UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 2008/2009

November 2008

EEM 221 – PRINSIP DAN MELANIK BAHAN

Masa: 3 jam

Sila pastikan bahawa kertas peperiksaan ini mengandungi SEMBILAN muka surat dan DUA muka surat LAMPIRAN yang bercetak sebelum anda memulakan peperiksaan ini.

Kertas soalan ini mengandungi ENAM soalan.

Jawab LIMA soalan.

Mulakan jawapan anda untuk setiap soalan pada muka surat yang baru.

Agihan markah bagi setiap soalan diberikan di sudut sebelah kanan soalan berkenaan.

Jawab semua soalan dalam bahasa Inggeris. Walau bagimanapun, satu soalan dibenarkan dijawab dalam bahasa Malaysia.

...2/-

1. (a) Apakah geometri-geometri berbeza di mana unit sel bagi jenis-jenis bahan yang berbeza ditemui dalam praktikal? Berikan parameter-parameter bagi 4 jenis unit-unit sel tersebut.

What are different geometries in which the unit cell of different types of metals are found in practice? Give the parameters of FOUR types of the unit cell.

(30%)

(b) Apakah teknik tidak-musnah untuk mengenal pasti struktur bagi sesuatu atom. Terangkan dengan terperinci teknik-teknik tersebut.

What is the non-destructive technique for the determination of structure of the atoms? Describe it in details.

(40%)

(c) 'Molybdenum' mempunyai struktur Kristal BBC, satu atom yang berjejari 0.1363nm, dan satu atom dengan berat 95.94g/mol. Kirakan dan bandingkan ketumpatannya secara teori dengan nilai eksperimennya iaitu 10.22 gm/cm^3.

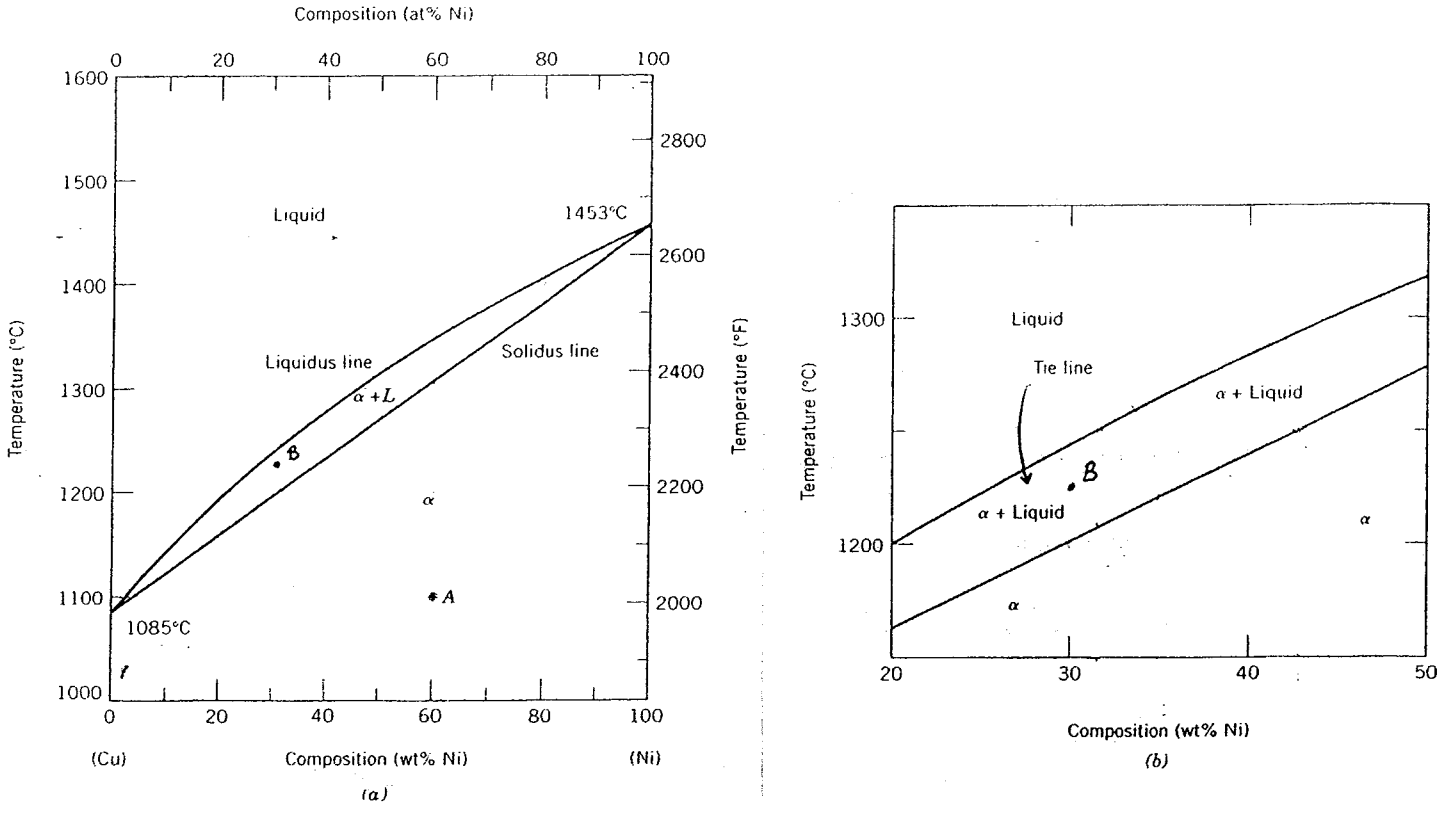
Molybdenum has a BCC crystal structure, an atomic radius of 0.1363nm, and an atomic weight of 95.94g/mol. Compute and compare its theoretical density with the experimental value equal to 10.22 gm/cm^3.

(30%)

2. (a) Jelaskan fasa bagi suatu sistem. Apakah dimaksudkan dengan gambarajah fasa? Terangkan sistem isomorphous. Rajah 1 menunjukkan gambarajah fasa bagi kuprum dan nikel. Bagaimanakah cara untuk mengenal pasti jumlah fasa-fasa di kedudukan B pada suhu 1225°C. Jelaskan prosedur-prosedur lengkap yang perlu dipatuhi dalam mengenal pasti jumlah fasa tersebut.

Define phase of a system. What is a phase diagram? Define isomorphous system. Figure 1 shows the phase diagram for copper and nickel. How will you determine the phase amounts at point B at a temperature of 1225°C. Describe the complete procedure you will follow in the determination of the phase amounts.

(50%)



Rajah 1
Figure 1

...4/-

(b) Bezakan di antara logam, seramik dan polimer berdasarkan kepada struktur atom masing-masing. Berikan beberapa penggunaan/aplikasi bagi ketiga-tiga bahan tersebut. Bagaimanakah anda mengelaskan seramik? Terangkan dengan jelas tentang kepentingan gentian optik dan bola galas seramik?

Differentiate between Metals, Ceramics and Polymers on the basis of their atomic structures. Give some of the applications of the three types of the materials. How will you classify ceramics? Explain briefly the importance of optical fiber and ceramic ball bearings.

(30%)

(c) Apakah yang anda fahami tentang pempolimeran? Bagaimanakah anda menunjukkan darjah pempolimeran? Bagaimana anda menjelaskan polimer? Berikan penerangan yang jelas tentang kepentingan polimer?

What do you understand by polymerization? How do you represent the degree of polymerization? How will you classify polymers? Give brief details of the important polymers.

(20%)

3. (a) Bagaimanakah anda mengenal pasti perbezaan di antara konduktor, semikonduktor dan penebat berdasarkan kepada teori jalur? Yang manakah di antara bahan-bahan berikut yang mempunyai ciri penebat yang terbaik?

How will you differentiate among conductor, semiconductor and insulator on the basis of band theory? Which of the following materials have the best insulating properties?

(i) Logam
Metals

(ii) Seramik
Ceramics

(iii) Polimer
Polymers

Berikan nama-nama bagi penebat semikonduktor dan konduktor yang terbaik.

Give the names of some best insulators, semi-conductors and conductors.

(35%)

(b) Apakah yang anda fahami tentang 'Kesan Hall'? Apakah kegunaannya? Beberapa jenis logam aloi dikenal pasti mempunyai konduktiviti elektrikal dan kebolehgerakan elektron bernilai 1.2×10^7 (Ω-m) dan $0.0050 m^2$/N-s masing-masing. Menggunakan suatu specimen bagi aloi ini, 35mm ketebalannya dilalui oleh arus dengan nilai 40A. Apakah medan magnetik yang perlu dikenakan untuk menghasilkan nilai 'voltage Hall' sebanyak -3.5×10^{-7} V?

What do you understand by Hall Effect? What are its applications? Some metal alloy is known to have electrical conductivity and electron mobility values of 1.2×10^7 (Ω-m) and $0.0050 m^2$/N-s respectively. Through a specimen, of this alloy of 35mm thickness, is passed a current of 40A. What magnetic field, would need to be imposed to yield a Hall voltage of -3.5×10^{-7} V?

(45%)

(c) Apakah yang anda fahami tentang rawatan pemanasan bagi suatu bahan? Apakah jenis-jenis rawatan pemanasan yang digunakan dalam praktikal? Terangkan suatu teknik yang meningkatkan aras tekanan dan melembutkan suatu bahan.

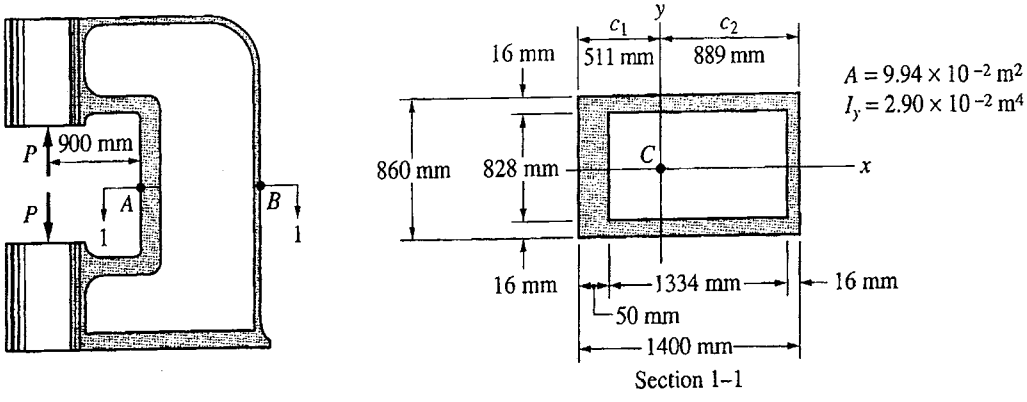
What do you understand by the heat treatment of the materials? What are the different types of heat treatments used in practice? Explain a technique which decreases the stress level and softens the metals.

(20%)

4. (a) Rangka bagi penekan hidraulik mempunyai dimensi dan ciri seperti ditunjukkan oleh keratan rentas 1-1 pada Rajah 2. Sekiranya P=1600 kN, tentukan tegasan-tegasan normal pada titik A dan B. C ialah titik tengah bagi keratan rentas 1-1.

The frame of a hydraulic press has the dimensions and the properties of section 1-1 shown in Figure 2. If P=1600 kN, determine the normal stresses at point A and B. C is the centroid of section 1-1.

(60%)



Rajah 2
Figure 2

...7/-

(b) Tentukan beban lenturan kritikal bagi kolum yang mempunyai saiz, 100-mm × 200-mm keratan rentas segiempat dan panjangnya 2.5 m dan hujung-hujungnya tetap. Anggap modulus kenyal ialah 200 GPa dan tegasan alah ialah 250 MPa.

Determine the critical buckling load of a column with full-size, 100-mm × 200-mm rectangular section having a length of 2.5 m and fixed ends. Assume that the modulus elasticity is 200 GPa and the yield stress is 250 MPa.

Diberikan:
Given:

$$C_C = \sqrt{\frac{2\pi^2 E}{\sigma_y}}$$

The J.B. Johnson formula: $\sigma_{cr} = \left[1 - \frac{(kL/r)^2}{2C_c^2}\right]\sigma_y$

The Euler formula: $\sigma_{cr} = \frac{\pi^2 E}{(kL/r)^2}$

(40%)

5. (a) Terbitkan sebutan bagi lenturan maksimum bagi satu rasuk julur dengan beban bertumpu pada hujung bebas dengan menggunakan:-

Derive the expression for maximum deflection of a cantilever beam with a concentrated load at the free end using:-

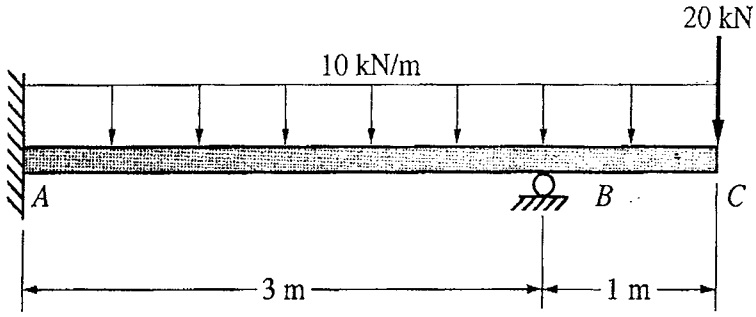
(i) Elastic Curve's formula

(ii) Moment Area Method

(60%)

(b) Tentukan tindakbalas-tindakbalas bagi rasuk julur tersangga yang ditunjukkan dalam Rajah 3.

Determine the reactions for the propped cantilever beam shown in Figure 3.



Rajah 3
Figure 3

(40%)

6. Bagi rasuk dalam Rajah 4(a).
For the beam shown in Figure 4(a).

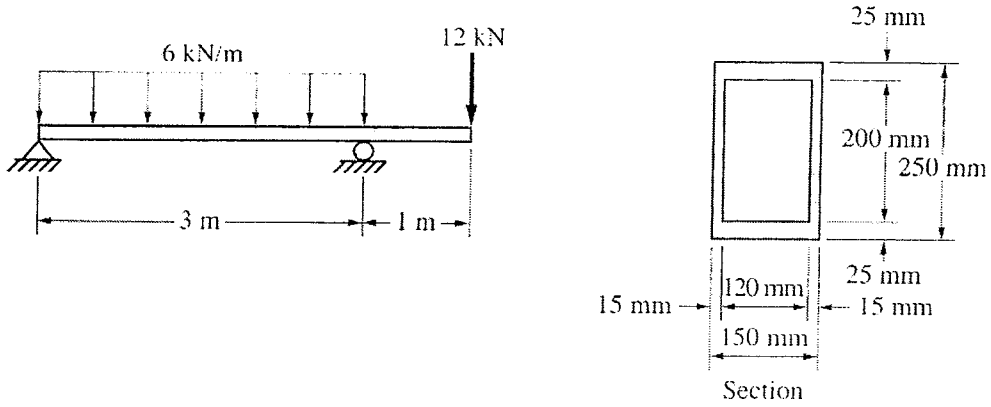
(i) Plot rajah-rajah daya ricih dan momen lenturan.

Plot shear force and bending moment diagrams.

(ii) Tentukan tegasan ricih maksima dan tegasan lenturan maksima bagi rusuk ditunjukkan dalam Rajah 4(a).

Determine the maximum shear stress and the maximum flexural stress in the beam shown in Figure 4(a).

(60%)

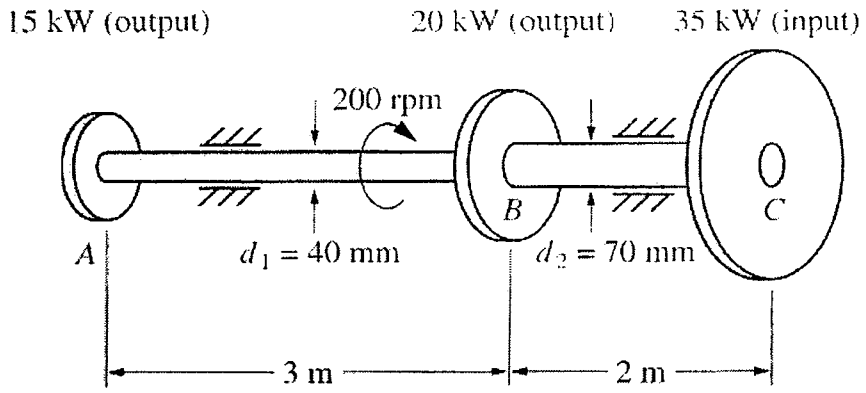


Rajah 4(a)
Figure 4(a)

(b) Satu aci keluli yang padu ditunjukkan dalam Rajah 4(b) menghantar kuasa masukan sebanyak 35kW pada kapi C kepada kapi A ban B. Kapi A mengeluarkan 15kW dan kapi B mengeluarkan 20kW. Tentukan tegasan ricih maksima di dalam aci-aci ini.

A solid steel shaft shown in Figure 4(b) transmits an input power of 35 kW at pulley C to pulleys A and B. Pulley A outputs 15 kW and pulley B outputs 20 kW. Determine the maximum shear stress in the shafts.

(40%)



Rajah 4(b)
Figure 4(b)

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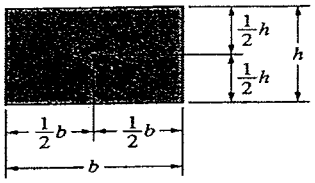
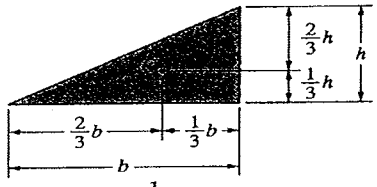
Centroids of Areas of Common Shapes

Rectangle



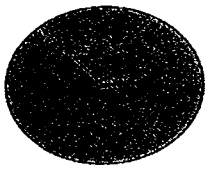
$$A = bh$$

Triangle



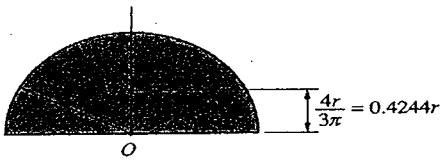
$$A = \frac{1}{2}bh$$

Circle



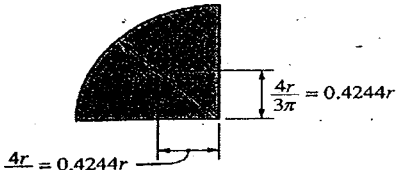
$$A = \pi r^2$$

Semicircle



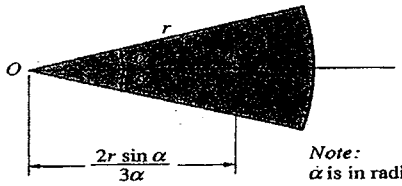
$$A = \frac{1}{2}\pi r^2$$

Quarter-Circle



$$A = \frac{1}{4}\pi r^2$$

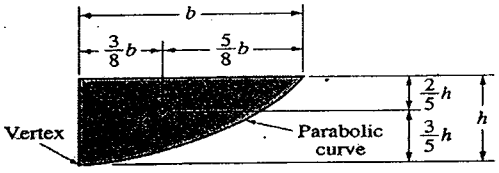
Sectors



Note: α is in radians.

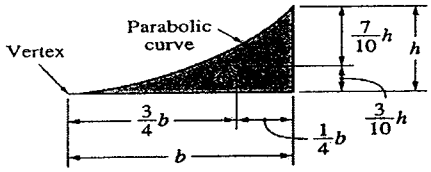
$$A = \alpha r^2$$

Semiparabolic Area

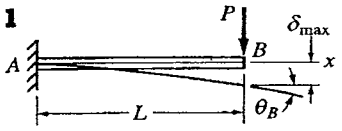
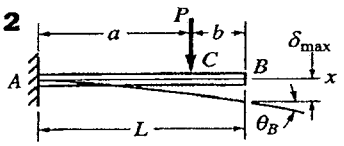
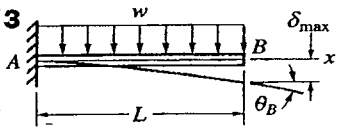
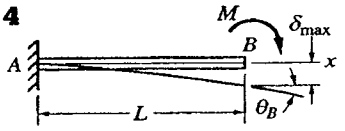
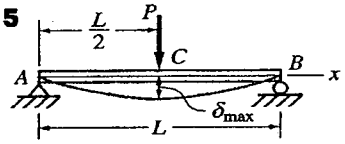
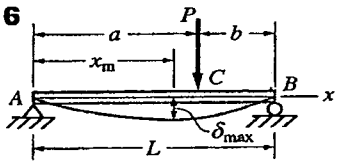
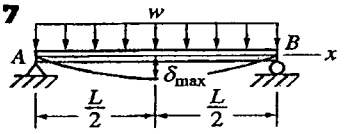
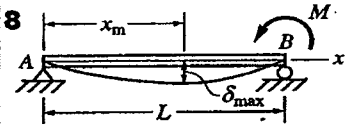


$$A = \frac{2}{3}bh$$

Parabolic Spandrel



$$A = \frac{1}{3}bh$$

Beam Loading and Deflection	Maximum Deflection	Slope at End(s)	Deflection Equations
1 	$\delta_{max} = \frac{PL^3}{3EI}$	$\theta_B = \frac{PL^2}{2EI}$	$\delta = \frac{Px^2}{6EI}(3L - x)$
2 	$\delta_{max} = \frac{P\alpha^2}{6EI}(3L - \alpha)$	$\theta_B = \frac{P\alpha^2}{2EI}$	$\delta_{AC} = \frac{Px^2}{6EI}(3\alpha - x)$ $\delta_{CB} = \frac{P\alpha^2}{6EI}(3x - \alpha)$
3 	$\delta_{max} = \frac{wL^4}{8EI}$	$\theta_B = \frac{wL^3}{6EI}$	$\delta = \frac{wx^2}{24EI}(x^2 - 4Lx + 6L^2)$
4 	$\delta_{max} = \frac{ML^2}{2EI}$	$\theta_B = \frac{ML}{EI}$	$\delta = \frac{Mx^2}{2EI}$
5 	$\delta_{max} = \frac{PL^3}{48EI}$	$\theta_A = \theta_B = \frac{PL^2}{16EI}$	$\delta_{AC} = \frac{Px}{48EI}(3L^2 - 4x^2)$
6 	For $a > b$: $\delta_{max} = \frac{Pb(L^2 - b^2)^{3/2}}{9\sqrt{3}EIL}$ at $x_m = \sqrt{\frac{L^2 - b^2}{3}}$	$\theta_A = \frac{Pb(L^2 - b^2)}{6EIL}$ $\theta_B = \frac{Pa(L^2 - a^2)}{6EIL}$	$\delta_{AC} = \frac{Pbx}{6EIL}(L^2 - x^2 - b^2)$ $\delta_{CB} = \frac{Pb}{6EIL}\left[\frac{L}{b}(x - a)^3 + (L^2 - b^2)x - x^3\right]$
7 	$\delta_{max} = \frac{5wL^4}{384EI}$	$\theta_A = \theta_B = \frac{wL^3}{24EI}$	$\delta = \frac{wx}{24EI}(L^3 + x^3 - 2Lx^2)$
8 	$\delta_{max} = \frac{ML^2}{9\sqrt{3}EI}$ at $x_m = \frac{L}{\sqrt{3}}$	$\theta_A = \frac{ML}{6EI}$ $\theta_B = \frac{ML}{3EI}$	$\delta = \frac{Mx}{6EIL}(L^2 - x^2)$