Printed Pages: 6 NME-012

(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 140662 Roll No. 1 3 0 3 2 4 0 8 2 9

B.TECH.

Theory Examination (Semester-VI) 2015-16

FINITE ELEMENT METHODS

Time : 3 Hours *Max. Marks : 100*

Note : Assume any missing data suitably.

Section-A

1. Attempt all parts. All parts carry equal marks. (2×10=20)

(a) What are the limitations of Galerkin formulation?

(b) Write down the stiffness matrix for 2D beam element.

(c) What do you mean by convergence in finite element analysis?

(d) Why polynomial shape functions are preferred?

(e) Specify stress and strain tensors for plane stress case.

(f) What are the advantages of expressing displacement field in Natural co-ordinates than generalized co-ordinates?

(g) Write down the shape functions for four noded rectangular elements.

(h) Write the shape function for constant strain triangle by using polynomial function.

(i) What are the conditions for a problem to be axisymmetric?

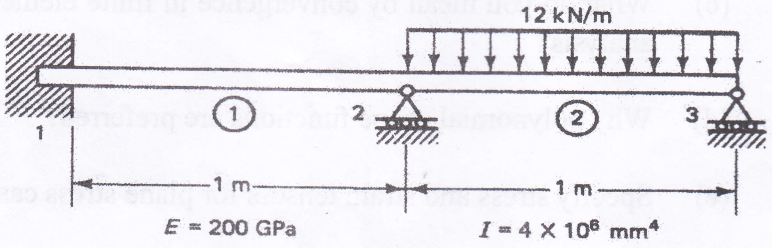
(j) What are the steps involved in finite element modeling?

Section-B

Note : Attempt any five questions from this section.

(10×5=50)

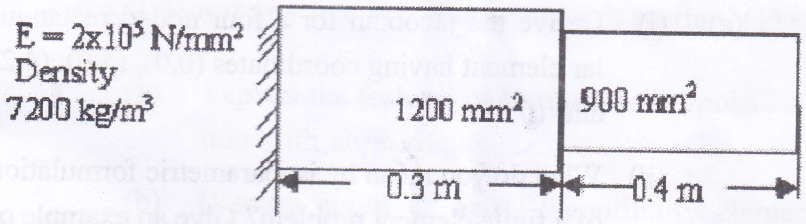
(a) Determine the vertical deflection at the midpoint of the distributed load for the beam shown in Fig.



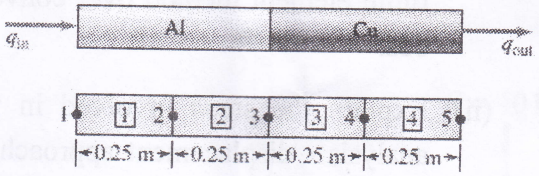
(b) Consider the axial vibrations of a steel bar shown in the Fig.:

i. Develop global stiffness and mass matrices.

ii. Determine the natural frequencies.



(c) The circular rod depicted in figure has an outside diameter of 60 mm, length of 1 m, and is perfectly insulated on its circumference. The left half of the cylinder is aluminum, for which k_x = 200 W/m-°C and the right half is copper having k_x = 389 W/m-°C. The extreme right end of the cylinder is maintained at a temperature of 80°C, while the left end is subjected to a heat input rate 4000 W/m². Using four equal-length elements, determine the steady-state temperature distribution in the cylinder.



(d) For a square, isotropics elastic body of thickness 'h', the displacement are approximated by:

$$u(x,y) = y(1-x)u_1 + x(1-y)u_2$$

$$v(x,y) = 0$$

Assuming plane stress condition, derive the stiffness matrix for the unit dimensioned square.

(e) (i) Derive the jacobian for a four noded rectangular element having coordinates (0,0), (4,0), (4,2) and (0,2).

(ii) What do you mean by isoparametric formulation of a finite element problem? Give an example of real field problem where super- parameteric elements can be used and why ?

(f) Evaluate the integral

$$I = \int_{-1}^{1} \frac{r^2 - 1}{(r+3)^2} dr$$

using Gaussian integration with one, two, and three integration points.

(g) (i) Discuss the advantages and disadvantages of finite element method over conventional methods.

(ii) Explain the steps involved in finite element analysis - displacement approach.

(h) (i) What are the convergence and compatibility requirements? Discuss in detail.

(ii) Differentiate conforming and non-conforming elements.

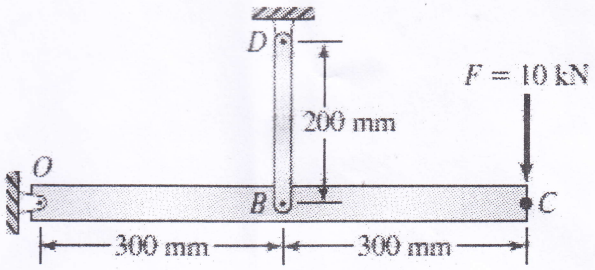
Section-C

Note: Attempt any two questions from this section. (15×2=30)

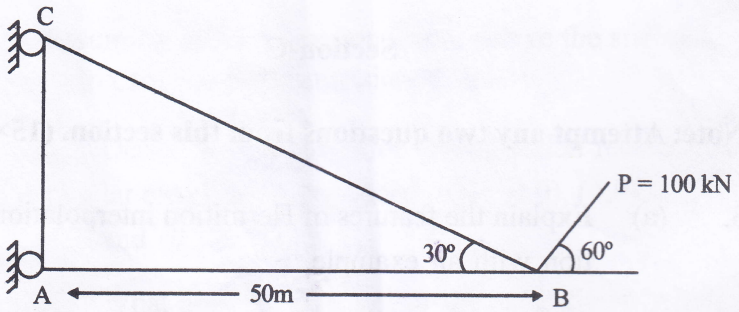
3. (a) Explain the features of Hermition interpolation function with an example.

   (b) Discuss about C^0 and C^1 continuity elements in detail.

4. In Figure, beam *OC* is supported by a smooth pin connection at *O* and supported at *B* by an elastic rod *BD*, also through pin connections. A concentrated load $F = 10$ kN is applied at *C*. Determine the deflection of point *C* and the axial stress in member *BD*. The modulus of elasticity of the beam is 207 GPa (steel) and the dimensions of the cross section are 40 mm × 40 mm. For elastic rod *BD*, the modulus of elasticity is 69 GPa (aluminum) and the cross-sectional area is 78.54 mm^2.



5. Develop the stifness matric & determine nodal displacement for given truss. Also find stresses in bar AB & BC.



Take cross section area for members as $0.2m^2$, E=220GPa.