



**FINAL
ALTERNATIVE ASSESSMENT**

(COVER PAGE)

Session : January 2022

Programme : Diploma in Electrical & Electronic Engineering (DEEI)

Course : EEE2108: Modern Control Systems Engineering

Date of Examination : 10 March 2022 (Thursday)

Time : 8.00am – 11.00am Reading Time : Nil

Duration : 3 Hours

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

Material permitted : Programmable Scientific Calculator

Materials provided : Nil

Examiner(s) : Ronald Jackson

Chief Moderator : Alan Wong Kam Mun

This paper consists of 6 printed pages, including the cover page

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
 EEE2108 MODERN CONTROL SYSTEMS ENGINEERING
 FINAL ALTERNATIVE ASSESSMENT: JANUARY 2022 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer **ALL** questions. All questions carry equal marks.

Question 1

A system with a transfer function given by,

$$G(s) = \frac{361}{s^2 + 16s + 361}$$

(a) Calculate the:

- | | |
|----------------------------|-----------|
| (i) Damping ratio, ζ | (2 marks) |
| (ii) Natural frequency | (2 marks) |
| (iii) Peak time | (2 marks) |
| (iv) Settling time | (2 marks) |
| (v) Rise time | (2 marks) |
| (vi) Percent overshoot | (2 marks) |

(b) Find the location of the second-order pair of poles for the second-order system specification below.

- | | |
|--------------------------------------|-----------|
| (i) Settling time, $T_s = 5$ seconds | (2 marks) |
| (ii) Peak time, $T_p = 2$ seconds | (2 marks) |

(c) Consider a closed-loop system is with the following transfer function

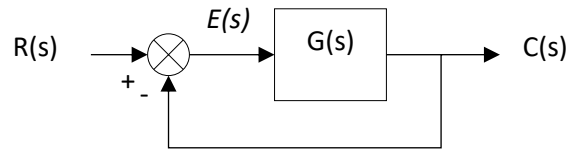
$$T(s) = \frac{s - 2}{s(s^2 + 6s + 25)}$$

- | | |
|--|-----------|
| (i) Determine the poles and zeros of $T(s)$ | (3 marks) |
| (ii) Plot the pole-zero map in the s-plane | (3 marks) |
| (iii) Is this system stable? Justify your answer | (3 marks) |

Question 2

(a) Using the Routh-Hurwitz criterion for a unity feedback system as shown in **Figure Q2**.

$$G(s) = \frac{1}{2s^4 + 5s^3 + s^2 + 2s}$$

**Figure Q2**

- (i) Find the poles in the right half-plane, left half-plane, and on $j\omega$ -axis (13 marks)
- (ii) Determine the stability of the system. (2 marks)

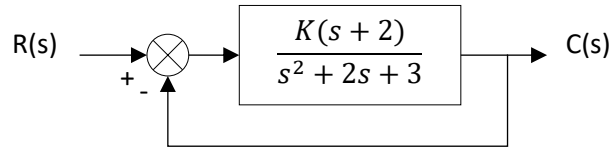
(b) For a unity feedback system with the forward transfer function given below:

$$G(s) = \frac{K(s + 20)}{s(s + 2)(s + 3)}$$

Find the range of K to make the system stable. (10 marks)

Question 3

Figure Q3 is unity feedback system.

**Figure Q3**

(a) Determine:

- | | |
|---|-----------|
| (i) The number of root-locus branches. | (1 marks) |
| (ii) The start and end points. | (2 marks) |
| (iii) The number of root-locus asymptotes. | (1 marks) |
| (iii) The angles of asymptotes made with the real-axis. | (1 marks) |
| (iv) The angle of departure. | (5 marks) |

(b) Find the break-in point. (7 marks)

(c) Sketch the root locus based on (a) and (b) above. (8 marks)

Question 4

(a) Given a transfer function of a system

$$G(s) = \frac{K(s + 3)}{s(s + 1)(s + 2)}$$

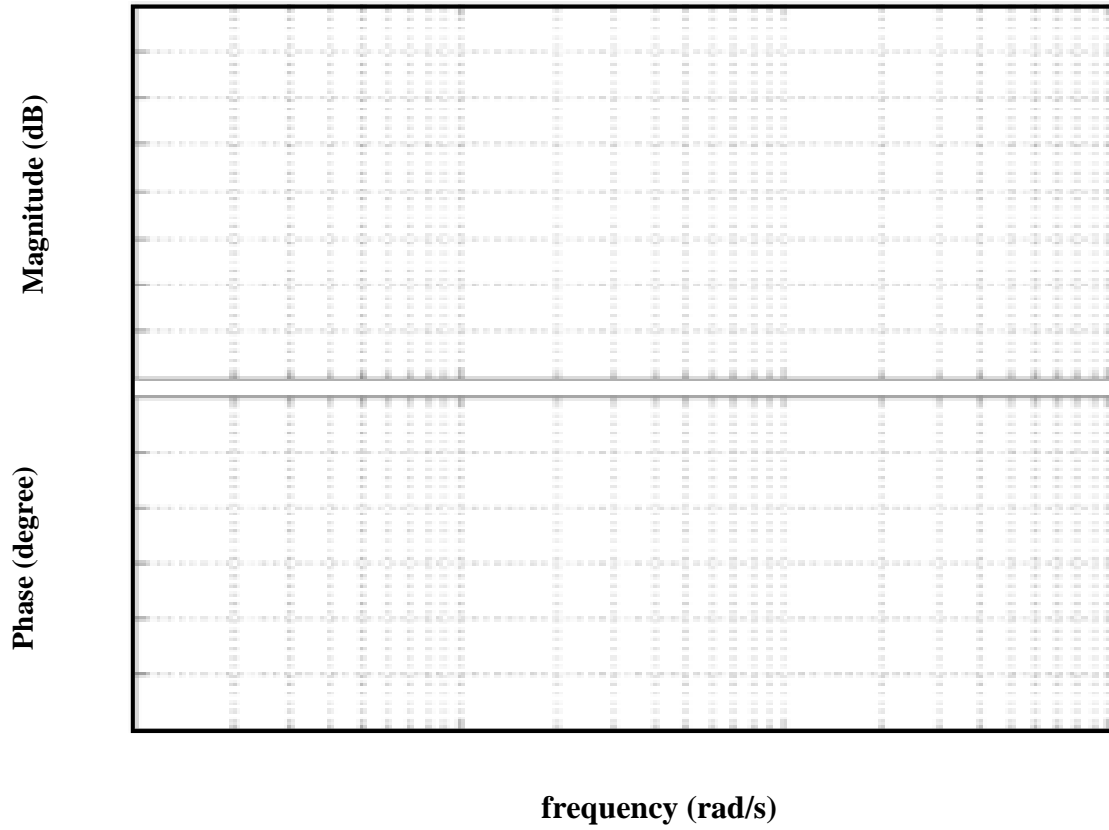
- (i) Sketch the Bode plot when $K=1$ to specify the corner frequency and slope gradient (20dB/dec). (10 marks)
- (ii) Find the gain Margin (dB) and Phase Margin (degree) from plot. (3 marks)
- (iii) Determine the stability of the system. (2 marks)

(b) Sketch the Nyquist plot for a system of

$$G(s) = \frac{3K(s + 9)}{(s^2 + 9)}$$

(10 marks)

Bode Diagram



~THE END~