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

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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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Expert Answer

Anonymous answered this
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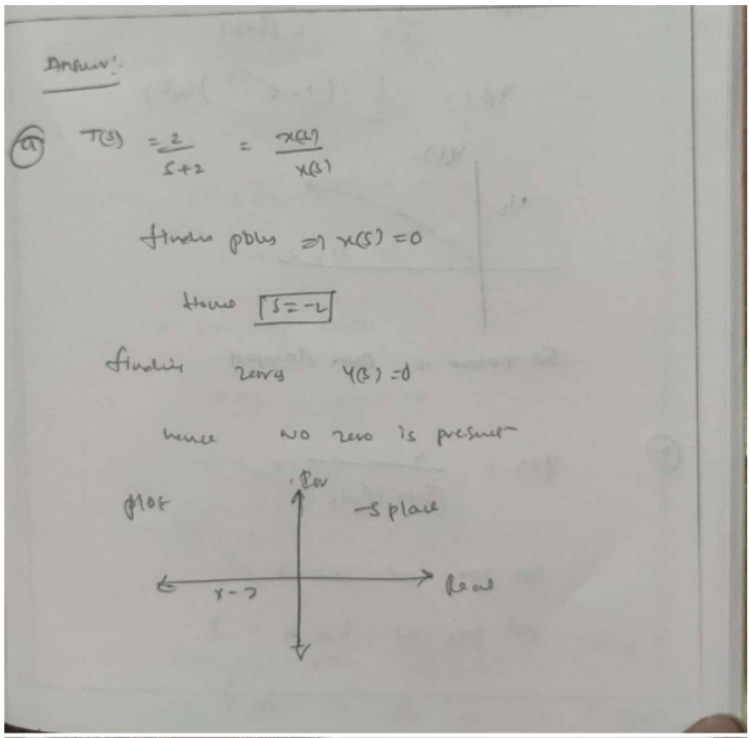
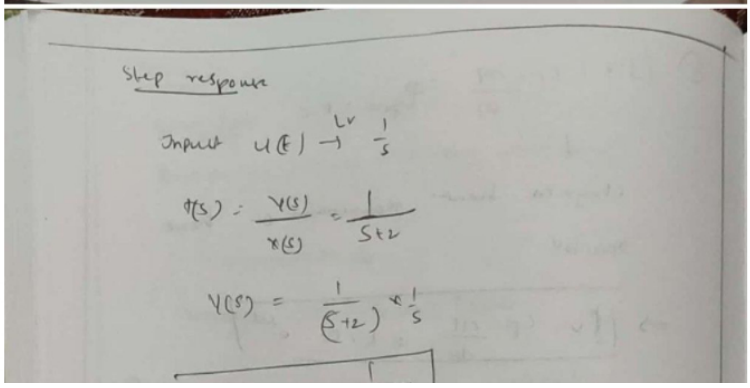


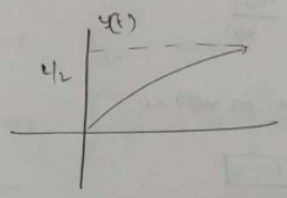


$$Y(s) = \frac{1}{s(s+2)}$$

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

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

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

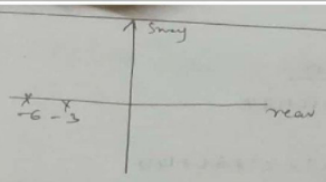


So nature is over clamped

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

one pole at $s = -3$

and pole at $s = -6$



Step response

$$T(s) = \frac{Y(s)}{X(s)} = \frac{5}{(s+3)(s+6)}$$

$$x(t) = u(t) \xrightarrow{LT} X(s) = \frac{1}{s}$$

$$Y(s) = \frac{5}{(s+3)(s+6)} \times \frac{1}{s}$$

⇒ System characteristic equation

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

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

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

on comparing with

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

$$\omega^2 = 18$$

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

$$2\xi\omega_n = 9$$

$$\xi_1 = \frac{9}{2\omega_n} = \frac{9}{2\times 9.242} = 1.060$$

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

(d)

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

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

Roots of denominator $q(s)$ is

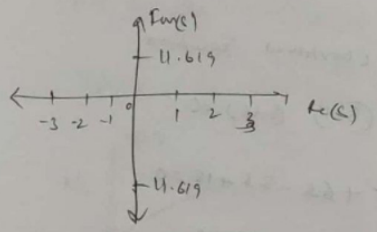
$$s = \frac{-6 \pm \sqrt{6^2-4(144)}}{2} = -3 \pm j\,11.619$$

$s_1 = -3 + 11.619\,i$

$s_2 = -3 + 11.6191\,i$

Numerator $n(s) = 20$

∴ No zeros the transfer function



⇒ We know that when pole of system are in the form of

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

If is under damped system

general form of its step response

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

By comparing Equation (1) and (2)

$\sigma_x = 3$ $\omega_x = 11.619$

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

(e)

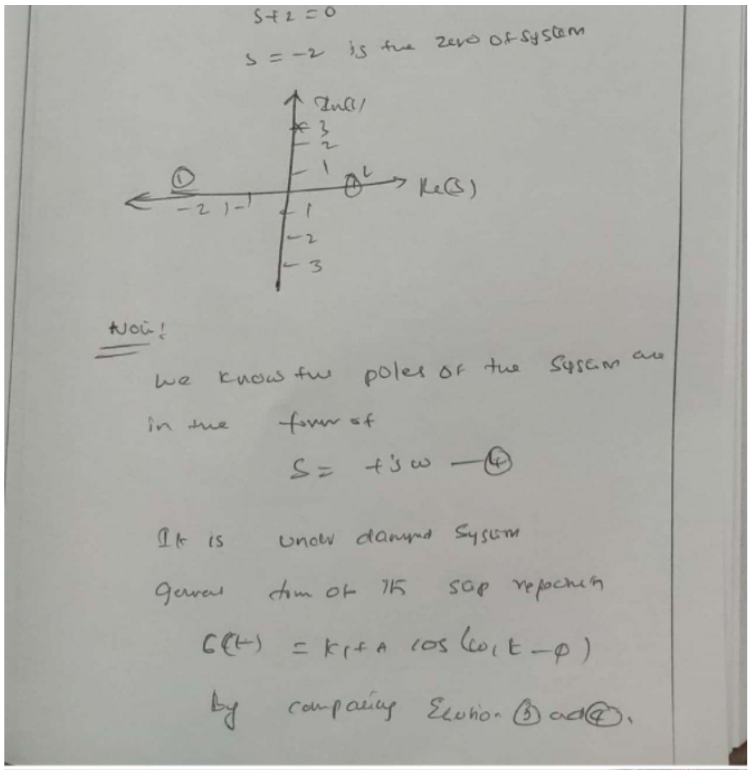
$$T(s) = \frac{s+2}{s^2+9}$$

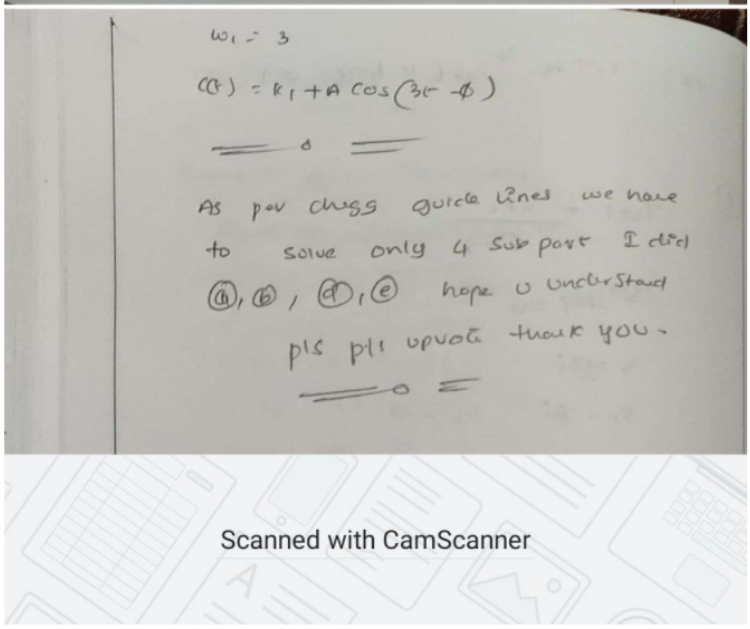
$s^2+9 = 0$

$s = \pm 3i$

$s_1 = 3i$ $s_2 = -3i$

Numerator $n(s) = s+2$





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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)- T +10)(s +20) 20 s2+6s+144 s+2 (s + 10

A: See answer

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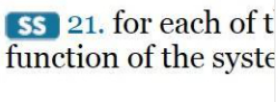
For each of the three unit step responses shown in Figure P4.7, find the transfer function of the system. [Sec...



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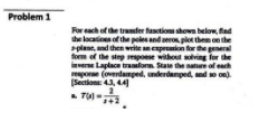
For each of the transfer functions shown below, find the locations of the poles and zeros, plot than on the j-pla...



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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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