NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

M.Tech

SEM: II - THEORY EXAMINATION (2023 - 2024)

Subject: Advanced Finite Element Analysis

Time: 3 Hours   **Max. Marks: 70**

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. *This Question paper comprises of **three Sections -A, B, & C.** It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

2. *Maximum marks for each question are indicated on right -hand side of each question.*

3. *Illustrate your answers with neat sketches wherever necessary.*

4. *Assume suitable data if necessary.*

5. *Preferably, write the answers in sequential order.*

6. *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*

<div align="center">

SECTION A   **15**

</div>

1. Attempt all parts:-

1-a.   Which method is commonly used for formulating FEM mathematically? (CO1)   1

       (a) Variational and Weighted residual approaches

       (b) Differential equations

       (c) Algebraic equations

       (d) Geometric equations

1-b.   Which property of materials is considered in plate bending problems with   1
anisotropic materials using FEM? (CO2)

       (a) Directional stiffness

       (b) Isotropic conductivity

       (c) Uniform density

       (d) Homogeneous elasticity

1-c.   What is the primary purpose of idealizing stiffness in beam elements for beam-   1
slab problems? (CO3)

       (a) To simplify structural analysis

        (b) To increase computational accuracy

        (c) To account for material nonlinearity

        (d) To enhance graphical visualization

1-d.	In mesh generation through computer graphics, what is the primary objective? (CO4)	1

        (a) To discretize the domain into finite elements

        (b) To optimize computational efficiency

        (c) To create graphical user interfaces

        (d) To validate numerical techniques

1-e.	Which statement best describes the role of Finite Element Method in CAD software? (CO5)	1

        (a) Provides numerical solutions to engineering problems

        (b) Only applicable to specific design tasks

        (c) Reduces design flexibility

        (d) Increases computational complexity

2. Attempt all parts:-

2.a.	What are the advantages of Finite Element Method (FEM)? (CO1)	2
2.b.	What are the key differences between plane stress and plane strain problems in Finite Element Analysis? (CO2)	2
2.c.	What are the limitation of idealized stiffness in beam elements? (CO3)	2
2.d.	Explain the process of mesh generation through computer graphics. (CO4)	2
2.e.	What factors should be considered when selecting a commercial FEM package for CAD applications? (CO5)	2

<div align="center">

SECTION B   **20**

</div>

3. Answer any <u>five</u> of the following:-

3-a.	Explain how the natural coordinate system simplifies computations in FEM. (CO1)	4
3-b.	Why is the convergence test essential in FEM analysis? Explain in brief. (CO1)	4
3-c.	What are the primary assumptions made in plane stress problems analyzed using Finite Element Method (FEM)? (CO2)	4
3-d.	Discuss the challenges associated with modeling 3D bodies using Finite Element Method (FEM). (CO2)	4
3.e.	Discuss the impact of simplifying structural geometry on computational efficiency. (CO3)	4

3.f. Discuss the steps involved in solution of numerical problem in for Finite Element Analysis. (CO4) 4

3.g. Describe the steps involved in solving existing complete designs using finite element analysis (FEA). (CO5) 4

## SECTION C 35

4. Answer any <u>one</u> of the following:-

4-a. Explore the importance of higher order elements in enhancing FEM analysis, considering their impact on solution accuracy, convergence, and computational efficiency in complex problems. (CO1) 7

4-b. Write short note on the following: (CO1) 7
(i) Weighted Residual Method
(ii) Variational Method

5. Answer any <u>one</u> of the following:-

5-a. Derive finite element formulation of one-dimensional heat conduction with convection. (CO2) 7

5-b. Explain the method of solving plate bending problems with isotropic materials with suitable example using FEM. (CO2) 7

6. Answer any <u>one</u> of the following:-

6-a. Discuss two advantages and two limitations of using idealized stiffness in beam elements for analyzing beam-slab problems. Evaluate how these advantages and limitations impact the accuracy and efficiency of structural analysis. (CO3) 7

6-b. For a beam as shown in figure, determine the displacement and slope at node 2. Also find the reaction forces and moment at node 1 and 3. Consider E = 210 GPa and I = 4 x 10^{-4} m^4. (CO3) 7
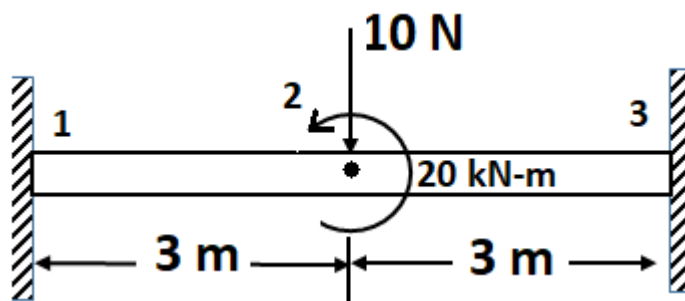
7. Answer any <u>one</u> of the following:-

7-a. Explain the steps involved in data preparation for Finite Element Analysis, including data organization, input parameter selection, and boundary condition specification. (CO4) 7

7-b. Discuss the role of collaboration and teamwork among team members in 7

optimizing the performance of Finite Element programming projects, emphasizing the benefits and challenges. (CO4)

8. Answer any <u>one</u> of the following:-

8-a.   Explain the process of finite element solution for existing complete designs, including pre-processing, analysis, and post-processing stages, and discuss the benefits of this approach over traditional methods. (CO5)   7

8-b.   What are the features are desirable in FEM packages for solving engineering problems? Also explain general purpose vs special purpose programs in FEM. (CO5)   7