



M.E DEGREE EXAMINATIONS: MAY 2018

(Regulation 2015)

Second Semester

CAD/CAM

P15CCT202 : Advanced Finite Element Analysis

COURSE OUTCOMES

- CO1: Applying the finite element procedure to solve 1D and 2D structural and heat transfer problems**
- CO2: Describe the finite element formulation of structural and heat transfer problems using 2D quadratic**
- CO3: Solve problems in axisymmetric elements**
- CO4: Demonstrate the iso-parametric formulation**
- CO5: Solve structural dynamics problems using 1D elements**

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Assertion (A): The degrees of freedom per node for the beam element is two. CO1 [K₂]
Reason (R): The beam element is considered to be straight and have constant cross-sectional area.
a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A
c) A is true but R is false d) A is false but R is true

2. The truss element is ----- element when viewed in the local coordinate system CO1 [K₂]
a) Beam element b) Bar element
c) Spring element d) Spar element

3. A triangular element with cubic displacement function requires _____ nodes CO2 [K₂]
to represent the complete and symmetric polynomial
a) 3 b) 6
c) 9 d) 10

4. Matching type item with multiple choice code

CO4 [K₂]

List I	List II
A. Sub parametric element	i. Curved boundaries
B. Super parametric element	ii. Pressure vessels
C. Axisymmetric element	iii. Beam element
D. Isoparametric element	iv. Shell element

- | | A | B | C | D |
|----|-----|----|-----|----|
| a) | ii | i | iii | iv |
| b) | iii | iv | ii | i |
| c) | ii | iv | iii | i |
| d) | iii | i | ii | iv |

5. Assertion (A): Element having external nodes and there is no internal nodes is called as serendipity elements. CO4 [K₂]

Reason (R): Serendipity elements are used only for solving nonlinear problems.

- | | |
|---|---|
| a) Both A and R are Individually true and R is the correct explanation of A | b) Both A and R are Individually true but R is not the correct explanation of A |
| c) A is true but R is false | d) A is false but R is true |

6. Axisymmetric problems are solved using ----- CO3 [K₂]

- | | |
|----------------------------------|--------------------------------|
| a) Cylindrical coordinate system | b) Spherical coordinate system |
| c) Polar coordinate system | d) Global coordinate system |

7. In the given properties which is not a mass matrix property CO5 [K₂]

- 1) Matrix symmetry
- 2) Conservation and positivity
- 3) Physical unsymmetries
- 4) Forms a unique matrix

- | | |
|--------|--------|
| a) 4,1 | b) 3,4 |
| c) 1,2 | d) 2,3 |

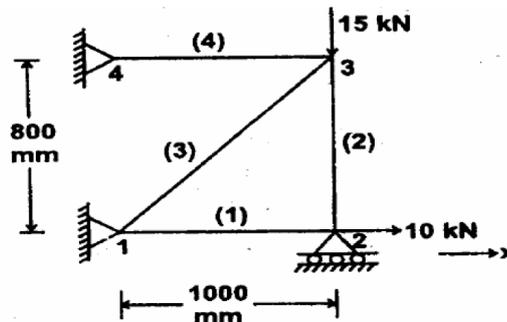
8. In axisymmetric problems having the total symmetry about the z-axis, all deformations and stresses are ----- of the rotation angle θ CO3 [K₂]

- | | |
|--------------|---------|
| a) Dependent | b) Zero |
|--------------|---------|

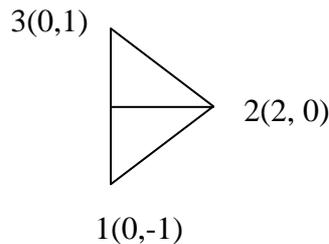
25. List the applications of axisymmetric element and discuss the general procedure followed in cylindrical tube subjected to an internal pressure “p” bar. CO3 [K₁]
26. The nodal coordinates for an axisymmetric triangular element are 1 (20,10), 2(40,10) and 3(30,50). Determine the strain-displacement matrix for that element. All dimensions are given in mm. CO3 [K₂]
27. Evaluate the integral $I = \int_{-1}^1 [3e^x + x^2 + 1/(x+2)]dx$, find by using 1 & 2 point gauss quadrature formula. CO4 [K₂]
28. Discuss in brief about Static condensation. CO4 [K₁]
29. Find the natural frequencies for the free vibration of a cantilever beam. CO5 [K₁]
30. Discuss about consistent and lumped mass matrix for bar and beam element. CO5 [K₂]

Answer any TWO Questions
PART D (2 x 10 = 20 Marks)

31. Consider a four bar truss shown in fig. Evaluate the nodal displacements and element stresses. Take $E = 2.1 \times 10^5 \text{ N/mm}^2$ and $A = 250 \text{ mm}^2$ for all elements. CO1 [K₂]



32. Evaluate stiffness matrix for the element shown in Fig. Assume plane stress conditions. $E = 3 \times 10^6 \text{ N/m}^2$, $t = 1\text{m}$, $\mu = 0.25$. The nodal displacements are $U_1=0, V_1=0.0025\text{m}$, $U_2=0.0012\text{m}, V_2=0, U_3=0, V_3=0.0025\text{m}$. Also find the principal stress



33. A flywheel is mounted on vertical shaft shown in figure. Both the ends of the shaft is fixed and its diameter is 50 mm. The mass of the flywheel is 500 kg. Radius of gyration is 0.5. Find the natural frequency of torsional vibration if the modulus of rigidity and density are 84GN/m^2 and 7800 kg/m^3 . CO5 [K₂]

