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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2023/2024**

COURSE NAME : SOLID MECHANICS
COURSE CODE : DAM 23303
PROGRAMME CODE : DAM
EXAMINATION DATE : JANUARY / FEBRUARY 2024
DURATION : 3 HOURS
INSTRUCTIONS : 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 **SEVEN (7)** PAGES

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JALAN TUN HUSSEIN ONN
75400 SKUDAI, JOHORE BAHRU
MALAYSIA

- Q1** (a) In each case, the beam is subjected to the loading shown in **Figure Q1 (a)**. Sketch the general shape of the shear and moment diagram for each case. (6 marks)
- (b) A beam AB is 20 meters long and carries a uniformly distributed load of 0.6 kN/m and a concentrated load of 3 kN and 5 kN at A and B, as shown in **Figure Q1 (b)**.
- (i) Sketch shear force and bending moment diagrams. (11 marks)
- (ii) Determine the location and magnitude of the maximum value of the bending moment (3 marks)
- Q2** (a) A rectangular cross-section plank is used to support the load on it, and the plank is supported at both ends. If the load is placed on the centre of the plank, draw a stress variation across the plank cross-section. (2 marks)
- (b) A beam is supported and loaded, as shown in **Figure Q2 (b)(i)**, and the beam cross-section detail is displayed in **Figure Q2 (b)(ii)**.
- (i) Determine the location of the neutral axis by referring to the reference **x-y** plane. (4 marks)
- (ii) Calculate the moment of inertia for the beam concerning the reference **x-y** plane. (3 marks)
- (iii) Determine the bending moment equations representing bending moment variation across the beam length. (4 marks)
- (iv) Calculate the value of bending stress on the top surface and lower surface of the beam at a location 2 m and 7 m from A. (4 marks)
- (c) Calculate the moment of inertia for a beam having a cross-sectional dimension, as shown in **Figure Q2 (c)**. State the location of its neutral axis location from the **x**-axis. (3 marks)

- Q3 (a) Define torsion and torque. (4 marks)
- (b) Explain the reasons behind the preference for hollow circular shafts over solid circular shafts. (6 marks)
- (c) **Figure Q3 (c)** shows an electric motor (power, $P = 4$ kW and rotation, $N = 200$ rpm) turning a shaft with a diameter, d . If the maximum allowable stress is $\tau_{\max} = 200$ MPa, determine the value of the shaft diameter, d . (10 marks)
- Q4 (a) Identify Circumferential stress (hoop stress) and Longitudinal stress. (4 marks)
- (b) A mild steel pipe diameter of 1.5 m and thickness of 15 mm is subjected to an internal fluid pressure of 1.5 N/mm². Calculate the hoop stress and longitudinal stress develop in the pipe wall. (6 marks)
- (c) A close cylindrical drum 600 mm in diameter and 2 m long has a shell thickness of 12 mm. Suppose it carries a fluid under a pressure of 3 N/mm². (Modulus Young, $E = 200$ GPa and Poisson's ratio, $\nu = 0.3$).
- (i) Calculate the longitudinal stress and hoop stress in the drum wall (4 marks)
- (ii) Determine the change in diameter, length, and volume of the drum. (6 marks)
- Q5 (a) Define the meaning of:
- (i) Principal Stress, $\sigma^{1/2}$ (1 mark)
- (ii) Principal Plane (1 mark)
- (b) As illustrated in **Figure Q5 (b)**, a steel rod is being loaded. The diameter of the rod is 50 mm. The force is exerted on 300 mm and 250 mm from the element M, for the loading condition:
- (i) Determine the reaction at the rod end, A. (4 marks)
- (ii) Determine the normal and shearing stress at point M on the end of the rod. (3 marks)

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- (iii) Calculate the element M's principal stress and principal plane. (7 marks)
- (iv) Sketch the element M principal plane. (4 marks)

-END OF QUESTIONS -

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lelinsakM nseplunonN nstedeL
amoldiO muligereH tleuO
pisevalakM nnoD niozzufi noT. norevint⁰

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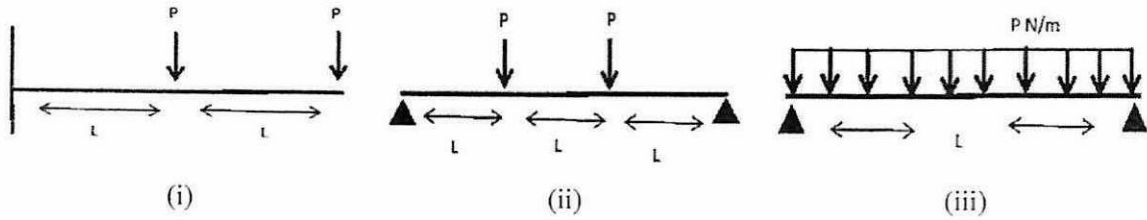


Figure Q1 (a)

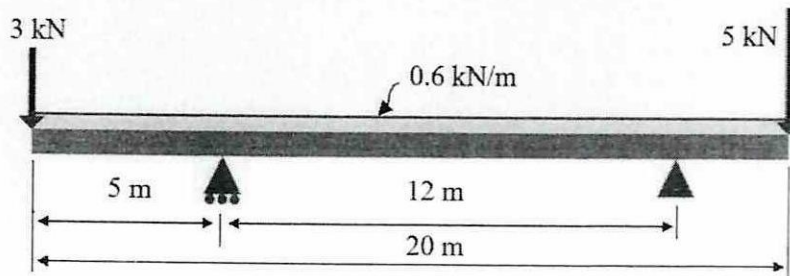


Figure Q1 (b)

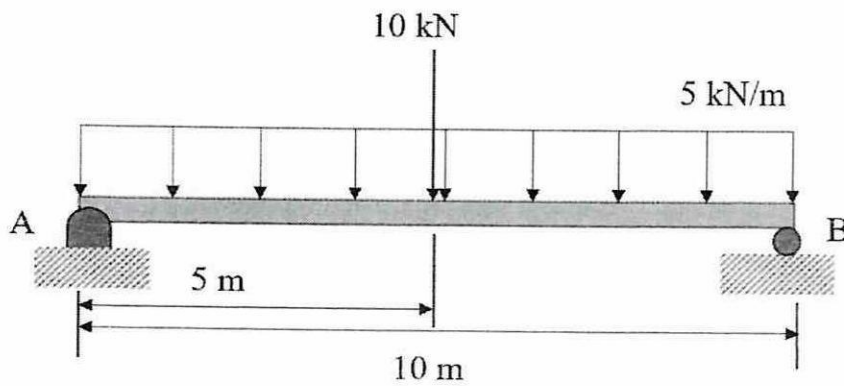


Figure Q2 (b) (i)

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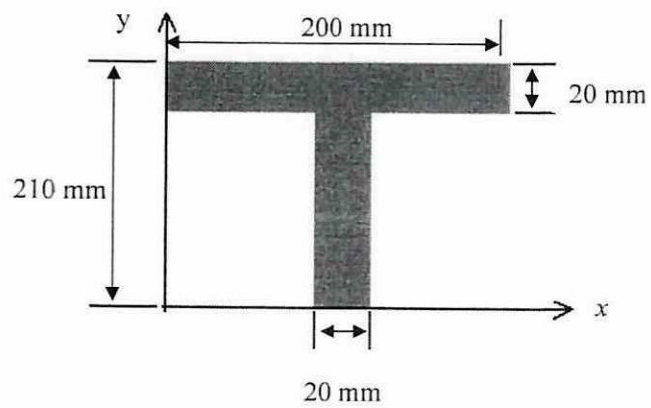


Figure Q2 (b)(ii)

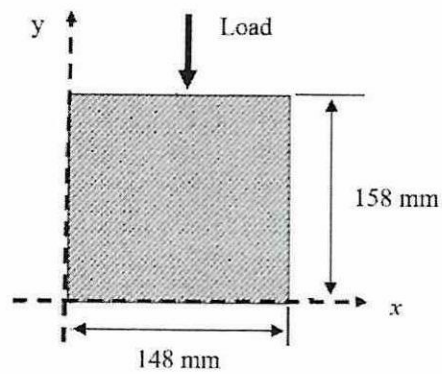


Figure Q2 (c)

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TAMBAHAN TAV HRP SATU DAMPAK
Penerapan
keberhasilan teknik rekayasa
dalam kehidupan sehari-hari
sangat penting dan bermanfaat bagi masyarakat.

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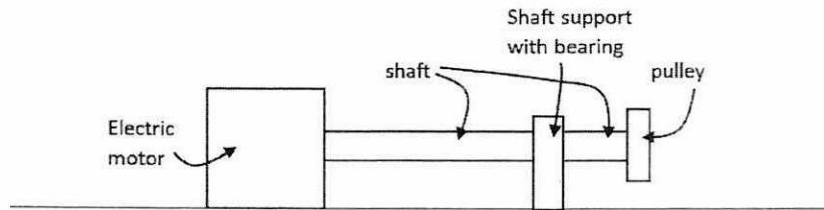


Figure Q3 (c)

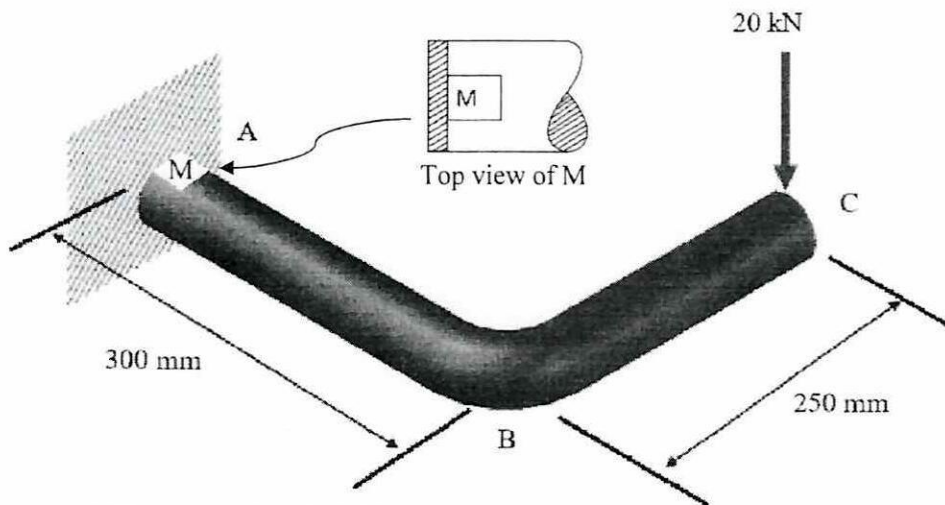


Figure Q5 (b)

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