UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN
Department of Electrical and Computer Engineering

ECE 498MH Signal and Image Analysis

Homework 8

Fall 2014

Assigned: Thursday, 3/9/2017 Due: Thursday, 3/16/2017

Reading: 1–40

Do **one** of the following two problems, and submit by 11:59pm 3/16/2017 (on Compass, if you don't hand it in during class). Homework will be returned on 3/28/2017. If you don't like your grade, then you can hand in the **other** problem for a grade, no later than 3/30/2017.

Problem 8.1

Consider the following ideal bandpass filter:

$$H(\omega) = \begin{cases} 1 & \frac{\pi}{2} < \omega < \frac{2\pi}{3} \\ 1 & \frac{-2\pi}{3} < \omega < \frac{-\pi}{2} \\ 0 & \text{otherwise} \end{cases}$$

(a) Use the formula for the inverse DTFT to find the impulse response $h[n]$.

(b) Double-check your answer to part (a) by expressing $H(\omega) = G(\omega) - F(\omega)$, where $G(\omega)$ and $F(\omega)$ are two different ideal lowpass filters. Look up, in the textbook or the slides, the formula for the impulse response of an ideal lowpass filter. Use the formula you find to write $g[n]$ and $f[n]$, and from them, find $h[n] = g[n] - f[n]$. Finally, show that your answer to part (b) is the same as your answer to part (a).

Problem 8.2

Consider the following ideal bandpass filter:

$$H(\omega) = \begin{cases} 1 & \frac{\pi}{5} < |\omega| < \frac{3\pi}{5} \\ 0 & \text{otherwise} \end{cases}$$

(a) Use the formula for the inverse DTFT to find the impulse response $h[n]$.

(b) Double-check your answer to part (a) by expressing $H(\omega) = G(\omega) - F(\omega)$, where $G(\omega)$ and $F(\omega)$ are two different ideal lowpass filters. Look up, in the textbook or the slides, the formula for the impulse response of an ideal lowpass filter. Use the formula you find to write $g[n]$ and $f[n]$, and from them, find $h[n] = g[n] - f[n]$. Finally, show that your answer to part (b) is the same as your answer to part (a).