Department of Civil and Environmental Engineering, Spring Semester, 2026

ENCE 353 Midterm 1, Open Notes and Open Book

Name : _____

E-mail (print neatly!): _____

Exam Format and Grading. This take home midterm exam is open notes and open book. You need to comply with the university regulations for academic integrity.

There are three questions. Partial credit will be given for partially correct answers, so please show all your working.

Please see the **class web page for instructions on how to submit your exam paper**.

Question	Points	Score
1	15	
2	15	
3	10	
Total	40	

Question 1 (15 points): Support Reactions and Bending Moments in a Connected Beam Structure.

Consider the multi-span connected beam structure shown in Figure 1.

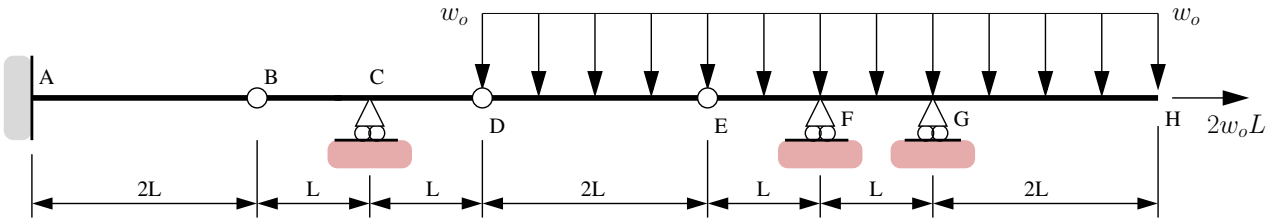

Figure 1. Front elevation view of multi-span connected beam structure.

The cantilever is fully-fixed to the wall at Point A. Points B, D and E are hinges. The beam segment D-E-F-G-H carries a uniformly distributed load w_o (force/per unit length). Finally, a horizontal point load $2w_oL$ is applied at point H.

[1a] (3 pts). Compute the degree of indeterminacy for the beam structure.

[1b] (3 pts). Compute the vertical reaction forces at nodes C, F and G.

[1c] (3 pts). Compute the **total force** at hinge B.

[1d] (6 pts). Draw and label diagrams showing how the **bending moment** and **axial force** vary along the beam, nodes A through H. Clearly indicate on your bending moment diagram, regions that are in tension/compression.

Question 2 (15 points): Tension, Compression and Zero-Force Members in a Truss Structure.

Consider the truss structure shown in Figure 2.

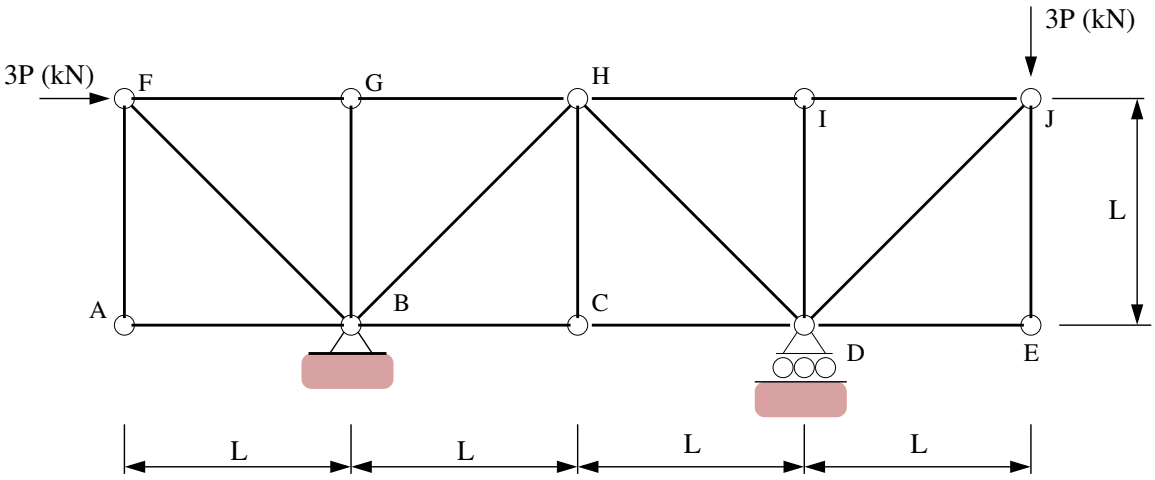

Figure 2. Elevation view of 17 bar truss structure.

Horizontal and vertical loads of **3P** kN are applied at nodes F and J, respectively.

[2a] (3 pts). Compute the **magnitude** and **direction** of the **total support reactions** at points B and D.

[2b] (3 pts). Identify the zero-force members (If you wish, you can simply annotate Figure 2).

[2c] (7 pts). Using the method of joints (or otherwise) show that: (1) The maximum tensile force in the structure is $3\sqrt{2}P$ kN (T), and (2) The maximum compressive force in the structure is $-3\sqrt{2}\ P$ kN (C).

[2d] (2 pts). Draw a simplified version of Figure 2 with **all of the zero force elements** removed.

Question 3 (10 points): Method of Sections.

The frame tower (see Figure 3) carries horizontal and vertical loads P kN at joints C, E, G and H.

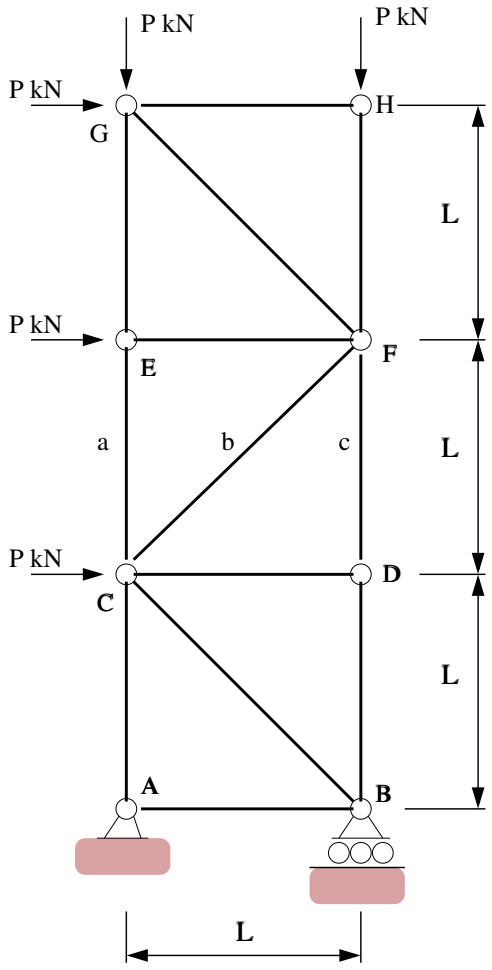

Figure 3. Elevation view of frame tower.

Use the **method of sections** to determine the forces in members a, b and c, as a function of the problem parameters L and P. Clearly indicate if the members are in tension or compression. Show all of your working.

Question 3 continued: