Code No: **R31031** **R10** **Set No. 1**

III B.Tech I Semester Supplementary Examinations, October/November - 2017

FINITE ELEMENT METHODS

(Common to Mechanical Engineering and Automobile Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any FIVE Questions
All Questions carry equal marks

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1 a) Write the advantages, disadvantages and applications of FEM. [7M]

b) Explain the potential energy formulation for obtaining element equations in Finite element methods. [8M]

2 a) What is the importance of natural coordinate system in the formulation of the finite element equations? Obtain the interpolation functions for a two noded axial element using local coordinate system, global coordinate system and natural coordinate system. [7M]

b) Discuss the effect of element shape and size on the convergence of the finite element solution. [8M]

3 Estimate the displacement vector, stresses and reactions for the truss structure as shown in fig.1 E= 20 x 10^6 N/cm^2, A=200mm^2 [15M]

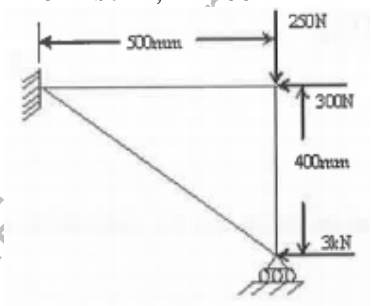

Fig.1

4 a) Derive Hermite shape functions and also discuss its properties. [7M]

b) Obtain the finite element equations for a beam element using the Hermite shape functions. [8M]

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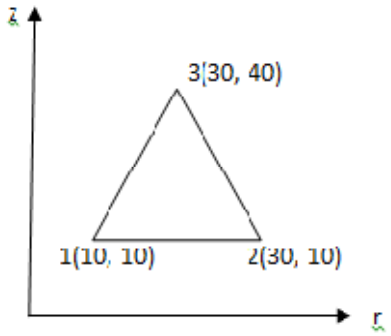
5 a) Derive the stiffness matrix for CST element. [7M]
b) Nodal coordinates for an Axi-Symmetric element are given below. Evaluate Stiffness Matrix. E=2x10^{5}N/mm^2, υ = 0.25. [8M]



6 a) Derive the shape functions of two dimensional four noded iso-parametric elements. Plot the shape functions. [7M]
b) Write a note on two point integration rule for 1-D and 2-D problems. [8M]

7 A circular fin of inner diameter 200 mm and outer diameter of 300 mm transfers heat from a small motorcycle engine. If the average engine surface temperature is 200^0 C, determine the temperature distribution along the fin surface. The thermal conductivity of the fin material is 20 W/m ^{0}C and the convective heat transfer coefficient between the fin and the atmosphere is 120W/m^{20}C. Assume an atmospheric temperature of 30^{0}C. Use at least three one dimensional elements. [15M]

8 Explain the following [15M]
a) Consistent vs. lumped mass matrices
b) Free vibration analysis using FEM.

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