



Course Title: Control Systems

Date: 2/6/2024

Course No: (610414+620443+640344)

Time allowed: 2 hours

Lecturer: Dr. Mohammed Mahdi

No. of Pages: 6

Q1 / 10	Q2 / 10	Q3 / 10	Q4 / 10	Total / 40

Question 1:**(10 Marks)****Objectives: Multiple choices about control systems concepts.**

1. PID effect is used in:

A) Existing of oscillation

B) Existing of steady state error

C) Existing of low speed response

D) All of the given choices

2. Given the characteristics equation $1+G(s) = s^3 + s^2 + 2s + 24 = 0$. The number of unstable roots are:

A) 1

B) 2

C) 3

D) None of the given

3. The system characteristics equation of $1 + k \frac{1}{s(s+1)(s+5)}$ has the breakaway point on x-axis at:

A) - 3.527

B) - 0.472

C) - 2.5486

D) None of the given

4. For the system $\frac{C(s)}{R(s)} = \frac{0.5}{(s^2+6s+9)}$ the settling time t_s (2%) sec. equals:

A) 0.115

B) 1.15

C) 11.5

D) None of the given

5. Given $\frac{Y(s)}{R(s)} = \frac{5}{s^2+2s+25}$ then for unit step input:A) $Y(0) = 0.2, Y(\infty) = 0$ B) $Y(0) = 0.2, Y(\infty) = \infty$ C) $Y(0) = 0, Y(\infty) = 0.2$

D) None of the given

Question 2:**(10 Marks)**

Objectives: This question is about calculating time response specifications and PID controller.

Given transfer function: $\frac{C(s)}{R(s)} = \frac{25}{s^2 + 5s + 25}$ It is required to calculate:

1. Kind of step response using **two methods**. (4 Ms).
2. Calculate **rising time, peak time, (Mp%), and settling time (5%)**. (4 Ms).
3. Which of the **PID controller combination** is better to use for unit step change in input?
Why? (2 Ms).

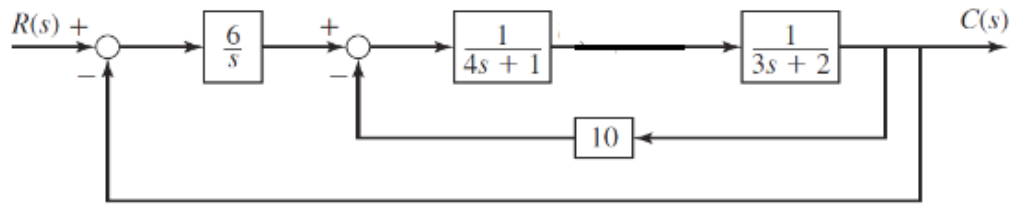
Question 3:

(10 Marks)

Objectives: This question is about 1st order system response and Mason's Gain formula.

A) Given transfer function of first order control systems $\frac{Y(s)}{R(s)} = \frac{1}{s+2}$ It is required to **directly find** its unit impulse and unit step responses. (5 Marks)

B) Given the following block diagram, apply Mason's Gain Formula to find transfer function $C(s) / R(s)$. (5 Marks)



Question 4:

(10 Marks)

Objectives: This question is about absolute stability and Root Locus.

- A) For the following characteristics equation, apply **Routh-Herwitz criterion to find the range of the gain k for stability.** (5 Marks)

$$s^4 + 3s^3 + 4s^2 + s + k = 0$$

B) Given: $1 + k \frac{(s+1)}{s(s+2)(s+4)(s+6)} = 0$ it is required to calculate **the first three steps**
of root locus. (5 Marks)

