QP Code: R262B009 | Reg. No | | | | | | | | | | | AY 25

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur (GIET University)

M.Tech. (Second Semester - Regular) Examinations, May – 2026

24MMTPE12002 – Finite Element Method

Time: 3 hrs | Maximum: 60 Marks

Answer ALL questions
(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions

		CO #	Blooms Level
a.	Briefly explain the general steps of the Finite Element Method (FEM) and highlight the purpose of each step in the analysis process.	CO1	K2
b.	Explain the process of deriving beam stiffness matrices.	CO2	K3
c.	How does the linear-strain approach improve accuracy in structural analysis? Briefly explain.	CO3	K4
d.	Define axisymmetric elements and their applications in engineering analysis.	CO4	K3
e.	Discuss the fundamental principles of plate bending analysis in the context of finite element methods.	CO3	K2

PART – B **(10 x 5 = 50 Marks)**

<u>Answer ***ALL*** the questions</u>

		Marks	CO #	Blooms Level
2. a.	Discuss how computers have revolutionized structural analysis. Highlight their impact on simulation, modeling, and design optimization.	5	CO1	K3
b.	Describe the evolution of computational methods in engineering analysis and their significance in modern design practices.	5	CO1	K2
	(OR)			
c.	Define the stiffness matrix in FEM. Explain its physical meaning and role in structural analysis.	5	CO2	K2
d.	Describe the FEM procedure from problem definition to result interpretation. Why is each step important?	5	CO1	K3
3.a.	Derive the stiffness matrix for a linear spring element and explain its physical significance.	5	CO2	K3
b.	Consider two spring elements connected in series. Formulate the global stiffness matrix using the superposition method.	5	CO2	K3
	(OR)			
c.	Derive the stiffness matrix for a bar element using shape functions and interpolation approach.	5	CO2	K3
d.	Formulate the global stiffness matrix for a two-element bar system and explain each step.	5	CO2	K3
4.a.	Explain the procedure for incorporating boundary conditions into the global stiffness matrix equation.	5	CO2	K3
b.	Two springs with stiffness k1=400N/m and k2 =200N/m are connected in series between two nodes. A force of 120N is applied at the free end. (a) Develop the global stiffness matrix	5	CO2	K3

	(b) Apply appropriate boundary conditions			
	(OR)			
c.	A linear spring element has stiffness k=500N/m. (a) Write the element stiffness matrix. (b) If nodal displacements are u1=0 and u2=0.02m, determine the nodal forces	5	CO2	K3
d.	Formulate the element stiffness matrix for a bar under axial loading in local coordinates.	5	CO2	K3
5.a.	Discuss the treatment of distributed body forces (such as gravity) and traction forces in plane strain conditions. How are these forces converted into equivalent nodal forces in FEM formulation?	5	CO3	K4
b.	Derive the expression for the load vector due to body forces and surface tractions in a 2D finite element.	5	CO3	K3
	(OR)			
c.	Describe the constant strain triangular (CST) element and explain why strain remains constant within the element.	5	CO3	K3
d.	Explain the advantages and limitations of using linear strain triangular elements in structural analysis.	5	CO3	K3
6.a.	Explain the concept of the parent (natural) domain in isoparametric finite elements. Why is it used in FEM formulation?	5	CO4	K4
b.	Discuss the importance of coordinate numbering and connectivity in assembling the global stiffness matrix for complex truss systems.	5	CO4	K3
	(OR)			
c.	Discuss the role of the Jacobian matrix in coordinate transformation and its significance in FEM.	5	CO4	K4
d.	Discuss the significance of linear strain triangular elements in finite element analysis.	5	CO4	K3

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