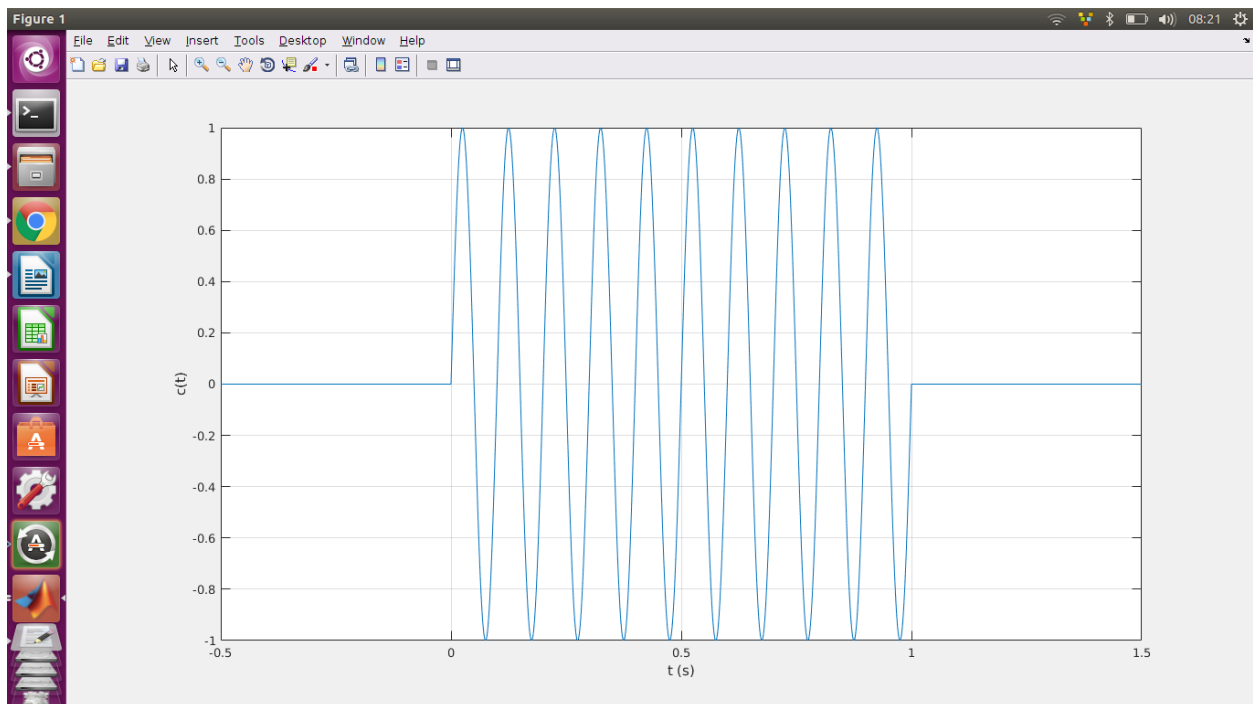# Homework 0

Bài 1:

a.

```
%fc = 10Hz
fc = 10;
%fs > 2fc va chon fs=800Hz
fs = 800;
%-0.5 < t < 0.5
t = -0.5:1/fs:1.5;
a = sin(2*pi*fc*t);
b = rectpuls(t - 0.5);
c = a.*b ;
%Ve do thi
plot(t,c);
grid on;
xlabel('t (s)');
ylabel('c(t)');
```


Biến đổi Fourier C(t):

$$c(t) = sin(2\pi fct)rect(t - \tfrac{1}{2})$$

$$C(f) = F\{c(t)\} = F\{sin(2\pi fct)rect(t - \tfrac{1}{2})\}$$

$$C(f) = F\{sin(2\pi fct)\} * F\{rect(t - \frac{1}{2})\}F\{w1(t)w2(t)\} = W1(f) * W2(f)$$

$$*/ F\{sin(2\pi fct)\} = j\frac{1}{2}[\delta(f + f0) - \delta(f - f0)]$$
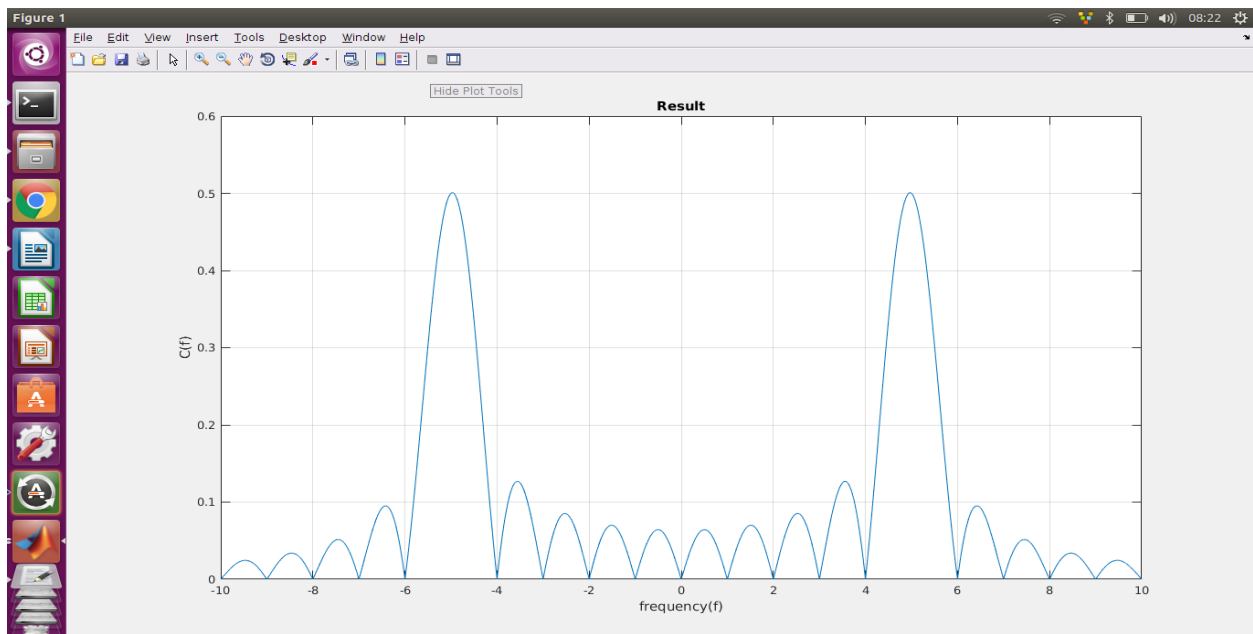
$$*/F\{rect(t - 1/2)\} = e^{-j\pi f} sinc(f)$$

$$\Rightarrow C(f) = j\frac{1}{2}[\delta(f + f0) - \delta(f - f0)] e^{-j\pi f} sinc(f)$$

$$w(t) * \delta(t + a) = w(t + a)$$

$$C(f) = j\frac{1}{2}\left[e^{-j\pi(f+f0)} sinc(f + f0) - e^{-j\pi(f-f0)} sinc(f - f0)\right]$$

b.

```
%fc = 5Hz
fc = 5;
f = -10:0.01:10;
%Su dung lenh abs(x)de tinh do lon cua tin hieu
c = abs(0.5*1j*(exp(-1j*pi*(f+fc)).*sinc(f+fc)-exp(-1j*pi*(f-fc)).*sinc(f-fc)));
plot(f,c);
grid on;
xlabel('frequency(f)');
ylabel('C(f)');
title('Result');
```

c.

- Phổ của two-side sine $= 0$

$$\text{Total Energy} = \int_0^\infty |C(f)|^2 df = 0.25J \; (Matlab)$$

$$\int_4^6 |C(f)|^2 df = 0.2265J = 90.6\% TotalEnergy \; (Matlab)$$

- Phổ của C(t) = 2 Hz (4Hz – 6 Hz)

Bài 2:

a.

$$y(t) = x(t)\cos(\omega 0 t)$$

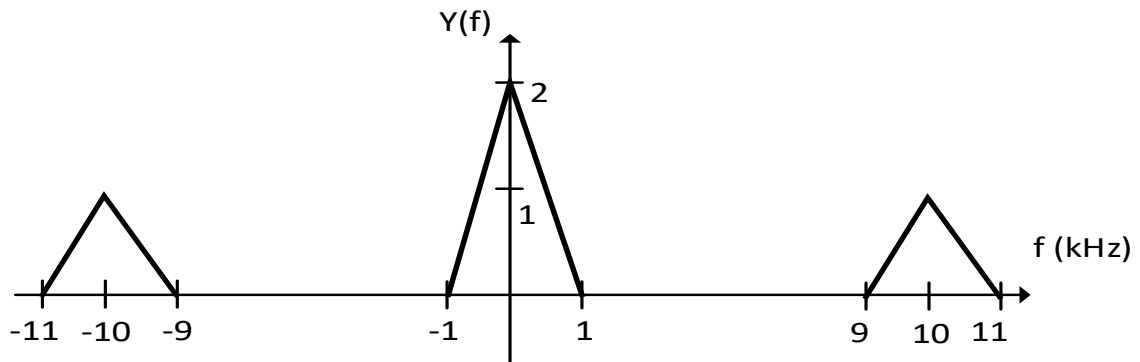$$\Rightarrow \qquad Y(f) = F\{y(t)\} = X(f) * F\{\cos(\omega 0 t)\}$$

$$F\{\cos(\omega 0 t)\} = \frac{1}{2}[\delta(f + f0) + \delta(f - f0)]$$

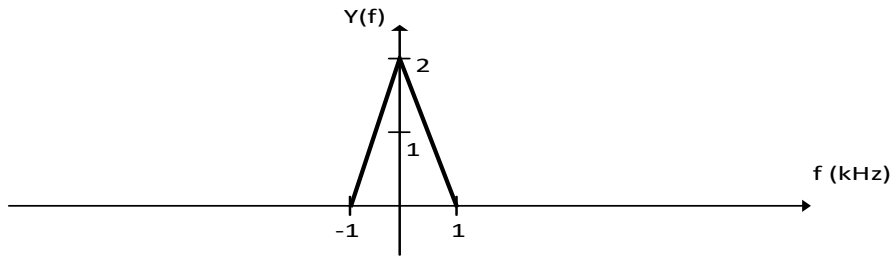$$Y(f) = X(f) * \frac{1}{2}[\delta(f + f0) + \delta(f - f0)]$$

$$=> Y(f) = \frac{1}{2}[X(f) * \delta(f + f0) + X(f) * \delta(f - f0)]$$

$$\Rightarrow Y(f) = \frac{1}{2}[X(f + f0) + X(f - f0)]$$

b.

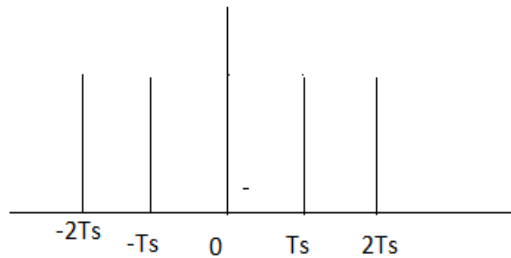c. Cho qua bộ lọc thông thấp thu được:

Bài 3:

a. $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nTs)$

-2Ts   -Ts   0   Ts   2Ts

b.

$$p(t) = \frac{1}{Ts}(1 + 2\cos(\omega st) + 2\cos(2\omega st))$$

Ta có:

$F\{\cos(\omega st)\} = \pi[\delta(\omega + \omega s) + \delta(\omega - \omega s)]$ và $F\{1\} = 2\pi\delta(\omega)$
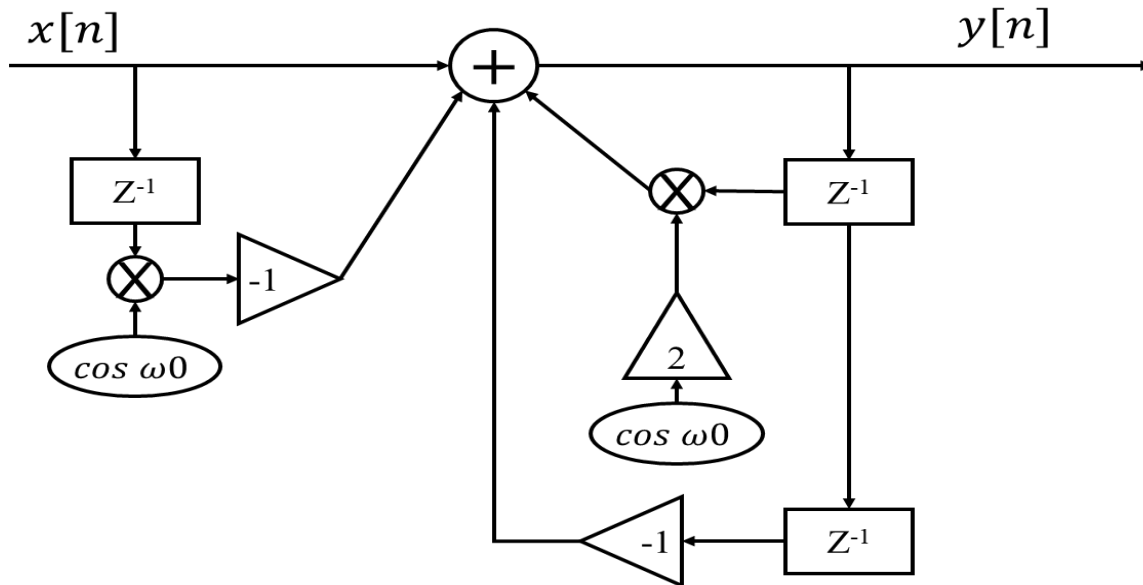
$\Rightarrow$ $p(t) = \frac{2\pi}{Ts}(\delta(\omega) + \delta(\omega + \omega s) + \delta(\omega - \omega s) + \delta(\omega + 2\omega s) + \delta(\omega - 2\omega s) \dots)$

$\Rightarrow$ $p(t) = \omega s \sum_{n=-\infty}^{\infty} \delta(\omega + n\omega s)$

Bài 4:

a.

$$y[n] = (2\cos\omega 0)y[n-1] - y[n-2] + x[n] - (\cos\omega 0)x[n-1]$$
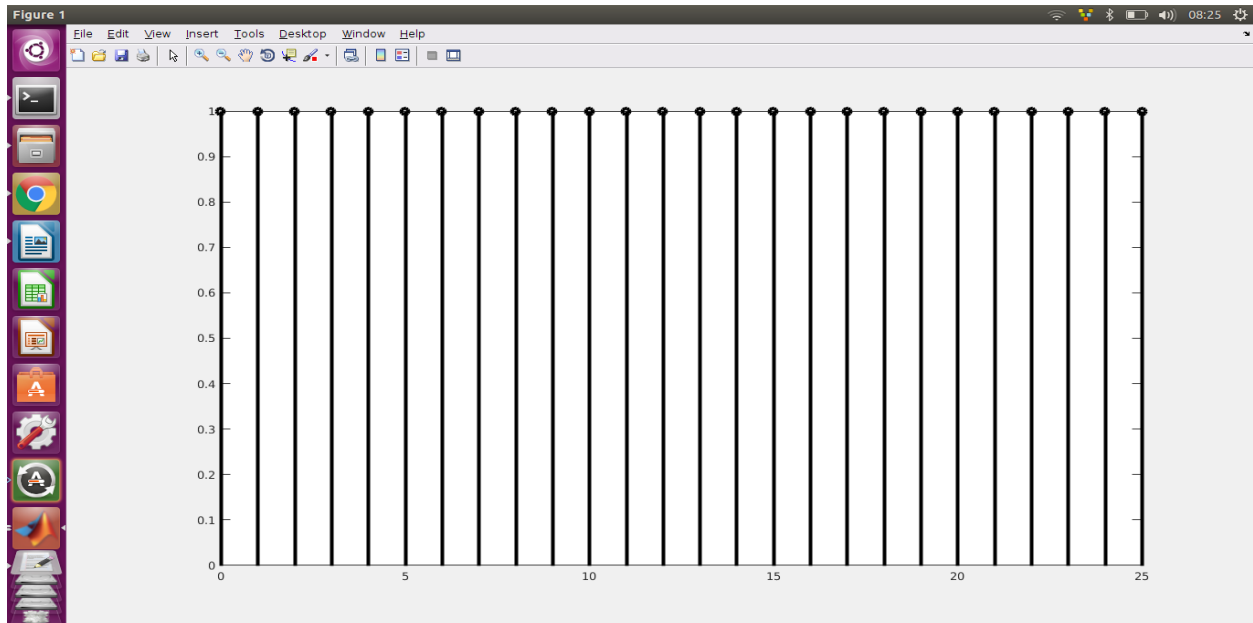
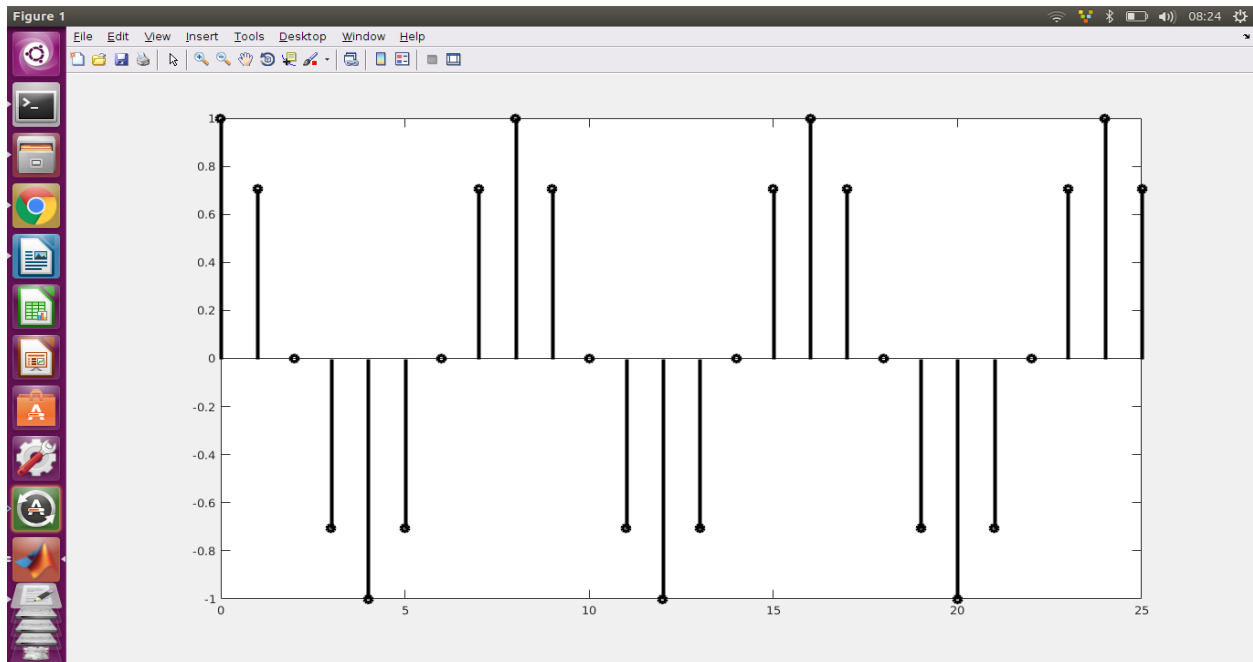b. $y[-1] = h[-1] = 0$ and $y[-2] = h[-2] = 0$ and $x[-1] = \delta\,[-1] = 0$

c. ROC: $|z| > \max\{|x_i|\} = 1$.

d.

$$\omega 0 = 0$$

$$\omega 0 = pi/4$$

$$\omega 0 = pi/2$$