KUMARAGURU college of technology
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Register Number: ……..

M.E DEGREE EXAMINATIONS: JUNE 2017

(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 approximation function for finding the displacements of one-dimensional bar elements are usually polynomials. CO1 [K_2]

   Reason (R) : It gives the linear variation and continuous values of displacement within the element

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

2. _____ is used to reduce the number of degrees of freedom to a finite number. CO1 [K_2]

   a) Discretization
   b) Finite element modeling
   c) Node numbering
   d) Geometry

3. A triangular element with cubic displacement function requires_____ nodes to represent the complete and symmetric polynomial. CO2 [K_2]

   a) 3
   b) 6
   c) 9
   d) 10

4. Match the elements of List I with no of nodes in List II CO2 [K_2]

List I	List II
A. CST Element	i. 4 nodes

B. LST Element	ii.9 nodes
C. QST Element	iii.3 nodes
D. Bilinear rectangular element	iv.6 nodes

	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): The stresses are independent of the θ coordinate in axisymmetric elements CO3 [K_2]

Reason (R): The component is symmetry about the Z-axis.

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 [K_2]

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

7. Identify the correct statement CO4 [K_2]

A. Isoparametric is derived from the use of same interpolation function to define the geometry of the element and displacement within the element.

B. An interpolation function is not used to approximate the physical parameter along the boundaries and interior of the element

C. When the same node locations are used for both approximations, the element is said to be isoparametric.

D. When fewer nodes are used to define the geometry than are used to define the field variable, the element is said to be sub parametric.

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

8. The concept of static condensation is utilized in---------- CO4 [K_2]

a) Forming of sub element
b) Forming of multiplex element
c) Forming of complex element
d) Forming of super element

9. With consistent mass matrix, the differential equation of vibration refers to ---------- CO5 [K_2]

a) elastic coupling
b) inertia coupling
c) mode superposition
d) Both inertia and elastic coupling

10. Identify the order of the polynomial in the following elements and arrange it in ascending increment. CO5 [K_2]

1. 4 noded tetrahedral element
2. 8 noded quadrilateral element
3. 10 noded triangular element
4. 5 noded line element

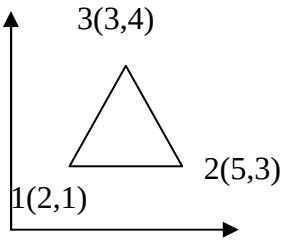
a) 1-2-3-4
b) 4-3-2-1
c) 3-4-2-1
d) 2-3-4-1

PART B (10 x 2 = 20 Marks)

11. State the properties of stiffness matrix. CO1 [K_2]
12. Why polynomial type of interpolation functions is mostly used in FEM? CO1 [K_2]
13. Write down the strain displacement matrix for two dimensional CST elements. CO2 [K_2]
14. Distinguish plane stress and plane strain analysis with suitable examples. CO2 [K_2]
15. List out the conditions for a problem to be axisymmetric. CO3 [K_2]
16. Sketch a finite element model for a long cylinder subjected to an internal pressure using axisymmetric element. CO3 [K_2]
17. Differentiate between material non linearity and geometric non linearity. CO4 [K_2]
18. Write down the shape functions for 4-noded linear quadrilateral element using natural coordinate system. CO4 [K_2]
19. Indicate the merits of lumped and consistent mass matrix CO5 [K_2]
20. Write down the characteristic equation for free vibration. CO5 [K_2]

PART C (10 x 5 = 50 Marks)

21. Explain the step by step procedure of FEM. CO1 [K_2]
22. Discuss in brief about the degrees of freedom. CO1 [K_2]
23. Determine the shape function of bilinear rectangular element using natural coordinate system. CO2 [K_2]
24. Calculate the linear interpolation function for the triangular element. CO2 [K_2]



25. Explain whether we can connect plane stress elements with axisymmetric element. CO3 [K_2]
26. Give some applications of axisymmetric element with examples. CO3 [K_2]
27. Evaluate the integral I = $\int_{-1}^{1}[x^2+\cos(x/2)]dx$,using 3 point gauss quadrature formula. CO4 [K_2]

28. Discuss in brief about Static condensation. CO4 [K_2]

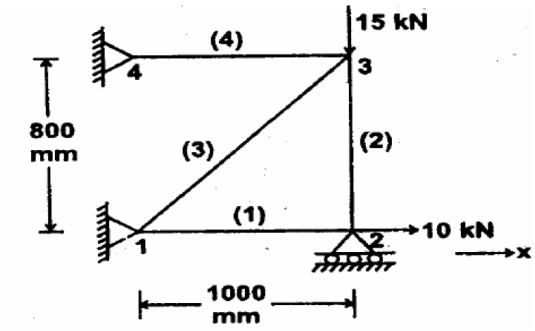
29. Find the natural frequencies for the free vibration of a cantilever beam. CO5 [K_2]

30. Discuss about consistent and lumped mass matrix for bar and beam element. CO5 [K_2]

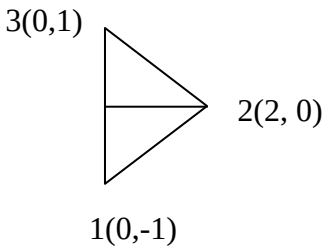
Answer any TWO Questions

PART D (2 x 10 = 20 Marks)

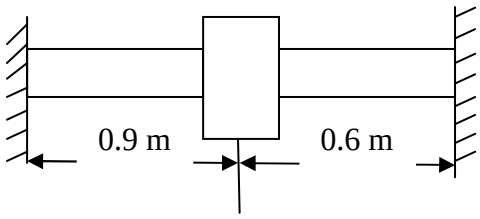
31. Consider a four bar truss shown in fig. Evaluate the nodal displacements and element stresses. Take E = 2.1 x 10^5 N/mm^2 and A = 250 mm^2 for all elements. CO1 [K_3]



32. Evaluate stiffness matrix for the element shown in Fig. Assume plane stress conditions. E = 30x106 N/m^2, t = 1m,μ = 0.25.The nodal displacements are U_1=0,V_1=0.0025m, U_2=0.0012m,V_2=0,U_3=0,V_3=0.0025m.Also find the principal stress CO2 [K_3]



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 [K_3]



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