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(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY

(MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE

OF

BACHELOR OF SCIENCE IN MECHANICAL AND INDUSTRIAL ENGINEERING

COURSE CODE: MIE 222

COURSE TITLE: SOLID MECHANICS II

DATE: 22-04-2022 **TIME: 12:00-14:00**

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

QUESTION ONE (compulsory) [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]***

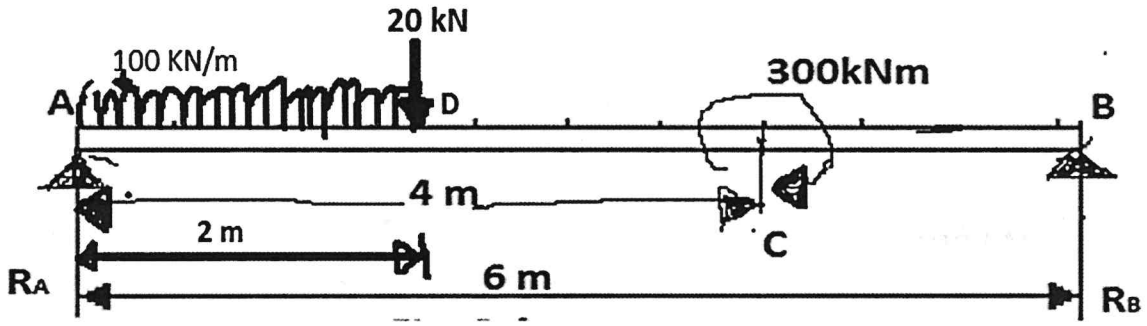

FIG Q1(a)

(b) For the beam shown in Fig. Q1(b) is a propped cantilever, using Macaulay's Method:

(i) Determine the deflection at C;

(ii) Determine the maximum deflection in span AB. **[10 marks]**

Take EI = 40,000 kNm^2

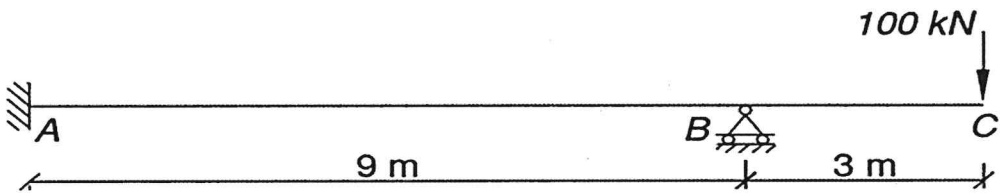

FIG Q1 (b)

QUESTION TWO (20 MARKS)

An external pressure of 20 MN/m^2 is applied to a thick cylinder of internal diameter 160 mm and external diameter 320 mm. If the maximum hoop stress permitted on the inside wall of the cylinder is limited to 45 MN/m^2, what maximum internal pressure can be applied assuming the cylinder has closed ends? What will be the change in outside diameter when this pressure is applied? E = 207 GN/m^2, v = 0.29.

QUESTION THREE (20 MARKS)

(a) An element in plane stress is subjected to stresses σ_x =50 MPa, σ_y = 30 MPa, and τ_{xy} = 20 MPa (see figure Q3(a)). Determine the principal stresses and show them on a sketch of a properly oriented element.

[10 marks]

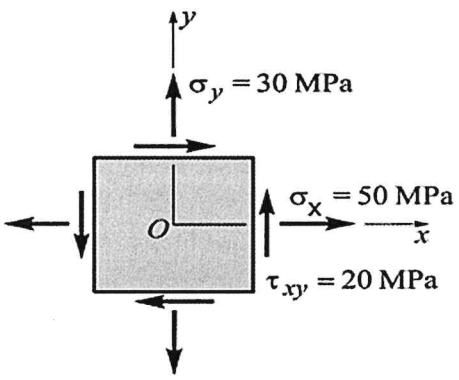

Fig Q 3[a]

(b) An element in plane stress is subjected to stresses $\sigma_x = -10$ MPa, σ_y = 50 MPa, and τ_{xy} = 25 MPa, as shown in the figure Q 3(b). Using Mohr's circle, determine the stresses acting on an element oriented at an angle $\theta = 45°$ from the *x axis.* Show these stresses on a sketch of an element oriented at the angle θ . **[10 marks]**

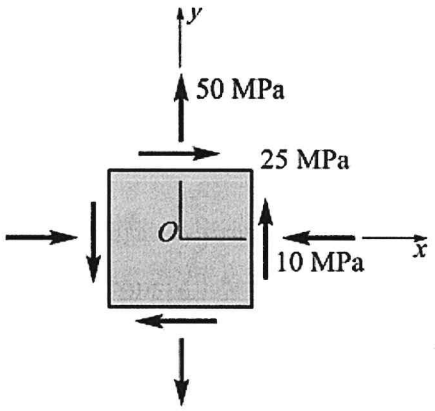

Fig Q3(b)

QUESTION FOUR (20 MARKS)

(a) Explain with reasons which theory of failure is best suited for:
   (i) Ductile material
   (ii) Brittle material [6 marks]

(b) Use the stress strain table Q4 to accurately draw in a graph paper a stress-strain curve and use the graph to answer the following questions:

(i) Show on the graph how to use the 0.2% strain offset to determine the yield stress.

(ii) For what range of stress is the material considered elastic?

(iii) Calculate the Modulus of Elasticity, E.

(iv) From the information given in the Table Q4 and the graph, determine the value of the ultimate stress,

(v) If a load produces a stress of 483 MPa, what is the permanent strain induced? What is the total strain? What is the elastic strain? What is the elastic strain? Show this work on the graph.

Stress (MPa)	0	44	88	132	177	221	265	309	353
Strain (10^{-3})	0	2	4	6	8	10	12	14	16
Stress (MPa)	397	415	431	446	457	465	473	479	485
Strain (10^{-3})	18	20	22	24	26	28	30	32	34
Stress (MPa)	491	497	502	508	503	497	491	485	
Strain (10^{-3})	36	38	40	42	44	46	48	50	