Lab Report – 2

ECS 330 : Experiment: Filter Design

Name: Ajay Choudhury (18018) Date of Submission: 27th January 2021

Solutions

Q.1. Solution

**Code:**

1. syms t w;
2. f1 = 20;
3. f2 = 40;
4. f3 = 60;
5. x = cos(2\*pi\*f1\*t) + cos(2\*pi\*f2\*t) + cos(2\*pi\*f3\*t);
6. ft = fourier(x, t, w)

**Output:**

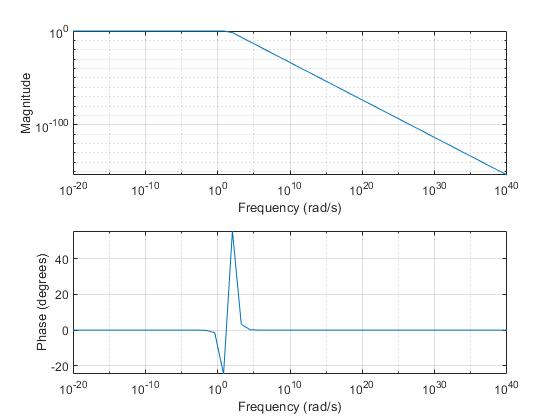
1. ft = pi\*(dirac(w - 40\*pi) + dirac(w + 40\*pi)) + pi\*(dirac(w - 80\*pi) + dirac(w + 80\*pi)) + pi\*(dirac(w - 120\*pi) + dirac(w + 120\*pi))

Q.2. Solution

**Code:**

1. [b , a] = butter (4, 40, ‘s’);
2. wband = logspace(-20, 40);
3. freqs(b, a, wband);

**Figure:** (On Next Page)



Q.3. Solution

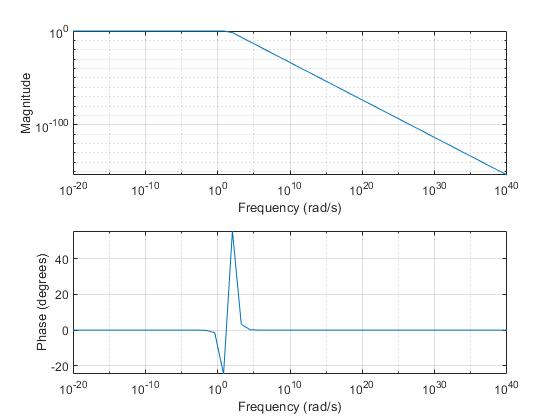
**Code:**

1. [b , a] = butter (4, 40, ‘s’);
2. wband = logspace(-20, 40);
3. freqs(b, a, wband);
5. H(w) = poly2sym(b, w) / poly2sym(a, w)

**Output:**

1. H(w) = 2560000/(w^4 + (3677647801095837\*w^3)/35184372088832 + (1501587004615895\*w^2)/274877906944 + (718290586151531\*w)/4294967296 + 2560000)

**Figure:**



Q.4. Solution

**Code:**

1. Y(w) = H(w).\*ft;
2. y(t) = ifourier(Y,w,t);

**Output:**

1. y(t) = ((4398046511104000\*pi\*exp(-pi\*t\*80i))/(70368744177664000\*pi^4 - 91941195027395925\*pi^3 + 60063480184635800\*pi^2 - 22985298756848992\*pi + 4398046511104000) + (4398046511104000\*pi\*exp(pi\*t\*80i))/(70368744177664000\*pi^4 + 91941195027395925\*pi^3 + 60063480184635800\*pi^2 + 22985298756848992\*pi + 4398046511104000) + (35184372088832000\*pi\*exp(-pi\*t\*40i))/(35184372088832000\*pi^4 - 91941195027395925\*pi^3 + 120126960369271600\*pi^2 - 91941195027395968\*pi + 35184372088832000) + (35184372088832000\*pi\*exp(pi\*t\*40i))/(35184372088832000\*pi^4 + 91941195027395925\*pi^3 + 120126960369271600\*pi^2 + 91941195027395968\*pi + 35184372088832000) + (35184372088832000\*pi\*exp(-pi\*t\*120i))/(2849934139195392000\*pi^4 - 2482412265739689975\*pi^3 + 1081142643323444400\*pi^2 - 275823585082187904\*pi + 35184372088832000) + (35184372088832000\*pi\*exp(pi\*t\*120i))/(2849934139195392000\*pi^4 + 2482412265739689975\*pi^3 + 1081142643323444400\*pi^2 + 275823585082187904\*pi + 35184372088832000))/(2\*pi)

Q.5. Solution

**Code:**

1. fs = 1000;
2. t1 = 0:1/fs:2-1/fs;
3. x\_numeric = double(subs(x,t,t1));
4. y\_numeric = double(subs(y,t,t1));
5. figure
6. subplot(2,1,1)
7. plot(t1,x\_numeric)
8. subplot(2,1,2)
9. plot(t1,y\_numeric)
10. ylim=[-4,4];
11. Y\_NUM=fft(y\_numeric);
12. X\_NUM=fft(x\_numeric);
13. n=length(X\_NUM);
14. f=(0:n-1)\*fs/n;
15. figure;
16. subplot(2,1,1);
17. plot(f(1:floor(length(X\_NUM)/2)), abs(X\_NUM(1:floor(length(X\_NUM)/2))));
18. xlabel('\textbf{Frequency (Hz)}', 'Interpreter', 'latex');
19. ylabel('\textbf{Magnitude}', 'Interpreter', 'latex');
20. grid;
21. subplot(2,1,2);
23. plot(f(1:floor(length(Y\_NUM)/2)), abs(Y\_NUM(1:floor(length(Y\_NUM)/2))));
24. xlabel('\textbf{Frequency (Hz)}', 'Interpreter', 'latex');
25. ylabel('\textbf{Magnitude}', 'Interpreter', 'latex');
26. grid;

**Figures:**

