Code No.: **3142**

FACULTY OF ENGINEERING

B.E. IV/IV Year (Mech./Prod.) I Semester (Main) Examination, December 2010

FINITE ELEMENT ANALYSIS

Time : 3 Hours] [Max. Marks : 75

Answer **all** *questions from Part A.*
Answer any **five** *questions from Part B.*

Part A — (Marks : 25)

1. Explain the terms: interpolation function, shape functions. 2
2. Explain the application of different elements used in finite element modeling. 2
3. Derive the shape functions of a 4-node isoparametric quadrilateral element. 3
4. Why numerical integration is required in isoparametric formulation? 2
5. What is Jacobian? State its significance in the isoparametric formulation. 3
6. State the advantage of considering a linear or quadratic triangle in terms of natural coordinates. 3
7. State principle of problem formulation by Galerkin-Weighted Residual method. 2
8. Write the reduced and consistent load vectors for a beam element with u.d.l. 2
9. Explain the way the boundary conditions of a one-dimensional fin with a free end are handled. 3
10. Write the problem formulation of a bar member under axial vibrations. 3

Part B — (Marks : 50)

11. For the bar shown in Fig. 1, calculate the support reactions. $E = 20\times10^6 N/cm^2$, $\alpha = 11\times10^{-6}/°C$.

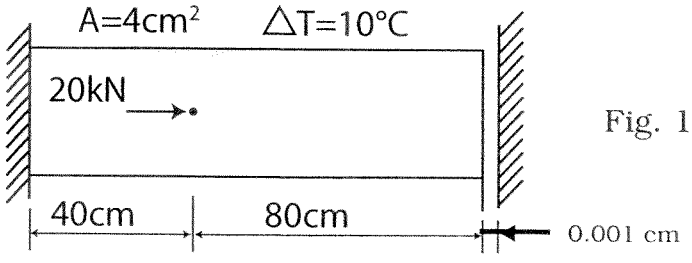

Fig. 1

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12. Calculate the stress in element 1 of the trass shown in Fig. 2. E = 20×10^6N/cm^2.

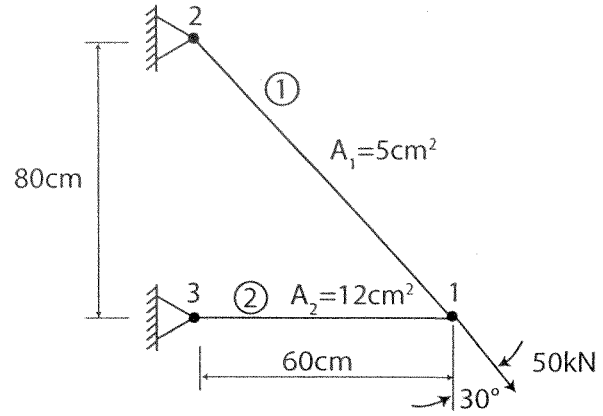

Fig. 2

13. Derive the element stiffness matrix and load vector for 1D element by using the potential energy approach.

14. A triangular element shown on Fig. 3 is specified by the nodal coordinates 1(2,2), 2((6,4), 3(4,6) cm. Determine the nodal point loads for the body force of 10N/cm^{3}is in the positive x-direction. Thickness of the element is 1 cm.

15. A quadrilateral element is specified by the nodal coordinates 1(1,1),2(5,1),3(6,6),4(2,4). The element nodal displacements at the respective nodes are 1(0,0), 2(0.2,0), 3(0.15,0.1), 4(0.5,0.1). Determine

    (a) the displacement at point *p* specified by the natural coordinates $\xi = 0.5$ and $\eta = -0.5$ in the master element.

    (b) a force of 100N in x-direction and 200N in– ve y-direction acts at the above point p. Determine the equivalent nodal point loads.

16. A circular fin of diameter 4 cm and length 40 cm is maintained at 250°C at the root and convection takes place through out the surface including the tip. The ambient temperature is 40°C. Take K = 40W/m°C and h = 25W/m^2°C. Assuming the fin has two linear elements determine the temperature distribution in the fin and also determine the heat removal rate.

17. Determine the eigen values and eigen vectors for the stepped bar shown in Fig. 3 E = 200Gpa, mass density p =7800 kg/m^3.

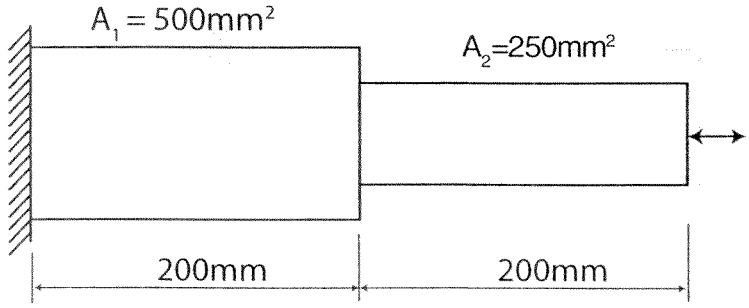

Fig. 3