

FALL 24 EC516 Problem Set 01

Due: Sunday September 15 (Before 11:59pm)

You must submit your homework attempt on Blackboard Learn. For this purpose, you must convert your homework attempt to a pdf file and upload it at the corresponding homework assignment on Blackboard Learn.

Problem 1.1 (Complex Arithmetic Review)

For each of the following complex numbers determine its magnitude and angle (also known as phase):

- (a) $1 + j$
- (b) $(1 + j)^*$ where $*$ represents complex conjugation.
- (c) $0.5 + j\sqrt{3}/2$
- (d) $0.5 - j\sqrt{3}/2$
- (e) -2.0

Problem 1.2 (Signals and Systems Review)

- A) Given that $e^{j\omega t} = \cos(\omega t) + j\sin(\omega t)$, show that $\cos(\omega t) = 0.5e^{j\omega t} + 0.5e^{-j\omega t}$
- B) Let $x(t) = \frac{1}{2\pi} \int_{-\infty}^{\infty} X(j\omega) e^{j\omega t} d\omega$ where $X(j\omega) = \pi\delta(\omega - 400\pi) + \pi\delta(\omega + 400\pi)$
Show that $x(t)$ is a sinusoid and determine how much that sinusoid would have to be shifted in time to make it an odd signal.
- A) Consider the complex exponential signal $g(t) = 2e^{j20\pi t}$ to answer each of the following questions
 - a) Is the signal $g(t)$ periodic? Justify your answer.
 - b) Plot by hand or via any software the real part of $g(t)$ as a function of t .
 - c) Plot by hand or via any software the imaginary part of $g(t)$ as a function of t .
 - d) Plot by hand or via software the absolute value of $g(t)$ as a function of t .

Problem 1.3 (Basic DSP Formulae)

The *Finite Sum Formula* and the *Infinite Sum Formula* are very useful in DSP.

- a) Show that the *Finite Sum Formula*, given as $\sum_{n=0}^{N-1} \alpha^n = \frac{1 - \alpha^N}{1 - \alpha}$, is valid for all non-zero complex numbers α .
- b) Determine the range of complex values α for which the *Infinite Sum Formula*, given below, is valid. *Justify your answer.*

$$\sum_{n=0}^{\infty} \alpha^n = \frac{1}{1 - \alpha}$$

Problem 1.4 (DSP advantages and disadvantages)

- a) What *advantages* does digital signal processing offer over analog signal processing? Write at least a couple of sentences.
- b) What are the *disadvantages* of digital signal processing with respect to analog signal processing? Write at least a couple of sentences.