Full Name: _____

EEE 5502 (Fall 2022) – Practice **Discrete-Time Fourier Transforms, 2022**

Question #1: Determine the discrete-time Fourier transform (DTFT) or inverse DTFT for the following equations. Use the discrete-time transform tables on the course website.

(a) $x[n] = (0.2)^n u[n] * (0.5)^{n-14} u[n-12]$

Solution:

$$\begin{aligned} x[n] &= (0.2)^n u[n] * (0.5)^{n-12-2} u[n-12] \\ &= (0.2)^n u[n] * 4(0.5)^{n-12} u[n-12] \\ X(\omega) &= \left(\frac{1}{1-0.2e^{-j\omega}}\right)\left(\frac{4e^{-j12\omega}}{1-0.5e^{-j\omega}}\right) \end{aligned}$$

(b) $x[n] = (-1)^n$

Solution:

$$\begin{aligned} x[n] &= \cos(\pi n) \\ X(\omega) &= \pi \sum_{k=-\infty}^{\infty} [\delta(\omega - \pi - 2\pi k) + \delta(\omega + \pi - 2\pi k)] \\ &= 2\pi \sum_{k=-\infty}^{\infty} \delta(\omega - \pi - 2\pi k) \end{aligned}$$

(c) $X(\omega) = \dfrac{e^{-j\omega 4}}{5 - e^{-j\omega}}$

Solution:

$$\begin{aligned} X(\omega) &= \frac{e^{-j\omega 4}}{5 - e^{-j\omega}} \\ &= \frac{(1/5)e^{-j\omega 4}}{1 - (1/5)e^{-j\omega}} \\ x[n] &= (1/5)(1/5)^{n-4} u[n-4] \\ &= (1/5)^{n-3} u[n-4] \end{aligned}$$

(d) $X(\omega) = \dfrac{\pi}{j} \displaystyle\sum_{k=-\infty}^{\infty} [\delta(\omega - \pi/2 - 2\pi k) - \delta(\omega + \pi/2 - 2\pi k)]$

Solution:

$$x[n] = \sin((\pi/2)n)$$