Mechanical/Automobile

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   5
       element.
    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
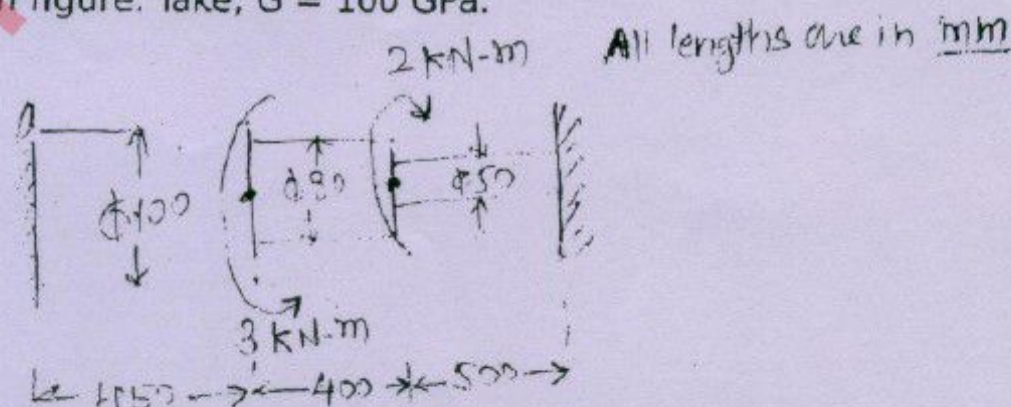   Compare with exact solution

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

   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

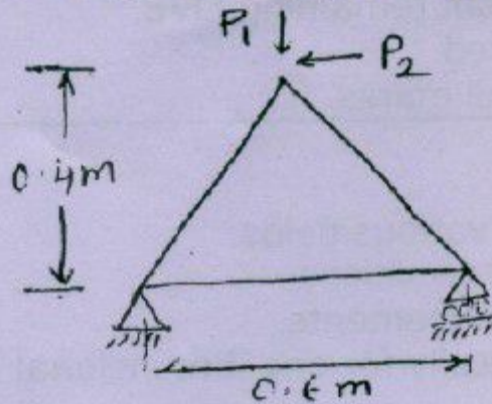| r	ξ_i	W_i
1	0.00	2.00
2	0.5773	1.00
3	0.00	0.8889
	0.7746	0.5556

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

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

2 kN-m   All lengths are in mm

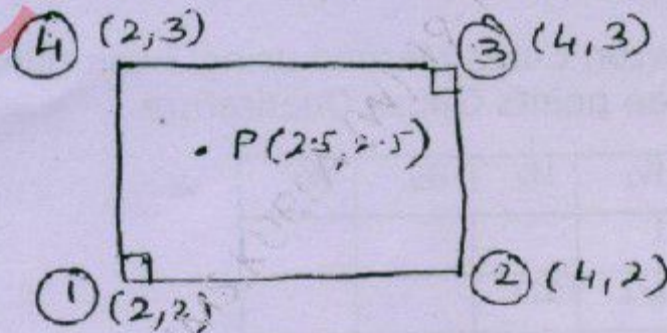3 kN-m

ke 1150 →←—400 —*←—500—→

[TURN OVER

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

   b. Analysis the plane truss for nodal displacement, element stresses and srtains. **14** Take , $P_1 = 5$ KN, $P_2 = 2$ KN, $E = 180$ Gpa, $A = 6$ cm2 for all elements.

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

   b. What are the h and p versions of finite element method? **7**
   c. Convergence requirement. **3**

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