B.Tech III Year II Semester (R09) Supplementary Examinations December/January 2015/2016

FINITE ELEMENT METHODS

(Mechatronics)

Time: 3 hours Max. Marks: 70

Answer any FIVE questions

All questions carry equal marks

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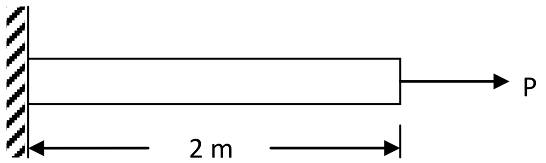
1 What is the basic idea of finite element method? Discuss the various engineering applications of this method.

2 Consider a 2 m long aluminium bar of 50 mm^2 cross-section area as shown in figure below. Take Young's modulus, $E = 7 \times 10^4\ N/mm^2$, P = 100 N and use two element mesh to model this problem. Using finite element method, find nodal displacements, element stresses and reaction.



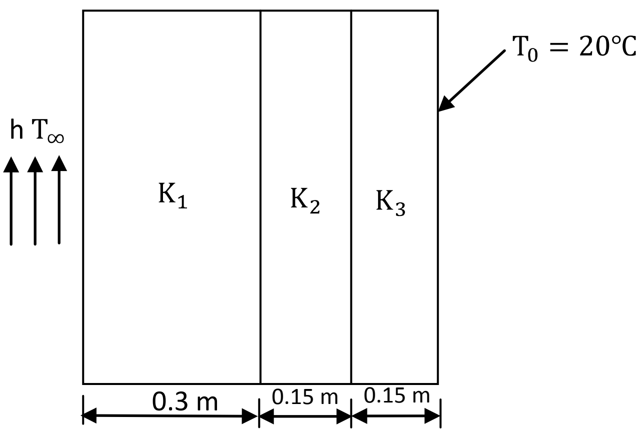
3 With an example, illustrate the use of Galerkin's method for deriving beam element equations.

4 Explain the basic concepts of plane stress and plane strain with examples for a triangular element.

5 (a) What are axisymmetric elements? Explain their applications in engineering with at least two specific examples.

(b) For a given number of nodes, generally which type of element is a better representation of true stress and displacement why?

6 A composite wall consists of 3 materials. The outer temperature is $T_0 = 20°C$. Convection heat transfer takes place on the inner surface of the wall with $T_\infty = 800°C$ and $h = 25\ W/m^2°C$. Determine the temperature distribution in the wall. Take $K_1 = 30\ W/m°C$, $K_2 = 50\ W/m°C$, $K_3 = 20\ W/m°C$. Make suitable assumptions if any, use finite element method.



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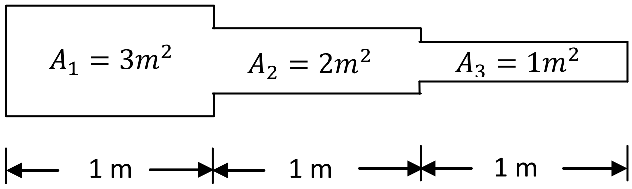
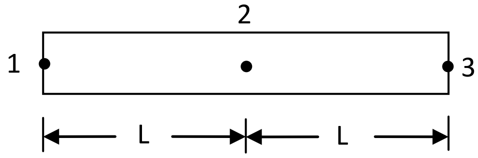
7 For a smooth pipe of variable cross section shown in figure below, determine the potential at the junctions, the velocities in each section of pipe and the volumetric flow rate using finite element method. Take the potential at the left end as 10 m^2/s and that at the right end as 1 m^2/s. Make suitable assumptions.



8 Determine the consistent – mass matrix for the one – dimensional bar discretized into two elements as shown in figure below.



Let the bar have modulus of elasticity E, mass density ρ and cross – sectional area A.

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