structures used in offshore environments, primarily for oil and gas exploration, renewable energy, and marine infrastructure.

2.Prerequisite: Understanding in relevant engineering principles and mathematics.

3.Objective of the Syllabus:

These objectives collectively aim to equip students with a comprehensive understanding and practical skills necessary to contribute effectively to the design and development of offshore structures in various industries. To design various offshore structures and study their behavior under different types of loading.

4.Course Outcomes:

S. No.	**Course Outcomes (Cos)**
CO1	a comprehensive understanding of the environmental loads and structural forms inherent to various offshore structures.
CO2	analyzing structural responses to varying loads, for both transient (dynamic) and steady-state (static) conditions.

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CO3	to calculate the response of structures to transient loads such as earthquakes and dynamic forces, employing numerical methods and software tools to ensure accurate and efficient analysis.
CO4	to analyze the static and dynamic behavior of concrete gravity platforms as rigid bodies resting on the seabed.
CO5	To calculate wind and wave loads on offshore structures according to relevant codes and standards.

5.Syllabus:

UNIT –I Loads and Structural Forms of Different Types of Offshore Structures
Elements of single d.o.f. system subjected to free and forced vibration.

UNIT –II Analysis for Transient and Steady State Force
Equivalent damping for nonlinear systems; Dynamics of multi d.o.f. systems; Eigen values and vectors; Iterative and transformation methods.

UNIT –III Mode Superposition
Fourier series and spectral method for response of single d.o.f. systems; Vibrations of bars, beams and cones with reference to soil as half space.

UNIT –IV- Behavior of Concrete Gravity Platform as a Rigid Body on Soil as a Continuum
Short- and long-term statistics of wind.

UNIT –V Static Wind Load
Effect of size, shape and frequency; Aerodynamic admittance function and gust factor, spectral response due to wind for various types of structures; Wave loads by Morison's equation; Static and dynamic analysis of fixed structures; Use of approximate methods.
BOOKS AND REFERENCES

Text books/References:

1. Brebbia C.A. Walker, Dynamic Analysis of Offshore Str., Newnes Butterworth
2. Sarpakaya T and Isaacson M., Mechanics of wave forces on offshore structures, Van Nostrand Reinhold New York,
3. Hallam M.G. Heaf N.J. and Wootton, L.R., Dynamics of Marine Structures, CIRIA Publications Underwater Engg., Group, London

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4. Graff W.J., Introduction to offshore Structures, Gulf Publishing Co., Houston, Taxas
5. Clough R.W. and Penzine J., Dynamic of Structures - II Ed., McGraw Hill Book CO.
6. Simiu E. and Scanlan R.H., Wind Effects on Structures, Wiley, New York 1978
7. Codes of Practice (latest versions), Such as API RP-2A, Bureau Veritas etc.
8. Proceedings of Offshore Technology Conference (OTC) Behavior of Offshore Structures (BOSS) and Other Conferences on offshore Engineering.

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

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Programme Structure	M. Tech in Structural Engineering
Semester	3rd
Subject Code	EMST2102B
Course Name	Reliability Based Civil Engineering Design
Course Credits	3 (T) + 1(P)= 4
Total Course Credit	90

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:

The civil engineering community, and structural engineers in particular, have long recognized the important role played by variability and incomplete information in their profession: (i) random system properties, (ii) unpredictable future loads and strength deterioration, (iii) human errors, and (iv) imperfect mathematical models. Ensuring adequate safety and reliability for all stakeholders in the presence of these uncertainties is therefore a central objective of design analysis and assessment of structural systems. This course aims to give the students the ability to model uncertainties and manage risks in civil engineering activities in a way that best serves the interests of society.

2.Prerequisite: Must have completed at least 2nd year UG curriculum in engineering with course(s) in Engineering Mechanics Must have taken courses in probability & statistics, linear algebra and basic calculus.

3.Objective of the Syllabus:

- Reinforce your knowledge of probability and statistics
- Learn how to quantify reliability and safety in civil engineering applications
- Learn how design specifications are based on reliability theory

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- Learn to simulate random variables and vectors
- Perform reliability-based design of a civil engineering system of your choice

4.Course Outcomes:

S. No.	Course Outcomes (Cos)
CO1	Identify the uses Reliability assessment techniques in civil engineering
CO2	Describe different techniques and procedure of Reliability techniques in civil engineering.
CO3	Use Reliability assessment techniques to identify where significant contributors of uncertainty occur in structural systems or where further research, testing and quality control could increase the safety and efficiency of the structure.
CO4	To apply probabilistic methods to enhance the reliability and safety of civil engineering structures
CO5	To assess the potential for failure and designing systems with adequate safety margins to ensure performance within acceptable limits of risk.

5.Syllabus:

Unit I Probability Theory

Mutually exclusive events, set theory, sample points and sample space, laws of probability, total probability theorem, Bays rule, random variables discreate and continuous, jointly distributed discrete variables, marginal distribution, conditional distribution, jointly distributed continuous variables functions of random variables, moments and expectations, common probability distribution normal Lognormal, Gamma and Beta distributions, external distributions.

Unit II Resistance Distribution and Parameters

Statics of properties of concrete and steel, statics of strength of bricks and mortar, Characterization of variables, allowable stresses based on specified reliability. Probabilistic Analysis of loads: Load as a stochastic process, dead load, statistical analysis of live loads-maximum sustained load intensity model, maximum total load model, wind load probability model for wind load.

Unit III Structural Reliability

Genera l expression for reliability, expression for probability of failure: reliability when strength (S) and load (L) follow normal distribution, lognormal distribution, exponential distribution, extreme value distributions, factor of safety corresponding to a give n reliability. Monte Carlo Study of Reliability: Monte Carlo Method-Inverse transformation technique, Application to columns beams and frames. Level 2 Reliability Method: Basic variables and failure surface, first order second moment methods-Hasofer and linds method, non-normal

distributions; determination of reliability index of structural elements.

Unit IV Reliability Based Design
Determination of partial safety checking formats, development of reliability-based criteria, optimal safety factors, calibration of IS 456 and IS 800.

Unit V Reliability of Structural Systems
System reliability, modeling of structural systems, bounds on system reliability, automatic generation of a mechanism, generation of dominant mechanisms, reliability analysis of R.C.C. and Steel Frames.

BOOKS AND REFERENCES
Text Books

1. Reliability analysis by R. Ranganathan, Jaico Publishing house.

2. Reliability of Structures by A S Nowak, K Collins, McGraw-Hill

3. Probability, Reliability and Statistical Methods in Engineering Design by Achintya Haldar and Sankaran Mahadevan, John Wiley & Sons, Inc.

4. Reliability Engineering and Risk Analysis by Mohammad Modarres, Mark Kaminskiy and Vasiliy Krivtsov, Marcel Dekker, Inc

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL.

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Programme Structure	**M. Tech in Structural Engineering**
Semester	**3rd**
Subject Code	**EMST2102C**
Course Name	**Advanced FEM and programming**
Course Credits	**3 (L) + 1(P)= 4**
Total Course Credit	**90**

Abbreviations: L-Lecture, P-Practical, T- Tutorial

1.Course Overview:

An Advanced Finite Element Method (FEM) and Programming course typically delves into sophisticated techniques for numerical modeling and analysis of complex engineering problems using computational tools.

2.Prerequisite: Prerequisites typically include proficiency in basic finite element method (FEM) concepts and programming fundamentals. Familiarity with numerical methods, linear algebra, and programming languages such as Python or MATLAB is recommended.

3.Objective of the Syllabus:

The finite element method is a numerical analysis technique for obtaining approximate solutions to a wide variety of engineering problems. This course covers the application of the finite element method to solve problems in the areas of structural engineering using different software and programming language.

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4.Course Outcomes:

S. No.	Course Outcomes (Cos)
CO1	students will be proficient in applying iso-parametric formulation techniques to accurately model and analyze plate and shell structures in engineering simulations.
CO2	To analyze the application of FEM for dynamic problems, including the implementation of consistent mass matrices for accurate simulation of structural dynamics.
CO3	To analyze and predict buckling behavior in structural systems, enhancing their understanding of stability and design optimization.
CO4	To model complex engineering systems using the Finite Element Method (FEM), encompassing both theoretical understanding and practical application.
CO5	A comprehensive understanding of computational aspects crucial for advanced engineering simulations, including numerical methods, algorithm implementation, and software utilization

5.Syllabus:

UNIT –I Iso-parametric formulation for plate and shell elements

Various types of elements; Hybrid elements.

UNIT –II FEM in dynamic problems, consistent mass matrix

Vibration of bars, beams and plate elements.

UNIT –III FEM in buckling problems

Geometric matrix, buckling of struts and plate elements.

UNIT –IV Modeling by FEM

Structural modeling by FEM for structures such as shear walls, core walls, bridges and cooling towers.

UNIT –V Computational aspects

Interpretation of results; comparison with other methods.

BOOKS AND REFERENCES:

Suggested Reading: -

1. Weaver, Johnson, Finite element and structural analysis
2. H. C Martin, Matrix structural analysis
3. C.F. Abel, C.S. Desai, Finite element methods, CBS Publishers New Delhi

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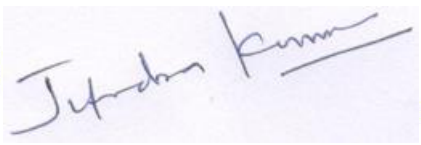
4. Buchanan, Finite element Analysis (Schaum Outline S), Tata McGraw Hill
5. Krishnamurthy, Finite element analysis, Tata McGraw Hill
6. Zinkiewicz, O.C. and Taylor, R.L., the Finite Element Method, McGraw-Hill
7. Reddy, J. N., an Introduction to Finite Element Method, McGraw-Hill, Singapore

Additional Learning Sources: -

1. Web links to e-learning: NPTEL.
2. Web links to e-learning: NCTEL



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