

Roll No .....

**MMAE-101****M.E/M.Tech. I Semester**

Examination, June 2017

**Finite Element Methods in Automobile Design***Time : Three Hours**Maximum Marks : 70*

**Note:** i) Attempt any five questions. All questions carry equal marks.  
 ii) Assume missing data suitably, if any.  
 iii) Draw neat and clean sketches/diagrams/figures wherever required.

1. a) What is the Finite Element Method (FEM)? Write about Least Square Method.  
 b) List classification of FEM methods. State the steps to be used in variational method of FEM. Compare it with subdomain method.
2. a) What is discretization? Write down the Node Numbering Scheme.  
 b) What are the various types of elements and nodes in FEM? Give example.
3. a) What is global, local and natural co-ordinates? Write about Quadratic Triangle Element? Compare it with other type of elements.  
 b) Compare 1D and 2D elements. Derive an expression for Consistent Mass Matrix of a Triangular Bending Element.

4. a) What is weighted residual method? Discuss any one of weighted residual method.  
 b) Discuss giving suitable example, applications of FEM applied to acoustics problems.
5. a) Find the natural frequency of vibration of a fixed-free bar in axial motion based on a one-element model using lumped mass matrix.  
 b) List FEM software packages available in market. Discuss the steps of Finite Element Analysis to solve Fluid mechanics problems Using ANSYS software.
6. a) Discuss various steps of contact analysis of gears using FEA.  
 b) Determine the support reaction forces at the two ends of the bar shown in Fig. 1, given the following:

$$P = 5 \times 10^4 \text{ N}, E = 2.0 \times 10^4 \text{ N/mm}^2,$$

$$A = 200 \text{ mm}^2, L = 145 \text{ mm}, \Delta = 1.1 \text{ mm}$$

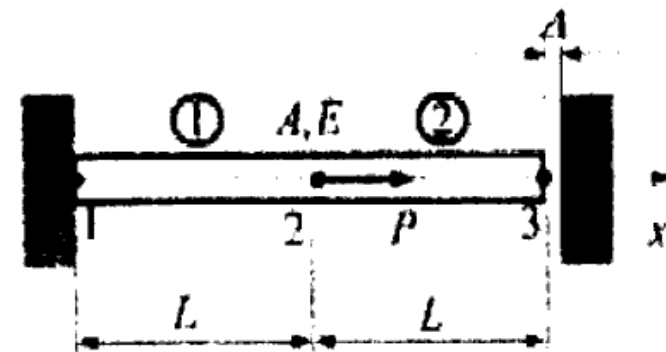


Fig. 1: Question 6 (b)

7. Two springs, having stiffnesses  $k_1 = 5 \times 10^4 \text{ N/m}$  and  $k_2 = 5 \times 10^5 \text{ N/m}$ , are connected in series as shown in Figure 2. Determine the displacements of nodes 2 and 3 when an axial load of  $P = 720 \text{ N}$  is applied at node 3 using the finite element method.

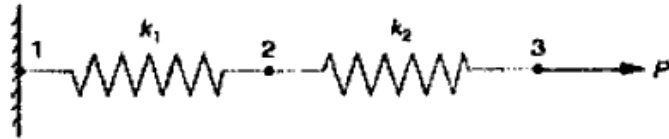


Fig.2: Question 7: Spring system.

8. Write short note on following: (Any two)
- a) Software packages MATLAB.
  - b) Jacobi Method for numerical solution of FE.
  - c) Torsion Analysis of Shafts using FEM.
  - d) Natural discretization Vs artificial discretization.

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