Basic Problems

19. (a) See plot below.

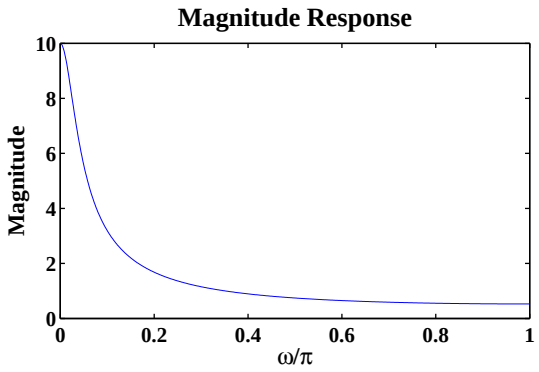

FIGURE 12.22: Magnitude spectra of $x[n]$.

(b) See plot below.

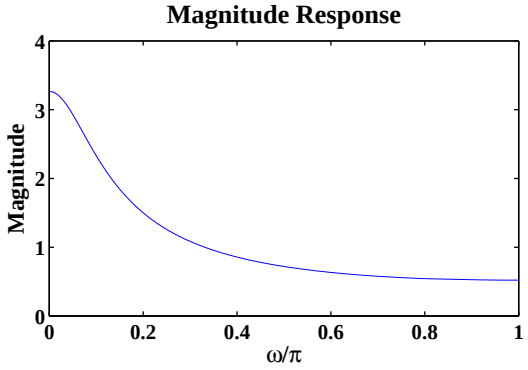

FIGURE 12.23: Magnitude spectra of $x_{\mathrm{D}}[n]$.

(c) tba.

MATLAB script:

```
% P1219: Decimation; Frequency Investigation
close all; clc
L = 101; n = 0:L-1;
xn = 0.9.^n;
w = linspace(0,1,501)*pi;
```

```
Hx = freqz(xn,1,w); Hxmag = abs(Hx);
D = 3;
yn = decimate(xn,D);
Hy = freqz(yn,1,w); Hymag = abs(Hy);
%% Plot
hfa = figconfg('P1219a','small');
plot(w/pi,Hxmag)
xlabel('\omega/\pi','fontsize',LFS);
ylabel('Magnitude','fontsize',LFS);
title('Magnitude Response','fontsize',TFS);
hfb = figconfg('P1219b','small');
plot(w/pi,Hymag)
xlabel('\omega/\pi','fontsize',LFS);
ylabel('Magnitude','fontsize',LFS);
title('Magnitude Response','fontsize',TFS);
```

20. Solution:

$$y[n] = \sum_{m=-\infty}^{\infty} x[3m] g_{\mathrm{r}}[n - 5m]$$

21. (a) See plot below.

    (b) $x[n] = \cos(0.3\pi n)$, $0 \leq n \leq 60$, $D = 3$, $k = 0$, and $k = 1$.

    (c) See plot below.

    (d) See plot below.

    (e) See plot below.

    MATLAB script:

```
% P1221: Illustrating function "downsample"
close all; clc
%% Part a:
n = 0:50; D = 4;
k = 0;
% k = 2;
xn = sin(0.2*pi*n);

%% Part b:
% n = 0:60; D = 3;
```

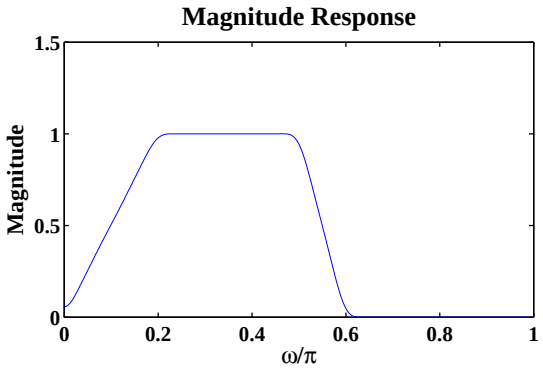

FIGURE 12.99: Magnitude spectra of $x[n]$.

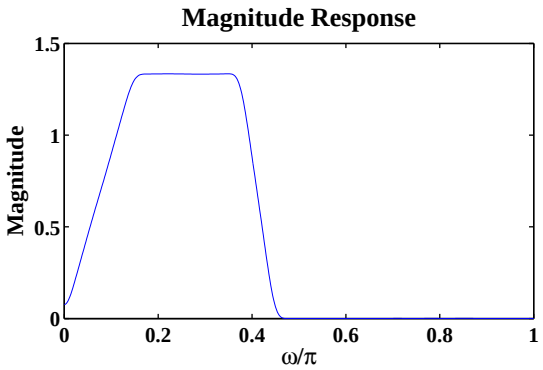

FIGURE 12.100: Magnitude spectra of the resampled sequence by a factor of $4/3$.

```
title('Magnitude Response','fontsize',TFS);
```

46. (a) See plot below.

    (b) tba.

    MATLAB script:

```
% P1246: Half-band lowpass filter
close all; clc
hn = [3 0 -19 -32 -19 0 3];
w = linspace(0,1,1001)*pi;
H = freqz(hn,1,w);
% H = 3 - 19*exp(-2j*w) - 32*exp(-3j*w) - 19*exp(-4j*w) + 3*exp(-6j*w);
Hmag = abs(H);
```

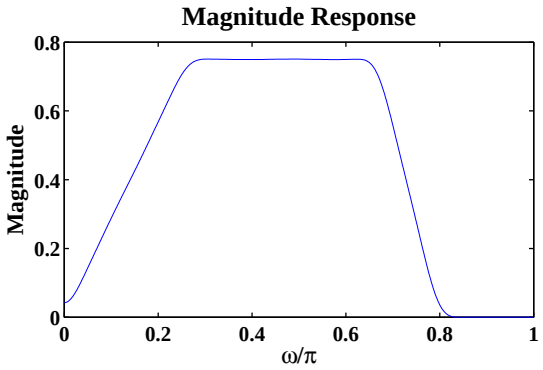

FIGURE 12.101: Magnitude spectra of the resampled sequence by a factor of $3/4$.

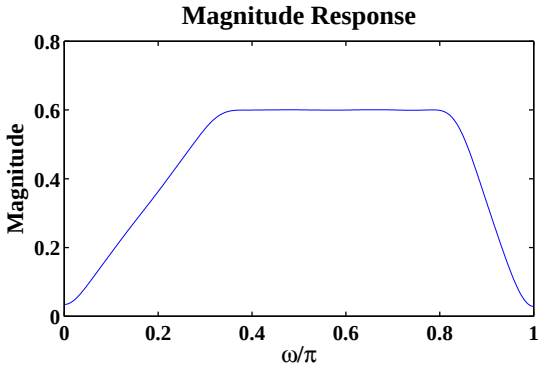

FIGURE 12.102: Magnitude spectra of the resampled sequence by a factor of $3/5$.

```
Hdb = 20*log10(Hmag./max(Hmag));
%% Plot
hfa = figconfg('P1246a','small');
plot(w/pi,Hdb);hold on
ylim([-60 0])
set(gca,'XTick',[0 pi/2 pi]/pi,'Xgrid','on')
xlabel('\omega/\pi','fontsize',LFS)
ylabel('Decibels','fontsize',LFS)
title('Magnitude Response (dB)','fontsize',TFS)
```

47. See plot below

    MATLAB script:

```
% P1247: Half-band lowpass filter design
```