Practice questions for SFWR ENG 3MX3

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1 Short Questions

1) Define the impulse response

2) What is the period and discrete frequency of $\cos(\frac{2\pi}{3}n)$

3) What is the frequency response of the system $y'' + y = x$.

4) What are the units for period and discrete frequency

2 Frequency Response

Given the frequency response

$$H(\omega) = \cos(\omega)$$

compute the output to the signal $x(n) = 2 + \cos(\frac{\pi}{2}n + \frac{\pi}{4}) + \sin(\pi n + \frac{3\pi}{2})$

3 State Space

Given the difference equation

$$y(n) = y(n-2) - x(n-2)$$

Determine the $[A, B, C, D]$ representation of the system.

4 Convolution

Given is a LTI system by its impulse response

$$h(n) = \delta(n) + \delta(n-2)$$

Determine the output of the system to the input

$$x(n) = \delta(n) + \delta(n-2) + \delta(n-4)$$

To obtain full credit you have to give **all** non zero values of y.

5 Frequency Response

- Compute the frequency response of the system

$$y(n) + y(n-1) = 2x(n) - 5x(n-2)$$

- Given the frequency response

$$H(\omega) = \frac{1 + e^{-i\omega}}{e^{-i\omega}}$$

compute the output to the signal $x(n) = \cos(\frac{\pi}{2}n + \frac{\pi}{4}) + \sin(\pi n + \frac{3\pi}{2})$

6 State Space

Given the following matrices:

$$A = \begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}, B = \begin{pmatrix} 1 \\ 0 \end{pmatrix}, C = \begin{pmatrix} 1 & 1 \end{pmatrix}, D = 1$$

Compute the zero state output to the input $x(n) = \delta(n) + \delta(n-1)$. (I like to see $s(n)$ and $y(n)$ for $n = 0, 1, 2, 3$.)

7 Compute the Impulse Response

Given the system

$$y(n) = x(n) - 2x(n-1) + 3x(n-3)$$

Compute a close form expression (not just numbers) that represents the impulse response of this system.

8 Complex Numbers

Convert the following numbers into the complex exponential representation:

$$1 + i, -1, -i, -1 - i$$

Compute the argument of the following complex numbers:

$$\frac{1}{1+i}, -2i, 2$$

9 State Space

Given the following state space equation:

$$s(n+1) = \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix} s(n) + \begin{pmatrix} 1 \\ 0 \end{pmatrix} x(n)$$

$$y(n) = \begin{pmatrix} 1 & 1 \end{pmatrix} s(n) + x(n)$$

Compute the zero state output to the input $x(n) = \delta(n)$. (I like to see $s(n)$ and $y(n)$ for $n = 0, 1, 2, 3, 4$.)

10 Discrete Fourier Series

Compute the Discrete dourier series with $N = 4$ of the signal $x(n) = 1 + \cos(\frac{1}{2}\pi n)$