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UNIVERSITI SAINS MALAYSIA

First Semester Examination  
2009/2010 Academic Session

November 2009

**IBK 201 – Fundamentals of Bioprocess Technology**  
*[Asas Teknologi Bioproses]*

Duration: 3 hours  
*[Masa: 3 jam]*

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Please check that this examination paper consists of FIVE pages of printed material before you begin the examination.

*[Sila pastikan bahawa kertas peperiksaan ini mengandungi LIMA muka surat yang bercetak sebelum anda memulakan peperiksaan ini.]*

**Instructions:** Answer **FIVE** (5) questions. You may answer the questions either in Bahasa Malaysia or in English.

***[Arahan:*** Jawab **LIMA** (5) soalan. Anda dibenarkan menjawab soalan sama ada [untuk KBI] dalam Bahasa Malaysia atau Bahasa Inggeris.]

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. Answer all parts of this question
  - (a) Define bioprocess technology (5 marks)
  - (b) Describe the application advantages of bioprocessing of crude oil (5 marks)
  - (c) Briefly discuss the advantages and disadvantages of chemically defined and complex media (10 marks)
  
2. Answer both parts of this question
  - (a) Briefly compare prokaryotes with eukaryotes in terms of internal organelle structures and functions. (10 marks)
  - (b) Briefly describe distinct features of actinomycetes and their important products. (10 marks)
  
3. A strain of mold was grown in a batch culture on glucose and the following data were obtained (Table 1)
  - (a) Plot a semi-log graph of growth against incubation time
  - (b) Calculate the maximum growth rate
  - (c) Calculate the substrate yield
  - (d) What is the expected maximum cell concentration if 150 g of glucose was used with the same size inoculum?

Table 1: Growth of mold on glucose over a fermentation period

Time (h)	Cell concentration (g/L)	Glucose concentration (g/L)
0	1.25	100
9	2.45	97
16	5.1	90.4
23	10.5	76.9
30	22	48.1
34	33	20.6

(20 marks)

4. Describe the factors that should be considered while choosing the cultivation system (batch or continuous flow stirred tank reactor).  
(20 marks)
5. Answer all parts of this question
- (a) List **five (5)** parameters and their measuring devices for monitoring and control of fermentation in a bioreactor.  
(5 marks)
- (b) Large-scale bioreactor places heavy demands on processes to sterilize fluids and gases entering the bioreactor. Discuss on the choice of sterilization methods to fulfill these demands.  
(15 marks)
6. Separation of insoluble products such as biomass, insoluble particles and macromolecules from the fermentation broth can be achieved through filtration, centrifugation, and coagulation and flocculation. Explain the principles and selection criteria of each method.  
(20 marks)
7. Using biological waste treatment as an example of the industrial utilization of mixed cultures, answer the following questions:
- (a) Classify waste materials generated in a society  
(b) Classify the treatment methods  
(c) Discuss the operational steps of waste treatment operation employing biological treatment  
(d) List the the types of aerobic reactor for this treatment  
(20 marks)

1. Jawab semua bahagian soalan ini

(a) Takrifkan teknologi bioproses

(5 markah)

(b) Jelaskan kebaikan penggunaan biopemprosesan minyak kasar

(5 markah)

(c) Bincangkan secara ringkas kebaikan dan kelemahan medium tertakrif kimia dan medium kompleks

(10 markah)

2. Jawab kedua-dua bahagian soalan ini

(a) Secara ringkas, bandingkan prokaryot dengan eukaryot berdasarkan struktur dan fungsi organel dalaman.

(10 markah)

(b) Secara ringkas, jelaskan sifat nyata aktinomisit dan produk-produk pentingnya.

(10 markah)

3. Sejenis strain kulapuk ditumbuhkan dalam kultur kelompok mengandungi glukosa dan data berikut diperolehi (Jadual 1)

(a) Plotkan graf semi-log pertumbuhan melawan masa pengeraman

(b) Kirakan kadar pertumbuhan maksimum

(c) Kirakan yil substrat

(d) Apakah kepekatan sel maksimum yang di jangkakan jika 150 g glukosa digunakan untuk saiz inokulum yang sama?

Jadual 1: Pertumbuhan kulapuk menggunakan glukosa sepanjang tempoh fermentasi

Masa (h)	Kepekatan sel (g/L)	Kepekatan glukosa (g/L)
0	1.25	100
9	2.45	97
16	5.1	90.4
23	10.5	76.9
30	22	48.1
34	33	20.6

(20 markah)

4. *Jelaskan faktor-faktor yang perlu dipertimbangkan semasa memilih sistem kultivasi (kelompok atau reaktor tangki teraduk aliran selanjar).*  
(20 markah)
5. *Jawab semua bahagian soalan ini*
- (a) *Senaraikan **lima (5)** parameter dan alatan mengukur untuk memantau dan mengawal fermentasi di dalam bioreaktor.*  
(5 markah)
- (b) *Bioreaktor skala-besar meletakkan tuntutan yang berat terhadap proses pensterilan larutan dan gas yang memasuki bioreaktor. Bincangkan pilihan kaedah-kaedah pensterilan untuk memenuhi tuntutan ini.*  
(15 markah)
6. *Pemisahan produk tidak larut seperti biojisim, partikel tidak larut dan makromolekul daripada kaldu fermentasi boleh dicapai melalui penapisan, pengemparan, dan koagulasi dan flokulasi. Jelaskan prinsip dan kriteria pemilihan setiap kaedah ini.*  
(20 markah)
7. *Menggunakan rawatan sisa secara biologi sebagai contoh penggunaan kultur campuran di industri, jawab soalan berikut:*
- (a) *Kelaskan bahan sisa yang dihasilkan dalam masyarakat*  
(b) *Kelaskan kaedah rawatan*  
(c) *Bincangkan langkah operasi rawatan sisa menggunakan rawatan biologi*  
(d) *Senaraikan jenis reaktor aerobik untuk rawatan ini*  
(20 markah)