Department of Electrical and Computer Engineering
The University of Alabama in Huntsville
Spring 2020

CPE 381: Fundamentals of Signals and Systems for Computer Engineers

Homework #4
Due: Wednesday, March 25 at 9:35 am
Please upload softcopy (PDF/DOC/DOCX) to Canvas

Student name:

1 20	2 20	3 20	4 40	Total

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1. (20 points) Pr. 5.38 (textbook).

   Magnitude response from poles and zeros—MATLAB
   Consider the following filters with the given poles and zeros and dc constant:

   $H_1(s):$ $K = 1$ poles $p_1 = -1, p_{2,3} = -1 \pm j\pi;$ zeros $z_1 = 1, z_{2,3} = 1 \pm j\pi$

   $H_2(s):$ $K = 1$ poles $p_1 = -1, p_{2,3} = -1 \pm j\pi;$ zeros $z_{1,3} = \pm j\pi$

   $H_3(s):$ $K = 1$ poles $p_1 = -1, p_{2,3} = -1 \pm j\pi;$ zero $z_1 = 1$

   Use MATLAB to plot the magnitude responses of these filters and indicate the type of filters they are.

2. (20 points) An ideal low pass filter *H(s)* with zero phase and magnitude response:

   $$|H(j\Omega)| = \begin{cases} 1 & -\pi \leq \Omega \leq \pi \\ 0 & otherwise \end{cases}$$

   a) Find the impulse response *h(t)* of the low-pass filter. Plot it and indicate whether this filter is causal system or not.

   b) What is the effect of shifting the central frequency of the ideal filter for 5π ?

3. (20 points)

A 12-bit AD converter is used to digitize signal with negative reference V_{R-} = 0.5V and positive reference V_{R+} = 2.5V.

a) (3 points) What is the quantization step?
b) (3 points) What is the output of the AD converter for V_{in} = 2.2 V ?
c) (2 points) What is the output of the AD converter for V_{in} = 0.35 V ?
d) (2 points) What is the output of the AD converter for V_{in} = 3.1 V ?

4. (40 points) Represent spectrum of the signal $x(t) = 8cos(100t)$.

$X(\Omega)$
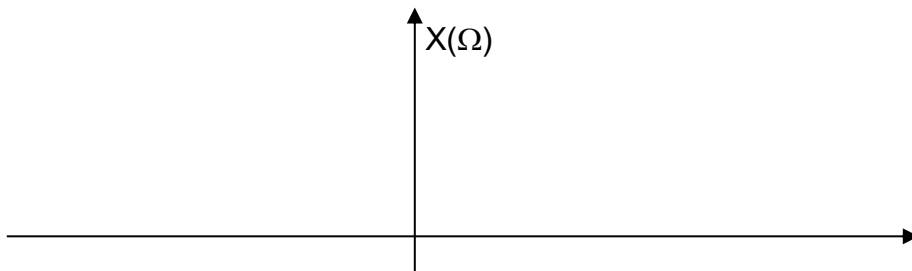
Represent magnitude and phase spectrum of the same signal sampled at Fs = 150 rad/s. Describe the effect.

$X(\Omega)$