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BAE/BAS515A

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2026

Finite Element Method

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks, L: Bloom's level, C: Course outcomes.

Module – 1

Q.1	a.	Define Finite Element Method and illustrate the basic steps involved in FEM.	M	L	C
			10	L2	CO1
	b.	Discuss the plain stress and plain strain problems and their equations.	10	L2	CO1

OR

Q.2	a.	Define Discretisation process and explain considerations to be taken in the Discretisation process.	10	L2	CO1
	b.	Use Rayleigh – Ritz method to find the displacement at the midpoint of the rod shown in Fig Q2(b)	10	L2	CO1

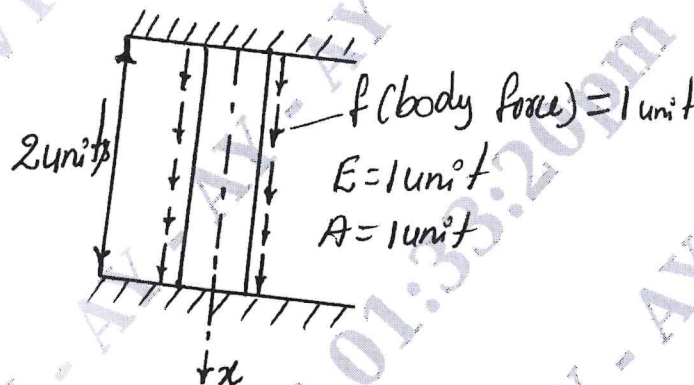


Fig Q2(b)

Module – 2

Q.3	a.	Define shape function and obtain the shape function of 1-D bar element in Global co-ordinate system.	10	L3	CO1
	b.	Determine the nodal displacement stress in each element and support reaction in the bar shown in Fig Q3(b), due to applied force $P = 100 \text{ kN}$. Take $E_{\text{steel}} = 200 \text{ GPa}$, $E_{\text{cu}} = 100 \text{ GPa}$.	10	L3	CO2

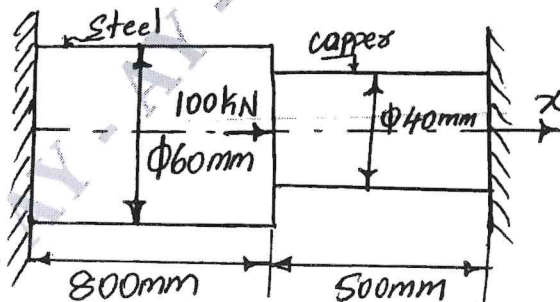


Fig Q3(b)

OR

Q.4	a. Derive elemental stiffness matrix for a bar element using minimum potential energy.	10	L3	CO2
	b. A truss shown in the Fig Q4(b). Determine the nodal displacement, element stresses, take $E = 210 \text{ GPa}$, $A = 600 \text{ mm}^2$ for each element. Fig Q4(b)	10	L3	CO2
Module – 3				
Q.5	a. Derive shape functions for CST element in natural coordinate system.	10	L3	CO2
	b. Obtain a 2-D rectangular element shape function in global coordinate system.	10	L3	CO2
OR				
Q.6	a. Derive shape function for nine noded rectangular elements.	10	L3	CO2
	b. Derive shape function of a 4-noded Tetrahedral element.	10	L3	CO2
Module – 4				
Q.7	a. Explain Isoparametric, subparametric and super parametric elements.	10	L2	CO3
	b. Illustrate the structure of computer program for FEM analysis.	10	L2	CO3
OR				
Q.8	a. Derive the shape function for axisymmetric elements (Triangular Element)	15	L3	CO3
	b. Explain Axisymmetric Formulation.	5	L2	CO3

Module – 5

Q.9	a.	Formulate the element conductivity matrix for one dimensional heat flow element.	10	L3	CO3
	b.	Determine the temperature distribution in the composite wall using 1D heat elements. Given : $K_1 = 25 \text{ W/m}^\circ \text{C}$, $K_2 = 35 \text{ W/m}^\circ \text{C}$, $K_3 = 55 \text{ W/m}^\circ \text{C}$, $h = 30 \text{ W/m}^2 \text{C}$, $T_\infty = 900^\circ \text{C}$, $A = \text{unit area}$.	10	L3	CO3
Diagram showing a composite wall with three layers of thermal conductivities k_1, k_2, and k_3. Each layer has a thickness of 0.2m. The wall is exposed to convection on both sides with heat transfer coefficient h and ambient temperature $T_0 = 25^\circ \text{C}$. Fig Q9(b)					
OR					
Q.10	a.	Explain the modes of heat transfer.	10	L3	CO3
	b.	Determine the temperature distribution of a rectangular fin as shown in Fig Q10(b). Assume steady state heat transfer and only conduction process. Take heat generated inside the fin as 500 W/m^3 .	10	L3	CO3
Diagram showing a rectangular fin with thermal conductivity $k = 600 \text{ W/m}^\circ \text{C}$, length 0.06m, and thickness 0.02m. The base temperature is 150°C. A cross-section shows width 0.04m and thickness 0.02m. Fig Q10(b)					
