



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011**

COURSE NAME : MECHANICS OF MATERIALS
COURSE CODE : BFC2083 / BFC20903
PROGRAMME : 2 BFF
EXAMINATION DATE : APRIL / MAY 2011
DURATION : 3 HOURS
INSTRUCTION : ANSWER FOUR (4) QUESTIONS ONLY.

THIS PAPER CONSISTS OF TEN (10) PAGES

Q1 A rigid bar in Figure **Q1** with neglected weight is hinged at B and loaded by P at point A so that the maximum stress in the steel and bronze rods do not exceed 150 MPa and 70 MPa respectively.

- (i) Determine the loads taken up by steel and bronze rods. (15 marks)
- (ii) Calculate the maximum value of load P (5 marks)
- (iii) What could be happen if the elastic limit one of the rod is exceeded? Briefly explain. (5 marks)

Q2 A T-shape cantilever beam id shown in Figure **Q2** has a fixed support at point A and free end at point B. The length of the beam is $L = 4$ m. A uniform distributed load with intensity $w = 10$ kN/m acts along the beam. The beam also subjected by a moment, $M = 20$ kNm at the free end of point B.

- (i) Determine the reactions of the cantilever beam. (4 marks)
- (ii) Sketch the shear force and bending moment diagrams. Label all the related values. (5 marks)
- (iii) Determine the flexural and shear stresses at the fixed support at point A. Then, sketch the distribution of flexural stress and shear stress diagrams at that point. (11 marks)
- (iv) What are the advantages of hollow section steel section compared to solid section for a flexural member? Briefly discuss. (5 marks)

Q3 A universal column size 203 x 203 x 46 kg/m from A to C is pinned at point A, B and C as in Figure **Q3**. The column is restrained by two beams in x-x direction but free in y-y. Some details are as follow:

I_{x-x}	= 4570 cm ⁴
I_{y-y}	= 1550 cm ⁴
σ_y	= 275 N/mm ²
A	= 58.7 cm ²
MOE	= 205 GPa

- (i) Calculate P_{cr} using Euler formula. (12 marks)
- (ii) What is the maximum stress of the column that can be applied? Give comment if necessary. (4 marks)
- (iii) Calculate σ_{cr} , if the restrained beams are removed. Give comment if necessary. (5 marks)
- (iv) What are the parameters should be reconsidered to enhance the column capacity if the limit of σ_y is unfulfilled? (4 marks)

Q4 A cantilever beam AB as shown in Figure **Q4** has 20 m span and carries a point load of 15 kN at point B. Given, MOE = 210 GPa and $I = 10 \times 10^6 \text{ mm}^4$.

- (i) Calculate the support reactions at point A. (5 marks)
- (ii) Derive the slope and deflection equations of the beam by using MacCaulay method. (12 marks)
- (iii) Determine the deflection of the beam at 5 m distance from point A. (3 marks)
- (iv) Double integration method and MacCaulay method are most likely similar in terms of the application of boundary conditions. With the aid of sketches, identify the boundary conditions for a simple supported beam and a cantilever beam. (5 marks)

- Q5**
- (a) A torque T is applied to a solid shaft as shown in Figure **Q5(a)**. Prove that the resisting torque at both walls are $T_1 = Tb/L$ and $T_2 = Ta/L$. (15 marks)
 - (b) A torque of 600 Nm is applied to a rectangular section as shown in Figure **Q5(b)**. Determine the thickness of t so that it will not exceed the shear stress of 80 MPa? Neglect stress concentration at the corners. (5 marks)
 - (c) Briefly explain on the application of torsion in engineering area. (5 marks)

- Q6** By referring to Figure **Q6** answer the following questions:
- (i) Determine the stability and determinacy of the truss. (3 marks)
 - (ii) Calculate the reactions at joints A and J. (5 marks)
 - (iii) Calculate the internal forces of members according to the given method:
 - Member CD and CB – method of joint
 - Member DG and DB – section method
 - Member AB and AJ – advanced computation(12 marks)
 - (iv) What is the importance of truss analysis? Briefly explain. (5 marks)

- S1** Satu bar tegar dalam Rajah Q1 dengan berat diabaikan, diengsel pada B dan dibebani oleh beban P pada titik A supaya tegasan maksimum rod keluli dan rod gangsa tidak melebihi 150 MPa dan 70 MPa.
- Tentukan daya yang ditanggung oleh rod keluli dan rod gangsa.
(15 markah)
 - Kira nilai maksimum beban P.
(5 markah)
 - Apakah yang boleh terjadi sekiranya had elastik salah satu rod tersebut dilebihi?
(5 markah)
- S2** Satu rasuk julus T ditunjukkan dalam Rajah Q2 diikat tegar pada titik A dan hujung bebas pada titik B. Panjang rasuk ialah $L = 4$ m. Beban teragih seragam berjumlah, $w = 10$ kN/m bertindak di sepanjang rasuk. Rasuk ini juga ditindaki momen, $M = 20$ kNm pada hujung bebas iaitu di titik B.
- Tentukan semua tindakbalas rasuk julus tersebut.
(4 markah)
 - Lakarkan gambarajah daya ricih dan momen lentur. Kemudian label semua nilai-nilai yang berkenaan.
(5 markah)
 - Tentukan tegasan lenturan dan ricih pada penyokong diikat tegar pada titik A. Kemudian, lakarkan gambarajah agihan tegasan lenturan dan tegasan ricih pada titik tersebut.
(11 markah)
 - Apakah kelebihan-kelebihan keratan keluli berongga berbanding keratan padu bagi sesebuah anggota lenturan? Bincangkan secara ringkas.
(5 markah)
- S3** Satu tiang semesta bersaiz 203 x 203 x 46 kg/m dari A ke C dipin pada titik A, B dan C seperti dalam Rajah Q3. Tiang dikekang oleh dua rasuk dalam arah x-x dan bebas kekang dalam arah y-y. Beberapa butiran lain adalah seperti berikut:

$$\begin{aligned}
 I_{x-x} &= 4570 \text{ cm}^4 \\
 I_{y-y} &= 1550 \text{ cm}^4 \\
 \sigma_y &= 275 \text{ N/mm}^2 \\
 A &= 58.7 \text{ cm}^2 \\
 \text{MOE} &= 205 \text{ GPa}
 \end{aligned}$$

- (i) Tentukan P_{cr} menggunakan formula Euler. (10 markah)
- (ii) Apakah tegasan maksimum yang boleh dikenakan kepada tiang tersebut? Beri komen sekiranya perlu. (5 markah)
- (iii) Kira σ_{cr} , sekiranya rasuk yang dikekang ditanggalkan. Beri komen sekiranya perlu. (5 markah)
- (iv) Apakah parameter-parameter yang perlu ditimbang semula untuk meningkatkan keupayaan tiang sekiranya had σ_y tidak dapat dipenuhi? (4 markah)
- S4** Satu rasuk julur AB dalam Rajah Q4 mempunyai rentang 20 m dan menanggung beban tumpu 15 kN pada titik B. Diberi, MOE = 210 GPa dan $I = 10 \times 10^6 \text{ mm}^4$.
- (i) Kira tindakbalas penyokong pada titik A. (5 markah)
- (ii) Terbitkan persamaan cerun dan persamaan pesongan rasuk dengan menggunakan kaedah MacCaulay. (12 markah)
- (iii) Tentukan pesongan rasuk pada jarak 5 m dari titik A. (3 markah)
- (iv) Kaedah kamiran berganda dan kaedah MacCaulay adalah hampir sama dari segi pengaplikasian had-had sempadan. Dengan bantuan lakaran, kenalpasti had-had sempadan bagi sebuah rasuk tupang mudah dan rasuk julur. (5 markah)
- S5** (a) Satu daya kilasan T dikenakan pada satu aci padu seperti ditunjukkan pada Rajah Q5(a). Buktikan bahawa jumlah kilasan yang ditanggung oleh kedua-dua dinding tersebut adalah bersamaan $T_1 = T_b/L$ dan $T_2 = T_a/L$. (15 markah)
- (b) Satu kilasan 600 Nm dikenakan terhadap satu keratan segiempat seperti pada Rajah Q5(b). Tentukan ketebalan t supaya nilai tegasan ricih 80 MPa tidak dilebihi? Abaikan tumpuan tegasan pada setiap penjuru keratan tersebut. (5 markah)

- (c) Terangkan dengan ringkas aplikasi kilasan dan bidang kejuruteraan.
(5 markah)
- S6** Dengan merujuk kepada Rajah **Q6**, jawab soalan-soalan berikut:
- (i) Tentukan kestabilan dan kebolehtentuan kekuda tersebut.
(3 markah)
- (ii) Kira semua tindakbalas pada sambungan A dan J.
(5 markah)
- (iii) Kira daya dalaman anggota-anggota berdasarkan kepada kaedah-kaedah berikut:
Anggota CD dan CB – kaedah sambungan
Anggota DG dan DB – kaedah keratan
Anggota AB dan AJ – pencongakan lanjutan
(12 markah)
- (iv) Apakah kepentingan analisis kekuda? Terangkan secara ringkas.
(5 markah)

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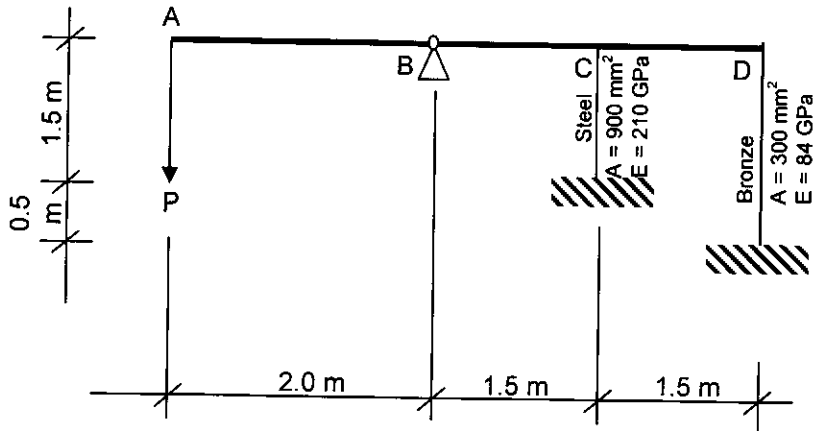


FIGURE Q1

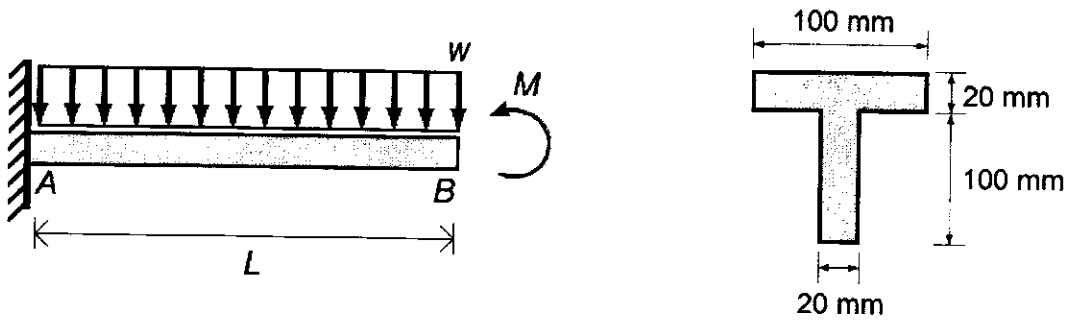


FIGURE Q2

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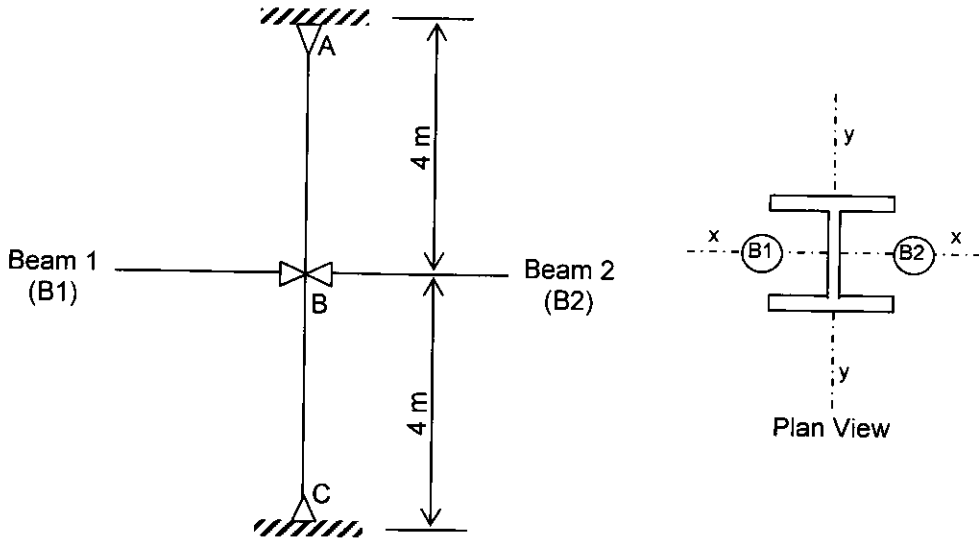


FIGURE Q3

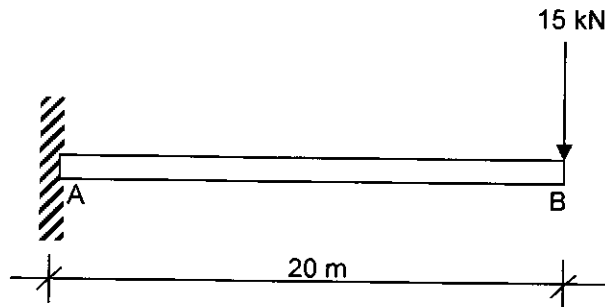


FIGURE Q4

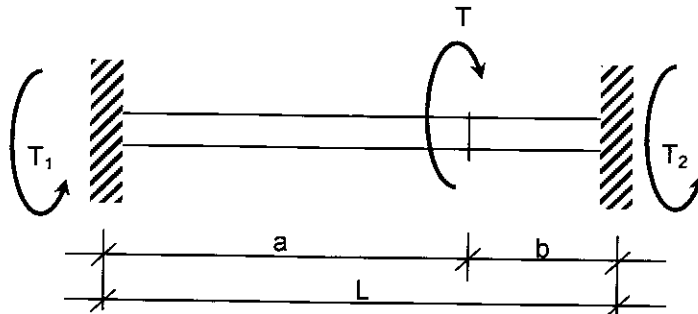


FIGURE Q5(a)

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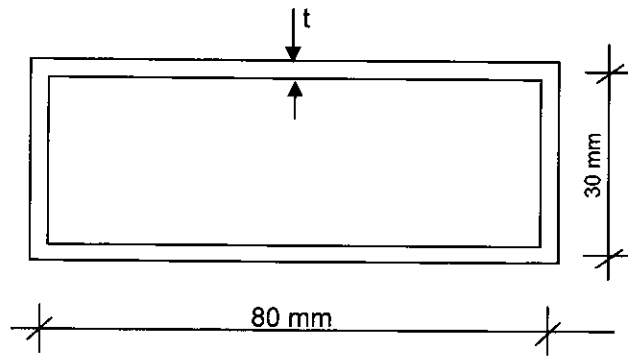


FIGURE Q5(b)

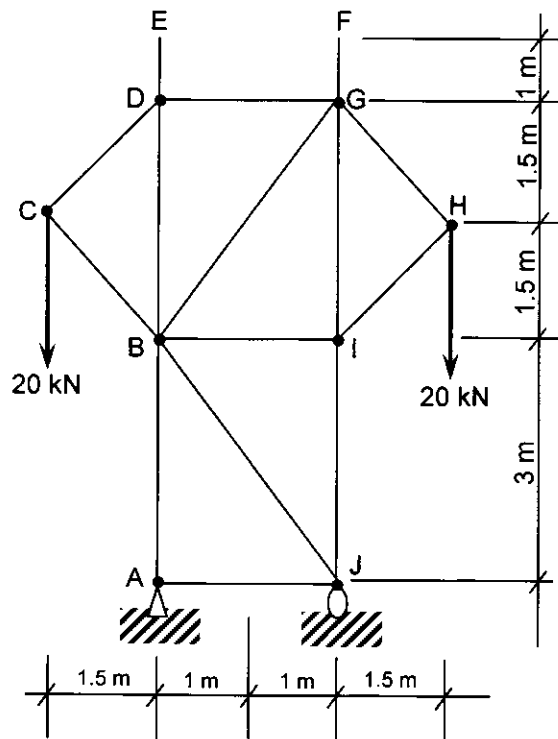


FIGURE Q6