MAE 143 A: Signals and Systems.
Homework #7

Assigned May 19. Due May 26

1. Explain each step of the following derivation carefully:

$$\frac{1}{2}\frac{2\mathrm{e}^{-jn\pi}}{-jn\frac{\pi}{2}} - \frac{1}{2}\left[\frac{\mathrm{e}^{-jn\frac{\pi}{2}t}}{\left(-jn\frac{\pi}{2}\right)^2}\right]_0^2 = \begin{cases} \frac{j2}{\pi n}, & \text{for even } n > 0, \\ -\frac{4+j2\pi n}{\pi^2 n^2}, & \text{for odd } n \end{cases}$$

2. A signal can be expressed as $x(t) = \sum_{k=1}^{\infty} \frac{1}{k}\cos\left(\frac{k\pi}{2}t + 30^0\right)$. Graph the magnitude and the phase spectrum of the signal. What is the average power of the signal?

3. A low-pass filter has the following frequency response:

$$H(\omega) = \begin{cases} \mathrm{e}^{-j\omega}, & -2 < \omega < 2 \\ 0, & \text{all other } \omega \end{cases}$$

   Compute the system response to the signal $x(t) = \sum_{k=1}^{\infty} \frac{1}{k}\cos\left(\frac{k\pi}{2}t + 30^0\right)$.

4. A band-pass filter has the following frequency response:

$$H(\omega) = \begin{cases} \frac{\omega}{\omega^2+1}, & \text{if } 10 < |\omega| < 20, \\ 0, & \text{otherwise} \end{cases}$$

   Compute the system response to the signal $x(t) = \sum_{k=1}^{\infty} \frac{1}{k}\cos\left(\frac{k\pi}{2}t + 30^0\right)$.