



KOLEJ YAYASAN PELAJARAN JOHOR
FINAL EXAMINATION

COURSE NAME : CONTROL SYSTEM
COURSE CODE : DEG 3163
EXAMINATION : OCTOBER 2018
DURATION : 2 HOURS 30 MINUTES

INSTRUCTION TO CANDIDATES

1. This examination paper consists of **FOUR (4) QUESTIONS**. Answer **ALL** questions in the answer booklet provided.
2. Candidates are not allowed to bring any material to examination room except with the permission from the invigilator.
3. Please check to make sure that this examination pack consist of:
 - i. Question Paper
 - ii. Answer Booklet
 - iii. Graph Paper

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO

This examination paper consists of 6 printed pages including front page

This paper contains of **FOUR(4)** questions. Answer **ALL** questions in the Answer Booklet.

Kertas soalan ini mengandungi **EMPAT(4)** soalan. Jawab **SEMUA** soalan di dalam buku jawapan yang disediakan.

QUESTION 1 / SOALAN 1

(a) What is a closed control system and state the characteristics in control system.

Apakah itu sistem kawalan gelung tertutup dan nyatakan kriterianya di dalam sistem kawalan.

(5 Marks / Markah)

(b) Draw the block diagram for a closed loop control system.

Lukiskan rajah blok untuk sistem kawalan gelung tertutup.

(3 Marks / Markah)

(c) Find the transfer function, $G(s) = \frac{V_L(s)}{V(s)}$ for the circuit shown in Figure Q1(c).

Dapatkan rangkap pindah, $G(s) = \frac{V_L(s)}{V(s)}$ bagi litar Rajah Q1(c) di bawah.

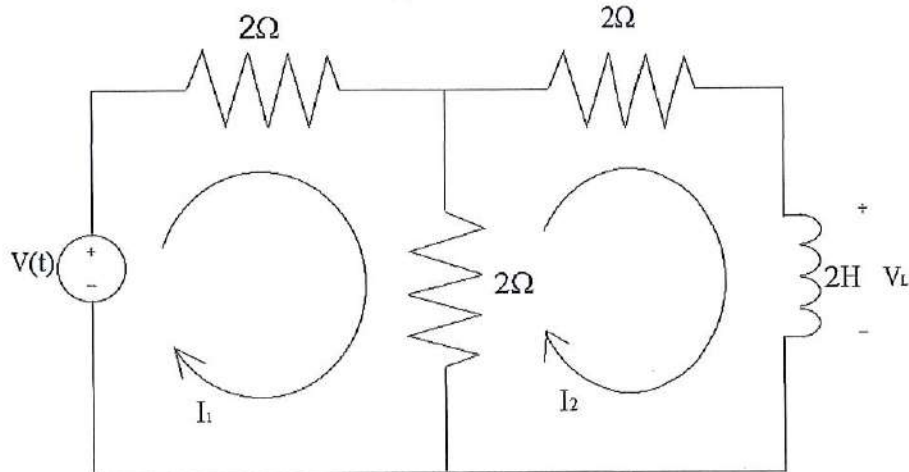


Figure Q1(c)/ Rajah Q1(c)

(10 Marks / Markah)

QUESTION 2 / SOALAN 2

Given the system in Figure Q2(a) below, find J and D to yield 20% percent overshoot and a settling time of 2 seconds for a step input of torque $T(t)$.

Diberi sistem pada Rajah Q2(a) di bawah, cari J dan D untuk menghasilkan 20% peratus lajukan dan masa penginapan pada 2 saat untuk masukan unit daya kilas $T(t)$.

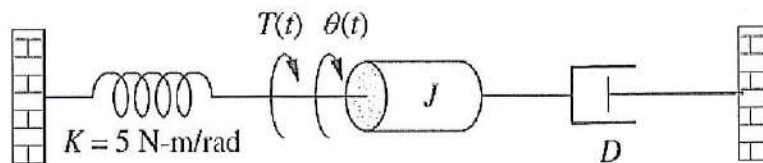


Figure Q2(a) / Rajah Q2(a)

(13 Marks / Markah)

QUESTION 3 / SOALAN 3

(a) Find the transfer function $C(s)/R(s)$ in the figure Q3(a) by using a Mason's Rule formula.

Tentukan rangkap pindah $C(s)/R(s)$ pada rajah Q3(a) dengan menggunakan Aturan Mason.

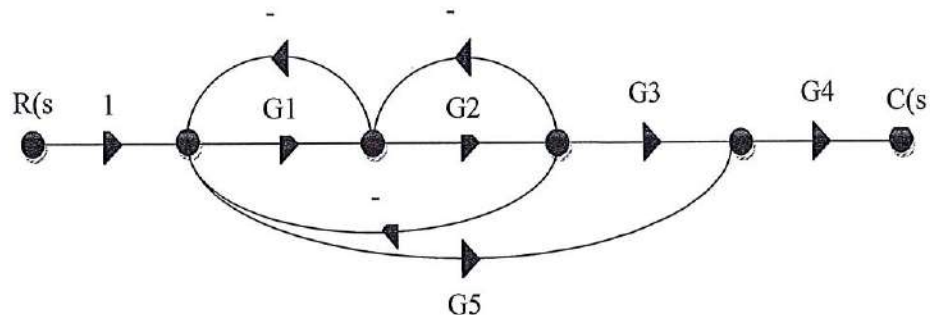


Figure Q3(a) / Rajah Q3(a)

(8 marks / markah)

- (b) Use Routh-Hurwitz stability criterion to determine how many roots with positive real parts for the equation.

Gunakan kriteria kestabilan Routh-Hurwitz untuk menentukan jumlah punca untuk bahagian sebenar positif untuk persamaan ini.

$$s^5 + 10s^4 + 30s^3 + 80s^2 + 344s + 480 = 0$$

(10 Marks / Markah)

- (c) Figure Q3(c) below shows the block diagram of the transfer function $C(s)/R(s)$. Find the stability of the system by using Routh-Hurwitz criterion.

Rajah Q3(c) di bawah menunjukkan rajah blok untuk rangkap pindah $C(s)/R(s)$. Cari kestabilan sistem dengan menggunakan kriteria Routh-Hurwitz.

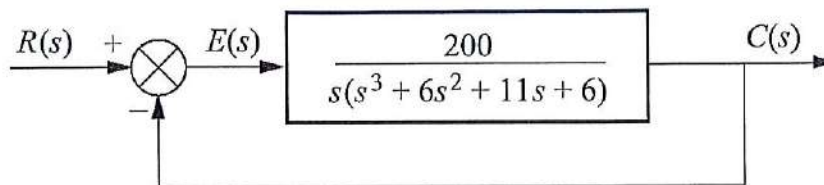


Figure Q3(c) / Rajah Q3(c)

(8 marks / markah)

QUESTION 4 / SOALAN 4

- (a) For the unity feedback control system shown in Figure Q4(a), where K and T are constants. The maximum overshoot (%O.S) for unit step is 10%. Peak time, t_p for the system is 0.75s.

Untuk sistem kawalan suapbalik unit ditunjukkan dalam Rajah Q4(a) dimana K dan T adalah pemalar. Lajakan maksimum bagi sambutan unit langkah ialah 10%. Masa puncak, t_p untuk sistem ialah 0.75s.

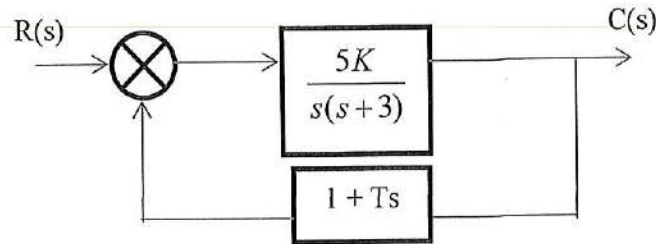


Figure Q4(a) / Rajah Q4(a)

- i) Define the transfer function system, $C(s)/R(s)$ in terms of K and T .
- ii) Express the damping ratio, ξ and natural frequency, ω_n in terms of K and T .
- iii) Specify damping ratio, ξ and natural frequency, ω_n .
- iv) Find the value of K and T .

- i) Ungkapkan rangkap pindah sistem, $C(s)/R(s)$ dalam sebutan K dan T .
- ii) Ungkapkan nisbah redaman, ξ dan frekuensi tabii, ω_n dalam sebutan K dan T .
- iii) Tentukan nisbah redaman, ξ dan frekuensi tabii, ω_n .
- iv) Cari nilai K dan T .

(18 Marks / Markah)

(b) An open loop system with unity feedback has an open loop transfer function $G(s)$ given by :

Satu sistem gelung buka suap balik uniti mempunyai rangkap pindah gelung buka $G(s)$ seperti berikut:

$$G(s) = \frac{K}{s(s+2)(s+10)}$$

If $K = 50$, sketch the Bode magnitude and phase plot using straight line approximation.

Sekiranya $K=50$, lakarkan plot Bode magnitud dan fasa menggunakan penghampiran garis lurus.

- i) Calculate the gain margin and phase margin.
Kirakan jidar gandaan dan jidar fasa.
- ii) State the stability of the unity feedback system.
Nyatakan kestabilan sistem suap balik unit.

[For the magnitude plot, use a scale of 1 unit = 20dB with maximum value 20dB and minimum value -80dB, for the phase plot, use of a scale of 1 unit= 45 o with maximum value = -45° and minimum value = -225°]

[Untuk plot magnitud, gunakan skala 1 unit = 20dB dengan magnitud maksimum 20dB dan magnitud minimum -80dB, untuk fasa, gunakan skala 1 unit = 45 dengan magnitud fasa maksimum -45° dan magnitud fasa minimum = -225°]

(25 Marks / Markah)

END OF QUESTION PAPER / KERTAS SOALAN TAMAT

