UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2010/2011

COURSE NAME	:	MECHANICS OF MATERIALS
COURSE CODE	:	BFC 2083/BFC 20903
PROGRAMME	:	2 BFF
EXAMINATION DATE	:	NOVEMBER/DECEMBER 2010
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

THIS PAPER CONSISTS OF FOURTEEN (14) PAGES

Q1 (a) Figure **Q1(a), Q1(b)** and **Q1(c)** shows an element with stress in x direction σ_x = 15 MPa, y direction σ_y = 5 MPa and shear stress τ_{xy} = 4 Mpa. Determine the following terms using Mohr's Circle Method.

(i) centroid, angle for maximum normal stress and radius of the circle
(6 marks)

(ii) stress on the element when it is rotated θ= 40° counter clockwise.
(9 marks)

(iii) maximum shear stress.
(2 marks)

(iv) principal stress.
(4 marks)

(b) Give the definition of the following terms.

(i) Poisson ratio.
(2 marks)

(ii) Modulus of elasticity.
(2 marks)

Q2 (a) Give the definition of the following terms.

(i) Shear force
(2 marks)

(ii) Bending moment
(2 marks)

(iii) Torsion
(2 marks)

(b) The simply supported beam is subjected to the loadings shown in Figure **Q2**. The beam is supported by pin at point A and roller at point C and has a 2 m cantilever span at right side. Based on the above information;

(i) Draw the free body diagram of the beam.
(2 marks)

(ii) Calculate the support reactions at point A and C of the beam.
(5 marks)

(iii) Draw the shear force diagram (SFD) and bending moment diagram (BMD) of the beam by showing the important values at the diagrams.

(12 marks)

Q3 Figure **Q3** shows a 6 m simply supported and its cross section. If the allowable tensile and compressive stresses are 50 MPa and 20 MPa respectively,

(a) determine center of gravity of moment of inertia of the section

(6 marks)

(b) determine the permissible load of w acting on the beam

(9 marks)

(c) calculate the maximum shear stress of the beam

(6 marks)

(d) Briefly explain the probability of occurrence if these maximum stresses are exceeded.

(4 marks)

Q4 (a) Boundary conditions are important in Double Integration and Macaulay Method. Give **two (2)** examples of the boundary condition in beam.

(4 marks)

(b) Figure **Q4** shows a beam subjected to point load at point B and uniformly distributed load from C to D. Given Modulus of Elasticity, $E = 8 \times 10^6$ N/mm^2 and inertia moment, $I = 15 \times 10^6$ mm^4. Determine,

(i) support reaction at A and D.

(5 marks)

(ii) general equation of deflection and slope the beam using Mac Caulay Method.

(5 marks)

(iii) deflection at point B and mid point of span CD.

(6 marks)

(iv) slope at point B.

(5 marks)

Q5 (a) (i) List **Five (5)** assumptions for Euler's formula.

(5 marks)

(ii) Steel rod BC and beam AB joined by pins at the junctions and supports as shown in Figure **Q5(a)**. Horizontal point load P applied at joint B. Given L = 1.2 m and h = 1.6 m. Modulus elasticity, yield stress, and diameter of rod BC are 200 GPa, 460 MPa, and 65 mm, respectively. Determine the maximum load the steel rod BC can withstand using Euler's buckling load formula and check whether the Euler's formula is appropriate or not.

(10 marks)

(b) (i) Figure **Q5(b)** shows a solid cylindrical steel rod *BC* fixed to a wall at *C* and a rigid lever at *B* and passes through a smooth bearing at *B*. The vertical load *P* applied at *A* causes a small displacement δ at end *A* of rigid lever *AB*. If $a = L/4$, prove that the corresponding maximum shearing stress in the rod is

$$\tau_{max} = \left(\frac{2Gd}{L^2}\right)\delta$$

where *d* is the diameter of the rod and *G* its modulus of rigidity.

(5 marks)

(ii) Knowing that the vertical load $P = 25$ kN, $d = 60$ mm, $a = 250$mm, $L = 1000$ mm, and modulus of rigidity is 77 GPa, determine the value of displacement δ at *A* and maximum shearing stress τ_{max}.

(5 marks)

Q6 Figure **Q6** is a statically determinate plane truss which subjected to concentrated loads of 15 kN at joints B and C.

(a) Give **Two (2)** assumptions used in a truss analysis

(4 marks)

(b) Calculate the reactions of the truss supports

(8 marks)

(b) Identify the most critical truss members which resisting the maximu compressive and tensile forces by using any appropriate methods of calculation.

(8 marks)

(d) Based on your opinion, how to reduce the numbers of zero force members in a plane truss design?

(4 marks)

S1 (a) Suatu unsur dalam tegasan satah ditindaki tegasan σ_x = 15 MPa, σ_y = 5 MPa dan τ_{xy} = 4 MPa, seperti yang ditunjukkan dalam Rajah **Q1(a), Q1(b)** dan **Q1(c)**. Menggunakan Kaedah Bulatan Mohr, tentukan

(i) pusat bulatan, sudut pada tegasan normal maksimum dan jejari bulatan.

(6 markah)

(ii) tegasan yang bertindak ke atas unsur yang diputar melalui sudut θ= 40° melawan arah jam.

(9 markah)

(iii) tegasan ricih maksimum.

(2 markah)

(iv) tegasan prinsipal.

(4 markah)

(b) Berikan definisi bagi istilah-istilah berikut:

(i) Nisbah Poisson.

(2 markah)

(ii) Modulus keanjalan.

(2 markah)

S2 (a) Berikan definisi bagi istilah-istilah berikut.

(i) Daya ricih

(2 markah)

(ii) Momen lentur

(2 markah)

(iii) Putiran

(2 markah)

(b) Sebatang rasuk sokong mudah ditindaki beban seperti yang dtunjukkan pada Rajah **Q2**. Rasuk tersebut disokong pin pada titik A dan rola pada titik C dan mempunyai rentang 2 m di sebelah kanan rasuk. Berdasarkan maklumat tersebut.

(i) Lukiskan gambarajah jasad bebas rasuk berkenaan.

(2 markah)

(ii) Kirakan tindak balas pada penyokong A dan C rasuk tersebut.

(5 markah)

(iii) Dengan menggunakan kaedah keratan, lukiskan gambarajah daya ricih (GDR) dan gambarajah momen lentur (GML) rasuk berkenaan dan tunjukkan nilai-nilai penting pada gambarajah tersebut.

(12 markah)

S3 Rajah **Q3** menunjukkan satu rasuk sokong mudah sepanjang 6 m serta keratan rentasnya. Jika tegasan tegangan dan mampatan yang dibenarkan masing-masing 50 MPa and 20 MPa,

(a) tentukan pusat graviti dan moment sifat tekun keratan

(6 markah)

(b) tentukan beban yang dibenarkan, w yang bertindak di atas rasuk tersebut

(9 markah)

(c) kira tegasan ricih maksimum rasuk

(6 markah)

(d) Terangkan kemungkinan yang akan berlaku sekiranya nilai-nilai tegasan melebihi tegasan maksimum?

(3 markah)

S4 (a) Keadaan sempadan adalah penting dalam kaedah Kamiran Berganda dan Mac Caulay. Berikan **Dua (2)** contoh tentang keadaan sempadan di dalam rasuk.

(4 markah)

(c) Rajah **Q4** menunjukkan rasuk yang dikenakan beban tumpu pada titik B dan beban teragih seragam dari C hingga D. Diberi Modulus Keanjalan, $E = 8 \times 10^6$ N/mm^2 dan momen sifatekun, $I = 15 \times 10^6$ mm^4. Tentukan

(i) tindakbalas pada penyokong A dan D.

(5 markah)

(ii) persamaan umum untuk pesongan dan cerun rasuk menggunakan Kaedah Mac Caulay.

(5 markah)

(iii) pesongan pada titik B dan titik tengah untuk rentang CD.

(6 markah)

(iv) cerun pada titik B.

(5 markah)

S5 (a) (i) Senaraikan **Lima (5)** anggapan untuk formula Euler.

(5 markah)

(ii) Rod besi BC dan rasuk AB disambungkkan menggunakan pin pada persimpangan dan disokong seperti Rajah **Q5(a)**. Beban tumpu melintang P dikenakan pada titik sambungan B. Diberi L = 1.2m dan h = 1.6m. Modulus keanjalan, tegasan optimum dan diameter rod BC adalah 200GPa, 460MPa dan 65mm. Tentukan beban maksimum untuk rod besi BC yang boleh menggunakan formula Euler dan tentukan samada formula Euler boleh digunakan atau tidak.

(10 markah)

(b) (i) Rajah **Q5(b)** menunjukkan satu rod besi silinder BC adalah diikiat tegar pada dinding C dan tuil tegar pada B melalui galas B. Beban tumpu P dikenakan pada A menyebabkan perubahan kecil δ pada hujung A dan rigid AB. Jika $a = L/4$, buktikan tegasan ricih maksimum dalam rod adalah

$$\tau_{\max} = \left(\frac{2Gd}{L^2}\right)\delta$$

di mana d adalah diameter rod dan G adalah modulus rigid.

(5 markah)

(ii) Diketahui beban menegak $P = 25$ kN, $d = 60$ mm, $a = 250$ mm, $L = 1000$ mm, dan modulus keanjalan adalah 77 GPa, tentukan nilai pesongan δ pada A dan tegasan ricih maksimum τ_{max}.

(5 markah)

S6 Rajah **Q6** menunjukkan sebuah kekuda satah boleh tentu statik yang ditindaki dengan daya tumpu sebanyak 15 kN pada sambungan B dan C.

(a) Berikan **Dua (2)** andaian yang digunakan dalam analisis sesebuah kekuda.
(4 markah)

(b) Kira tindakbalas pada penyokong kekuda tersebut
(8 markah)

(c) Kenalpasti anggota-anggota kekuda yang menanggung daya dalaman mampatan dan tegangan maksimum dengan menggunakan sebarang kaedah pengiraan yang sesuai.
(9 markah)

(d) Berdasarkan pendapat anda, bagaimanakah cara untuk mengurangkan bilangan anggota berdaya sifar.
(4 markah)

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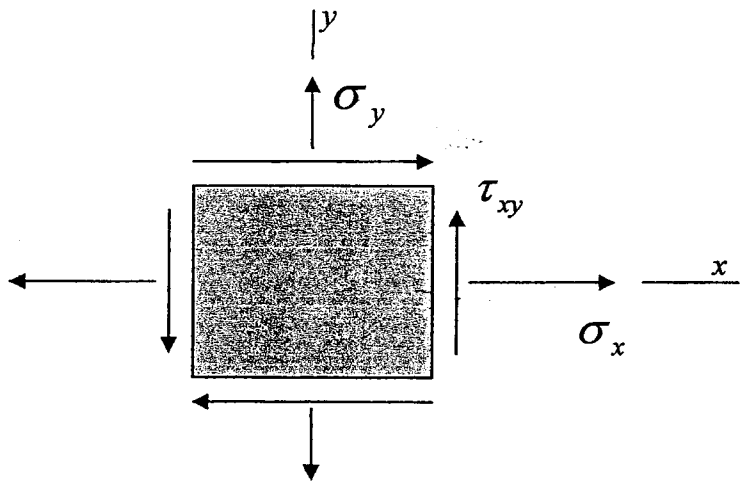

FIGURE Q1(a)

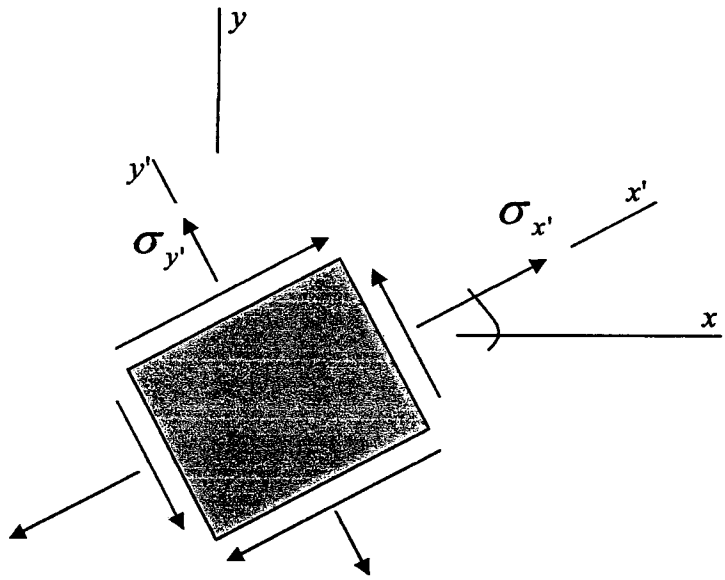

FIGURE Q1(b)

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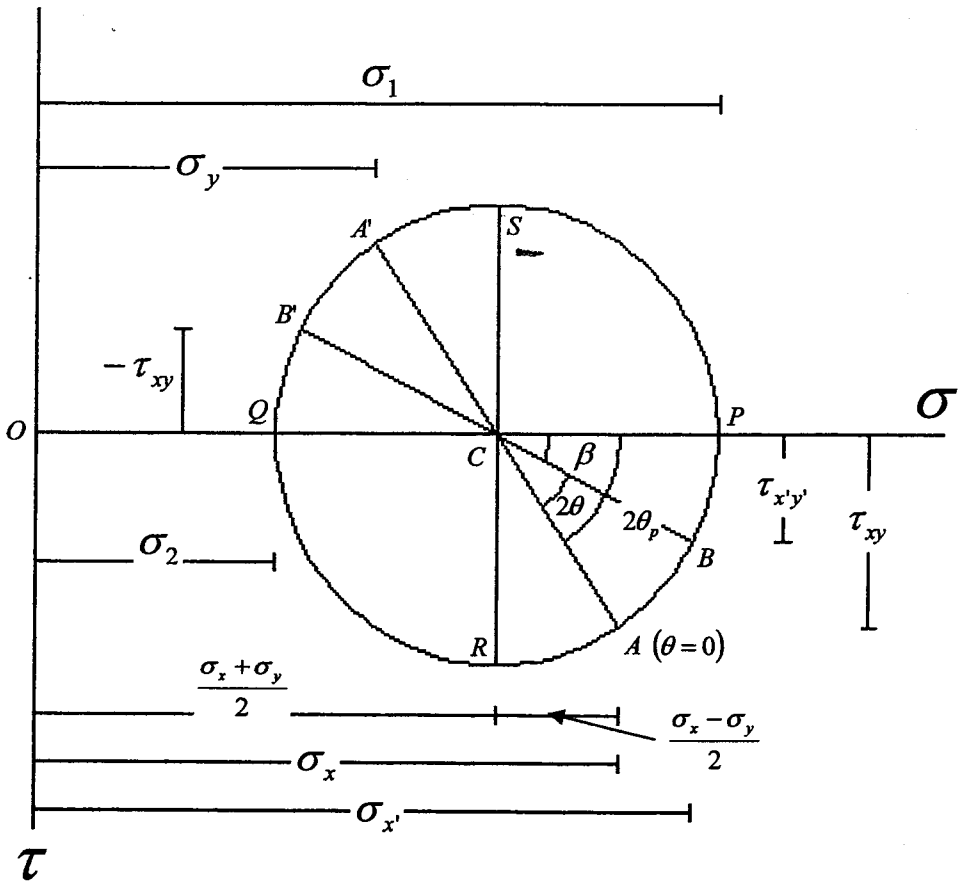

FIGURE Q1 (c)

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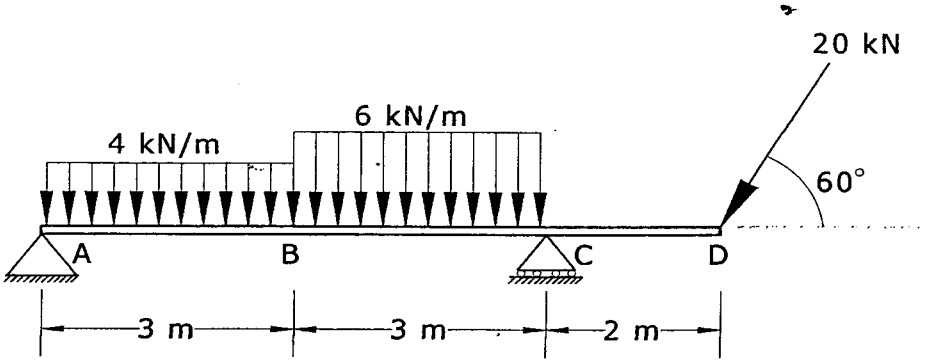

FIGURE Q2

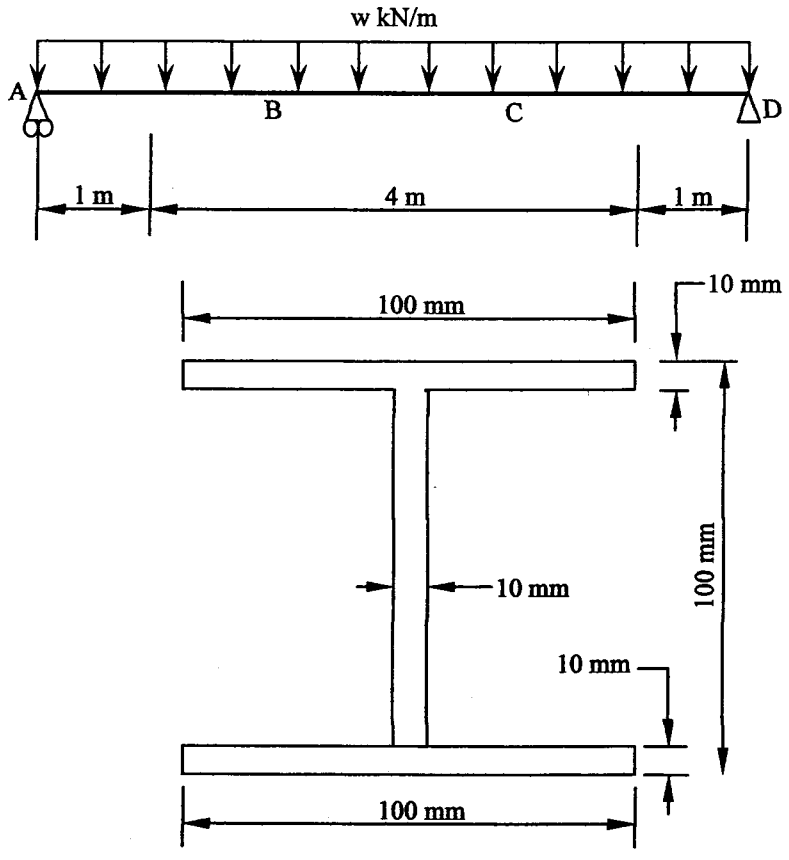

FIGURE Q3

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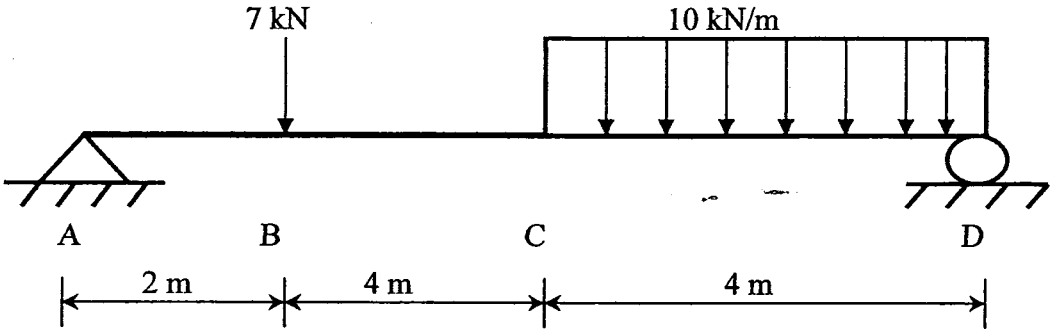

FIGURE Q4

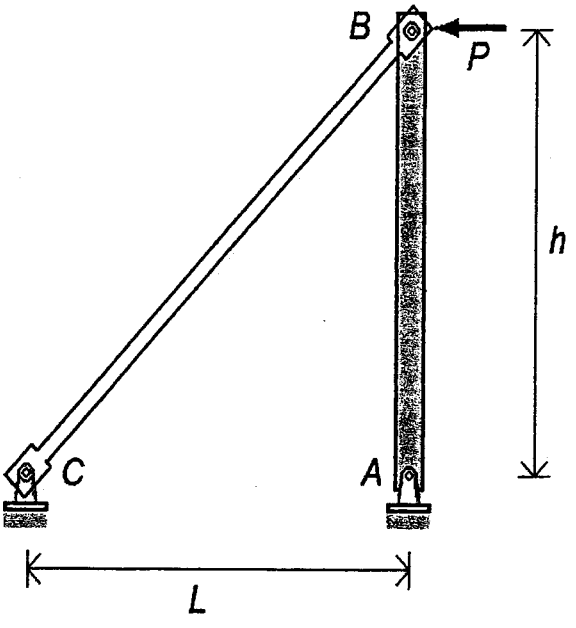

FIGURE Q5(a)

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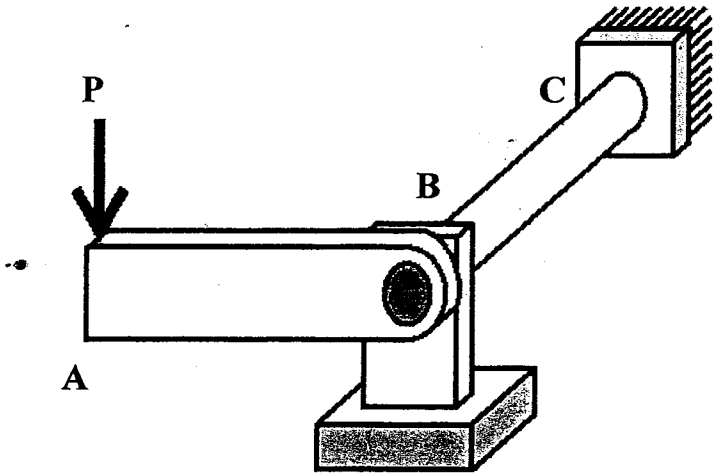

FIGURE Q5(b)

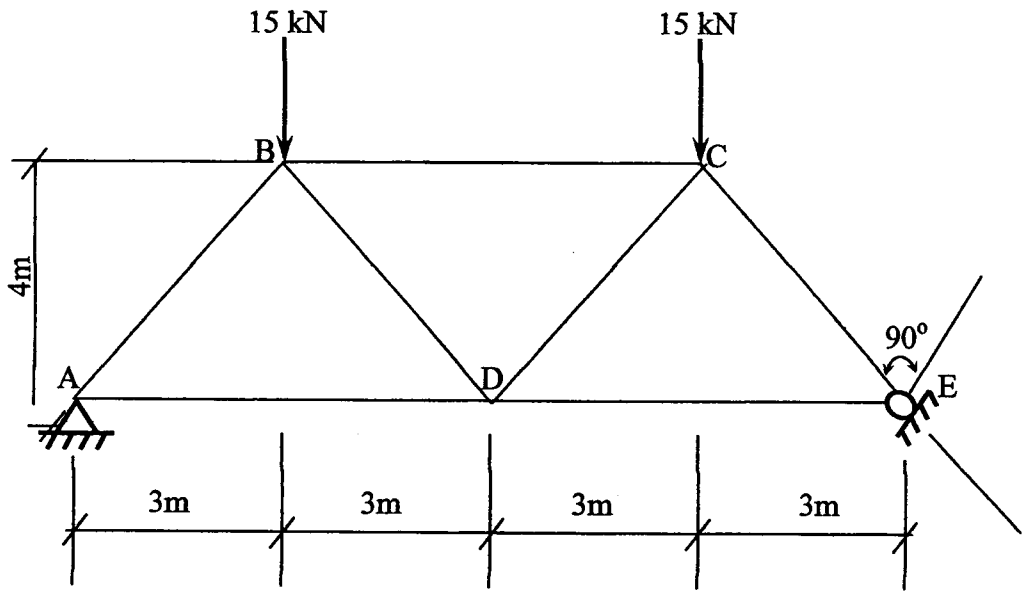

FIGURE Q6