UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	DAC 12503
PROGRAM CODE	:	DAA
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	2 HOURS 30 MINUTES
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 **SEVEN (7)** PAGES

Q1 (a) Draw and label the stress-strain relationship diagram.

[2 marks]

(b) Based on your understanding in **Q1(a)** briefly describe the following terms: elastic limit, plastic limit, yield stress, and strain hardening.

[8 marks]

(c) Three types of bars named cooper, bronze, and aluminium are connected as shown in **Figure Q1(c)**. Determine the following;

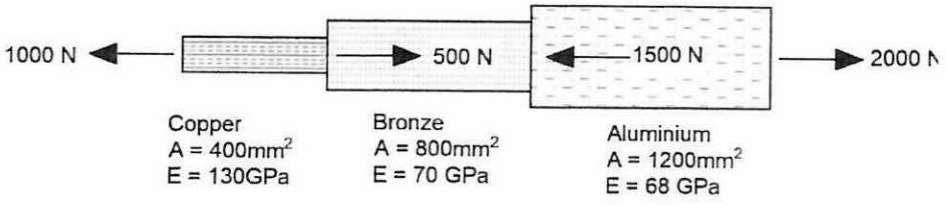


Figure Q1(c)

(i) The force needed in each bar for equilibrium. Your answer must include the FBD sketch for each cross-section.

[6 marks]

(ii) The normal stress for each bar.

[6 marks]

(iii) The total deflection of these bars.

[3 marks]

Q2 A simply supported beam that has a length of 6 m is shown in **Figure Q2**. If it is loaded with a triangular distributed load of 45kN/m from A to B.

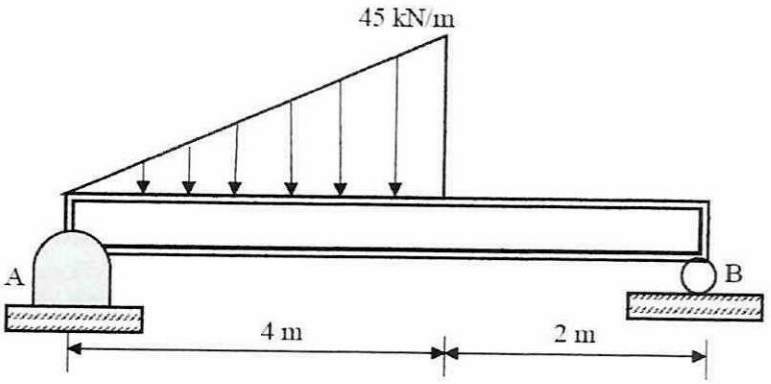


Figure Q2

(i) Determine the support reactions.

[5 marks]

(ii) Generate the shear force diagram based on a detailed calculation.

[7.5 marks]

(iii) Generate the bending moment diagram based on a detailed calculation.

[7.5 marks]

(iv) Based on your answer in Q2(ii) and Q2(iii), identify the inflection point.

[5 marks]

Q3 (a) **Figure Q3(a)** shows a simply supported beam with cross-section of 30cm x 50cm loaded with a uniform distributed load of 30kN/m. The reaction support at both A and B is 90kN (↑).

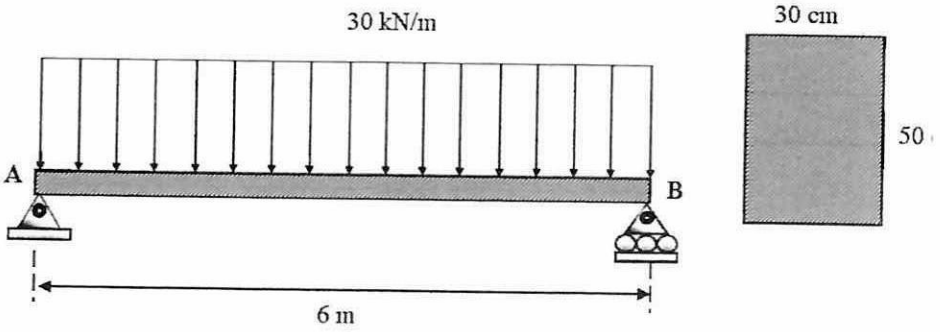


Figure Q3(a)

(i) Calculate the maximum moment of the beam.

[2 marks]

(ii) Calculate the moment of inertia of the beam.

[4 marks]

(iii) Calculate the maximum bending stress in the beam.

[4 marks]

(b) A simply supported beam AB has the cross-sectional area shown in **Figure Q3(b)**. A distributed load of 40 kN/m is acting on the beam. If it is subjected to a shear of, V = 80 kN,

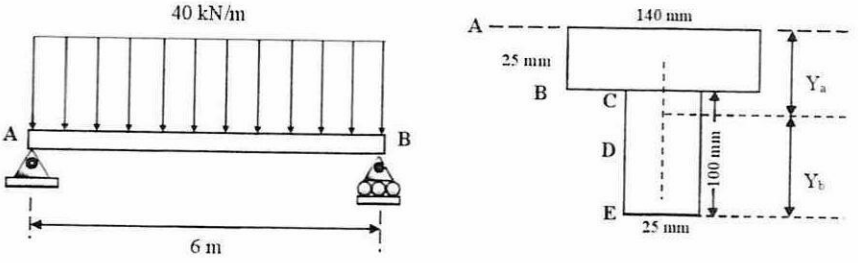


Figure Q3(b)

i. Calculate the heights of y_a and y_b.

[4 marks]

ii. Determine the second moment of inertia, I for the composite T shape.

[3 marks]

iii. Determine the shear stress magnitude over the cross section at B (flange) and C (web).

[6 marks]

iv. Draw the shear stress distribution profile across the beam section.

[2 marks]

Q4 The state of stresses on a plane is given as $\sigma_x = 15MPa$, $\sigma_y = 5MPa$ and $\tau_{xy} = 4MPa$. By using Mohr's circle method,

(i) Sketch the state of stress of the element.

[4 marks]

(ii) Calculate the value the of center and radius of the circle.

[4 marks]

(iii) Determine the stresses when it is oriented 40° counterclockwise.

[9 marks]

(iv) Calculate the normal and shear principal stresses of the plane element.

[6 marks]

(v) Sketch the transformation stresses on the element.

[2 marks]

-END OF QUESTIONS-

FINAL EXAMINATION

SEMESTER/SESSION:2/20222023 PROGRAMME CODE : DAA

COURSE NAME: MECHANICS OF MATERIAL COURSE CODE : DAC12503

FORMULA

$$\sigma = \frac{P}{A} \qquad \tau = \frac{P}{A} \qquad \delta = \frac{PL}{AE} \qquad \sigma_{max} = \frac{My}{I}$$

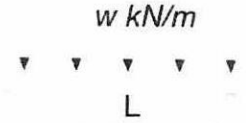
$$\sigma_{x'} = \left(\frac{\sigma_x + \sigma_y}{2}\right) + \left(\frac{\sigma_x - \sigma_y}{2}\right)\cos 2\theta + \tau_{xy}\sin 2\theta \qquad \theta_s = \frac{1}{2}\tan^{-1}\left(-\frac{\sigma_x - \sigma_y}{2\tau_{xy}}\right)$$

$$\sigma_{y'} = \left(\frac{\sigma_x + \sigma_y}{2}\right) - \left(\frac{\sigma_x - \sigma_y}{2}\right)\cos 2\theta - \tau_{xy}\sin 2\theta \qquad \sigma_{max} = \sigma_1 = \left(\frac{\sigma_x + \sigma_y}{2}\right) + R$$

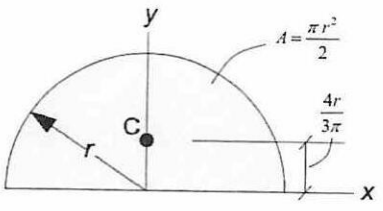
$$\sigma_{min} = \sigma_2 = \left(\frac{\sigma_x + \sigma_y}{2}\right) - R \qquad \theta_p = \frac{1}{2}\tan^{-1}\left(\frac{2\tau_{xy}}{\sigma_x - \sigma_y}\right)$$

$$\tau_{x'y'} = -\left(\frac{\sigma_x - \sigma_y}{2}\right)\sin 2\theta + \tau_{xy}\cos 2\theta$$

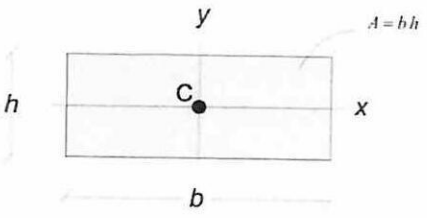
$$\sigma' = \frac{\sigma_x + \sigma_y}{2} \qquad R = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^{\ 2}}$$



$$M_{max} = \frac{wL^2}{8} \qquad y = \frac{A_1 d_1 + A_2 d_2}{\sum A}$$



Semicircular area $I_x = I_y = \frac{1}{8}\pi r^4$



Rectangular area $I_x = \frac{1}{12}bh^3$

$I_y = \frac{1}{12}hb^3$