

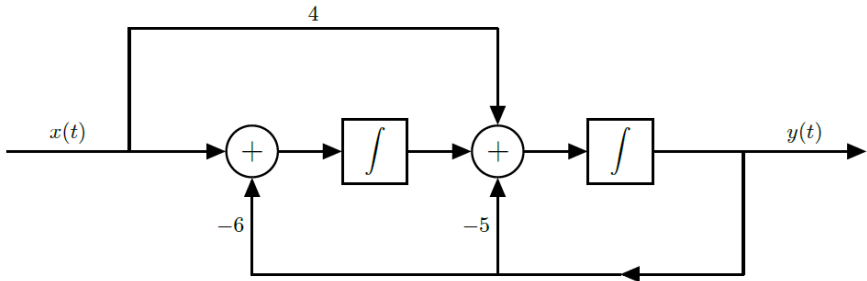
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Question: (20 pts) This is an LTI system: 4 a(t) g(t) + s + us -6 -5 (a) Firstly ...

(20 pts) This is an LTI system:



- (a) Firstly determine the differential equation that represents the system above
- (b) Determine the frequency response of the system.
- (c) Determine the Impulse response of this system from its frequency response.
- (d) (5 pts) Find the output $y(t)$ for the input $x(t) = \frac{1}{4}e^{-t/4}u(t)$ using the frequency response.

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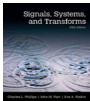
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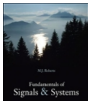
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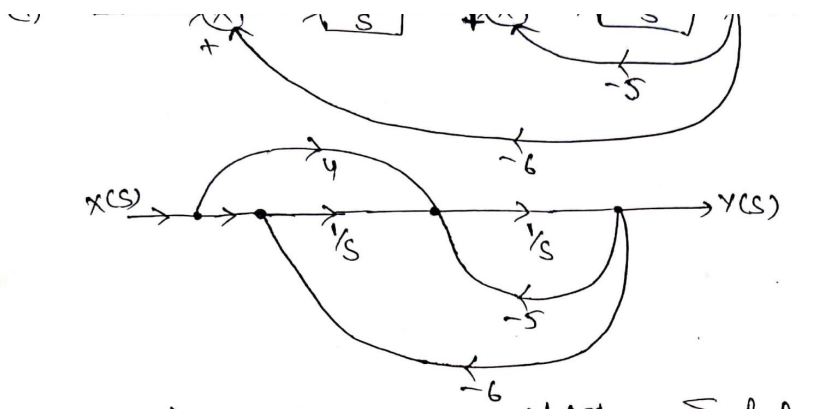
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transfer function $G(s) = \frac{Y(s)}{X(s)} = \frac{\sum_k P_k \Delta_k}{\Delta}$

k = no. of forward path, P_k = the k th forward path gain

$\Delta = 1 - (\sum \text{loop gains}) + (\sum \text{non-touching loop gain taken two at a time}) - \dots$

$\Delta_1 = 1$ $P_1 = \frac{4}{s}$

$\Delta_2 = 1$ $P_2 = \frac{1}{s^2}$

L = loop gain

$L_1 = \frac{-5}{s}$, $L_2 = \frac{-6}{s^2}$

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$$G(s) = \frac{Y(s)}{X(s)} = \frac{\frac{4}{s} + \frac{1}{s^2}}{1 + \frac{5}{s} + \frac{6}{s^2}}$$

$$\frac{Y(s)}{X(s)} = \frac{4s+1}{s^2+5s+6} = \frac{-7}{s+2} + \frac{11}{s+3}$$

differential equation

$$Y(s)(s^2+5s+6) = (4s+1)X(s)$$
$$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 6y(t) = 4\frac{dx(t)}{dt} + x(t)$$

(b) $G(j\omega) = \frac{j4\omega + 1}{(j\omega)^2 + j5\omega + 6}$

(c) apply inverse laplace transform

$$g(t) = -7e^{-2t}u(t) + 11e^{-3t}u(t).$$

(d) $x(t) = \frac{1}{4}e^{-t/4}u(t)$

$$X(s) = \frac{1}{4} \times \frac{1}{s + \frac{1}{4}}$$
$$Y(s) = \frac{-7}{4(s+2)(s+\frac{1}{4})} + \frac{11}{4(s+3)(s+\frac{1}{4})}$$
$$Y(s) = \frac{1}{s+2} - \frac{1}{s+3}$$

apply inverse laplace transform

$$y(t) = (e^{-2t} - e^{-3t})u(t).$$

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Q: (20 pts) This is a LTI system defined by the frequency response below: $H(j\omega) = j\omega + 4 - \omega^2 + 5j\omega + 6$ (a) Firstly determine the differential equation that represents the system above. (b) Determine the impulse response of the system. (c) Find $Y(j\omega)$ when the input is $x(t) = e^{-4t}u(t) - te^{-4t}u(t)$. d) Find the output $y(t)$

A: [See answer](#)

Q: Compute the discrete-time Fourier series coefficients, and sketch the magnitude and phase spectra for the signals below.

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

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