EC401 HW05 Spring 2020

Due Date: Wednesday March 18, 2020

You must submit your homework on paper (all pages of your submission stapled together) during the first 10 minutes of lecture on the due date. Please be sure to write your name on the first page of the homework you submit. Additionally, if you have collaborated on the homework with other individuals enrolled in EC401 this semester, please identify them as your collaborators on the first page of the submitted homework.

HW05.1

For each of the parts of this problem, plot the given complex number as a point in a plane and write the number in *polar* (magnitude and angle) representation. In each part, you should also specify the magnitude and the phase of the complex number.

(a) $1-j$

(b) -1

(c) -2

(d) $-j$

(e) $2j$

(f) $-1-j$

(g) $\frac{1}{2} - j\frac{\sqrt{3}}{2}$

(h) $\frac{\sqrt{2}}{2} + j\frac{\sqrt{2}}{2}$

HW05.2

For each of the parts of this problem, plot the given complex number as a point in a plane and write the number in *rectangular* (real part and imaginary part) representation. Please note that $e^{j\theta} = \cos\theta + j\sin\theta$.

(a) $0.5e^{j\pi}$

(b) $0.5e^{-j\pi}$

(c) $0.5e^{j3\pi}$

(d) $2e^{j3\pi/2}$

(e) $2e^{-j3\pi/2}$

(f) $\sqrt{2}e^{j\pi/4}$

(g) $\sqrt{2}e^{j3\pi/4}$

(h) $\sqrt{2}e^{-j3\pi/4}$

HW05.3

For each of the parts of this problem, plot the given expression for a complex number as a point in a plane. Please note that $e^{j\theta} = \cos\theta + j\sin\theta$.

(a) $je^{j\pi/2}$

(b) $-je^{j\pi/2}$

(c) $(1+j)e^{j\pi/4}$

(d) $e^{j3\pi}(0.5+j0.5)(-2-j2)$

(e) $\dfrac{1+j}{1-j}$

(f) $(1+j)(1-j)$

(g) $(1+j)^2$

(h) $\dfrac{1}{32}(1+j)^{10}$

HW05.4

Determine whether or not each of the following signals is *periodic*. Justify your answer in each case. Also, if you determine that a signal is periodic, please specify its *fundamental period.*

(a) $x(t) = e^{j1000\pi t}$

(b) $x(t) = e^{j2000\pi t} + e^{j1000\pi(t-1)}$

(c) $x(t) = \sum_{k=-\infty}^{\infty} u(t+1+5k) - u(t-1+5k)$

(d) $x(t) = \cos(1000\pi(t-0.0005))$

(e) $x[n] = \sum_{k=-\infty}^{\infty} \delta[n-3k] + 2\delta[n-1-3k]$

(f) $x[n] = \cos(0.125\pi n) + \sin(0.25\pi n + 0.16\pi)$

(g) $x[n] = n^2 \cos(1000\pi n)$

(h) $x[n] = e^{j\frac{\pi}{16}n}$

(i) $x[n] = \sin(2n)$

HW05.5

Suppose $x(t) = u(t) - u(t-6)$. Determine the *numerical value* of the expression in each of the following parts. *Justify your answer* in each case.

(a) $\int_{-\infty}^{\infty} x(\tau)\delta(\tau - 3)\,d\tau$

(b) $\int_{-\infty}^{\infty} x(\tau)\delta(\tau - 7)\,d\tau$

(c) $\int_{-\infty}^{\infty} x(\tau)\delta(-\tau - 3)\,d\tau$

(d) $\int_{-\infty}^{\infty} x(\tau)\delta(-\tau - 7)\,d\tau$

(e) $\int_{-\infty}^{\infty} \tau^2 x(\tau)\delta(\tau - 3)\,d\tau$

HW05.6

Suppose $x[n] = 2\{u[n] - u[n-3]\}$. Plot each of the signals specified in the following parts of this problem. In each case, *justify your answer*.

(a) $g[n] = \sum_{k=0}^{2} x[n - 4k]$

(b) $g[n] = \sum_{k=-\infty}^{n} x[k]$

(c) $g[n] = \sum_{k=-\infty}^{n-5} x[k]$

(d) $g[n] = \sum_{k=-\infty}^{\infty} x[k]\delta[n-k]$

(e) $g[n] = \sum_{k=-\infty}^{\infty} x[k]\delta[n-k-2]$