

SULIT



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

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI I : 2022 / 2023

DEJ30013: BASIC CONTROL SYSTEM

TARIKH : 20 DISEMBER 2022

MASA : 2.30 PM - 4.30 PM (2 JAM)

Kertas ini mengandungi **ENAM (6)** halaman bercetak.

Bahagian A: Struktur (4 soalan)

Bahagian B: Esei(1 soalan)

Dokumen sokongan yang disertakan : Formula

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

SECTION A : 80 MARKS
BAHAGIAN A : 80 MARKAH

INSTRUCTION:

This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:

Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab semua soalan.

QUESTION 1

SOALAN 1

- CLO1
C1
- (a) State **FOUR (4)** basic components of a control system.
Nyatakan EMPAT (4) komponen asas sistem kawalan.
- [4 marks]
[4 markah]
- CLO1
C2
- (b) Explain briefly the closed loop control system with an aid of a suitable diagram.
Jelaskan secara ringkas sistem kawalan gelung tertutup dengan bantuan gambarajah yang sesuai.
- [6 marks]
[6 markah]
- CLO1
C3
- (c) By referring to Figure A1 (c), temperature control system is one example of closed-loop control system. Draw the general block diagram of the system and explain the operations of the system.
Dengan merujuk kepada Rajah B1 (c), sistem kawalan suhu adalah salah satu contoh sistem kawalan gelung tertutup. Lukis gambarajah blok umum sistem dan terangkan operasi sistem tersebut.

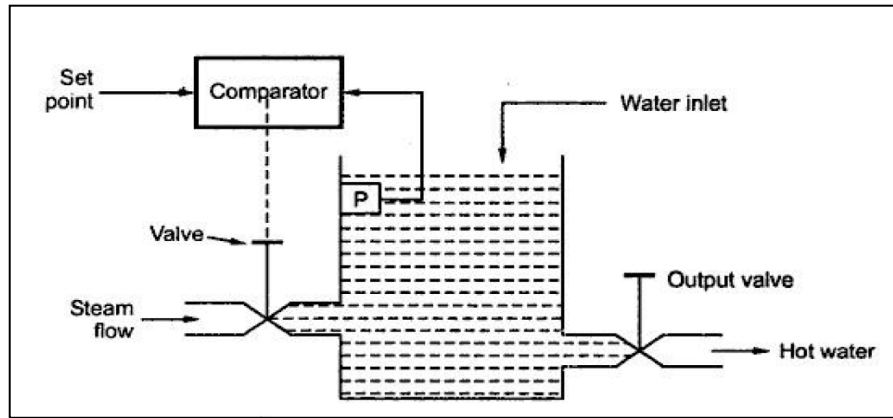


Figure A1 (c)/Rajah A1(c)

[10 marks]
[10 markah]

QUESTION 2

SOALAN 2

CLO1
C1

- (a) List **FOUR (4)** procedures to determine the transfer function of a control system.

Senaraikan EMPAT (4) tatacara menentukan rangkap pindah bagi sistem kawalan.

[4 marks]

[4 markah]

CLO1
C2

- (b) By referring to Table A2 (b), fill in the correct answers for (i), (ii), (iii), (iv), (v) and (vi).

Merujuk kepada Jadual B2(b), isikan jawapan yang betul untuk (i), (ii), (iii), (iv), (v) dan (vi).

Table A2 (b)/Jadual A2(b)

Element	Time domain expressions for voltage	Laplace domain expression for voltage	Laplace domain behaviour
Resistance, R	(i)	$I(s) R$	R
Capacitance, C	(ii)	(iv)	sL
Inductance, L	(iii)	(v)	(vi)

[6 marks]

[6 markah]

CLO1
C3

- (c) Solve the response of the unity feedback system whose open-loop transfer function is for a unit step input.

Selesaikan sambutan sistem suapbalik yang mempunyai fungsi rangkaian pindah gelung terbuka berikut bagi masukan unit langkah.

$$G(s) = \frac{3}{s(3+4)}$$

[10 marks]

[10 markah]

QUESTION 3**SOALAN 3**CLO1
C1

- (a) Define the Rise Time (T_r) together with the formula of transient response.

Definisikan Masa kenaikan (T_r) beserta dengan formula bagi sambutan fana.

[4 marks]

[4 markah]

CLO1
C2

- (b) With a suitable diagram, explain the maximum overshoot of the transient response system.

Dengan graf yang sesuai, terangkan lanjakan maksimum sistem sambutan fana.

[6 marks]

[6 markah]

CLO1
C3

- (c) A unity feedback system is characterised by an open loop transfer function. Show the steady state errors for unit-step, unit-ramp and unit-acceleration inputs for the transfer function below:

Sistem maklum balas dicirikan oleh fungsi pemindahan gelung terbuka.

Tunjukkan ralat keadaan mantap untuk input langkah unit, unit-ramp dan unit-pecutan bagi fungsi pemindahan dibawah:

$$G(s) = \frac{1}{s(0.5s+1)(0.2s+1)}$$

[10 marks]

[10 markah]

QUESTION 4

SOALAN 4

CLO1
C1

- (a) The controllers are basically classified as discontinuous and continuous controllers. State the difference between these two controllers.

Pengawal pada dasarnya dikelaskan kepada pengawal tidak berterusan dan berterusan. Nyatakan perbezaan kedua – dua pengawal tersebut.

[4 marks]

[4 markah]

CLO1
C2

- (b) Express the mathematical equation for each composite controller

Terangkan persamaan matematik untuk setiap jenis pengawal rencam.

[6 marks]

[6 markah]

CLO1
C3

- (c) By referring to Figure A2(c), calculate the output value of PD controller when $K_p = 6\%$ and $K_d = 0.4\%$ with $P(0) = 25\%$.

Berdasarkan kepada rajah A2 (c), kirakan nilai keluaran bagi pengawal jenis P+D, apabila $K_p = 6\%$, $K_D = 0.4\%$ and $P(0) = 25\%$.

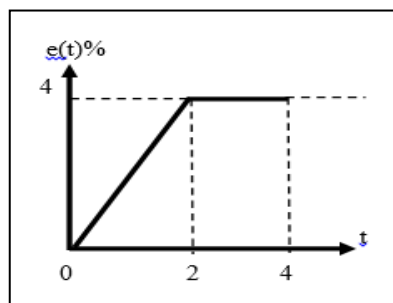


Figure A4 (c) / Rajah A4 (c)

[10 marks]

[10 markah]

SECTION B: 20 MARKS**BAHAGIAN B: 20 MARKAH****INSTRUCTION:**

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

ARAHAN:

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

QUESTION 1**SOALAN 1**

CLO1
C3, DP1,
DP3,
DP4, DP5

In principle, no matter how complicated the block diagram of the closed loop system is, it can be reduced to the standard single loop by using a certain rule. Solve the transfer function for the system shown in Figure B1 using the Block diagram reduction rule.

Pada dasarnya, tidak kira betapa rumitnya gambarajah blok sistem gelung tertutup, ia boleh dikurangkan kepada gelung tunggal standard dengan menggunakan peraturan tertentu. Selesaikan fungsi pemindahan untuk sistem yang ditunjukkan dalam Rajah B1 menggunakan peraturan pengurangan gambarajah blok.

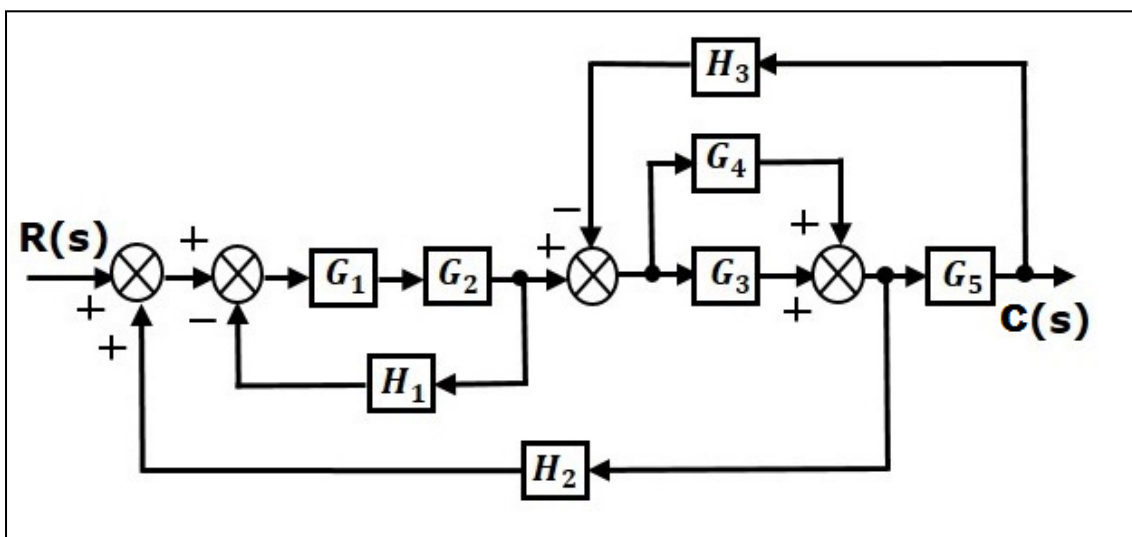


Figure B1/Rajah B1

[20 marks]

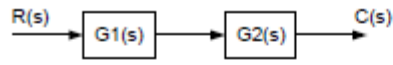
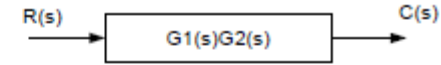
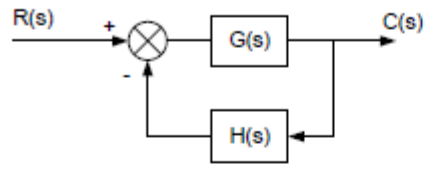
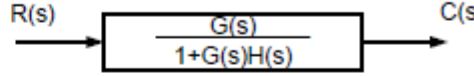
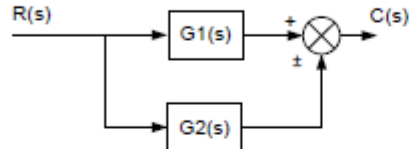
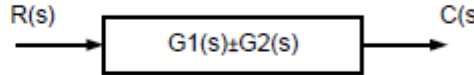
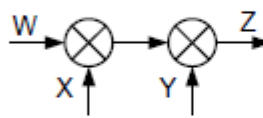
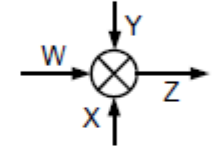

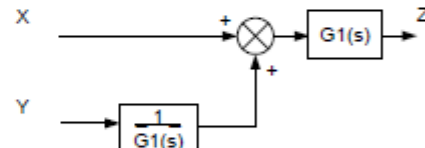
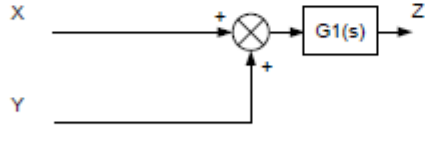
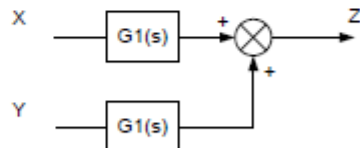
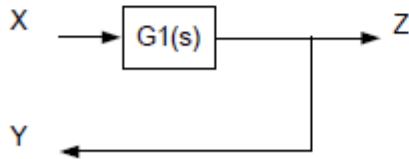
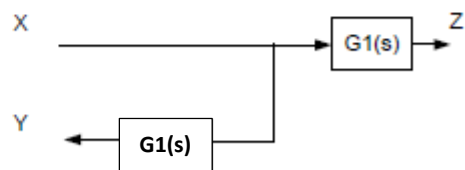
[20 markah]

SOALAN TAMAT

Standard Laplace Transform Pairs

$f(t) = \mathcal{L}^{-1}\{F(s)\}(t)$	$F(s) = \mathcal{L}\{f(t)\}(s) = \int_0^{\infty} e^{-at} f(t) dt$
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	