UNIVERSITY OF ILLINOIS
Department of Electrical and Computer Engineering
ECE 417 Multimedia Signal Processing

Lecture 2 Sample Problem Solutions

Problem 2.1

N	A
1	1.0
3	0.97
5	0.90
7	0.81
9	0.70
11	0.57

Problem 2.2

$$X[k] = \frac{256}{2} e^{-j\frac{255}{2}\left(\frac{2\pi k}{256} - \frac{1}{3}\right)} \text{dsinc}\left(\frac{2\pi k}{256} - \frac{1}{3}, 256\right) + \frac{256}{2} e^{-j\frac{255}{2}\left(\frac{2\pi k}{256} + \frac{1}{3}\right)} \text{dsinc}\left(\frac{2\pi k}{256} + \frac{1}{3}, 256\right)$$

Problem 2.3

$$H(e^{j\omega}) = \frac{N}{2}\text{dsinc}\left(\omega - \frac{\pi}{N}, N\right) + \frac{N}{2}\text{dsinc}\left(\omega + \frac{\pi}{N}, N\right)$$

Problem 2.4

The DTFT of $g[-n]$ is

$$\begin{aligned} \text{DTFT}\left\{g[-n]\right\} &= \sum_{n=-\infty}^{\infty} g[-n]e^{-j\omega n} \\ &= \sum_{n=-\infty}^{\infty} g[n]e^{j\omega n} \end{aligned}$$

The last line above is obviously $G(e^{-j\omega})$, i.e., flipping left-to-right in time means also flipping left-to-right in frequency. If $g[n]$ is a real-valued function of time, the last line above is also equal to $G^*(e^{j\omega})$, the complex conjugate of $G(e^{j\omega})$. Therefore

$$Z(e^{j\omega}) = G^*(e^{j\omega})Y(e^{j\omega}) = G^*(e^{j\omega})G(e^{j\omega})X(e^{j\omega})$$

$$H(e^{j\omega}) = G^*(e^{j\omega})G(e^{j\omega}) = |G(e^{j\omega})|^2$$