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ECE 205 (23-24)

(University of Choice)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2023/2024 ACADEMIC YEAR

BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: **ECE 205**

COURSE TITLE: **SOLID MECHANICS FOR ELECTRICAL ENGINEERS**

DATE: **5/12/2023** **TIME:** **8:00 AM - 10:00 AM**

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 4 Printed Pages. Please Turn Over

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QUESTION ONE **[30 marks]**

(a) A horizontal beam AB is simply supported at A and B, 6 m apart. The beam is subjected to a clockwise couple of 300 kNm , a 20 kN point load and 100 kN/m spread load at a distance of 4 m, 2 m and 2m respectively 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.

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

[20 marks]

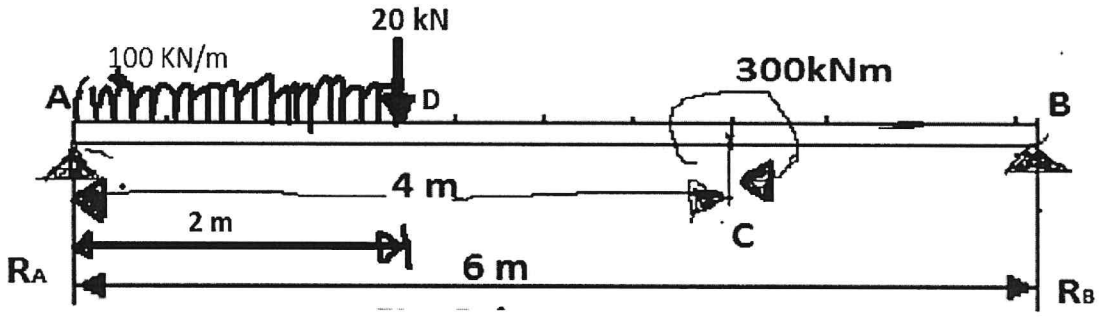

FIG Q1(a)

(b) A steel rod of 3 cm diameter and 5 m long is connected to two grips and the rod is maintained at a temperature of 95°C. Determine the stress and pull exerted when the temperature falls to 30°C, if

(i) The ends do not yield and

(ii) The ends yield by 0.12 cm. **[10 marks]**

Take E = 200 GPa and α = 12 X 10^{-6} /°C

QUESTION TWO **[20 marks]**

The block is subjected to an axial compression of P = 400 kN (see figure Q 2). Use a = 60 mm, b = 40 mm, and L = 200 mm. If dimensions b and L are changed to 40.02 and 199.7 mm, respectively, calculate:

(i) Poisson's ratio;

(ii) The modulus of elasticity;

(iii)The final value of the dimension a; and

(iv) (iv)The shear modulus of elasticity. *[20 marks]*

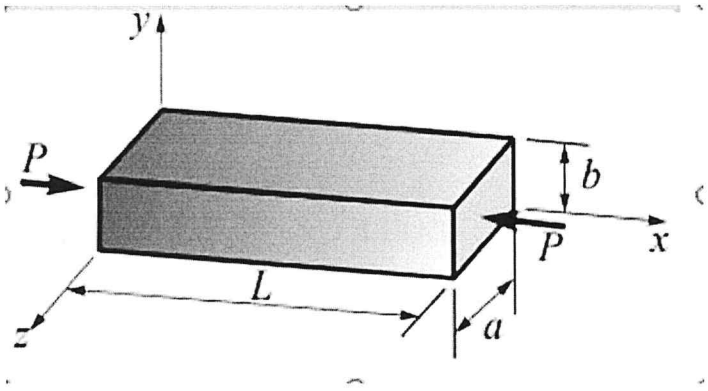

Fig Q2

QUESTION THREE **[20 marks]**

(a) Define the terms: column, strut and crippling load **[6 marks]**

(b) How will you justify that Rankine's formula is applicable for all lengths of columns, ranging from short to long columns. **[5 marks]**

(c) A hollow mild steel tube 8 m long and 60 mm internal diameter and 5 mm thick is used as a strut with both ends hinged. Find the crippling load and safe load taking factor of safety as 3. Take E = 200 GPa. **[9 marks]**

QUESTION FOUR **[20 marks]**

A tension test was performed on a steel specimen having an original diameter of 13 mm and a gauge length of 51 mm. The data is listed in the **Table Q.4** below.

(a) Calculate stress in each case and plot stress-strain diagram in a graph paper. **[10 marks]**

(b) Determine approximately the modulus of elasticity **[3 marks]**

(c) Determine the modulus of toughness. **[2 marks]**

(d) Determine the ultimate stress **[3 marks]**

(e) Determine the modulus of rapture. **[2 marks]**

TABLE Q4

	LOAD kN	STRAIN X 10^{-4}
1	0	0
2	6.67	2.5
3	20.46	7.5
4	35.58	12.5
5	48.93	17.5
6	52.49	25
7	52.49	40
8	53.38	100
9	73.84	200
10	88.96	500
11	95.63	1400
12	86.74	2000
13	82.29	2300