Reg. No. | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2023

Seventh Semester

ME18701 – FINITE ELEMENT ANALYSIS

(Regulation 2018/2018A)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT
CO 1	The students will apply the principles involved in the finite element approach on mechanical systems
CO 2	The students will solve structural problems using 1D elements involving engineering applications
CO 3	The students will apply the concept of 2D plane elasticity and analyze the stresses in structural members
CO 4	The students will solve thermal and vibration problems using 1D elements
CO 5	The students will differentiate the shape functions and stiffness matrix for Isoperimetric elements

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	List out any four advantages of using Finite Element Analysis.	**1**	**1**
2.	List out the various weighted-residual methods.	**1**	**1**
3.	How will you identify the stress developed in a truss element?	**2**	**2**
4.	Write the stiffness matrix for a beam element of length "l".	**2**	**2**
5.	Define 'Plane stress' and 'Plane strain' with suitable example.	**3**	**1**
6.	Write down the stress-strain relationship matrix for plane stress condition.	**3**	**2**
7.	Differentiate consistent mass matrix and lumped mass matrix.	**4**	**1**
8.	Write the stiffness matrix for 1D heat conduction and convection.	**4**	**1**
9.	What is meant by super parametric and sub parametric element?	**5**	**1**
10.	What is the purpose of Gaussian quadrature?	**5**	**2**

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	Consider an object with the differential equation for a problem as $\frac{d^2y}{dx^2}+300x^2=0, \quad 0\le x\le 1$ With the boundary conditions y(0) = 0, y(1) = 0. Find the solution of the problem using trail function as $y=a_1x(1-x^3)$. Use any two methods and compare it based on the solution.	**(14)**	**1**	**3**

(OR)

(b)	Discuss about the general procedure in FEM for an industrial application..	**(14)**	**1**	**3**
12. (a)	Determine the nodal displacement, element stresses and support reactions of the axially loaded bar as shown in Figure 1. Take E = 200 GPa and P = 30 kN.	**(14)**	**2**	**3**

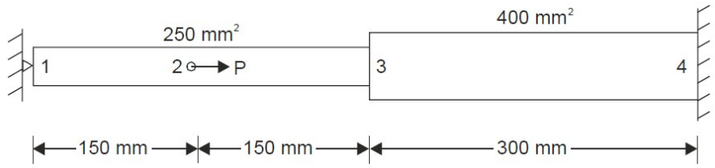
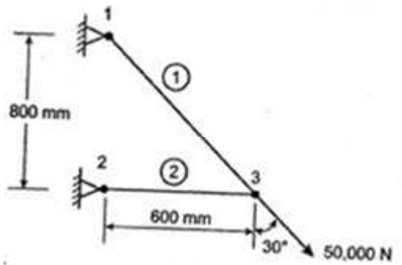


Figure 1

(OR)

(b)	Determine the nodal displacement for the given Truss. Take the cross-sectional area as 1000 mm^2 and E = 200 GPa. Refer Figure 2	**(14)**	**2**	**3**



13. (a)	The nodal co-ordinates of the triangular element are shown in Figure 3. At the interior point P, the x co-ordinate is 3.5 and $N_1 = 0.4$, calculate N_2, N_3 and the y coordinate at point P.	**(14)**	**3**	**3**

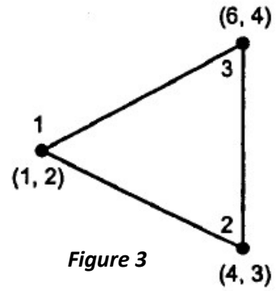


Figure 3

(OR)

(b)	For the constant strain triangular element shown in Figure 4, determine strain-displacement matrix and Stress-strain matrix. Take t = 20 mm and E = 2 x 10^5 N/mm^2.	**(14)**	**3**	**3**

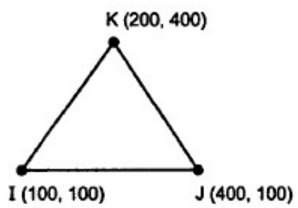


Figure 4

Q. CODE:977364

14. (a)	For the longitudinal bar with length 2L, modulus of elasticity E, mass density ρ, and cross-sectional area A, Determine the first two natural frequencies using consistent mass matrix.	**(14)**	**4**	**3**
	(OR)			
(b)	An aluminium alloy fin of 1 cm diameter, 6 cm long, protrudes from a wall which is maintained at 50°C. The ambient air temperature is 10°C. The thermal conductivity and heat transfer coefficient are 2 W/cm°C and 0.2 W/cm^2°C respectively. Determine the temperature distribution of fin. Use two finite element method.	**(14)**	**4**	**3**
15. (a)	Evaluate the integral using Gaussian Quadrature. $$I = \int_{-1}^{1} \left(x^7 + 5x^3 + 7x + 3 \right) dx$$	**(14)**	**5**	**3**
	(OR)			
(b)	Derive the shape function for 9 - noded quadrilateral element	**(14)**	**5**	**3**

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	For the iso-parametric four-noded quadrilateral element with nodal points (1,1), (5,1), (6,6) and (1,4), determine the Cartesian co- ordinates of point P which has local co-ordinates, ε = 0.5, η =0.5	**(10)**	**5**	**5**

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