



**KOLEJ YAYASAN PELAJARAN JOHOR
ONLINE FINAL EXAMINATION**

COURSE NAME : CONTROL SYSTEMS
COURSE CODE : DKE 2163
EXAMINATION : DECEMBER 2021
DURATION : 2 HOURS 30 MINUTES

**INSTRUCTION TO CANDIDATES/
ARAHAN KEPADA CALON**

1. This examination paper consists of **FOUR (4)** questions. /
*Kertas soalan ini mengandungi **EMPAT (4)** soalan.*
2. Students are allowed to refer to resources such as lecture notes, books, internet or any other relevant resources. /
Pelajar dibenarkan merujuk kepada sumber seperti nota kuliah, buku, internet atau mana-mana sumber yang berkaitan.
3. Answer ALL questions in the answer sheet which is A4 size paper (or other paper with the consent of the relevant lecturer). /
*Jawab **SEMUA** soalan di dalam kertas jawapan iaitu kertas bersaiz A4 (atau lain-lain kertas dengan persetujuan pensyarah berkaitan).*
4. Write your details as follows in the upper left corner for each answer sheet: /
Tulis butiran anda sepertimana berikut di penjuru atas kiri bagi setiap kertas jawapan:
 - i. Student Full Name. / *Nama Penuh Pelajar.*
 - ii. Identification Card (I/C) No. / *No. Kad Pengenalan.*
 - iii. Class Section. / *Seksyen Kelas.*
 - iv. Course Code. / *Kod Kursus.*
 - v. Course Name. / *Nama Kursus.*
 - vi. Lecturer Name. / *Nama Pensyarah.*
5. Each answer sheet must have a page number written at the bottom right corner. /
Setiap helai kertas jawapan mesti ditulis nombor muka surat di penjuru bawah kanan.
6. Answer should be handwritten, neat and clear. /
Jawapan hendaklah ditulis tangan, kemas dan jelas.

**DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO /
JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU**

This examination paper consists of 5 printed pages including front page
Kertas soalan ini mengandungi 5 halaman bercetak termasuk muka hadapan

This examination paper consists of **FOUR (4)** questions. Answer **ALL** the questions in an answer sheet.

Kertas soalan ini mengandungi EMPAT (4) soalan. Jawab SEMUA soalan dalam kertas jawapan.

QUESTION 1/ SOALAN 1

(a) Based on **Figure 1(a)**, label the boxes below with an example of equipment for a closed-loop system.

Berdasarkan Rajah 1(a), label kotak-kotak di bawah dengan contoh peralatan untuk sistem gelung-tertutup.

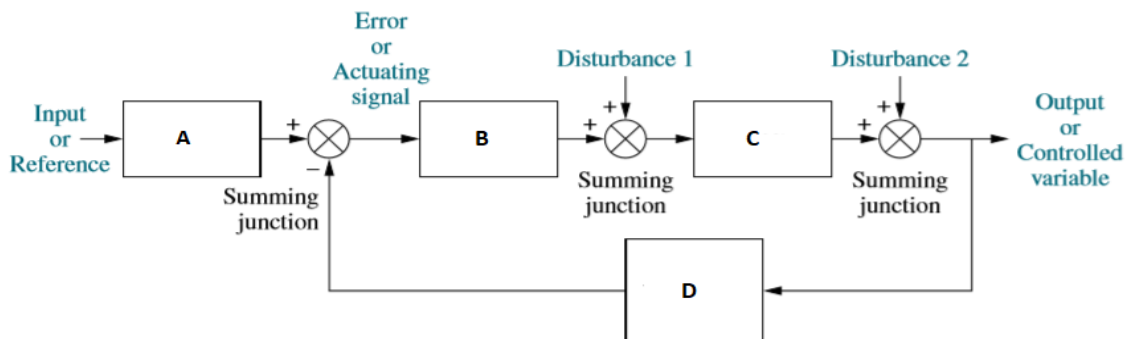


Figure 1(a) / Rajah 1(a)

(8 marks / 8 markah)

(b) There are two mechanical systems for transfer function modelling which are translational and rotational. Find the transfer function, $X(s) / F(s)$, for the system in **Figure 1(b)**. Begin by drawing their free-body diagram.

Terdapat dua sistem mekanikal untuk pemodelan rangkap pindah iaitu translasi dan putaran. Cari rangkap pindah, $X(s) / F(s)$, untuk sistem dalam Rajah 1(b). Bermula dengan melukis rajah jasad-bebas.

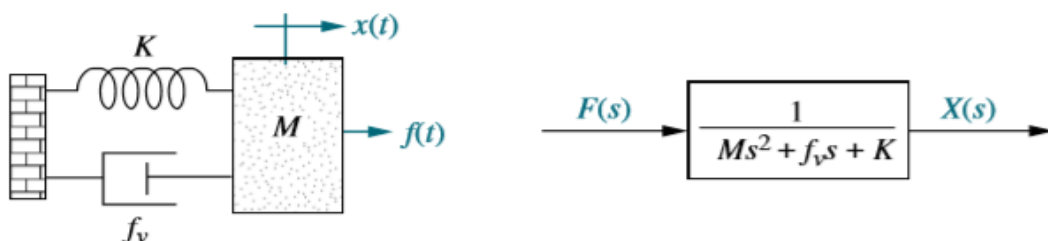


Figure 1(b) / Rajah 1(b)

(10 marks / 10 markah)

QUESTION 2/ SOALAN 2

Show the transfer function, $X_2(s)/F(s)$, for the translational mechanical system of **Figure 2**.

Tunjukkan rangkap pindah, $X_2(s)/F(s)$, bagi sistem mekanikal penterjemah pada **Rajah 2**.

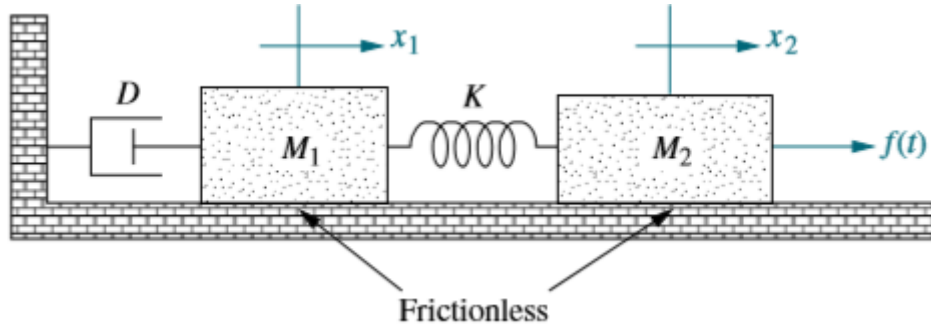


Figure 2 / Rajah 2

(12 marks / 12 markah)

QUESTION 3/ SOALAN 3

(a) Explain **three** (3) topologies of block diagrams in terms of block diagram example and their transfer function, $G_e(s)$.

Terangkan **tiga** (3) bentuk topologi rajah blok pada contoh rajah blok dan rangkap pindah, $G_e(s)$.

(9 marks / 9 markah)

(b) Reduce the system in **Figure 3** to a single transfer function.

Mudahkan sistem dalam **Rajah 3** kepada rangkap pindah tunggal.

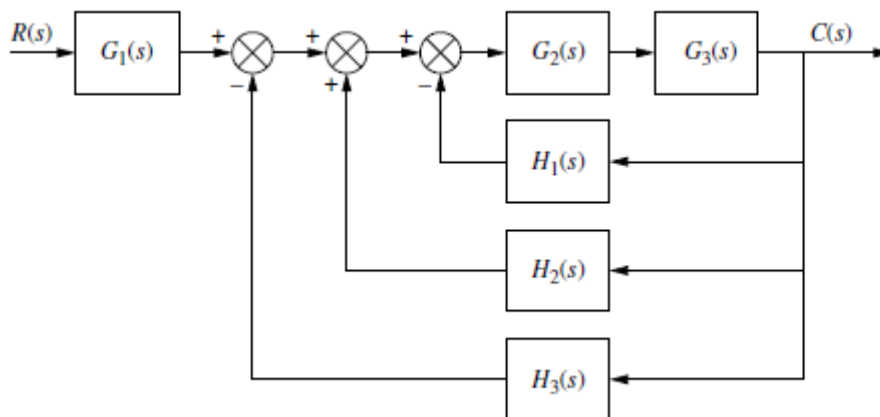


Figure 3 / Rajah 3

(8 marks / 8 markah)

- (c) 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 / 10 markah)

QUESTION 4/ SOALAN 4

- (a) Given the transfer function, $G(s)$ for the control system shown in **Figure 4(a)** below. Referring to **Figure 4(b)**, answer the questions that follows:

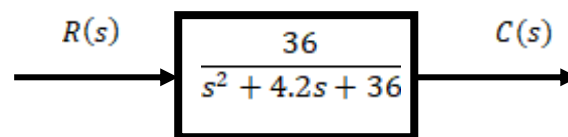


Figure 4(a) / Rajah 4(a)

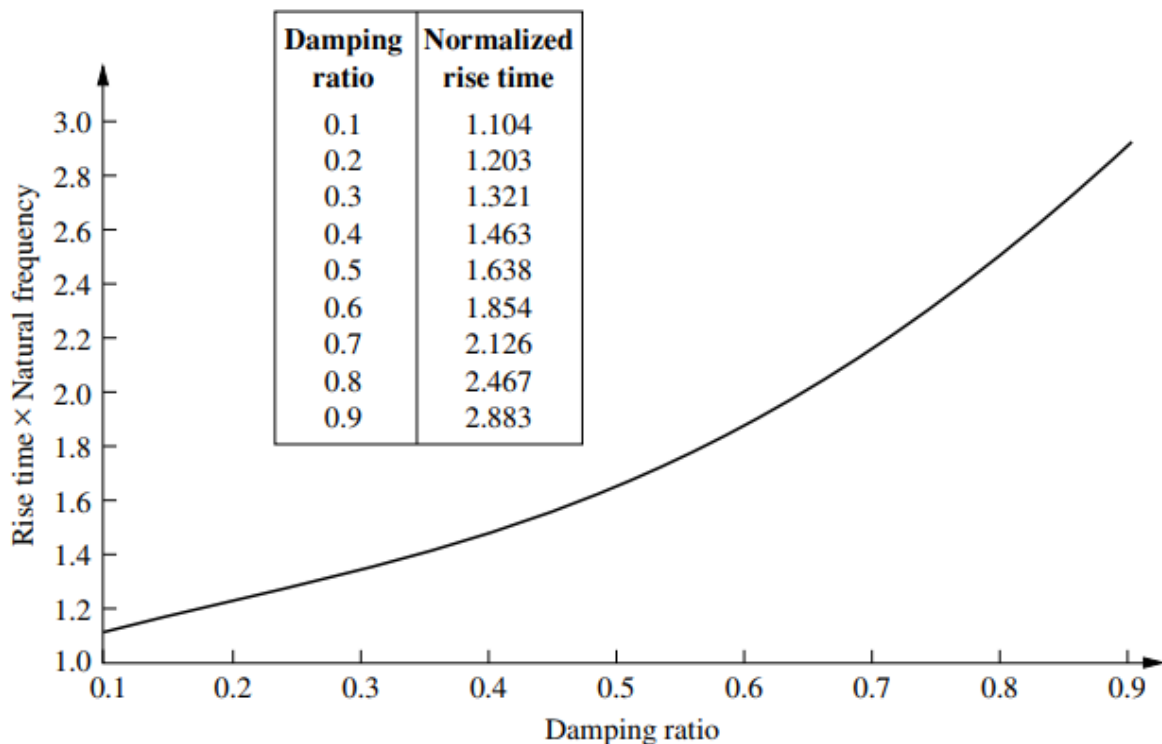


Figure 4(b) / Rajah 4(b)

- i) Shows the damping ratio, ξ and natural frequency, ω_n .
- ii) Determine peak time, T_p , percent overshoot, %OS, settling time, T_s , and rise time, T_r .
- iii) Characterize the nature of the response.
- iv) Draw the response.

(18 marks /18 markah)

Diberi rangkap pindah, $G(s)$ untuk sistem kawalan ditunjukkan dalam **Rajah 4(a)** dibawah.

Merujuk pada **Rajah 4(b)**, sila jawab soalan berikut:

- i) Tunjukkan nisbah redaman, ξ dan frekuensi tabii, ω_n .
- ii) Tentukan masa puncak, T_p , peratus lajukan, %OS, masa selesai, T_s , dan masa menaik, T_r .
- iii) Cirikan sifat tindak balas.
- iv) Lukis tindak balas.

- (b) Solve the transfer function, $C(s)/R(s)$, for the signal-flow graph in **Figure 5**.

Selesaikan Rangkap, $C(s)/R(s)$, untuk graf isyarat –laluan pada **Rajah 5**.

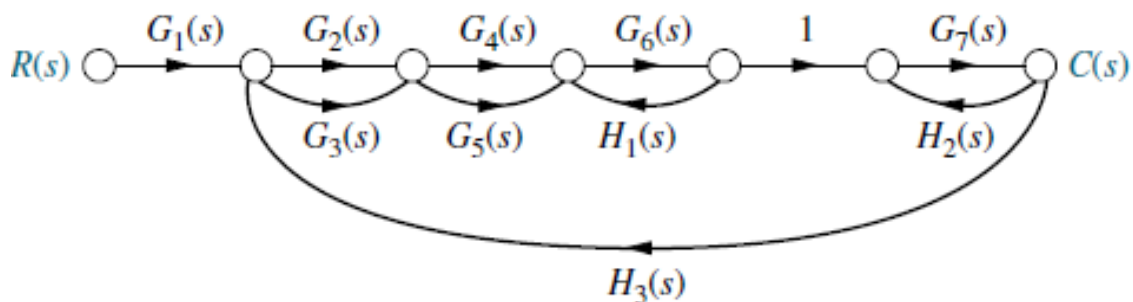


Figure 5 / Rajah 5

(25 marks /25 markah)

[100 MARKS/ 100 MARKAH]

END OF QUESTION PAPER/ KERTAS SOALAN TAMAT