

**SULIT**



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

**JABATAN KEJURUTERAAN ELEKTRIK**

**PEPERIKSAAN AKHIR**

**SESI JUN 2017**

**DEJ3133: BASIC CONTROL SYSTEM**

**TARIKH : 24 OKTOBER 2017**

**MASA : 8.30 PAGI – 10.30 PAGI (2 JAM)**

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Kertas ini mengandungi **DUA BELAS (12)** halaman bercetak.

Bahagian A: Objektif (10 soalan)

Bahagian B: Struktur (4 soalan)

Bahagian C: Esei (2 soalan)

Dokumen sokongan yang disertakan: Formula Laplace, Rajah 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. The portion of a system which is to be controlled or regulated is known as

*Bahagian sistem yang akan dikawal atau diatur dikenali sebagai*

- |                                     |                                 |
|-------------------------------------|---------------------------------|
| A disturbance<br><i>gangguan</i>    | C controller<br><i>pengawal</i> |
| B comparator<br><i>pembandingan</i> | D process<br><i>proses</i>      |

CLO1  
C2

2. Which of the following statement best describe the closed loop control system?

*Yang manakah antara berikut paling sesuai menerangkan tentang sistem kawalan gelung tertutup?*

- A Desirable responses to commands  
*tindak balas yang wajar kepada arahan*
- B Good regulation against disturbance  
*pengaturan yang baik terhadap gangguan*
- C Low sensitivity to changes in the plant parameters  
*sensitiviti yang rendah kepada perubahan di dalam parameter loji*
- D All of the above  
*semua di atas*

CLO1  
C2

3.

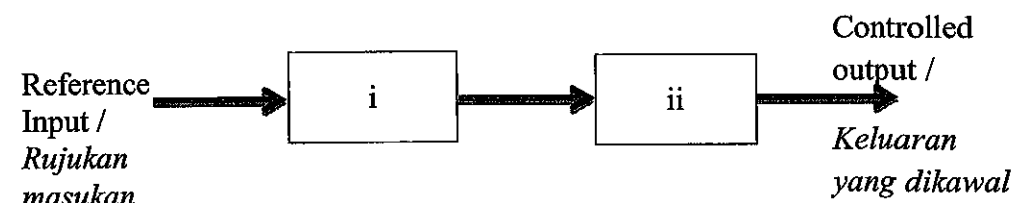


Figure A3 / Gambarajah A3

Select the **CORRECT** answers for Figure A3.Pilih jawapan yang **BETUL** untuk Gambarajah A3.

- A i. Controller and ii. Actuator  
i. Pengawal dan ii. Penggerak
- B i. Controller and ii. Process to be controlled  
i. Pengawal dan ii. Proses yang perlu dikawal
- C i. Process to be controlled and ii. Measurement element  
i. Proses yang perlu dikawal dan ii. Elemen pengukuran
- D i. Controller and ii. Measurement element  
i. Pengawal dan ii. Elemen pengukuran

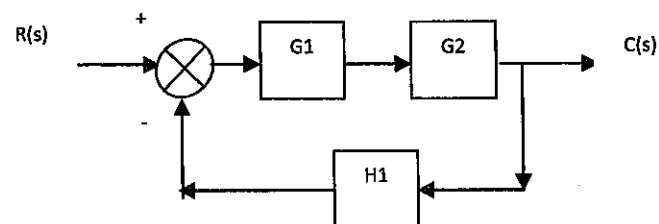
CLO2  
C34. Obtain the resultant output  $C(s)$  in terms of the input  $R(s)$ .Dapatkan hasil keluaran  $C(s)$  dalam sebutan  $R(s)$ .

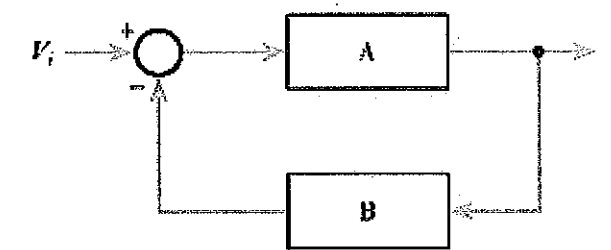
Figure A4 / Gambarajah A4

- 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. Determine the transfer function of the following arrangement.

Tentukan rangkap pindah bagi susunan berikut.



- A  $(1+AB) / B$
- B  $A / (1+AB)$
- C  $(1+AB) / A$
- D  $B / (1+AB)$

CLO1  
C1

6. The difference between desired output and actual output of a system is called \_\_\_\_\_.

Perbezaan antara keluaran yang diharapkan dengan keluaran sebenar bagi sesebuah sistem dipanggil \_\_\_\_\_.

- A transient state error  
ralat keadaan fana
- B steady state error  
ralat keadaan mantap
- C transient response  
sambutan fana
- D steady state response  
sambutan keadaan mantap

CLO1  
C2

7. Which of the following best describe overdamped systems?  
*Kenyataan manakah yang paling sesuai menerangkan sistem redaman lampau?*

- A Overdamped system is a system which the damping ratio is  $\xi = 1$   
*Sistem redaman lampau adalah sistem di mana nisbah redaman adalah  $\xi = 1$*
- B Overdamped system is a system which the damping ratio is  $\xi < 1$   
*Sistem redaman lampau adalah sistem di mana nisbah redaman adalah  $\xi < 1$*
- C Overdamped system is a system which the damping ratio is  $\xi > 1$   
*Sistem redaman lampau adalah sistem di mana nisbah redaman adalah  $\xi > 1$*
- D Overdamped system is a system which the damping ratio is  $\xi = 0$   
*Sistem redaman lampau adalah sistem di mana nisbah redaman adalah  $\xi = 0$*

CLO1  
C1

8. Select the **CORRECT** statement about the characteristics of proportional mode.  
*Pilih kenyataan yang BENAR 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*

CLO1  
C2

9. Based on the statement below, which controller would best fit this situation?  
*Berdasarkan kenyataan di bawah, pengawal yang manakah sesuai untuk mentafsirkan keadaan ini?*

- Simple heater control for maintaining temperature.  
*kawalan pemanas mudah untuk mengekalkan suhu*
- If the temperature increases, the drive to the heater must be decreased.  
*Jika suhu meningkat, dorongan untuk pemanas perlu dikurangkan.*

- A Two position controller / *pengawal dua keadaan*
- B Derivative controller / *pengawal pembezaan*
- C Integral controller / *pengawal kamilan*
- D Proportional controller / *pengawal berkadar*

CLO2  
C3

10. The range of measured variable for a certain control system is 2mV to 10mV and the set point is 7mV. Calculate the error in percentage of span when the measured variable is 6.5mV.  
*Julat pembolehubah yang telah diukur untuk satu sistem kawalan tertentu ialah 2mV kepada 10mV dan setpointnya ialah 7mV. Hitung ralat dalam peratus span apabila pembolehubah yang telah diukur ialah 6.5mV.*

- A 0.625%                              C 6.25%
- B 70%                                    D 53.3%

## 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  
C1QUESTION 1  
SOALAN 1

- a. State **THREE (3)** classification of control system.  
*Nyatakan TIGA (3) klasifikasi bagi sistem kawalan.*

[3 marks]  
[3 markah]CLO1  
C2

- b. Explain the following terms briefly:

*Terangkan terminology berikut secara ringkas:*

- i. System / Sistem
- ii. Disturbance / Gangguan

[5 marks]  
[5 markah]CLO2  
C3

- c. Home heating system is one example of real time applications for closed loop system. Illustrate the general block diagram of the system with complete labelling and description of each element.

*Sistem pemanas rumah adalah salah satu contoh aplikasi masa sebenar bagi sistem gelung tertutup. Gambarkan rajah blok umum bagi sistem tersebut bersama label penuh beserta penerangan setiap elemen.*

[7 marks]  
[7 markah]CLO1  
C1QUESTION 2  
SOALAN 2

- a. Define Laplace Transform.  
*Definisikan Laplace Transform.*

[3 marks]  
[3 markah]CLO1  
C2

- b. Express the Laplace transform of  $f(t) = 12$  by using Direct Integration Method.  
*Terbitkan Jelmaan Laplace bagi  $f(t) = 12$  menggunakan Kaedah Kamilan Terus.*

[5 marks]  
[5 markah]CLO2  
C3

- c. Calculate the inverse Laplace transform for the following function.  
*Kirakan songsangan Jelmaan Laplace bagi fungsi berikut.*

$$\frac{C(s)}{R(s)} = \frac{s+2}{s(s+3)(s+4)}$$

[7 marks]  
[7 markah]CLO1  
C1QUESTION 3  
SOALAN 3

- a. List **THREE (3)** effects of damping ratio ( $\zeta$ ) on 2nd Order system performance  
*Senaraikan TIGA (3) kesan nisbah redaman ( $\zeta$ ) terhadap prestasi sistem tertib kedua*

[3 marks]  
[3 markah]CLO1  
C2

- b. By drawing a suitable diagram, briefly explain the meaning of steady state error  
*Dengan melukis gambarajah yang sesuai, terangkan secara ringkas maksud ralat keadaan mantap.*

[5 marks]  
[5 markah]

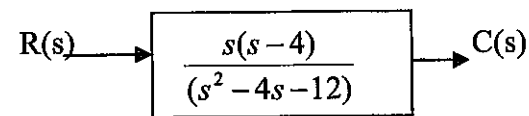
CLO2  
C3

Figure C3(c) / Gambarajah C3(c)

- c. By referring to Figure C3(c), calculate all values of poles and zeros for the system and then sketch the system's poles and zeros on the s-plane.

*Dengan merujuk Gambarajah C3(c), kira semua nilai bagi kutub dan sifar untuk sistem tersebut dan kemudian lakarkan kutub dan sifar untuk sistem tersebut di atas satah-s.*

[7 marks]  
[7 markah]

CLO1  
C1

#### QUESTION 4 SOALAN 4

- a. Identify **THREE (3)** advantages of Proportional plus Integral plus Derivative (P+I+D) controller mode.  
*Kenalpasti **TIGA (3)** kelebihan bagi mode pengawal jenis P+I+D.*

[3 marks]  
[3 markah]

CLO1  
C2

- b. Outline the controller output of Proportional plus Derivative (P+D) controller mode in Figure B4(b).

*Lukiskan keluaran pengawal jenis P+D pada Rajah B4(b).*

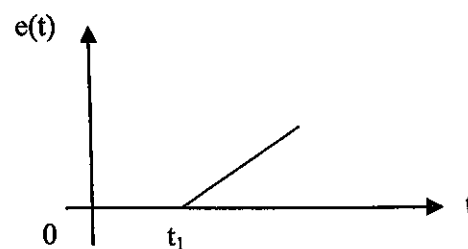


Figure B4(b)/Rajah B4(b)

[5 marks]  
[5 markah]

CLO2  
C3

- c. By referring to Figure B4(c), calculate the output value of PD controller when  $K_p=6\%$  and  $K_D=0.4\%$  with  $p(0)=25\%$ .

*Berdasarkan kepada Rajah B4(c), kirakan nilai keluaran bagi pengawal jenis PD apabila  $K_p=6\%$  dan  $K_D=0.4\%$  dengan  $p(0)=25\%$ .*

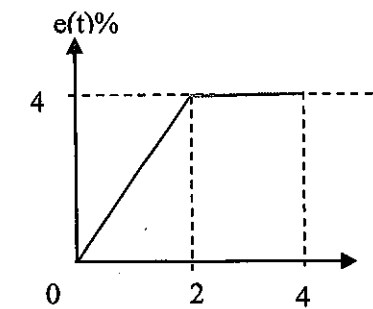


Figure B4(c) / Rajah B4(c)

[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**

Solve the transfer function of the system shown in Figure C1 by using Block Reduction Method.

Selesaikan rangkap pindah bagi sistem yang ditunjukkan di Rajah C1 dengan menggunakan Kaedah Pengecilan Blok Diagram.

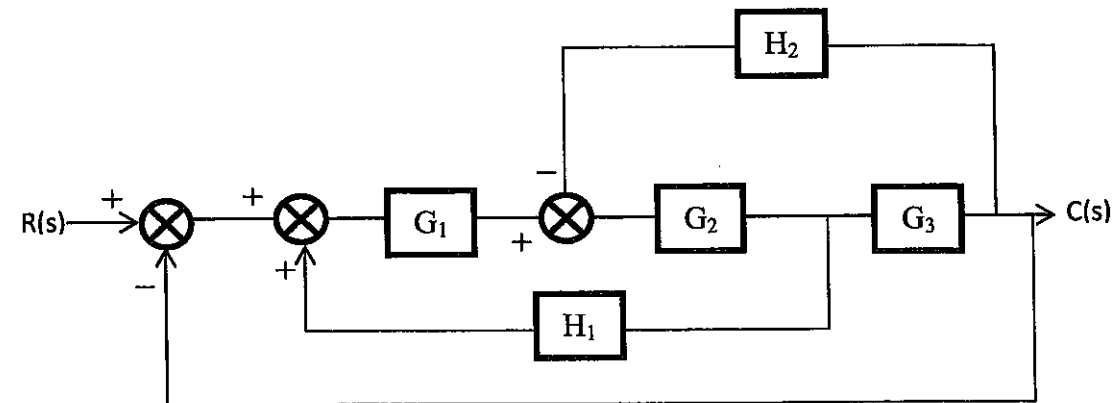


Figure C1 / Rajah C1

[15 marks]  
[15 markah]

**QUESTION 2**

**SOALAN 2**

CLO2  
C3

By referring to the system in Figure C2, calculate the value of Time rise ( $T_r$ ) and % Maximum overshoot (% $M_p$ ) for this system.

Merujuk kepada sistem dalam Gambarajah C2, kirakan nilai bagi Masa naik ( $T_r$ ) dan % Lajakan maksima (%  $M_p$ ) bagi sistem ini.

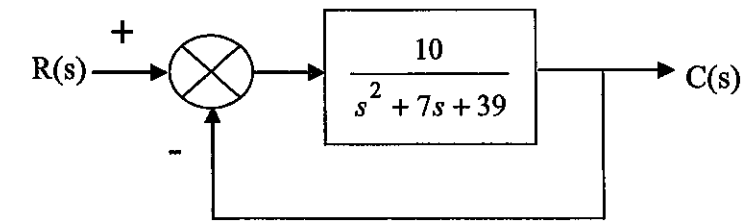


Figure C2 / Gambarajah C2

[15 marks]  
[15 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 RULES

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