VASAVI COLLEGE OF ENGINEERING *(AUTONOMOUS)*, HYDERABAD
Accredited by NAAC with A++ Grade
B.E. (Mech. Engg.) VII-Semester Supplementary Examinations, July-2022
Finite Element Analysis

Time: **3 hours**   Max. Marks: **60**

*Note: Answer all questions from **Part-A** and any **FIVE** from **Part-B***

Part-A (10× 2 = 20 Marks)

Q. No.	Stem of the question	M	L	CO	PO
1.	List the advantages and disadvantages of finite element method.	2	1	1	1
2.	What does discretization means in the finite element method?	2	1	1	3
3.	Write the transformation matrix required to transform local to global displacements of a plane truss element.	2	1	2	3
4.	Show the shape functions of a plane beam element.	2	1	2	4
5.	Differentiate sub-parametric, Iso-parametric and Super parametric finite elements.	2	2	3	1
6.	State the conditions required for axi-symmetric problem formulation and mention any two examples.	2	2	3	3
7.	Define geometric isotropy.	2	1	4	1
8.	Write the numerical integration two point formula.	2	1	4	4
9.	State Hamilton's principle.	2	1	5	1
10.	List the properties of eigen vectors.	2	1	5	2

Part-B (5 × 8 = 40 Marks)

11.	For the bar assembly shown in Fig-1, determine the nodal displacements, the forces in each element, and the reaction at the support.	8	2	1	3

A_1, E_1, L_1 A_2, E_2, L_2 20,000 N

$A_1 = 400$ mm² $A_2 = 225$ mm²
$E_1 = 150$ GPa $E_2 = 100$ GPa
$L_1 = 200$ mm $L_2 = 200$ mm

Fig-1

12. The plane truss shown in Fig-2 is subjected to a downward vertical load at node 2. For both elements, A=150 mm^2, E=200 GPa. Determine
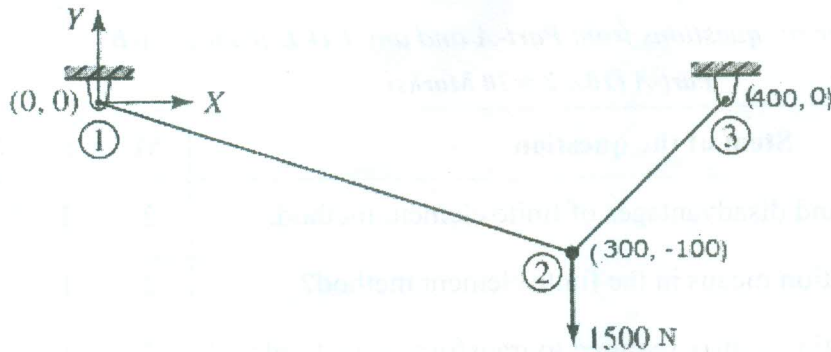

Fig-2

|		6	2	2	4
a)	The deflection of node 2.	6	2	2	4
b)	The axial stress in each element.	2	3	2	3
13. a)	A triangular element is specified by the nodal co-ordinates 1(10,10) mm, 2(50,30) mm and 3(40,60) mm in Cartesian space. Determine the Natural co-ordinates at the point P(30,30) mm.	4	3	3	3
b)	Develop the Load vector for the CST element subjected to uniform pressure on edge 1-3 as shown in Fig-3.	4	3	3	4

Co-ordinates:
1: (20,40) mm
2: (60,10) mm
3: (60,80) mm
Pressure p_1= 6 N/mm^2
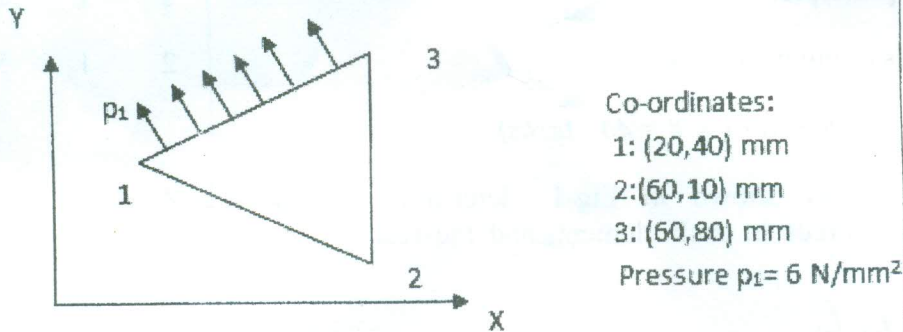
Fig-3

14. a)	Show the type of finite elements with their degrees of freedom.	4	2	4	1
b)	Solve the integral I by two point Gaussian quadrature.	4	2	4	3

$$I= \int_{-1}^{1} \int_{-1}^{1} (2x^2 + 3xy + 4y^2)\, dx\, dy$$

		M	L	CO	PO
15.	For a stepped bar shown in Fig.4,				
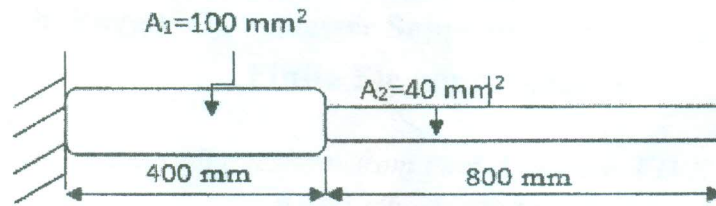
Fig.4

		M	L	CO	PO
a)	Estimate the natural frequencies.	6	3	5	3
b)	Infer the eigen vectors.	2	4	5	4
16. a)	If a displacement field is described by $u = (x^2 - 2y^3 + 5xy)10^{-3}$; $v = (-3x^3 + y^2 - 7y)10^{-3}$, determine ε_x, ε_y and γ_{xy} at the point $x = -3$ and $y = 1$.	4	3	1	3
b)	Develop the Stiffness matrix for a plane Truss element.	4	3	2	4
17.	Answer any *two* of the following:				
a)	Develop and show the shape functions of a 4-noded iso-parametric quadrilateral element.	4	3	3	4
b)	Discuss convergence requirements	4	3	4	3
c)	Develop the lumped and consistent mass matrix for a linear bar element.	4	3	5	4

M : Marks;   L: Bloom's Taxonomy Level;   CO; Course Outcome;   PO: Programme Outcome

i)	Blooms Taxonomy Level – 1	20%
ii)	Blooms Taxonomy Level – 2	32.50%
iii)	Blooms Taxonomy Level – 3 & 4	47.50%

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