MACHAKOS UNIVERSITY

University Examinations for 2021/2022 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF BUILDING & CIVIL ENGINEERING

FIRST YEAR SECOND TERM EXAMINATION FOR

DIPLOMA IN BUILDING TECHNOLOGY

DIPLOMA IN CIVIL ENGINEERING

2707 / 103 ST: STRUCTURES I

DATE: 6/4/2022 **TIME: 8.30-11.30 AM**

INSTRUCTIONS

- *This paper consists of **Eight** questions.*
- *Answer* **FIVE** *questions.*
- *All questions carry equal marks.*
- *Maximum marks for each part of the question are as shown.*

1. A beam is loaded as shown in figure 1.

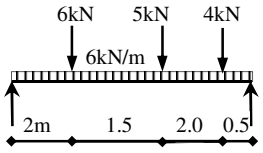

Fig. 1

a) Draw the shear force and bending moment diagrams.

b) Determine the position of the maximum sagging bending moment.

c) Calculate the maximum sagging bending moment. (20 marks)

2. a) Calculate the position of the Centre of gravity for the figure shown in figure 2. (5 marks)

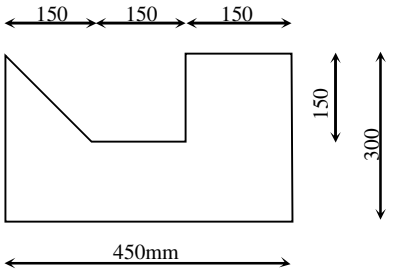

Fig. 2

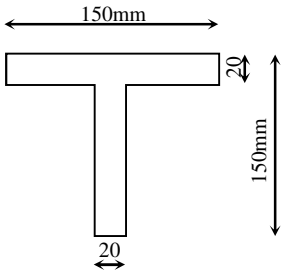

Fig. 3

b) A Tee section measures 150mm X 150mm X 20mm as shown in figure 3. Calculate:

i. The position of the Neutral Axis.

ii. The Moment of Inertia, $I_{xx.}$

iii. The Section Moduli Z_{xx} about both extreme fibres. (15 marks)

3. Figure 4 shows the cross section of a beam carrying a uniformly distributed load over an effective span of 3.6m.

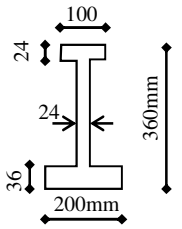

Fig. 4

a) Calculate the position of the neutral axis.

b) Determine $I_{xx.}$

c) Determine the values of $Z_{xx.}$

d) Calculate the safe uniformly distributed load that the beam can carry if the tensile stress is not to exceed $20N/mm^2$ and the compressive stress $100N/mm^2$. (20 marks)

4. Figure 5 shows a loaded beam.

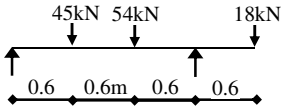

Fig. 5

a) Determine the reactions

b) Draw the shear force diagram

c) Draw the bending moment diagram (20 marks)

5. Figure 6 shows the cross section of a structural member.

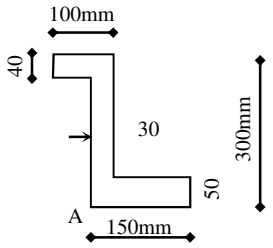

Fig. 6

a) Determine the position of the centroid.

b) Calculate the values of I_{xx} and I_{yy}

c) Calculate the values of r_{xx} and r_{yy}

d) Calculate the section moduli Z_{xx} and Z_{yy} about the bottom left corner A(20 marks)

6. A horizontal cantilever beam 2m long has a T shaped section as shown in figure 7. It carries a uniformly distributed load of 10kN/m along its entire length. Calculate the maximum tensile and compressive stresses. (20 marks)

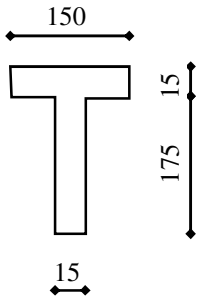

Fig. 7

7.

a) State ***Four*** assumptions made in the theory of simple bending. (4 marks)

b) A rectangular beam 150mm wide X 300mm deep is simply supported over an effective span of 3.6m. Determine the uniformly distributed load that the beam can carry if the bending stress is not to exceed $25N/mm^2$ (8 marks)

c) Using vector components, determine the magnitude and direction of the resultant of the concurrent forces shown in figure 8. (8 marks)

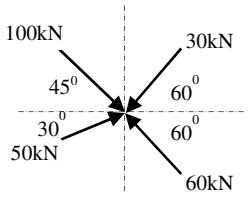

Fig. 8

8. A timber beam having a rectangular cross section 240 X 85mm wide is loaded as shown in figure 9. Determine the following:

a) The maximum bending stress in the beam

b) The bending stress in the beam at a point 0.2m to the left of point B and 30mm below the upper edge of the section. (20 marks)

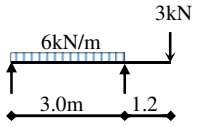

Fig. 9