



# **TECHNICAL UNIVERSITY OF MOMBASA**

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**FACULTY OF ENGINEERING AND TECHNOLOGY**

**DEPARTMENT BUILDING AND CIVIL ENGINEERING**

**UNIVERSITY EXAMINATION FOR:**

**BSC IN CIVIL ENGINEERING**

**ECE 2317: THEORY OF STRUCTURES IV**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2 HOURS**

**DATE: 12 May 2016**

## **Instructions to Candidates**

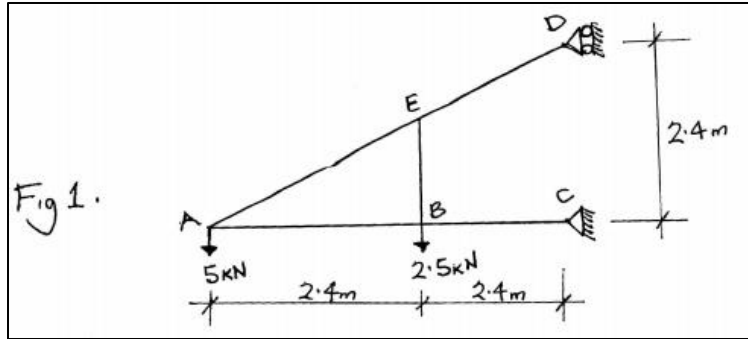
You should have the following for this examination

*-Answer Booklet, Drawing Instruments, Scientific calculator, examination pass and student ID*

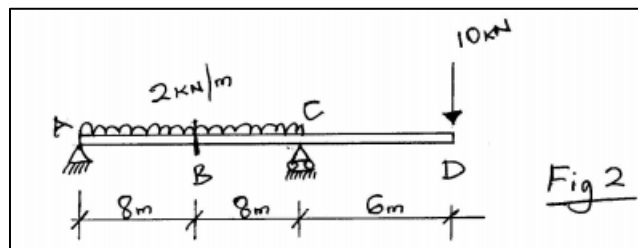
This paper consists of five questions. Attempt question ONE (Compulsory) and any other TWO questions.

## **Question ONE (Compulsory) – 30 marks**

a) Find the deflection at point A in the figure 1 below. Take the cross-sectional area for all members to be  $12,000\text{mm}^2$  and  $E = 200\text{GPa}$ . All other dimensions are given in the figure. (15 marks)



- b) Find the displacement and slope at the tip of the cantilever beam loaded as shown in Fig. 2. Assume the flexural rigidity of the beam  $EI$  to be constant for the beam and given as  $290 \text{ kN.m}^2$  (5 marks)

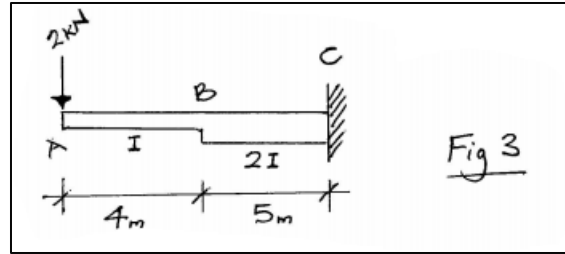


- c) State the following
- (i) Principle of virtual work (2 marks)
  - (ii) Castigliano's Second Theorem (2 marks)
  - (iii) First Moment of Area Theorem (2 marks)
  - (iv) Complementary Work (2 marks)
  - (v) Least Work Theorem (2 marks)

(10 marks)

### Question TWO

Using the moment area method find the deflection at point D and the slope at point B and C as shown in the figure 3 below. Take the flexural rigidity of the member to be constant. (20 marks)



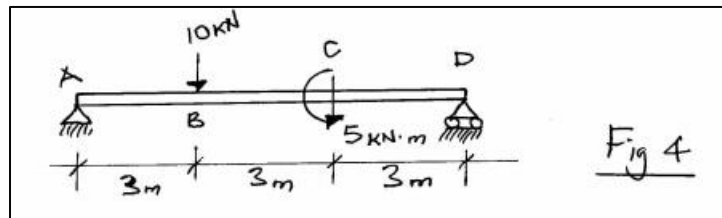
**Question THREE**

a) Using the principle of virtual displacement show that the virtual work of translation is zero. Assume the body is in equilibrium and is a plane rigid body.

(10 marks)

b) Using the conjugate beam method find the rotation at point A as shown in the figure 4 below.

(10 marks)



**Question FOUR**

Find the horizontal and vertical deflection components of joint A using the method of virtual work. Refer to the truss in figure 5 below.

**Question FIVE**

a) Using the least work theorem find the displacement at point B as shown in the figure 6 below.

(10 marks)

b) Using Castigliano's Second Theorem determine vertical displacement at point B as shown in the beam below (Figure 7). Assume the flexural rigidity is constant.

(10 marks)