T.E. (SEM.-VI) (CBSGS) (MECHANICAL ENGG.)
FINITE ELEMENT ANALYSIS

19th Dec. 2015
3.00 pm to 6.00 pm

**QP Code : 6470**

**Revised Course**

**(3 Hours)** **[Total Marks : 80**

N.B
1. Question No. 1 is compulsory
2. Attempt any four questions from remaining FIVE.
3. Assume suitable data if required.
4. Figures to the right indicate full marks.

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1. Attempt any four of following;
   a. Explain applications of FEA in various fields. 5
   b. State different types of Boundary conditions. 5
   c. Explain with sketches: types of elements. 5
   d. Explain Shape function graphically for one dimensional Linear and quadratic element. 5
   e. Explain Gauss Elimination Method using an example. 5

2. a. Solve following differential equation 12

$$\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} - 6y = 0; \qquad 0 \le x \le 1$$

BCs: y (0) = 0 and y' (1) = 0.1; Find y(0.2) using variational method and Compare with exact solution

b. Evaluate following integral $I = \int_{-1}^{1} (3^x - x)\,dx$ 8

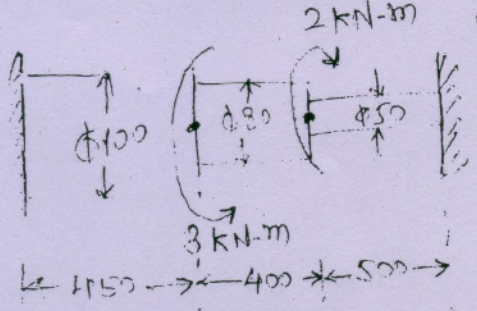
Using (a) Newton Cotes Method using 3 sampling points.
(b) Three points Gauss Quadrature

| r | $W_1$ | $W_2$ | $W_3$ | $W_4$ |
|---|---|---|---|---|
| 1 | 1 | | | |
| 2 | 1/2 | 1/2 | | |
| 3 | 1/6 | 4/6 | 1/6 | |
| 4 | 1/8 | 3/8 | 3/8 | 1/8 |

| r | $\xi_i$ | $W_i$ |
|---|---|---|
| 1 | 0.00 | 2.00 |
| 2 | 0.5773 | 1.00 |
| 3 | 0.00 | 0.8889 |
| | 0.7746 | 0.5556 |

3. a. Find the natural frequency of axial Vibrations of a bar of uniform cross section of 20 $mm^2$ and length 1 m. Take, E = 2 × $10^5$ $N/mm^2$ and ρ = 8000 $kg/m^3$. Consider two linear elements. 10

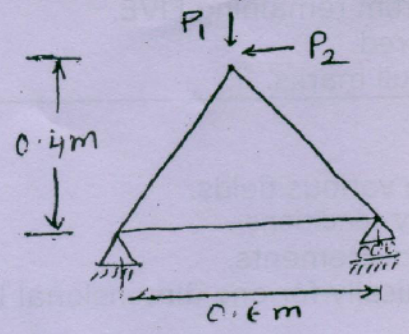
b. Using Direct Stiffness method, determine the nodal displacements of stepped bar shown in figure. Take, G = 100 GPa. 10




**[TURN OVER**

4. a. Explain Lumped and consistent mass matrix. **6**

b. Analysis the plane truss for nodal displacement, element stresses and srtains. Take , $P_1 = 5$ KN, $P_2 = 2$ KN, E = 180 Gpa, A = 6 $cm_2$ for all elements. **14**

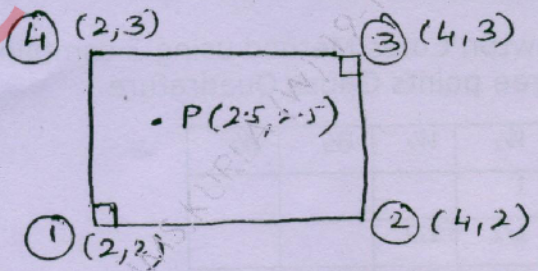



5. a. Solve following differential equation $\frac{d^2y}{dx^2} - 10x^2 = 5; \quad 0 \le x \le 1$ **12**

BCs: y0) = y(1) = 0. Using Rayleigh-Ritz method, mapped over entire domain using one parameter method

b. Find the shape function for two dimensional eight noded element. **8**

6. a. Coordinates of nodes of a quadrilateral element are as shown in the figure below. Temperature distribution at each node is computed as $T_1 = 100^0$ C, $T_2 = 60^0$ C, $T_3 = 50^0$ C and $T_4 = 90^0$ C. compute temperature at point P (2.5, 2.5). **10**




b. What are the h and p versions of finite element method? 7

c. Convergence requirement. 3

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