Fall 2018 - Problem Set 4
ECE 301: Signals and Systems

Prof.Aly El Gamal

Due Date : October 26, 2018

Instructions

1. Please write clearly and legibly.
2. Your solutions must include detailed steps and/or explanations. Do not simply state the answer.
3. Write your full name(first,last), PUID on your homework submission.
4. All problems carry almost equal weight.

Problem 1

For each of the Fourier Transforms shown in figure 1 and 2, evaluate the following

a $E = \int_{-\infty}^{\infty} |x(t)|^2$

b $D = \frac{d}{dt}x(t)|_{t=0}$

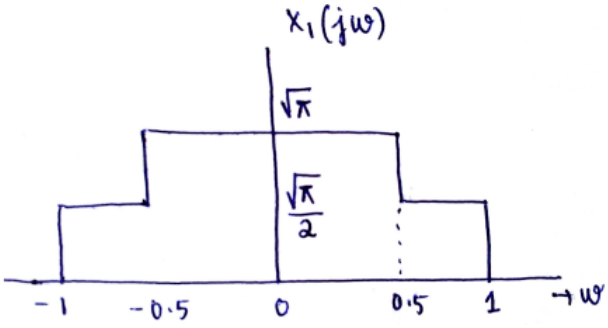

Figure 1: $X_1(j\omega)$

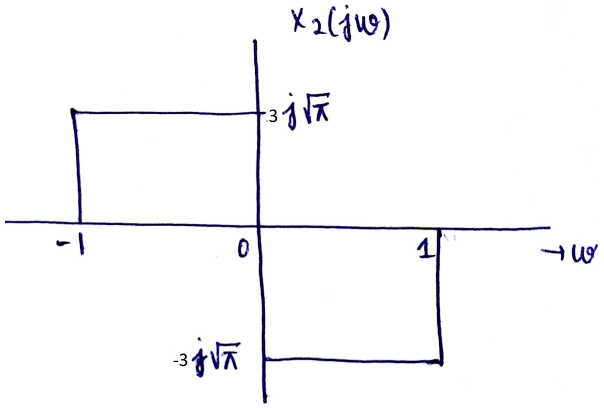

Figure 2: $X_2(j\omega)$

Problem 2

What are the practical considerations while designing a Low Pass Filter. Given an example of the approximation of the Fourier Transform of the Low Pass Filter.

Problem 3

Consider the modulation system as shown below in figure 3. The input signal is $x(t)$ and has Fourier Transform $X(j\omega)$ that is zero for $|\omega| > \omega_M$ as shown in figure 4. The output of the system is y(t).

a Sketch $Y(j\omega)$ which is the Fourier transform of $y(t)$. Show your work in detail and give explanations wherever necessary.

b Is $x(t)$ real or purely imaginary? Is $x(t)$ even or odd signal?

c Is $y(t)$ real or purely imaginary? Is $y(t)$ even or odd signal?

d For the demodulation system shown in figure 5, find the value of the constant 'c' which is required to reconstruct x(t) accurately. Show your work in detail and give explanations wherever necessary

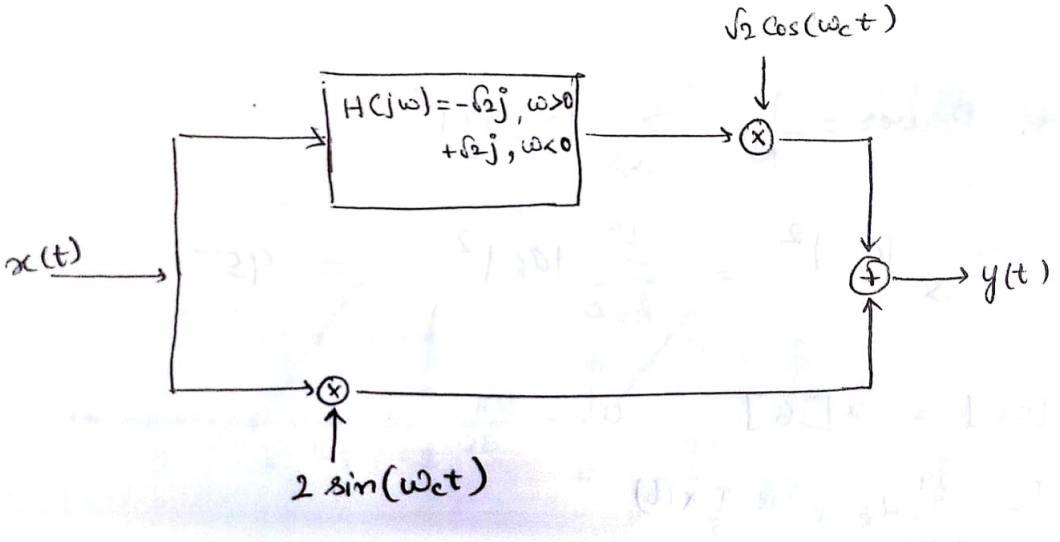

Figure 3: Modulation System

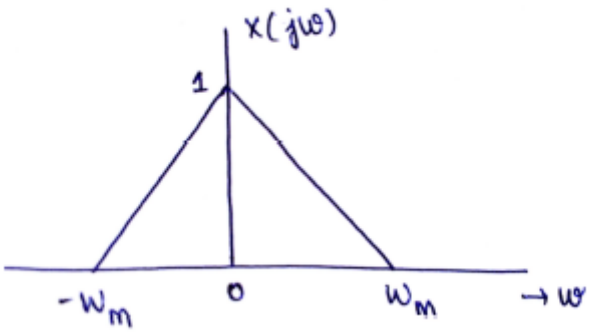

Figure 4: $X_2(j\omega)$

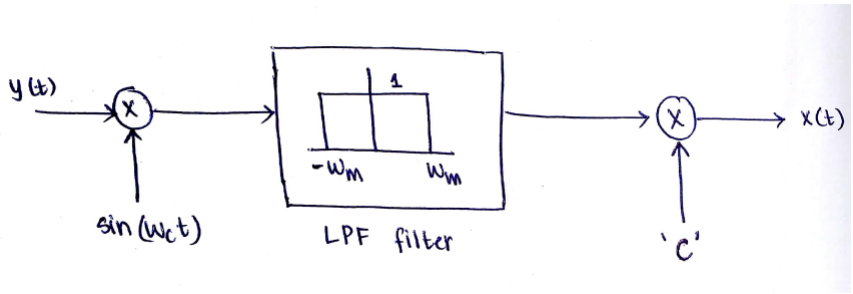

Figure 5: Demodulation System

Problem 4

a Given $X(j\omega) = \frac{5}{2}\frac{\sin(4\omega)}{\omega}$, find x(t).

b Let $Y(j\omega)$ be obtained by multiplying $X(j\omega)$ with an impulse train as shown in figure 6. Note that $X(j\omega)$ is as given in part (a). Find y(t).

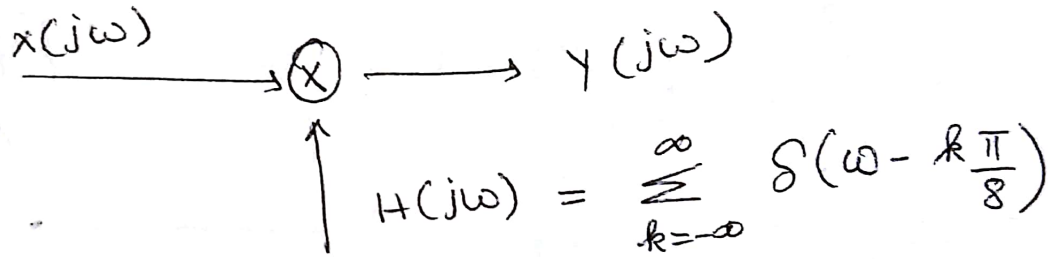

Figure 6: $x_2(t)$

Problem 5

a Find the Fourier Transform of the signal $\frac{\sin(2t)\sin(3t)}{t^2}$

b Find the Inverse Fourier Transform of $\frac{\sin^2(2\omega)}{\omega^2}$

c Find the Fourier Transform of the signal in figure 7.

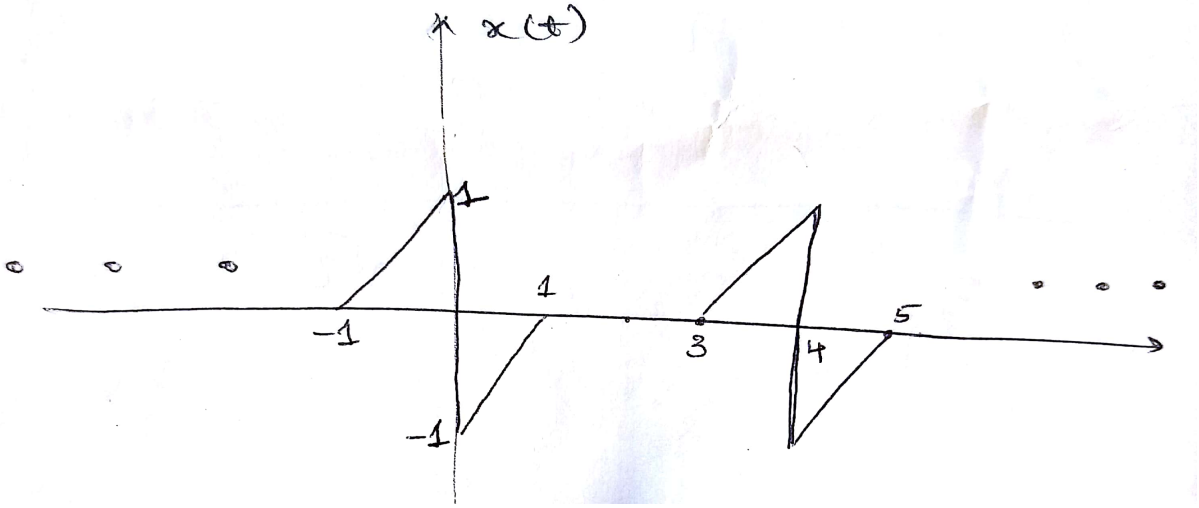

Figure 7: Caption