PART A / *BAHAGIAN A*

(1). (a). Establish what is an open and a close loop system?
Terangkan apakah itu sistem gelung terbuka dan tutup?

(5 marks/*markah*)

(b). Compare between Block Diagram (BD) and Signal Flow Graph (SFG)?

Bandingkan antara Rajah Blok (BD) dan Graf Aliran Isyarat (SFG)?

(10 marks/*markah*)

(c). Define block diagram (BD)?
Jelaskan mengenai gambarajah blok (BD)?

(5 marks/*markah*)

(2). (a). The block diagram of a control system is illustrated in Figure 1. Determine the equivalent transfer function, T(s) = Y(s)/R(s) using:

Gambarajah blok bagi sebuah sistem kawalan ditunjukkan pada Rajah 1. Tentukan fungsi pindah yang setara, T(s) = Y(s)/R(s) dengan menggunakn:

(i). Block diagram rules
Peraturan gambarajah blok

(ii). Mason's gain rule
Peraturan gandaan Mason.

…3/-

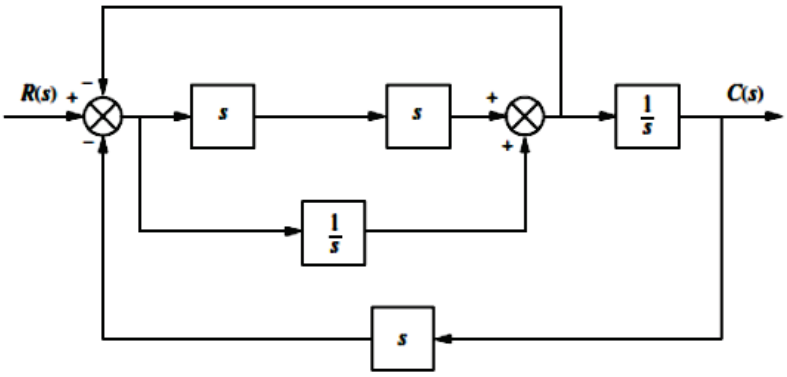

Figure 1: Block diagram of a control system

Rajah 1: Gambarajah blok bagi sebuah system kawalan

(10 marks/*markah)*

(b). A waste stream (dilute acid) is neutralized by adding a base stream of known concentration to a stirred neutralization tank as shown in Figure 2. The concentration and flow rate of the waste acid stream vary unpredictably. The effluent stream pH can be measured but a significant time delay occurs due to the downstream location of pH probe. If the waste treatment system is represented by

$$Y(s) = \frac{2 + c^{-3s}}{(s+2)(s+3)}$$

Suatu aliran buangan (asid cair) akan dineutralkan dengan penambahan suatu aliran asas dengan kepekatan yang diketahui dalam sebuah tangki peneutralan teraduk seperti ditunjukkan dalam Rajah 2. Kepekatan dan kadar aliran buangan tersebut berubah tanpa dijangka. pH aliran buangan tersebut boleh diukur tetapi dengan tempoh tertangguh yang panjang disebabkan kedudukan alat pH yang terletak di hilir. Jika sistem rawatan buangan boleh diwakili dengan

$$Y(s) = \frac{2 + c^{-3s}}{(s+2)(s+3)}$$

…4/-

Solve the inverse Laplace transform of this system. The delayed signal can be represented as y(t-θ) where θ is the time delay and L[y(t-θ)] = $e^{-\theta s}.Y(s)$.

Selesaikan songsangan transformasi Laplace bagi sistem tersebut. Isyarat tertangguh boleh diwakili dengan y(t-θ) di mana θ adalah tempoh tertangguh dan L[y(t-θ)] = $e^{-\theta s}.Y(s)$.

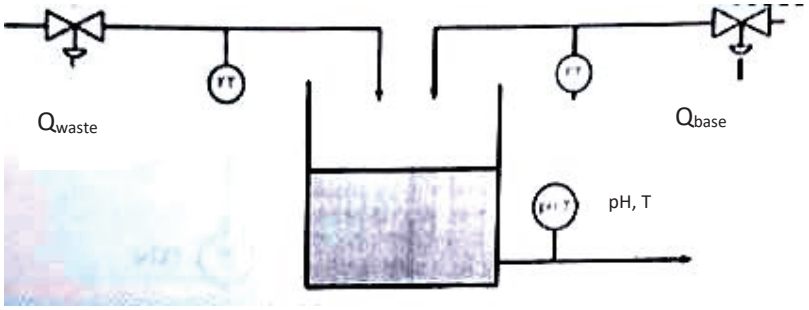

Figure 2 – Waste water treatment tank

Rajah 2- Tangki rawatan buangan air

(10 marks/markah)

(3). (a). (i). Explain the relationship between three (3) main electrical components and its imaginary equivalent.

Terangkan hubungan antara tiga (3) komponen elektrik utama dengan persamaan imaginasi.

(5 marks/*markah)*

(ii). Determine the model of a system (i.e in time domain) in which transfer function is

Tentukan model bagi sebuah sistem (dalam domain masa) dengan fungsi pindah.

…5/-

$$G(s) = \frac{s^2}{(s+1)(s+2)}$$

(5 marks/*markah)*

(iii). Determine the transfer function, G(s)= $V_o(s)$/ $V_i(s)$ for electrical network as shown in Figure 3;

Tentukan fungsi pindah G(s)= $V_o(s)$/ $V_i(s)$ bagi litar elektrik yang ditunjukkan dalam Rajah 3.

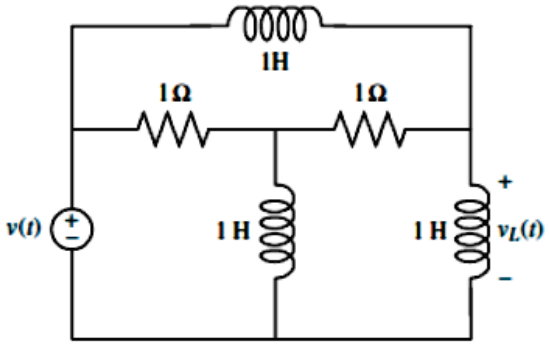

Figure 3 –Electrical network of devices

Rajah 3- Peranti jaringan elektrik

(10 marks/*markah)*

PART B / *BAHAGIAN B*

(4). (a). State the advantages and limitation of algebraic method for determining stability of a system.

Nyatakan kelebihan dan kekurangan kaedah algebra bagi penentuan kestabilan sesuatu sistem.

(4 marks/*markah)*

(b). Given the characteristic equation:

$2S^4 + 8S^3 + 12S^2 + 8S + 2(1 + K) = 0$

Compute the value of K so that the system is stable.

Diberi persamaan cirian:

$2S^4 + 8S^3 + 12S^2 + 8S + 2(1 + K) = 0$

Kirakan nilai untuk K supaya sistem berada dalam keadaan stabil.

(8 marks/*markah)*

(c). Using R-H criterion, analyze how many poles there are on the leftt half plane for the following characteristic equation.

Dengan menggunakan kriteria R-H, analisa berapa bilangan kutub pada satah sebelah kiri bagi persaman cirian berikut.

$$Q(s) = S^6 + 4S^5 + 3S^4 + 2S^3 + S^2 + 4S + 4 = 0$$

(8 marks/*markah)*

(5). (a). Why derivative control is usually augmented by proportional control. Explain.

Kenapa penggunaan kawalan hasil kebezaan selalunya ditambahbaik bersama kawalan berkadaran. Terangkan

(4 marks/*markah)*

(b). A derivative controller has a gain of 10 s.
Suatu pengawal jenis kebezaan mempunyai nilai kenaikan sebanyak 10 s.

(i). Compute the controller output if the controller is subjected to a constant error of 5.

Tentukan nilai keluaran kawalan jika pengawal dikenakan pekali ralat sebanyak 5.

(ii). From the value in part (i), plot graf output versus time. Assume that initial controller output is zero.

Daripada nilai bahagian (i), plot graf keluaran melawan masa. Andaikan keluaran permulaan kawalan adalah sifar.

(10 marks/*markah)*

(c). Derive the mathematical equation for rise time and settling time for first order system.

Terbitkan persamaan matematik bagi masa naik dan masa penetapan untuk sistem tertib pertama.

(6 marks/*markah)*

(6). (a). Sketch and analyze the root locus for the following open loop transfer function.

Lakar dan lakukan analisis terhadap londar punca bagi rangkap pindah gelung terbuka berikut.

(14 marks/*markah)*

$$KGH = \frac{K}{s(s^2 + 6s + 8)}$$

(b). Given the characteristic equation for a system control is $S^3 + 2S^2 + 2S + 13 = 0$. Verify the stability of the system by determine the roots of the characteristic equation.

Diberikan persamaan pencirian bagi suatu sistem kawalan adalah $S^3 + 2S^2 + 2S + 13 = 0$. *Tentusahkan kestabilan sistem ini dengan mencari nilai punca-punca kepada persamaan pencirian tersebut.*

(6 marks/*markah)*

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