ECE 300
Signals and Systems
Homework 9

Due Date: *Monday* February 12 at 5 PM
Note: Exam 3 Tuesday February 13, Lab Practical Wednesday February 14

Note: Use the Fourier transform table given out in class. Also, you do not need to plot the figures in the problems where the text problem says to plot the figure.

Problems

1. Find the fraction of the total signal energy (as a percentage) contained between 100 and 300 Hz in the signal $x(t)$ given below:

$$x(t) = 5\,\mathrm{sinc}\left(\frac{t}{0.002}\right) + 5\,\mathrm{sinc}\left(\frac{t}{0.001}\right) \quad \textit{Answer } 56\%$$

2. K & H, Problem 3.21 (**a,b,c** only)

3. K & H, Problem 3.24

4. K & H, Problem 5.14

5. K & H, Problem 5.16 (**a, b, c** only)

6. Consider a linear time invariant system with transfer function given by

$$H(\omega) = \begin{cases} 5e^{-j2\omega} & |\omega| \le 2 \\ 0 & else \end{cases}$$

with input $x(t) = \dfrac{8}{\pi}\,\mathrm{sinc}^2\left(\dfrac{2(t\text{-}1)}{\pi}\right)$. The output of the system is $y(t)$.

a) Determine $X(\omega)$.

b) Sketch the spectrum of $X(\omega)$ (magnitude and phase) accurately labeling the axes and important points.

c) Sketch the spectrum of $H(\omega)$ (magnitude and phase) accurately labeling the axes and important points.

d) Determine $y(t)$, the output of the system.

$$\textit{Answer } y(t) = \frac{20}{\pi}\,\mathrm{sinc}\left[\frac{2}{\pi}(t-3)\right] + \frac{10}{\pi}\,\mathrm{sinc}^2\left[\frac{1}{\pi}(t-3)\right]$$

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