EECS202000 Signals and Systems
Homework #5

(Due December 17, 2021 before noon. Please submit in PDF format to the course website.)

Note: Detailed derivations are required to obtain a full score for each problem. (Total 100%)

1. (8%) Problem 5.25 of the textbook for $Y(e^{j\omega}) = B(\omega)e^{-j\omega} + A(\omega)e^{j\omega}$.

2. (4%+4%+4%+4%) Problem 5.35 of the textbook.

3. (4%+4%+4%+4%) Problem 6.27 (a), (b), (c), and (d) of the textbook. (No need to solve (e).)

4. (6%+6%+6%) Problem 6.39 (f), (i), and (k) of the textbook.

5. (4%+4%+4%+4%) Problem 7.23 of the textbook.

6. (6%+6%) Problem 7.26 of the textbook. Moreover, suppose that $H(j\omega)$ is replaced with a lowpass filter with cutoff frequency $\omega_c = \omega_2 - \omega_1$. How can the signal $x(t)$ be further reconstructed from the output of this filter. (Hint: Recall that frequency shifting can be performed by multiplying the time-domain signal with a complex exponential.)

7. (8%+6%) Problem 7.29 of the textbook for

$$X_c(j\omega) = \begin{cases} 1 - \frac{2|\omega|}{3\pi \cdot 10^4}, & |\omega| < \frac{3\pi}{2} \cdot 10^4, \\ 0, & \text{otherwise.} \end{cases}$$

Moreover, suppose that $x[n]$ is upsampled by a factor of 3 and, then downsampled by a factor of 4 to get $x_b[n]$. The signal $x_b[n]$ is passed through the discrete-time filter instead of $x[n]$. Sketch $X_b(e^{j\omega})$, $Y(e^{j\omega})$, $Y_p(e^{j\omega})$, and $Y_c(j\omega)$ in this case.