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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

September / October 2023 Supplementary Examinations

Programme: B.E. **Semester: VI**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 20ME6DCMFE / 16ME6DCMFE **Max Marks: 100**
Course: Modelling and Finite Element Analysis **Date: 19.09.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1 a) Derive equilibrium equations in 3 D **08**

b) Derive potential energy functional for a bar element **04**

c) Use Rayleigh Ritz method to find stress and displacement at the midpoint of a bar shown in fig.1. Take E = 70 GPa, A= 100 mm^2. Assume second order polynomial for displacement. **08**

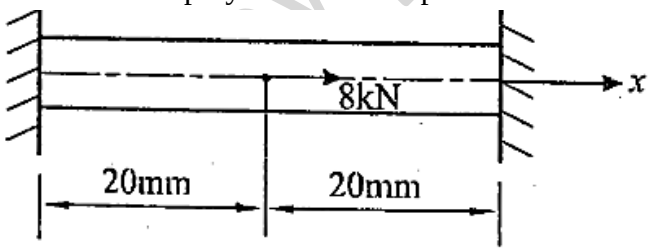

Fig. 1

OR

2 a) Compute the integral using one point and two point Gaussian quadrature $I = \int_{-1}^{+1} \left(3e^{\xi} + \xi^2 + \frac{1}{\xi+2}\right)$ **06**

b) For a spring element shown in fig.2, determine the nodal displacements using principle of minimum potential energy **06**

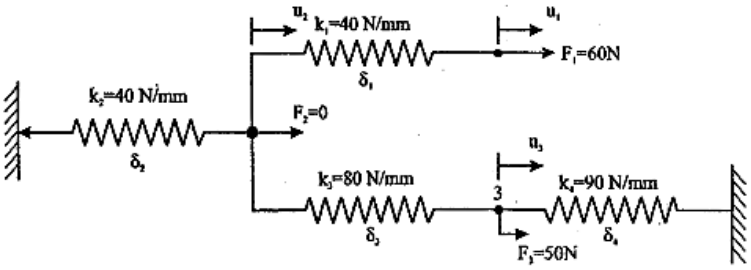

Fig.2

c) Using Galerkin's method, find the expression for displacement of cantilever beam shown in fig.3 **08**

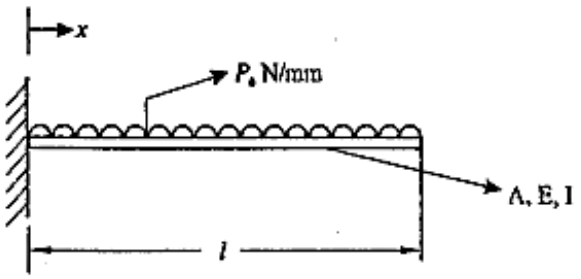

Fig. 3

UNIT - II

3 a) Derive the shape functions for 1-D bar element in Global coordinate and natural coordinate system. **10**

b) Consider the bar shown in fig 4. An axial load of 200 KN is applied as shown in figure. (a) Determine nodal displacement (b) Stresses in each element (c) Determine the reaction forces **10**

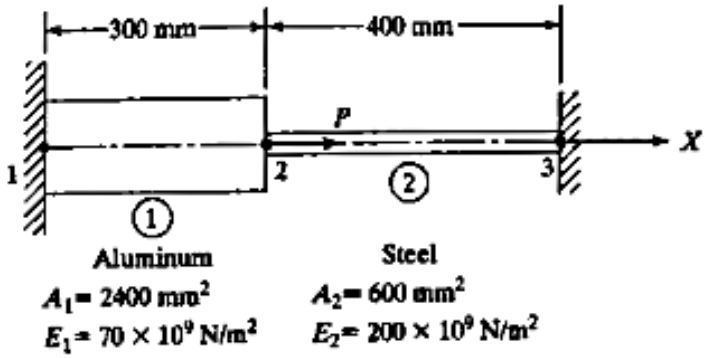

Figure 4

UNIT - III

4 a) For the truss shown in fig.5, determine nodal displacements, element stresses and support reactions given E = 2 x 10^5 N/mm^2, A= 200 mm^2 **14**

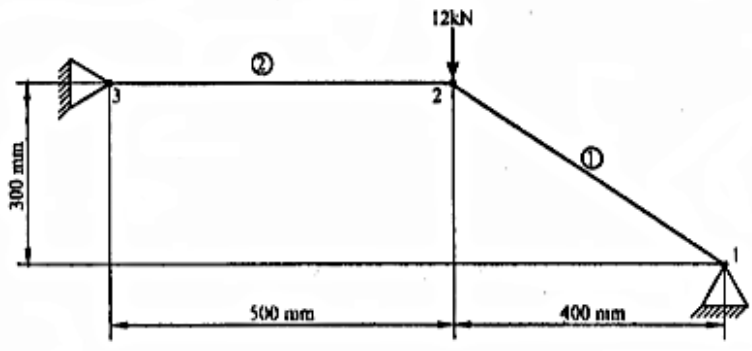

Fig. 5

b) Derive Hermitian shape function for a beam element. **06**

UNIT - IV

5 a) Sketch 2D constant strain element indicating the degrees of freedom. Compute expressions **10**
i) Jacobean
ii) Strain displacement matrix

b) A CST element has coordinates 1(0, 0), 2(250, 0) and 3(250, 250) and thickness 20mm. E = 200 GPa and ν = 0.25. If element displacement vector is given by $\{0, 0, 0.001, 0.002, -0.003, 0.002\}^T$mm, determine the element stress under plane stress condition. **10**

OR

6 a) Formulate the shape function for 1-D cubic Bar element and sketch their variations. **08**

b) Discuss the characteristics of Iso-parametric, Sub-parametric and Super-parametric elements **06**

c) Explain convergence ctiteria. **06**

UNIT - V

7 a) Derive conductivity matrix due to conduction for 1D heat transfer element **06**

b) Derive shape function for 1D heat transfer element in natural and global coordinates **06**

c) Determine the nodal temperatures for the composite wall shown in fig. 6 **08**

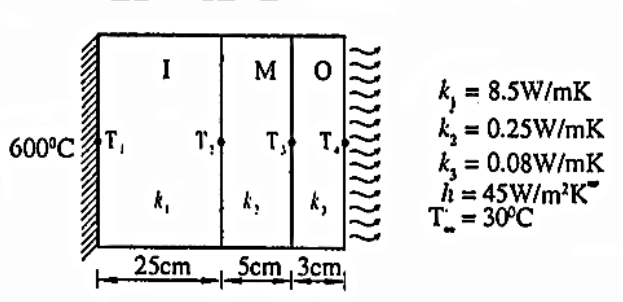

Fig. 6

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