UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012

COURSE NAME	:	MECHANICS OF MATERIAL
COURSE CODE	:	BFC 20903/BFC 2083
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	JANUARY 2012
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

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

(i) normal stress (3.5 marks)

(ii) shear stress (3.5 marks)

(iii) strain (3 marks)

(b) Given the principal stress at point P and Q are σ_{max} = 16.4 MPa and σ_{min} = 3.6 MPa respectedly rotated at an angle of 19.3°. Using Mohr Circle method, determine:

(i) Normal stress at $\theta = 0°$ (5 marks)

(ii) Plane stresses if the elements rotated at $\theta = 40°$ (5 marks)

(iii) Maximum shear stress (5 marks)

Q2 (a) List **Five (5)** assumptions in the developing of Elastic Bending Theory.

(5 marks)

(b) The simply supported beam shown in Figure **Q2 (a)** is loaded with the uniformly distributed load of 12 kN/m from A to B and bending moment of 5 kNm at C. The cross section of the beam is shown in Figure **Q2 (b).**

(i) Determine the maximum shear force and bending moment of the beam.

(6 marks)

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

(8 marks)

(iii) Determine the maximum bending stress in tension and compression in the beam and sketch the bending stress distribution diagrams.

(6 marks)

Q3 (a) Based on Figure **Q3(a),** provide 6 boundary conditions that can be used to obtain the value of constant '*C*' in double integration method.

(12 marks)

(b) A simply supported beam is subjected to uniformly distributed and point loads as shown in Figure **Q3(b).** By using Macaulay method, calculate the beam deflection at 3 meter from support A and slope at support A. Given E = 5 x 10^6 N/mm^2 and I = 9 x 10^6 mm^4.

(13 marks)

Q4 (a) Explain the failure mode of long and short columns.

(5 marks)

(b) A hollow alloy tube 4.5 m long with external and internal diameter of 50 mm and 35 mm respectively as found to extend 4.2 mm under a tensile force of 60 kN. The tube was pinned at both ends. Determine:

(i) strain of the tube
(ii) modulus of elasticity of the tube
(iii) buckling load of the tube

(20 marks)

Q5 Two bars of steel and aluminum are subjected to torques as shown in Figure **Q5**. If the allowable shear stress for steel bar is 70 MPa and for aluminum is half of the steel, determine:

(i) 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)

(ii) 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 **Q5**.

(8 marks)

(i) the angle of twist at end B for both materials. Use the formula as provided in Table **Q5**.

(8 marks)

(iv) the material that gives better performance, and state a reason.

(3 marks)

Q6 (a) Give the definition of truss and name **Three (3)** types of trusses that used for roof construction.

(3 marks)

(b) The pin-jointed truss shown in Figure **Q6** is supported pinned at A and roller at E. The truss is subjected to a uniformly distributed load of 20 kN/m along member BD and vertical point load of 20kN at point G.

(i) Prove the truss is statically determinate.

(2 marks)

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

(14 marks)

(iii) Calculate the forces in member AB, BG and GF by using Method of Section.

(6 marks)

S1 (a) Dengan bantuan gambarajah yang sesuai, terangkan perkara berikut:

(i) tegasan normal (3.5 markah)

(ii) tegasan ricih (3.5 markah)

(iii) terikan (3 markah)

(b) Diberikan tegasan principal pada titik P dan Q adalah masing-masing σ_{maks} = 16.4 MPa dan σ_{min} = 3.6 MPa yang telah diputar pada sudut θ=19.3°. Dengan menggunakan kaedah bulatan Mohr, tentukan:

(i) Tegasan normal pada permukaan sudut putaran θ = 0°. (5 markah)

(ii) Tegasan yang bertindak pada unsur yang diputar dengan θ = 40°. (5 markah)

(iii) Tegasan ricih maksimum. (5 markah)

S2 (a) Senaraikan **Lima (5)** anggapan dalam pengembangan Teori Elastik Lenturan. (5 markah)

(b) Satu rasuk disokong mudah seperti ditunjukkan dalam Rajah **Q2 (a)** dibebankan dengan beban teragih seragam, 12 kN/m dari A ke B dan momen 5 kNm pada C. Keratan rentas rasuk adalah seperti ditunjukkan dalam Rajah **Q2 (b).**

(i) Tentukan daya ricih dan momen lentur maksimum untuk rasuk. (6 markah)

(ii) Kirakan momen sifatekun, *I* bagi luas keratan rentas. (8 markah)

(iii) Tentukan tegasan lentur maksimum bagi tegangan dan mampatan di dalam rasuk dan lakarkan agihan tegasan lentur. (6 markah)

S3 (a) Berpandukan kepada Rajah **Q3 (a),** berikan 6 keadaan sempadan yang boleh digunakan bagi mendapatkan nilai pemalar '*C*' di dalam kaedah kamiran berganda.

(12 markah)

(b) Sebatang rasuk sokong mudah ditindaki oleh beban teragih seragam dan beban tumpu seperti di dalam Rajah **3(b).** Dengan menggunakan kaedah Macaulay, kirakan pesongan rasuk 3 meter dari penyokong A dan cerun di penyokong A. Diberikan $E = 5 \times 10^6$ N/mm^2 dan $I = 9 \times 10^6$ mm^4.

(13 markah)

S4 (a) Terangkan mod kegagalan untuk tiang panjang dan tiang pendek.

(5 markah)

(b) Satu tiub aluminium berongga 4.5 meter panjang mempunyai garis pusat luar 50 mm dan garis pusat dalam 35 mm. Tiub tersebut mengalami pemanjangan sebanyak 4.2 mm apabila dikenakan daya tegangan 60 kN. Tiub diikat dengan sambungan pin pada kedua-dua hujung. Tentukan:

(i) terikan pada tiub
(ii) modulus keanjalan tiub
(iii) beban lengkokan untuk tiub

(20 markah)

S5 Dua batang bar keluli dan aluminum dikenakan daya kilasan seperti dalam Rajah **Q5**. Jika tegasan ricih yang dibenarkan bagi keluli ialah 70 MPa dan untuk alumininum pula separuh daripada keluli, tentukan:

(i) modulus ketegaran bagi kedua-dua bahan. Diberikan MOE_{St} = 200 GPa dan $\nu_{St} = 0.3$, manakala MOE_{Al} = 70 GPa dan $\nu_{Al} = 0.35$.

(6 markah)

(ii) daya kilasan maksimum (T_1 and T_2) yang boleh dikenakan pada kedua-dua bahan. Pemalar bar segiempat dalam kilasan diberikan dalam Jadual **Q5**.

(8 markah)

(iii) sudut putaran pada penghujung B bagi kedua-dua bahan. Guna formula yang diberikan dalam Jadual **Q5**.

(8 markah)

(iv) bahan yang memberikan prestasi yang lebih baik, dan nyatakan satu alasan.

(3 markah)

S6 (a) Berikan definisi kekuda dan nyatakan 3 jenis kekuda yang digunakan untuk pembinaan bumbung.

(3 markah)

(b) Kekuda sambungan pin yang ditunjukkan dalam Rajah **Q6** disokong pin di A dan rola di E. Kekuda dikenakan beban teragih seragam 20kN/ m sepanjang anggota BD dan beban tumpu 20kN pada titik G.

(i) Buktikan bahawa kekuda ini adalah boleh tentu statik.

(2 markah)

(ii) Tentukan daya dalam setiap anggota kekuda dengan menggunakan Kaedah Sendi. Nyatakan sama ada anggota kekuda dalam tegangan atau mampatan.

(14 markah)

(iii) Kirakan daya dalam anggota AB, BG dan GF. Guna Kaedah Keratan.

(6 markah)

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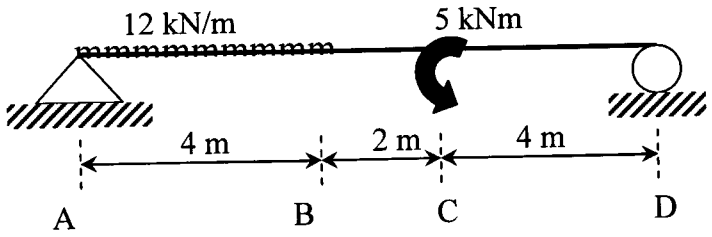

FIGURE Q2 (a)

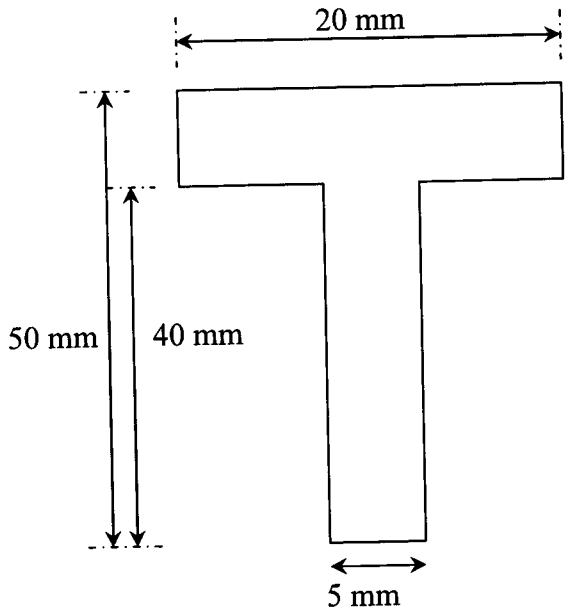

FIGURE Q2 (b)

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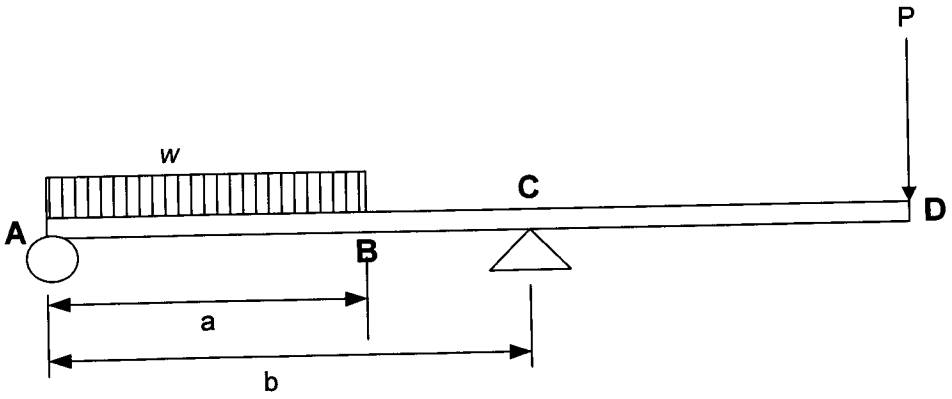

FIGURE Q3(a)

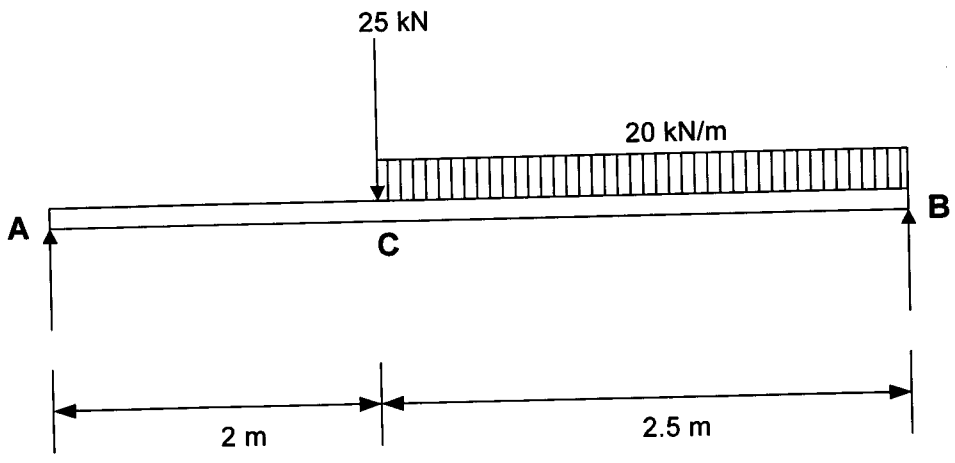

FIGURE Q3(b)

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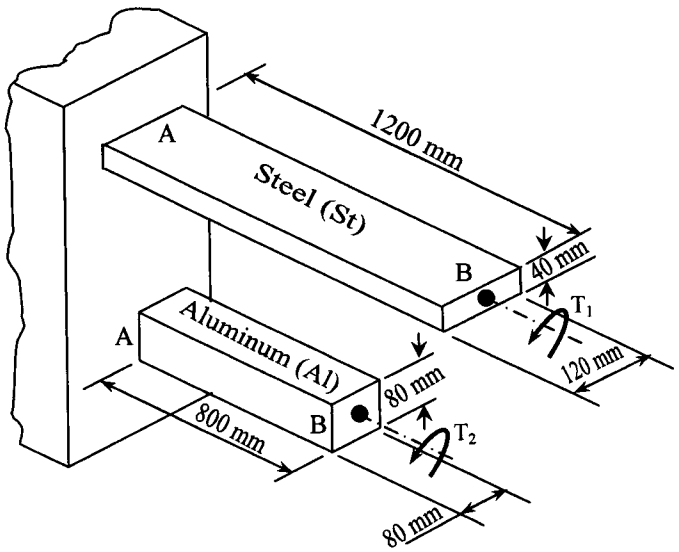

FIGURE Q5

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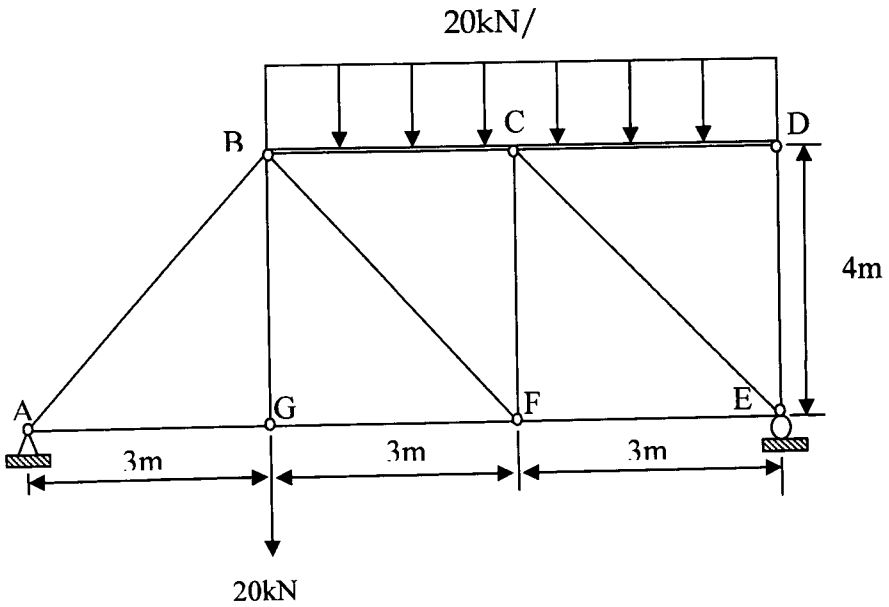

FIGURE Q6

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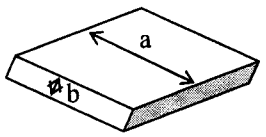
TABLE Q5

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



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