Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BFC 2083/BFC 20903
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS FROM **FIVE (5)** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 (a) Explain briefly with the aid of sketches **two (2)** types of stress and strain.
(8 marks)

(b) A steel rod as in Figure **Q1(a)** is stretched between two rigid walls and carries a tensile load of 6000 N at 30°C. If the allowable stress is not to exceed 140 MPa at -10°C, what is the minimum diameter of the rod? Assume $\alpha = 11.7\ \mu m/(m \cdot °C)$ and E = 200 GPa.
(6 marks)

(c) The state of plane stress at a point is shown on the element as in Figure **Q1(b)**. Using a Mohr's circle method, determine the:

(i) Average normal stress and the radius of the Mohr's circle
(3 marks)

(ii) Normal and shearing stresses after rotated 30^o counter-clockwise
(4 marks)

(iii) Principal stresses and maximum in plane shear stress
(4 marks)

Q2 A cantilever T-beam is subjected to two concentrated load of P/4 at A and P at B. The cross section of T-beam and its dimensions are shown in Figure **Q2**.

(a) Calculate the shear force and bending moment values at support C of the T-beam in terms of PL.
(5 marks)

(b) From the calculated values of shear and moment at support C, draw and label the values of shear force and bending moment diagrams in terms of PL at A, B and C.
(10 marks)

(c) Calculate the Neutral Axis and Moment of Inertia (I) of the T-beam.
(5 marks)

(iv) If the total length of the beam is L = 4 m and the allowable flexural stress (tension or compression) is 180 MPa, determine the value of load P (kN) that can be applied to the T-beam.
(5 marks)

Q3 (a) Explain briefly on the moment-area method and the assumptions used.

(5 marks)

(b) The moment area method is based on two theorems, one is used to determine slope and the other to determine the displacement at a point on the elastic curve of the beam. Describe and illustrate the equations related to these two theorems.

(10 marks)

(c) From Figure **Q3**, determine the slope and deflection at A using moment-area method. Assume EI is constant.

(10 marks)

Q4 (a) List **three (3)** types of roof trusses with aid of sketches.

(6 marks)

(b) A pin-connected truss are loaded with vertical and horizontal point load and supported as shown in Figure **Q4**.

(i) Prove that the plane truss is a statically determinate structure

(3 marks)

(ii) Calculate all internal member forces by using Method of Joint

(16 marks)

Q5 (a) A long and slender structural aluminum [E = 70 GPa] flanged shape (Figure **Q5(a)**) is used as a 7-m-long column. The column is supported in the x direction at base A and pinned at ends A and C against translation in the y and z directions. Lateral support is provided to the column so that deflection in the x–z plane is restrained at mid-height B; however, the column is free to deflect in the x–y plane at B (Figure **Q5(a)**). Determine the maximum compressive load P the column can support if a factor of safety of 2.5 is required. In your analysis, consider the possibility that buckling could occur about either the strong axis (i.e., the z axis) or the weak axis (i.e., the y axis) of the aluminum column.

(10 marks)

(b) A compound shaft drives several pulleys, as shown in Figure **Q5(b)**. Segments (1) and (2) of the compound shaft are hollow aluminum [G = 28 GPa] tubes, which have an outside diameter of 75 mm and a wall thickness of 3 mm. Segments (3) and (4) are solid 40 mm diameter steel [G = 80 GPa] shafts. The shaft lengths are a = 2.0 m, b = 0.8 m, c = 1.4m, and d = 1.4 m. The following torques are applied to the pulleys in the directions

indicated: T_A= 1050 Nm, T_B = 1400 Nm, T_D = 535 Nm, and T_E = 185 Nm. The bearings shown allow the shaft to turn freely. Calculate

(i) The maximum shear stress in the compound shaft.
(5 marks)

(ii) The rotation angle of flange C with respect to pulley A.
(5 marks)

(iii) The rotation angle of pulley E with respect to pulley A.
(5 marks)

- END OF QUESTION –

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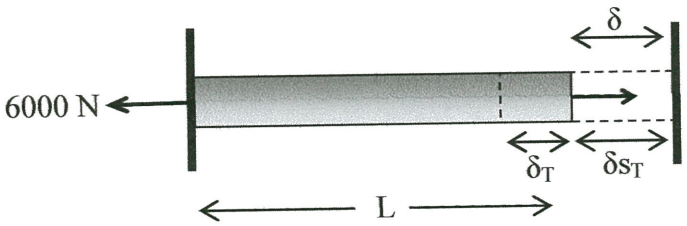

FIGURE Q1(a)

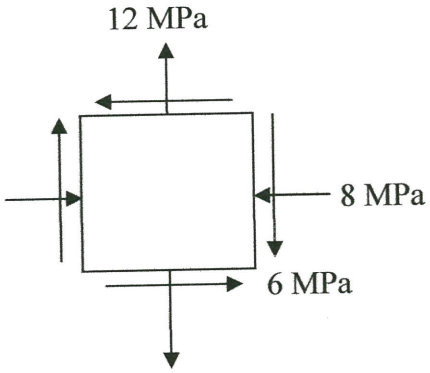

FIGURE Q1(b)

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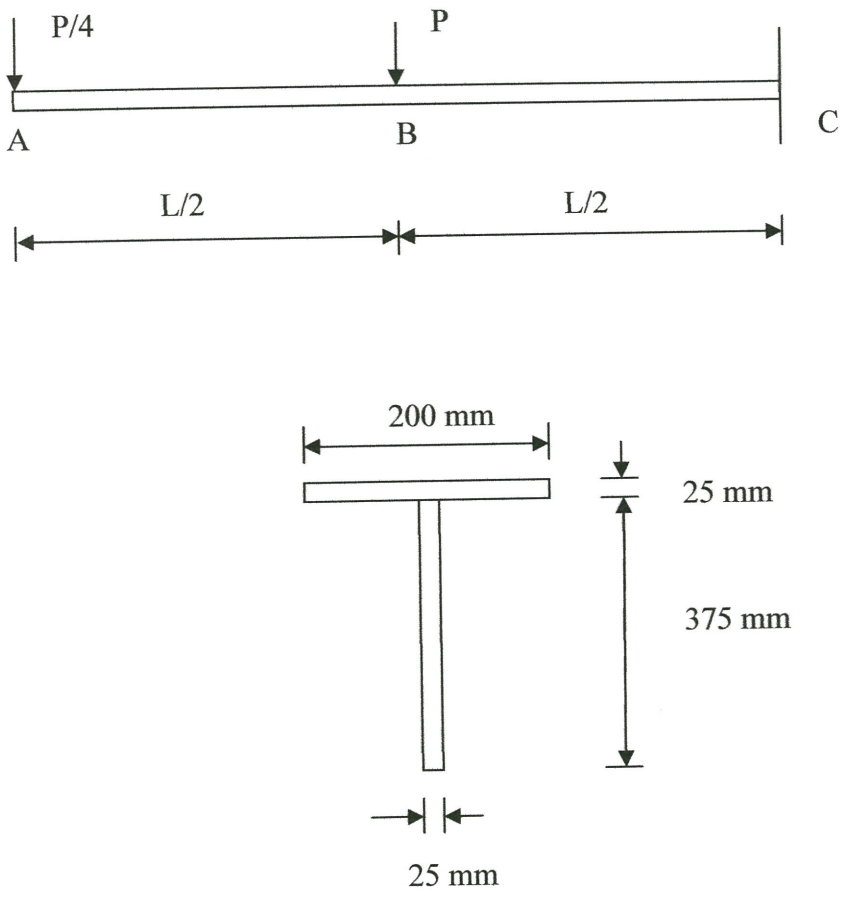

FIGURE Q2

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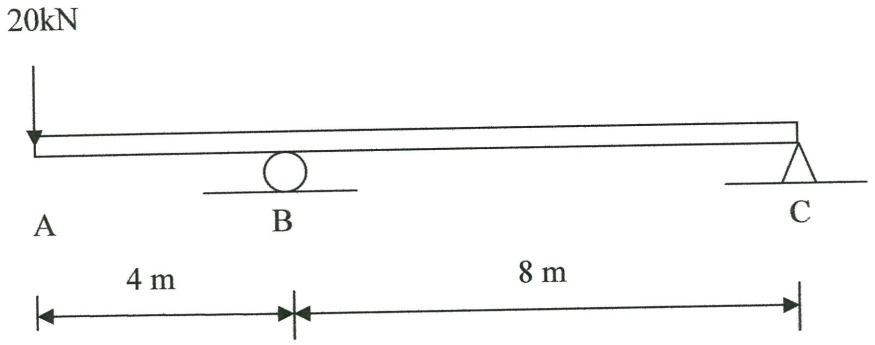

FIGURE Q3

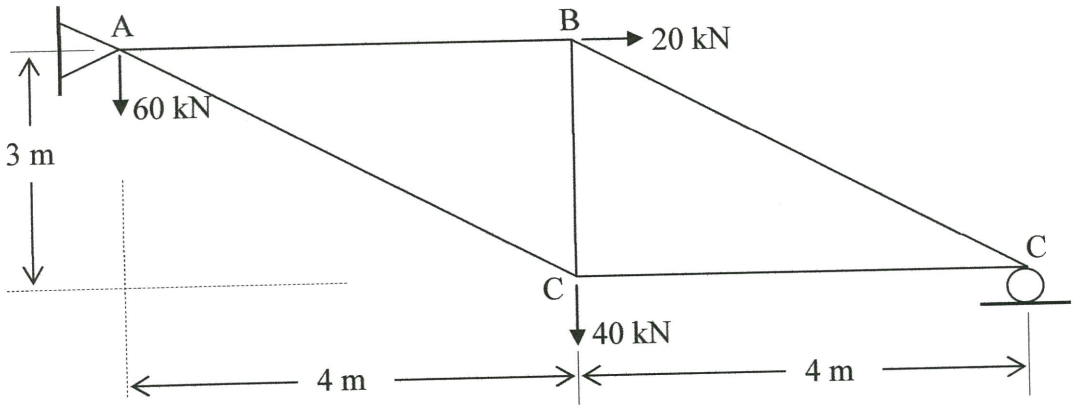

FIGURE Q4

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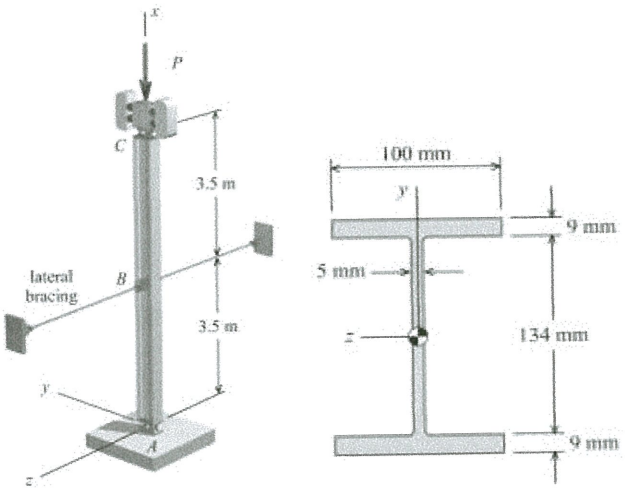

FIGURE Q5(a)

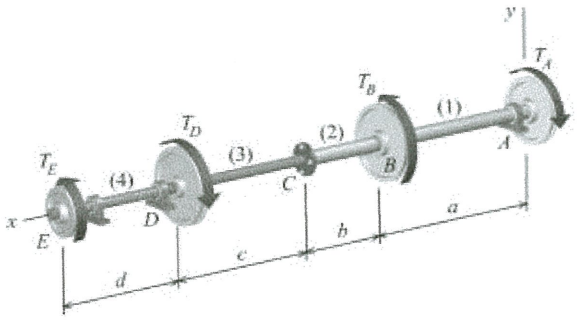

FIGURE Q5(b)