(*University of Choice*)

# MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

**MAIN CAMPUS**

## UNIVERSITRY REGULAR EXAMINATIONS 2020/2021 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: TUESDAY 9TH FEBRUARY 2021 TIME: 9.00 – 11.00 AM**

**INSTRUCTIONS:**

1. This paper contains FIVE questions
2. Answer any FOUR question
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**

(a) Describe what happens to a steel specimen subjected to a gradually varying tensile stress to failure. (5 Marks)

(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 x 10$^{-6}$/°Cand $E_b$ =105kN/mm$^2$, $\alpha_b$ = 21 x 10$^{-6}$/°C respectively. Diameter of steel = 40mm and that of brass = 70mm.

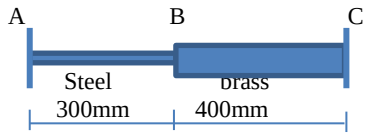


Figure Q1

**QUESTION TWO**

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

(b) 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 /mm$^2$ and Poisson's ratio $\mu$ = 0.3

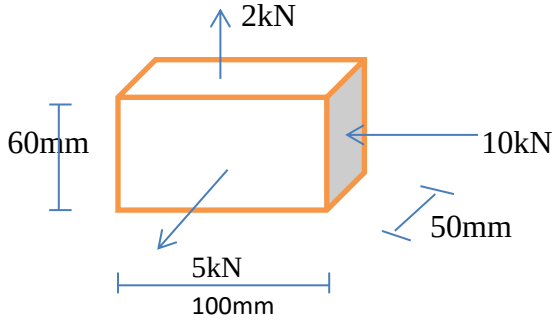


Figure Q2

**QUESTION THREE**

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

(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)

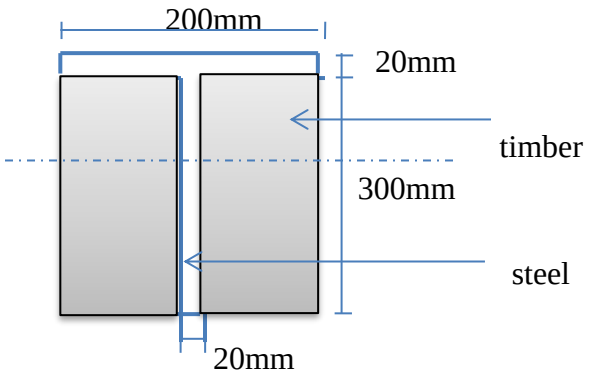


Figure Q3

**QUESTION FOUR**

At a point in a material, an element is subjected to stresses as shown in Figure Q4. Determine

i) the principal stresses and their orientation (7 Marks)

ii) the maximum shear stress and its orientation (6 Marks)

iii) the normal and shear stresses on the plane at 40° to the horizontal (4.5 marks)

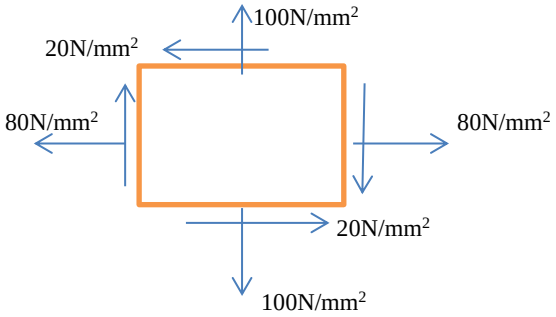


Figure Q4

**QUESTION FIVE**

a) 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)

b) 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. (5 Marks)

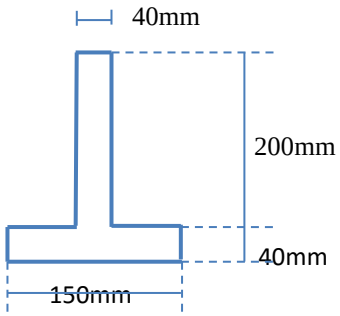


Figure Q5