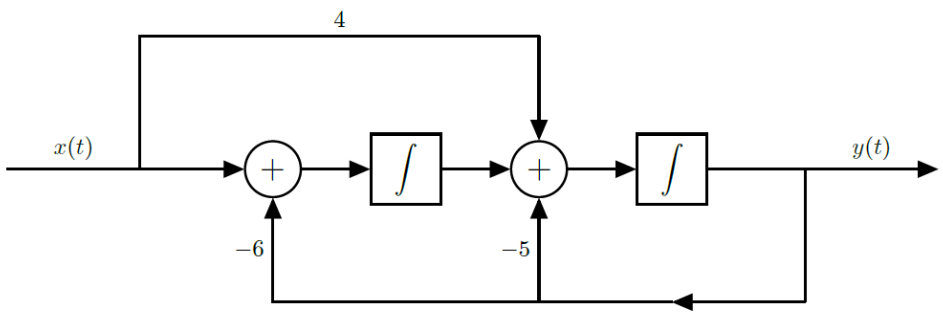
Question: DON'T USE LAPLACE; This is an LTI system. 4 x(t) g(t) + TH + T...

DON'T USE LAPLACE ; This is an LTI system.



(a) Find the differential equation which represents this system.

(b) Find the frequency response of this system.

(c) Find 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.

PLEASE, DON'T USE LAPLACE TRANSFORM

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Expert Answer

Anonymous answered this
805 answers

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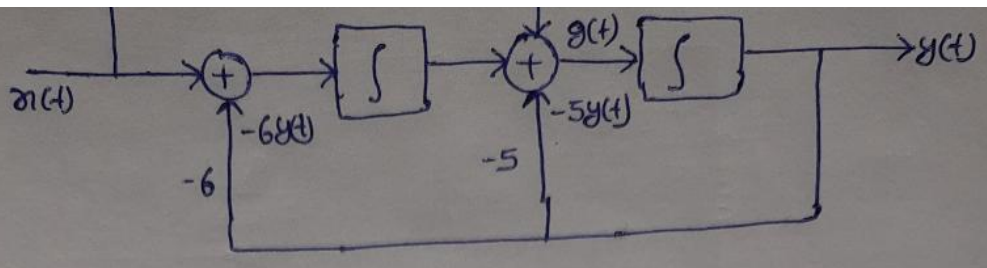


(a) $g(t) = 4x(t) - 5y(t) + \int [x(t) - 6y(t)]\,dt$

& $y(t) = \int g(t)\,dt = \int [4x(t) - 5y(t) + \int [x(t) - 6y(t)]\,dt]\,dt$

Differentiate it once

$$\frac{dy(t)}{dt} = 4x(t) - 5y(t) + \int [x(t) - 6y(t)]\,dt$$

Differentiate it once more

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

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

Differential Equation

(b) $(j\omega)^2 Y(j\omega) + 5(j\omega)Y(j\omega) + 6Y(j\omega) = 4(j\omega)X(j\omega) + X(j\omega)$

$$\boxed{Y(j\omega)[6 + j5\omega - \omega^2] = X(j\omega)[1 + j4\omega]}$$

Frequency response

(c) $$\frac{Y(j\omega)}{X(j\omega)} = \frac{1 + j4\omega}{6 - \omega^2 + j5\omega}$$

using partial fraction

$$H(j\omega) = \frac{Y(j\omega)}{X(j\omega)} = \frac{7}{2 + j\omega} - \frac{3}{3 + j\omega}$$

Take inverse fourier transform

$$\boxed{h(t) = [7e^{-2t} - 3e^{-3t}]u(t)}$$

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

Take fourier transform

$$X(j\omega) = \frac{1}{4}\left(\frac{1}{\frac{1}{4} + j\omega}\right)$$

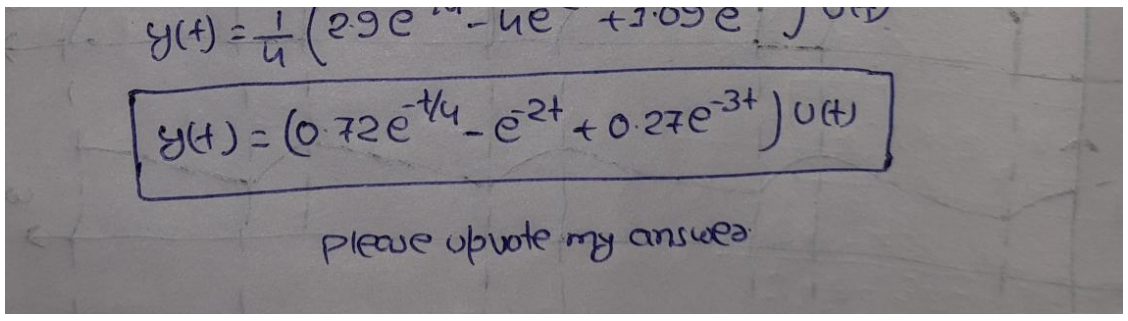
$$\frac{Y(j\omega)}{X(j\omega)} = \left(\frac{7}{2 + j\omega} - \frac{3}{3 + j\omega}\right)$$

$$Y(j\omega) = \left(\frac{7}{2 + j\omega} - \frac{3}{3 + j\omega}\right)\frac{1}{4}\left(\frac{1}{\frac{1}{4} + j\omega}\right)$$

$$Y(j\omega) = \frac{1}{4}\left[\left(\frac{7}{2 + j\omega}\right)\left(\frac{1}{\frac{1}{4} + j\omega}\right) - \left(\frac{3}{3 + j\omega}\right)\left(\frac{1}{\frac{1}{4} + j\omega}\right)\right]$$

$$Y(j\omega) = \frac{1}{4}\left[\frac{4}{\frac{1}{4} + j\omega} - \frac{4}{2 + j\omega} - \frac{1.090}{\frac{1}{4} + j\omega} + \frac{1.090}{3 + j\omega}\right]$$

$$Y(j\omega) = \frac{1}{4}\left[\frac{2.9}{\frac{1}{4} + j\omega} - \frac{4}{2 + j\omega} + \frac{1.09}{3 + j\omega}\right]$$



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Q: (15 pts) Using Fourier Transform properties, please solve them (a) (5 pts) Firstly derive a Fourier transform of the signal e-It|. (b) (5 pts) Deterimine the Fourier transform of te-1t|. (C) (5 pts) Using the result of part b find the Fourier transform of (1442)2 ·

A: See answer

Q: (20 pts) This is an LTI system: 4 a(t) g(t) + s + us -6 -5 (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 ä(t) = {e=t/4u(t) using the frequency response.

A: See answer