

Homework #06

Problem 1 Please prove the following CTFTs

$$rect(t) \stackrel{CTFT}{\leftrightarrow} sinc(f)$$

$$sinc(t) \stackrel{CTFT}{\leftrightarrow} rect(f)$$

$$\delta(t) \stackrel{CTFT}{\leftrightarrow} 1$$

$$1 \stackrel{CTFT}{\leftrightarrow} \delta(f)$$

$$e^{-at}u(t) \stackrel{CTFT}{\leftrightarrow} \frac{1}{a + j2\pi f}$$

Problem 2 Please prove the following DTFTs

$$x[n] = \begin{cases} 1, |n| \leq M \\ 0, else \end{cases} \stackrel{DTFT}{\leftrightarrow} X(f) = \frac{\sin((2M+1)\pi f)}{\sin(\pi f)}$$

$$x[n] = \frac{\sin(K\pi n)}{\pi n} \stackrel{DTFT}{\leftrightarrow} X(f) = \begin{cases} 1, |f| \leq K/2 \\ 0, else \end{cases}$$

$$\delta[n] \stackrel{DTFT}{\leftrightarrow} 1$$

$$1 \stackrel{DTFT}{\leftrightarrow} \delta(f)$$

$$a^n u[n] \stackrel{DTFT}{\leftrightarrow} \frac{1}{1 - ae^{-j2\pi f}}$$

Problem 3 Please prove the following CTFSSs

$$x(t) = \sum_{n=-\infty}^{+\infty} \delta(t - nT) \quad \begin{array}{c} \text{CTFS} \\ \longleftrightarrow \end{array} \quad X[k] = 1$$

$$e^{+j2\pi\frac{m}{T}t} \quad \begin{array}{c} \text{CTFS} \\ \longleftrightarrow \end{array} \quad X[k] = \begin{cases} T, k = m \\ 0, \text{else} \end{cases}$$

Problem 4 Please prove the following DTFSs

$$x[n] = \sum_{l=-\infty}^{+\infty} \delta[n - lN] \quad \begin{array}{c} \text{DTFS} \\ \longleftrightarrow \end{array} \quad X[k] = 1$$

$$e^{+j2\pi\frac{m}{N}n} \quad \begin{array}{c} \text{DTFS} \\ \longleftrightarrow \end{array} \quad X[k] = \begin{cases} N, k = m \\ 0, \text{else} \end{cases}$$