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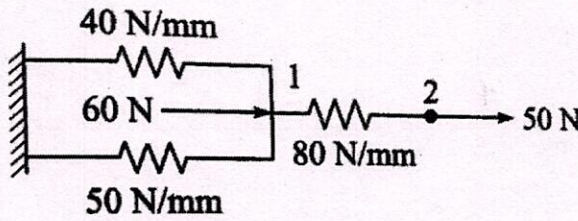
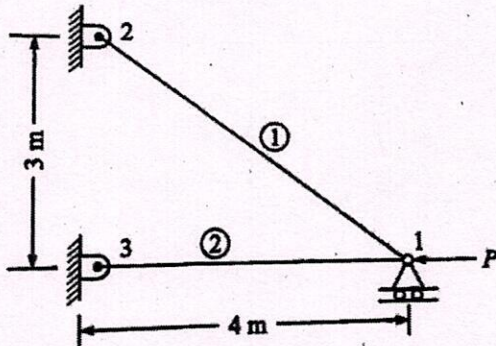
B.E. (Mechanical Engineering)-6<sup>th</sup> Semester  
MEC-602: Finite Element Methods

Time allowed: 3 Hours

Max. Marks: 50

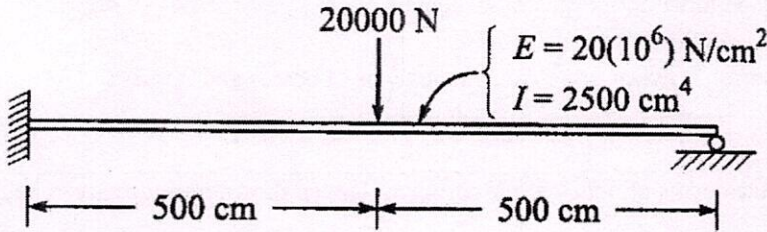
**NOTE:** Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section.

x-x-x

|                                              |                                                                                                                                                                                                                                                                                                                                                                                                                           |                            |
|----------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|
| 1                                            | <ul style="list-style-type: none"> <li>i. State the principle of Minimum Potential Energy.</li> <li>ii. What are the steps of finding an approximate solution using Rayleigh Ritz method?</li> <li>iii. Write value of shape function for quadratic element.</li> <li>iv. What is meant by a mode in dynamic analysis?</li> <li>v. What is the difference between finite element analysis of beams and frames?</li> </ul> | (2X5)                      |
| <b>Section A(Attempt any two questions )</b> |                                                                                                                                                                                                                                                                                                                                                                                                                           |                            |
| 2                                            | <p>a) Determine the displacements of nodes of the spring system as shown in figure given below.</p>  <p>b) Explain Von Mises Stress.</p>                                                                                                                                                                                               | <p>6</p> <p>4</p>          |
| 3                                            | <p>For the two bar truss as shown in figure, determine the nodal displacements and elemental stresses. A force of <math>P = 1000</math> kN is applied at node 1. Assume <math>E = 210</math> GPa and crosssectional area as <math>600</math> mm<sup>2</sup> for each element.</p>                                                     | 10                         |
| 4                                            | <ul style="list-style-type: none"> <li>a) Explain mesh refinement and mesh convergence.</li> <li>b) Explain draw quadratic shape functions.</li> <li>c) Derive the thermal load vector for one dimensional bar element.</li> </ul>                                                                                                                                                                                        | <p>4</p> <p>3</p> <p>3</p> |

(2)

## Section B (Attempt any two questions )

|    |                                                                                                                                                                                                                                                                                                                                           |                   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 5  | <p>A beam fixed at one end and supported by a roller at the other end, has a 20kN concentrated load applied at the Centre of span as shown in figure. Calculate the nodal displacement vector and shear force and bending moment for each element.</p>  | 10                |
| 6. | <p>Write notes on following</p> <p>a) Guyan Reduction</p> <p>b) Structural optimization</p>                                                                                                                                                                                                                                               | <p>5</p> <p>5</p> |
| 7  | <p>a) Explain the different situations where axisymmetric analysis can be used? Discuss the stress and strain components for axisymmetric elements.</p> <p>b) Explain the concept of eigen value problem in finite element analysis., including the formulation of eigen value equation and its solution.</p>                             | <p>5</p> <p>5</p> |

x-x-x