UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 4 Examination in Engineering: December 2018

Module Number: CE 4203 **Module Name: Structural Analysis II**

[Three Hours]

[Answer **all questions**, each Question carries 20 Marks]

Q1. A pin ended strut of length L and flexural rigidity EI is subjected to a horizontal force W at mid-span as shown in Figure Q1.

(a) Determine the buckling load

[15 Marks]

(b) Determine the mid-span deflection.

[5 Marks]

Q2. (a) Explain why von Mises Theory is referred to Haigh Theory.

[2 Marks]

(b) Express Haigh Theory in terms of Energy Concept.

[2 Marks]

(c) For a 3-D system determine the Haigh Theory with usual notation.

[5 Marks]

(d) Hence deduce the Haigh Theory for a 2-D system

[3 Marks]

(e) Sketch (d) above in (σ_1, σ_2) plane giving salient point of the yield locus.

[8 Marks]

Q3. A continuous uniform beam with two hinges is shown in Figure Q3. Determine the influence the influence lines for;

(a) Reactions R_A and R_B

[4 Marks]

(b) Bending moment and shear force at B

[6 Marks]

(c) Taking "a" is equal to 3 m, determine maximum Bending moment when

(i) Uniformly distributed load of 10 kN/m over a length of 4 m traverse the beam

[5 Marks]

(ii) Uniformly distributed load of 5 kN/m over a length of 12 m traverse the beam

[5 Marks]

Q4. A plane frame shown in Figure Q4 has the plastic moment capacity of Mp in all other members except for the long vertical member which is 2Mp. All the dimensions and plastic moment capacities are shown in Figure Q4. Determine;

(a) The number of independent mechanisms

[8 Marks]

(b) Write down work equations for each case

[4 Marks]

(c) Collapse mechanism based on the work equations derived above.

[2 Marks]

(d) The failure mechanism which satisfies the Uniqueness theorem.

[6 Marks]

Q5. a) A three-hinged parabolic arch of uniform cross section has a span of 30 m and a rise of 5 m. It is subjected to uniformly distributed load of intensity 2 kN/m as shown in Figure Q5. Show that the bending moment is equal to zero at any cross section of the arch.

[6 Marks]

b) A suspension bridge of 60 m main span is supported by two sets of cables hangings in a parabolic form. The supports of the piers are at the same level and the cables have a central dip of 6 m below this level. Backstays are inclined 30° to the horizontal. The bridge is subjected to uniformly distributed load of 20 kN/m. The total dead weight of the bridge deck is 1500 kN which is assumed to be uniformly distributed load along the 60 m length.

i) Calculate the maximum tension in the cable for the above loading

[3 Marks]

ii) Determine the tension in the back-stay, if the cables pass over pulleys.

[3 Marks]

iii) Determine the cross sectional area of cable if the permissible stress for the cable material is 150 N/mm^2

[4 Marks]

iv) Determine horizontal and vertical forces on piers

[2 Marks]

v) Discuss different anchoring techniques for back-stays.

[2 Marks]

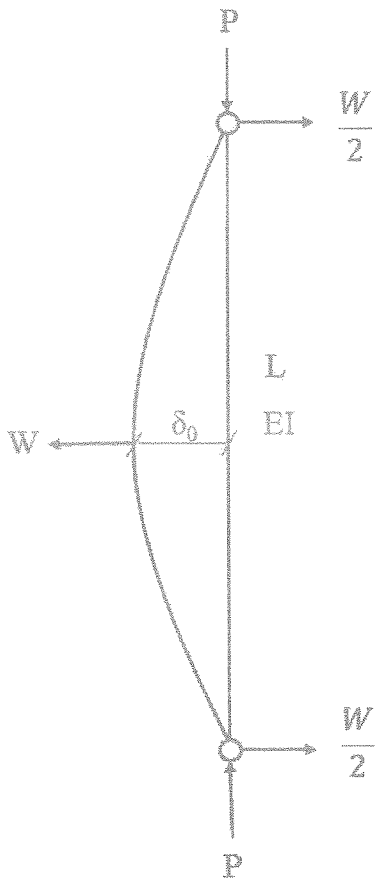

Figure Q1

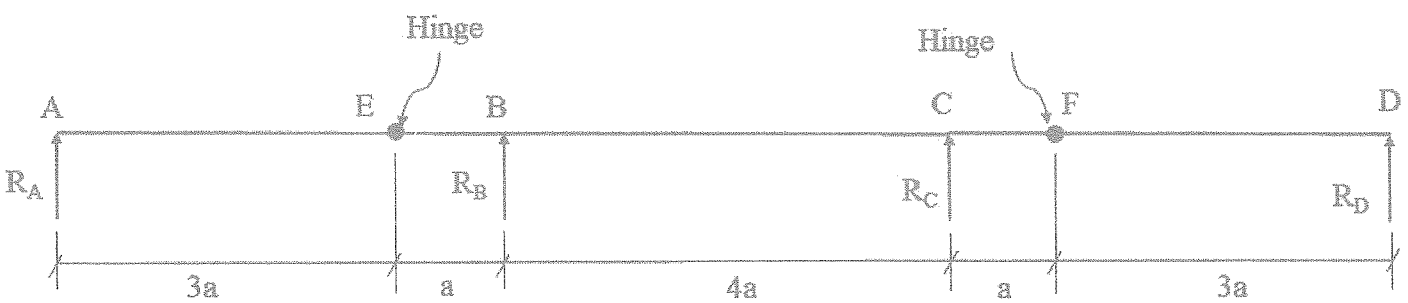

Figure Q3

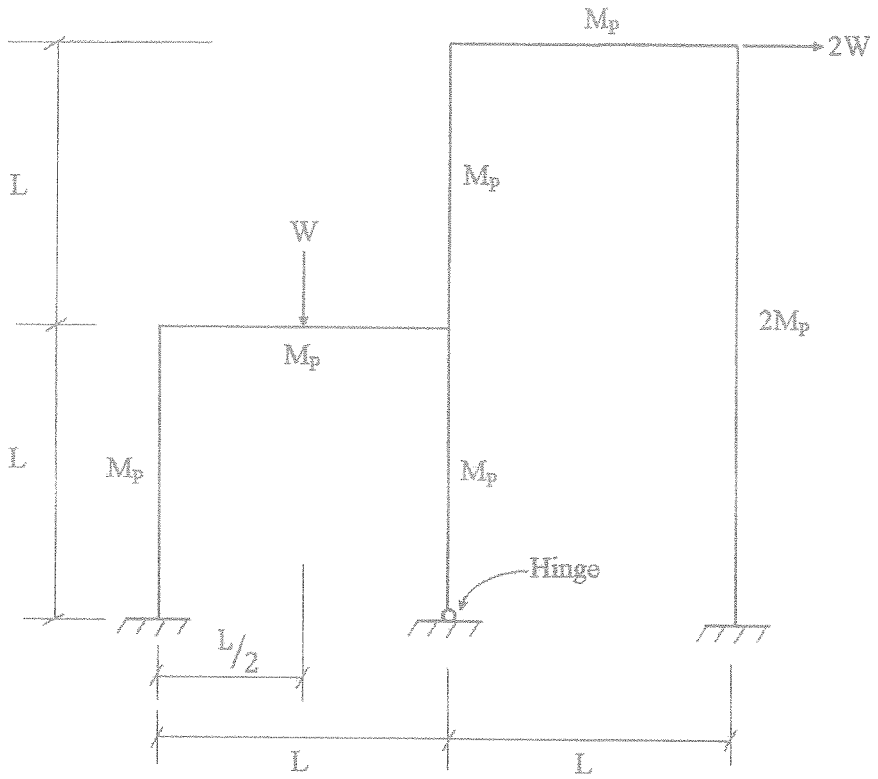

Figure Q4

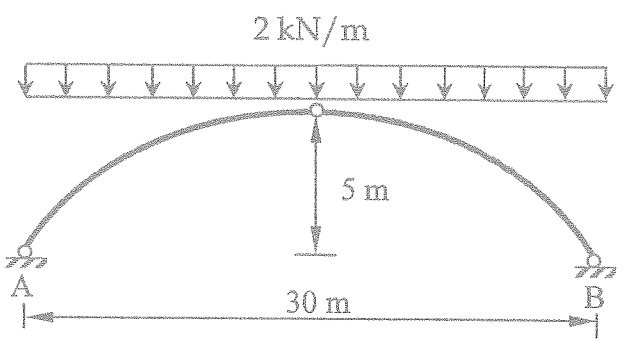

Figure Q5