

SULIT



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENGAJIAN TINGGI**

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI II : 2021/2022

DEJ30013 : BASIC CONTROL SYSTEM

TARIKH : 05 JULAI 2022

MASA : 2.30 PETANG - 4.30 PETANG

Kertas ini mengandungi **LAPAN (8)** halaman bercetak.
Bahagian A: Struktur (3 soalan)
Bahagian B: Esei (1 soalan)

Dokumen sokongan yang disertakan : Jadual Laplace dan Pengecilan Rajah
Blok

**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIBERITAHU
OLEH KETUA PENGAWAS**

SULIT

SECTION A: 75 MARKS
BAHAGIAN A: 75 MARKAH

INSTRUCTION:

This section consists of **THREE (3)** structured questions. Answer **ALL** questions.

ARAHAN:

*Bahagian ini mengandungi **TIGA (3)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1
C3

- a) Real Time Application such as Traffic Light Control System is an Open Loop system. With the aid of a block diagram, write **THREE (3)** reasons why a traffic light control system is an open loop.

*Aplikasi Masa Nyata seperti Sistem Kawalan Lampu Isyarat adalah system gelung tertutup. Dengan bantuan gambarajah blok, tuliskan **TIGA (3)** sebab mengapa sistem kawalan lampu isyarat adalah gelung terbuka.*

[8 marks]

[8 markah]

CLO1
C3

- b) Figure A1(b) is Automatic Iron. By referring to the figure, show whether this system is open loop or close loop and draw the block diagram of the system.

Rajah A1(b) ialah Seterika Automatik. Dengan merujuk kepada rajah tersebut, tunjukkan sama ada sistem ini gelung terbuka atau gelung tutup dan lukis gambarajah blok sistem



Figure A1(b): Automatic Iron
 Gambarajah A1(b): Seterika Automatik

[8 marks]

[8 markah]

CLO1
C3

- c) Calculate the transfer function of the electrical network as shown in Figure A1(c).

Kirakan rangkap pindah bagi rangkaian elektrik seperti yang ditunjukkan pada Rajah A1(c).

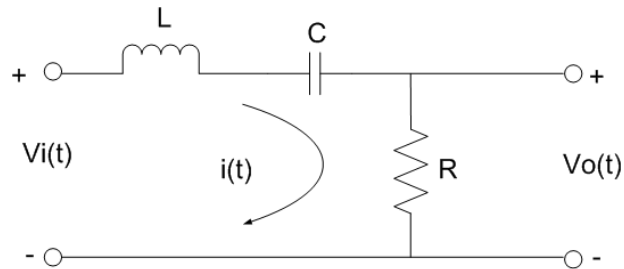


Figure A1(c) / Rajah A1(c)

[9 marks]
[9 markah]

QUESTION 2
SOALAN 2

CLO1
C3

- a) Derive the transfer function, $\frac{C(s)}{R(s)}$ of simple close loop system as shown in Figure A2(a).

Terbitkan rangkap pindah, $\frac{C(s)}{R(s)}$ bagi sistem gelung tertutup yang mudah seperti Rajah A2(a)



Figure A2(a) / Rajah A2(a)

[8 marks]
[8 markah]

CLO1
C3

- b) Based on Figure A2(b) below, derive the transfer function of the system by using block reduction technique.

Berdasarkan Rajah A2(b) di bawah, terbitkan fungsi pemindahan system dengan menggunakan teknik pengurangan rajah blok.

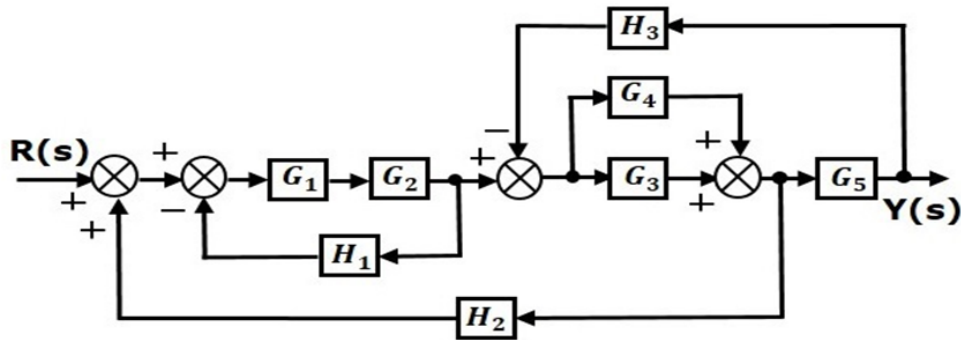


Figure A2(b)/Rajah A2(b)

[8 marks]
[8 markah]

- c) By using Signal Flow Graph, solve the overall transfer function $\frac{C(s)}{R(s)}$ for system in Figure A2(c).

CLO1
C3

Dengan menggunakan Graf Aliran Isyarat, selesaikan fungsi pemindahan keseluruhan $\frac{C(s)}{R(s)}$ untuk sistem dalam Rajah A2(c).

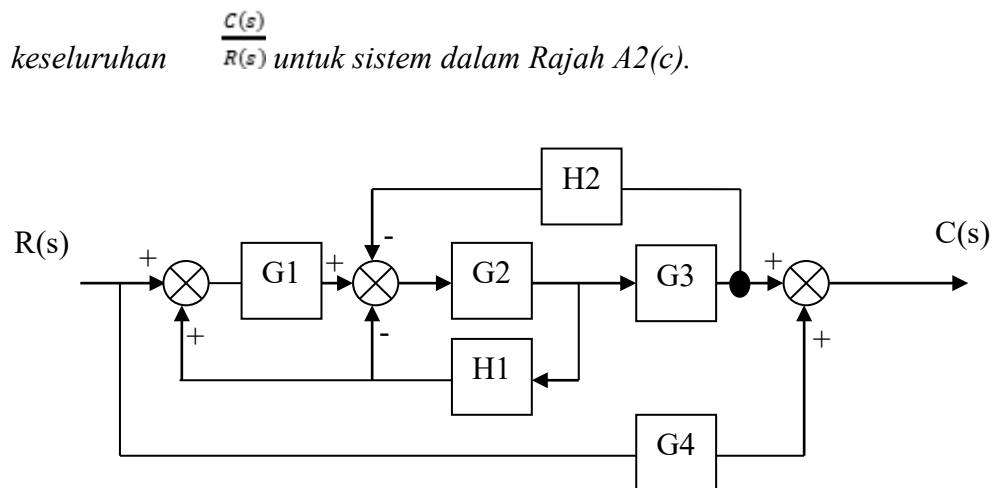


Figure A2 (c) / Rajah A2(c)

[9marks]
[9 markah]

QUESTION 3

SOALAN 3

CLO1
C3

- a) From the controller shown in Figure A3(a), A3(b) and A3(c) below, write the types of composite mode controller and the mathematical equation for each controller.

Daripada pengawal yang ditunjukkan dalam rajah A3(a), A3(b) dan A3(c) di bawah, tuliskan jenis pengawal mod campuran/rencam dan persamaan matematik bagi setiap jenis pengawal.

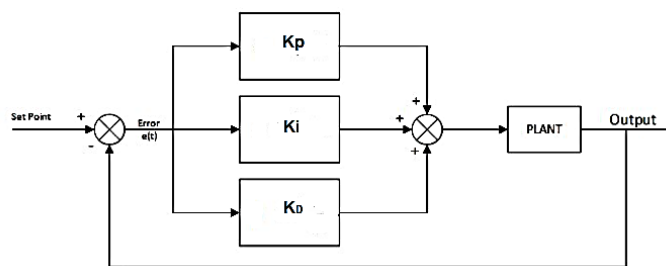


Figure A3(a) / Rajah A3(a)

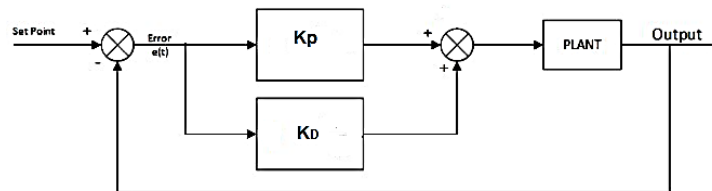


Figure A3(b) / Rajah A3(b)

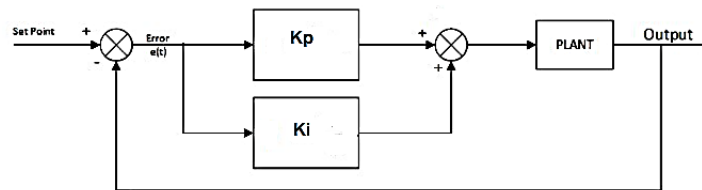


Figure A3(c) / Rajah A3(c)

[8 marks]
[8 markah]

- b) Given a composite controller that combines proportional and derivation controllers. The settings of the controller are $K_p = 4\%$, and $K_i = 6\%$ while $p(0) = 25\%$. By referring to Figure A3(b), calculate the controller output in % after 2 minutes.

Diberi pengawal komposit yang menggabungkan pengawal berkadar dan pengawal kamilan. Tetapan bagi pengawal adalah $K_p = 4\%$, dan $K_i = 6\%$ manakala $p(0) = 5\%$. Merujuk kepada Rajah A3(b), kirakan keluaran pengawal selepas 2 minit.

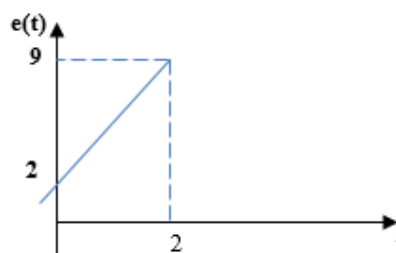


Figure A3(b)/ Rajah A3(b)

[8 marks]
[8 markah]

CLO1
C3

- c) The system is a single loop non-unity feedback as shown in Figure A3(c). Calculate the error steady state for unit step input and unit ramp input and the transfer function $\frac{c(s)}{R(s)}$ for the close loop system.

Sistem ini adalah satu gelung tunggal dengan suapbalik bukan unti seperti yang ditunjukkan dalam Rajah A3(c). Kirakan ralat keadaan mantap bagi masukan jenis langkah dan masukan jenis tanjak dan rangkap pindah gelung tertutup bagi sistem tersebut.

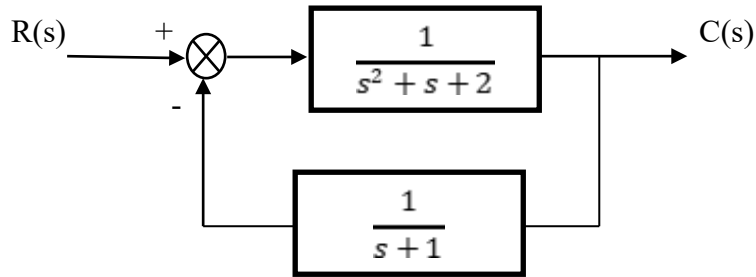


Figure A3(c)/Rajah A3(c)

[9marks]

[9 markah]

SECTION B: 25 MARKS**BAHAGIAN B: 25 MARKAH****INSTRUCTION:**

This section consists of **ONE (1)** essay question. Answer the question.

ARAHAN:

*Bahagian ini mengandungi **SATU (1)** soalan esei. Jawab soalan tersebut.*

QUESTION 1**SOALAN 1**CLO1
C3

Figures B1 show the responses curve of the system. Write the classification of the response and prove it then calculate the damping ratio, natural frequency, rise time, settling time if tolerance band is $\pm 2\%$ and solve the transfer function for the systems.

Rajah B1 menunjukkan keluk tindak balas sistem. Tuliskan klasifikasi tindakbalas dan buktikan kemudian kirakan nisbah redaman, frekuensi natural, masa menaik, masa penetapan jika jalur toleransi ialah 2% dan selesaikan rangkap pindah bagi sistem tersebut.

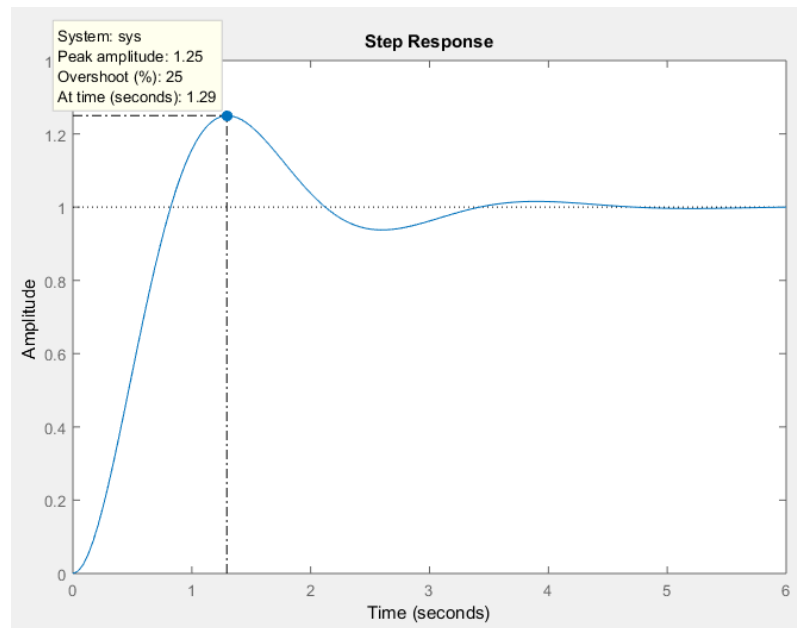


Figure B1(a)

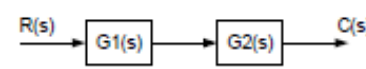
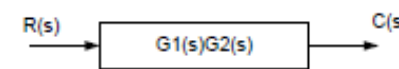
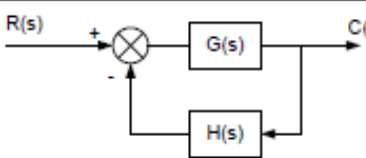
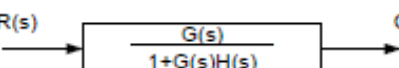
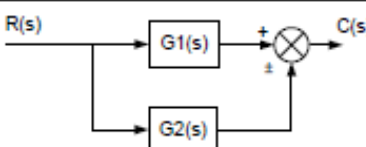
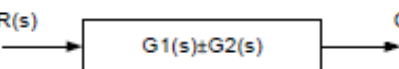
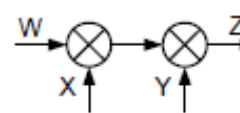
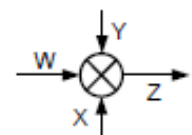

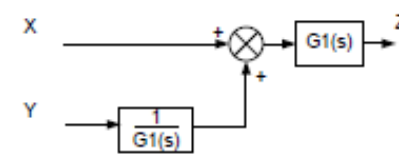
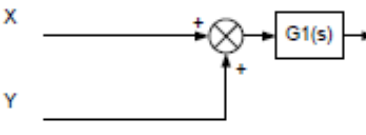
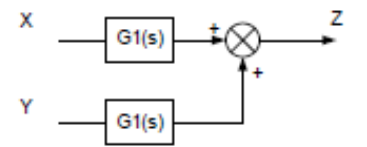
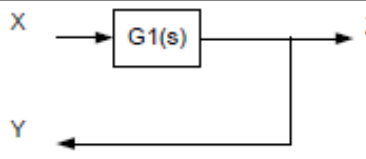
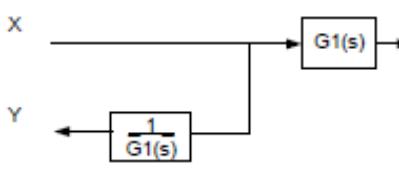
[25 marks]
[25 markah]

SOALAN TAMAT

Standard Laplace Transform Pairs

$f(t) = \mathcal{L}^{-1}\{F(s)\}(t)$	$F(s) = \mathcal{L}\{f(t)\}(s) = \int_0^{\infty} e^{-st} f(t) dt$
1	$\frac{1}{s}, \quad s > 0$
$t^n, \quad n \text{ an integer}$	$\frac{n!}{s^{n+1}}, \quad s > 0$
e^{at}	$\frac{1}{s-a}, \quad s > a$
$\sin bt$	$\frac{b}{s^2 + b^2}, \quad s > 0$
$\cos bt$	$\frac{s}{s^2 + b^2}, \quad s > 0$
$e^{at} f(t)$	$F(s-a)$
$e^{at} t^n, \quad n \text{ an integer}$	$\frac{n!}{(s-a)^{n+1}}, \quad s > a$
$e^{at} \sin bt$	$\frac{b}{(s-a)^2 + b^2}, \quad s > a$
$e^{at} \cos bt$	$\frac{(s-a)}{(s-a)^2 + b^2}, \quad s > a$
$t \sin bt$	$\frac{2bs}{(s^2 + b^2)^2}, \quad s > 0$
$t \cos bt$	$\frac{s^2 - b^2}{(s^2 + b^2)^2}, \quad s > 0$
$y' = \dot{y} = \frac{dy}{dt}$	$sY(s) - y(0)$
$y'' = \ddot{y} = \frac{d^2y}{dt^2}$	$s^2Y(s) - sy(0) - \dot{y}(0)$

BLOCK DIAGRAM REDUCTION TABLE

Case	Original structure	Equivalent structure
1		
2		
3		
4		
5		
6		
7		
8	