(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITRY SUPPLEMENTARY/SPECIAL EXAMINATIONS 2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE OF BACHELOR OF SCIENCE IN CIVIL AND STRUCTURAL ENGINEERING AND BACHELOR OF TECHNOLOGY IN BUILDING CONSTRUCTION

COURSE CODE: CSE 213

COURSE TITLE: STRENGTH OF MATERIALS

DATE: 25 JULY 2022 TIME: 8AM – 10AM

INSTRUCTIONS:

1. This paper contains Five questions
2. Answer Question one and any other Three Questions
3. Marks for each question are indicated in the parenthesis.
4. Examination duration is 2 **Hours**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE **(Compulsory)**

(a) Describe the tensile test for a steel specimen and how the modulus of elasticity can be determined from the results. (5 Marks)

(b) Derive an expression relating bulky density, K, Young's Modulus, E, and Poisson's ratio, μ, for a material subjected to equal pressures in three dimensions. (5 Marks)

(c) What are the assumptions made in theory of bending for engineering materials (5 Marks)

(d) Show that in a beam of rectangular cross section subjected to transverse shearing force, the value of the maximum shear stress is 50% greater than the average shear stress. (5 Marks)

(e) At a point in a material, an element is subjected to stresses two dimensions. Find an expression for the normal and shear stresses on the plane at θ^o to the horizontal (12.5 mks)

QUESTION TWO

(b) A rod consisting of cylindrical portions is restrained at both ends as shown in Figure Q1. The rod is initially unstressed.

(i) Determine the normal stress induced in the steel and brass portions when their temperature is increased by 50°C. (10 Marks).

(ii) What is the final displacement of point B. (2.5 Marks).

Modulus of elasticity and coefficient of expansion for steel and brass are $E_s = 210kN/mm^2$, $\alpha_s = 12 \times 10^{-6}/°C$ and $E_b = 105kN/mm^2$, $\alpha_b = 21 \times 10^{-6}/°C$ respectively. Diameter of steel = 40mm and that of brass = 70mm.

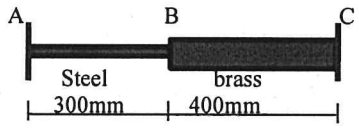

Figure Q1

QUESTION THREE

(a) A steel block 50mm x 60mm x 100mm is subjected to forces as shown in Figure Q2. Determine the volumetric strain, hence the change in volume. (12.5 Marks)

Take modulus of elasticity E = 200kN /mm² and Poisson's ratio $\mu = 0.3$

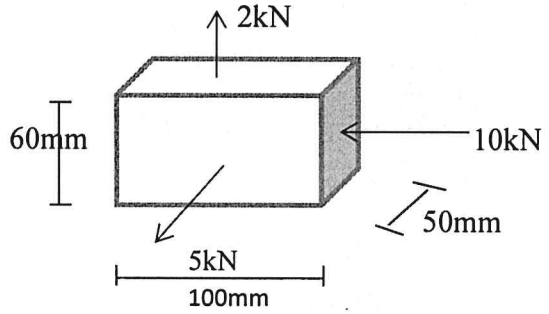

Figure Q2

QUESTION FOUR

(b) A T-shaped steel beam is strengthened by securely bolting it to two pieces of timber as shown in Figure Q3. If a moment of 50kNm is applied about the horizontal axis, determine a) the maximum bending stress in the timber b) the bending stress in the steel along the top edge. The modula ratio E_{steel}/E_{timber} is 20.

(12.5 Marks)

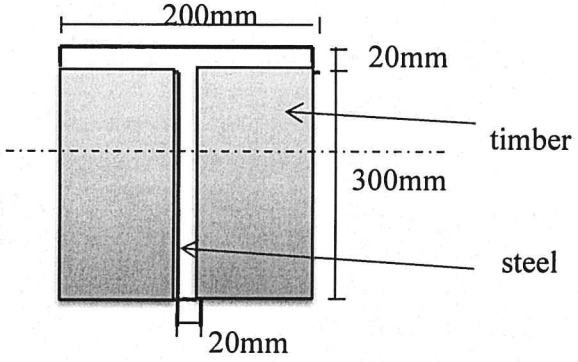

Figure Q3

QUESTION FIVE

a) A beam of cross section shown in Figure Q5 is subjected to a transverse shearing force of 300kN.

i) What is the maximum shear stress (5.5 Marks)

ii) sketch the shear stress distribution across the section. (7 Marks)

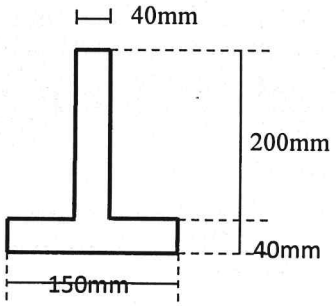

Figure Q5