



**UTHM**  
Universiti Tun Hussein Onn Malaysia

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

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

COURSE NAME : SOLID MECHANICS 2  
COURSE CODE : BDA20903  
PROGRAMME : BDD  
EXAMINATION DATE : DECEMBER 2018/JANUARY 2019  
DURATION : 3 HOURS  
INSTRUCTION : ANSWER **FOUR (4)** QUESTIONS IN PART A AND CHOOSE **ONE(1)** QUESTION FROM PART B.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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**PART A**

**Q1.** The strain rosette is mounted on a beam, and the strain gauge arrangement is shown in **Figure Q1**. The readings are obtained for each gauge:  $\varepsilon_a = 200 \times 10^{-6}$ ,  $\varepsilon_b = 100 \times 10^{-6}$ , and  $\varepsilon_c = -75 \times 10^{-6}$ .

- (a) Determine the strain components:  $\varepsilon_x$ ,  $\varepsilon_y$ , and  $\gamma_{xy}$  (5 marks)
- (b) Draw the Mohr's circle to calculate the principle strains (5 marks)
- (c) Determine the average normal strain and the maximum in-plane shear strain (5 marks)
- (d) Illustrate the deformed element due to the strain conditions (5 marks)

**Q2.** A steel truss as in **Figure Q2** is slowly loaded at D downward. Identify the trusses that are undergoes compression and determine whether the trusses are buckled or not if the joint is pin-connected (Assuming that the length of each truss is 1 m, external diameter is 50 mm, thickness is 1 mm, modulus of elasticity 200GPa and the angle is  $60^\circ$ ).

(20 marks)

**Q3** In a thick cylinder problem,

- (a) Illustrate the type of stresses that would be developed when a thick cylinder is under internal pressure condition. Write down the basic Lamé's equations used in thick cylinder. (8 marks)
- (b) A thick spherical shell of 400 mm internal diameter is subjected to an internal fluid pressure of  $1.5 \text{ N/mm}^2$ . If the permissible tensile stress in the shell material is  $3 \text{ N/mm}^2$ , find the necessary thickness of the shell. (12 marks)

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**Q4.** A thin-walled column has a circular cross section of diameter 200 mm and thickness 5 mm. It carries an axial tension load of 20 kN and a torque of 20 kNm. If the material of the column fails in tensile test at a stress of 130 MPa, determine if the loadings cause the column to fail according to the following theories of elastic failure:-

(a) Tresca theory.

(12 marks)

(b) Von Mises theory.

(8 marks)

### PART B

**Q5.** The acrobat in **Figure Q5** has a weight of 800 N ( $\approx 80$  kg), and suspends himself uniformly from the center of the high bar (pipe). The modulus of elasticity of pipe is 200 GPa and has an outer diameter of 25 mm and a wall thickness of 3 mm. Determine:-

a) The maximum deflection of pipe

(10 marks)

b) If the deflection at (a) not to exceed 10 cm, what is the maximum weight of acrobat.

(10 marks)

**Q6.** (a) Using an appropriate diagram, explain the meaning of

(i) the *modulus of toughness* and

(2 marks)

(ii) the *modulus of resilience*.

(2 marks)

(b) Members of the truss shown in **Figure Q6** consist of section of steel pipe. Each member has cross-sectional area of  $1945 \text{ mm}^2$ . Use  $E = 200 \text{ GPa}$  and  $g = 9.81 \text{ ms}^{-2}$ . A body of mass,  $m = 10 \text{ kg}$  moving with a velocity,  $V_0$  hits the truss at point A.

(i) Determine the largest speed  $V_0$  that results the maximum deflection of end A equal to 1.5 mm downward. (12 marks)

(ii) If the body of mass  $m = 10 \text{ kg}$  is released from the rest and falls a distance  $h$  before strikes the truss at points A, determine the distance  $h$  that results the maximum deflection of end A equal to 1.5 mm downward. (4marks)

-END OF QUESTION-

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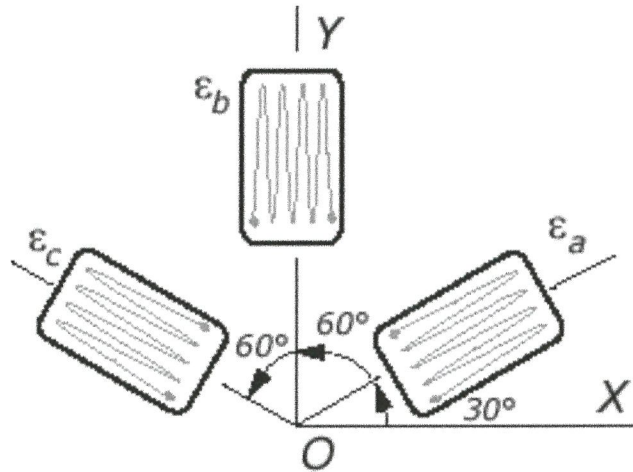


Figure Q1

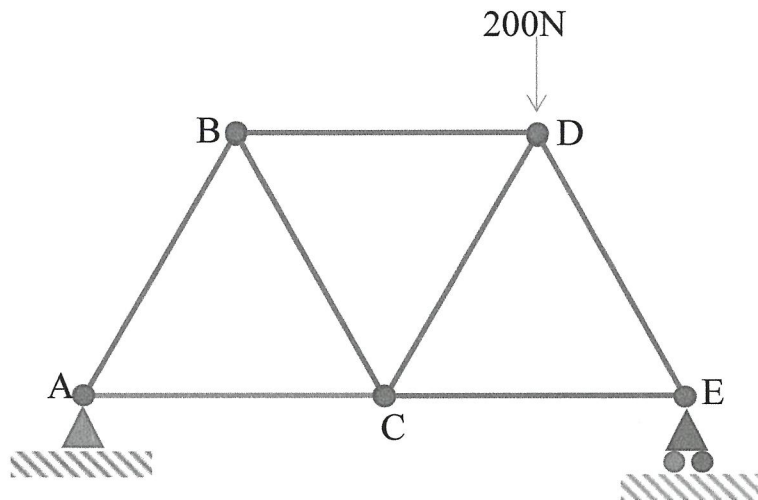


Figure Q2

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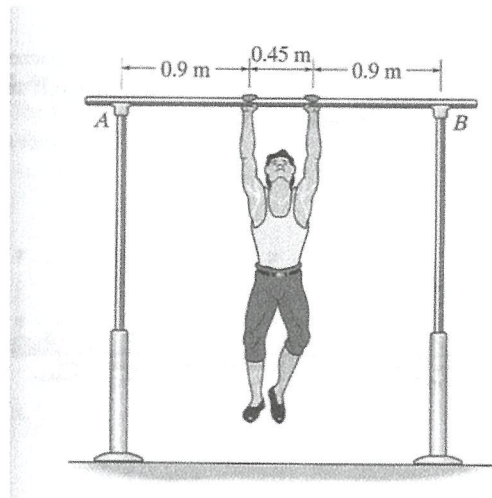


Figure Q5

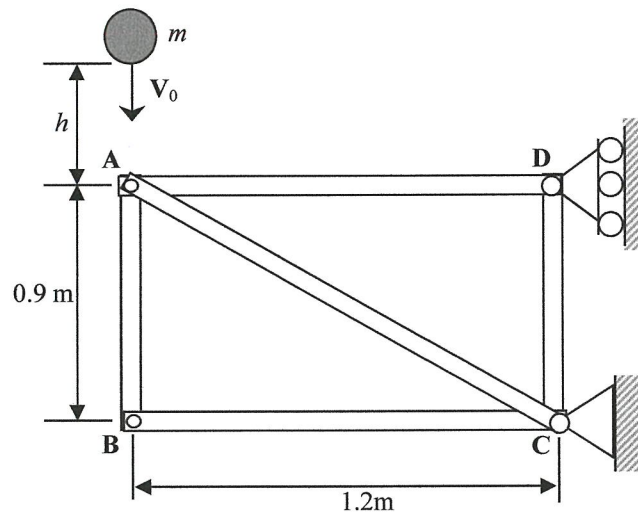


Figure Q6

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