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Question Paper Code : 41043

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Sixth Semester

Mechanical Engineering

080120032 – FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering)

(Regulation 2008)

Time : Three hours — Maximum : 100 marks

Instructions :

Answer ALL questions.

Any missing data may be suitable assumed.

PART A — (10 × 2 = 20 marks)

1. What is the principle of skyline solution based on Gaussian elimination?

2. Mention the basic steps of Galerkin method.

3. What is the need for coordinate transformation in solving truss problems?

4. Illustrate the two Hermite shape functions associated with slope as applicable for beam element.

5. Specify the strain displacement matrix of CST element and comment on it.

6. What are non-homogenours boundary conditions? Give an example.

7. Sketch a finite element model for a long cylinder subjected to an internal pressure using axisymmetric elements.

8. Distinguish between plane stress and plane strain conditions.

9. What are superparametric elements? Give an example.

10. Specify the shape functions of four node quadrilateral element.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Describe the historical background of FEM. (6)

(ii) Explain the relevance of FEA for solving design problems with the aid of examples. (10)

Or

(b) A rod fixed at its ends is subjected to a varying body force as shown in Fig.1. 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 $\sigma(x)$.

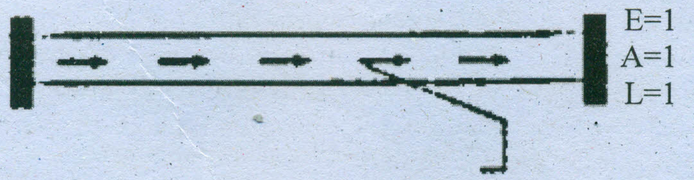

Fig. 1

12. (a) Determine the extension of the bar shown in Fig. 2 due to self weight and a concentrated load of 600N applied at its end. Given b_1 = 200 mm. b_2 = 100 mm and t = 20 mm. Use two spar elements to solve the problem. Take $E = 2\times10^5 N/mm^2$ and $\rho = 0.8\times10^{-4} N/mm^3$.

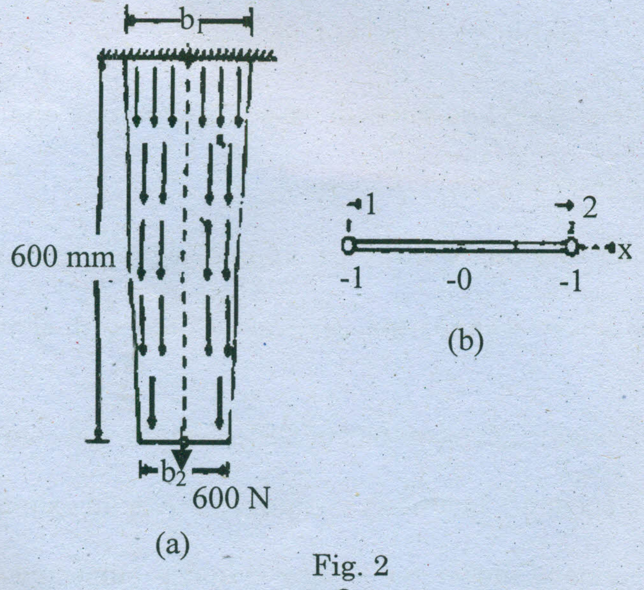

Fig. 2

Or

(b) A cantilever beam of length 3.4 m has an elastic spring support of stiffness 230 kN/m at its free end, where a point load of 13 kN acts. Take Young's modulus as 200 GPa and area moment of inertia of the cross-section as $1\times10^{-4} m^4$. Determine the displacement and slope at the node and the reactions.

13\. (a) Derive the characteristic matrix for a two dimensional heat conduction problem using triangular element by Galerkin approach.

Or

(b) Consider a rectangular plate of length 3500 mm and width 2500 mm having a thickness of 300 mm. It is subjected to a uniform heat source of 200 W/m^3 acting over the whole body. The temperature of the top side of the body is maintained at 130°C. The body is insulated on the other edges. Take the thermal conductivity of the material as 35 W/m°C. Determine the temperature distribution using triangular elements.

14\. (a) A triangular plate of thickness 9 mm has vertices P(40, 40), Q(100, 40) and R(70, 130). It is fixed at P and supported on rollers at Q. There is a vertical downward load of 5 kN applied at R. Take Young's modulus as 200 GPa. Determine the nodal displacements accounting for body weight. Take density of material as 7800 kg/m^3.

Or

(b) Establish the shape functions and derive the strain displacement matrix for an axisymmetric triangular element.

15\. (a) A four node quadrilateral element is defined by nodal coordinates (in 'mm') as 1(3, 8), 2(10, 5), 3(12, 18) and 4(5, 16). The nodal displacement vector is given by $q = [0,0,2,0,1.6,1.2,0,0.6]^T$.

Evaluate the stress at the point P(7, 12) of the element, assuming plane stress condition. Take Young's modulus and Poisson's ratio as $30 \times 10^6\ N/m^2$ and 0.3 respectively.

Or

(b) Derive the body force and traction (uniformly distributed) force vectors for four node quadrilateral element.

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