Department of Civil and Environmental Engineering, Fall Semester, 2014

ENCE 353 Final Exam, Open Notes and Open Book

Name : _____

Exam Format and Grading. The exam will be 2 hrs plus five minutes to read the questions. **Only attempt four questions.** Cross out the question that you did not attempt in the table below. No extra credit will be given for attempting five questions – we will simply grade and count the first four questions.

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

Question	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
Total	40	

Question 1: 10 points

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

Figure 1: Front elevation view of a cantilevered beam structure.

[1a] (5 pts) Use the Muller-Breslau Principle to compute the influence line diagram for the vertical reaction **at B**.

[1b] (5 pts) Now suppose that spans A-B and B-C carry a uniform load of w_o/L N/m. Using your influence line diagram from Part [1a], compute the vertical reaction **at B**.

Question 2: 10 points

Consider the cantilevered beam structure shown in Figure 2.

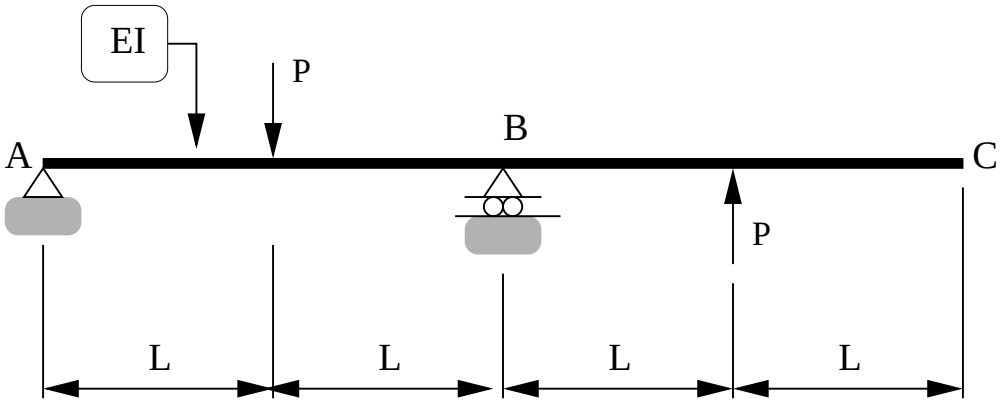

Figure 2: Front elevation view of a cantilevered beam structure.

[2a] (4 pts) Use the method of moment-area to compute the rotation at point A.

[2b] (4 pts) Use the method of moment-area to compute the vertical deflection of the beam at point C.

[2c] (2 pts) Draw the deflected shape of the beam. Indicate the sections of beam where the curvature is constant.

Question 3: 10 points

Consider the truss structure shown in Figure 3.

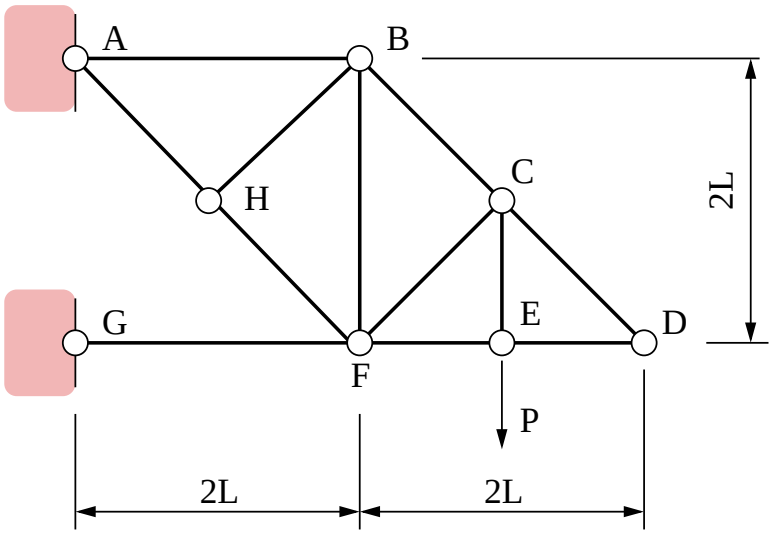

Figure 3: Elevation view of a pin-jointed truss.

The horizontal and vertical degrees of freedom are fully-fixed at supports A and G. The truss carries a vertical load P at node E. All frame members have cross section properties AE.

[3a] (3 pts) Use the method of joints to identify all of the zero-force members. Label these members on Figure 3.

[3b] (3 pts) Compute the support reactions at A and G as a function of P and L.

[3c] (4 pts) Derive an expression for the vertical deflection at node E, as a function of P, L and AE.

Question 4: 10 points

Consider the simply supported beam structure shown in Figure 4.

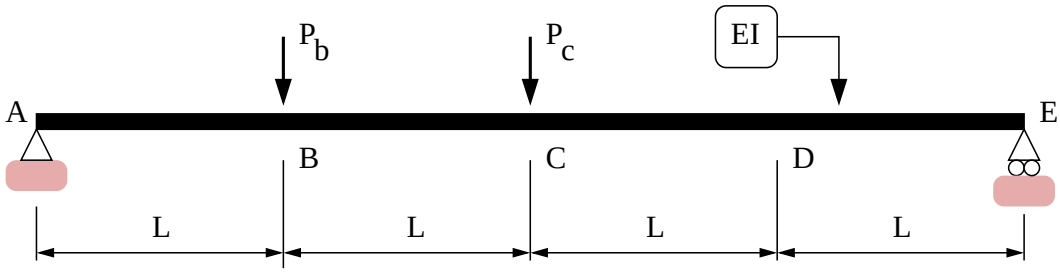

Figure 4: Front elevation view of a simply supported beam.

[4a] (10 pts) Use the principle of virtual forces to compute the two-by-two flexibility matrix connecting the vertical displacements at points B and C to applied loads P_b and P_c, i.e.,

$$\begin{bmatrix} \triangle_b \\ \triangle_c \end{bmatrix} = \begin{bmatrix} f_{11} & f_{12} \\ f_{21} & f_{22} \end{bmatrix} \begin{bmatrix} P_b \\ P_c \end{bmatrix}. \tag{1}$$

Question 4 continued ...

Question 5: 10 points

The three-pinned arch structure shown in Figure 5 carries a uniformly distributed load W (N/m) across its entire 6m span.

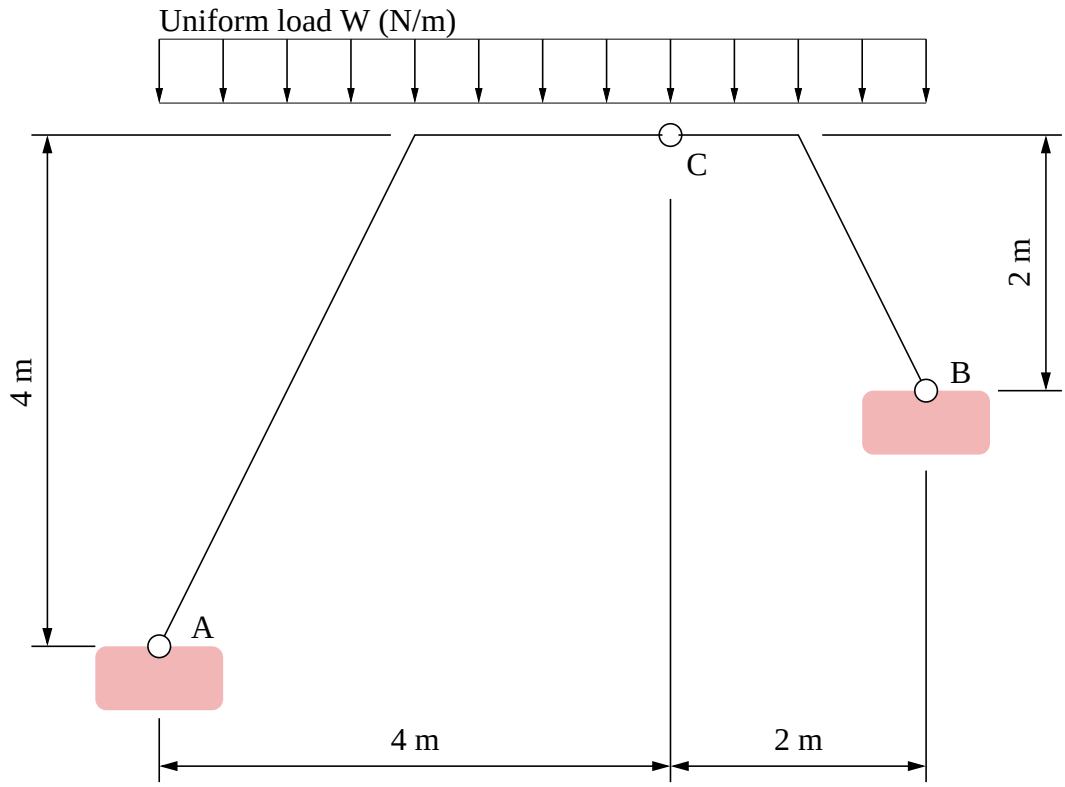

Figure 5: Elevation view of a three-pinned arch structure carrying a uniformly distributed load.

[5a] (10 pts). Compute the vertical and horizontal components of reaction force at supports A and B.

Part 5a continued ...