UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2008/2009

Peperiksaan Semester Pertama
Sidang Akademik 2008/2009

NOVEMBER 2008

EPP 201/3 - MANUFACTURING TECHNOLOGY 1
TEKNOLOGI PEMBUATAN 1

Duration: 3 hours
Masa: 3 jam

INSTRUCTIONS TO CANDIDATE :
ARAHAN KEPADA CALON :

Please check that this paper contains ELEVEN (11) printed pages, ONE (1) page appendix and SEVEN (7) questions before you begin the examination.
*Sila pastikan bahawa kertas soalan ini mengandungi **SEBELAS BELAS** (11) **mukasurat,** **SATU** (1) **Lampiran** dan **TUJUH** (7) **soalan** yang bercetak sebelum anda memulakan peperiksaan.*

Answer FIVE (5) questions only. Answer not more than THREE question in either part A or B.
Jawab LIMA (5) soalan sahaja. Jawab tidak lebih dari TIGA soalan sama ada dalam Bahagian A atau B

Answer all questions in English OR Bahasa Malaysia OR a combination of both.
*Jawab semua soalan dalam **Bahasa Inggeris** ATAU **Bahasa Malaysia** ATAU kombinasi kedua-duanya.*

Appendix/*Lampiran* **[1 page/***mukasurat***]**

Answer to each question must begin from a new page.
Jawapan bagi setiap soalan mestilah dimulakan pada mukasurat yang baru.

PART A/*BAHAGIAN A*

Q1. [a] List TWO (2) possible negative consequences of each of the following case in rolling process.

i) Speed of rollers are very much higher than optimum.
ii) Speed of rollers are very much lower than optimum.

Senaraikan DUA (2) akibat negatif pada setiap kes dalam proses gelekan berikut :

i) Kelajuan penggelek jauh lebih tinggi dari optimum.
ii) Kelajuan penggelek jauh lebih rendah dari optimum.

(20 marks/*markah***)**

[b] Your company wishes to embark into production of rails tracks for the commuter train in Kuala Lumpur.

i) Suggest THREE feasible methods of production to produce the required shape.
ii) Compare and contrast the three methods in terms of material properties, and speed of production.
iii) Choose the 'best' method and propose how to implement the method of production. Use sketches to explain.

Syarikat anda ingin mengeluarkan trek jalan keretapi bagi tren komuter di Kuala Lumpur.

i) Cadangkan TIGA kaedah pembuatan mungkin untuk mengeluarkan bentuk yang diperlukan.
ii) Banding dan beza ketiga-tiga kaedah tersebut dari segi bahan, dan kadar pengeluaran.
iii) Pilih kaedah 'terbaik' dan cadangkan bagaimana melaksanakan kaedah pembuatan itu. Gunakan lakaran untuk penerangan anda.

(30 marks/*markah***)**

[c] **A copper plate of thickness 25 mm, width of 228 mm has true stress of 80 MPa. The material had to undergo two passes in a rolling process. The rollers radii are 300mm and are made from the same material. Each thickness reduction is 75% of the previous value while the plate also widens in each pass.**

i) For the first pass, the rollers rotate at 100 rpm. Calculate the roll slip in contact, minimum coefficient of friction, true strain and roll force.
ii) For the second pass, calculate the roll slip in contact and speed of rollers.
iii) Calculate the final width, thickness, and outgoing velocity of material.

Kepingan tembaga ketebalan = 25 mm dan lebar 228 mm mempunyai tegasan sebenar 80 MPa. Bahan tersebut di lalukan dua kali dalam proses gelekan. Penggelek-penggelek yang diguna berjejari 300mm dan dibuat dari bahan yang sama. Pengurangan tebal adalah 75% dari sebelumnya pada setiap kali digelek manakala lebar kepingan pula akan bertambah.

i) Bagi laluan pertama, penggelek berputar 100 psm. Kira gelincir gelek yang bertemu, pekali geseran minimum, terikan sebenar dan daya gelek.
ii) Bagi laluan kedua, Kira gelincir gelek yang bertemu dan halaju penggelek.
iii) Kira lebar dan tebal serta halaju bahan kerja yang terhasil.

(50 marks/*markah*)

Q2. [a] **Sheet metal based industries are common in Malaysia. The main operation are shearing and bending.**

i) List FOUR types of operations in sheet metal shearing process.
ii) Using diagrams as aid, explain briefly the mechanism of shearing.

Industri kepingan logam merupakan industri lazim di Malaysia. Operasi utama industri ini adalah pemotongan dan pembengkokan.

i) Senaraikan EMPAT operasi lain dalam proses memotong kepingan logam.
ii) Dengan bantuan gambarajah, terangkan secara ringkas mekanisma pemotongan.

(25 marks/*markah*)

[b] **One of the four factors that affect springback during sheet metal bending is yield stress.**

i) List the other THREE (3) factors.
ii) Explain the mechanism of springback due to the four factors.
iii) Suggest TWO (2) methods that can reduce the effect of springback.

Salah satu dari empat faktor yang menjadi penyebab pada berlakunya bidasan semasa pembengkokan kepingan logam adalah tegasan alah.

i) Senaraikan TIGA (3) lagi faktor.
ii) Terangkan mekanisma bidasan berdasarkan keempat-empat faktor itu.
iii) Cadangkan DUA (2) kaedah bagi megurangkan kesan bidasan.

(35 marks/*markah*)

[c] **A steel container of height 105 mm and internal diameter 60 mm is made by deep drawing from a blank of 1.7 mm thick. Its bottom radius is 9.5 mm. Assume container's wall thickness equals 90% of the blank.**

i) Calculate the starting blank diameter.
ii) Calculate the diameters of the drawing punch and die. State your assumption.
iii) Calculate the initial deep drawing force.

Kaleng keluli bertinggian 105 mm dan diameter dalaman 60 mm dibuat menerusi kaedah penarikan dalam dari bahan kepingan berketebalan 1.7 mm. Jejari bahagian bawah kaleng adalah 9.5 mm. Andaikan ketebalan dinding kaleng 90% daripada ketebalan bahan kepingan.

i) Kira diameter bahan kepingan logam asal.
ii) Kira diameter penghentak dan acuan dalam proses penarikan dalam ini. Nyatakan andaian anda.
iii) Kira daya bagi penarikan dalam yang mula.

(40 marks/*markah*)

Q3. [a] Welding is one of the methods to join metal and a part of an assembly process.

i) State TWO (2) types of fusion welding and TWO (2) type of solid state welding.
ii) Explain briefly ONE (1) fusion welding process and ONE (1) solid state welding process. Illustrate your explanation with diagram.

Kimpalan merupakan kaedah menyambungkan logam dan sebahagian daripada proses pemasangan.

i) Nyatakan DUA (2) jenis kimpalan lakur dan DUA (2) jenis kimpalan berkeadaan pepejal.
ii) Terangkan secara ringkas SATU (1) proses kimpalan lakur dan SATU (1) proses kimpalan berkeadaan pepejal.

(30 marks/*markah*)

[b] Mechanical fastening generally requires that the components have holes through which fasteners are inserted.

i) Give TWO (2) reasons why careful preparation of hole is important
ii) State THREE (3) reasons for choosing mechanical fastening over other joining method.

Pengikat mekanikal biasanya memerlukan lubang agar pengikat boleh disisipkan.

i) Beri DUA (2) sebab mengapa penyediaan lubang perlu dilakukan dengan cermat.
ii) Nyatakan TIGA (3) sebab pengikat mekanikal dipilih berbanding kaedah penyambungan yang lain.

(40 marks/*markah*)

[c] A heat source impinges and transfers 5W/mm^2 to the surface of a low carbon steel part. Assume circular impingement where 70% of the power transfer within the 0.5 cm diameter (inner circle) and 90% of the power transfer within the 1.3 cm diameter (outer circle).

i) Calculate the power density in the area of the inner circle.
ii) Calculate the power density in the area of the outer ring.

Satu punca haba dikenakan pada pemukaan bahan kerja dari keluli karbon rendah dan memindahkan 5W/mm^2 kepadanya. Andaikan bahagian terkena haba berbentuk bulat di mana 70% daripada kuasa terpindah dalam lingkungan lingkaran dalam berdiameter 0.5 mm dan 90% daripada kuasa terpindah dalam lingkungan lingkaran luar berdiameter 1.3mm.

i) Kira isipadu kuasa dalam kawasan lingkaran dalam.
ii) Kira isipadu kuasa dalam kawasan lingkaran luar.

(30 marks/*markah*)

PART B/*BAHAGIAN B*

Answer not more than THREE (3) questions.
Jawab tidak lebih dari TIGA (3) soalan sahaja.

Q4. [a] **An aluminum disk of 400 mm in diameter and 50 mm thick is to be casted in an open mold operation. The melting temperature of aluminum is 660°C and the pouring temperature will be 800°C. Assume that the amount of aluminum heated will be 5% more than needed to fill the mold cavity.**

Calculate the amount of heat that must be added to the metal to heat it to the pouring temperature, starting from a room temperature of 25°C. The heat of fusion of aluminum = 389.3J/g. Assume the specific heat has the same value for solid and molten aluminum.

Density ρ= 2.70 g/cm^3 and specific heat C = 0.21 Cal/g-°C = 0.88 J/g-°C.

Sebuah cakera aluminium tulen akan dihasilkan menggunakan proses acuan terbuka. Cakera tersebut berdiameter 400 mm dengan ketebalan 50 mm. Takat lebur bagi aluminium adalah 660°C manakala suhu tuangan adalah 800°C. Dianggarkan jumlah aluminium yang diperlukan ialah 5% lebih tinggi daripada yang ditetapkan agar leburan dapat memenuhi rongga acuan.

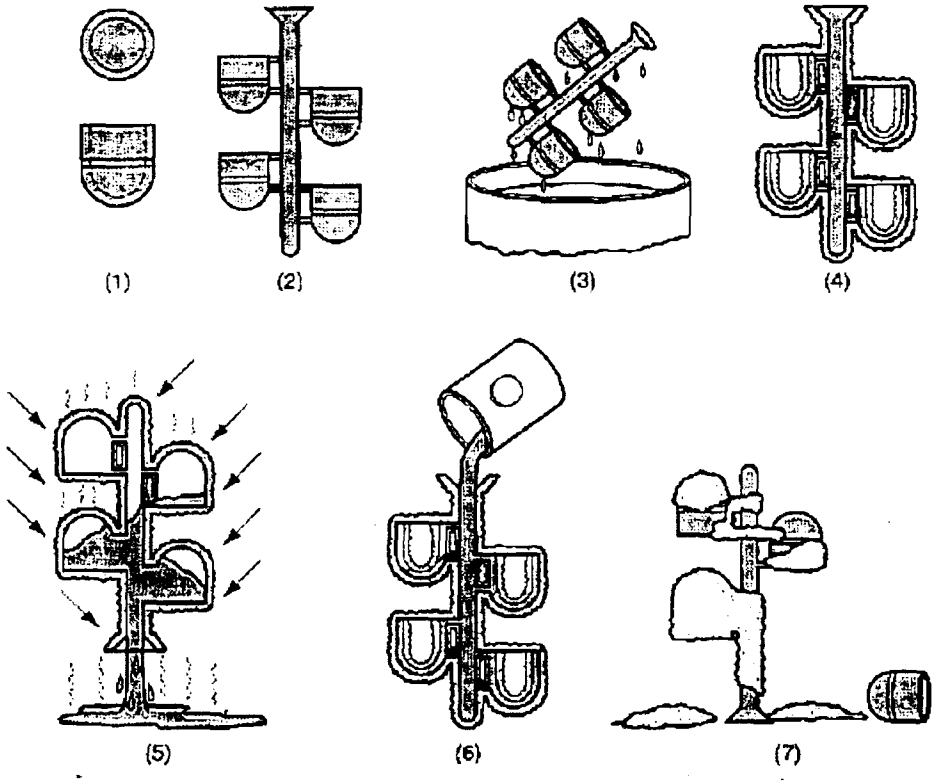
Kirakan jumlah haba yang perlu ditambah untuk memanaskan logam sehingga mencapai suhu tuangan yang bermula dari suhu bilik iaitu 25°C. Haba pelakuran bagi aluminium = 389.3J/g. Haba tentu bagi aluminium padu dan aluminium lebur dianggap sama.

Ketumpatan, ρ= 2.70 g/cm^3 and haba tentu C = 0.21 Cal/g-°C = 0.88 J/g-°C.

(30 marks/*markah***)**

[b] Explain briefly every step of the casting process shown below.

Terangkan dengan ringkas setiap langkah bagi proses tuangan dibawah.



(40 marks/*markah*)

[c] The downsprue leading into the runner of a certain mold has a length 175 mm. The cross-sectional area at the base of the sprue is 400 mm^2. The mold cavity has a volume of 1000 mm^3.

Determine:

(i) The velocity of the molten metal flowing through the base of the downsprue,

(ii) The volume rate of flow, and

(iii) The time required to fill the mold cavity.

Bagi suatu acuan, sprubawah yang menyambung kepada 'runner' mempunyai panjang 175 mm. Luas keratan di dasar spru ialah 400 mm^2. Isipadu rongga acuan ialah 1000 mm^3.

Kirakan:

(i) Halaju bagi leburan logam yang mengalir melalui dasar sprubawah,
(ii) Kadar isipadu aliran, dan
(iii) Masa yang diperlukan untuk mengisi-penuh rongga acuan.

(30 marks/*markah*)

Q5. [a] **The cavity of a casting mold has the following dimensions: L = 250 mm, W = 125 mm and H = 20 mm.**

Determine the dimensions of the final casting after cooling to room temperature if the cast metal is aluminum where solidification shrinkage is 6.6% and solid thermal contraction during cooling is 5.6%. Assume that the mold is full at the start of solidification and that shrinkage occurs uniformly in all directions.

Rongga daripada acuan tuangan mempunyai ukuran: L = 250 mm, W = 125 mm and H = 20 mm.

Jika logam yang dituang adalah aluminium dimana pengecutan pemejalan ialah 6.6% dan pengecutan terma padu selama penyejukan ialah 5.6%, berapakah ukuran bagi hasil tuangan akhir setelah ia disejukkan pada suhu bilik. Anggapkan acuan adalah penuh ketika pengerasan logam mulai berlaku dan pengecutan adalah sekata pada setiap arah.

(20 marks/*markah*)

[b] **The total solidification times of three casting shapes are to be compared: (1) a sphere, (2) a cylinder, in which the length-to-diameter ratio = 1.0, and (3) a cube. For all three geometries, the volume V = 1000 cm^3. The same casting alloy is used in the three cases.**

(i) Determine the relative solidification times for each geometry.
(ii) Based on the results of part (i), which geometric element would make the best riser?
(iii) If Cm = 3.5 min/cm^2 in Chvorinov's Rule, compute the total solidification time for each casting.

Jumlah masa pemejalan bagi tiga bentuk geometri tuangan dibandingkan iaitu: (1) suatu sfera, (2) suatu silinder dengan nisbah panjang-terhadap-garis pusat = 1.0, dan (3) suatu kiub. Isipadu bagi ketiga-tiga bentuk geometri, V = 1000 cm^3. Bagi setiap kes, digunakan aloi tuangan yang sama.

(i) Dapatkan relatif nisbah pemejalan bagi setiap geometri.
(ii) Berdasarkan keputusan di bahagian (i), geometri yang manakah akan menghasilkan 'riser' yang terbaik?
(iii) Jika di dalam Chvorinov's Rule, Cm = 3.5 min/cm^2, kirakan jumlah masa pemejalan bagi setiap tuangan.

(40 marks/*markah*)

[c] **A riser in the shape of a sphere is to be designed for a sand casting mold. The casting is a rectangular plate, with length = 200 mm, width = 100 mm, and thickness = 18 mm. If the total solidification time of the casting itself is known to be 3.5 min, determine the diameter of the riser so that it will take 25% longer for the riser to solidify.**

Riser yang berbentuk sfera akan di rekabentuk bagi acuan tuangan pasir. Tuangan adalah berbentuk plat segiempat dengan panjang = 200 mm, lebar = 100 mm, and tebal = 18 mm. Jika jumlah masa pemejalan bagi tuangan diketahui ialah selama 3.5 min, kirakan diameter bagi riser supaya ia mengambil masa 25% lebih lama untuk riser memejal.

(40 marks/*markah*)

Q6. [a] **Merchant's Force Circle is a method for calculating the various forces involved in the cutting process. Write the procedure to construct the diagram, and using free hand, sketch the diagram.**

Merchant's Force Circle adalah kaedah untuk mengira pelbagai daya yang terlibat di dalam proses pemotongan. Tuliskan prosedur untuk melukis gambarajah tersebut dan lakarkan bentuk gambarajah tersebut.

(60 marks/*markah*)

[b] **The cutting force and thrust force in an orthogonal cutting operation are: F_c= 1470 N and F_t = 1589 N. The rake angle = 5°, the width of the cut = 5.0 mm, the chip thickness before the cut = 0.6, and the chip thickness ratio = 0.38.**

Determine
(i) the shear strength of the work material and
(ii) the coefficient of friction in the operation.

Daya pemotongan dan daya thrust dalam operasi 'orthogonal cutting' adalah Fc= 1470 N and Ft = 1589 N. Sudut sadak = 5°, lebar pemotongan = 5.0 mm, ketebalan cip sebelum pemotongan = 0.6, dan nisbah ketebalan cip = 0.38.

Kirakan

(i) kekuatan ricih bagi benda kerja dan

(ii) pemalar geseran (coefficient of friction) dalam operasi.

(40 marks/*markah*)

Q7. [a] **A drilling operation is to be performed with a 25.4 mm diameter twist drill on a steel work part. The hole is a blind-hole at a depth = 50 mm, and the point angle = 118°. Cutting conditions are: speed = 25 m/min, feed = 0.25 mm/rev.**

Determine:

(a) the cutting time to complete the drilling operation, and

(b) metal removal rate during the operation, after the drill bit reaches full diameter.

Operasi penggerudian dilakukan terhadap bahagian logam dengan menggunakan 'twist drill' yang berdiameter 25.4 mm. Lubang ditebuk pada kedalaman = 50 mm, dan sudut titik = 118°. Keadaan pemotongan ialah: halaju = 25 m/min, suapan = 0.25 mm/rev.

Kirakan:

(a) masa pemotongan yang diperlukan untuk operasi penggerudian tersebut, dan

(b) kadar pemotongan logam ketika operasi, setelah penggerudian mencapai diameter sepenuhnya.

(30 marks/*markah*)

[b] **A face milling operation is used to machine 5 mm from the top surface of a rectangular piece of aluminum 400 mm long by 100 mm wide. The cutter has four teeth (cemented carbide inserts) and is 150 mm in diameter. Cutting conditions are: v = 3 m/s, f = 0.27 mm/tooth, and d = 5.0 mm.**

Determine: (a) time to make one pass across the surface, and
(b) metal removal rate during cutting.

Operasi pemilan permukaan digunakan untuk memotong 5 mm daripada permukaan atas bagi aluminium berbentuk segiempat tepat yang berukuran 400 mm panjang dan 100 mm lebar. Pemotong mempunyai empat gigi yang masing-masing berdiameter 150 mm. Keadaan pemotongan ialah: v = 3 m/s, f = 0.27 mm/gigi, and d = 5.0 mm.

Kirakan: *(a) masa yang diperlukan untuk sekali melalui permukaan, dan*
(b) kadar penyingkiran logam ketika pemotongan.

(30 marks/*markah*)

[c] **A turning operation is performed on a piece of steel whose specific energy is 2.8 N-m/mm^3. The cutting speed, feed rate, and depth of cut are 3 m/s, 0.25 mm/rev, and 4 mm respectively. Using the values of density, specific heat of the material, thermal conductivity, and thermal diffusivity which are 7.87 g/cm^3, 0.11 Cal/g-°C., 0.046 J/s-mm-°C., and k/ρC respectively, calculate:**

i) the mean temperature rise.

ii) if it's mechanical efficiency = 90%, how much power will the lathe draw in performing this operation

Use 1 cal = 4.186 J, and assume ambient temperature = 20°C,

Suatu operasi pelarikan dijalankan ke atas kepingan logam yang mempunyai tenaga tentu sebesar 2.8 N-m/mm^3. Halaju pemotongan, kadar suapan, dan kedalaman pemotongan berturut turut ialah 3.0 m/s, 0.25 mm/rev, dan 4.0 mm. Dengan menggunakan nilai ketumpatan, nilai tentu haba dari kepingan logam yang dipakai, keberaliran terma, dan keresapan terma berturut turut ialah 7.87 g/cm^3, 0.11 Cal/g-°C., 0.046 J/s-mm-°C., dan k/ρC,
kirakan:

i) anggaran kenaikan suhu pemotongan.

ii) kuasa pelarikan yang diperlukan sekiranya kecekapan mekanikal mencapai 90%.

Guna 1 cal = 4.186 J, dan andaikan suhu persekitaran = 20°C.

(40 marks/*markah*)

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LAMPIRAN

Equations *Rumus-rumus*	
$A = 0.5\ D \tan(90 - (\theta/2))$	$T_m = d/f_r$
$A = [d(D - d)]^{0.5}$	$T_m = (L + A)/f_r$
$A = O = D/2$	$T_m = (L + 2A)/f_r$
$A = O = [w(D - w)]^{0.5}$	$Tm = (t + A)/f_r$
$D_f = D_0 - 2d$	$\Delta T = [(0.4U)/(\rho C)](vt_0/K)^{0.333}$
$f_r = Nf$	$v = (2gh)^{0.5}$ $g = 981\ cm/s^2$ $Q = v_1A_1 = v_2A_2$
$f_r = Nn_tf$	$T_{MF} = V/Q$
$H = \rho V\{C_s(T_m - T_0) + H_f + C_l(T_p - T_m)\}$	$T_{TS} = Cm(V/A)^n$
$N = v/(\pi D)$	$V = \pi D^3/6$ $A = \pi D^2$
$N = v/(\pi D_0)$	$V = \pi D^2H/4$ $A = 2\pi D^2/4 + \pi DL$
$R_{MR} = (\pi D^2f_r)/4$	$V = L^3$
$R_{MR} = vfd$	$A = 6L^2$
$R_{MR} = wdf_r$	$T_m = L/f_r$
$Tm = (\pi D_0L)/(fv)$	