KOLEJ YAYASAN PELAJARAN JOHOR
ONLINE FINAL EXAMINATION

COURSE NAME	:	**CONTROL SYSTEMS**
COURSE CODE	:	**DKE 2163**
EXAMINATION	:	**JUNE 2022**
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 **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.*
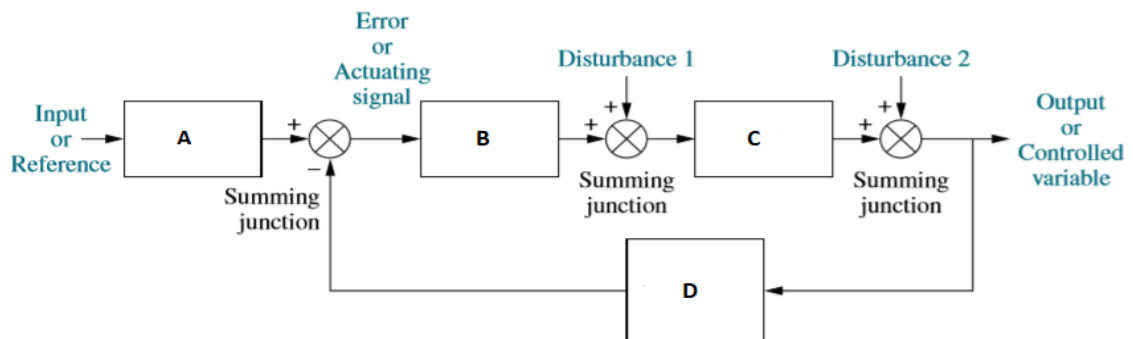

Figure 1(a) / *Rajah 1(a)*

(**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.*
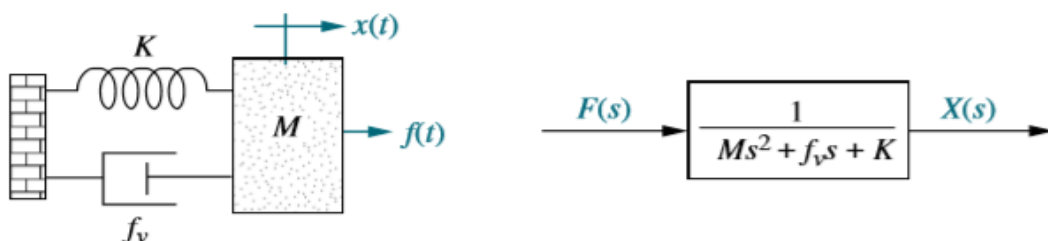

Figure 1(b) */ Rajah 1(b)*

(**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.**

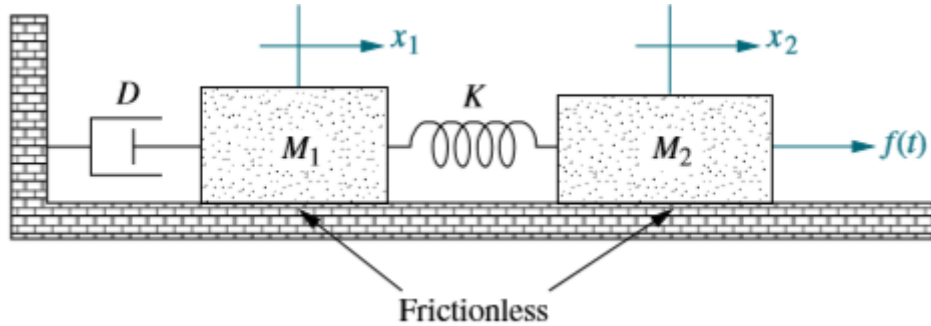*Tunjukkan rangkap pindah, $X_2(s)/F(s)$, bagi sistem mekanikal penterjemah pada **Rajah 2.***

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, Ge(s).

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

(9 marks / 9 markah)

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

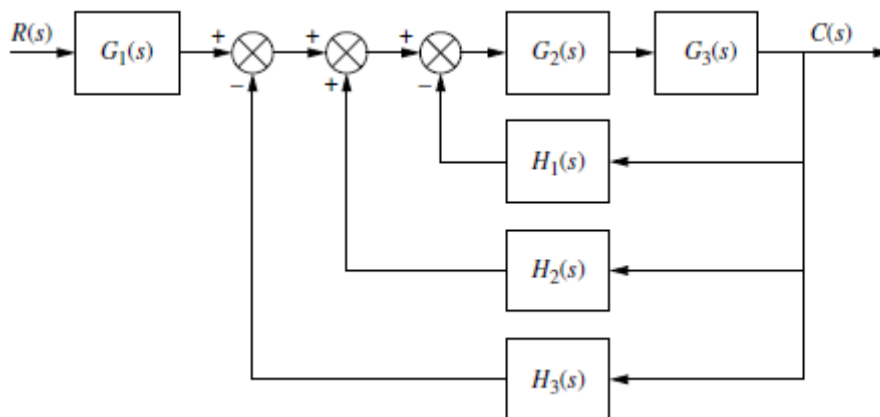*Mudahkan sistem dalam **Rajah 3** kepada rangkap pindah tunggal.*

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:
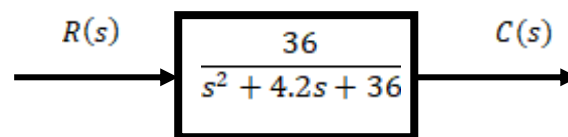

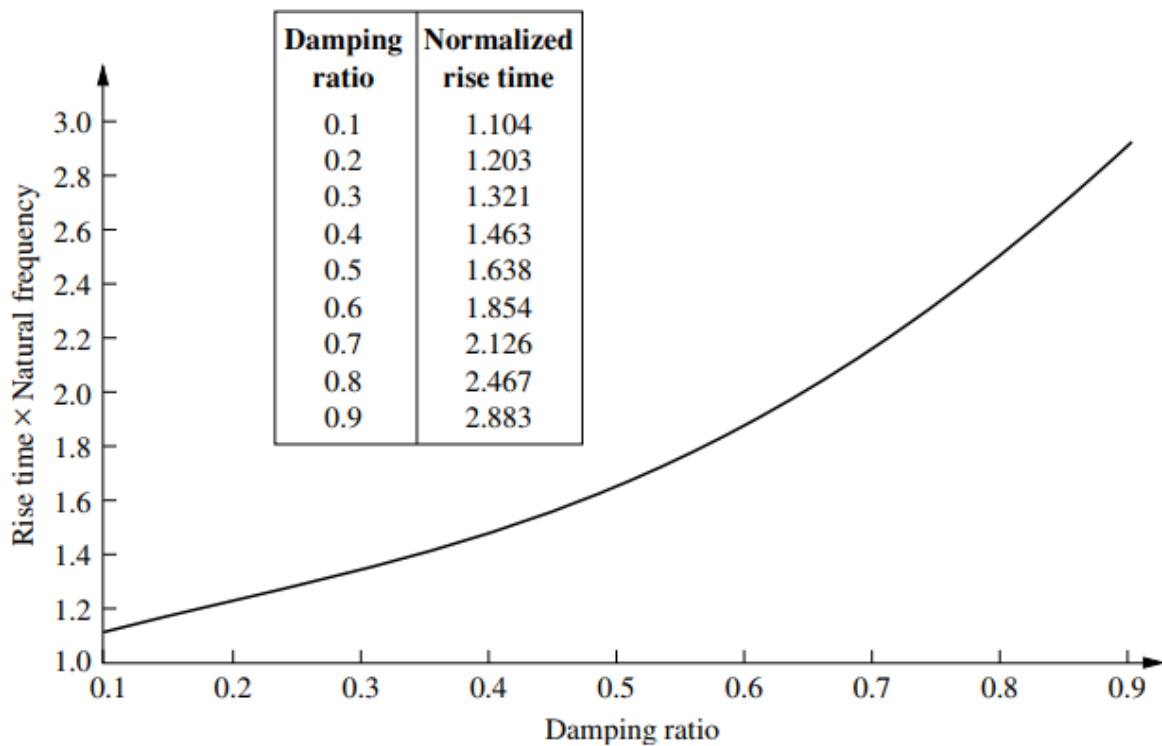$$R(s) \rightarrow \boxed{\dfrac{36}{s^2 + 4.2s + 36}} \rightarrow C(s)$$

Figure 4(a) / *Rajah 4(a)*

Damping ratio	Normalized rise time
0.1	1.104
0.2	1.203
0.3	1.321
0.4	1.463
0.5	1.638
0.6	1.854
0.7	2.126
0.8	2.467
0.9	2.883

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 lajakan,%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.**

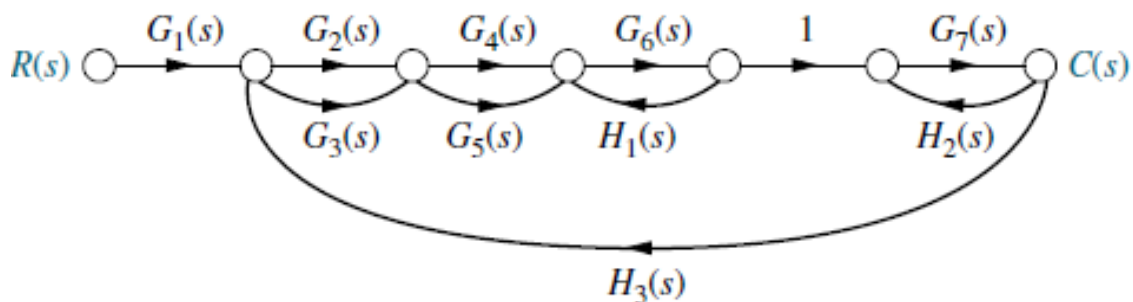*Selesaikan Rangkap , C(s)/R(s), untuk graf isyarat –laluan pada* **Rajah 5.**

Figure 5 / *Rajah 5*

(25 marks /25 *markah*)

[100 MARKS/ 100 *MARKAH*]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*