

**SULIT**



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

**JABATAN KEJURUTERAAN ELEKTRIK**

**PEPERIKSAAN AKHIR**

**SESI JUN 2017**

**DEJ5163: CONTROL SYSTEMS**

**TARIKH : 3 NOVEMBER 2017**

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

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**Kertas ini mengandungi TUJUH (7) halaman bercetak.**

**Bahagian A: Struktur (4 soalan)**

**Bahagian B: Esei (2 soalan)**

**Dokumen sokongan yang disertakan : Kertas Semilog Graf, Kertas Graf**

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**JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN**

**(CLO yang tertera hanya sebagai rujukan)**

**SULIT**

**SECTION A : 60 MARKS****BAHAGIAN A : 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.*

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

- (a) List **THREE (3)** types of application for operational amplifier

*Senaraikan TIGA (3) jenis aplikasi bagi penguat kendalian.*

[3 marks]

[3 markah]

CLO1  
C2

- (b) Based on Figure Q1(b), calculate the feedback resistor,  $R_f$  if the given values are  $V_1 = 0.5 \text{ V}$ ,  $V_2 = 10 \text{ V}$ ,  $V_3 = 20 \text{ V}$ ,  $V_{out} = -45 \text{ V}$ ,  $R_1 = 2 \text{ k}\Omega$ ,  $R_2 = 10 \text{ k}\Omega$  and  $R_3 = 20 \text{ k}\Omega$

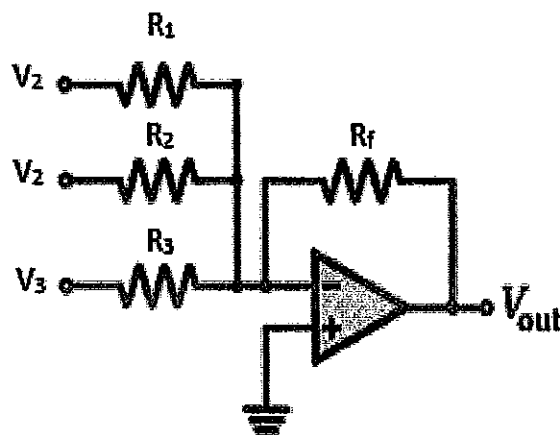


Figure Q1(b)/ Rajah Q1(b)

*Berdasarkan Rajah Q1(b), kirakan nilai perintang suapbalik,  $R_f$  jika diberikan nilai-nilai*

*$V_1 = 0.5 \text{ V}$ ,  $V_2 = 10 \text{ V}$ ,  $V_3 = 20 \text{ V}$ ,  $V_{out} = -45 \text{ V}$ ,  $R_1 = 2 \text{ k}\Omega$ ,  $R_2 = 10 \text{ k}\Omega$  and  $R_3 = 20 \text{ k}\Omega$*

[5 marks]

[5 markah]

CLO2  
C3

(c) Sketch the Ziegler-Nichols Continuous Tuning Procedure for the PID Controller.

[7 marks]

[7 markah]

## QUESTION 2

## SOALAN 2

CLO1  
C1(a) Define the terms **stable** and **unstable** in the analysis of stability system.*Takrifkan istilah stabil dan tidak stabil dalam analisis sesuatu sistem kestabilan.*

[3 marks]

[3 markah]

CLO1  
C2

(b) Based on the characteristic equation of a system given below, determine the stability of range K by using Routh Hurwitz criterion.

$$2s^3 + 8s^2 + s + 8K + 2 = 0$$

*Berdasarkan persamaan ciri bagi sebuah sistem yang diberikan dibawah, nyatakan kestabilan bagi julat K dengan menggunakan Kriteria Routh Hurwitz.*

[5 marks]

[5 markah]

CLO2  
C3

(c) Based on Figure Q2(c), determine the stability of the system under the feedback control by using the Routh Hurwitz criterion.

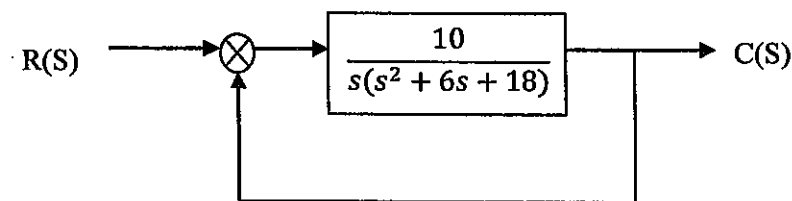
*Berdasarkan Rajah Q2(c), tentukan kestabilan bagi sistem kawalan suapbalik dengan menggunakan kriteria Routh Hurwitz*

Figure Q2(c)/ Rajah Q2(c)

[7 marks]

[7 markah]

## QUESTION 3

## SOALAN 3

CLO1  
C1(a) List **TWO (2)** parameters used in the Polar/Nyquist plot to determine the stability of the system.*Senaraikan DUA (2) parameter yang digunakan dalam plot Polar/Nyquist untuk menentukan kestabilan sesuatu system.*

[2 marks]

[2 markah]

(b) There are **TWO (2)** methods to analyze system stability which are known as Polar and Nyquist plot. Explain the Polar Plot stability analysis.*Terdapat DUA (2) kaedah untuk menganalisa kestabilan sistem iaitu Plot Kutub dan Nyquist. Jelaskan analisa kestabilan Plot Kutub.*

[5 marks]

[5 markah]

CLO2  
C3

(c) Based on the open loop transfer function below, sketch the Polar Plot by using the shortcut method.

*Berdasarkan rangkap pindah gelung terbuka dibawah, lakarkan Plot Kutub dengan menggunakan kaedah pintasan.*

$$G(s) = \frac{30}{s(1 + 0.5s)}$$

[8 marks]

[8 markah]

## QUESTION 4

## SOALAN 4

CLO1  
C1

- (a) State the meaning of the elements below in sketching the Root Locus.

*Nyatakan makna elemen-elemen dibawah dalam melakarkan Lokus Punca.*

- i. m
- ii. n
- iii. n - m

[3 marks]

[3 markah]

CLO1  
C2

- (b) Describe angles of departure from a complex pole in the Root Locus design method.

*Jelaskan Sudut berlepas dari kutub khayal dalam Kaedah Rekabentuk Lokus Punca.*

[4 marks]

[4 markah]

CLO2  
C3

- (c) Based on the open loop transfer function given, calculate the value of the angle asymptotes and centroid point.

*Berdasarkan rangkap pindah gelung terbuka yang diberikan, kirakan nilai sudut asimptot dan titik persilangan.*

$$G(s)H(s) = \frac{k(s+1)}{s(s^2+2s+5)}$$

[8 marks]

[8 markah]

## SECTION B: 40 MARKS

## BAHAGIAN B: 40 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

Based on the open loop transfer function given, draw the Bode diagram and calculate the value of gain margin, phase margin and determine the stability of the system.

$$G(j\omega)H(j\omega) = \frac{200}{j\omega(5+j\omega)(10+j\omega)}$$

(Scale y axis : 1cm: 10 dB, 1 cm: 45°)

(Scale x axis : Frequency  $\omega$  (rad/s) : 0.1, 1.0, 10 )*Berdasarkan rangkap pindah gelung terbuka yang diberi, lukiskan rajah Bode dan kirakan nilai jidar gandaan, jidar fasa dan nyatakan kestabilan sistem.*

$$G(j\omega)H(j\omega) = \frac{200}{j\omega(5+j\omega)(10+j\omega)}$$

(Skala paksi y : 1cm: 10 dB, 1 cm: 45°)

(Skala paksi x : Frequency  $\omega$  (rad/s) : 0.1, 1.0, 10 )

[20 marks]

[20 markah]

**QUESTION 2****SOALAN 2**CLO2  
C4

Draw the root locus for the transfer function of the control system given below:

*Lukiskan londar punca bagi rangkap pindah sistem kawalan diberikan seperti di bawah:*

$$H(s) = \frac{K}{s(s^2 + 4s + 8)}$$

(Scale x axis and y axis : 2cm : 1 unit)

*(Skala paksi x dan paksi y : 2cm : 1 unit)*

[20 marks]

[20 markah]

**SOALAN TAMAT**