EC401 PRACTICE TEST 2 (Spring 2020)

60 minutes, Closed Book, No Electronics, Formula Sheet Provided.

Throughout this test, $\delta[n]$ and $u[n]$ denote the unit impulse and unit step respectively.

Problem 1 (10 points)

Determine the numerical value of the integral specified as:

$$\int_{5}^{25} u(\tau)\delta(3-\tau)d\tau$$

Justify your answer.

Problem 2 (10 points)

For the signal given in each part of this problem, determine whether or not it can be said to be an *amplitude-scaled* and/or *time-shifted* version of a *single continuous-time complex exponential signal of a particular frequency*.

(a) $x_1(t) = (1 + 0.5j)e^{j0.25\pi t}$
(b) $x_2(t) = (-2)^t$
(c) $x_3(t) = \delta(t-2)$
(d) $x_4(t) = \int_{-\infty}^{\infty} \delta(t-\tau)d\tau$

Justify each answer.

Problem 3 (10 points)

If $x[n] = u[n] - u[n-3]$ and $h[n] = u[n-3] - u[n-8]$, and

$$y[n] = x[n] * h[n].$$

Determine the smallest integer m and the largest integer k for which it is guaranteed that $y[m] \neq 0$ and $y[k] \neq 0$. *Justify your answers*.

Problem 4 (10 points)

Consider a continuous-time LTI system S with impulse response

$$h(t) = u(t) - u(t-2).$$

Sketch the output $y(t)$of system S if the input signal is

$$x(t) = \sum_{k=0}^{3} \delta(t-4k) - \delta(t-1-4k)$$

Problem 5 (10 points)

Sketch the magnitude of the DTFT of $x[n] = 1 + (-1)^n + e^{\frac{j5\pi n}{3}}$. *Justify your answer*.

Problem 6 (10 points)

Consider an LTI system Q with impulse response $h[n] = u[n] - u[n-3]$. Sketch the output signal of system Q if the input signal is $x[n] = 1 + \cos\left(\frac{2\pi n}{3} + \frac{\pi}{13}\right)$.

Justify your answer.

Problem 7 (5 points)

Sketch the magnitude of the DTFT of $q[n] = \cos^2(0.25\pi n)$