Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BFC 20903
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	FEBRUARY 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 An alloy specimen having a diameter of 12.8 mm and a gauge length of 50 mm was tested to fracture. Load and deformation data obtained during the test are given in **Table Q1**. By sketching appropriate graph, determine the following;

(a) the modulus of elasticity.

(4 marks)

(b) the proportional limit.

(4 marks)

(c) the ultimate strength.

(3 marks)

(d) the yield strength (0.05% offset).

(3 marks)

(e) the yield strength (0.20% offset).

(3 marks)

(f) the fracture stress.

(4 marks)

(g) the true fracture stress if the final diameter of the specimen at the location of the fracture was 11.3 mm.

(4 marks)

Q2 A steel T shape is used to support the loads shown on the beam in **Figure Q2(a)**. The dimensions of the shape shown in **Figure Q2(b)** where $d = 450$ mm, $b_f = 300$ mm, $t_f = 25$ mm, and $t_w = 16$ mm.

(a) Draw shear force diagram (SFD) and bending moment diagram (BMD).

(10 marks)

(b) Calculate the moment of inertia about z-axis.

(5 marks)

(c) Draw the bending stress profile from the cross-section.

(5 marks)

(d) Determine the maximum transverse shear stress profile from the cross-section.

(5 marks)

Q3 The simply supported beam shown in **Figure Q3** consists of a W530 × 92 structural steel wide-flange shape [$E = 200$ GPa, $I = 554 \times 10^6$ mm^4].

(a) Determine the support reactions at support A and C

(5 marks)

(b) Compute the slope of the beam at A using the Macaulay's method.

(10 marks)

(c) Compute the deflection of the beam at B using the Macaulay's method.

(10 marks)

Q4 A steel tube with Modulus Young, $E = 200$ GPa and yield strength, $\sigma_y = 250$ MPa has a length of $L = 1{,}400$ mm supports an eccentrically applied load P as shown in **Figure Q4**. The tube has an outside diameter of 60 mm and a wall thickness of 5 mm. If the eccentricity, $e = 9$ mm, determine;

(a) Determine the maximum load P which can be applied without causing either buckling or yielding of the tube.

(5 marks)

(b) Calculate the corresponding maximum deflection midway between A and B.

(10 marks)

(c) State five (5) ways to improve the torsional rigidity in a tube cross-section. Provide your sketch where appropriate.

(10 marks)

– END OF QUESTIONS –

FINAL EXAMINATION

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Load (kN)	Change in Length (mm)	Load (kN)	Change in Length (mm)
0	0		
7.6	0.02	43.8	1.50
14.9	0.04	45.8	2.00
22.2	0.06	48.3	3.00
28.5	0.08	49.7	4.00
29.9	0.10	50.4	5.00
30.6	0.12	50.7	6.00
32.0	0.16	50.4	7.00
33.0	0.20	50.0	8.00
33.3	0.24	49.7	9.00
36.8	0.50	47.9	10.00
41.0	1.00	45.1	fracture

TABLE Q1

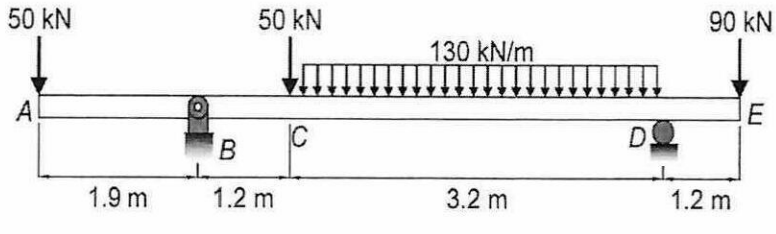

FIGURE Q2 (a)

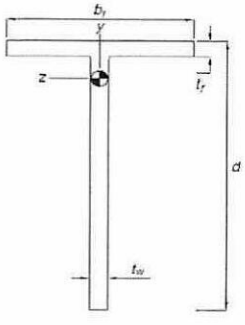

FIGURE Q2 (b)

FINAL EXAMINATION

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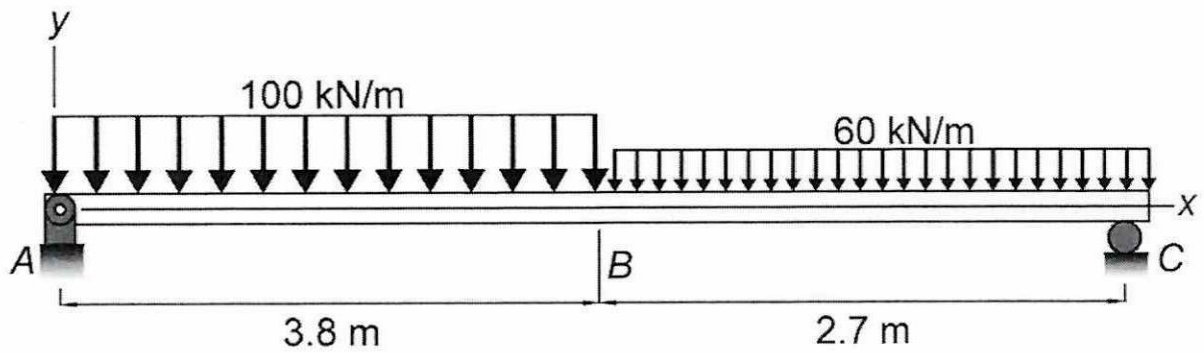

FIGURE Q3

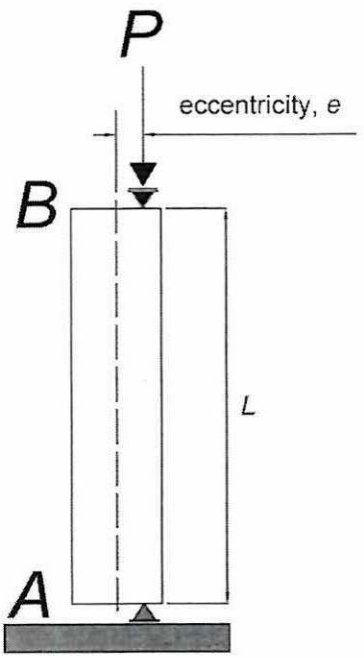

FIGURE Q4