Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VI • EXAMINATION – SUMMER • 2014

Subject Code: 163401 Date: 19-05-2014

Subject Name: Finite Element Analysis in manufacturing engineering

Time: 10:30 am - 01:00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Explain Rayleigh-Ritz method with example. **07**

(b) Explain the Galerkin approach with all force terms. **07**

Q.2 **(a)** Explain the elimination approach of imposing boundary conditions. **07**

(b) Explain any two Gaussian elimination methods. **07**

OR

(b) Explain the penalty approach of imposing boundary conditions. **07**

Q.3 **(a)** Discuss shape function and quadratic shape functions with respect to one dimensional problem. **07**

(b) Consider the thin (steel) plate in fig.-(1) the plate has a uniform thickness t = 1 in., young's modulus E = 30 x 10^6 psi, and weight density ρ = 0.2836 lb/in^3 . In addition to its self-weight, the plate is subjected to a pint load P = 100 lb at its mid point. **07**

1) Model the plate with two finite elements.
2) Write down expressions for the element stiffness matrices and element body force vectors.
3) Assemble the structural stiffness matrix K and global load vector F.
4) Using the elimination approach, solve for the global displacement vector-Q.
5) Evaluate the stresses in each element.
6) Determine the reaction force at the support.

OR

Q.3 **(a)** Explain the potential energy approach with all force terms. **07**

(b) Explain the temperature effect in one dimensional problem with example. **07**

Q.4 **(a)** Consider the bar shown in fig.-(2). An axial load P = 200 x 10^3 N is applied as shown. Using the penalty approach for handling boundary conditions, do the following: **07**

1) Determine the nodal displacements.
2) Determine the stress in each material.
3) Determine the reaction forces.

(b) Explain the properties of stiffness matrix K. **07**

OR

Q.4 **(a)** An axial load P = 300 x 10^3 N is applied at 20°C to the rod as shown in fig.-(3). The temperature is then raised to 60°C. **07**

1) Assemble the K and F matrices.
2) Determine the nodal displacements and element stresses.

(b) Consider the four bar truss shown in fig.-(4). It is given that E= 29.5 x 10^6 psi and A_e = 1 $in.^2$ for all elements. Determine the element stiffness matrix for each element and assemble the structural stiffness matrix K for the entire truss. **07**

Q.5 **(a)** Explain the axisymmetric FEA of a pressure vessel. **07**

(b) Explain the FEA simulation of solidification of castings. **07**

OR

Q.5 **(a)** Explain the application of FEM in various metals forming process. **07**

(b) Explain the FEA simulation of metal cutting process. **07**

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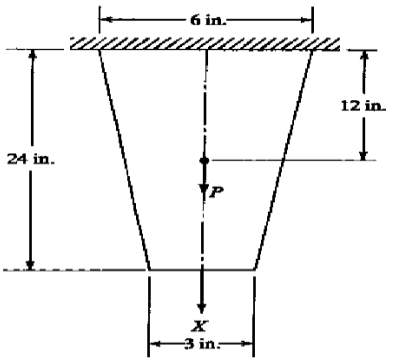
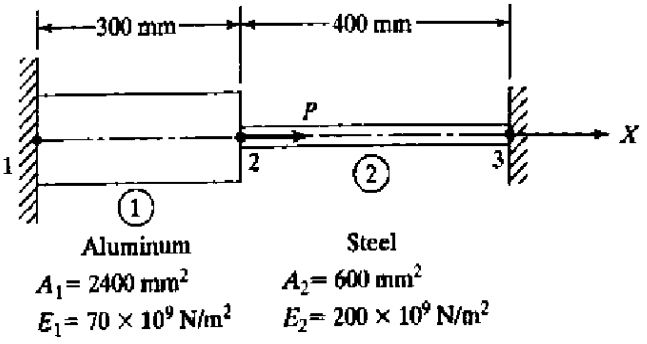
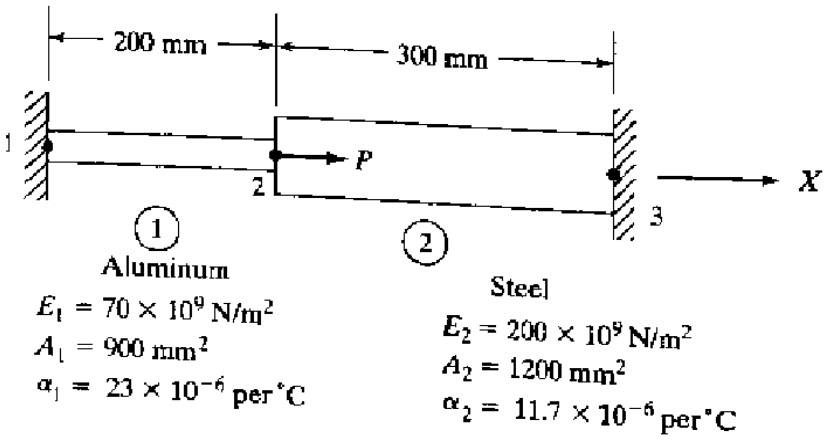


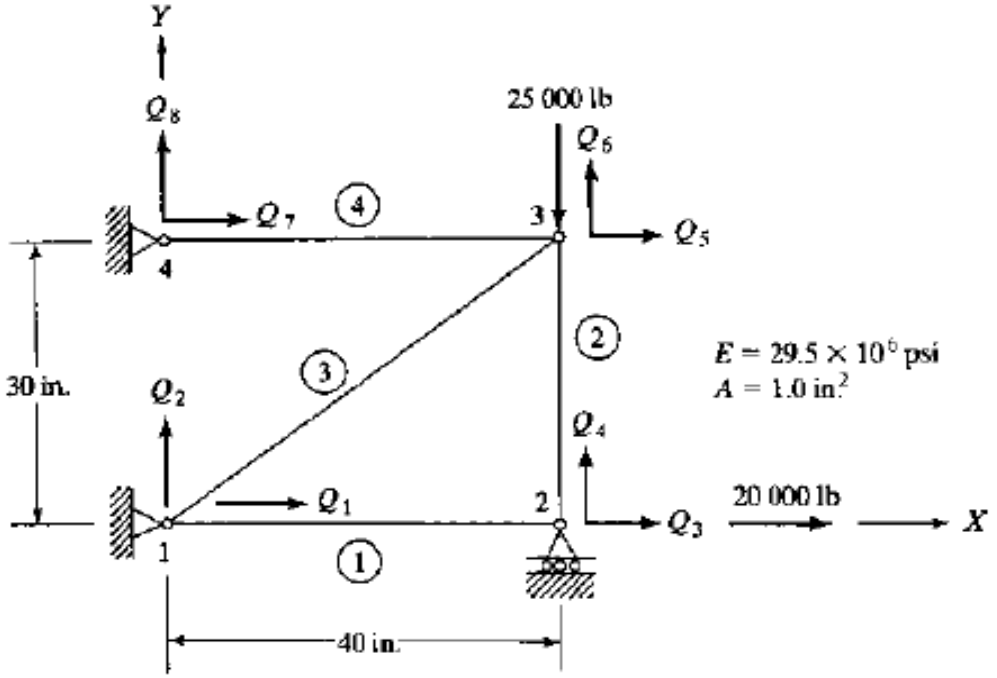
Q.3 (b) Fig.-(1)



Q.4 (a) Fig.-(2)



Q.4 (a) Fig.-(3)



Q.4 (b) Fig.-(4)