

CPE 381: Fundamentals of Signals and Systems for Computer Engineers

Homework #4

Due: Wednesday, March 29 at 9:35 am
Please upload softcopy (PDF file) to Canvas

Student name:

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1 20	2 20	3 20	4 40	Total

1. (20 points) Consider the following filters with the given poles and zeros and DC constant.

$$H_1(s): K = 1; \text{ poles } p_1 = -1, p_{2,3} = -0.5 \pm j2\pi; \text{ zeros } z_{1,2} = \pm j2\pi;$$

$$H_2(s): K = 1; \text{ poles } p_1 = -1, p_{2,3} = -1 \pm j2\pi; \text{ zeros } z_1 = 1, z_{2,3} = 1 \pm j2\pi;$$

$$H_3(s): K = 1; \text{ poles } p_1 = -1, p_{2,3} = -1 \pm j2\pi; \text{ zeros } z_1 = 1$$

Use MATLAB to plot the magnitude response of these filters and indicated the type of filters they represent.

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

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

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

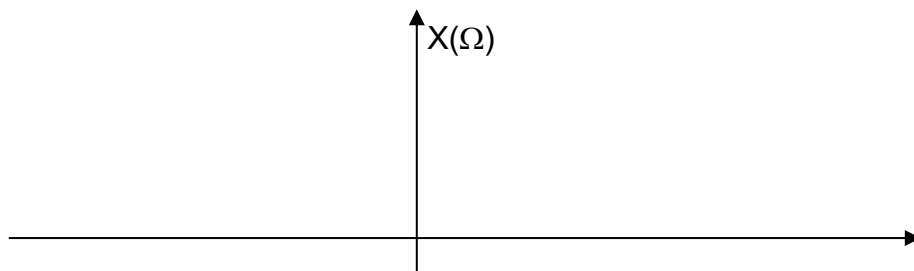
b) What is the effect of shifting the central frequency of the ideal filter for 9π ?

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 $V_{in} = 2.3 V$?
- 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 $V_{in} = 2.9 V$?

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



Represent magnitude and phase spectrum of the same signal sampled at $F_s = 150$ rad/s. Describe the effect.

