# MACHAKOS UNIVERSITY

**University Examinations for 2020/2021Academic Year**

**SCHOOL OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT OF BUILDING AND CIVIL ENGINEERING**

**SECOND YEAR SPECIAL/ SUPPLEMENTARY EXAMINATION FOR**

**BACHELOR OF SCIENCE IN CIVIL ENGINEERING**

**ECV 209: THEORY OF STRUCTURES II**

**DATE: 25/3/2021** **TIME: 2.00-4.00 PM**

**INSTRUCTIONS**

- *This paper comprises of five questions. Answer **three** questions*
- *Question one is **compulsory** and carry 30 marks*
- *Answer any other **two** questions*

1. a) A continuous beam is carrying uniformly distributed load of 2 kN/m as shown in Fig.1. The moment of inertia of span ABC AB is twice that of span. Evaluate reactions and draw bending moment and shear force diagrams (hint Use three moment equation) (15 marks)

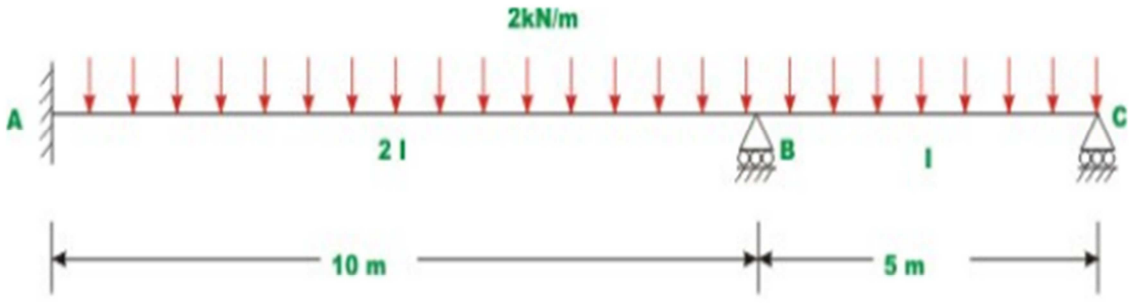


fig 1

b) Draw the influence lines for the vertical reaction and the reaction moment at support A and shear and bending moment at point B of the cantilever shown in figure 2.

(15 marks)

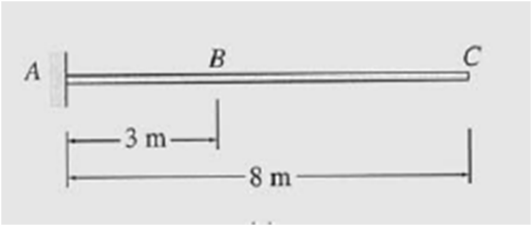


Fig 2

2. A parabolic arch hinged at the springing and crown has a span of 20m. The central rise of the arch is 4m. It is loaded with a uniformly distributed load of intensity 2Kn/M on the left 8m length. Calculate :

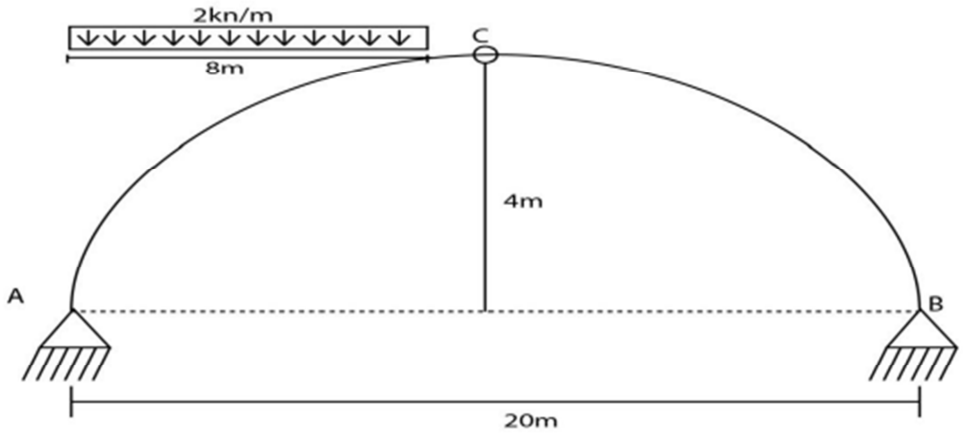


Fig 3

a) The direction and magnitude of reactions at the hinges

b) The bending moments, normal thrust and shear at 4m and 15 m from the left end

c) The maximum positive and negative bending moments (20 marks)

3. A beam ABC of length 9m has one support at the left end and the other support at a distance of 6m from the left end. The beam carries a point load of 1kN at the right end and also 4kN/m over a length of 3m. Determine the slope and deflection at point C (20 marks)

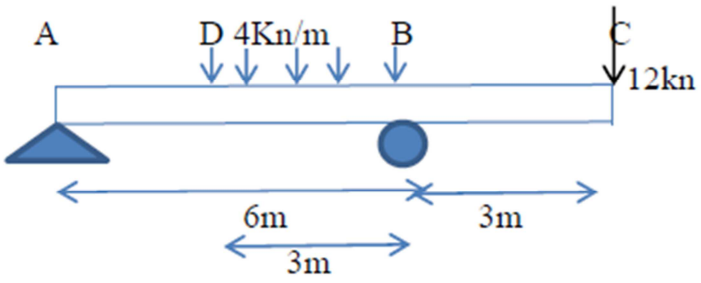

Fig 4

4. Analyze the continuous beam shown in Figure 5 using the method of consistent deformations. Also, draw the bending moment diagram. *EI* is constant for entire beam.

(20 marks)

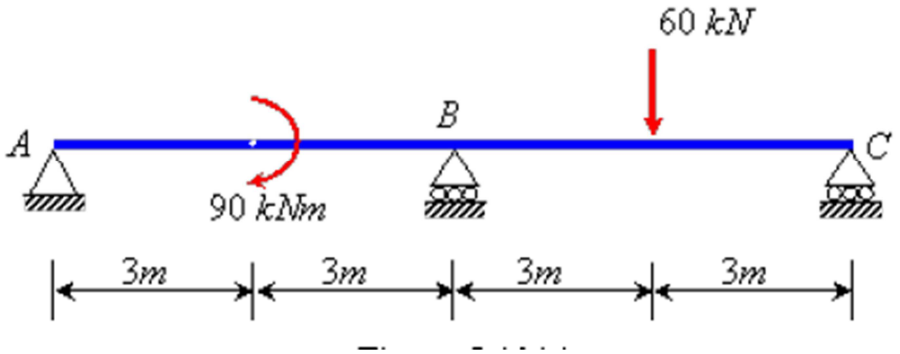


Figure 5

5. An overhanging beam ABC is loaded as shown in figure 4. Find the slopes over each support and the right end. Find also the maximum upward deflection between the supports and the deflection at the right end using Macaulay's method. Take E=2*10$^5$N/mm$^2$ and I=5*10$^3$mm$^4$.

(20 marks)

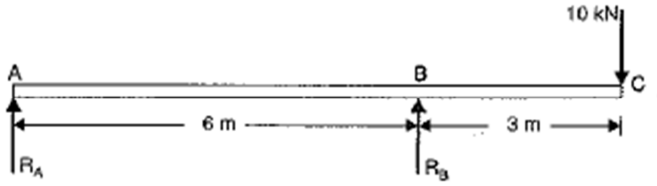


Figure 6

$$\frac{M_\ell L_\ell}{I_\ell} + 2M_c\left(\frac{L_\ell}{I_\ell} + \frac{L_r}{I_r}\right) + \frac{M_r L_r}{I_r}$$

$$= -\sum \frac{P_\ell L_\ell^2 k_\ell}{I_\ell}(1 - k_\ell^2) - \sum \frac{P_r L_r^2 k_r}{I_r}(1 - k_r^2) - \frac{w_\ell L_\ell^3}{4I_\ell} - \frac{w_r L_r^3}{4I_r}$$

$$- 6E\left(\frac{\Delta_\ell - \Delta_c}{L_\ell} + \frac{\Delta_r - \Delta_c}{L_r}\right)$$