

**SULIT**



**BAHAGIAN PEPERIKSAAN DAN PENILAIAN  
JABATAN PENDIDIKAN POLITEKNIK  
KEMENTERIAN PENDIDIKAN MALAYSIA**

**JABATAN KEJURUTERAAN ELEKTRIK**

**PEPERIKSAAN AKHIR  
SESI DISEMBER 2017**

**DEJ3133: BASIC CONTROL SYSTEM**

**TARIKH : 12 APRIL 2018  
MASA : 2.30 PETANG – 4.30 PETANG(2 JAM)**

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Kertas ini mengandungi **SEPULUH (10)** halaman bercetak.

Bahagian A: Objektif (10 soalan)  
Bahagian B: Struktur (4 soalan)  
Bahagian C: Esei (2 soalan)

Dokumen sokongan yang disertakan : Formula Laplace dan Pengecilan Blok

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

(CLO yang tertera hanya sebagai rujukan)

**SULIT**

**SECTION A : 10 MARKS**  
**BAHAGIAN A : 10 MARKAH**

**INSTRUCTION:**

This section consists of **TEN (10)** objective questions. Mark your answers in the OMR form provided.

**ARAHAN :**

*Bahagian ini mengandungi **SEPULUH (10)** soalan objektif. Tandakan jawapan anda di dalam borang OMR yang disediakan.*

CLO1  
C1

1. State an automatic control related to an industrial process.  
*Nyatakan kawalan automatik yang berkaitan dengan proses perindustrian*

- |   |  |   |   |
|---|--|---|---|
| A | A design gap<br><i>jurang rekabentuk</i> | C | A specification<br><i>spesifikasi</i>         |
| B | Automation<br><i>Automasi</i>            | D | Negative feedback<br><i>Suapbalik negatif</i> |

CLO1  
C2

2. Based on the following statement, classify the type of the control system below:  
*Berdasarkan pernyataan berikut, kelaskan jenis sistem kawalan berikut:*

- Output quantity has no effect on the input quantity  
*Kuantiti keluaran mempunyai kesan kepada kuantiti masukan.*
- No facility to correct automatically the error generated in the output.  
*Tiada kemudahan untuk membetulkan kesilapan yang terjana itu secara automatic di keluaran.*
- The output can be varied by varying the input but due to the external disturbance, system output may change.  
*Keluaran boleh diubah dengan mengubah nilai masukan tetapi dengan adanya gangguan, keluaran mungkin akan berubah.*

- A Open loop control system  
*Sistem kawalan gegelung terbuka*
- B Closed loop control system  
*Sistem kawalan gegelung tertutup*
- C Multivariable control system  
*Sistem kawalan pembolehubah*
- D Combinational control system  
*Sistem kawalan gabungan*

CLO1  
C2

3. Which of the following is an open loop control system?  
*Antara berikut yang manakah sistem kawalan gelung terbuka?*

- A Home Heating System  
*Sistem pemanas rumah*
- B Ship stabilization  
*Kapal penstabil*
- C D.C. motor speed control  
*Kawalan kelajuan motor D.C*
- D Stepper motor positioning system  
*Sistem kedudukan motor pelangkah*

CLO2  
C3

4. Choose the correct transfer function by referring to Figure A4.  
*Pilih rangkap pindah yang betul berdasarkan Rajah A4.*

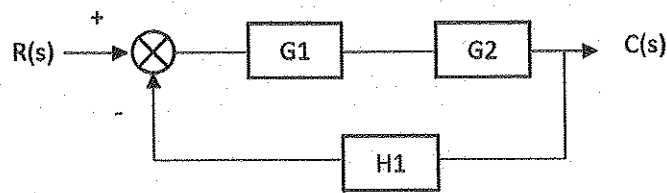


Figure A4 / Rajah A4

- A  $\frac{C(s)}{R(s)} = \frac{G1G2}{1+G1G2H1}$
- B  $\frac{C(s)}{R(s)} = \frac{G1G2}{1-G1G2H1}$
- C  $\frac{C(s)}{R(s)} = \frac{G1+G2}{1+G1G2H1}$
- D  $\frac{C(s)}{R(s)} = \frac{G1+G2}{1-G1G2H1}$

CLO1  
C2

5. Which of these answers DOES NOT represent the basic elements associated with block diagram?  
*Diantara jawapan – jawapan ini manakah yang TIDAK mewakili elemen – elemen asas berkaitan dengan gambarajah blok?*

- A Blocks  
*Blok – blok*
- B Error detector  
*Pengesan ralat*
- C Summing point  
*Titik penjumlah*
- D Transfer function of element show inside the block  
*Rangkap pindah elemen di dalam blok.*

CLO1  
C1

6. The response of the system as shown in Figure A6, refers to \_\_\_\_\_.  
*Sambutan kepada sistem seperti yang ditunjukkan dalam Rajah A6, merujuk kepada \_\_\_\_\_.*

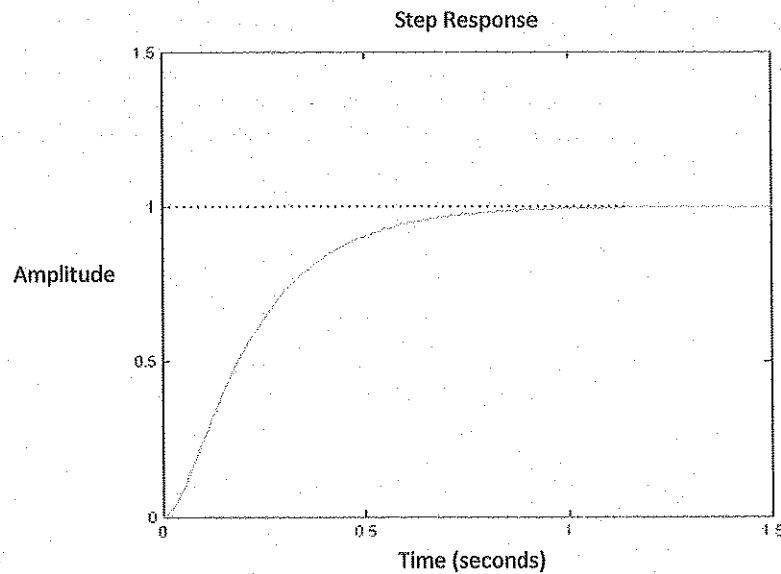


Figure A6 / Rajah A6

- |  |   |
|--|---|
| A Underdamped<br><i>Teredam kurang</i> | C Critically damped<br><i>Teredam genting</i> |
| B Overdamped<br><i>Teredam lebih</i>   | D Undamped<br><i>Tak teredam</i>              |

CLO1  
C2

7. If the characteristic equation is given as  $s^2+6s+8=0$ , therefore the system is  
*Jika persamaan ciri diberi seperti  $s^2+6s+8=0$ , maka sistem tersebut adalah*

- |   |
|---|
| A undamped<br><i>tiada redaman</i>            |
| B underdamped<br><i>kurang redaman</i>        |
| C critically-damped<br><i>redaman genting</i> |
| D overdamped<br><i>redaman lampau</i>         |

CLO1  
C1

8. Identify the error signal in a control system.  
*Tentukan isyarat ralat dalam sistem kawalan.*

- A The difference between the measured value and the set value  
*Perbezaan antara nilai yang diukur dengan nilai yang disetkan*
- B The sum of measured value and the set value  
*Hasil tambah nilai yang diukur dengan nilai yang disetkan*
- C The ratio of measured value to the set value  
*Nisbah nilai yang diukur terhadap nilai yang disetkan*
- D The ratio of set value to the measured value  
*Nisbah nilai yang disetkan terhadap nilai yang diukur*

CLO1  
C2

9. Which of the following statement is **CORRECT** about the characteristic of the Proportional mode?  
*Yang mana kenyataan berikut **BETUL** tentang ciri mod berkadar?*

- A The controller output is constant when the error is zero  
*Output pengawal malar apabila ralat ialah sifar*
- B The controller output is zero when the error is zero  
*Output pengawal ialah sifar apabila ralat ialah sifar*
- C The controller output remains at fixed value when the error is zero  
*Output pengawal kekal di nilai tetap apabila ralat ialah sifar*
- D All of the above  
*Kesemua di atas*

CLO2  
C3

10. The range of measured variable for certain control system is 4mV to 20mV and a set point of the system is 10mV. Calculate percentage of error when the measured variable is 8mV.  
*Julat bagi pemboleh ubah yang diukur untuk suatu system kawalan ialah 4mV hingga 20mV dan titik set bagi sistem tersebut ialah 10mV. Kirakan peratusan ralat apabila pemboleh ubah yang diukur ialah 8mV.*

- A 0.125%
- B 5%
- C 12.5%
- D 25%

**SECTION B : 60 MARKS****BAHAGIAN B : 60 MARKAH****INSTRUCTION:**

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

**ARAHAN:**

*Bahagian ini mengandungi EMPAT (4) soalan berstruktur. Jawab SEMUA soalan.*

CLO1  
C1**QUESTION 1****SOALAN 1**

- a) List down **THREE (3)** advantages of block diagram.

*Senaraikan TIGA (3) kebaikan gambarajah blok*

[3 marks]

[3 markah]

CLO1  
C2

- b) Identify **FIVE (5)** differences between an opened loop control system and a closed loop control system.

*Kenalpasti LIMA (5) perbezaan antara sistem gelung terbuka dan sistem gelung tertutup.*

[5 marks]

[5 markah]

CLO2  
C3

- c) Identify either a Traffic Flow Control System using a timer (Traffic Light) is an open loop or closed loop system? Explain with suitable block diagram.

*Kenal pasti sama ada Sistem Kawalan Aliran Trafik menggunakan pemasa (Lampu Trafik) adalah gelung terbuka atau sistem gelung tertutup? Terangkan dengan gambarajah blok yang sesuai.*

[7 marks]

[7 markah]

CLO1  
C1QUESTION 2  
SOALAN 2

- a) List **THREE (3)** elements associated with block diagram.  
*Senaraikan TIGA (3) elemen di dalam sesebuah gambarajah blok.*

[3 marks]

[3 markah]

CLO1  
C2

- b) By referring to the system shown in **Figure B2(b)**, calculate its transfer function where  $V_o(t)$  is output and  $V_i(t)$  is input to the system.

*Dengan merujuk kepada sistem pada **Rajah B2(b)**, kirakan rangkap pindahnya dimana  $V_o(t)$  adalah keluaran and  $V_i(t)$  adalah masukan bagi sistem ini.*

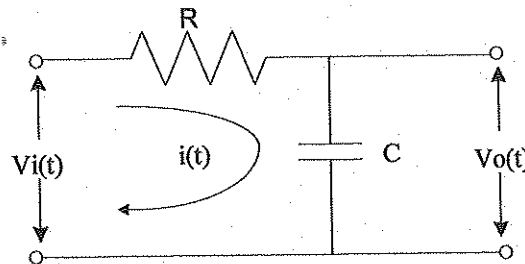


Figure B2(b) /Rajah B2(b)

[5 marks]

[5 markah]

CLO2  
C3

- c) Calculate the inverse Laplace Transform of the following function.

$$F(s) = \frac{s + 5}{s^2 + 5s + 4}$$

*Kirakan Jelmaan Laplace songsang bagi fungsi berikut.*

$$F(s) = \frac{s + 5}{s^2 + 5s + 4}$$

[7 marks]

[7 markah]

CLO1  
C1

## QUESTION 3

## SOALAN 3

- a) Briefly describe the definitions of Transient Response and Steady State Response.

*Huraikan secara ringkas maksud Sambutan Fana dan Sambutan Mantap.*

[3 marks]

[3 markah]

CLO1  
C2

- b) Sketch and label the time response specification of a system.

*Lakar dan labelkan Spesifikasi Sambutan Masa bagi sesebuah sistem.*

[5 marks]

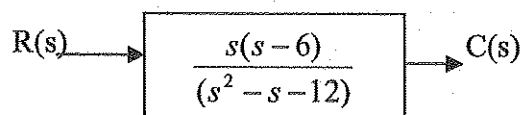
[5 markah]

CLO2  
C3

- c) By referring to **Figure C3(c)**, calculate all values of poles and zeros for the system.

Hence sketch the system's poles and zeros on the s-plane.

*Dengan merujuk kepada Rajah C3(c), kirakan semua nilai bagi kutub dan sifar untuk sistem tersebut. Kemudian lakarkan kutub dan sifar untuk sistem tersebut di atas satah-s.*



**Figure C3(c) / Rajah C3(c)**

[7 marks]

[7 markah]



CLO1  
C1

## QUESTION 4

## SOALAN 4

- a) State **THREE (3)** types of controllers that are classified as composite control modes.

*Nyatakan TIGA (3) jenis pengawal yang diklasifikasikan sebagai mod kawalan rencam.*

[3 marks]  
[3 markah]

CLO1  
C2

- b) By referring to the **Figure Q4(b)**, calculate the output value of PD controller.

Given that  $K_P = 3$  and  $K_D = 0.5$  with  $p(0) = 20\%$ .

*Berdasarkan kepada Rajah Q4(b), kirakan nilai keluaran bagi pengawal jenis PD.*

*Diberi  $K_P = 3$  and  $K_D = 0.5$  dengan  $p(0) = 20\%$ .*

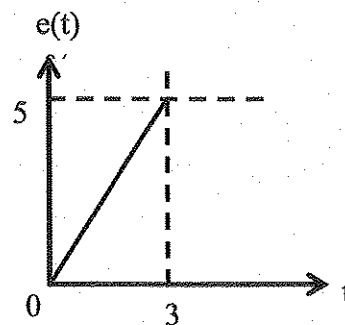


Figure Q4(b) / Rajah Q4(b)

[5 marks]  
[5 markah]

CLO2  
C3

- c) A Proportional + Integral (PI) controller is used to control certain process. The settings of the controller are  $k_p = 2\%$  and  $k_i = 4\%$  per min. While  $p(0) = 30\%$ , the error signal is  $3t + 4$  where  $t$  is the time. Calculate the controller output in percentage (%) after 2 minutes.

*Satu pengawal perkadaran + kamiran (PI) digunakan untuk mengawal proses tertentu. Tetapan  $k_p = 2\%$  dan  $k_i = 4\%$  setaip min. Manakala  $p(0) = 30\%$ , isyarat ralat ialah  $3t + 4$  dimana  $t$  ialah masa. Kirakan keluaran pengawal dalam peratus (%) selepas 2 minit.*

[7 marks]  
[7 markah]

## SECTION C : 30 MARKS

## BAHAGIAN C : 30 MARKAH

## INSTRUCTION:

This section consists of **TWO (2)** essay questions. Answer **ALL** questions.

## ARAHAN:

Bahagian ini mengandungi **DUA (2)** soalan esei. Jawab **SEMUA** soalan.

## QUESTION 1

## SOALAN 1

CLO2  
C3

Calculate the inverse Laplace Transform of the following function:

$$F(s) = \frac{2(s+10)}{(s+5)(s+8)(s+2)}$$

Kirakan songsangan Jelmaan laplace bagi fungsi berikut:

$$F(s) = \frac{2(s+10)}{(s+5)(s+8)(s+2)}$$

[15 marks]

[15 markah]

## QUESTION 2

## SOALAN 2

CLO2  
C3

By referring to the system in **Figure C2**. Identify the value of **K** and **P** so that the system has an overshoot of 30% and the peak time of 3 seconds. Assume that a unit step is given as an input to the system.

Merujuk kepada sistem dalam **Rajah C2**. Kenalpasti nilai bagi **K** dan **P** supaya sistem mempunyai 30% lampau lajak maksima dan masa puncak 3 saat. Anggapkan satu masukan unit langkah diberikan sebagai masukan kepada sistem ini.

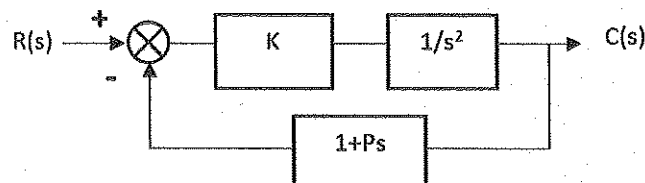


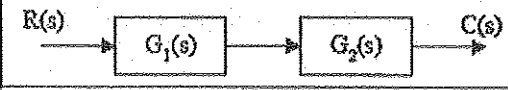
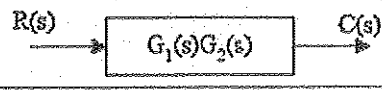
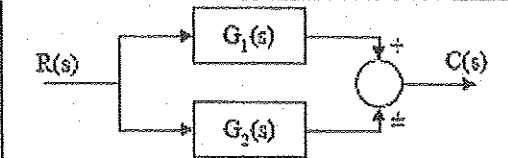
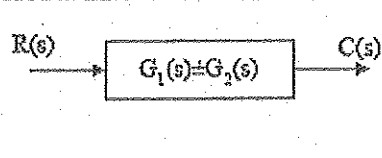
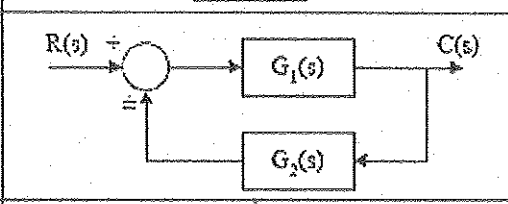
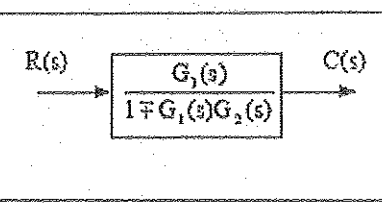
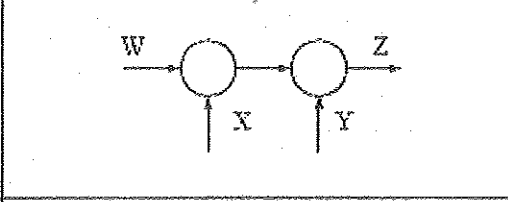
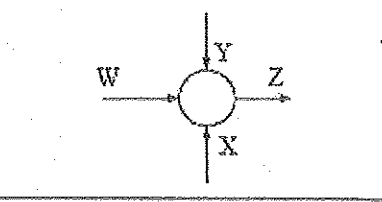
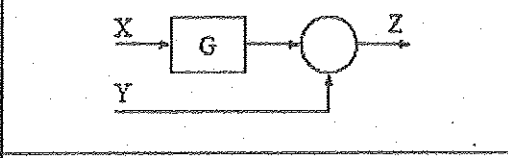
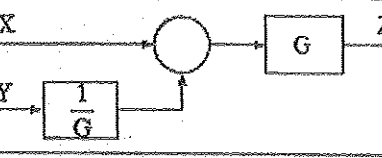
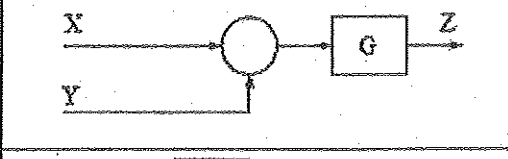
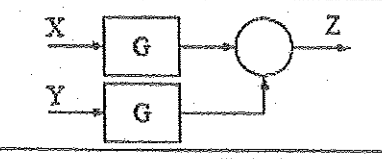
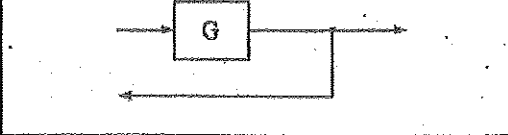
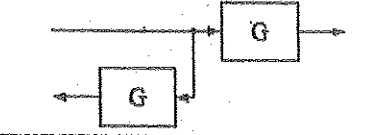
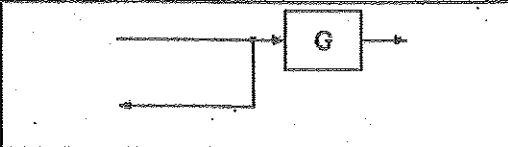
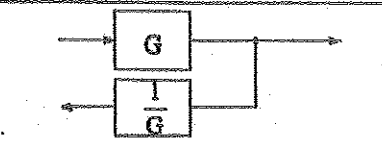
Figure C2/ Rajah C2

[15 marks]

[15 markah]

SOALAN TAMAT

### Block diagram reduction rules

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

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