UNIVERSITY OF RUHUNA

Faculty of Engineering

Mid-Semester 4 Examination in Engineering: November 2014

Module Number: CE4209

Module Name: Structural Analysis II (Old Curriculum)

[Two Hours]

[Answer **all questions**. Each question carries 10 marks]

All Standard Notations denote their regular meanings

Q1. a) State two advantages and disadvantage of using arch as a major structural component of a bridge instead of beam.

[1 Mark]

b) Discuss the degree of static indeterminacy of three hinged arches and two hinged arches.

[1 Mark]

c) A three-hinged parabolic arch of uniform cross section has a span of 20 m and a rise of 4 m. It is subjected to uniformly distributed load of intensity 2 kN/m as shown in Figure Q1(a). Show that the bending moment is zero at any cross section of the arch.

[3 Marks]

d) A two hinged parabolic arch of constant cross section is subjected to a distributed load of intensity 3 kN/m at left half of the arch, as shown in Figure Q1(b). The span and rise of the arch are 20 m and 4 m respectively.

I. Determine the horizontal thrust acting at the support.

II. Find the bending moment and axial force at horizontal distance of 5m to the left side of the support B.

[5 Marks]

Hint: For a two-hinged parabolic arch, horizontal thrust, H, (with usual notations and sign convention) is given by the equation;

$$H = \frac{\int \frac{M_0 \bar{y}}{EI} dx}{\int \frac{\bar{y}^2}{EI} dx} \qquad \text{where } \bar{y} = \frac{4dx(L-x)}{L^2}$$

Q2. a) What is the difference between the basic action of an arch and a suspension cable?

[1 Mark]

b) A suspension cable is supported at two points A and D, and D is 2 m below the level of A as shown in Figure Q2. The horizontal distance between A and D is 5.5 m. The cable is subjected to two point loads of 4 kN and 8 kN at distance 2 m and 4 m respectively from A.

I. Determine the tension in each segment of the cable.
II. Find the value for dimension h?

[3 Marks]

c) A bridge cable slung between two piers 80 m apart carries a load of 30 kN/m of span. The supports of the piers are at the same level and cable at its lowest point sags 8 m below this level. Calculate the maximum value of the cable tension.

Find the tension in the back-stay and the pressure on the pier if the cable passes over saddles and back-stay is inclined at 30° to horizontal. If the cable passes over pulley, find the horizontal and vertical pressure on the pier. The inclination of back-stays are same.

[6 Marks]

Hint: horizontal component of force at any point along the cable is given by the equation;

$$F_H = \frac{w_0 L^2}{2h}$$

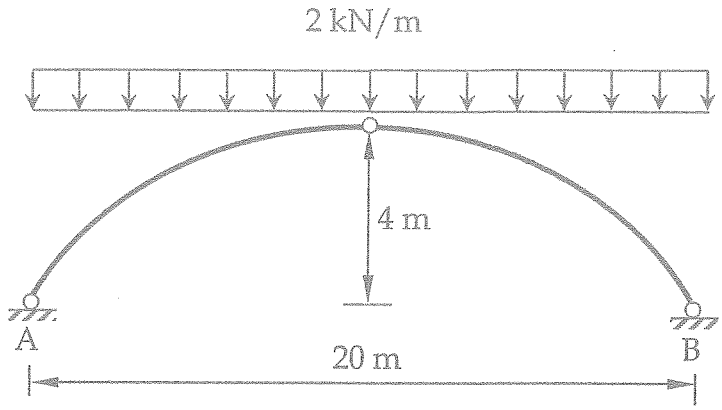

Figure Q1 (a)

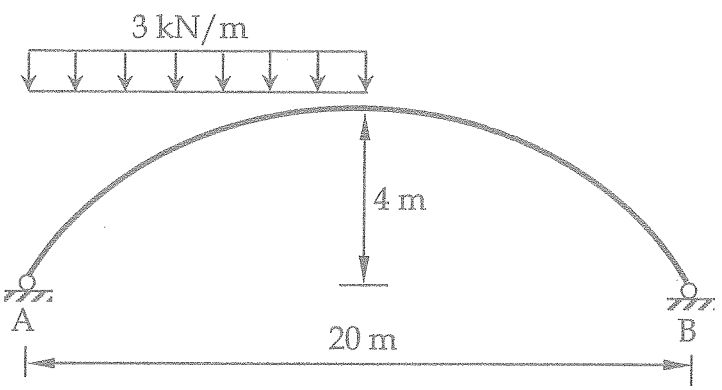

Figure Q1 (b)

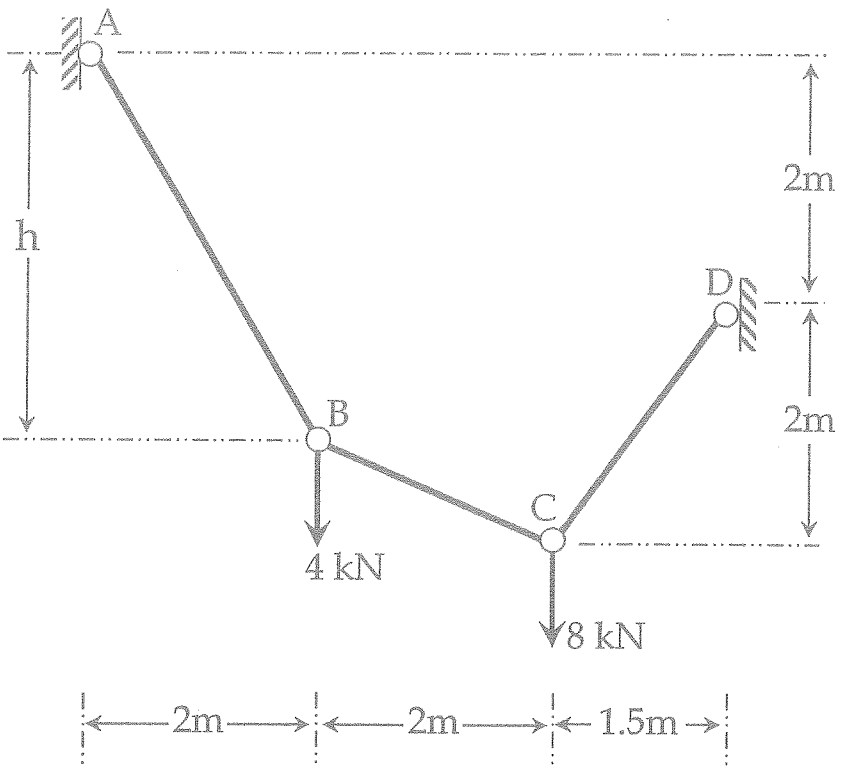

Figure Q2