(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: TEM 222

COURSE TITLE: SOLID MECHANICS I

DATE: 21/04/2023 **TIME: 3:00 PM – 5:00 PM**

INSTRUCTIONS TO CANDIDATES

1. This paper consists of **FOUR** questions
2. Answer Question **ONE (Compulsory)** and any other **TWO** Questions
3. All symbols have their usual meaning

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 5 Printed Pages. Please Turn Over

TEM 222

QUESTION ONE (compulsory) [30 MARKS]

(a) A 6 m horizontal beam AE is simply supported at A and D, 5 m apart. The beam is subjected to an **anticlockwise couple** of 400 kNm at the right end **E**, a 300 kN point load at the mid point of a 4 m long 100 kN/m spread from the left end as shown in Fig. Q 1(a). If E = 200 GN/m^2 and I = 2 x 10^{-4} m^4, determine:

(i) Deflection at the point where couple is acting

(ii) The maximum deflection between the supports ***A*** and ***D.***

(iii) *Using appropriate graph papers draw shear force and bending moment diagrams*

[20 marks]

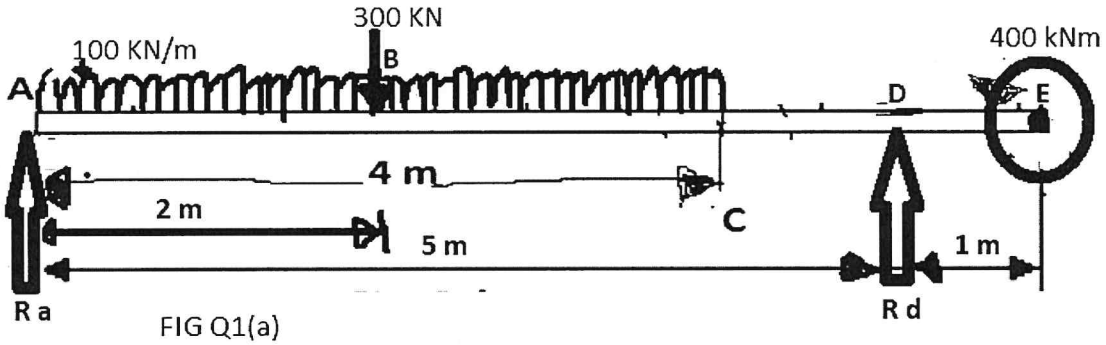

FIG Q1(a)

(b) A steel tube of 30 mm external diameter and 20 mm internal diameter encloses a copper rod of 15 mm diameter to which it is rigidly joined at each end. If, at a temperature of 10°C there is no longitudinal stress, calculate the stresses in the rod and tube when the temperature is raised to 200°C. Take *E* for steel and copper as ***210 GPa*** and ***100 GPa*** respectively. The values of the coefficient of linear expansion for steel and copper are given as ***11 x 10^{-6} per °C*** and ***18 x 10^{-6} per °C*** respectively. **[10 marks]**

QUESTION TWO (20 MARKS)

A 50.8 mm diameter bar 1.83 m long shortens 1.19 mm under an axial load of 178 kN. If the diameter is increased 0.01 mm during loading, calculate:

(a) Poisson's ratio; **[6 marks]**

(b) The modulus of elasticity; and **[7 marks]**

(c) The shear modulus of elasticity. **[7 marks]**

QUESTION THREE (20 MARKS)

(a) Explain how failure of a short and long column takes place? **[6 marks]**

(b) A hollow cylindrical cast iron column is 4 m long with both ends fixed. Determine the minimum diameter of the column if it has to carry a safe load of 250 kN with a factor of safety of 5. Take the internal diameter as 0.8 times the external diameter. Take σ_c = 550 MPa and $\alpha = {}^{1}/_{1600}$ in Rankine's formula.

[14 marks]

QUESTION FOUR (20 MARKS)

(a) Distinguish between the following, giving due explanation:

(i) Stress and strain

(ii) Force and stress, and

(iii) Tensile stress and compressive stress. **[12 marks]**

(b) A tensile test was conducted on a mild steel bar. The following data was obtained from the test:

(i) Diameter of the steel bar	***= 3 cm***
(ii) Guage length of the bar	***=20 cm***
(iii) Load at elastic limit	***= 250 kN***
(iv) Extension at a load of 150 kN	***= 0.21 mm***
(v) Maximum load	***= 380 kN***
(vi) Total extension	***= 60 mm***
(vii) Diameter of the rod at failure	***= 2.25 cm***

Determine :

(a) The Young's Modulus	**[2 marks]**
(b) The stress at elastic limit	**[2 marks]**
(c) The percentage elongation	**[2 marks]**
(d) The percentage decrease in area.	**[2 marks]**