UNIVERSITI SAINS MALAYSIA

Second Semester Examination
2010/2011 Academic Session

April/May 2011

IBK 313 - BIOPROCESS INSTRUMENTATION AND CONTROL
[PERALATAN DAN PENGAWALAN BIOPROSES]

Duration: 2 hours
[Masa: 2 jam]

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 **ALL (4)** questions. You may answer the questions either in Bahasa Malaysia or in English.

*[**Arahan**: Jawab **SEMUA (4)** 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].

...2/-

1. An automatic control system is a preset closed-loop control system that requires no operator action. Stability in an automatic control system refers to the ability of a control loop to return a controlled variable to a steady, non-oscillation condition. However, there are three types of oscillations that can occur in a control loop. If a control system fails, the operator must be able to take over and control the process manually.

   (a) Define the terminology used in an automatic control system

   i) Control system
   ii) Control system input
   iii) Control system output
   iv) Open loop control system
   v) Closed loop control system

   (5 marks)

   (b) Explain in detail why we need an automatic control system

   (10 marks)

   (c) Elaborate each of the oscillation that can occur in a control loop. Which type of oscillation is desired in an automatic control system and why?

   (10 marks)

2. Answer all parts in this question.

   (a) Elaborate the principle of pH measurement

   (10 marks)

   (b) Explain in detail how a typical pH electrode works.

   (10 marks)

   (c) Elaborate double junction reference electrode and its application.

   (5 marks)

3. There are many different types of temperature sensors on the market. They can be primarily distinguished based on price, linearity, suitable temperature range, stability, ruggedness and suitability for integration into automated measurement systems. Instruments for measuring temperature can be classified according to the nature of the change in the measurement probe produced by the change of temperature. They have been divided into liquid expansion, gas expansion and solid expansion.

   (a) List out three different types of temperature sensors. List one advantage and one disadvantage of each type of temperature sensor.

   (10 marks)

   (b) Explain the principles of the following expansion.

   i) Liquid expansion (mercury in glass thermometer)
   ii) Gas expansion (Bourdon tube)
   iii) Solid expansion (Bimetal system)

   (15 marks)

4. Answer all parts in this question.

   (a) Discuss in detail the principles of magnetic float level sensor.

   (10 marks)

   (b) Elaborate the level sensors state below.

   i) Ultrasonic level sensors

   (5 marks)

   ii) Optical interface level sensors

   (5 marks)

   iii) Pneumatic level sensors

   (5 marks)

1. *Sistem kawalan automatik adalah sistem kawalan gelung tertutup praset yang tidak memerlukan tindakan pengendali. Kestabilan dalam satu sistem kawalan automatik merujuk kepada keupayaan satu gelung kawalan untuk mengembalikan satu pemboleh ubah terkawal ke keadaan stabil, tanpa keadaan ayunan. Bagaimanapun, terdapat tiga jenis ayunan yang boleh berlaku dalam satu gelung kawalan. Jika satu sistem kawalan gagal, pengendali mesti mampu mengambil alih dan mengawal proses secara manual.*

   (a) *Takrifkan istilah yang diggunakan dalam system kawalan automatik*

   i) *Sistem kawalan*
   ii) *Input sistem kawalan*
   iii) *Output system kawalan*
   iv) *Sistem kawalan gelung terbuka*
   v) *Sistem kawalan gelung tertutup*

   (5 markah)

   (b) *Jelaskan secara terperinci mengapa kamu perlu satu system kawalan automatik*

   (10 markah)

   (c) *Hurai setiap ayunan yang boleh berlaku dalam satu gelung kawalan. Ayunan yang mana jenis diingini dalam satu sistem kawalan automatik dan mengapa?*

   (10 markah)

2. *Jawab semua soalan di bahagian ini.*

   (a) *Huraikan prinsip ukuran pH*

   (10 markah)

   (b) *Jelaskan secara terperinci bagaimana pH elektrod berkerja*

   (10 markah)

   (c) *Huraikan elektrod rujukan persimpangan berganda dan kegunaannya.*

   (5 markah)

3. *Terdapat pelbagai jenis alat pengesan suhu di pasaran. Terutamanya, mereka boleh dibezakan berdasarkan harga, kelinearan, julat suhu sesuai, kestabilan, kelasakkan dan kesesuaian untuk diintegrasi ke dalam automatik sistem ukuran. Alatan untuk mengukur suhu boleh diklasifikasikan mengikut sifat dari perubahan probe ukuran yang dihasilkan oleh perubahan suhu. Mereka telah dibahagikan ke dalam pengembangan cecair, pengembangan gas dan pengembangan pepejal.*

   (a) Senaraikan tiga jenis pengesan suhu. Senaraikan satu kelebihan dan satu kekurangan bagi setiap jenis pengesan suhu tersebut.

   (10 markah)

   (b) Jelaskan prinsip-prinsip pengembangan seperti berikut:

   i) Pengembangan cecair (Merkuri di dalam thermometer kaca)
   ii) Pengembangan gas (Bourdon tube)
   iii) Pengembangan pepejal (Sistem dwilogam)

   (15 markah)

4. *Jawab semua soalan di bahagian ini.*

   (a) Bincangkan secara terperinci prinsip-prinsip pengesan aras apungan magnetik.

   (10 markah)

   (b) Huraikan pengesan-pengesan aras yang dinyatakan di bawah.

   i) Pengesan aras ultrasonik

   (5 markah)

   ii) Pengesan aras antara muka optikal

   (5 markah)

   iii) Pengesan aras pneumatik

   (5 markah)