

**UNIVERSITI TUN HUSSEIN ONN MALAYSIA****FINAL EXAMINATION
SEMESTER I
SESSION 2011/2012**

COURSE NAME : **MECHANICS OF MATERIALS I**

COURSE CODE : **BDA 10402 / BDA 1042**

PROGRAMME : **BACHELOR OF MECHANICAL
ENGINEERING WITH HONOURS**

EXAMINATION DATE : **JANUARY 2012**

DURATION : **3 HOURS**

INSTRUCTION : **ANSWER FIVE (5) QUESTIONS
OUT OF SIX (6) QUESTIONS**

THIS QUESTION PAPER CONSISTS OF EIGHT (8) PAGES

- Q1 a) The block shown in **FIGURE Q1 (a)** is subjected to a compressive force of $2kN$. Determine the average normal and average shear stress developed in the wood fibers that are oriented along section $a-a$ at 30° with the axis of the block.
- (5 marks)
- b) The three suspender bars are made of A-36 steel and have equal cross-sectional areas of $450mm^2$. Determine the average normal stress in each bar if the rigid beam is subjected to the loading shown in **FIGURE Q1 (b)**.
- (15 marks)
- Q2 The beam is supported by roller at A and a smooth pin at B as shown in **FIGURE Q2**.
- a) Draw the free body diagram of the entire beam
- b) Determine the reaction at A and B
- c) Draw the shear and moment diagrams for the beam and determine the shear and moment as functions of x .
- (20 marks)
- Q3 A compound beam has dimensions and shape as shown in **FIGURE Q3**. A moment of $M = 10 \text{ kNm}$ acts on the beam as shown in the figure.
- Determine:
- a) The maximum tensile stress
- b) The maximum compressive stress in the beam
- (20 marks)
- Q4 The angle of rotation of end A of the gear and shaft system as shown in **FIGURE Q4** must not exceed 4° . The shaft are made of a steel which $\tau_{all} = 65 \text{ MPa}$ and $G=77 \text{ GPa}$. Determine the largest torque T which can be safely applied at end A.
- (20 marks)

- Q5 A thin cylinder 80 mm internal diameter, 500 mm long with the shell thickness of 2mm is subjected to an internal pressure of 6 MN/m². The material properties of the cylinder; E= 200 GPa and $\nu=0.3$.
- Illustrate the cylinder showing the conditions as described above
 - Determine the hoop and longitudinal stress. Illustrate the stress in the cylinder shell
 - Calculate the inner diameter because of the internal pressure
- (20 marks)

- Q6 The stress state of small finite element of a mechanical part is shown in **FIGURE Q6**.
- Based on the information written in the figure, write down the stress condition σ_x , σ_y and σ_{xy}
 - Draw the Mohr's circle to find the principle stresses
 - Calculate the equivalent stress state at 60° clockwise orientation by using Mohr's circle
- (20 marks)

- S1 a) Bongkah di dalam RAJAH S1 (a) dikenakan daya mampatan $2kN$. Tentukan tegasan normal purata dan tegasan ricih purata yang terbentuk di dalam serat kayu yang dipotong sepanjang garisan $a-a$ bersudut 30° dengan paksi bongkah tersebut.
(5 markah)
- b) Tiga batang besi diperbuat daripada besi A-36 dan mempunyai luas permukaan yang sama iaitu $450mm^2$. Tentukan tegasan normal purata di dalam setiap batang besi sekiranya rasuk tegar tersebut dikenakan daya-daya seperti di dalam RAJAH S1 (b).
(15 markah)
- S2 Rasuk disokong oleh pengguling di A dan pin di B seperti ditunjukkan dalam RAJAH S2.
- a) Lukiskan gambarajah beban bebas bagi keseluruhan rasuk
- b) Tentukan daya tindakbalas pada A dan B
- c) Lukiskan rajah daya ricih dan rajah momen bagi rasuk tersebut dan juga tentukan daya ricih dan momen sebagai fungsi x
(20 markah)
- S3 Satu rasuk gabungan mempunyai dimensi dan bentuk seperti dalam RAJAH S3. Satu momen $M = 10 kNm$ dikenakan pada rasuk seperti ditunjukkan dalam rajah.
Kirakan:
- a) tegasan terikan maksimum
- b) tegasan mampatan maksimum pada rasuk
(20 markah)
- S4 Sudut putaran hujung A bagi sistem gear dan aci adalah ditunjukkan seperti RAJAH S4 mestilah tidak melebihi 4° . Aci tersebut diperbuat dari keluli dengan $\tau_{all} = 65 MPa$ dan $G=77 GPa$. Kirakan dayakilas T paling tinggi yang selamat dikenakan pada hujung A.
(20 markah)

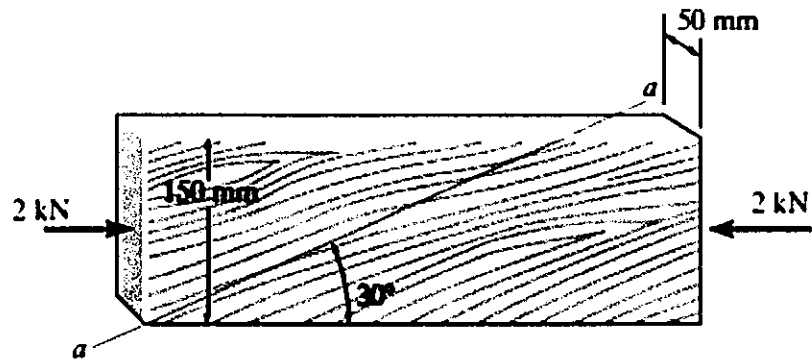
- S5 Satu silinder nipis bergarispusat dalam 80mm, panjang 500mm dan ketebalan 2mm dikenakan tekanan dalaman 6 MN/m^2 . Maklumat bahan silinder tersebut ialah $E= 200 \text{ GPa}$ and $\nu=0.3$.
- Lukiskan rajah silinder menunjukkan keadaan seperti di atas
 - Tentukan tegasan *hoop* dan *longitudinal*. Lakarkan tegasan pada permukaan silinder
 - Kirakan garispusat dalam disebabkan tekanan dalaman
- (20 markah)

- S6 Keadaan tegasan pecahan kecil elemen tak terhingga dari satu bahagian mekanikal adalah seperti ditunjukkan dalam **RAJAH S6**.
- Dari maklumat yang diberi dari rajah, tuliskan keadaan tegasan σ_x σ_y dan σ_{xy}
 - Lukiskan rajah bulatan Mohr untuk mendapatkan tegasan-tegasan utama
 - Kirakan keadaan tegasan seimbang pada 60° ikut pusingan jam menggunakan rajah bulatan Mohr
- (20 markah)

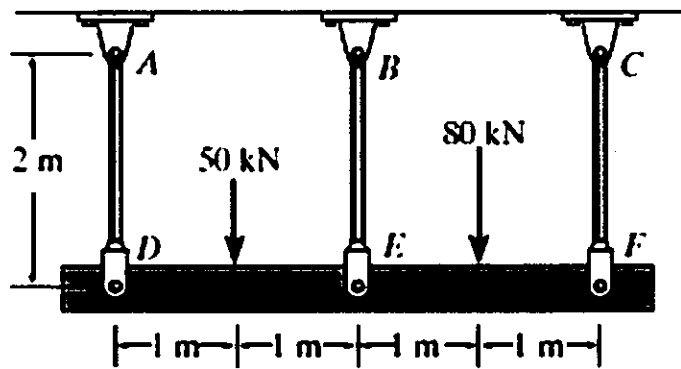
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QUESTION Q1 (a)



QUESTION Q1 (b)

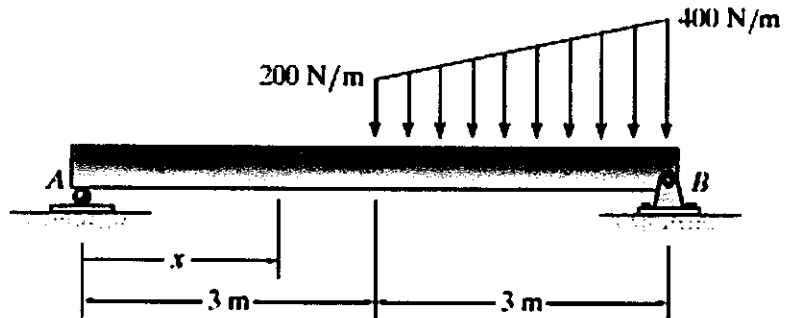
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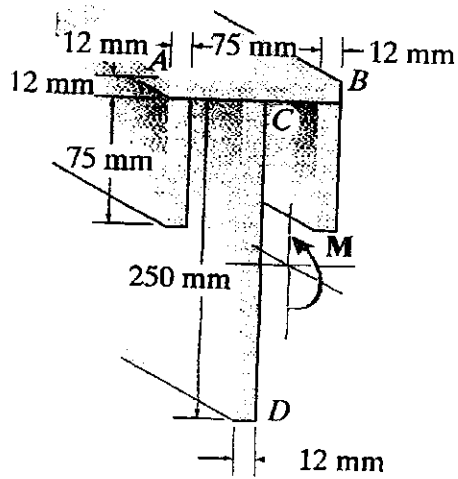
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QUESTION Q2



QUESTION Q3

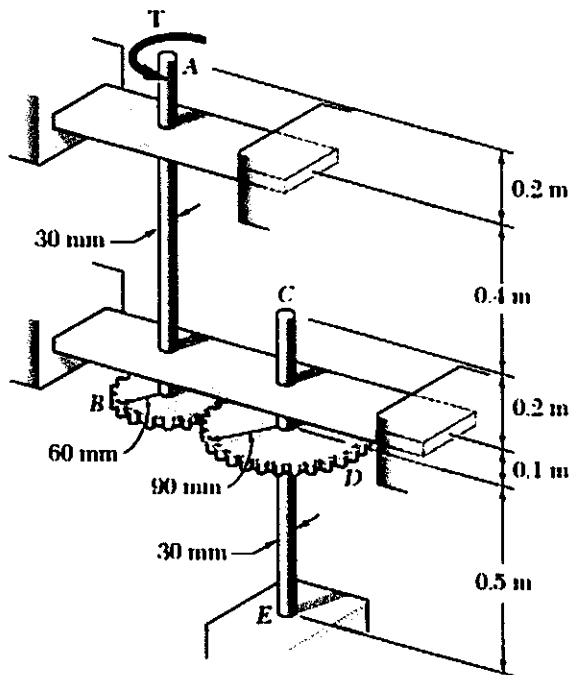
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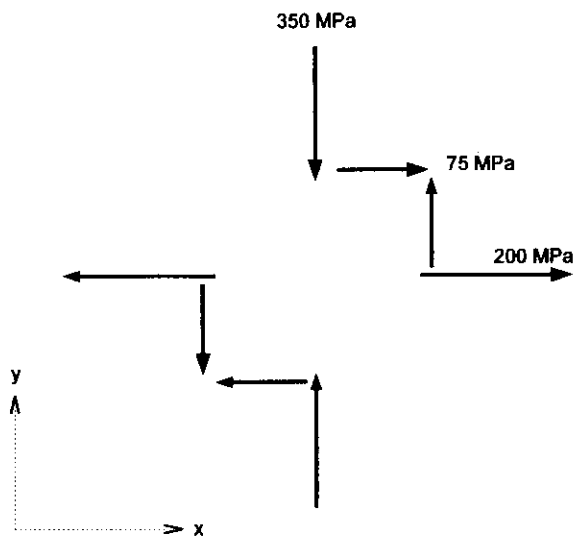
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QUESTION Q4



QUESTION Q6