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Question: For each of the transfer functions shown below, find the locati...

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For each of the transfer functions shown below, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on).

6. For each of the transfer functions shown below, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on). [Sections: 4.3, 4.4]

$$a. T(s) = \frac{2}{s+2}$$

$$b. T(s) = \frac{5}{(s+3)(s+6)}$$

$$c. T(s) = \frac{10(s+7)}{(s+10)(s+20)}$$

$$d. T(s) = \frac{20}{s^2+6s+144}$$

$$e. T(s) = \frac{s+2}{s^2+9}$$

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

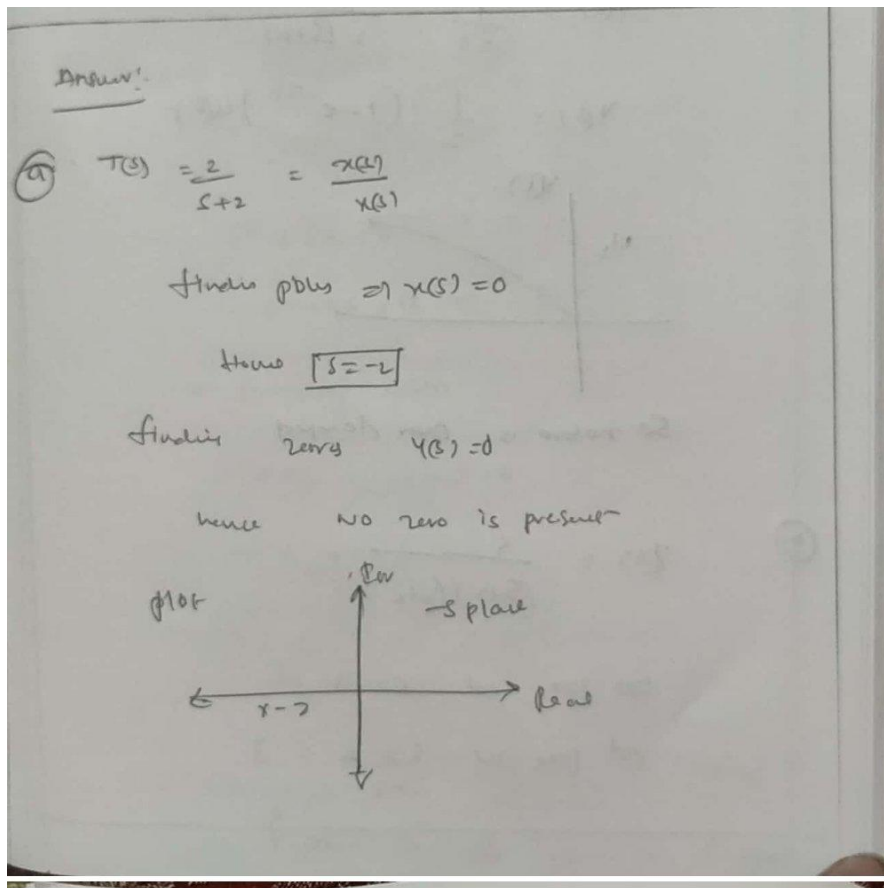
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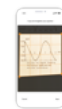
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Input $u(t) \rightarrow \frac{1}{s}$

$$Y(s) = \frac{Y(s)}{X(s)} = \frac{1}{s+2}$$

$$Y(s) = \frac{1}{(s+2)} \times \frac{1}{s}$$

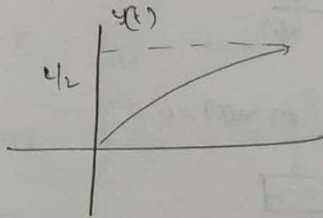
$$Y(s) = \frac{1}{s(s+2)}$$

Partial fraction expansion

$$Y(s) = \frac{1}{s(s+2)}$$

$$Y(s) = \frac{1}{2s} - \frac{1}{2(s+2)}$$

$$y(t) = \frac{1}{2} (1 - e^{-2t}) u(t)$$



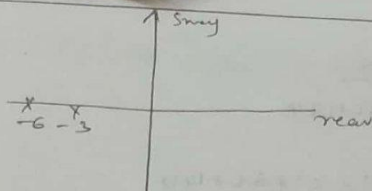
So nature is over damped

(b)

$$Y(s) = \frac{s}{(s+3)(s+6)}$$

one pole at $s = -3$

and pole at $s = -6$



Step response

$$Y(s) = \frac{s}{(s+3)(s+6)}$$

$$Y(s) = \frac{s}{(s+3)(s+6)} \times \frac{1}{s}$$

⇒ System characteristic Equation

$$(s+3)(s+6) = 0$$

$$s^2 + 6s - 3s + 18 = 0$$

$$s^2 + 9s + 18 = 0$$

on comparing with

$$s^2 + 2\zeta\omega_n s + \omega_n^2 = 0$$

$$\omega_n^2 = 18$$

$$\omega_n = \sqrt{18} = 4.2426$$

$$2\zeta\omega_n = 9$$

$$\zeta = \frac{9}{2\omega_n} = \frac{9}{2 \times 4.2426} = 1.0606$$

$\zeta > 1$ is So system over damped.

(d)

$$G(s) = \frac{20}{s^2 + 6s + 144}$$

Denominator $q(s) = s^2 + 6s + 144$

Roots of denominator $q(s)$ is

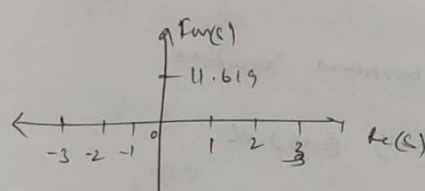
$$s = \frac{-6 \pm \sqrt{6^2 - 4(144)}}{2} = -3 \pm j11.619$$

$$s_1 = -3 + j11.619i$$

$$s_2 = -3 - j11.619i$$

Numerator $n(s) = 20$

∴ No zeros the transfer function



\Rightarrow We know that when poles of system are in the form of

$$s = \sigma_x \pm j\omega_x \quad \text{--- (2)}$$

It is under damped system
 general form of step response

$$c(t) = k_1 + a e^{-\sigma_x t} \cos(\omega_x t - \phi)$$

By comparing Equation (1) and (2)

$$\sigma_x = 3 \quad \omega_x = 11.6199$$

$$c(t) = k_1 + a e^{-3t} \cos(11.619t - \phi)$$

(E)

$$T(s) = \frac{s+2}{s^2+9}$$

$$s^2 + 9 = 0$$

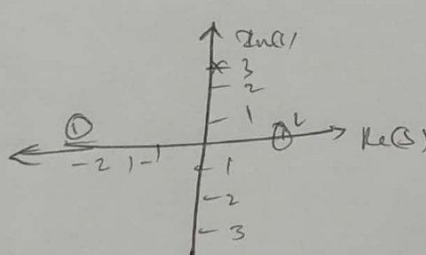
$$s = \pm 3i$$

$$s_1 = 3i \quad s_2 = -3i$$

Numerator $n(s) = s+2$

$$s+2 = 0$$

$s = -2$ is the zero of system



Now!

We know the poles of the system are in the form of

$$s = \pm j\omega \quad \text{--- (4)}$$

It is under damped system



$$C(t) = K_1 + A \cos(\omega_1 t - \phi)$$

By comparing Equation (3) and (4),

$$\omega_1 = 3$$

$$C(t) = K_1 + A \cos(3t - \phi)$$

=====

As per chess guide lines we have to solve only 4 sub part I did (a), (b), (d), (e) hope u understand pls pls upvote thank you -

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Q: Problem 3.0 For each of the transfer functions shown below, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on). a. $T(s) = s + 2$ b. $T(s) =$

A: [See answer](#) 100% (1 rating)

Q: Q6 For each of the transfer functions shown below, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on) 10(s+7) c. $T(s) = \frac{T+10}{(s+20)}$ 20 $s^2+6s+144$ $s+2$ $(s+10)$

A: [See answer](#)

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form of the step response with details.

For each of the transfer functions shown below, find the locations of the poles and zeros, plot them on the s-plane, and then write an expression for the general form of the step response without solving for the inverse Laplace transform. State the nature of each response (overdamped, underdamped, and so on). [Sections: 4.3, 4.4]

$T(s) = \frac{5}{s+2}$ a. $T(s) = \frac{1}{s+2}$
[See answer](#)

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Q: Please explain how to find the general form of the step response with details.

A: [See answer](#) 100% (1 rating)

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A: [See answer](#) 100% (1 rating)

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