Department of Civil and Environmental Engineering,   Fall Semester, 2016

ENCE 353 Midterm 1, Open Notes and Open Book

Name : _____

Exam Format and Grading. This exam has three questions. Partial credit will be given for partially correct answers, so please show all your working.

Question	Points	Score
1	15	
2	15	
3	10	
Total	40	

Question 1 (15 points): Shear Forces and Bending Moments in a connected Beam Structure.

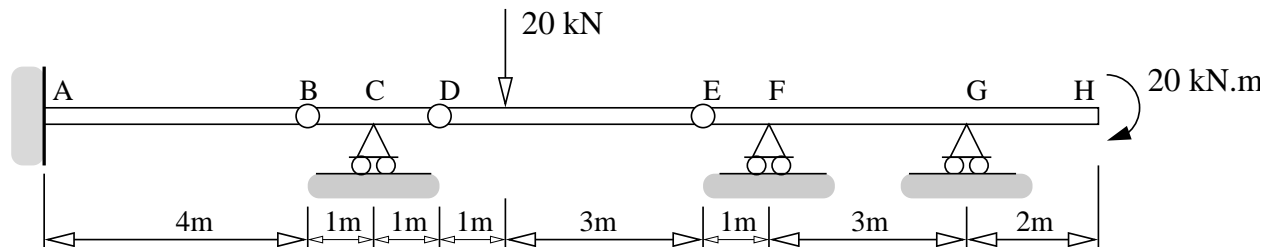Consider the multi-span beam structure shown in Figure 1.

Figure 1: Multi-span beam structure.

The cantilever is fully-fixed to the wall at Point A. Points B, D and E are hinges. An external moment of 20 kN.m is applied at Point H.

[**1a**] (2 pts). Compute the degree of indeterminacy for the beam structure.

[**1b**] (4 pts). Compute the reactions at points A, C, F and G.

[1c] (7 pts). Compute and draw the shear force and bending moment diagrams along the beam.

[1d] (2 pts). Indicate on Figure 1 where you believe the beam fibre will be in compression (C) and tension (T).

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

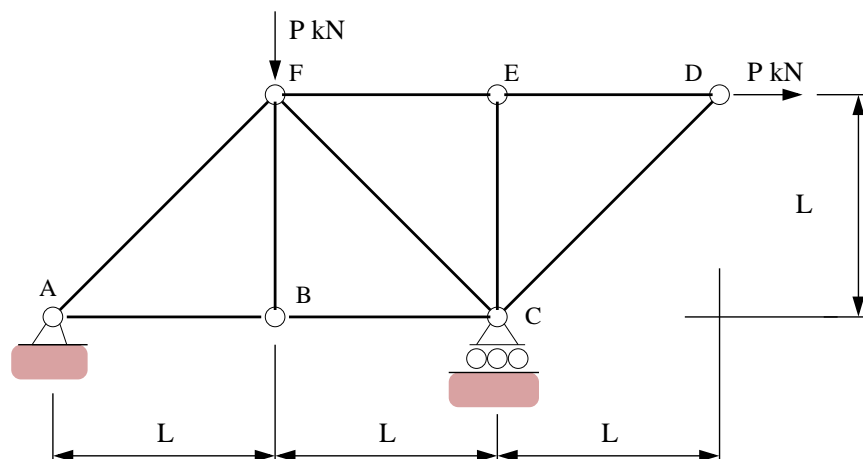Consider the truss structure shown in Figure 2.

Figure 2: Nine-bar truss structure.

A horizontal load of P kN is applied at node D, and a vertical load of P kN is applied at node F.

[2a] (4 pts). Compute the support reactions at points A and C.

[2b] (4 pts). Identify the zero-force members.

4

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

Question 3 (10 points): Degree's of Indeterminacy.

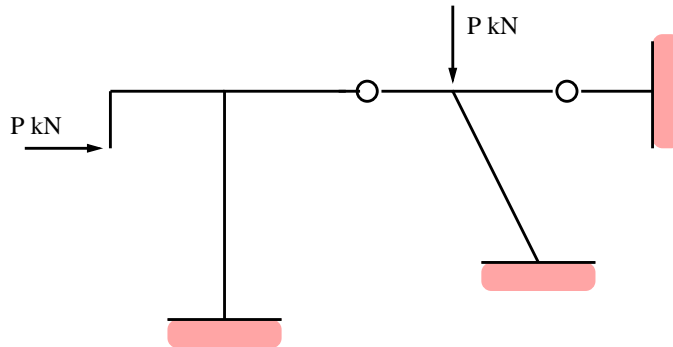[3a] (5 pts). Compute the degree of indeterminacy for the structure shown in Figure 3.

Figure 3: Simple portal frame.

[3b] (5 pts). Using the method of trees (or otherwise), compute the degree of indeterminacy for the moment-resistant frame shown in Figure 4.
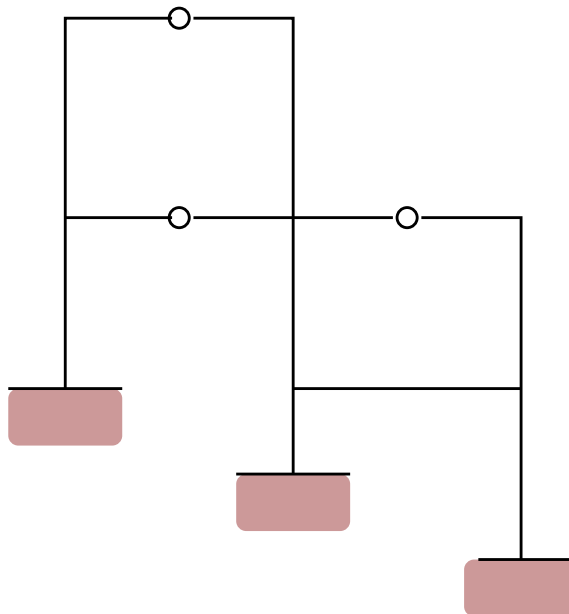

Figure 4: Elevation view of a moment-resistant frame.