



Department of Computer Systems Engineering,  
University of Engineering and Technology, Peshawar,  
Pakistan

Midterm Exam (Fall 2023)  
Time Allowed: 2 hours  
Total Pages: 2 (including this)

Course Title: Control Systems  
Course Code: CSE-310  
Max Marks: 30

**INSTRUCTIONS:**

1. Write your name and registration number on the question paper; and write your complete particulars/details as required on the front sheet of answer sheet.
2. All questions are compulsory. There are total three questions. Any question attempted twice will be marked zero.
3. Please write the same question number while attempting it and do not renumber the questions yourself.
4. This paper is closed book. All answers must be supported by facts and calculations.
5. Use blue or black ink only. Any answer or part of answer written with pencil will be marked zero.

Student Name: UMAIR ADAM Registration No: 20PNCSE1960

The following formula might be helpful in solving the problems.

$$G(s) = C(sI - A)^{-1}B + D$$

**Question 1 (10 Marks):** Compute the zeros, poles and check the stability of the following three transfer functions:

$$G_1(s) = \frac{35.2s^2 + 14s - 365}{(s+3)(s-2)(s+15)}$$

$$G_{191}(s) = \frac{1}{(s+365.32)(s+298345)(s+15011)}$$

$$H_1(s) = (s-365.32)(s-298345)(s-15011)$$

**Question 2 (10 marks):** A transfer function can be converted into state-space model using canonical form. We have different types of canonical forms. Let  $G(s)$  be a transfer function whose canonical form is given as follows:

$$G(s) = \frac{b_3s^3 + b_2s^2 + b_1s + b_0}{s^4 + a_3s^3 + a_2s^2 + a_1s + a_0}$$

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ -a_0 & -a_1 & -a_2 & -a_3 \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \end{bmatrix}$$

$$C = [b_0 \quad b_1 \quad b_2 \quad b_3], \quad D = [0]. \quad (1)$$

Consider the system as shown in Figure 1, where  $R(s)$  is the input,  $C(s)$  is the output and the symbol  $\Sigma$  denotes the summer or summing junction. Obtain the state-space representation of the system shown in Figure 1, using the above canonical form expressed in Equation (1).

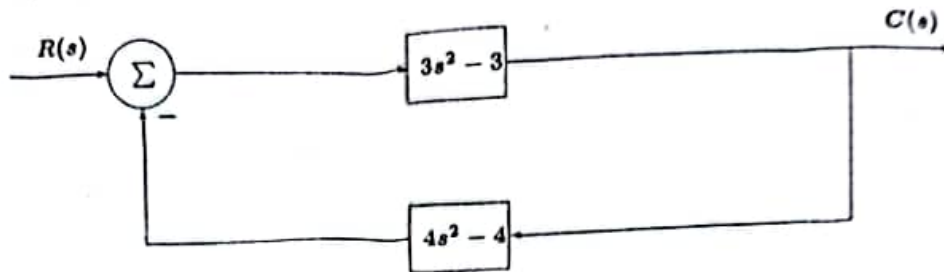


Figure 1: Figure to consider for solving Question 2

Question 3 - CLO2 (10 marks): The step response of a first order transfer function is shown in Figure 2. Analyze the step response and estimate the transfer function of the system from the step response shown in Figure 2.

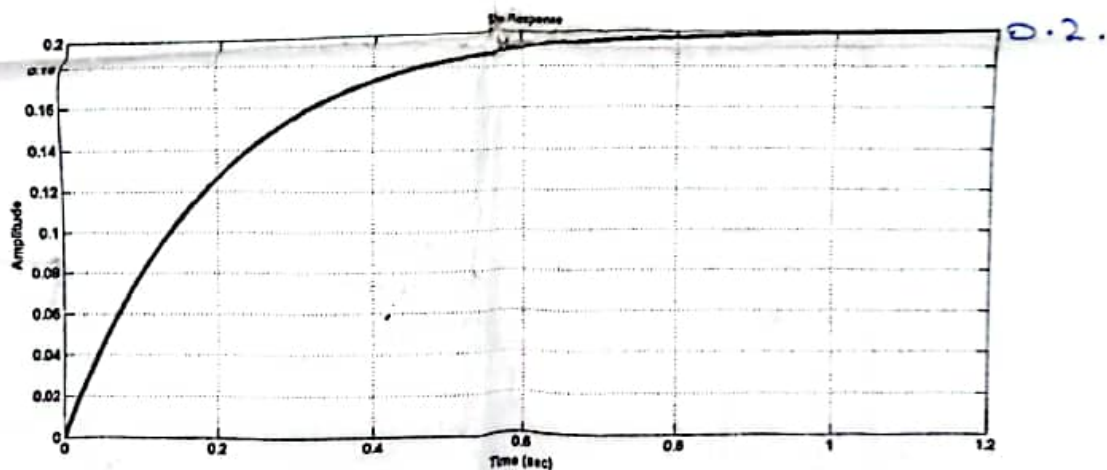


Figure 2: Figure to consider for Question 3



Department of Computer Systems Engineering,  
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Pakistan

Final Term Exam (Fall 2023)  
Time Allowed: 2 hours  
Total Pages: 2 (including this)

Course Title: Control Systems  
Course Code: CSE-310  
Max Marks: 50

**INSTRUCTIONS:**

1. Write your name and registration number on the question paper; and write your complete particulars/details as required on the front sheet of answer sheet.
2. All questions are compulsory. There are total four questions. Any question attempted twice will be marked zero.
3. Please write the same question number while attempting it and do not renumber the questions yourself.
4. This paper is closed book. All answers must be supported by facts and calculations.
5. Use blue or black ink only. Any answer or part of answer written with pencil will be marked zero.

Student Name: ..... Registration No: .....

The following formula might be helpful in solving the problems.

$$P = [B \quad AB \quad A^2B \quad \dots \quad A^{n-1}B]$$

$$Q = \begin{bmatrix} C \\ CA \\ CA^2 \\ \vdots \\ CA^{n-1} \end{bmatrix}$$

$$G(s) = C(sI - A)^{-1}B + D$$

Question 1 (10 Marks): Consider the following system:

$$\begin{aligned}\dot{x}(t) &= Ax(t) + Bu(t) \\ y(t) &= Cx(t).\end{aligned}$$

where

$$A = \begin{bmatrix} 0 & 3 & 1 \\ 2 & 8 & 1 \\ -10 & -5 & -2 \end{bmatrix}, B = \begin{bmatrix} 10 \\ 0 \\ 0 \end{bmatrix}, C = [1 \ 0 \ 0]$$

Is the following system stable? Also find out how many poles are in the left half-plane and right half-plane. Your answer must be supported by some calculations and facts.

Question 2 (10 Marks): Using the Routh-Hurwitz criterion, tell whether the following transfer function is stable or not for value of  $K = 1.55$ .

$$P(s) = \frac{K^2 - 15K}{s(s^2 + s + 1)(s + 2) + K}$$

Question 3 (20 Marks): Consider the following system:

$$\begin{aligned}\dot{x}(t) &= Ax(t) + Bu(t) \\ y(t) &= Cx(t).\end{aligned}$$

where

$$A = \begin{bmatrix} -2 & 0 \\ 0 & 1 \end{bmatrix}, B = \begin{bmatrix} 2 \\ 1 \end{bmatrix}, C = [3 \ 0]$$

It seems that the above system is unstable. Is it possible to stabilize the system using a suitable controller? (Your answers should be based on facts and calculations.) If it is possible to stabilize the above system, then design a suitable controller  $K$  or  $L$ .

Guide for choosing desired location of controller eigenvalues: Consider registration number 15PWCSE1234, then  $f = 1, g = 2, h = 3, i = 4$ . Choose your controller poles as  $(-f \times 2, -g \times 2, -h \times 2, -i \times 2)$  and observer eigenvalues as  $(-f \times 10, -g \times 10, -h \times 10, -i \times 10)$ . Use your own registration number instead of 15PWCSE1234.

Question 4 (10 Marks): Consider the following second order system:

$$\begin{aligned}\dot{x}(t) &= Ax(t) + Bu(t) \\ y(t) &= Cx(t).\end{aligned}$$

where

$$A = \begin{bmatrix} 1 & -1 \\ 1 & 1 \end{bmatrix}, B = \begin{bmatrix} k_1 \\ k_2 \end{bmatrix}, C = [k_3 \ k_4]$$

Determine the range of values for  $k_1, k_2, k_3$  and  $k_4$  such that this system is controllable and observable.



Professional Ethics

*[Signature]*

Marks: 20

Time: 2hrs

Note: Attempt All the questions.

- Q1. **Define** moral dilemma and elaborate different types of dilemma with example.  
[CLO-1] (5)
- Q2. Below is a list of scenarios to present for students to **explain and debate**. They are based primarily on ethics and logical reasoning. They will encourage students to take a stand and defend their viewpoint. Students can circle an answer and then explain their choice in writing. [CLO-1] (Answer will not be more than four lines) (2.5+2.5=05)
1. Suppose that you and your close friend both are working with an organization. Employer of the organization trust you and your friend, and often share extremely confidential documents. One day you came to know that you friend is going to share that documents with the opponent to gain some more money and pay medical bills for his only child surgery. Should you: A) report it to the employer, B) Ask your friend not share the documents, C) Not get involved at all.
  2. During Covid-19 pandemic outbreak the government has ordered to release Rs.1200 for each family. If you, as District officer, are requested by your relative to release Rs.2400 for him. You do not want to spoil your relationship with him. Under such circumstances, how would you deal with the situation? A) Release the extra amount of money which your relative has requested for. B) Refuse your relative the extra amount and strictly follow the rules. C) Show your relative the copy of the Government instructions and then persuade him to accept the amount as prescribed?
- Q3. **Analyze** different stages of moral development and Maslow's hierarchy of needs.  
[CLO-1] (5)
- Q4. **Investigate** how engineers are responsible experimenters. [CLO-2] (5)

GOD LUCK

UNIVERSITY OF ENGINEERING & TECHNOLOGY PESHAWAR  
Department of Computer System Engineering, 7<sup>th</sup> Semester, Final Term Examination Fall-2023  
**Professional Ethics**

Time: 2hrs

Marks: 50

Note: Attempt All the questions.

- Q1. **Elucidate** the role of duty ethics plays in shaping the ethical responsibilities of professionals in their respective fields. [CLO-1] (12.5)
- Q2. How does utilitarianism **apply** to engineering decisions with regards to maximizing overall benefits for society? [CLO-1] (12.5)
- Q3. In your **analysis**, how do you see the impact of protecting individual human rights on fostering global peace and cooperation? [CLO-2] (12.5)
- Q4. What ethical **considerations** arise in the context of <sup>Contract</sup>~~constitutional~~ law, and how do they influence legal decision-making? [CLO-2] (12.5)

GOOD LUCK



Note: Attempt all questions on the answer sheet. Try to be concise in your answers and not write examples which have no meaning to the question being asked.

**Question No. 1 (Marks=5) (CLO-1)**

What is your understanding of the "Bathtub Curve", and "Idealized Curve". How do they differentiate from one another. Give an example to clear this concept.

**Question No. 2 (Marks=5) (CLO-2)**

Describe a process framework in your own words. When we say that framework activities are applicable to all projects, does this mean that the same work tasks are applied for all projects, regardless of size and complexity? Explain.

**Question No. 3 (Marks=5) (CLO-2)**

What are the advantages and disadvantages of developing software in which quality is "good enough"? That is, what happens when we emphasize development speed over product quality?

**Question No. 4 (Marks=5) (CLO-2)**

Is it possible to combine process models? Which phases are similar and which are different? Give an example showing your understanding of the question.