Total No. of Questions : 8]   [Total No. of Printed Pages : 4

Roll No

MMIP-205
## M.E./M.Tech., II Semesters
Examination, May 2018
Finite Element and Computer Aided Engineering
Time : Three Hours
Maximum Marks : 70

Note: i) Attempt any five questions.
ii) All questions carry equal marks.
iii) Assume suitable data, if any.

1. a) A rod fixed at its ends is subjected to a varying body force as shown in figure. Use the Rayleigh-Ritz method with an assumed displacement field $u = a_0 + a_1 x + a_2 x^2$ to determine displacement $u(x)$ and stress $\sigma(x)$

$E = 2 \times 10^{11}$ N/m^2
$A = 1$ m^2
$L = 1$ m
$f = 2x^3 + x$
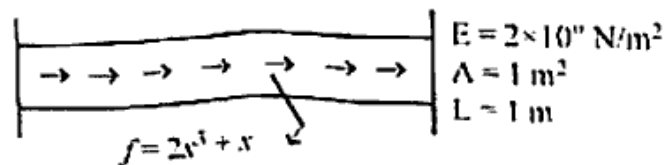
b) Consider the differential equation along with the initial condition

$$\frac{dy}{dx} + 3u = x, \quad 0 \leq x \leq 1$$

$$u(0) = 1$$

Solving this using Galerkin's method assuming an initial approximation $u = a + bx + cx^2$

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2. a) Consider the functional I for minimization given by

$$I = \int_0^L \frac{1}{2} k \left(\frac{\partial y}{\partial x} \right)^2 dx + \frac{1}{2} h (a_0 - 800)^2 \text{ with } y = 20 \text{ at } x = 60.$$

Given $k = 20$, $h = 25$ and $L = 60$, determine a_0, a_1 and a_2 using the polynomial approximation $y(x) = a_0 + a_1 x + a_2 x^2$ in the Rayleigh-Ritz method.

b) A two-element finite element solution for a rod in following figure has been obtained as $Q = [0 \quad 0.5 \quad 0.25]^t$ mm. If the element shape function used where $N_1 = \frac{[1 - \xi]^2}{4}$.

$N_2 = \frac{[1 + \xi]^2}{4}$ evaluate the displacement u at the midpoint of element 1 - 2.
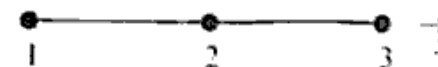
3. a) What is the basic idea of MESH GENERATION SCHEME? Explain it by given suitable example.

b) What is Counter Plotting and explain its applications?

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4. a) What is the system customization and Design Automation.

b) for the beam and loading shown in following fig.

determine (1) the slope at 2 and 3 and (2) the verticle deflection at the midpoint of the distributed load.

12 kN/m

① ②

I m — I m

E - 200 GPa   I = 4×10⁶ mm⁴

6000N   6000N

1000N-m   1000N-m

2   3
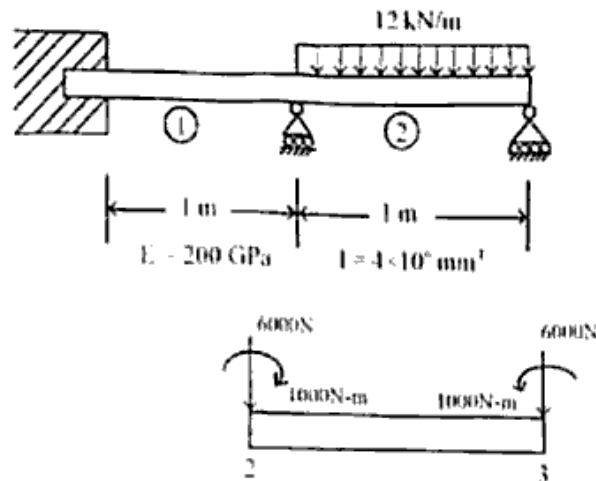
5. a) Determine the stiffness matrix for beams on elastic support.

b) Determine the modelling and boundary conditions for overlaying beams with gap.

6. a) Find the deflection at the load and the slopes at the ends for the steel shaft shown in fig. consider the shaft to be simply supported at bearings A and B.

$I_1 = 5 \times 10^4$ mm⁴   2000N

$I_2 = 3 \times 10^4$

A   B

150 mm — 75 mm — 125mm

E = 200 GPa
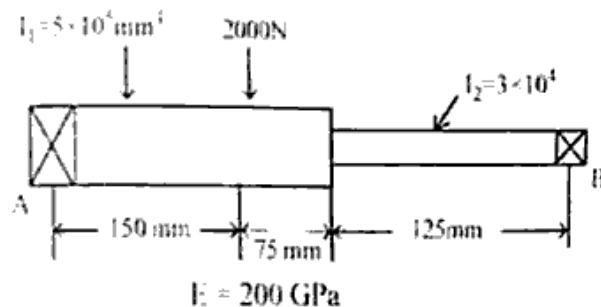
b) Determine the stiffness matrix for Plane Frames.

a) A three span beam is shown in fig. Determine the deflection curve of the beam and evaluate the reaction at the supports.

1500 lb/ft

4000 lb

A   B   C   D   E

5 ft — 5 ft — 8 ft — 6 ft

E = 30×10⁶ psi

I = 305 in⁴
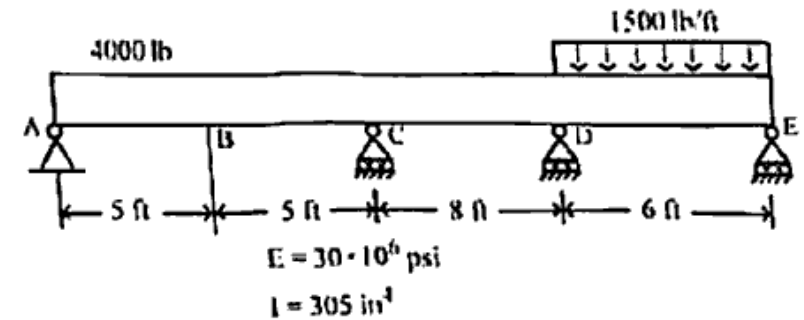
b) Discuss the shape function for beam element.

8. Write short notes on:

a) Weighted residual approach

b) Product data exchange (IGES/STEP)

c) Variational formulation

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