Department of Civil and Environmental Engineering, Fall Semester, 2014

ENCE 353 Midterm 2, Open Notes and Open Book

Name : ____________________

Exam Format and Grading. This exam has four questions. Answer question 1. Then answer **two of the three** remaining questions. Cross out the question you do not want graded in the table below.

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

Question	Points	Score
1	20	
2	10	
3	10	
4	10	
Total	40	

Question 1: 20 points

COMPULSORY: Moment-Area and Deflections. Consider the cantilevered beam structure shown in Figure 2.

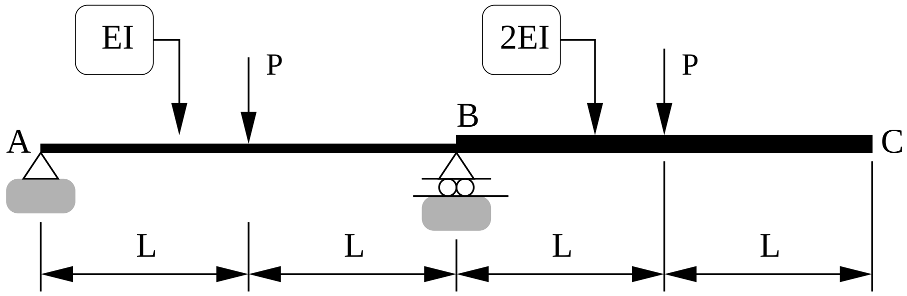

Figure 1: Front elevation view of a cantilevered beam structure.

Notice that segments A-B and B-C have cross-sectional properties EI and 2EI, respectively.

[1a] (5 pts) Compute and draw the M(x)/EI diagram for the complete beam A-B-C.

[1b] (5 pts) Draw and label a diagram of the deflected shape. Clearly indicate on your diagram regions of the beam having zero curvature.

[1c] (5 pts) Draw and label a diagram showing how the rotation at A is related to the beam deflections at points B and C.

[1d] (5 pts) Use the method of moment-area to compute the vertical deflection of the beam at point C.

Question 2: 10 points

OPTIONAL: Influence Lines. Consider the two-span beam structure shown in Figure 2.

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

[2a] (5 pts). Use the Muller-Breslau Principle to compute the influence line diagram for the vertical reaction at A.

[2b] (5 pts). Now suppose that span B-C carries a uniform load of w_o/L N/m. Using your influence line diagram from question [2a], compute the vertical reaction at A.

Question 3: 10 points

OPTIONAL: Principle of Virtual Work. Figure 3 is a front elevation view of a simple truss that supports a horizontal load P at node C. All three truss members have cross section properties AE.

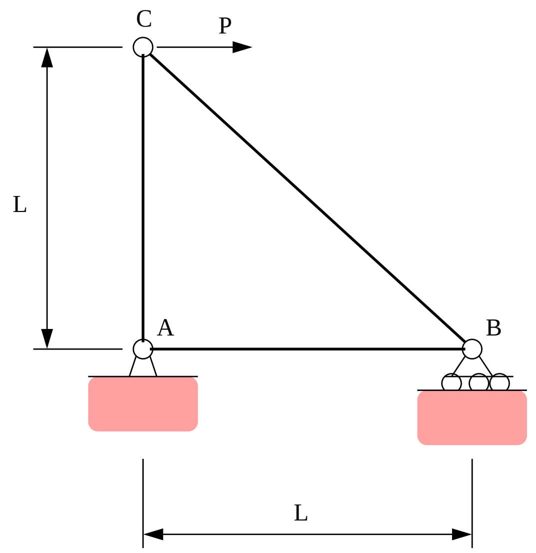

Figure 3: Front elevation view of a simple truss.

[3a] (10 pts). Use the **method of virtual forces** to show that the horizontal deflection at node C is:

$$\triangle = \frac{2PL}{AE}\left[1+\sqrt{2}\right]. \tag{1}$$

Question 4: 10 points

OPTIONAL: Principle of Virtual Work. Figure 4 is a front elevation view of a two-span beam structure that carries a vertical load of 8 kips at the midspan of section A-B. The beam is constructed from a material having modulus of elasticity E = 29,000 ksi.

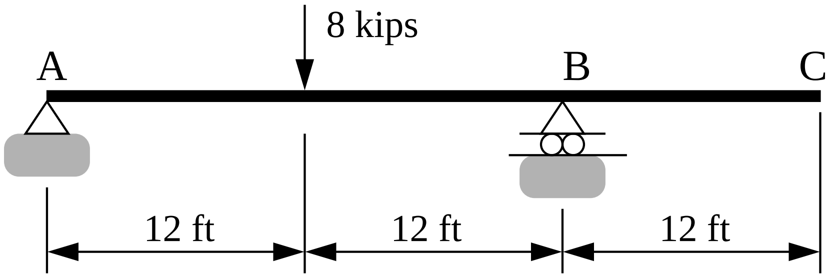

Figure 4: Front elevation view of a two-span beam structure.

[4a] (4 pts). Use the method of virtual work to find the virtical deflection of the beam at the midspan of A-B as a function of I, the beam moment of inertia.

[4b] (3 pts). Use the method of virtual work to compute the rotation of the beam at B as a function of I.

[4c] (3 pts). Use your results from parts [4a] and [4b] to determine the smallest value of I will satisfy the constraint: max vertical deflection is less than 0.5 inches.