Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

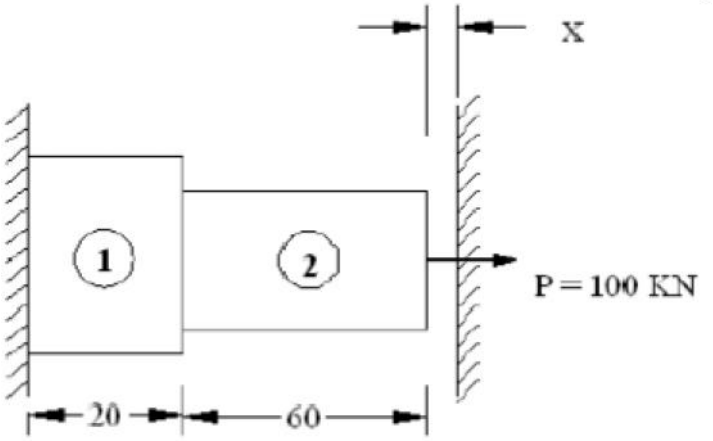
M.Tech. Winter 2019 - 20 Examination

Semester: 1 **Date: 17/12/2019**
Subject Code: 203219102 **Time: 10:30am to 1:00pm**
Subject Name: Finite Element Analysis in Design & Manufacturing **Total Marks: 60**

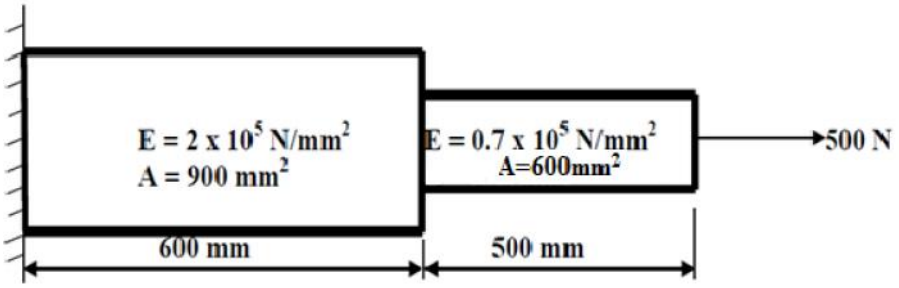
Instructions:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions wherever necessary.
4. Start new question on new page.

Q.1 A) Explain Penalty approach and Elimination approach for FEA. **(05)**
B) State the applications of FEA in the field of engineering. **(05)**
C) Explain the statement "FEM operates from part to the whole". **(05)**

Q.2 **Answer the following questions**. (Attempt any three) **(15)**
A) Draw a sketch of following elements showing nodes:
(i) Quadrilateral (ii) Six node triangular (iii) Tetrahedral
B) What is shape function? Derive linear shape functions for 1-dimensional bar element in terms of natural coordinate.
C) Discuss the assumptions taken in the derivation of stiffness matrix.
D) Find the nodal displacements for the axially loaded stepped bar as shown in figure below using Penalty approach. E=200Gpa, A1= 200 mm^2, A2 =180 mm^2 and x= 0.1 mm.



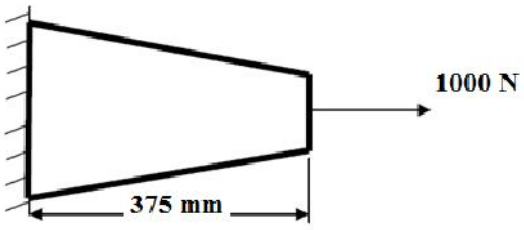
Q.3 A) List and describe the general steps of the Finite Element Method. **(07)**
B) Consider the stepped bar shown in figure below. Determine the Nodal Displacement, Stress in each element, Reaction forces.



(08)

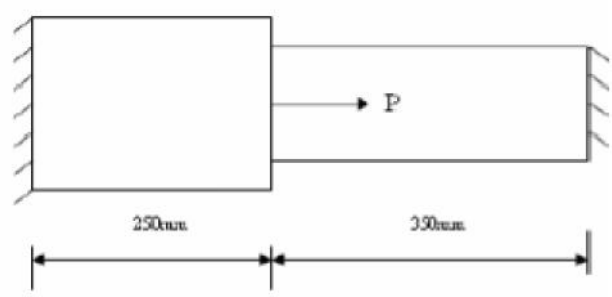
OR

B) Consider the Tapered bar shown in figure. Determine the Nodal Displacement, Stress in each element, Reaction forces E = 2 x 10^5 N/mm^2, Area at root, A1 = 1000 mm^2, Area at the end, A2 = 500 mm^2. **(08)**



Q.4

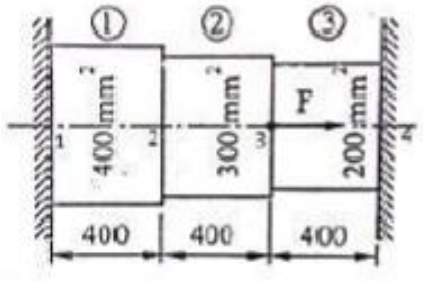
A) A two-step bar as shown in Figure is subjected to thermal loading conditions. An axial load P = 200 x 10^3 N applied 20° C to the end. The temperature of the bar is raised by 50 ° C. Consider E1 = 70 x 10^3 N/mm^2, E2 = 200 x 10^3 N/mm^2, A1 = 700mm^2, A2 = 1000mm^2, α1 = 23 x 10^{-6} per °C and α2 = 11.7 x 10^{-6} per °C. Determine the Element stiffness matrix, Global stiffness matrix and force vector.



(07)

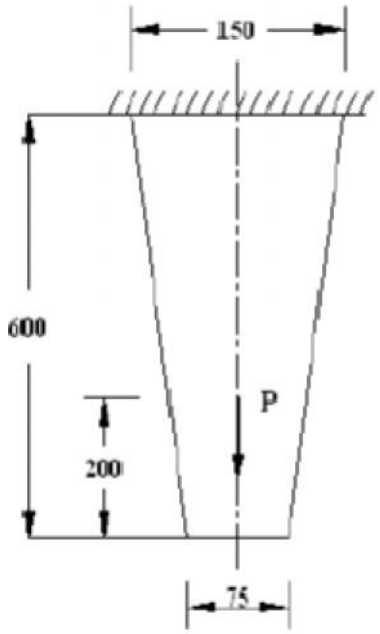
OR

A) Consider the bar shown in figure. An axial load F=35 KN is applied as shown. Using penalty approach for handling boundary conditions, determine nodal displacements and support reactions. Take E=200 Gpa for all elements. Length of each element is in mm.



(07)

B) A thin plate as shown in figure has a uniform thickness of 10 mm and modulus of elasticity is 200 Gpa. The plate is subjected to a point load P = 500 N as shown in figure. Model the problem with two elements and find stresses in each element.



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