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**UNIVERSITI TUN HUSSEIN ONN  
MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2022/2023**

COURSE NAME : MECHANICS OF MATERIAL  
COURSE CODE : BNP 20203  
PROGRAMME CODE : BNC  
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 SIX (6) PAGES

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**Q1** A plane element is subjected to a set of stresses as shown in **Figure Q1**. Answer all questions (a) to (c) below:

(a) Determine the principal stresses and the plane locations in which they occur.

(5 marks)

(b) Determine the maximum shear stresses and the locations of the plane in which they occur.

(5 marks)

(c) Determine the normal and shear stresses in the plane at a  $30^\circ$  (counterclockwise) angle to the X plane.

(6 marks)

(d) **Figure Q1(d)** shows the rigid bar AB supported by a steel rod AC with a diameter of 20 mm and an aluminum block having a cross sectional area of 1800 mm<sup>2</sup>. The 18-mm-diameter pins at A and C are subjected to single shear. If the failure stress for the steel and aluminium is  $(\sigma_{st})_{fail} = 680\text{MPa}$  and  $(\sigma_{al})_{fail} = 70\text{MPa}$  respectively, and the failure shear stress for each pin is  $\tau_{fail} = 900\text{MPa}$ , determine the largest load P that can be applied to the bar. Apply a factor of safety of F.S. = 2

(9 marks)

**Q2** The cantilever beam which has length L is shown in **Figure Q2**. It is loaded with moment at point A, B and C;

(a) Prove the beam is statically determinate beam.

(3 marks)

(b) Calculate the support reactions.

(6 marks)

(c) Determine the shear force value with the aid of shear force diagram.

(6 marks)

(d) Determine the bending moment value with the aid of bending moment diagram.

(10 marks)

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- Q3** (a) Double Integration Method and Macaulay Method has similar boundary condition. With the aid of sketches, identify the boundary conditions for a simply supported beam and cantilever beam. (5 marks)
- (b) Beam AB as shown in **Figure Q3(b)** has a span of 4m. The beam is subjected to uniformly distributed load of 10 kN/m. Answer all questions (i) to (iii) below:
- (i) Calculate the support reactions at point A and B. (2 marks)
- (ii) Derive the bending moment – deflection equation, slope – deflection equation and deflection equation of the beam by using Double Integration Method. (12 marks)
- (iii) Determine the slope and deflection of the beam at 1m and 3m from the support at point A. (6 marks)
- Q4** (a) Explain the following statements;
- (i) Types of internal forces (2 marks)
- (ii) Identify type of external forces or load should be applied in truss system and determine part at the truss that the load should be exerted. (4 marks)
- (b) **Figure Q4(b)** shows a truss structure which supported by a pin at joint A and a roller at joint H. Vertical load of 155 kN and horizontal load 125 kN are applied at joint F and B respectively. Using Method of Sections, determine the following statements;
- (i) Determine the stability and determinacy of the truss structure. (3 marks)
- (ii) Calculate the reaction force at Joint A and Joint H. (3 marks)
- (iii) Determine the force in member EG, DG and DF only. State if the members are in tension or compression. (13 marks)

-END OF QUESTIONS -

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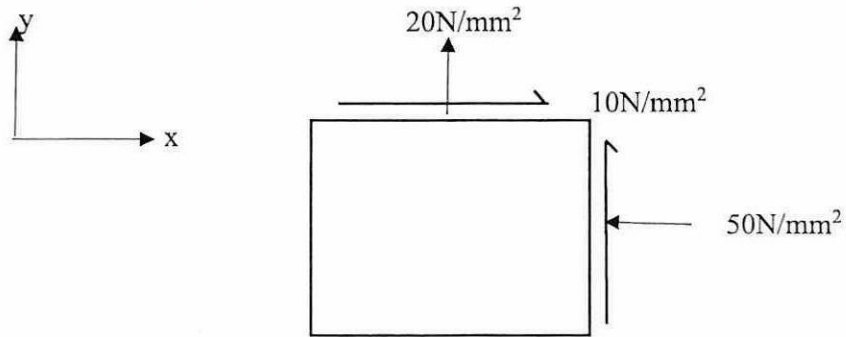


Figure Q1

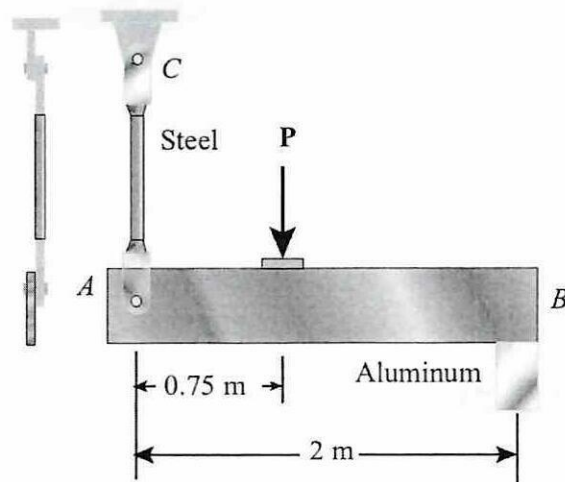


Figure Q1(c)

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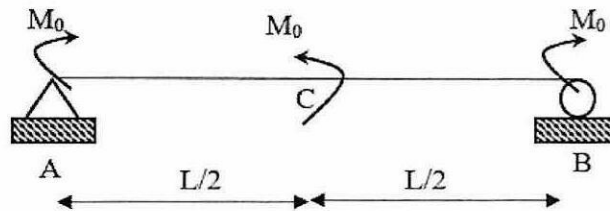


Figure Q2

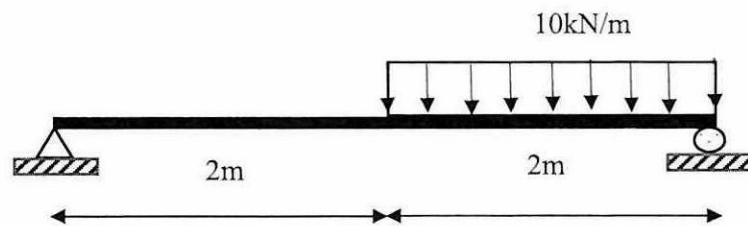


Figure Q3(b)

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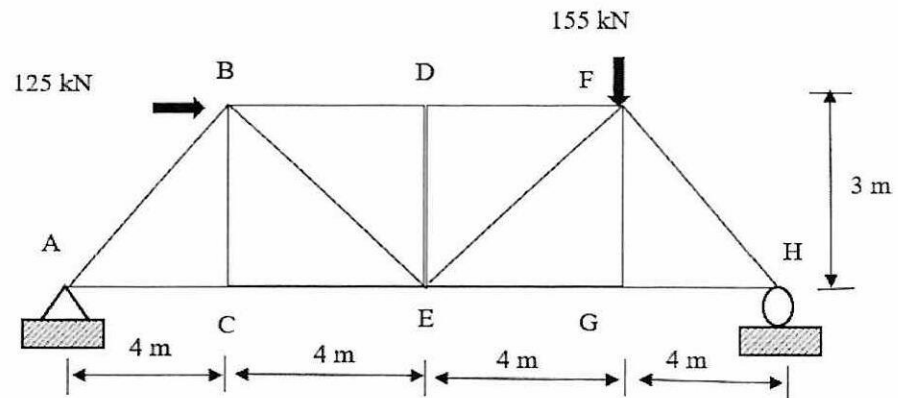


Figure Q4(b)