KOLEJ YAYASAN PELAJARAN JOHOR

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FINAL EXAMINATION

COURSE NAME	:	**CONTROL SYSTEMS**
COURSE CODE	:	**DEE2183**
EXAMINATION	:	**JUNE 2024**
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. Candidate are not allowed to bring any material to examination room except with the permission from the invigilator. The formula was attached at the back question paper. /
   Calon tidak dibenarkan untuk membawa sebarang bahan/nota ke bilik peperiksaan tanpa arahan/kebenaran daripada pengawas. Rumus dilampirkan di belakang kertas soalan peperiksaan.

3. Please check to make sure that this examination pack consists of: /
   Pastikan kertas soalan peperiksaan ini mengandungi:
   i. Question Paper /
      Kertas Soalan.
   ii. Answering Booklet. /
      Buku Jawapan.

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) Describe the use of **four (4)** test waveforms used in control systems and draw the respective waveforms.

*Terangkan kegunaan **empat (4)** gelombang ujian yang digunakan pada sistem kawalan dan lukis gelombang tersebut.*

(8 marks / *markah*)

(b) Fill in the blanks in the **Table 1** below of the differences between closed-loop and open-loop systems.

*Isikan tempat kosong pada **Jadual 1** di bawah berkenaan perbezaan antara sistem gelung tertutup dan gelung terbuka.*

Closed-loop system *Sistem gelung tertutup*	Open-loop system *Sistem gelung terbuka*
	Does not have the feedback path. *Tidak mempunyai laluan suapbalik.*
Output response: greater accuracy. *Respon keluaran : ketepatan yang tinggi.*	
	Sensitive to noise, disturbances and changes in the environment. *Sensitif terhadap kebisingan, gangguan dan perubahan persekitaran.*
The system can compare the output response with the input and make a correction if there is any difference. *Sistem mampu membandingkan respon keluaran dengan masukan dan membuat pembetulan jika terdapat perbezaan.*	
	Simple and inexpensive. *Mudah dan murah.*

Table 1 / *Jadual 1*

(10 marks / *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.***

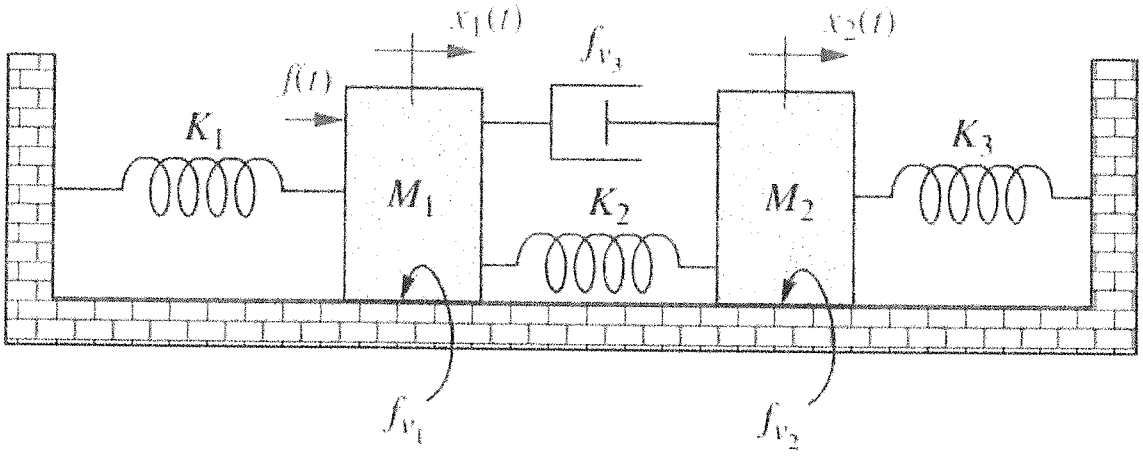

Figure 2 / *Rajah 2*

(12 marks / *markah*)

QUESTION 3/ *SOALAN 3*

(a) Describe **three (3)** transient response specifications of First Order System with their respective formula.

Terangkan ***tiga (3)*** *spesifikasi tindak balas sementara pada Sistem Susunan Pertama bersama formula mereka.*

(9 marks *markah*)

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

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

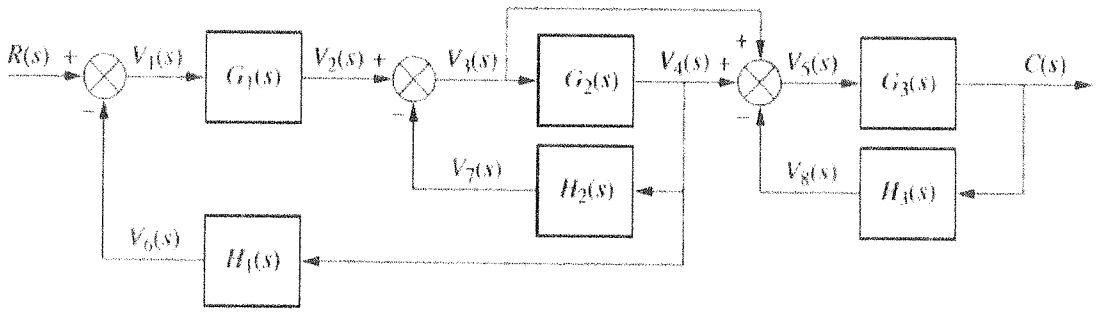

Figure 3 / *Rajah 3*

(8 marks / *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 / *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:

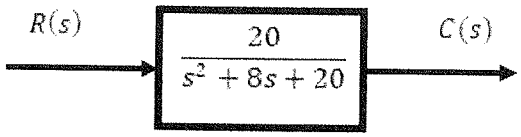

Figure 4 (a) / *Rajah 4 (a)*

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

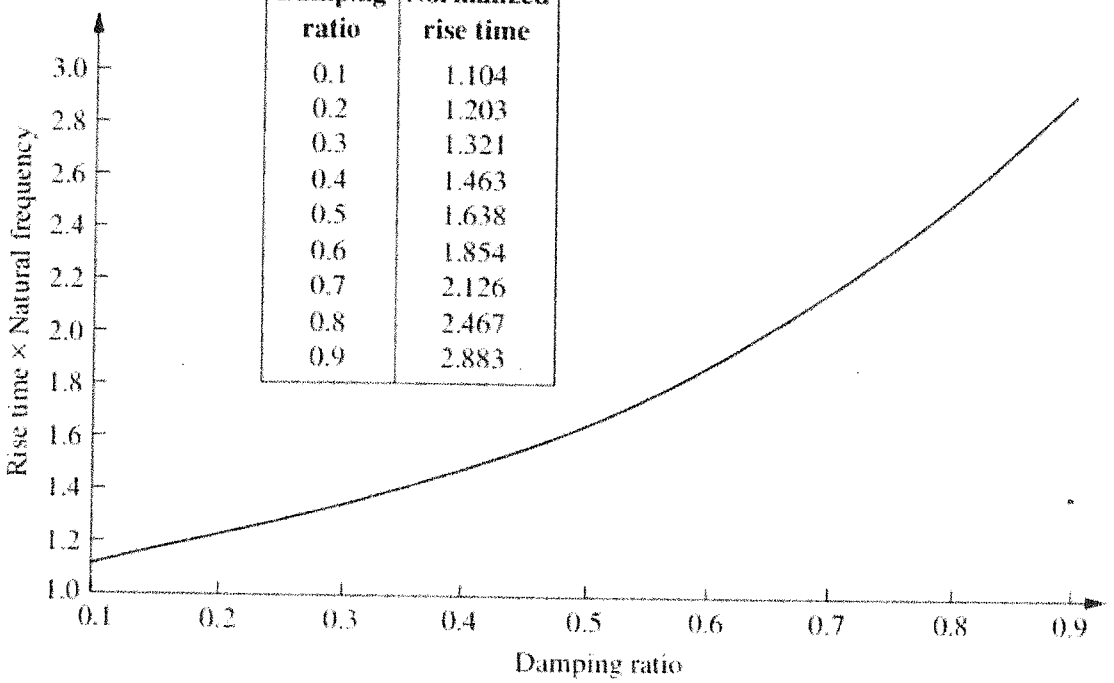

Figure 4 (b) / *Rajah 4 (b)*

i) show the natural frequency, ω_n and damping ratio, ξ.

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 / *markah*)

Diberi rangkap pindah, G(s) untuk sistem kawalan ditunjukkan dalam ***Rajah 4 (a)*** *di bawah. Berdasarkan* ***Rajah 4 (b),*** *sila jawab soalan berikut:*

i) tunjukkan frekuensi tabii, ω_n dan nisbah redaman, ξ.

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.***

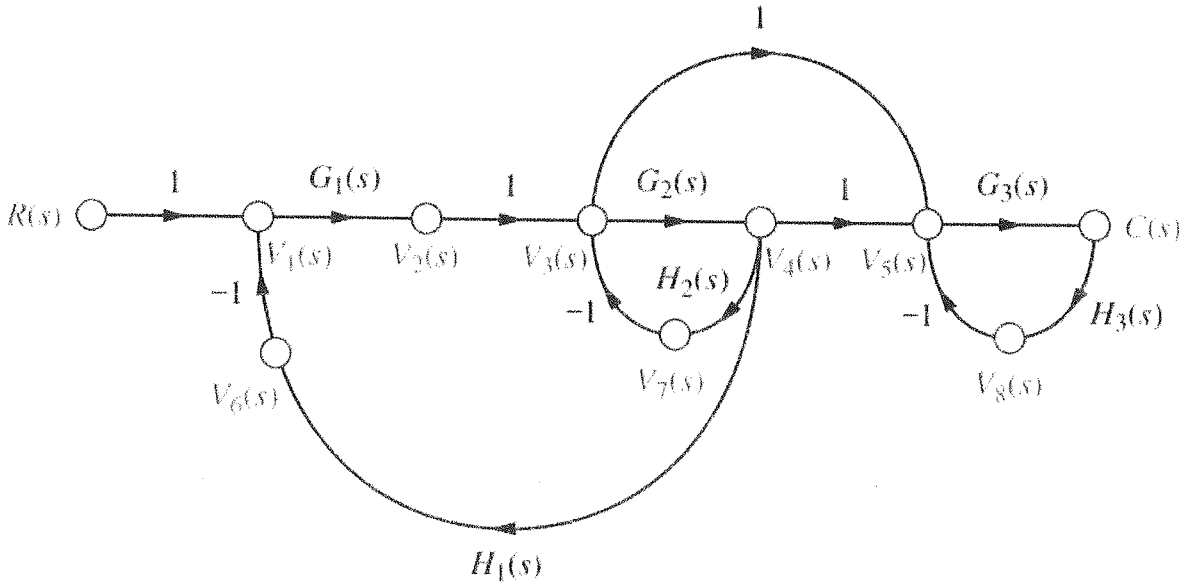

Figure 5 / *Rajah 5*

(25 marks / *markah*)

[100 MARKS/ *MARKAH*]

END OF QUESTION PAPER/ *KERTAS SOALAN TAMAT*