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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Seventh Semester, B.E. - Mechanical Engineering

Semester End Examination; Dec – 2016/Jan - 2017

Finite Element Method

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer any **FIVE** full questions, selecting atleast **ONE** full question from each **unit**.*

UNIT -I

1 a. a Differentiate between Continuum method and Finite element method 6

b. Explain the rules to guide the placement of the nodes when obtaining approximate solution to a differential equation. 6

c. Evaluate integral using Gauss quadrature formula and compare with exact value 8

$I = \int_0^3 (x^2 - 1)dx$

2 a. Explain in detail the convergence requirements for the finite element solutions. 8

b. Solve a set of simultaneous linear equations using Gaussian elimination method 12

$$2x_1 + 2x_2 + x_3 = 9$$
$$2x_1 + x_2 = 4$$
$$x_1 + x_2 + x_3 = 6$$

UNIT –II

3 a. Explain the isoparametric, subparametric and superparametric elements 6

b. Draw the shape functions of a one dimensional line element with three nodes. 4

c. Derive shape function for quadratic quadrilateral element using Lagrangian method. 10

4 a. Show that interpolation function for linear triangular elements is given by 10

$N_i = \frac{1}{2} A_e (a_i + b_i x + c_i y)$ where $i = 1, 2, 3$

b. With example distinguish between Essential and Natural boundary conditions. 5

c. State the properties of stiffness matrix. 5

UNIT -III

5. The thin plate of uniform thickness as shown in Fig. Q 5. In addition to the self weight, the plate is subjected to point load of P at mid depth. Evaluate stresses in each element 20

6. For the structure shown in Fig. Q 6. Determine the nodal displacements 20

UNIT -IV

7. A beam of length 10m as shown in Fig. Q 7, fixed at one end and supported by a roller at the other end carries a 20 kN concentrated load at the centre of the span. By taking the modulus of elasticity of material as 200 GPa and moment of inertia as 24×10^{-6} m^4, evaluate the deflection under load 20

Contd.....2

8. Determine the stiffness matrix, load vector and deflection on the beam shown in Fig. Q 8. 20

UNIT - V

9. Calculate the temperature distribution of one dimensional fin with the physical properties given below in Fig. Q9. The fin is rectangular in shape and is 8 cm long. Assume that convection heat loss occurs from the end of the fin. Model the fin by four elements. 20

10. For the composite wall shown in Fig. Q10 calculate the interface temperatures 20

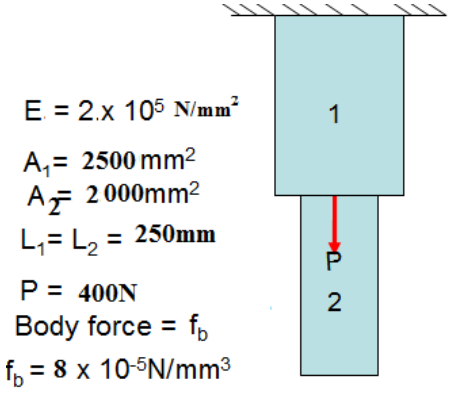


Fig. Q 5

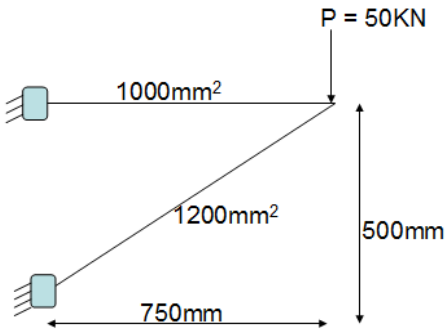


Fig. Q 6

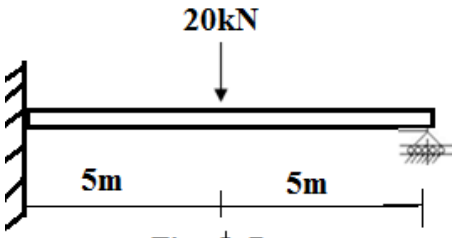
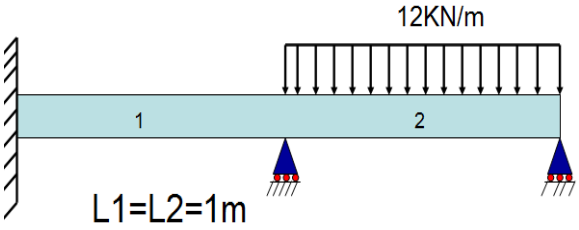


Fig. Q 7



E = 200GPa I = 4 X 10^6N/mm^4

Fig. Q 8

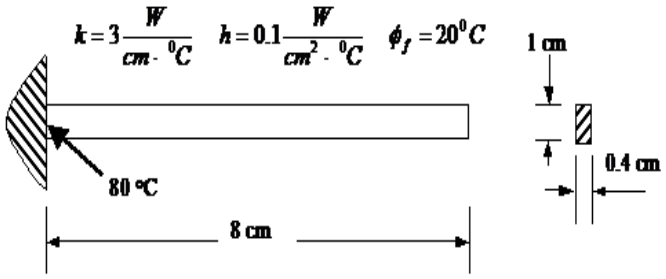


Fig. Q 9

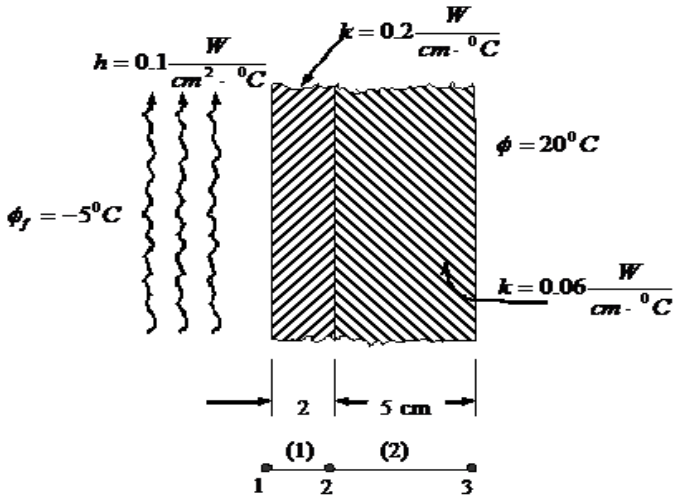


Fig. Q 10