

Prob. 1

(a) As an example, the spectra using $N = 512$ of digits 1 and 2 from **phone_0.wav** are shown in Figure 1. Your solution may vary depending on the phone signal analyzed and selected value of N .

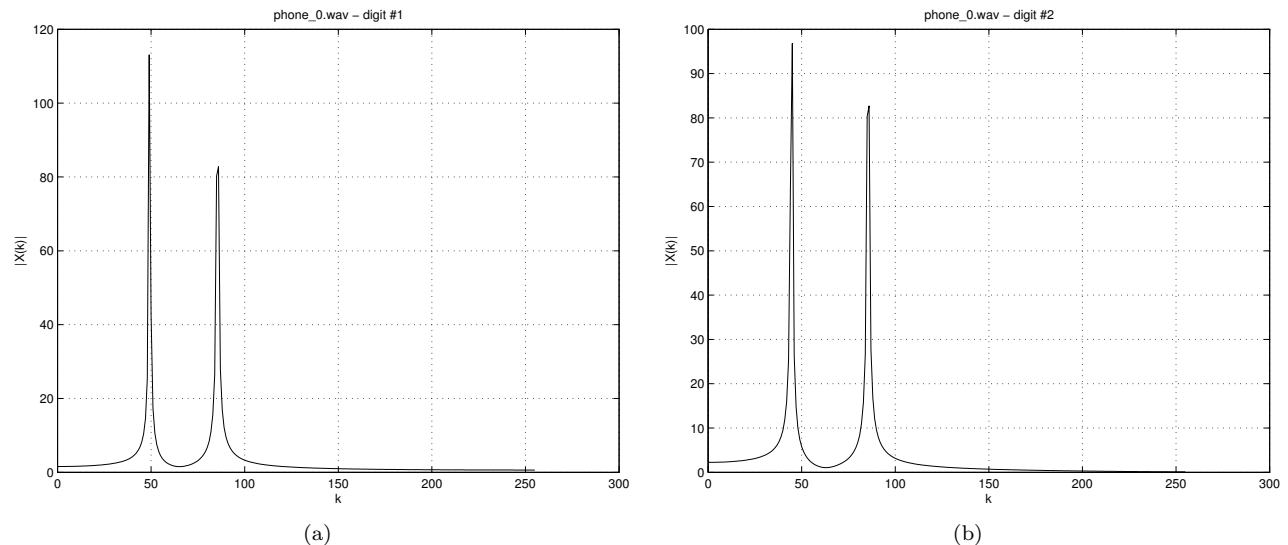


Figure 1: Plots for Prob. 6.

(b) For Digit #1 (**phone_0.wav**), the spectral peaks occur at $k_1 = 49$ and $k_2 = 86$ which is equivalent to $f_1 = k_1/N * f_s = 766$ Hz (row 2) and $f_2 = k_2/N * f_s = 1344$ Hz (col 2). These frequencies correspond to the number '5'.

For Digit #2 (**phone_0.wav**), the spectral peaks occur at $k_1 = 45$ and $k_2 = 86$ which is equivalent to $f_1 = k_1/N * f_s = 703$ Hz (row 1) and $f_2 = k_2/N * f_s = 1344$ Hz (col 2). These frequencies correspond to the number '2'.

(c) The phone numbers being dialed in each file are as follows:

Table 1: Phone numbers dialed

phone_0.wav	5217300	Red Brick
phone_1.wav	5227700	Dominos
phone_2.wav	5213697	Fox's
phone_3.wav	5213434	Dion's
phone_4.wav	5213456	Papa Johns
phone_5.wav	5256770	Zeffiro
phone_6.wav	5228866	Uno's
phone_7.wav	5213505	Lorenzos
phone_8.wav	5236262	Little Caesars
phone_9.wav	5224566	Pizza Hut

Prob. 2

(a) Reproduction of Figures 10.1.6(a) and 10.1.7(a) can be found in Figs. 2 (a) and (b). Magnitude response (in dB) and phase response can be found in Fig. 2 (c) and (d).

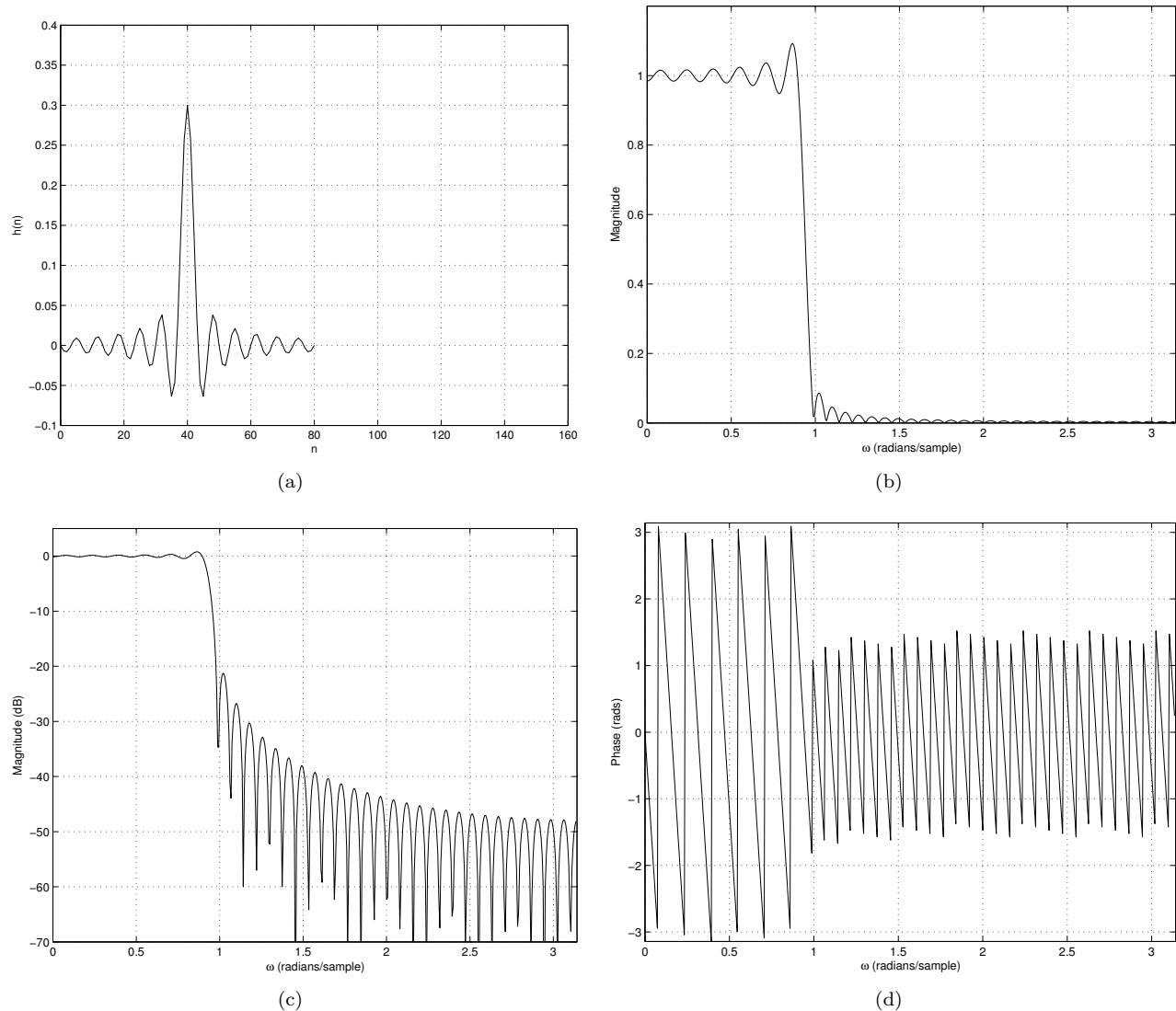


Figure 2: Plots for Prob. 2(a) filter coefficients, (b) magnitude response (in normal units), (c) magnitude response (in dB), and (d) phase response.

(b) Reproduction of Figures 10.1.6(b) and 10.1.7(b) can be found in Fig. 3 (a) and (b). Magnitude response (in dB) and phase response can be found in Fig. 3 (c) and (d).

(c) The rectangular window has a narrow mainlobe than the Hamming window, therefore the filter's transition band is narrower as seen in Fig. 2 (c) versus Fig. 3 (c). The Hamming window has smaller sidelobes than the rectangular window, therefore the filter's stopband attenuation and sidelobes are smaller as seen in Fig. 2 (c) versus Fig. 3 (c).

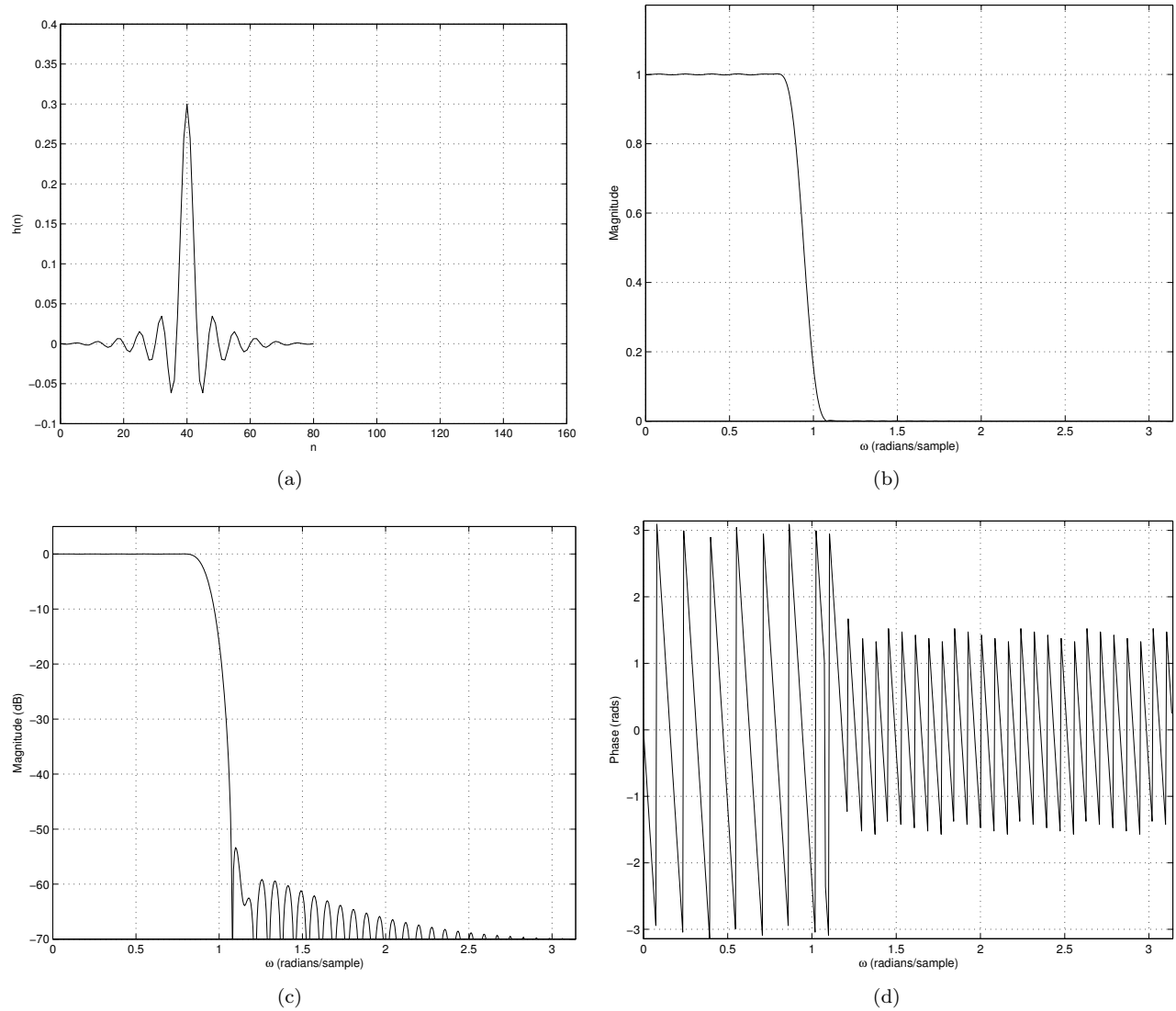


Figure 3: Plots for Prob. 2(a) filter coefficients, (b) magnitude response (in normal units), (c) magnitude response (in dB), and (d) phase response.

Prob. 3

We design a LPF with cutoff $\omega_c = 0.7\pi$ and then frequency shift by π . Filter coefficients and magnitude response (in dB) for Hamming-widowed FIR HPF design can be found in Figs. 4 (a) and (b).

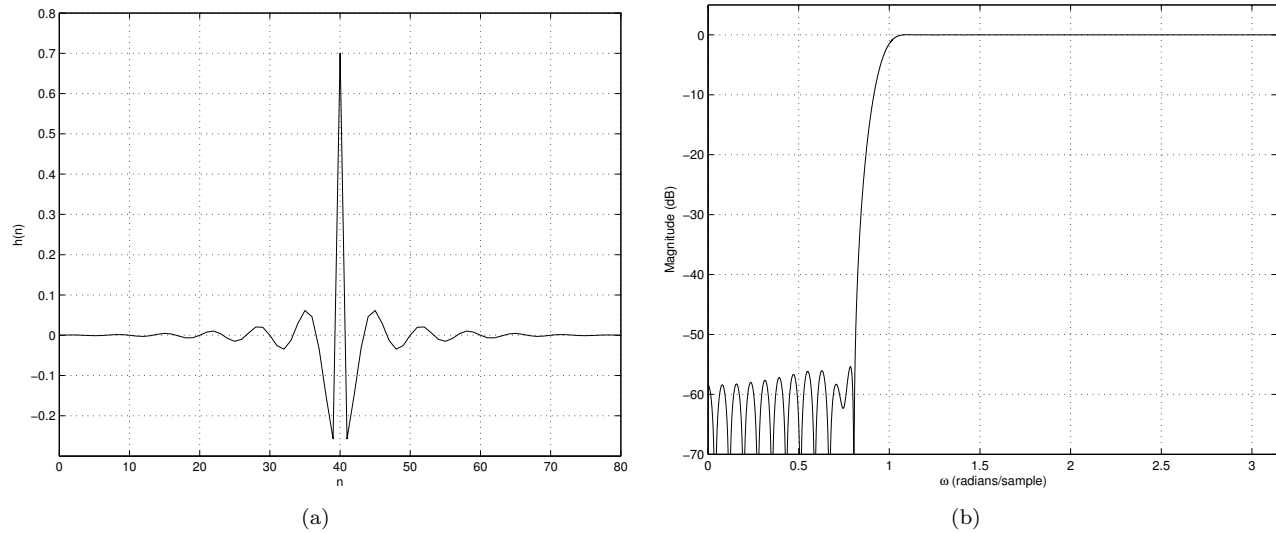


Figure 4: Plots for Prob. 3 (a) filter coefficients and (b) magnitude response.

Prob. 4

We design a LPF with cutoff $\omega_c = 0.1\pi$ and then frequency shift by $\pi/2$. Filter coefficients and magnitude response (in dB) for Hamming-widowed FIR BPF design can be found in Figs. 5 (a) and (b).

Textbook Problems

Solutions to textbook problems may be found in the online solution manual.

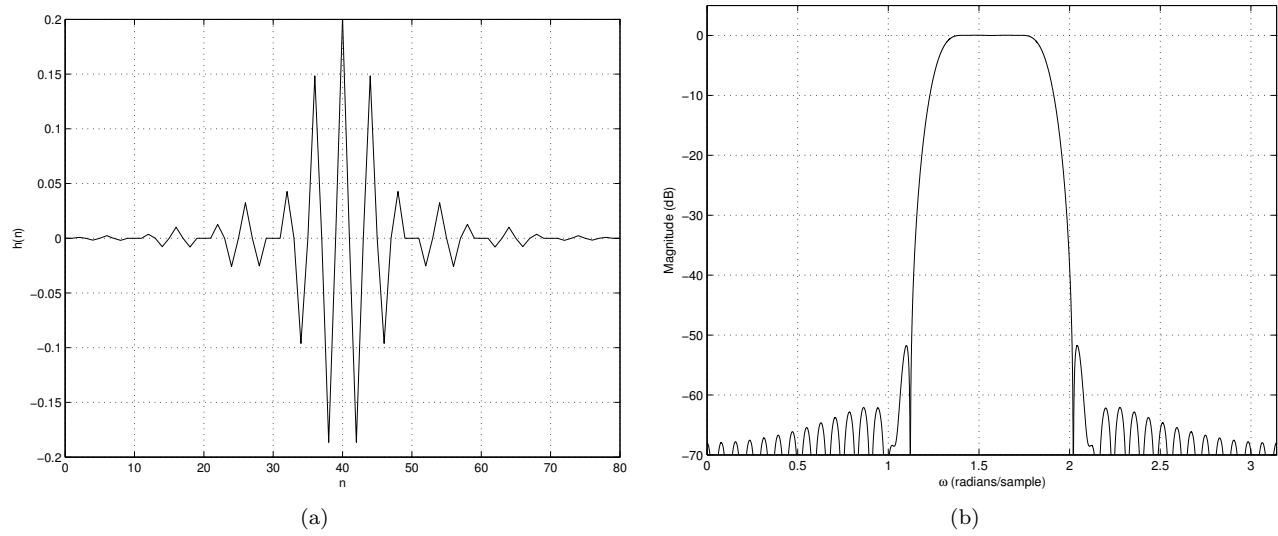


Figure 5: Plots for Prob. 3 (a) filter coefficients and (b) magnitude response.