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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019**

COURSE NAME : MECHANICS OF MATERIALS
COURSE CODE : BNP 20203
PROGRAMME CODE : BNA/BNB/BNC
EXAMINATION DATE : DECEMBER 2018 / JANUARY 2019
DURATION : 3 HOURS
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS ONLY

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THIS QUESTION PAPER CONSISTS OF **TWELVE (12)** PAGES

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- Q1** (a) Define the following term:
- (i) Normal force (1 mark)
 - (ii) Shear force (2 marks)
 - (iii) Torque (2 marks)
- (b) A plane element is subjected to a set of stresses as shown in **Figure Q1(b)**.
- (i) Determine the principal stresses and the locations of the planes where they occur. (3 marks)
 - (ii) Determine the maximum shearing stresses and the locations of the planes where they occur. (3 marks)
 - (iii) Determine the normal and shearing stresses after the element shown has been rotated through 25° clockwise. (5 marks)
 - (iv) Prove the answers from (a)-(c) by using Mohr circle. (9 marks)

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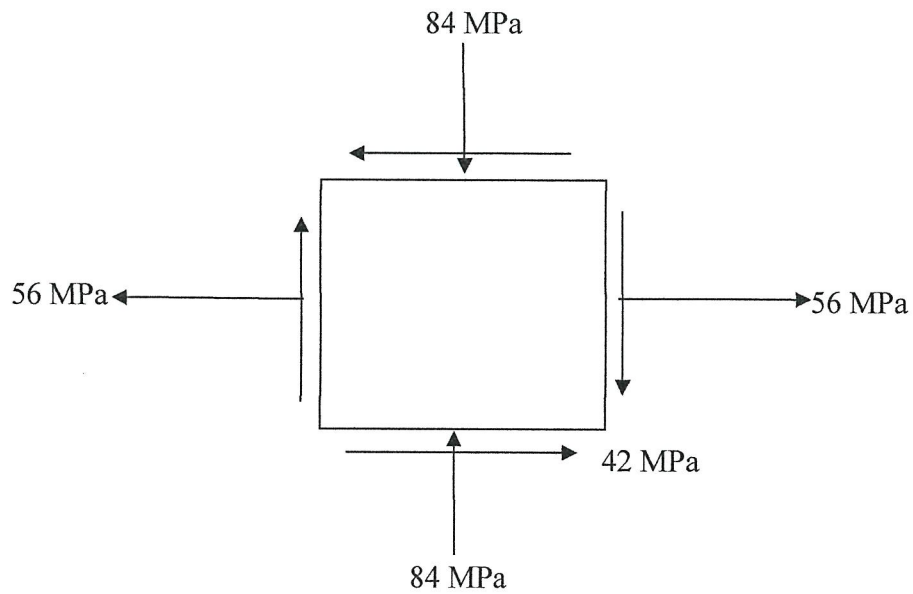


Figure Q1(b)

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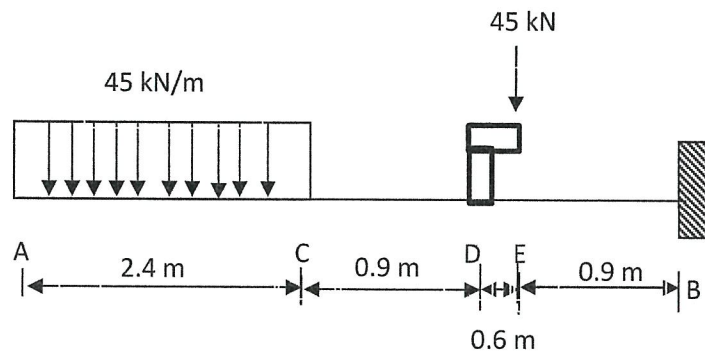


Figure Q2

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- Q3** **Figure Q3** shows an overhanging beam ABC of length 5m is subjected to a UDL. The cross section of the beam is shown in Figure Q3(a);
- (a) Determine the centroid of the beam's cross section shown in **Figure Q3 (a)**.
(4 marks)
 - (b) Determine the maximum shear and moment along the beam.
(5 marks)
 - (c) Calculate the moment inertia, I of the cross-sectional area.
(4 marks)
 - (d) Analyze the maximum bending stress in tension and compression in the beam and sketch the bending stress distribution diagrams.
(6 marks)
 - (e) Calculate the shear stress at point D in the cross-sectional area of beam.
(6 marks)

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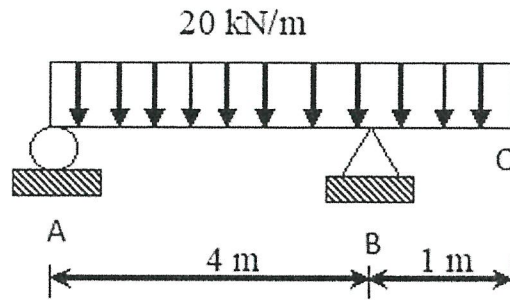


Figure Q3

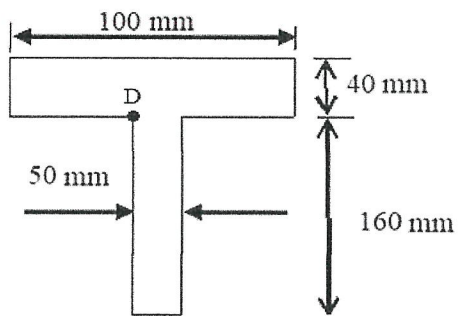


Figure Q3 (a)

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Q4 A simply supported beam with 8 m span length subjected to a distribution load 20 kN/m at point CD as shown in **Figure Q4(a)**. Given $E= 30 \text{ kN/mm}^2$ and a cross section in mm as shown **Figure Q4(b)**. Solve the problems by using Macauly's Method.

(a) Define reaction force and moment function of beam. (4 marks)

(b) Determine the boundary condition. (2marks)

(c) Derive the general equation of bending moment, slope-deflection and deflection-equation of the beam. (8 marks)

(d) Analyze the maximum displacement in the beam. (11 marks)

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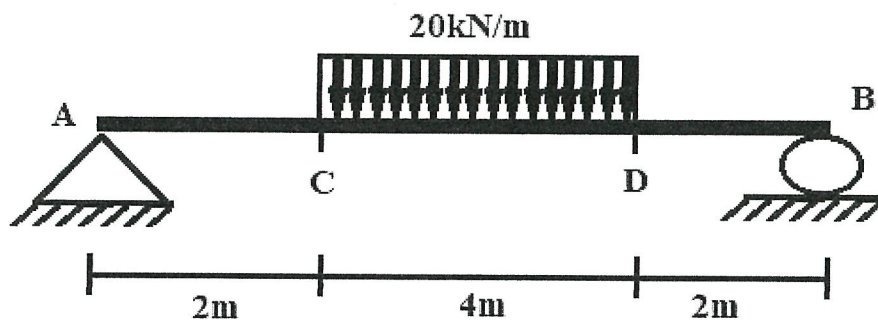


Figure Q4(a)

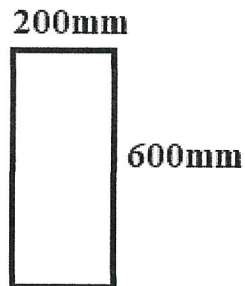


Figure Q4(b)

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- Q5** (a) Define the following statement;
- (i) Truss Structure (3 marks)
 - (ii) Stability and Determinacy (3 marks)
- (b) List **TWO (2)** assumptions of analysis to determine the member's force of the truss. (2 marks)
- (c) **Figure Q5(c)** shows a truss structure which supported by a pin at joint A and a roller at joint B. Vertical load of 10 kN and horizontal load 8 kN are applied at joint F and C respectively. Using Method of Joints, determine the following statement;
- (i) Determine the stability and determinacy of the truss structure. (2 marks)
 - (ii) Calculate the reaction force at Joint A and joint B. (1 marks)
 - (iii) The wooden headframe is subjected to the loading shown in **Figure Q5(c)**. Determine the force in member ED, ID and DC only. State if the members are in tension or compression. (13 marks)

- END OF QUESTIONS -

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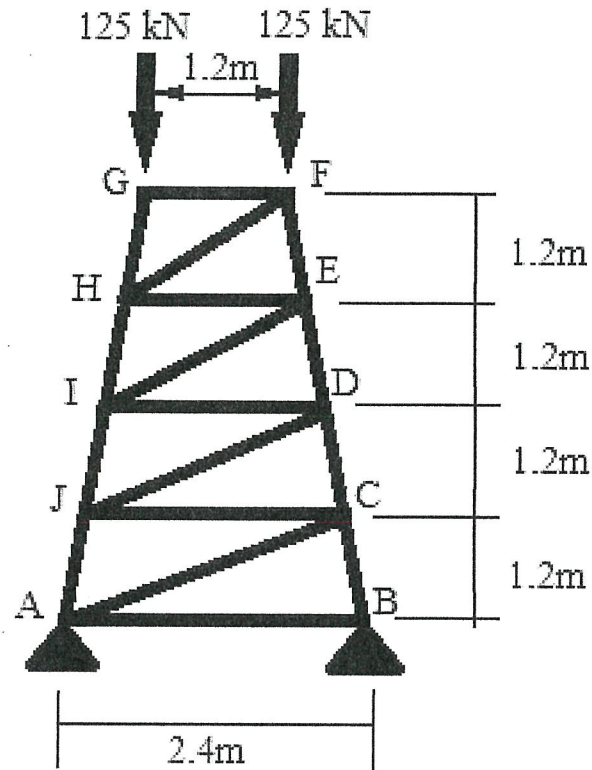
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LIST OF EQUATIONS

$$1. \sigma = \frac{P}{A}$$

$$2. \tau = \frac{P}{A}$$

$$3. \varepsilon = \frac{\delta}{L}$$

$$4. \sigma = E\varepsilon$$

$$5. \sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta + \tau_{xy} \sin 2\theta$$

$$6. \sigma_{y'} = \frac{\sigma_x + \sigma_y}{2} - \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$$

$$7. \tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$$

$$8. \sigma_{max,min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$9. \tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$10. \tan 2\theta_p = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

$$11. \tan 2\theta_s = -\frac{\sigma_x - \sigma_y}{2\tau_{xy}}$$

$$12. I_x = \frac{bh^3}{12}; I_y = \frac{b^3h}{12}; I_{circle} = \frac{\pi d^4}{64}$$

$$13. \sigma = \frac{My}{I}$$

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