ZHEJIANG UNIVERSITY - UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

ECE 310 Digital Signal Processing – Spring 2021

Homework 1

Prof. Zhi-Pei Liang **Due: January 22, 2021**

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1. Evaluate and represent your final answer in both Cartesian and polar forms.
   (a) $3e^{-j\pi/4} + 4e^{j\pi/4}$
   (b) $\dfrac{(1+j)^2}{1-j}$

2. Determine all the roots of $2z^3 + 3 = 0$ on the complex plane.

3. Sketch the following signals:
   (a) $\sin\left(\frac{\pi}{3}n\right)\delta[n-2]$
   (b) $n(u[n] - u[n-8])$
   (c) $u[-n+3]u[n+5]$

   where $u[n]$ is the unit step signal in the discrete-time variable n.

4. Express the sequence $\{x[n]\} = \{\cdots, 0, -1, 0, \underset{\uparrow}{3}, 0, 7, 0, \cdots\}$ in terms of the unit pulse (impulse) signal $\delta[n]$. Here $\cdots$ denotes zeros.

5. Sketch (by hand) the magnitude and phase of $G(\omega) = \sin(\omega/2)$ over the interval $\omega \in [-\pi, \pi]$. Label your plots.

6. Derive closed-form expressions for the magnitude and phase of the function $G(\omega) = 1 - e^{-j\omega}$ of the real variable ω. Sketch (by hand) the magnitude and phase over the interval $\omega \in [-\pi, \pi]$. Label your plots.

7. Consider the following discrete-time system

$$y[n] = x[n] + 2x[n-2].$$

   Determine if the system is: 1) linear; 2) time-invariant.

8. Consider the following discrete-time system

$$y[n] = 10x[n]\cos(0.25\pi n).$$

   Determine if the system is: 1) linear; 2) time-invariant.