



Islamic University of Gaza
Electrical Engineering Department
EELE 3360 Control Systems
Incomplete Final Exam
December 1, 2025

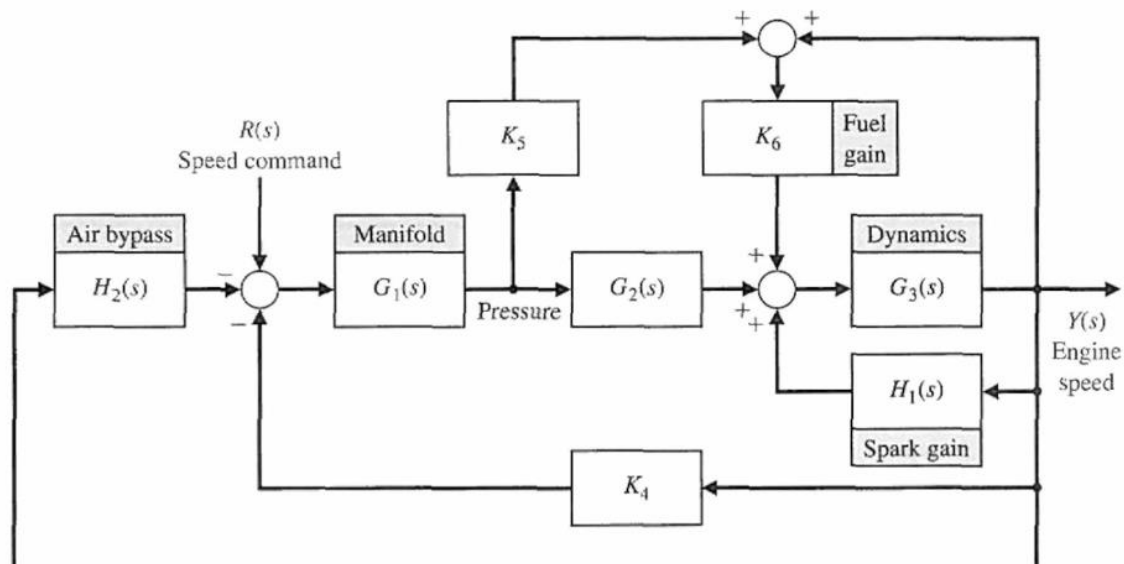
Dr. Basil Hamed

Exam Time: 10:00-1:00

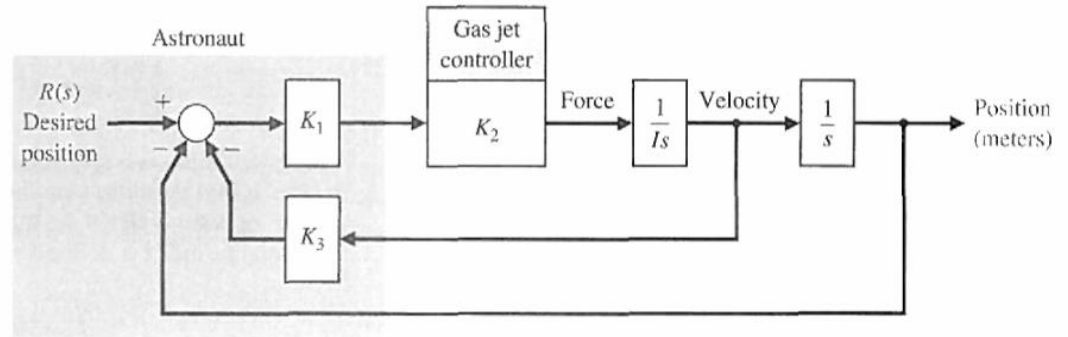
Name	
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GOOD Luck

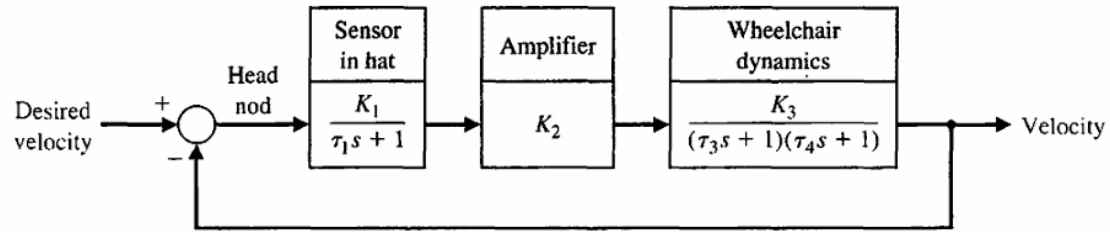
1. For system given in the Figure, find Transfer Function using Mason Gain Formula. $T(s) = \frac{Y(s)}{R(s)}$ (10 PT)



2. The gas-jet propulsion device illustrated in Figure below; the controller can be represented by a gain K_2 the moment of inertia (I) of the equipment and man is 25 kg m^2
- Determine the necessary gain K_3 to maintain a steady-state error equal to 1 cm when the input is a ramp $r(t) = t$ (meters). (5 PT)
 - With this gain K_3 , determine the necessary gain $K_1 K_2$ in order to restrict the percent overshoot to 10% (5PT)



3. The block diagram of a control system with feedback is shown in Figure below, typical values for the time constants are $\tau_1 = 0.5$ s, $\tau_3 = 1$ s, and $\tau_4 = 1/4$ s
- Determine the limiting gain $K = K_1 K_2 K_3$ for a stable system. (5 PT)
 - When the gain K is set equal to one-third of the limiting value, determine the settling time (5 PT)



4. A system is given

$$\dot{\mathbf{x}}(t) = \mathbf{A}\mathbf{x}(t) + \mathbf{B}u(t)$$

$$y(t) = \mathbf{C}\mathbf{x}(t)$$

where

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

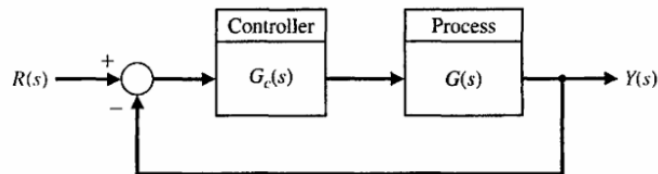
Compute and plot the root locus as $0 < K < \infty$. For what values of K is the system stable?

(8 PT)

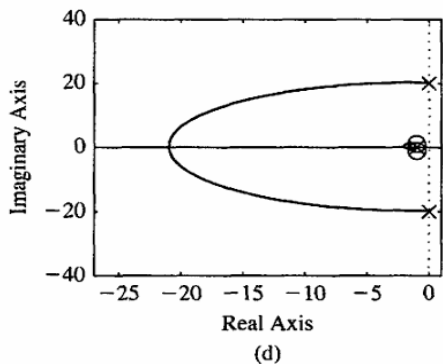
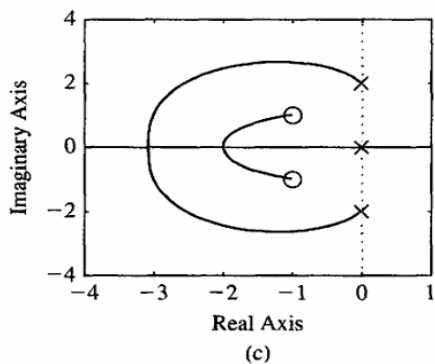
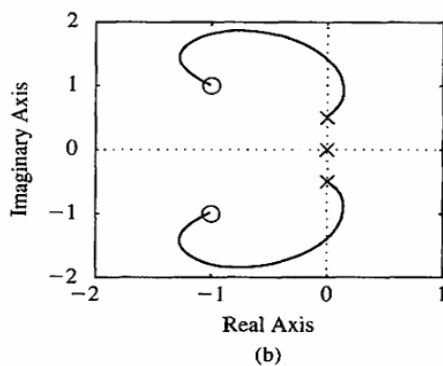
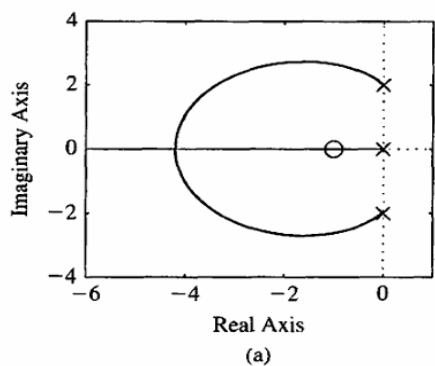
5. In the following True or False and Multiple Choice problems, circle the correct answer.

- A type-1 system has a zero steady-state tracking error to a ramp input. (True or False) (2PT)
- The number of zeros of the forward path transfer function at the origin is called the type number. (True or False) (2PT)
- The Routh-Hurwitz criterion is a necessary and sufficient criterion for determining the stability of linear systems. (True or False) (2PT)
- The root locus always starts at the zeros and ends at the poles of $G(s)$. (True or False) (2PT)
- The roots of the characteristic equation are the poles of the closed-loop system. (True or False) (2PT)
- consider the feedback system in Figure below, where (4 PT)

$$L(s) = G_c(s)G(s) = \frac{K(s + 1 + j)(s + 1 - j)}{s(s + 2j)(s - 2j)}.$$



Which of the following is the associated root locus?



- vii. A single-input, single-output system has the state variable representation (4 PT)

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -5 & -10 \end{bmatrix} \mathbf{x} + \begin{bmatrix} 1 \\ 0 \end{bmatrix} u$$

$$y = [0 \quad 10] \mathbf{x}$$

The transfer function of the system $T(s) = Y(s)/U(s)$ is

a. $T(s) = \frac{-50}{s^3 + 5s^2 + 50s}$

b. $T(s) = \frac{-50}{s^2 + 10s + 5}$

c. $T(s) = \frac{-5}{s + 5}$

d. $T(s) = \frac{-50}{s^2 + 5s + 5}$

- viii. Compute the minimal value of K so that the steady-state error due to a unit step disturbance is less than 10%. (4PT)

$$G_c(s) = K, \text{ and } G(s) = b/(s+1)$$

a. $K = 1 - \frac{1}{b}$

b. $K = b$

c. $K = 10 - \frac{1}{b}$

d. The steady-state error is ∞ for any K

