CBCS SCHEME

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15AE651

Sixth Semester B.E. Degree Examination, Jan./Feb. 2021
Finite Element Method

Time: 3 hrs. Max. Marks: 80

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

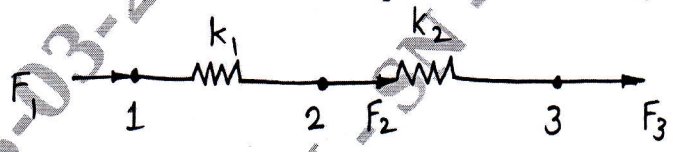
Module-1

1 a. Discuss various applications of FEA in different domains. **(04 Marks)**

b. Briefly explain the convergence requirements of a displacement model. **(04 Marks)**

c. Consider the two element system depicted in Fig.Q.1(c), given that node 1 is attached to a fixed support, yielding the displacement constraint, $u_1 = 0$, $k_1 = 5N/m$, $k_2 = 75N/m$, $F_2 = F_3 = 75N$. For these forces, find the nodal displacements u_2 and u_3. **(08 Marks)**

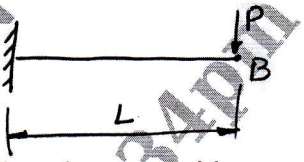
Fig.Q.1(c)



OR

2 a. A cantilever beam of span 'L' is subjected to a point load at free end. Derive an equation for deflection at free end using R-R method. Assume polynomial displacement function. **(10 Marks)**

Fig.Q.2(a)



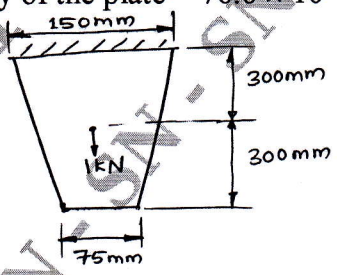
b. Explain simplex, complex and multiplex elements with example each. **(06 Marks)**

Module-2

3 a. Derive element stiffness matrix for 1D bar element. **(06 Marks)**

b. Determine displacement, stresses and support reactions for a thin plate of uniform thickness of 25mm as shown in Fig.Q.3(b), subjected to a point load of 1kN at its centre. Take value $E = 2 \times 10^5 N/mm^2$, weight density of the plate = $76.6 \times 10^{-6} N/mm^3$. **(10 Marks)**

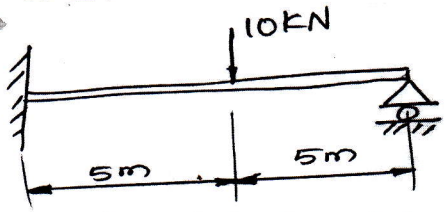
Fig.Q.3(b)



OR

4 a. For the beam element shown in Fig.Q.4(a), find the deflection under given load. Take $E = 2 \times 10^8 kN/m^2$ and $I = 4 \times 10^{-6} m^4$. **(10 Marks)**

Fig.Q.4(a)



b. Write Hermite shape function equation and plot the variation of same (only equation and sketch). **(06 Marks)**

Module-3

5 a. Derive shape function of a CST element in natural coordinate system. (08 Marks)
b. Derive stiffness matrix for 4-noded tetrahedral element. (08 Marks)

OR

6 a. Explain with a neat sketch, serendipity and Lagrange family. (08 Marks)
b. Derive shape function for eight-noded hexahedral element. (08 Marks)

Module-4

7 a. With a neat sketch, explain ISO, sub and super parametric elements. (06 Marks)
b. Explain the characteristics of Isoparametric quadrilateral elements. (10 Marks)

OR

8 a. Explain the structure of computer program for FEM analysis. (08 Marks)
b. Explain briefly the axisymmetric formulation finite element modeling of triangular element. (08 Marks)

Module-5

9 a. Deduce the governing differential equation for one-dimensional heat conduction. (06 Marks)
b. Find the distribution in the 1D fin shown in Fig.Q.9(b). Take two element for FE idealization. (10 Marks)

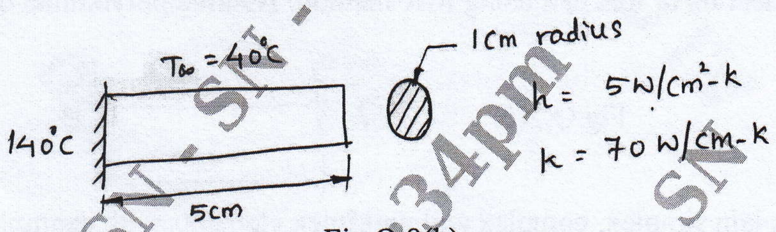


Fig.Q.9(b)

OR

10 a. Explain formulation of Hamilton's principle. (06 Marks)
b. Determine the temperature distribution through the composite wall subjected to convention heat loss on right side surface with convective heat transfer coefficient as shown in Fig.Q.10(b). take ambient temperature as -5°C. (10 Marks)

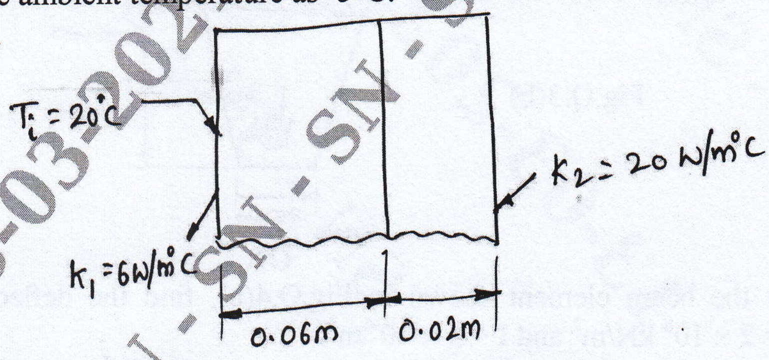


Fig.Q.10(b)

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