Second Semester Examination
2017/2018 Academic Session

May/June 2018

EBP 412/3 – Speciality Engineering Polymer
[Polimer Kejuruteraan Khusus]

Duration : 3 hours
[Masa : 3 jam]

Please ensure that this examination paper contains ELEVEN printed pages before you begin the examination.
[Sila pastikan bahawa kertas peperiksaan ini mengandungi SEBELAS muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]

This paper consists of SEVEN questions. TWO questions in PART A, THREE questions in PART B and TWO questions in PART C.
[Kertas soalan ini mengandungi TUJUH soalan. DUA soalan di BAHAGIAN A,, TIGA soalan di BAHAGIAN B dan DUA soalan di BAHAGIAN C..]

Instruction: Answer **FIVE** questions. Answer **ALL** questions from PART A and **TWO** questions from PART B and **ONE** questions in PART C. If a candidate answers more than five questions only the first five questions answered in the answer script would be examined.
*[**Arahan**: Jawab **LIMA** soalan. Jawab **SEMUA** soalan dari BAHAGIAN A, **DUA** soalan dari BAHAGIAN B dan **SATU** soalan dari BAHAGIAN C. Jika calon menjawab lebih daripada lima soalan hanya lima soalan pertama mengikut susunan dalam skrip jawapan akan diberi markah.]*

The answers to all questions must start on a new page.
[Mulakan jawapan anda untuk semua soalan pada muka surat yang baru.]

You may answer a question either in Bahasa Malaysia or in English.
[Anda dibenarkan menjawab soalan sama ada dalam Bahasa Malaysia atau Bahasa Inggeris.]

In the event of any discrepancies in the examination questions, the English version shall be used.
[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah digunapakai.]

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PART A / *BAHAGIAN A*

1. (a). Describe three structural components of a crystalline polymers and how each of them contributes to the properties of the liquid crystal.

Terangkan tiga komponen dalam struktur polimer cecair hablur serta bagaimana setiap satunya menyumbang kepada sifat cecair hablur?

(40 marks/*markah*)

(b). One of the important characteristic of a material to be used in semiconductor packaging is low dielectric constant.

(i). Explain why low dielectric constant is very important for the application.

(ii). Suggest a method to reduce dielectric constant of polymer P (Figure 1). Explain your answer.

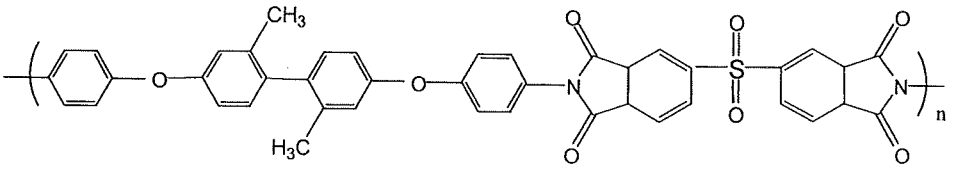


Figure 1: Chemical structure of polymer P

Rajah 1: Struktur kimia polimer P

Salah satu kriteria penting untuk bahan yang digunakan dalam pembungkusan semikonduktor ialah pemalar dielektrik yang rendah.

(i). Jelaskan mengapa pemalar dielektrik yang rendah penting dalam aplikasi tersebut.

(ii). Cadangkan satu kaedah untuk mengurangkan pemalar dielektrik untuk polimer P (Rajah 1). Jelaskan jawapan anda.

(30 marks/*markah*)

(c). An underfill plays a very important role in flip chip technology. Name the polymer normally used as an "underfill". Describe the functions of an underfill in the application.

"underfill" memainkan peranan yang amat penting dalam teknologi serpihan flip. Namakan polimer yang selalunya digunakan sebagai "underfill". Terangkan kegunaan "underfill" dalam aplikasi tersebut.

(30 marks/*markah*)

2. (a). Explain what is biopolymer and its importance in tissue engineering applications.

Jelaskan apakah biopolimer dan kepentingannya dalam aplikasi kejuruteraan tisu.

(20 marks/*markah*)

(b). Describe briefly the differences between microparticles and microspheres. Suggest what kind of processing and product that can be obtained from either microparticles or microspheres for drug delivery system.

Jelaskan secara ringkas apakah perbezaan antara mikropartikal dan mikrosfera. Berikan cadangan anda berkenaan pemprosesan dan produk yang dapat dihasilkan daripada mikropartikal atau mikrosfera dalam sistem penghantaran ubatan.

(50 marks/*markah*)

(c). There are two types of polymeric hydrogels namely physical and chemical cross-linked. Give examples for both hydrogels and describe how they are prepared. Discuss the advantages and disadvantages for each type of polymeric hydrogels.

Terdapat dua jenis polimer iaitu sambung-silang fizikal dan kimia. Berikan contoh dan jelaskan bagaimana ia boleh dihasilkan. Bincangkan kelebihan dan kekurangan kedua-dua jenis polimer hidrogel tersebut.

(30 marks/*markah*)

PART B / *BAHAGIAN B*

3. (a). Responsive polymers are envisioned to be very interesting for controlled release and smart systems. The underlying principle of responsiveness can be described by the polymer changes to the stimuli. Describe the polymer conformation in respond to pH, temperature and light.

Polimer responsif dijangkakan menjadi menarik untuk sistem penghantaran terkawal dan pintar. Ini adalah berdasarkan keupayaannya untuk bertindakbalas atau berubah, bagi setiap stimuli. Jelaskan konformasi polimer berdasarkan respon kepada pH, suhu dan cahaya.

(40 marks/*markah*)

(b). In developing drug delivery devices, several criteria need to be fullfilled such as controlled drug release and biodegradable materials. Such properties will specifically affect the final performance of the drug delivery devices.

Dalam pembangunan peranti penghantaran ubatan, beberapa kriteria perlu dipenuhi sebagai contoh penghantaran ubatan yang terkawal dan bahan yang biodegradasi. Sifat- sifat yang dinyatakan akan memberi kesan kepada prestasi akhir peranti penghantaran ubatan tersebut.

(i). Give two types of biodegradable polymers used in drug delivery system

Berikan dua jenis polimer terbiodegradasi yang digunakan dalam sistem penghantaran ubatan

(ii). Propose two most appropriate methods to produce a biodegradable with controlled released drug delivery device

Cadangkan dua kaedah yang sesuai bagi menghasilkan peranti penghantaran ubatan yang terbiodegradasi dengan penghantaran ubatan yang terkawal

(30 marks/*markah*)

(c). With the aid of illustration, discuss two types of processing techniques to fabricate porous polymeric scaffold. Discuss advantages and disadvantages of each method

Dengan bantuan illustrasi, bincangkan dua jenis teknik pemprosesan untuk menghasilkan perancah polimer yang berongga. Bincangkan kelebihan dan kekurangan bagi setiap kaedah.

(30 marks/*markah*)

4. (a). Fluoropolymer coatings are ideal for pharmaceutical and biopharmaceutical processing equipment because of their excellent chemical and thermal resistance. Explain FOUR key properties for the mentioned applications.

Salutan fluropolimer adalah ideal bagi alatan pemprosesan farmaseutikal dan biofarmasuetikal kerana ia mempunyai rintangan kepada bahan kimia dan haba yang sangat baik. Jelaskan EMPAT sifat-sifat utama bagi kegunaan yang dinyatakan.

(40 marks/*markah*)

(b). Polytetrafluoroethylene (PTFE), has excellent thermal property (T_m = 327 °C) but low creep-resistance. A fluorinated ethylene propylene (FEP) copolymer, which is a copolymer of tetrafluoroethylene and hexafluoro-propylene has good creep –resistance but poor thermal property (Tm = 200 °).

Politetrafluoroetilena (PTFE), mempamerkan kestabilan terma yang baik (Tm = 327 °C) tetapi rintangan krip yang lemah. Kopolimer etilen-propilena terflurin (FEP), yang merupakan kopolimer tetrafluoroetilena dan heksafluoro-propilena mempunyai rintangn krip yang tinggi dengan kestabilan terma yang rendah (Tm = 200 °).

(i). Suggest reasons for their different thermal property
Cadangkan sebab-sebab bagi perbezaan sifat terma antara dua fluropolimer ini.

(ii). Suggest suitable applications and their properties for both fluoropolymers
Cadangkan aplikasi yang sesuai dan sifat-sifat bagi kedua-dua fluropolimer ini .

(30 marks/*markah*)

(c). Fluoropolymers are divided into two classes of perfluorinated and partially fluorinated polymers. Write a short essay on the two classes of fluoropolymers based on their chemical structures, properties and applications.

Fluropolimer dibahagikan kepada dua kelas poliperflorina dan sebahagiannya florina. Tuliskan esei ringkas pada dua kelas fluropolimer berdasarkan struktur, sifat dan aplikasi kimia mereka.

(30 marks/*markah*)

5. (a). Polymeric biomaterials consist of various types of polymers including synthetic and naturally derived materials. Describe the advantages of synthetic biopolymers over naturally derived biopolymers.

Biobahan berasaskan polimer terdiri daripada pelbagai jenis polimer termasuklah biopolimer sintetik dan biopolimer berasaskan bahan semulajadi. Jelaskan kelebihan biopolimer sintetik berbanding biopolimer berasaskan bahan semulajadi.

(10 marks/*markah*)

(b). Write short note on the selection of biopolymers, chemical structures, properties and applications for the following fields :

Tulis nota ringkas bagi pemilihan biopolimer, struktur kimia, sifat-sifat dan kegunaan bagi bidang-bidang berikut :

(i). Dental / *Pergigian*

(ii). Orthopedic / *Ortopedik*

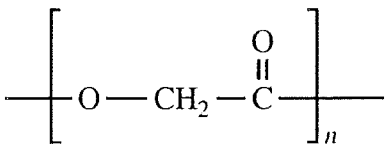
(iii). Drug delivery systems / *Sistem penghantaran ubatan*

(60 marks/*markah*)

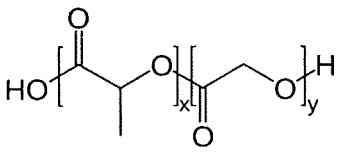
(c). Among these three biopolymers (Figure 2), suggest the appropriate candidate for the fabrication of scaffold for cartilage applications. Discuss reasons why that polymer was chosen.

Antara ketiga-tiga biopolimer (Rajah 2), cadangkan calon biopolimer yang paling sesuai bagi penghasilkan perancah untuk kegunaan tulang rawan. Bincangkan sebab-sebab biopolimer tersebut dipilih.

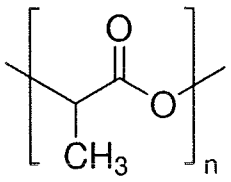
(30 marks/*markah*)



(a)



(b)



(c)

Figure 2: Polyester biopolymers (a) Poly(glycolic acid) (PGA), (b) poly(lactic-co-glycolic acid) (PLGA) and (c) poly(lactic acid) (PLA)

Rajah 2: Poliester biopolimer (a) Poli(glikolik asid) (PGA), (b) poli(laktik-ko-glikolik asid) (PLGA) dan (c) poli(laktik asid)(PLA)

PART C / *BAHAGIAN C*

6. (a). Vectra polyester is an example of thermotropic liquid crystalline polymers (LCP). What is thermotropic LCP? Explain the synthesis of Vectra.

Poliester Vectra adalah satu contoh polimer termotropik. Apakah termotropik LCP? Jelaskan sintesis Vectra.

(40 marks/*markah*)

(b) The following liquid crystalline polymer (Figure 3) is very intractable to processing due to its high melting point. Suggest two methods to overcome this problem.

Polimer cecair hablur berikut (Rajah 3) sukar diproses kerana suhu leburnya amat tinggi. Cadangkan dua kaedah bagi mengatasi masalah ini.

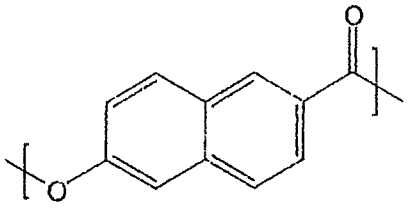


Figure 3: Structure of liquid crystal polymer

Rajah 3: Struktur polimer kristal

(20 marks/*markah*)

(c). Kevlar is one of the most widely used LCP due to its exceptional strength, heat and flame resistance. Discuss how Kevlar is synthesized and explain what makes Kevlar a very strong polymer.

Kevlar adalah salah satu LCP yang paling banyak digunakan kerana kekuatan yang luar biasa, dan rintangan terhadap haba dan api. Bincangkan bagaimana Kevlar dihasilkan dan jelaskan apakah yang menjadikan Kevlar sangat kuat.

(40 marks/*markah*)

7. (a). Describe steps involve in photolithographic techniques during integrated circuit fabrication.

Perihalkan langkah-langkah yang terlibat dalam teknik-teknik fotolitografi semasa pembuatan litar bersepadu.

(30 marks/*markah*)

(b). What is negative photoresist? Illustrate and give example of the mechanism of negative photoresist

Apakah yang dimaksudkan dengan fotorintang negatif? Gambarkan dan berikan contoh mekanisme fotorintang negatif.

(40 marks/*markah*)

(c). Table 1 shows type of photoresists that can be applied at various wavelength during photolithographic process

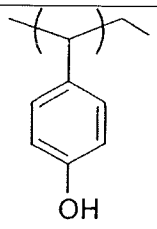
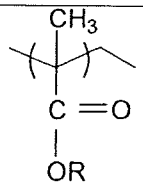
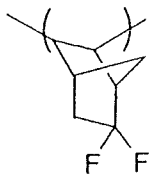
(i). What is the effect of reducing the wavelength of radiation during this process on the Integrated Circuit (IC) fabrication?

(ii). Why the polyhydroxystyrene (A) is not used at a radiation below 248 nm?

(iii). What is the effect of fluorine in photoresist C during photolitographic process?

Table 1: Different photosists used at different wavelengths

Jadual 1: Fotorintang berbeza yang digunakan pada jarak gelombang berbeza

	A	B	C
Photoresist / Fotorintang			
Wavelength / jarak gelombang (nm)	248	193	157

Jadual 1 menunjukkan fotorintang yang digunakan pada pelbagai jarak gelombang pancaran semasa proses fotolitografi.

(i). Apakah kesan pengurangan jarak gelombang sinaran dalam proses ini semasa fabrikasi Litar Tersepadu (IC)?

(ii). Mengapakah polihidroksistirena (A) tidak digunakan pada sinaran kurang dari 248 nm?

(iii). Apakah kesan unsur florin dalam fotorintang C semasa proses fotolitografi?

(30 marks/*markah*)

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