

GUJARAT TECHNOLOGICAL UNIVERSITY**BE - SEMESTER-VIII (NEW) EXAMINATION – WINTER 2017****Subject Code: 2181911****Date: 10/11/2017****Subject Name: Finite Elements Method(Department Elective II)****Time:02:30 PM TO 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) Define: Nodes, Primary Nodes, Secondary Nodes and Internal Nodes. **03**
 (b) How will you discretise the FEA model in 1D, 2D and 3D. **04**
 (c) List and describe the general steps of the Finite Element Method. **07**

- Q.2** (a) Explain: Local Coordinates, Global Coordinates, Natural Coordinates and Area Coordinates. **03**
 (b) Explain the penalty approach of imposing boundary conditions. **04**
 (c) Explain Gaussian Elimination method with example. **07**

OR

- (c) Consider the bar shown in fig. an axial load $P = 200 \times 10^3 \text{N}$ is applied as shown in **Fig. 1**. Using the penalty approach for handling boundary conditions do the following: **07**
 a) Determine the nodal displacements. b) Determine the stress in each material
 c) Determine the reaction forces.

- Q.3** (a) Write the expression for potential energy π . **03**
 (b) Explain the axisymmetric FEA of a pressure vessel. **04**
 (c) Obtain a shape function and stiffness matrix for four noded quadrilateral **07**
 07 element.

OR

- Q.3** (a) List out Euler-Lagrange Equation. **03**
 (b) Explain the properties of stiffness matrix K . **04**
 (c) Explain Rayleigh-Ritz method with example. **07**
- Q.4** (a) Explain the FEA simulation of solidification of castings. **03**
 (b) What are the Field problems in FEA? What is advantage and disadvantage of FEA? **04**
 (c) Explain the temperature effect in one dimensional problem. **07**

OR

- Q.4** (a) Explain applications of FEM in metal cutting process. **03**
- (b) Explain Consistent and Lumped mass matrices. **04**
- (c) Consider the thin (steel) plate as shown in **Fig. 2**. The plate has a uniform thickness $t = 1$ in., young's modulus $E = 30 \times 10^6$ psi, and weight density $\rho = 0.2836$ lb/in³. 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.

- Q.5** (a) Discuss the term CST & LST. **03**
- (b) Explain the potential energy approach with all force terms. **04**
- (c) Explain the Galerkin approach in detail. **07**

OR

- Q.5** (a) Explain stress- strain relations in linear elastic material for FEA? **03**
- (b) Discuss shape function and quadratic shape functions with respect to one dimensional problem. **04**
- (c) List out the software used to solve FEM problems and discuss the applications of FEM. **07**

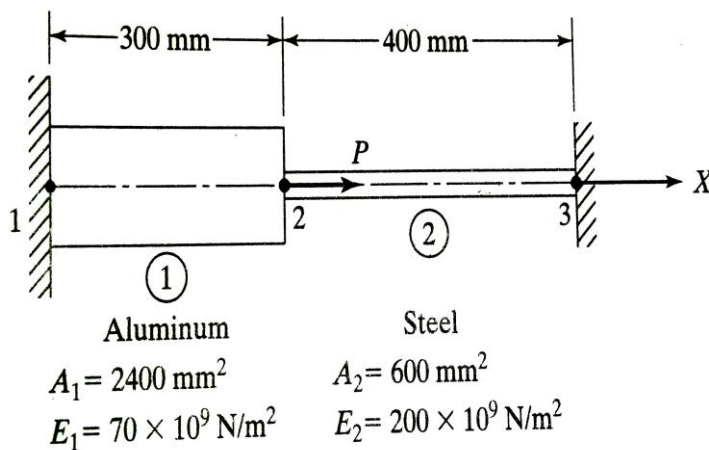


Fig. 1.

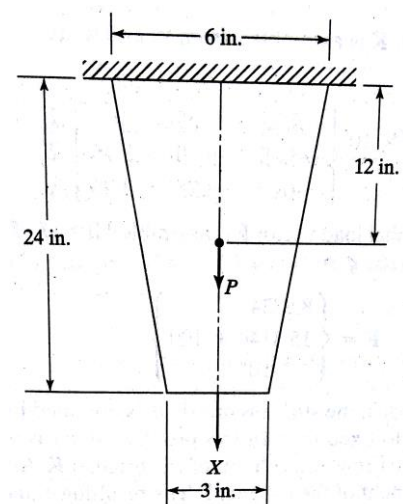


Fig. 2.
