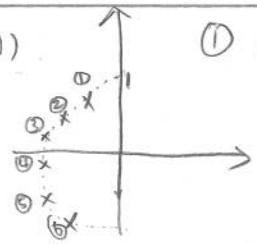
ECEn 380

Homework 7

6: 42, 60, 61-63, 65, 66, 68

Benjamin Bergeson

6.42 (a)



① $e^{j\frac{7\pi}{12}}$ ② $e^{j\frac{3\pi}{4}}$ ③ $e^{j\frac{11\pi}{12}}$ ④ $e^{-j\frac{11\pi}{12}}$ ⑤ $e^{-j\frac{3\pi}{4}}$ ⑥ $e^{-j\frac{7\pi}{12}}$

(b)

$$H(s) = \frac{1}{(s-e^{j\frac{7\pi}{12}})(s-e^{-j\frac{7\pi}{12}})(s-e^{j\frac{3\pi}{4}})(s-e^{-j\frac{3\pi}{4}})(s-e^{j\frac{11\pi}{12}})(s-e^{-j\frac{11\pi}{12}})}$$

(c)

$$\frac{1}{s^6 + 3.8637 s^5 + 7.4641 s^4 + 9.1416 s^3 + 7.4641 s^2 + 3.8637 s + 1}$$

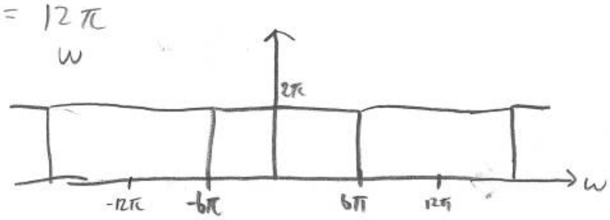
$$\boxed{\frac{d^6 y}{dt^6} + 3.8637 \frac{d^5 y}{dt^5} + 7.4641 \frac{d^4 y}{dt^4} + 9.1416 \frac{d^3 y}{dt^3} + 7.4641 \frac{d^2 y}{dt^2} + 3.8637 \frac{dy}{dt} + y = x}$$

6.60 $784 \cdot 9 \cdot 2 = \boxed{14112 \text{ Hz}}$

6.61 limiting $\omega = 100\pi$ $f = 50$ $\boxed{\text{sampling rate} > 100 \text{ samples/sec}}$

6.62 $\text{rect}\left(\frac{\omega}{4\pi}\right) * \underbrace{2\pi\delta(\omega) + 2\pi[\delta(\omega-4\pi) + \delta(\omega+4\pi)]}$

Sampling rate = 6 Hz = 12π ω



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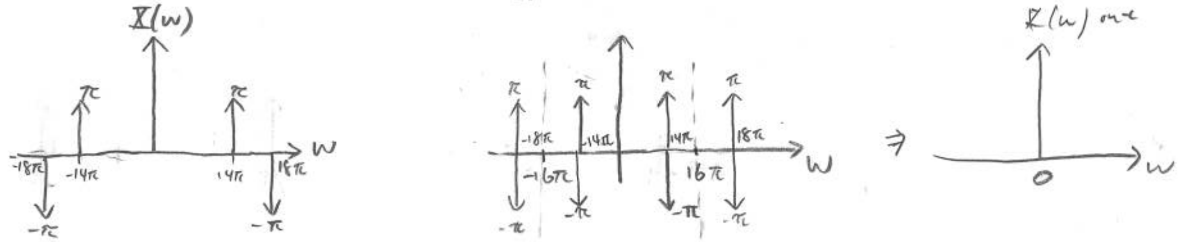
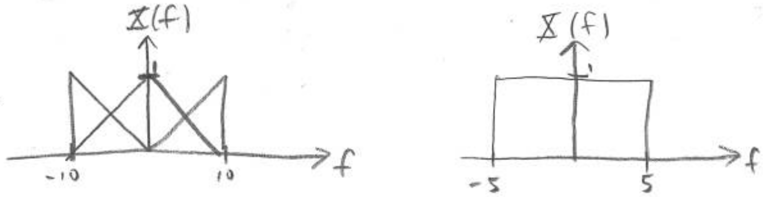
$\boxed{6.63}$ $x(t) = \cos(14\pi t) - \cos(18\pi t)$ 16 Hz $\omega_s = 32\pi$

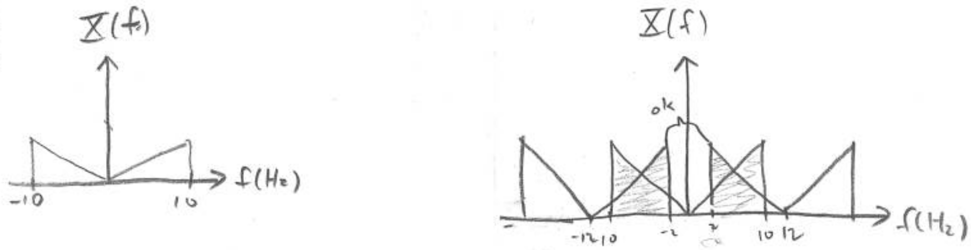
$$X(\omega) = \pi\left[\delta(\omega - 14\pi) + \delta(\omega + 14\pi)\right] - \pi\left[\delta(\omega - 18\pi) + \delta(\omega + 18\pi)\right]$$



$\boxed{6.65}$



$\boxed{6.66}$



$\boxed{-2 < f < 2}$

$\boxed{6.68}$ $x^2(t) = x(t) \cdot x(t) = X(\omega) * X(\omega)$ Bandlimiting frequency : 10k

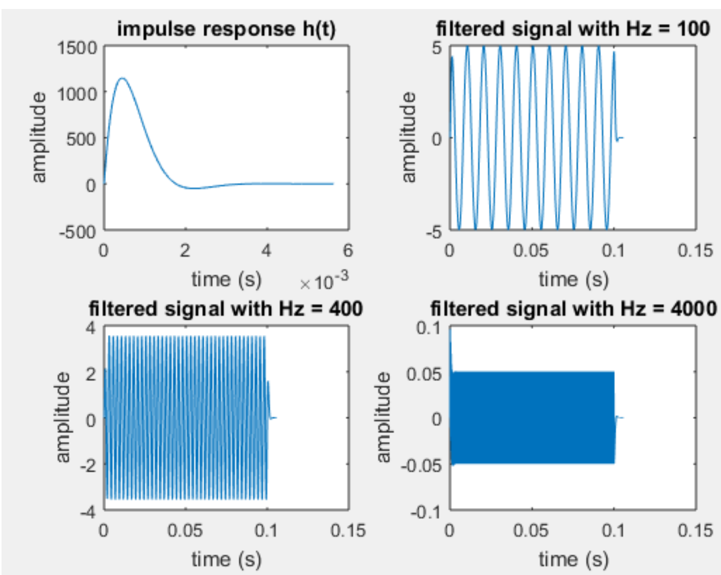
Nyquist sampling rate > 20ksamples /sec

```
function [h] = h_t(fc,dt)
wc = 2*pi*fc;  %the corner frequency in rads/s
%a1_bwf and a2_bwf are coefficients obtained from table 6-3 in the book (pg
285).
a1_bwf = 1.41;
a2_bwf = 1;
%a1 and a2 are coefficients associated with the 2nd order
%differential equation.
a1 = a1_bwf * wc;
a2 = a2_bwf * wc * wc;
r = roots([1, a1, a2]);  %obtain the roots of the polynomial.
%b2 is a coefficient according to equation 2.121 in the book it represents b2
b2 = wc^2;

sigma = abs(real(r(1)));
%Now let's set up the impulse response
tau = 1/sigma;

%time parameters
time_beg = 0;
time_end = 10*tau;
t = time_beg:dt:time_end - dt;  %time array

%impulse response
%notice that the equation is simplifies because b1 = 0
h = ((b2/(r(1) -r(2))).*exp(r(1).*t)) -  ((b2/(r(1) -r(2))).*exp(r(2).*t));
end
```



(a) It still does.

(b) -3 = 20 log(x/5)   x = 3.54

(c) Because the amplitude goes down 20 dB per decade, and because it is a second order filter, then using this equation: -43 = 20log(x/5) and got that it should be 100 times smaller.