Group: Gr - 1

Final Makeup Exam

Fall 2024

1) [15 pts.]

a) [5 pts] Find the period and fundamental frequency of DT signal y[n], if it is periodic, given .

$$x[n] = e^{j\frac{3\pi n}{8}} + e^{j\frac{5\pi n}{6}}$$

$$y[n] = x^2[n]$$

$N_y =$ 48

$\omega_{yo} = \frac{\pi}{24}$

$$y[n] = e^{j\frac{3\pi n}{4}} + e^{j\frac{5\pi n}{3}} + 2e^{j\frac{29\pi n}{24}}$$

$$\omega_1 = \frac{3\pi}{4} = \frac{2\pi}{N_1}\cdot a \quad a = 3 \quad N_1 = 8$$

$$\omega_2 = \frac{5\pi}{3} = \frac{2\pi}{N_2}\cdot b \quad b = 5 \quad N_2 = 6$$

$$\omega_3 = \frac{29\pi}{24} = \frac{2\pi}{N_3}\cdot c \quad c = 29 \quad N_3 = 48$$

$$N_y = 6\cdot N_1 = 8\cdot N_2 = 1\cdot N_3 = 48$$

$$\omega_{yo} = \frac{2\pi}{N_y} = \frac{2\pi}{48} = \frac{\pi}{24}$$

b) [5 pts.] Knowing $W_N^n = e^{-j\frac{2\pi}{N}n}$ and the N point DFT of a signal

$$X[k] = \sum_{n=0}^{N-1} W_N^n x[n]$$

Find DFT only at a single frequency $X[3]$, if $x[n] = \{-1,0,1,-1,1,0,-1,1\}$.

$X[3] =$

$$X(3) = \sum_{n=0}^{8-1} e^{-j\frac{2\pi}{8}}$$

c) [5 pts.] If a 5V N-bit ADC is used to sample a CT signal with a dynamic range of [0-100mV] find the quantization error for N=8 bit and N=16 bit converters in percentages

[30 pts.] a) For a system with impulse response

$$H(s) = \frac{5s^2 + 4s + 4}{s(s^2 + 2s + 2)} \quad ROC: -1 < \sigma < 0$$

Find the poles and zeros

Determine if it is causal, anti-causal or non-

Draw its inverse

Useful Equations

Basic Signals

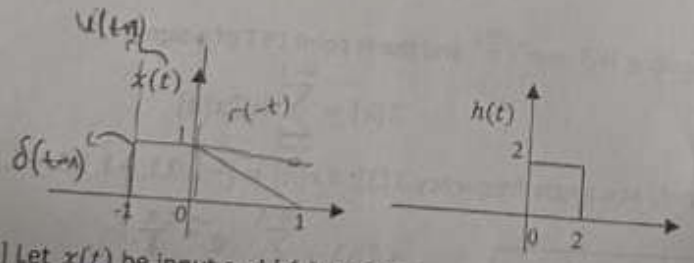
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2) [15 pts.] Find the inverse Laplace transform of

$$H(s) = \frac{s^2 + 100}{(s+10)(s^2 - 2s + 10)}, \qquad RoC: \{-10 < \sigma < 1; -\infty < \Omega < \infty\}$$

$$H(s) = \frac{C_1}{s+10} + \frac{C_2(s-1) + C_3}{(s-1)^2 + 9}$$

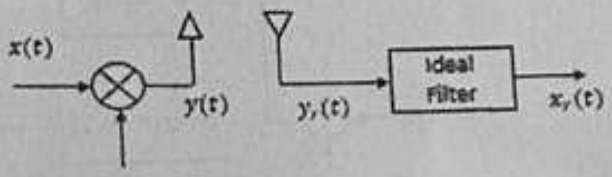
$$C_1 = (s+10).H(s) = \frac{100 + 100}{\ldots}$$



3) [20 pts.] Let $x(t)$ be input and $h(t)$ impulse response of a continues LTI system. Plot the system response y(t).

$x(t) = \delta(t+1) + u(t+1) + r($

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4) a) [20 pts.] Plot the power spectrum of the received $y_r(t)$ and filtered $x_r(t)$ signals, if the message transmitted is

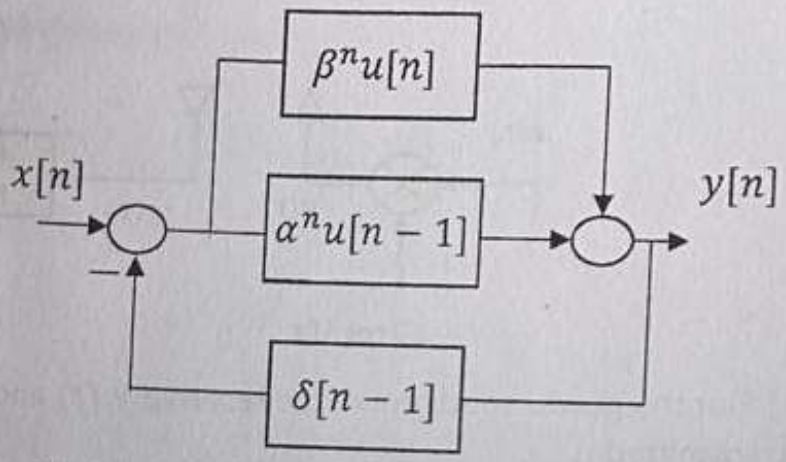
$$x(t) = 2e^{-4|t|}$$

Transmission channel losses given by

$$y_r(t) = 0.9y(0.8t - 1.2)$$

b) [5 pts.] Determine ideal filter characteristics

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5) For the LTI system shown with $|\alpha| < 1,\ |\beta| < 1$
   a) [10 pts.] Find the equivalent transfer function.
   b) [15 pts.] Find the step response $s[n]$ with parameters $\alpha = 0.2,\ \beta = 0.8$

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