M.E. DEGREE EXAMINATIONS: JUNE 2015

(Regulation 2014)

Second Semester

CAD/CAM

P14CCT202**:** Advanced Finite Element Analysis

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-
PART A (10 x 1 = 10 Marks)

1. Identify the order of the polynomial in the following elements and arrange it in ascending   [K$_1$]
increment.

   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) 2-3-4-1   d) 3-4-2-1

2. _____ is used to reduce the number of degrees of freedom to a finite number   [K$_2$]

   a) Discretization   b) Finite element modeling

   c) Node numbering   d) Geometry

3. The other name for linear strain triangular element is   [K$_1$]

   a) Linear displacement triangular element   b) Cubic displacement triangular element

   c) Quadratic displacement triangular element   d) Quartic displacement triangular element

4. Match elements of List I with no. of nodes in List II   [K$_2$]

List I	List II
A. CST element	i. 4 nodes
B. LST element	ii. 3 nodes
C. QST element	iii. 6 nodes
D. Bilinear rectangular element	iv. 9 nodes

   a) A-i, B-ii, C-iii, D- iv   b) A-ii, B-iii, C-iv, D- i

   c) A-iii, B-ii, C-i, D- iv   d) A-ii, B-iii, C-i, D- iv

5. In axisymmetric problems having the total symmetry about the z-axis, all deformations and stresses are _____ of the rotational angle θ [K₁]

   a) Dependent   b) Zero

   c) Positive   d) Independent

6. Axisymmetric problems are solved using   [K₁]

   a) Cylindrical coordinate system   b) Spherical coordinate system

   c) Polar coordinate system   d) Global coordinate system

7. Identify the false statement   [K₂]

   A. Isoparametric is a name that implies certain properties for an element that is integrated in a normalized space.

   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) All are true except B   b) B & C are false

   c) All are true except C   d) All are false except D

8. The concept of static condensation is utilized in   [K₂]

   a) Forming of sub element   b) Forming of multiplex element

   c) Forming of complex element   d) Forming of super element

9. In the given properties which not a Mass Matrix Property   [K₁]

   1) matrix symmetry

   2) conservation and positivity

   3) physical unsymmetries

   4) Forms a unique matrix

   a) 1,2   b) 2,3

   c) 3,4   d) 4,1

10. The general governing equation for free axial vibration of a rod is given by   [K₁]

   a) $AE\dfrac{\partial^2 u}{\partial x^2} = \rho A \dfrac{\partial^2 u}{\partial t^2}$ b) $A\dfrac{\partial^2 u}{\partial x^2} = \rho AL \dfrac{\partial^2 u}{\partial t^2}$

   c) $AE\dfrac{\partial^2 u}{\partial x^2} = \rho \dfrac{\partial^2 u}{\partial t^2}$ d) $A\dfrac{\partial^2 u}{\partial x^2} = \rho A \dfrac{\partial^2 u}{\partial t^2}$

PART B (10 x 2 = 20 Marks)

11. Differentiate bar element and beam element. $[K_2]$

12. Define degrees of freedom $[K_1]$

13. Draw the LST element and define. $[K_4]$

14. Distinguish plane stress and plane strain analysis with suitable examples. $[K_2]$

15. List the types of non-linearity. $[K_1]$

16. Draw any two axi symmetric element. $[K_4]$

17. Write down the general element stiffness matrix equation for isoparametric quadrilateral element. $[K_1]$

18. Differentiate between super parametric and sub parametric element. $[K_2]$

19. Write down the characteristic equation for free vibration. $[K_1]$

20. How mass matrix differs from the stiffness matrix? $[K_2]$

PART C (6 x 5 = 30 Marks)

21. Explain the FEM step by step procedure $[K_2]$

22. Determine the shape function of bilinear rectangular element using natural coordinate system. $[K_4]$

23. List the properties of stiffness matrix. $[K_1]$

24. Explain the concept of static condensation with a diagram $[K_2]$

25. List the advantages of Gaussian 'quadrature' numerical integration for isoparametric elements. $[K_1]$

26. Differentiate between static and dynamic analysis with examples. $[K_2]$

PART D (4 x 10 = 40 Marks)

27. Determine the nodal displacement of each bar structure shown below taking $[K_3]$
    K_1=20 kN/m
    K_2=10 kN/m
    K_3=15 kN/m
    K_4=20 kN/m
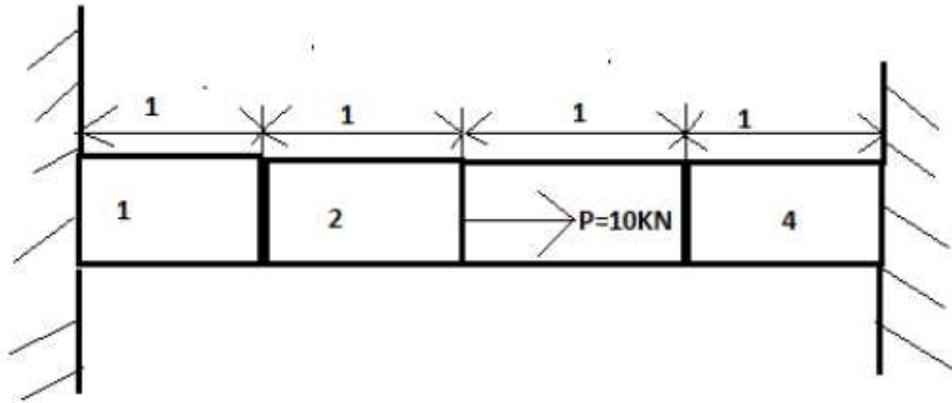
28. For a long cylinder of inside diameter 80mm and outside diameter 120mm snugly fits in a hole over its full length. The cylinder is subjected to an internal pressure of 5 MPa. Using two element model over a length of 10mm, evaluate nodal displacement s. Take E = 200 GPa and $\gamma = 0.3$. [K₃]

29. A four noded rectangular element is shown in figure. Determine the following: [K₃]
(i)Jacobian matrix
(ii)Strain Displacement matrix
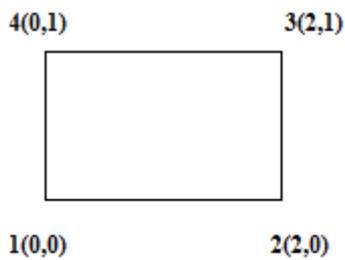
$Take E = 2 \times 10^5 \, N/mm$;   v=0.25:

$\in = 0; \quad \eta = 0$

$u = [0, 0, 0.003, 0.004, 0.006, 0.004, 0, 0]^T$
Assume plane stress condition.

30. Formulate the element stiffness matrix and mass matrix for a rod under free axial vibration. [K₆]

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