MASTER OF CONSTRUCTION ENGINEERING EXAMINATION, 2024
(1st Semester)

ADVANCED STRUCTURAL ANALYSIS

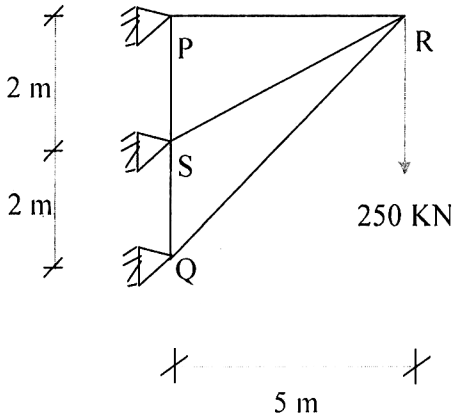
Answer any **four questions**. All question carry equal marks. Explain your answer with neat sketches if necessary. Assume any other relevant data not provided.

1. a) Deduce the **Stiffness Matrix** of **N** numbers of Springs connected in a series by **Matrix method** of analysis. **10**

b) The spring constants are K, 2K, 3K, 4K, 5K, 6K, 7K, 8K, 9K of nine (9) numbers of springs connected in a series, which is subjected to a force of **100 KN**. **Formulate the matrix equation** of static equilibrium if **K = 10 KN/m**. 7

c) Derive **Transformation Matrix** of Truss Element from Local Coordinate to **Global** Coordinate system. **8**

2. a) Evaluate the horizontal and vertical components of **deflection of the free end R** of the bracket truss as shown in Fig.1 by **Matrix Method** of analysis. **15**



E = 2.1 X 10^5MPa for all Members.

c/s Area of PR = 20.38 cm^2 (1 ISA 150X115X8)

c/s Area of SR, QR = 2X15.39 cm^2 (2 ISA 100X100X8)

c/s Area of PS, SQ = 15.39 cm^2 (ISA 100X100X8)

Fig. 1: Truss Problem

b) Calculate also the **Member Forces** of **PR, SR & QR** of the same truss. **10**

3. a) Deduce **Shape Function** for **Beam Element** in Finite Element Method. **8**

b) Derive the **stiffness matrix of Beam Element** in local coordinate system adopting finite element method. **17**

4. a) Deduce the **Strain-Displacement** and **Stress-Strain** relationship for a **Triangular Element** in Plain Stress FEM Problem. **15**

b) Derive the **Stiffness matrix** for the **Triangular element** in plain stress problem. **10**

5. a) Deduce the expression of **consistent load vector** by virtual work method. **10**

b) Calculate the Slope and Deflection at Point Q of the Fixed Beam from FEM formulation. The depth of beams PQ and QR RS are 300 mm and 500 mm. The width of all these beams are 250 mm. E = 2.5 X 10^4 MPa. **15**

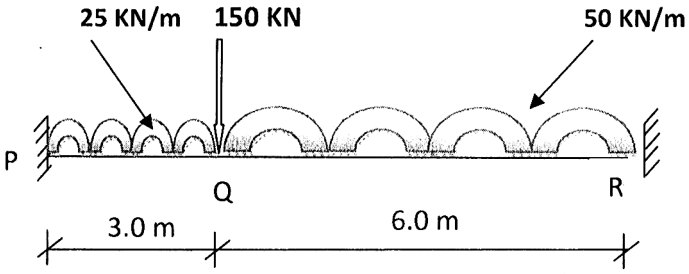


Fig. 2: Fixed Beam

6. a) Derive the **Shape functions** of **Truss element** and **Shape functions** for a **Rectangular element** in plain stress problem and discuss the **relationship** between these two set of **Shape functions**. **12**

b) Deduce the expression of **Slope, Curvature, Bending Moment, Shear Force** and **Loading intensity** from deformations at a regular grid of 'a' in **Finite Difference Method** (FDM) formulation. **13**