

# CBCS SCHEME

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15ME61

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019

## Finite Element Analysis

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.



### Module-1

- 1 a. Define Finite Element Method, explain basic steps involved in FEM (10 Marks)
- b. A rectangular bar is subjected to an axial load "p" as shown in Fig.Q1(b), determine the expression for P.E functional and hence determine value of the potential energy (PE) for the following data :  $E = 200\text{GPa}$ ,  $P = 3\text{kN}$ ,  $L = 100\text{mm}$ ,  $b = \text{width} = 20\text{mm}$ ,  $t = 10\text{mm}$ . (06 Marks)

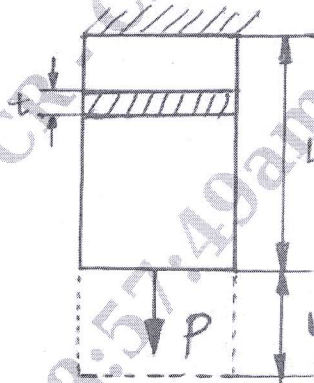


Fig.Q1(b)

OR

- 2 a. Find the maximum deflection using Galerkin's method, Fig.Q2(a). (10 Marks)

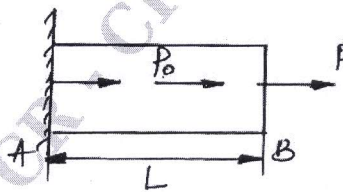


Fig.Q2(a)

- b. Explain Simplex, Complex and Multiplex Elements with examples. (06 Marks)

### Module-2

- 3 a. Derive the shape function of a bar element in Global Co-Ordinate System. (10 Marks)

- b. Use two-point Gaussian quadrature formula to evaluate the integral  $I = \int_0^3 (2\xi - \xi) d\xi$ .

(06 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

OR

- 4 a. The structured member shown in Fig.Q4(a) consists of two bars. An axial load of  $P = 200\text{kN}$  is loaded as shown. Determine the following :
- i) Element Stiffness Matrix
  - ii) Global Stiffness Matrix
  - iii) Global Load Vector
  - iv) Modal Displacement.
- (06 Marks)

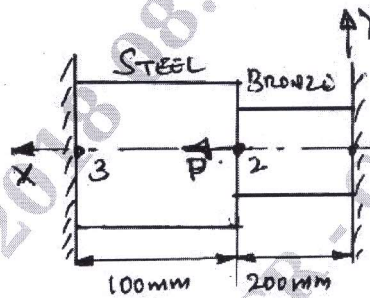


Fig.Q4(a)

- b. A 4 bar truss element as shown in Fig.Q4(b), determine i) Nodal displacement ii) stress in each element, area of truss element =  $100\text{mm}^2$ ;  $E = 2 \times 10^5 \text{N/mm}^2$ . (10 Marks)

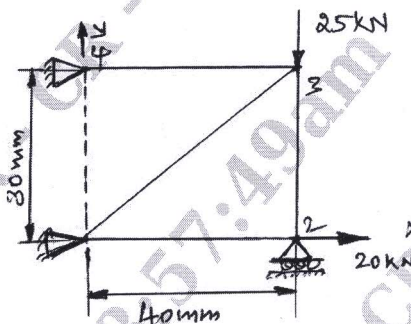


Fig.Q4(b)

**Module-3**

- 5 a. Derive Hermite shape functions of a beam element and show the variation of the shape function over the element. (10 Marks)
- b. Derive the potential energy functional ( $\pi$ ) for beam. (06 Marks)

OR

- 6 a. A cantilever beam subjected to point load of  $250\text{ kN}$  as shown in Fig.Q6(a). Determine the deflection at the free end and the support reactions. Take  $E = 200\text{GPa}$ ,  $I = 4 \times 10^6 \text{mm}^4$ . (10 Marks)

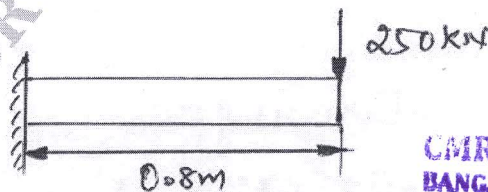


Fig.Q6(a)

- b. Derive the stiffness matrix for a circular shaft subjected to pure torsion. (06 Marks)

**Module-4**

- 7 a. Derive the one-dimensional formulation of fin (Heat transfer thin fins). (10 Marks)  
 b. Determine the temperature distribution in the rectangular fin as shown in Fig.Q7(b). Assume steady and only conduction process. Take heat generated inside the fin as  $400\text{W/m}^3$ . (06 Marks)

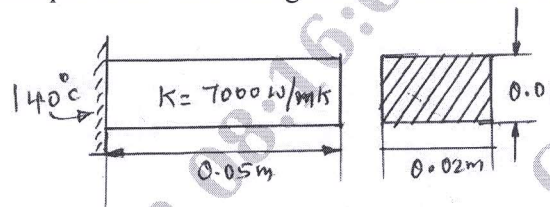


Fig.Q7(b)

**OR**

- 8 a. For the smooth pipe shown in Fig.Q8(a) with uniform cross-section of  $1\text{m}^2$ , determine the flow velocities at the centre and right end, knowing the velocity at the left is  $V_x = 2\text{m/sec}$ . (10 Marks)

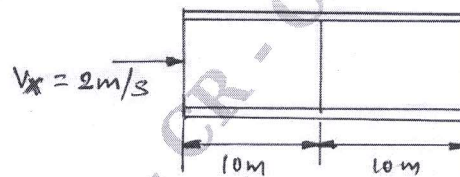


Fig.Q8(a)

- b. Derive the stiffness matrix for one dimensional fluid element. (06 Marks)

**Module-5**

- 9 a. Derive the stiffness matrix of axisymmetric bodies with triangular elements. (10 Marks)  
 b. For the element of an axisymmetric body rotating with a constant angular velocity  $\omega = 1000\text{ rev/min}$  as shown in Fig.9(b). Determine the body force vector. Include the weight of the material, where the specific density is  $7850\text{ kg/m}^3$ . (06 Marks)

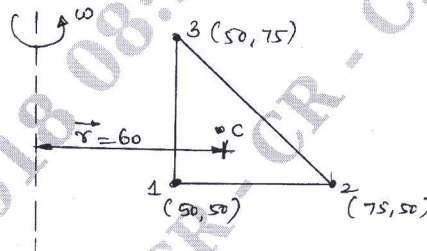


Fig.Q9(b)

**OR**

- 10 a. Derive the consistent mass matrix for truss element. (06 Marks)  
 b. Determine the natural frequency of longitudinal vibration of the bar shown in Fig.Q10(b). Take  $E = 200\text{GPa}$ ;  $\rho = 7840\text{ kg/m}^3$ ;  $A = 240\text{mm}^2$ . (10 Marks)

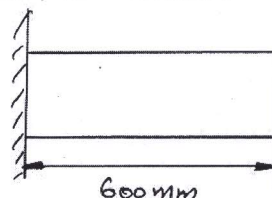


Fig.Q10(b)

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