Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI • EXAMINATION – WINTER • 2014**

**Subject Code: 163401 Date: 26-11-2014**

**Subject Name: FEA in manufacturing engineering**

**Time:02:30 pm - 05:00 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 the elimination approach of imposing boundary conditions. | **07** |
| | **(b)** | Explain the penalty approach of imposing boundary conditions. | **07** |
| **Q.2** | **(a)** | Explain Rayleigh-Ritz method with example. | **07** |
| | **(b)** | Explain any two Gaussian elimination methods. | **07** |
| | | **OR** | |
| | **(b)** | Explain the Galerkin approach with all force terms. | **07** |
| **Q.3** | **(a)** | Explain the temperature effect in one dimensional problem with example. | **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 $\rho$ = 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.<br>1) Model the plate with two finite elements.<br>2) Write down expressions for the element stiffness matrices and element body force vectors.<br>3) Assemble the structural stiffness matrix K and global load vector F.<br>4) Using the elimination approach, solve for the global displacement vector-Q.<br>5) Evaluate the stresses in each element.<br>6) Determine the reaction force at the support. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Explain the potential energy approach with all force terms. | **07** |
| | **(b)** | Discuss shape function and quadratic shape functions with respect to one dimensional problem. | **07** |
| **Q.4** | **(a)** | An axial load P = 300 x $10^3$ N is applied at 20°C to the rod as shown in fig.-(2). The temperature is then raised to 60°C.<br>1) Assemble the K and F matrices.<br>2) Determine the nodal displacements and element stresses. | **07** |
| | **(b)** | Explain the properties of stiffness matrix K. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | For the configuration shown in Fig.-(3), determine the deflection at the point of load application using a one-element model. If a mesh of several triangular elements is used, comment on the stress values in the elements close to the tip. | **07** |
| | **(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 metal cutting process. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Explain the application of FEM in various metals forming process. | **07** |

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

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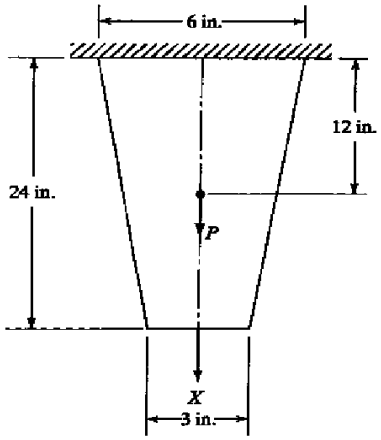
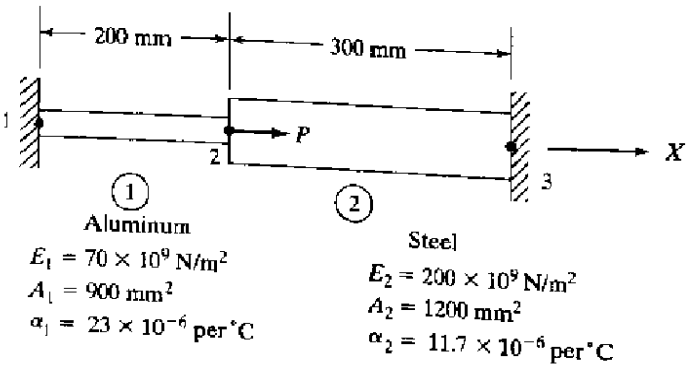
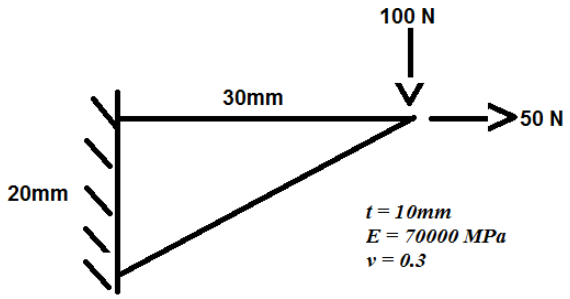


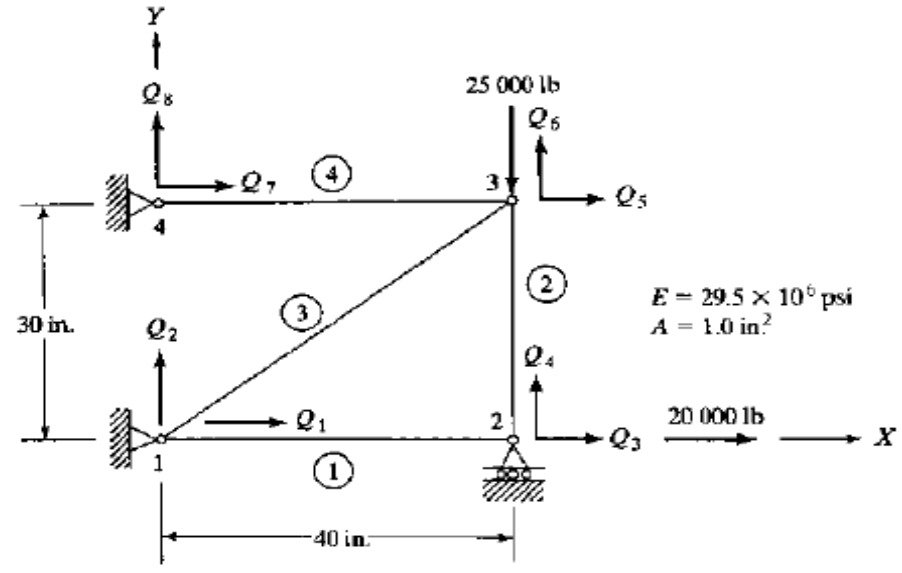

**Q.3 (b) Fig.-(1)**




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




**Q.4 (b) Fig.-(3)**




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