Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	MECHANIC OF MATERIALS
COURSE CODE	:	BNP 20203
PROGRAMME	:	BNA/BNB/BNC
EXAMINATION DATE	:	DECEMBER 2014/ JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

Q1 (a) With the aid of suitable diagrams, explain the following term:

(i) normal stress

(5 marks)

(ii) shear stress

(5 marks)

(b) Given normal stress are σ_x = -50 N/mm^2, σ_y = 10 N/mm^2, dan τ_{xy} = -40 N/mm^2 as shown in **Figure Q1**. By using Mohr Circle method, determine:

(i) Principal stress

(5 marks)

(ii) Plane stress if the elements rotated at $\theta = 45^o$, and

(5 marks)

(iii) Maximum shear stress

(5 marks)

Q2 A simply supported beam in **Figure Q2** is loaded with a uniform distributed load of 2 kN/m from point A to point B, couple moment at point C and a point load of 5 kN applied at its free end at point D.

(a) Calculate the reactions at pinned and roller support.

(4 marks)

(b) By applying an equilibrium analysis on the beam portions:

(i). calculate the shear force and bending moment acting on the beam, and

(15 marks)

(ii). draw the Shear Force Diagram (SFD) and Bending Moment Diagram (BMD) acting on the beams.

(6 marks)

Q3 Triangular forces are applied to a beam of the cross section shown in **Figure Q3(a)**. The cross section of the beam is shown in **Figure Q3(b)**.

(a) Calculate the reactions of the support beam.

(5 marks)

(b) Calculate the moment inertia, I of the cross sectional area.

(10 marks)

(c) If the maximum bending moment was given as 161.08 kNm, determine the maximum bending stress in tension and compression in the beam and sketch the bending stress distribution diagrams.

(10 marks)

Q4 Two bars of steel and aluminum are subjected to torques as shown in **Figure Q4**. If the allowable shear stress for steel bar is 70 MPa and for aluminum is half of the steel, determine:

(a) Modulus of rigidity for both materials. Given MOE_{St} = 200 GPa and ν_{St} = 0.3, whereas MOE_{Al} = 70 GPa and ν_{Al} = 0.35.

(6 marks)

(b) The maximum torques (T_1 and T_2) can be applied to both materials. The coefficients for rectangular bars in torsion are given in **Table Q4**.

(8 marks)

(c) The angle of twist at end B for both materials. Use the formula as provided in **Table Q4**.

(8 marks)

(d) The material that gives better performance, and state a reason.

(3 marks)

Q5 (a) List **Two (2)** assumptions of analysis to determine the member's force of the truss.

(2 marks)

(b) The structure mechanics involves determination of unknown forces on the structures. Identify the equations for determination of its equilibrium.

(3 marks)

(c) In **Figure Q5**, a statically determinate plane truss is pinned at A and supported by roller at B.

(i) Prove that plane truss is statically determinate structure.

(2 marks)

(ii) Determine the support reaction at A and B.

(5 marks)

(iii) Determine all member forces by using Method of Joints. State whether the member are in tension or compression.

(13 marks)

- END OF QUESTION -

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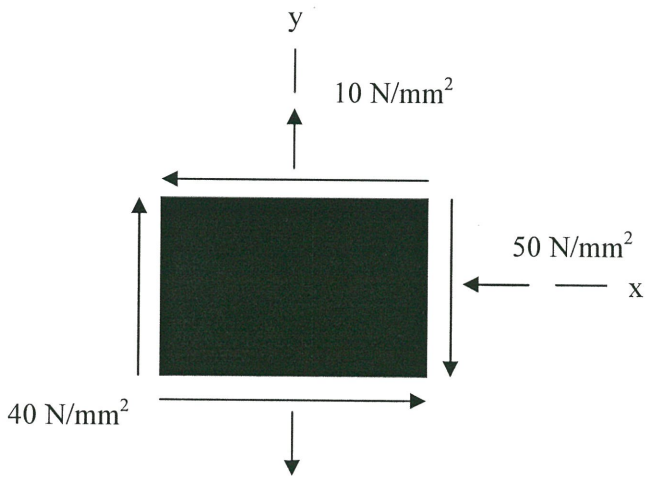

FIGURE Q1

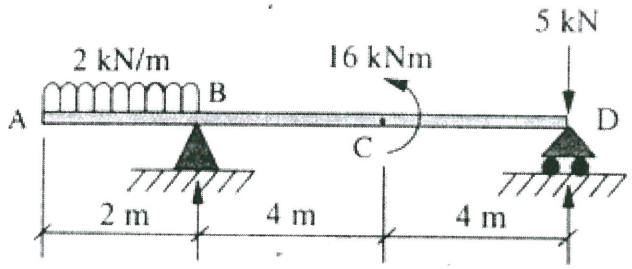

FIGURE Q2

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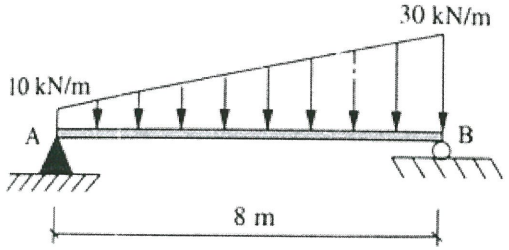

FIGURE Q3 (a)

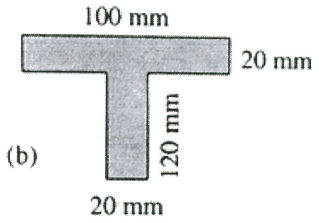

FIGURE Q3 (b)

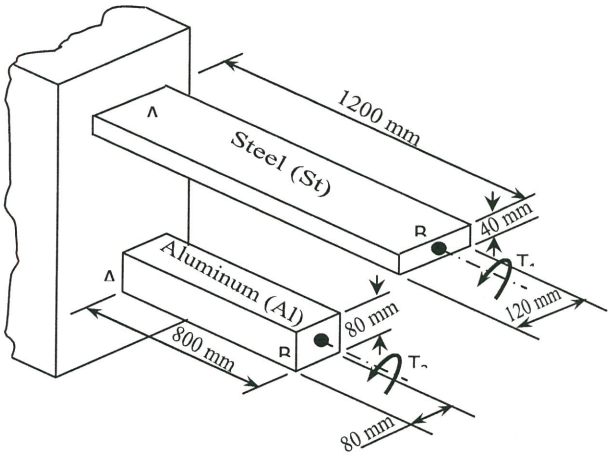

FIGURE Q4

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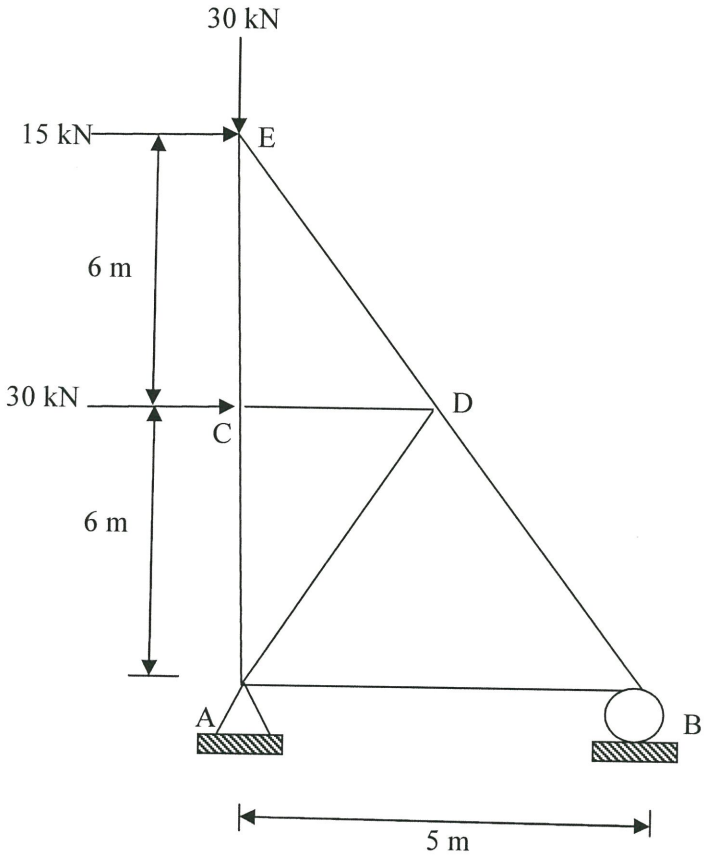

FIGURE Q5

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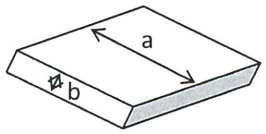
TABLE Q5

$$\tau_{max} = \frac{T}{c_1 ab^2} \qquad \phi = \frac{TL}{c_2 ab^3 G}$$



a/b	C_1	C_2
1.0	0.208	0.1406
1.2	0.219	0.1661
1.5	0.231	0.1958
2.0	0.246	0.229
2.5	0.258	0.249
3.0	0.267	0.263
4.0	0.282	0.281
5.0	0.291	0.291
10.0	0.312	0.312
∞	0.333	0.333

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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. $\sigma_{x'} = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2} \cos 2\theta - \tau_{xy} \sin 2\theta$
7. $\tau_{x'y'} = -\frac{\sigma_x - \sigma_y}{2} \sin 2\theta + \tau_{xy} \cos 2\theta$
8. $I_x = \frac{bh^3}{12}$; $I_y = \frac{b^3h}{12}$; $I_{circle} = \frac{\pi d^4}{64}$
9. $\sigma = \frac{My}{I}$