CBCS SCHEME

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18SM61

Sixth Semester B.Tech. Degree Examination, June/July 2023
Finite Element Method

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Write the equations of equilibrium and strain displacement equation for 3D elastic problem. **(10 Marks)**

b. For the spring shown in Fig.Q.1(b). Determine the nodal displacement using principle of minimum potential energy. **(10 Marks)**

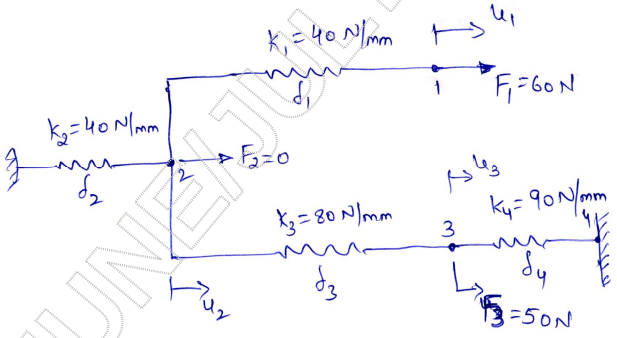


Fig.Q.1(b)

OR

2 a. Explain Rayleigh Ritz method for FEM. **(10 Marks)**

b. Explain the types of FEM elements. List the applications of FEM. **(10 Marks)**

Module-2

3 a. Using direct stiffness method, determine the nodal displacement of stepped bar as shown in Fig.Q.3(a). Also determine reaction support, stresses in each element. Take E = 200GPa. **(10 Marks)**

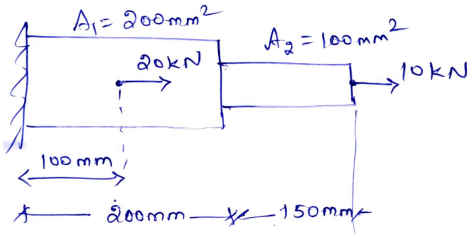


Fig.Q.3(a)

b. Derive the stiffness matrix in trusses. **(10 Marks)**

OR

4 a. For the 2 bar truss as shown in Fig.Q.4(a). Determine the displacement at node 2 and stresses in both the elements. Take E = 70GPa, A = 200mm^2. **(10 Marks)**

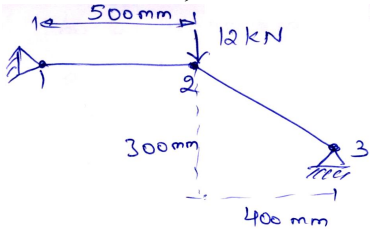


Fig.Q.4(a)

b. Derive stiffness matrix for spring element. **(10 Marks)**

Module-3

5 a. Derive the stiffness matrix for beams. **(10 Marks)**

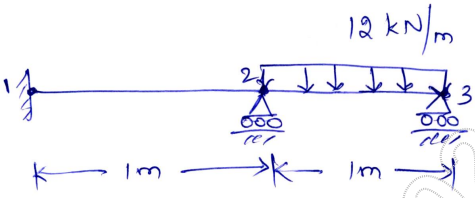
b. For the beam shown in Fig.Q.5(b). Determine:

i) Slope at node

ii) Vertical deflection at mid point of distributed load.

Take E = 200GPa, I = $4 \times 10^6 mm^4$.

Fig.Q.5(b)



(10 Marks)

OR

6 a. Derive the equation for Hermite shape function. **(10 Marks)**

b. A beam fixed at one end and supported by a roller at the other end has a 20kN concentrated load applied at the center of the stand as shown in Fig.Q.6(b). Calculate the deflection under the load. Take E = $20 \times 10^6 N/cm^2$, I = $2500 cm^4$. **(10 Marks)**

Module-4

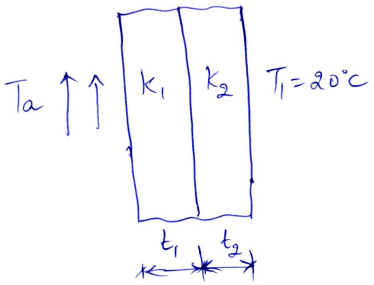
7 a. A composite slab consists of three materials with thermal conductivity of 20W/m°C, 30W/m°C, 50W/m°C and thickness 0.3m, 0.15m and 0.15m respectively. The outer surface is at 20°C and the inner surface is exposed to the convective heat transfer coefficient of 25 W/m^2°C and a medium at 800°C. Determine the temperature distribution within the wall. **(10 Marks)**

b. Write the rate equations for conduction, convection and radiation. **(10 Marks)**

OR

8 a. Determine the temperature distribution through the composite wall shown in Fig.Q.8(a) when the convection heat loss occurs on the left surface. Assume unit area. Assume wall thickness t_1 = 4cm, t_2 = 2cm, k_1 = 0.5W/cm°C, k_2 = 0.05W/cm°C, h = $0.1 W/cm^2$°C and T_a = -5°C. **(10 Marks)**

Fig.Q.8(a)



b. Write a note on fluid flow through porous medium and its analysis through FEM. **(10 Marks)**

Module-5

9 a. Define Axisymmetric solid. Write the equation of equilibrium. **(10 Marks)**

b. Write a note on consistent element mass matrix of one dimensional bar element. **(10 Marks)**

OR

10 a. Explain the formulation of point mass and distributed masses. **(10 Marks)**

b. Write a note on lumped mass matrix of bar element. **(10 Marks)**

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