[4960] - 1070

M.E. (Mechanical) (Design)

FINITE ELEMENT METHOD

(2013 Pattern)

Time : 3 Hours]

[Max. Marks :50

Instructions to the candidates:

1) Answer any five questions.

2) Figures to the right indicate full marks.

Q1) a) Distinguish between FEM & FDM. **[5]**

b) Sketch the shape functions of one dimensional beam element with 2 DoF (vertical displacement & rotation) at each node. **[5]**

Q2) a) Explain in brief with the help of a field problem in engineering the following terms in FEM. **[5]**

   i)   Physical model.

   ii) Mathematical model with differential equation.

   iii) FEM model.

   iv) Element matrix equations.

b) Solve following equation using two parameter trial solution by **[5]**

   i)   Point collocation method (Residual at $x = \frac{1}{3}$ & $x = \frac{2}{3}$ made equal to zero)

   ii) Galerkin method

   $$\frac{dy}{dx} - x = 0$$

   with $y(0) = 1$ and domain from $x = 0$ to $x = 1$.

P.T.O.

Q3) a) Evaluate the integral **[5]**

$$I = \int_{-1}^{1} (x^3 - 4x^2 + 2x + 8).\,dx$$

with two Gauss point numerical integration. Compare results with exact integration.

b) Explain what do you mean by Isoparametric formulation. Why do we use isoparametric elements instead of sub-parametric & superparametric ones. **[5]**

Q4) a) A quadrilateral element is defined by co-ordinates (1, 4), (4, 2), (5, 6) & (2,7). The temperature at these nodes are 20, 30, 40 and 25°C. Determine the temperature at Point P(3, 4). **[5]**

b) Explain how node numbering affects bandwidth of stiffness matrix in FEM. **[5]**

Q5) a) Explain why a linear triangular element (CST) is stiff element. Suggest suitable remedies for this element in Industry practice. **[5]**

b) Differentiate between Kirchoff's and Mindlin's theory for thin plate formulations. **[5]**

Q6) a) Compare linear & non-linear finite element analysis with respect to **[5]**

   i) Load displacement relation.

   ii) Stress strain relation.

   iii) Superposition.

   iv) Reversibility.

b) Differentiate between Newton Raphson & Modified Newton Raphson procedure for solving non-linear problem. **[5]**

Q7) a) Classify different types of dynamic problems. Explain briefly which matrix equations are solved in **[5]**

   i) Free vibration problems.

   ii) Transient problems.

b) Find first two natural frequencies of a bar with one end fixed with following details : **[5]**

Length = 1m   Area = 30 mm²

E = 2 × 10⁵ MPa

Density = 7800 kg/m³

Use two elements and lumped mass matrix approach.

Q8) a) Differentiate between 'h' & 'p' refinement techniques with suitable example. **[5]**

b) Explain what do you understand by submodeling. Give practical examples where the approach is useful. **[5]**