ECE 2050 Autumn 2023 Homework 9
Due 5:00 pm, **Thursday November 9, 2023**
Upload to Carmen as a single PDF document

BC:9.1 Evaluate the following integrals. If the result is a constant, give a numerical value for it:

a.)

$$\int_{-\infty}^{2} \left(\frac{\cos^2\left(100\pi t + 15^o\right)}{10 - \sin^2(50\pi t)} \right) \delta(t + 2.4) dt$$

b.)

$$\int_{-\infty}^{2} \left(\frac{\cos^2\left(100\pi t + 15^o\right)}{10 - \sin^2(50\pi t)} \right) \delta(t - 2.4) dt$$

c.)

$$\int_{-\infty}^{\infty} e^{j\omega t} \left(\sum_{k=-\infty}^{\infty} \left(\frac{7}{4}\right)^{-|k|} \delta\left(\omega - \frac{2\pi k}{5}\right) \right) d\omega$$

d.)

$$\int_{-\pi}^{\pi} \frac{\sin(9\hat{\omega})}{\sin\left(\hat{\omega}/2\right)} \delta(\hat{\omega} + 0.75\pi) d\hat{\omega}$$

e.)

$$\int_{-\pi}^{\pi} \frac{\sin(9\hat{\omega})}{\sin\left(\hat{\omega}/2\right)} \left(\sum_{k=-\infty}^{\infty} \delta(\hat{\omega} + 0.75\pi - 2\pi k) \right) d\hat{\omega}$$

BC:9.2 Find the discrete time Fourier transform (DTFT) for the following sampled time signals. (Hint use the tables of DTFT pairs and DTFT properties)

a.)

$$x_a[n] = \left(1.25 e^{j0.25\pi}\right)^{3-n} u[n-3]$$

b.)

$$x_b[n] = \text{rect}\left(\frac{n-4}{16}\right)$$

c.)

$$x_c[n] = \text{rect}\left(\frac{n-4}{16}\right) \delta[n-10]$$

d.)

$$x_d[n] = \text{rect}\left(\frac{n-4}{16}\right) \delta[n+10]$$

e.)

$$x_e[n] = (2.5)^{3-n} \cos\left(0.25\pi n\right) u[n-3]$$

BC:9.3 Find the sampled time signal that corresponds to each of the following normalized spectra. (Hint use the tables of DTFT pairs and DTFT properties)

a.)

$$\hat{X}_a(e^{j\hat{\omega}}) = \sum_{k=-\infty}^{\infty} e^{j7\hat{\omega}} \left[\delta(\hat{\omega} + \frac{7\pi}{8} - 2\pi k) + \delta(\hat{\omega} - \frac{7\pi}{8} - 2\pi k) \right]$$

b.)

$$\hat{X}_b(e^{j\hat{\omega}}) = \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.17\pi}\right)$$

c.)

$$\hat{X}_c(e^{j\hat{\omega}}) = 1 - \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.35\pi}\right)$$

d.)

$$\hat{X}_d(e^{j\hat{\omega}}) = e^{j7\hat{\omega}} \sum_{k=-\infty}^{\infty} \text{rect}\left(\frac{\hat{\omega} - 2\pi k}{0.85\pi}\right)$$

e.)

$$\hat{X}_e(e^{j\hat{\omega}}) = \cos(7\hat{\omega}) + 1$$

BC:9.4 A LTI discrete time system has an impulse response

$$h[n] = 4(0.55)^{n-3} u[n] - 0.5(\text{-}0.25)^n u[n-3]$$

Find the transfer function, $\hat{H}(e^{j\hat{\omega}})$, in the normalized frequency domain. Use Matlab to plot the magnitude and phase (in degrees) of $\hat{H}(e^{j\hat{\omega}})$ in the range of $-\pi \leq \hat{\omega} \leq \pi$. Attach your Matlab source code with the plots.