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B.Tech DEGREE EXAMINATION, NOVEMBER 2023

Seventh Semester

18AUE443T - FINITE ELEMENT ANALYSIS

(For the candidates admitted during the academic year 2020 - 2021 & 2021 - 2022)

Note:

i. **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.

ii. **Part - B** and **Part - C** should be answered in answer booklet.

Time: 3 Hours **Max. Marks: 100**

PART - A (20 × 1 = 20 Marks)

Answer **all** Questions

		Marks	BL	CO
1.	For 1-D bar elements, if the structure has two nodes, then the stiffness matrix formed has an order of_____ (A) 2*2 (B) 3*3 (C) 4*4 (D) 6*6	1	1	1
2.	The total potential energy is the algebraic sum of (A) Integral strain energy and work potential (B) Integral strain energy and external work done. (C) Integral stress energy and work potential (D) Integral stress energy and external work done	1	1	1
3.	The numbers of nodes for 1 D element are (A) 1 (B) 2 (C) 3 (D) 4	1	1	1
4.	The shape function of the beam elements are known as (A) Hermite shape functions (B) Element shape functions (C) Hermite element functions (D) Hermite cubic element functions	1	1	1
5.	At Fixed Support, the Displacements (U) Are Equal To (A) 1 (B) U = N1.U1 + N2. U2 (C) Infinity (D) 0	1	1	2
6.	In a Cantilever Beam, at the free end, the reaction force will be. (A) Ae/L (B) -Ae/L (C) Infinity (D) 0	1	1	2
7.	In four bar mechanism analysis, which type of joints should be given (A) Prismatic (B) Revolute (C) Cylindrical (D) Screw	1	2	2
8.	Criteria for convergence test in FEA (A) Obtain the same result for different numbers of divisions. (B) Obtain the same result for different elements. (C) Obtain the same result for different BC's (D) Obtain same result for different model	1	1	2
9.	Finite element method is a _____ technique? (A) Analytical (B) Experimental (C) Numerical (D) A & B	1	1	3
10.	Which of the following coordinate systems is used for defining a particular part of a structure? (A) Local (B) Global (C) Natural (D) Middle	1	2	3

11.	Which of the following techniques is used for solving simple differential equations? (A) Finite element method (B) Finite volume method (C) Finite difference method (D) Analytical method	1	2	3
12.	The minimum potential energy method is also called _____? (A) Finite element method (B) Strain energy method (C) Weighted residual method (D) Galerkin method	1	1	3
13.	The number of degrees of constraint of a planar revolute joint is (A) 1 (B) 2 (C) 3 (D) 6	1	2	4
14.	Which one of the following packages is extensively used for kinematic and dynamic analysis of mechanisms? (A) ANSYS (B) ABAQUS (C) HYPERMESH (D) ADAMS	1	1	4
15.	What will be the size of the stiffness matrix when a structure is meshed with 5 bar elements? (A) 2*2 (B) 4*4 (C) 5*5 (D) 6*6	1	1	4
16.	_____ Analysis deals with forces involved in a mechanism (A) Kinetic (B) Kinematic (C) Dynamic (D) Static	1	2	4
17.	The load calculated for each element based on thermal expansion of that element is, (A) q E α ΔT (B) A q α ΔT (C) A E α ΔT (D) A E q ΔT	1	2	5
18.	When the inertia effect due to the mass of the component and externally applied load is considered, then the analysis is called as (A) Static analysis (B) Dynamic analysis (C) Thermal analysis (D) Buckling analysis	1	2	5
19.	A natural mode of vibration represents _____at each node. (A) Absolute displacement (B) Relative displacement (C) Proportional displacements (D) Absolute strain	1	2	5
20.	LST element contains _____nodes (A) 1 (B) 2 (C) 3 (D) 6	1	3	5

PART - B (5 × 4 = 20 Marks)

Answer **any 5** Questions

		Marks	BL	CO
21.	State the methods of engineering analysis.	4	1	1
22.	What is the structural and non-structural problem in FEA?	4	1	1
23.	Is a beam element an isoparametric element? Explain.	4	1	2
24.	If a displacement field in the x direction is given by $u=2x^2+4y^2+6xy$. Determine the strain in the x direction.	4	3	2
25.	Define CST and LST elements.	4	1	4
26.	What are the conditions for a problem to be axisymmetric?	4	1	4
27.	List out the applications of Multibody dynamics.	4	1	5

PART - C (5 × 12 = 60 Marks)

Answer **all** Questions

Marks	BL	CO

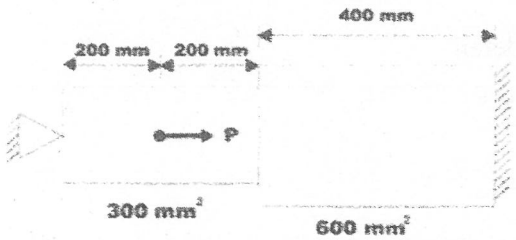
28. (a) Derive the Rayleigh-Ritz method — 12 | 2 | 1

(OR)

(b) Derive the stiffness matrix for a one-dimensional linear bar element and state its properties.

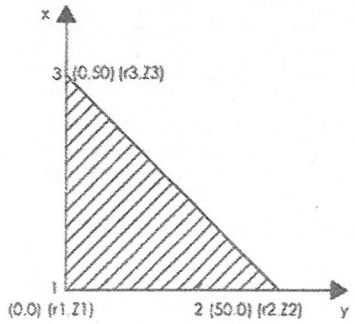
29. (a) A structure shown in the figure is subjected to axial load. Determine — 12 | 3 | 2
1. Nodal Displacement
2. Element Stresses
3. Support Reactions

Take: Load P = 400 KN ; E = 2 X 10^5 N/mm^2

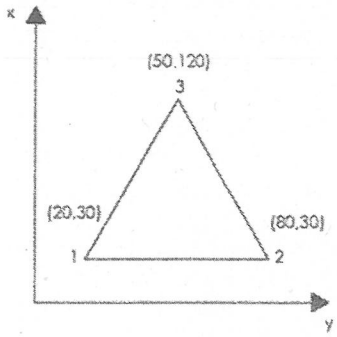


(OR)

(b) For the axisymmetric element shown in fig., determine the stiffness Mathis: let E = 2x10^5 N/mm^2: Y = 0.25
To Find; Stiffness matrix [K]

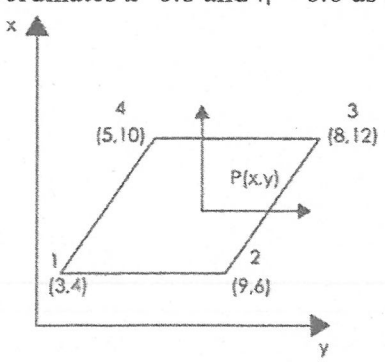


30. (a) Determine the stiffness matrix for the Constant Strain Triangle (CST) element shown in the figure. The coordinates are in mm. Assume plane stress condition. Take E = 210 GPa, $\gamma = 0.25$, and t = 10 mm. — 12 | 3 | 3



(OR)

(b) Determine the Cartesian coordinates of the point 'p', which has local coordinates £=0.8 and η = 0.6 as shown in Fig.



31.	(a) Explain Modal Analysis in detail.	12	2	4
	(OR)			
	(b) A furnace wall is made up of three layers: the inside layer with a thermal conductivity of 8.5 W/mK, the middle layer with a conductivity of 0.25 W/mK, and the outer layer with a conductivity of 0.08 W/mK. The respective thickness of the inner, middle, and outer layers are 25 cm, 5 cm, and 3 cm, respectively. The inside temperature of the wall is 600°C, and the outside of the wall is exposed to atmospheric air at 30°C with a heat transfer coefficient of 45 W/m^2K. Determine the nodal temperatures.			
32.	(a) Discuss different mechanical joints with relevant diagrams and equations.	12	2	5
	(OR)			
	(b) Explain forward and Inverse Dynamics in detail.			

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