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**UNIVERSITI TUN HUSSEIN ONN
MALAYSIA**

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

COURSE NAME : SOLID MECHANICS
COURSE CODE : DAM 11203 / DAM 23303
PROGRAMME CODE : DAM
EXAMINATION DATE : JULY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWERS FIVE (5) QUESTIONS ONLY
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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Q1 (a) Define the followings;

- (i) Normal Stress
- (ii) Normal Strain
- (iii) Thermal Stress

(6 marks)

(b) Two cylindrical rods, steel rod AB and aluminium rod BD are joined at B and restrained by rigid supports at A and D. Two loads 50 kN and 100 kN are applied at B and C as shown in **Figure Q1(b)**. Given $E_{st} = 200$ GPa and $E_{al} = 72$ GPa. Determine;

- (i) the reactions at A and D
- (ii) the deflection of point B

(14 marks)

Q2 (a) A cantilevered beam has a length L with a loading P applied at the end of the beam.

- (i) Draw the diagram of the beam.

(2 marks)

- (ii) Prove that the maximum bending moment, $M_{max} = -PL$

(5 marks)

(b) A simply supported beam is loaded as shown in **Figure Q2(b)**.

- (i) Draw the shear and bending moment diagrams.

(8 marks)

- (ii) Determine the maximum absolute values of the shear and the bending moment.

(5 marks)

- Q3** (a) (i) Define area moment of inertia (I). (2 marks)
- (ii) Prove that area moment of inertia of rectangular shape of a beam cross section is $bd^3/12$. (6 marks)
- (b) The composite beam as shown in **Figure Q3(b)** consists of a Douglas fir wood core and three A-36 steel plates. If the allowable bending stress for the wood is $(\sigma_{\text{allow}})_w = 20$ MPa and for the steel $(\sigma_{\text{allow}})_{st} = 130$ MPa, determine the maximum moment that can be applied to the beam. Given $E_w = 13.1$ GPa and $E_{st} = 200$ GPa. (12 marks)
- Q4** (a) State **FOUR (4)** example the application of torsion. (4 marks)
- (b) Two solid steel shafts, each of 30 mm diameter, are connected by the gears as shown in **Figure Q4(b)**. Knowing that $G = 77$ GPa, determine the angle through which end A rotates when a 200 Nm torque is applied at A. (16 marks)

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- Q5**
- (a) Describe about thin wall cylinder. (3 marks)
- (b) State **FOUR (4)** example of thin wall cylinder. (4 marks)
- (c) The cylindrical pressure tank shown in **Figure Q5(c)** has an inside diameter of 1.6 m and a wall thickness of 35 mm. The pressure in the tank is 1700 kPa. An additional axial load of 180 kN is applied to the top end of the tank through a rigid bearing plate. Determine ;
- (i) the stresses σ_x , σ_y and τ_{xy} on a stress element at point A, which is on the outside surface of the tank.
- (ii) the normal and shearing stresses on an inclined plane oriented at $+30^\circ$ from the x-axis. (13 marks)
- Q6**
- (a) Give **TWO (2)** methods to compute principal stresses. (2 marks)
- (b) Explain the procedures for analysis, if state of stress at a point is known for a given orientation of an element of material. (4 marks)
- (c) For the state of plane stress shown in **Figure Q6(c)**, determine:
- (i) the principal planes (2 marks)
- (ii) the principal stresses (2 marks)
- (iii) the maximum shearing stress and the corresponding normal stress (4 marks)
- (iv) draw the Mohr's Circle for the state of plane loaded (6 marks)

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- END OF QUESTIONS -

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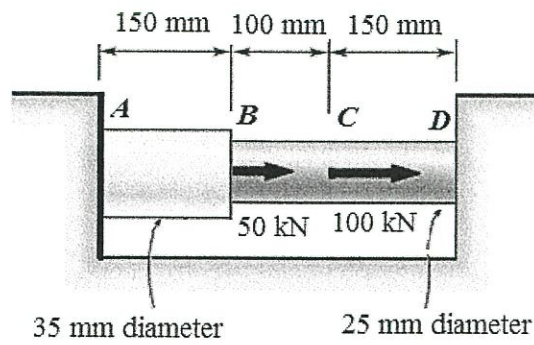


Figure Q1(b)

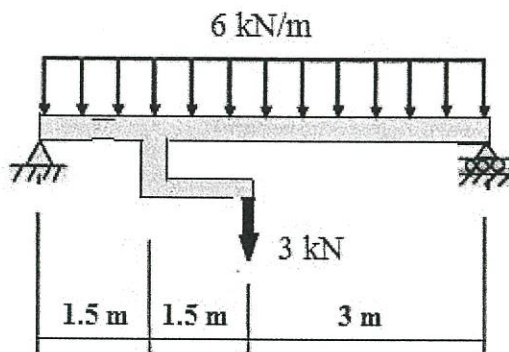


Figure Q2(b)

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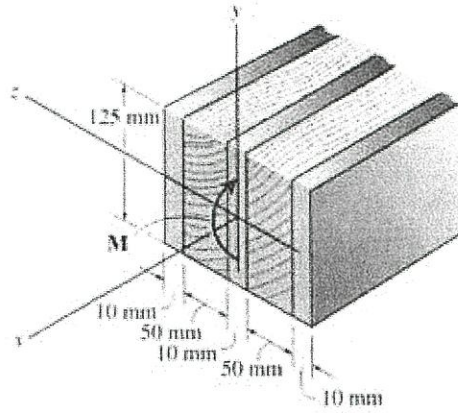


Figure Q3(b)

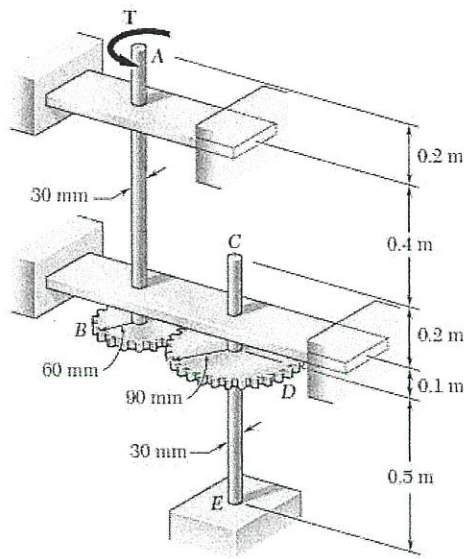


Figure Q4(b)

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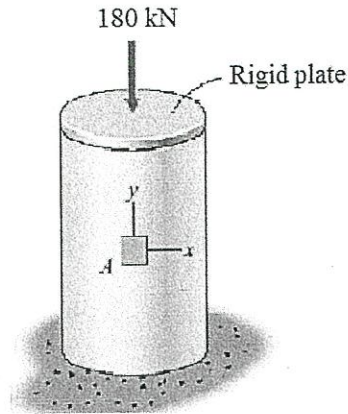


Figure Q5(c)

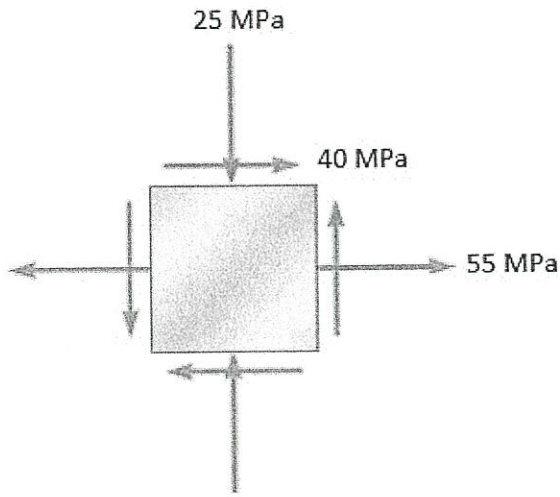


Figure Q6(c)

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