CBCS Scheme

USN

15ME61

Sixth Semester B.E. Degree Examination, June/July 2018
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 FEM. Discuss various applications of FEA in different domain. **(04 Marks)**

b. Explain convergence requirements of a displacement field. **(04 Marks)**

c. Using minimum potential energy determine the nodal displacement of a spring system shown in Fig. Q1(c). **(08 Marks)**

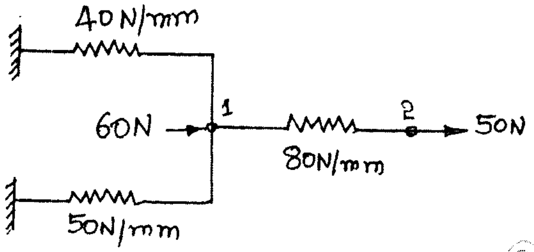

Fig.Q1(c)

OR

2 a. Using Rayleigh – Ritz method, determine the displacement at midpoint and stress variation in a one dimensional rod as shown in Fig.Q2(a). **(09 Marks)**

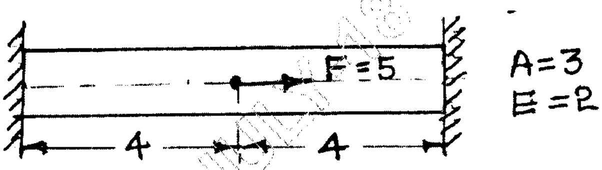

Fig.Q2(a)

b. Write stress-strain relations for plain stress and plain strain conditions. **(04 Marks)**

c. What do you mean by simplex, complex and multiplex elements? **(03 Marks)**

Module-2

3 a. What are higher order element? Derive shape function for 1D quadratic element in natural co-ordinates. **(06 Marks)**

b. Deduce expression for shape function for four noded tetrahedral element (TET4) using Lagrange interpolation functions. **(06 Marks)**

c. Evaluate $\int_{-1}^{+1} (x^2 + \sin \frac{\pi x}{2})\, dx$ using suitable Gauss points numerical integration. **(04 Marks)**

OR

4 a. For the stepped bar shown in Fig.Q4(a). Determine the nodal displacements, stress in eac element and left support reaction. **(10 Marks)**

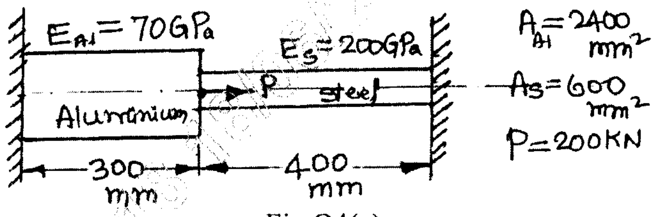

Fig.Q4(a)

b. With assumptions, deduce element stiffness matrix used for analysis of trusses. **(06 Marks)**

Module-3

5 a. Derive Hermite shape function for a beam element. **(08 Marks)**

b. For the beam and loading as shown in Fig.Q5(b), determine deflection, slope and suppo reaction. Take E = 110GPa, I = 5×10^{-4} m^4. **(08 Marks)**

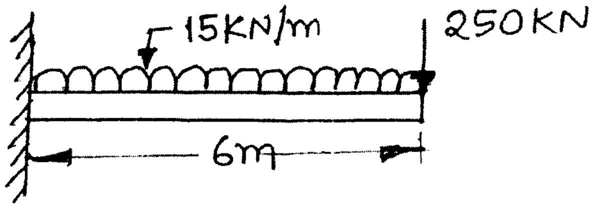

Fig.Q5(b)

OR

6 a. Derive torsional stiffness matrix for a circular shaft subjected to pure torsion. **(06 Marks)**

b. For the circulars stepped shaft shown in Fig.Q6(b) determine stresses and angle of twist. **(10 Marks)**

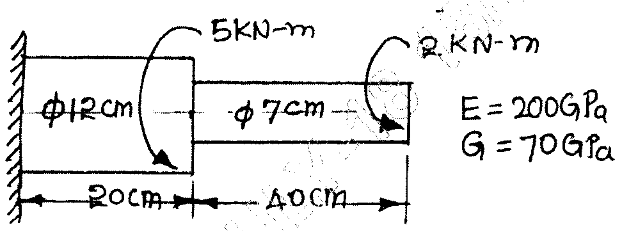

Fig.Q6(b)

Module-4

7 a. Briefly describe rate equations and boundary conditions in heat transfer analysis. **(06 Marks)**

b. Determine the temperature distribution through composite wall shown in Fig.Q7(b) whe the convective heat loss occurs on the right surface. Take K_1 = 6W/m°C an K_2 = 20 W/m°C. **(10 Marks)**

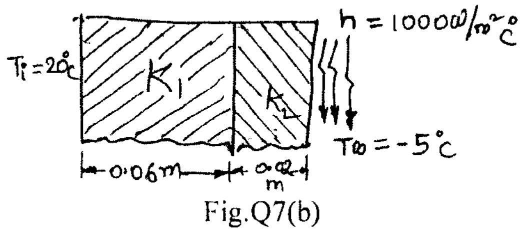

Fig.Q7(b)

OR

8 a. Deduce the governing differential equation for one-dimensional fluid flow through a process medium. **(06 Marks)**

b. For the smooth pipe of variable c/s shown in Fig.Q8(b). Determine the potential at the junction the velocities in each section of pipe and the volumetric flow rate. The potential at the left end is $P_1 = 12m^2/S$ and that at right end is $P_4 = 3\ m^2/S$. Take $K_x = 1$. **(10 Marks)**

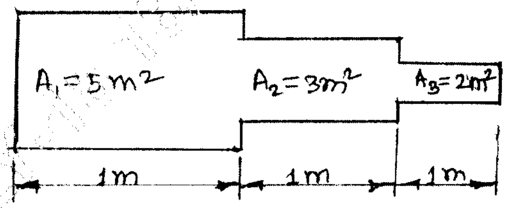

Fig.Q8(b)

Module-5

9 a. What is an axisymmetric element? Derive Jacobian matrix for axisymmetric triangular element. **(08 Marks)**

b. For the element of an axisymmetric body rotating with constant angular velocity W = 1000 rev/min as shown in Fig.Q9(b). Determine the body force vector including weight of material with specific density is 7850 kg/m^3. **(08 Marks)**

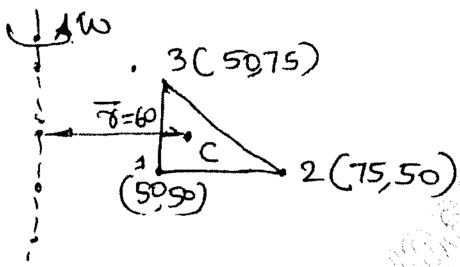

Fig.Q9(b)

OR

10 a. Derive an expression of element mass matrix for a bar element. **(06 Marks)**

b. For the stepped bar shown in Fig.Q10(b) determine the eigen values and eigen vector. Take $A_1 = 400mm^2$, $A_2 = 200mm^2$, $\rho = 7850\ kg/m^3$, E = 200GPa. **(10 Marks)**

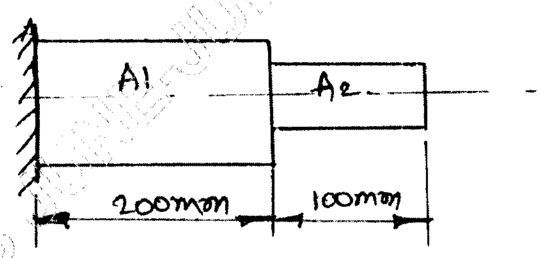

Fig.Q10(b)

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