

EE3114 HW-2 Solutions

2-1 Find the impulse response of the system with transfer function from input to output given by

$$H(s) = \frac{2s + 1}{s^2 + 3s + 2}$$

(3 points)

SOLUTION:

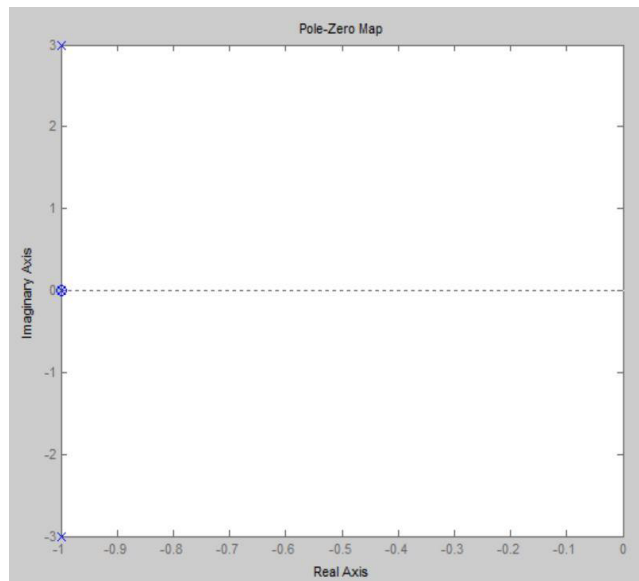
$$H(s) = \frac{2s + 1}{s^2 + 3s + 2} = \frac{3}{s + 2} + \frac{-1}{s + 1}$$

$$h(t) = \mathcal{L}^{-1}(H(s)) = (3e^{-2t} - e^{-t})u(t)$$

REMARKS:

1. $h(t) = \begin{cases} 3e^{-2t} - e^{-t} & t \geq 0 \\ 0 & t < 0 \end{cases}$ is also right.
2. Students who only got 2 points missed the unit step $u(t)$.

2-2 Given the following pole-zero map:



Find its corresponding ordinary differential equation. **(3 points)**

SOLUTION:

Zero $-1 + 0j$

Poles $-1 + 0j, -1 \pm 3j$

Transfer Function

$$\frac{Y(s)}{U(s)} = \frac{s + 1}{(s + (1 + 3j))(s + (1 - 3j))(s + 1)}$$

Then

$$(s + (1 + 3j))(s + (1 - 3j))(s + 1)Y(s) = (s + 1)U(s),$$

$$(s^3 + 3s^2 + 12s + 10)Y(s) = (s + 1)U(s).$$

Ordinary Differential Equation

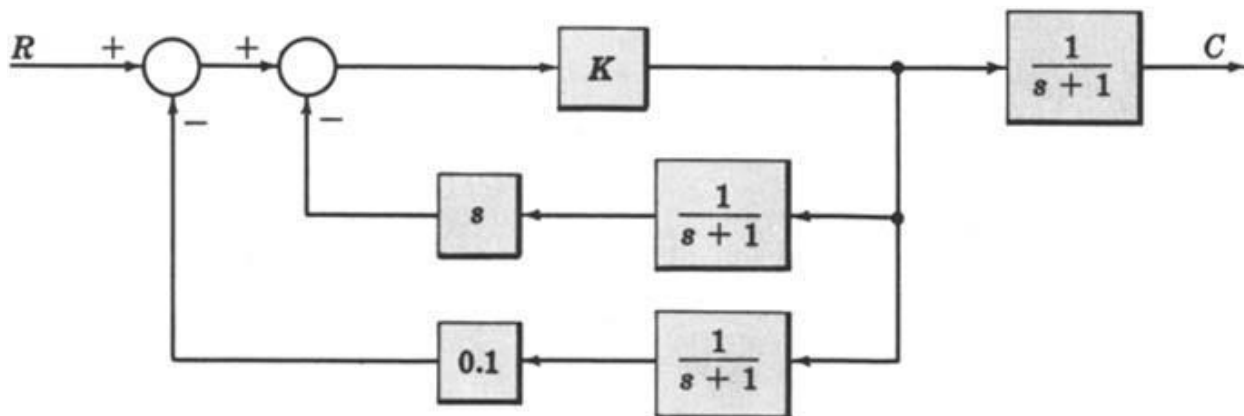
$$\frac{d^3y(t)}{dt^3} + 3\frac{d^2y(t)}{dt^2} + 12\frac{dy(t)}{dt} + 10y(t) = \frac{du(t)}{dt} + u(t)$$

REMARKS:

Students who got 1 point missed the zero or pole $-1 + 0j$.

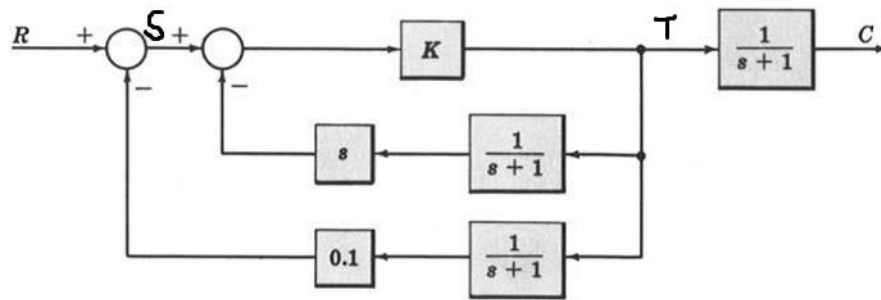
Students who got 2 points did the zero-pole cancelation on the transfer function.

2-3 From the following block diagram, find the transfer function from input R to output C:



(4 points)

SOLUTION:



Transfer Function

$$H_1(s) = \frac{T(s)}{S(s)} = \frac{K}{1 + K \frac{s}{s+1}} = \frac{Ks + K}{(K+1)s + 1}$$

$$H_2(s) = \frac{T(s)}{R(s)} = \frac{H_1(s)}{1 + H_1(s) \frac{0.1}{s+1}} = \frac{Ks + K}{(K+1)s + 1 + 0.1K}$$

$$\frac{C(s)}{R(s)} = \frac{1}{s+1} H_2(s) = \frac{K}{(K+1)s + 1 + 0.1K}$$

REMARKS:

Students who got 2 points because they did not derive the right results.

Students who got 3 points because they did not finish the simplification of the final results.