KSCP Examination
2020/2021 Academic Session

September 2021

EAS254 – Structural Analysis

Duration : 3 hours

Please ensure that this examination paper contains **SIX (6)** printed pages including appendix before you begin the examination.

Instructions: This paper contains **FIVE (5)** questions. Answer **ALL** questions.

All questions **MUST BE** answered on a new page.

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1. **Figure 1** shows a frame subjected to a concentrated moment of 20 kNm about point B and a linearly varying distributed load from 0 kN/m at point C to 5 kN/m at point B. Support A is a fixed support and support C is a roller support placed on an inclined plane at 15^0 from horizontal plane. Use the virtual work method to determine the horizontal deflection at joint B of the frame. Take E = 200 GPa and $I = 250 \times 10^6$ mm^4. Neglect the deflection due to axial work.

[20 marks]

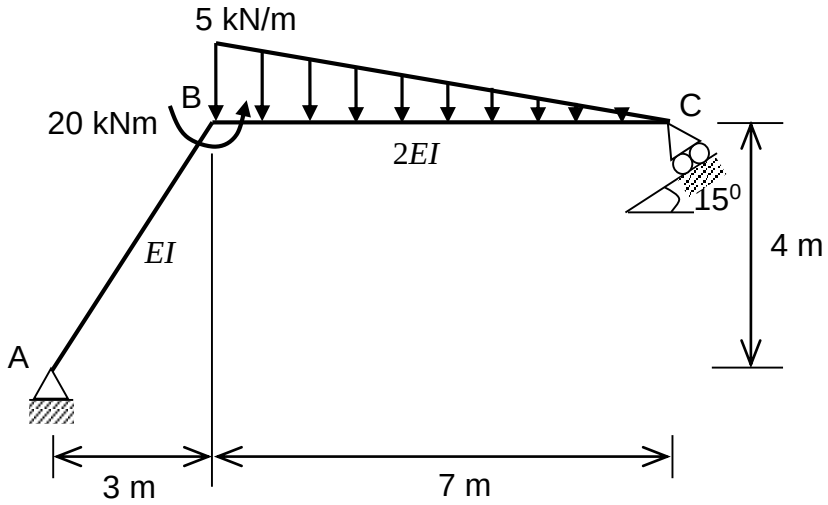

Figure 1

2**.** **Figure 2** shows a beam carrying a uniformly distributed load of 5 kN/m for span AB and 10 kN/m for span CD. Two additional point loads of 20 kN each act on span BC. Supports A and E are fixed, whereas supports B, C and D are pinned. *EI* is constant for the beam.

(a). Compute the internal moments at the joints of the beam by using Moment Distribution Method. Fixed end moment is given in the **Appendix**.

[14 marks]

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(b). Draw the shear force diagram and the qualitative deflected shape for the beam.

[6 marks]

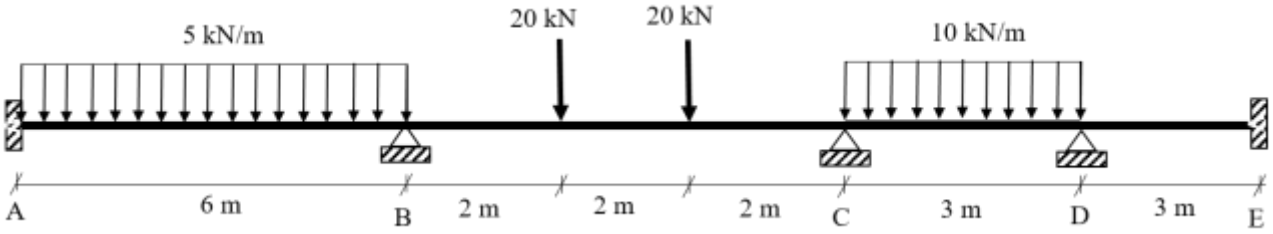

Figure 2

3. **Figure 3** shows a frame carrying a uniformly distributed load of 10 kN/m for member ABCD. A 20 kN point load acts at the middle span of BE and CF. Support A is pinned whereas supports D, E and F are fixed. *EI* is constant for the frame.

(a). Compute the internal moments at the joints of the frame by using Slope Deflection Method. Fixed end moment is given in the **Appendix**.

[15 marks]

(b). Draw the bending moment diagram for the frame.

[5 marks]

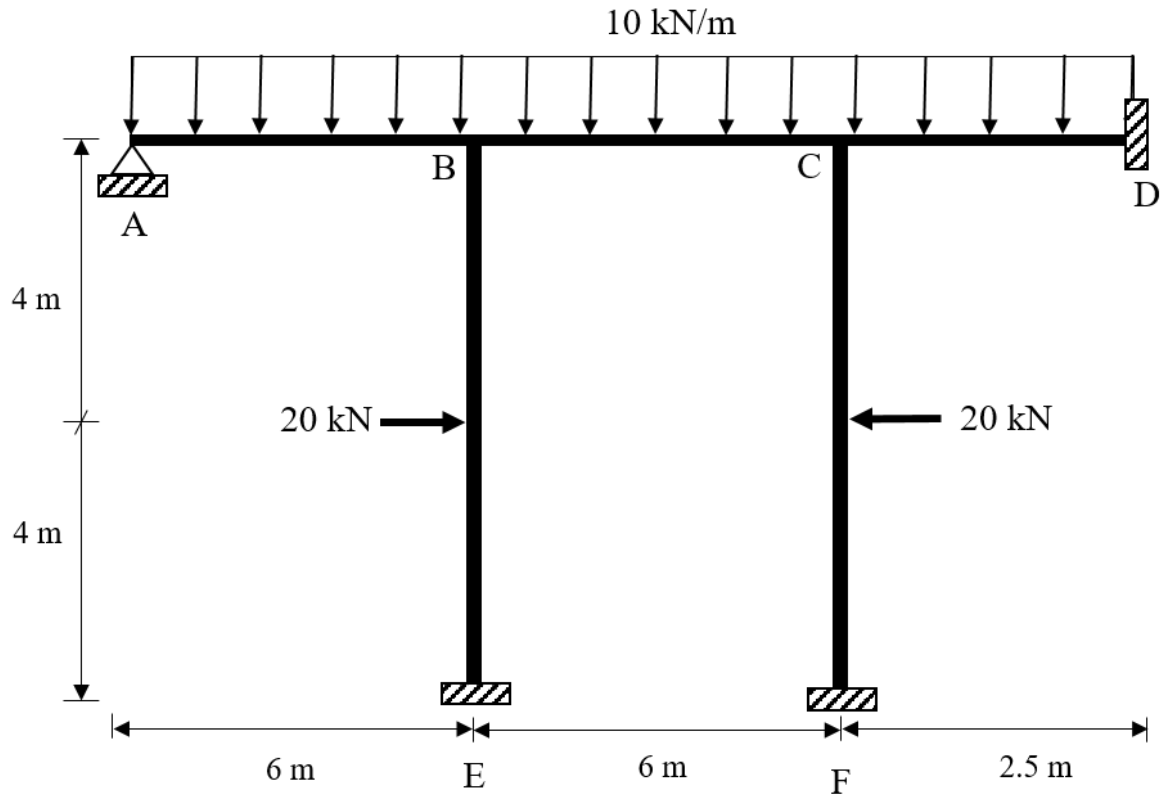

Figure 3

4. (a). The truss system shown in **Figure 4** is subjected to two vertical loads, F_1 and F_2 at Joints B and C, respectively. Supports A and D consist of a pin and roller, respectively. Determine the reaction forces at supports A and D, and the force in each truss member using the method of least work. Set F_1 = 50 kN and F_2 = 40 kN. The cross-sectional area, A and Young's Modulus, E of the truss members are constant.

[16 marks]

(b). The truss system shown in **Figure 5** is subjected to a few concentrated loads. Without any calculation, explain the analysis procedure to determine the force in each member of the truss.

[4 marks]

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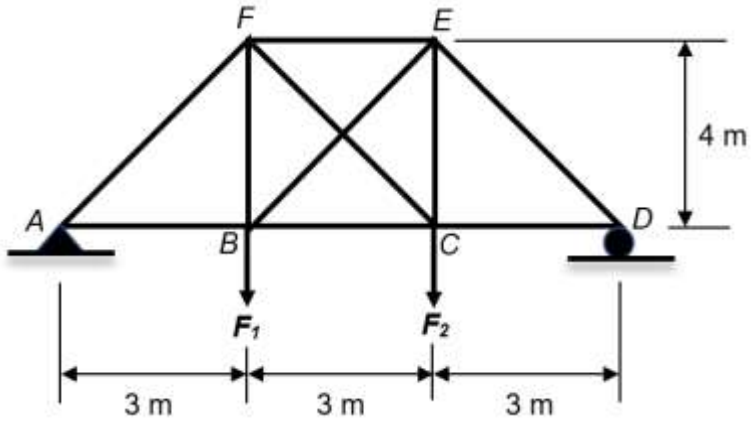

Figure 4

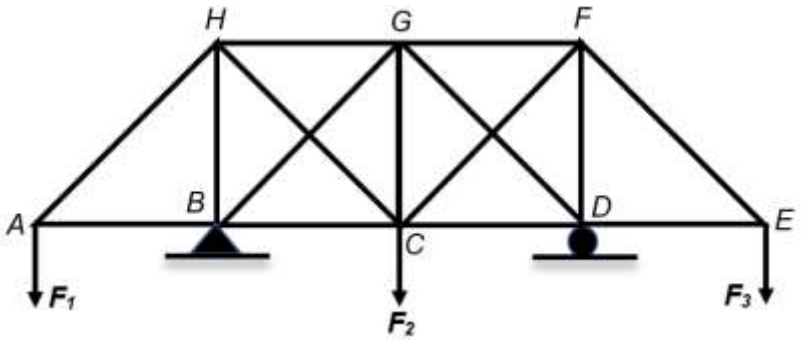

Figure 5

5. The cross-sectional area for segments AB, BC and CD of the beam shown in **Figure 6** are constant. The beam is subjected to various point loads and uniformly distributed loads. Calculate the plastic moment M_p for the beam using

(i). Equilibrium method

(ii). Virtual work method

[20 marks]

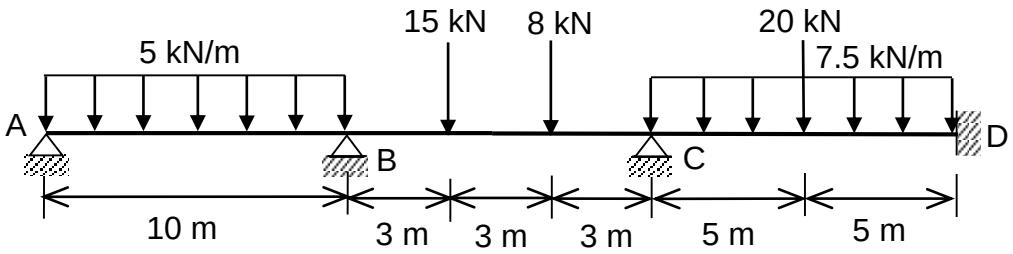

Figure 6

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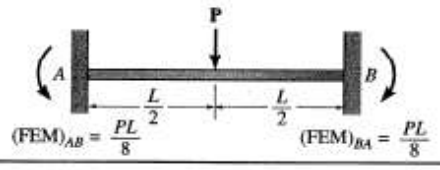
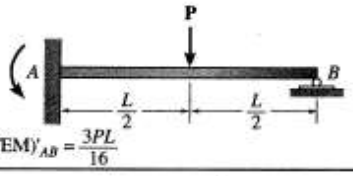
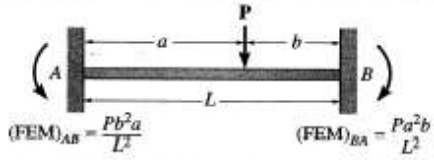
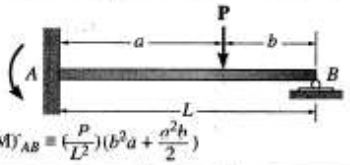
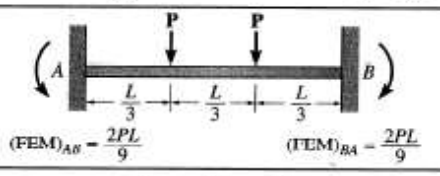
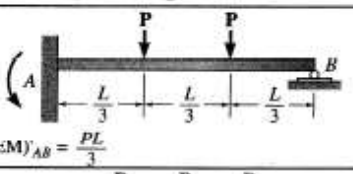
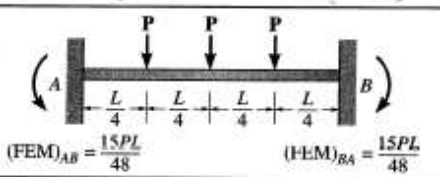
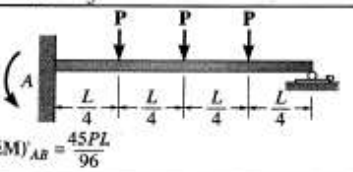
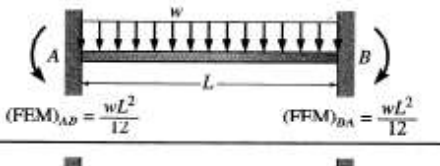
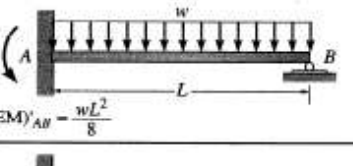
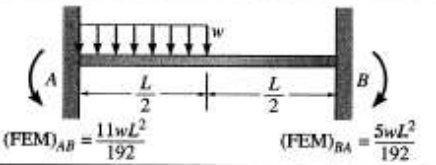
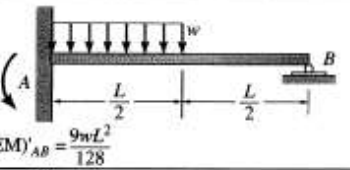
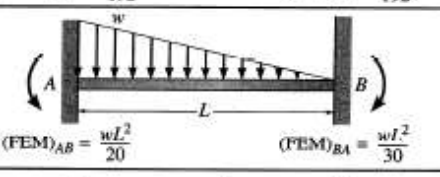
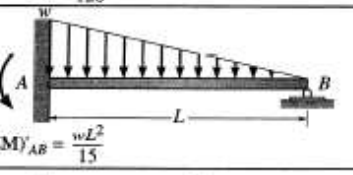
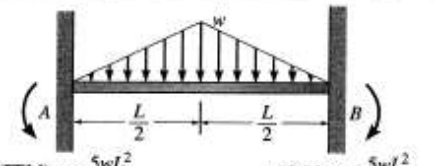
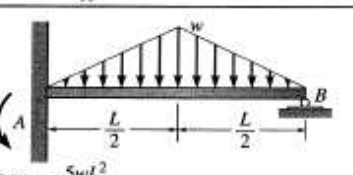
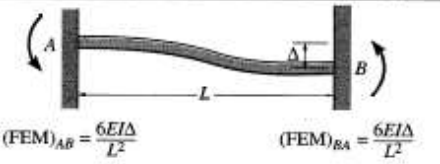
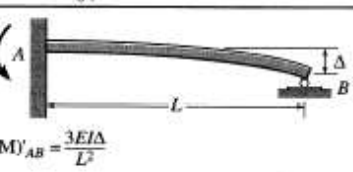
APPENDIX

 $(FEM)_{AB} = \frac{PL}{8}$ $(FEM)_{BA} = \frac{PL}{8}$	 $(FEM)'_{AB} = \frac{3PL}{16}$
 $(FEM)_{AB} = \frac{Pb^2a}{L^2}$ $(FEM)_{BA} = \frac{Pa^2b}{L^2}$	 $(FEM)'_{AB} = (\frac{P}{L^2})(b^2a + \frac{a^2b}{2})$
 $(FEM)_{AB} = \frac{2PL}{9}$ $(FEM)_{BA} = \frac{2PL}{9}$	 $(FEM)'_{AB} = \frac{PL}{3}$
 $(FEM)_{AB} = \frac{15PL}{48}$ $(FEM)_{BA} = \frac{15PL}{48}$	 $(FEM)'_{AB} = \frac{45PL}{96}$
 $(FEM)_{AB} = \frac{wL^2}{12}$ $(FEM)_{BA} = \frac{wL^2}{12}$	 $(FEM)'_{AB} = \frac{wL^2}{8}$
 $(FEM)_{AB} = \frac{11wL^2}{192}$ $(FEM)_{BA} = \frac{5wL^2}{192}$	 $(FEM)'_{AB} = \frac{9wL^2}{128}$
 $(FEM)_{AB} = \frac{wL^2}{20}$ $(FEM)_{BA} = \frac{wL^2}{30}$	 $(FEM)'_{AB} = \frac{wL^2}{15}$
 $(FEM)_{AB} = \frac{5wL^2}{96}$ $(FEM)_{BA} = \frac{5wL^2}{96}$	 $(FEM)'_{AB} = \frac{5wL^2}{64}$
 $(FEM)_{AB} = \frac{6EI\Delta}{L^2}$ $(FEM)_{BA} = \frac{6EI\Delta}{L^2}$	 $(FEM)'_{AB} = \frac{3EI\Delta}{L^2}$

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