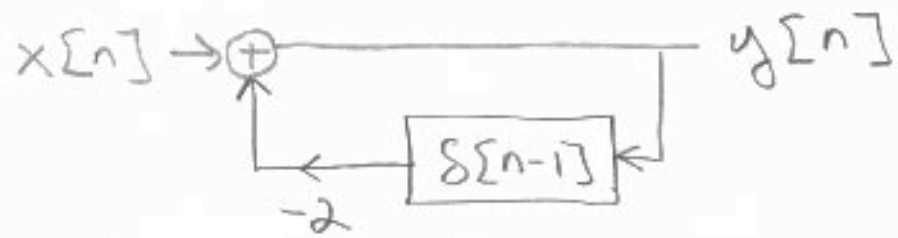
Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

For the system



(A) write the system equation.

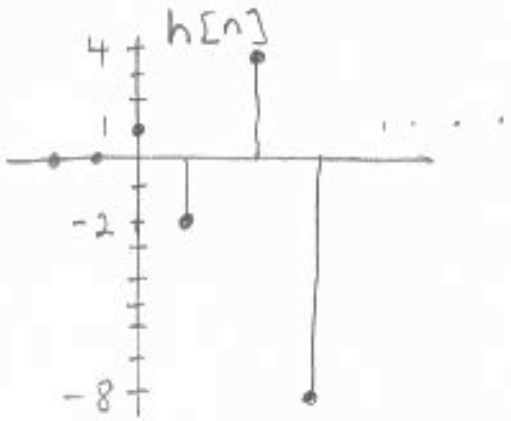
(B) sketch the impulse response

(C) is it IIR or FIR?

Answer

(A) $y[n] = x[n] - 2y[n-1]$

(B)



(C) IIR

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

The input to a LTI system is

$$x(t) = \cos(3t) - \sin(3t) + \cos(9t)$$

(A) what is the fundamental freq. ω_0?

(B) what is the fundamental period T_0?

Which of the following are possible outputs?

(C) $y(t) = 6 + \cos(9t)$

(D) $y(t) = \cos(3t) + 2\cos(9t)$

(E) $y(t) = 3\cos(3t - 1)$

(F) $y(t) = 2\sin^2(3t)$

Answer

(A) $\omega_0 = 3$

(B) $T_0 = \frac{2\pi}{3}$

(D) and (E) are possible

(C) and (F) are not.

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

FT9 (Problem Type Acronym) _____ (Name) _____ (ID #)

Question

Find the fourier transform $X(\omega)$ for

$$x(t) = 1 + e^{-t}u(t)$$

Answer

$$1 \overset{F}{\longleftrightarrow} 2\pi\delta(\omega)$$

$$e^{-t}u(t) \overset{F}{\longleftrightarrow} \int_{-\infty}^{+\infty} e^{-t}u(t)e^{-j\omega t}dt =$$

$$\int_0^{\infty} e^{-(1+j\omega)t}dt = -\frac{1}{1+j\omega}e^{-(1+j\omega)t}\Big|_0^{\infty} =$$

$$\frac{1}{1+j\omega}$$

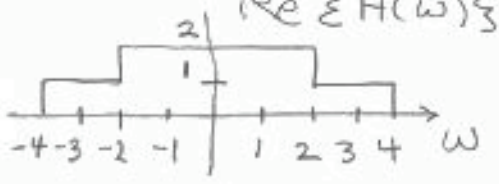
$$X(\omega) = 2\pi\delta(\omega) + \frac{1}{1+j\omega}$$

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

A system has a frequency response $\mathrm{Re}\{H(\omega)\}$



with the imaginary part $\mathrm{Im}\{H(\omega)\}=0$

Given an input $x(t) = 2 - \sin t + \cos 3t$

(A) what is the Fourier Transform, $X(\omega)$?

(B) what is the output signal, $y(t)$?

(C) what is its Fourier Transform, $Y(\omega)$?
(hint: $Y(\omega) = X(\omega)H(\omega)$)

Answer

(A) $X(\omega) = 4\pi\delta(\omega) + \pi\delta(1-\omega) - \pi\delta(1+\omega) + \pi\delta(3-\omega) - \pi\delta(3+\omega)$

(B) $4 - 2\sin t + \cos 3t$

(C) $8\pi\delta(\omega) + 2\pi\delta(1-\omega) - 2\pi\delta(1+\omega) + \pi\delta(3-\omega) - \pi\delta(3+\omega)$

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym | Name | ID #

Question

The impulse response of a system is

$h(t) = u(t)$

(A) Find its Fourier Transform $H(\omega)$.

(B) since $x(t) * h(t) = y(t) \Rightarrow X(\omega) H(\omega) = Y(\omega)$

What does this system do?

1) Delay
2) Integrate
3) Differentiate
4) Amplify

Answer

(A) $$H(\omega) = \int_{-\infty}^{+\infty} h(t) e^{-j\omega t} dt = \int_{-\infty}^{+\infty} u(t) e^{-j\omega t} dt$$

$$= \int_{0}^{+\infty} e^{-j\omega t} dt = -\frac{1}{j\omega} e^{-j\omega t} \Big|_{0}^{\infty} = \frac{1}{j\omega}$$

(B) integrate

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FS4 (Problem Type Acronym) _____ (Name) _____ (ID #)

Question

Compute the Fourier series of

$$x(t) = -3 + \cos(\pi t) - 2\sin(2\pi t)$$

what is ω_0?

what is the average power?
(use Parseval's relation)

Answer

$a_0 = -3$

$a_1 = \frac{1}{2} \quad a_{-1} = \frac{1}{2}$

$a_2 = j \quad a_{-2} = -j$

$\omega_0 = \pi$

$$P = \sum_{k=-\infty}^{\infty} |a_k|^2 = |-3|^2 + |\tfrac{1}{2}|^2 + |\tfrac{1}{2}|^2 + |j|^2 + |-j|^2$$

$$= 9 + \frac{1}{4} + \frac{1}{4} + 1 + 1$$

$$= 11\frac{1}{2}$$

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

The Fourier series of $x(t)$ is

$a_0 = 6$

$a_1 = 1 + \frac{j}{2}$ $\quad a_{-1} = 1 - \frac{j}{2}$

$a_2 = -3$ $\quad a_{-2} = -3$

(A) what is $x(t)$, if $\omega_0 = 4$

(B) what is the Fourier Series of $\frac{dx(t)}{dt}$?

(C) what is the Fourier Series of $2x(t-\frac{\pi}{2})$?

Answer

(A) $x(t) = 6 + 2\cos(4t) - \sin(4t) - 6\cos(8t)$

(B) $\frac{dx(t)}{dt} \overset{Fs}{\longleftrightarrow} jk\omega_0 a_k$

$a_0 = 0$

$a_1 = 4j - 2$ $\quad a_{-1} = -4j - 2$

$a_2 = -24j$ $\quad a_2 = 24j$

(C) $x(t-2) \overset{Fs}{\longleftrightarrow} e^{-jk\omega_0} a_k$

$a_0 = 12$

$a_1 = 2 + j$ $\quad a_{-1} = 2 - j$

$a_2 = -3$ $\quad a_{-2} = -3$

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

Given $x(t) = \sin(t/2\pi)$

$y(t) = \cos(t/2\pi)$

(A) what is the fundamental freq. ω_0

(B) what is the fundamental period T_0

(C) find Fourier Series of $x(t)$ and $y(t)$

(D) what is the average power of each signal (use Fourier Series)

(E) should shifting a signal change its average power?

Answer

(A) $\omega_0 = 1/2\pi$

(B) $T_0 = 1$

(C) $x(t) \overset{Fs}{\longleftrightarrow} a_1 = -j/2$, $a_{-1} = +j/2$

(D) power of $x(t) = (-j/2)^2 + (j/2)^2 = \frac{1}{2}$

$y(t) \overset{Fs}{\longleftrightarrow} b_1 = 1/2$, $b_{-1} = 1/2$

power of $y(t) = (\frac{1}{2})^2 + (\frac{1}{2})^2 = \frac{1}{2}$

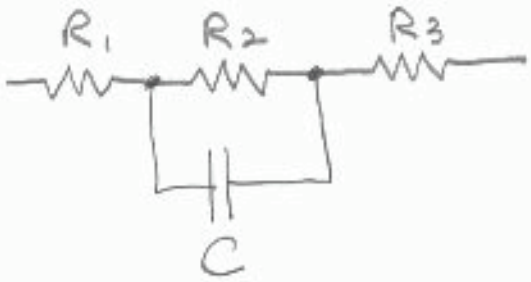
(E) shifting should <u>not</u> change it.

Use 0.7 mm mechanical pencil. Keep 0.25 inch from edge of box. Erase mistakes thoroughly.

Problem Type Acronym _____ Name _____ ID # _____

Question

(A) What is the impedance of this circuit?



(B) what is the impedance when $\omega = 0$?

(C) what is the impedance when $\omega = \infty$?

(D) explain (B) and (C) in English.

Answer

(A) $Z = R_1 + \dfrac{1}{\frac{1}{R_2} + j\omega C} + R_3 = R_1 + \dfrac{R_2}{1 + j\omega R_2 C} + R_3$

(B) $Z\big|_{\omega=0} = R_1 + R_2 + R_3$

(C) $Z\big|_{\omega=\infty} = R_1 + R_3$

(D) at $\omega = 0$, the cap has ∞ impedance and you have 3 resistors in series. at $\omega = \infty$ The cap shorts out R_2 leaving just R_1 and R_3 in series.