First Semester Examination
2019/2020 Academic Session

December 2019 / January 2020

EPP322 – Advanced Manufacturing Process
[Proses Pembuatan Termaju]

Duration : 3 hours
Masa : 3 jam

Please check that this examination paper consists of SEVEN [7] printed pages before you begin the examination.

[Sila pastikan bahawa kertas soalan ini mengandungi TUJUH [7] mukasurat bercetak sebelum anda memulakan peperiksaan.]

INSTRUCTIONS : Answer **ALL FIVE [5]** questions.
*[**ARAHAN** : Jawab **SEMUA LIMA [5]** soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

1. [a] Define thermoset and thermoplastic material. Differentiate between thermoset and thermoplastic, give THREE (3) differences.

Definisikan bahan termoset dan termoplastik. Bezakan antara termoset dan termoplastik, berikan TIGA (3) perbezaan.

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

[b] PLASTICO Sdn. Bhd. is a company specializing in production of plastic products ranging from small size components to large household product such as water tank up to 500 litres capacity. The company needs to increase production and at the same time maintain lower cost of production. Select the appropriate process for production of (i) precise plastic screw and (ii) 500 litre water tank. Justify your choice.

PLASTICO Sdn. Bhd. merupakan sebuah syarikat yang mengkhusus dalam pengeluaran produk plastik dari komponen yang bersaiz kecil sehingga produk rumah yang bersaiz besar seperti tangka air sebesar 500 liter kapasiti. Syarikat ini perlu meningkatkan pengeluaran dan pada masa sama mengekalkan kos pengeluaran yang rendah. Pilih proses pengeluaran yang sesuai untuk pengeluaran (i) skru plastik jitu dan (ii) tangki air 500 liter. Justifikasikan pilihan anda.

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

[c] Malaysia is still dependent on manufacturing based economy, but must adapt to new competitive environment in a highly connected world. Sustainable manufacturing will the edge for the country. Give your justification why sustainable manufacturing should be adopted by Malaysia in facing global competition.

Malaysia masih bergantung terhadap ekonomi berasaskan pembuatan tetapi mesti disesuaikan dengan persekitaran baru yang kompetitif dalam dunia yang amat berhubung-kait. Pembuatan lestari akan memberikan kelebihan kepada negara. Berikan justifikasi kenapa pembuatan lestari sepatutnya diguna pakai oleh Malaysia dalam menghadapi persaingan global.

(40 marks/*markah***)**

2. [a] Powder metallurgy has some economic benefits as compared with casting and machining technique for metal component production. Make a comparison between powder metallurgy and casting method and highlight the economic benefits of powder metallurgy.

Metalurgi serbuk mempunyai faedah ekonomi berbanding teknik penuangan dan pemesinan untuk penghasilan komponen logam. Bezakan antara metalurgi serbuk dan kaedah penuangan dan tonjolkan faedah ekonomi metalurgi serbuk.

(40 marks/*markah*)

[b] A green compact of Aluminum 6061-T6 with dimension length, L = 10 mm, width, W = 10 mm and height, H = 10 mm and porosity of 10% was obtained by room temperature pressing of fine aluminum metal powder. The compact is then sintered at 500 °C for 2 hours to consolidate into solid metal cube. The sintered metal cube has density equal to 96% its theoretical density (density of Aluminum, ρ_{Al} = 2.7 g/cm^3) and shrinkage during sintering is linear. Calculate the following:

Satu mampatan hijau Aluminum 6061-T6 dengan ukuran panjang, L = 10 mm, lebar, W = 10 mm dan ketinggian, H = 10 mm dan keliangan 10% diperolehi selepas proses mampatan serbuk halus logam aluminum pada suhu bilik. Mampatan tersebut kemudiannya disinter pada 500 °C selama 2 jam untuk memadatkannya kepada kiub logam aluminum. Kiub logam tersinter tersebut mempunyai kepadatan bersamaan 96% kepadatan teorinya (kepadatan Aluminum, ρ_{Al} = 2.7 g/cm^3) dan pengecutan semasa pensinteran adalah linear. Kirakan yang berikut:

(i) volume of the cubic green compact
isipadu kiub mampatan tersebut

(ii) mass of aluminum powder used to make the cube
jisim serbuk aluminum yang digunakan untuk menghasilkan kiub tersebut

(iii) final mass of the Aluminum cube after sintering
jisim akhir kiub aluminum tersebut selepas pensinteran

(iv) final volume of the Aluminum cube after sintering
isipadu akhir kiub aluminum selepas pensinteran

(60 marks/*markah*)

3. [a] Component failure in high speed machinery often associated with tiny cracks which propagate into larger cracks. Surface treatment of component may be used in order to minimize the risk of premature failure. Explain and justify an appropriate treatment method that can be used to treat the component.

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Kegagalan komponen dalam mesin berkelajuan tinggi selalunya berkaitan dengan rekahan halus yang merebak kepada rekahan besar. Rawatan permukaan komponen boleh digunakan untuk mengurangkan risiko kegagalan pramatang. Terangkan dan justifikasikan kaedah rawatan yang sesuai untuk merawat komponen tersebut.

(40 marks/*markah***)**

[b] Ring compression test was conducted to determine the coefficient of friction of a steel ring. The steel ring has initial and final dimension as given below:

Ujian mampatan gelung dilakukan untuk menentukan pekali geseran satu gelung besi. Gelung besi tersebut mempunyai dimensi asal dan dimensi akhir seperti diberikan di bawah:

Initial OD_o = 19 mm; Final OD_f = 31.15 mm
Initial ID_o = 9.5 mm; Final ID_f = 7.6 mm
Initial Height, H_o = 0.64 mm; Final Height, H_f = 0.448 mm

Based on Figure 3[b] below, determine the coefficient of friction of the steel ring.

Berdasarkan Rajah 3[b] di bawah, tentukan pekali geseran gelung besi tersebut.

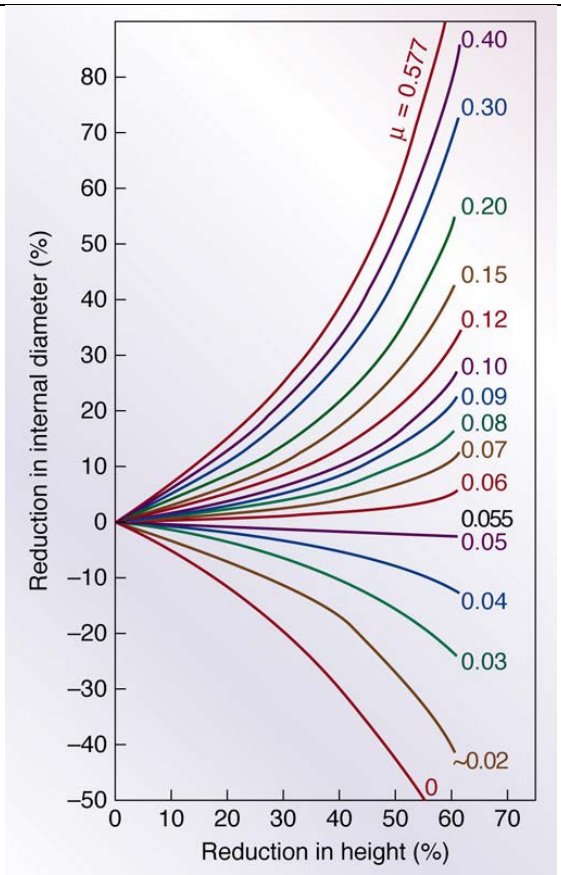

Figure 3[b]: Friction coefficient chart
Rajah 3[b]: Carta pekali geseran

(40 marks/*markah***)**

[c] Calculate the plating thickness in electroplating process of a (10 mm length x 10 mm width x 10 mm height) solid-metal cube using current of 5 A, and plating time of 0.5 hours. Assume that c = 0.08.

Kira ketebalan saduran dalam proses elektrosaduran silinder logam (10 mm panjang x 10 mm lebar x 10 mm tinggi) menggunakan arus 5 A dan masa saduran 0.5 jam. Andaikan pemalar c = 0.08

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

4. [a] Describe the difference between n-type and p-type dopant in the context of semiconductor manufacturing.

Terangkan perbezaan antara n-jenis dan p-jenis dopant dalam konteks pembuatan semikonduktor.

(20 marks/*markah*)

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[b] State ONE (1) material used as a selective oxidation material and mention its significance in semiconductor manufacturing?

Namakan SATU (1) bahan yang digunakan sebagai bahan pengoksidaan terpilih dan nyatakan kepentingannya dalam pembuatan semikonduktor?

(20 marks/*markah*)

[c] Fabrication of microelectronic devices requires series of processes. Summarize the important steps beginning with wafer preparation until a microelectronic device is obtained.

Fabrikasi peranti mikroelektronik memerlukan beberapa siri proses. Ringkaskan langkah penting bermula dengan penyediaan wafer sehinggalah satu peranti mikroelektronik diperolehi.

(40 marks/*markah***)**

[d] Explain the difference between die, chip and wafer in context of microelectronics.

Jelaskan perbezaan antara dai, cip dan wafer dari konteks mikroelektronik.

(20 marks/*markah*)

5. [a] The MEMS devices are applicable to macroscale machine elements, which of the following parts can be manufactured using micro-manufacturing process, and why?

Peranti MEMS boleh digunakan untuk elemen mesin makro. Manakah antara komponen mesin yang berikut boleh dihasilkan menggunakan proses pembuatan mikro, dan mengapa?

(i) hinge
engsel

(ii) spur gear
gear spur

(iii) ball bearing
Galas bebola

(iv) bevel gear
gear serong

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(v) worm gear
gear cacing

(25 marks/*markah*)

[b] Describe the significance of the planarization and chemical−mechanical polishing (CMP) in wafer industry.

Terangkan kepentingan planarization & polishing kimia (CMP) dalam industri wafer.

(20 marks/*markah*)

[c] Figure 5[c] shows a suspended cantilever structure on top an n-type Si substrate. The structure was constructed by surface micromachining. Describe the prior steps before this structure is produced using sketches.

Rajah 5[c] menunjukkan satu struktur rasuk di atas substrat Si jenis n. Struktur tersebut telah dihasilkan menggunakan pemesinan mikro permukaan. Terangkan langkah pemesinan utama sebelum struktur ini dihasilkan mengunakan lakaran.

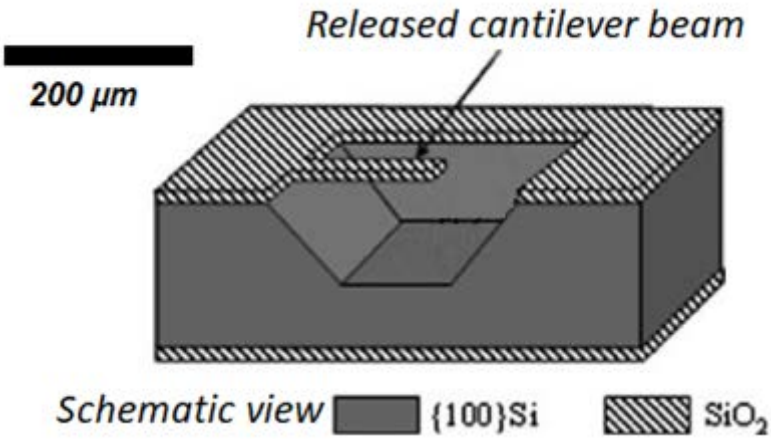

Figure 5[c]
Rajah 5[c]

(55 marks/marks)

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