LAB REPORT - 6

Submitted by -

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Q1 $x(t) = \begin{cases} 1 & |t| \leq T \\ 0 & \text{otherwise} \end{cases}$

given $T=2$

$$X(j\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$\Rightarrow X(j\omega) = \int_{-2}^{2} 1 \cdot e^{-j\omega t}\, dt$$

$$= \left. \frac{e^{-j\omega t}}{-j\omega} \right|_{-2}^{2}$$

$$\Rightarrow X(j\omega) = \frac{e^{2j\omega} - e^{-2j\omega}}{j\omega}$$

Q2 $x(t) = e^{-a|t|} = \begin{cases} e^{-at} & t>0 \\ e^{at} & t<0 \end{cases}$

$$X(j\omega) = \int_{-\infty}^{0} e^{at} e^{-j\omega t} dt + \int_{0}^{\infty} e^{-at} e^{-j\omega t} dt$$

$$= \int_{-\infty}^{0} e^{(a-j\omega)t} dt + \int_{0}^{\infty} e^{-(a+j\omega)t} dt$$

$$= \cancel{\left(\frac{1}{a-j\omega}\right)}$$

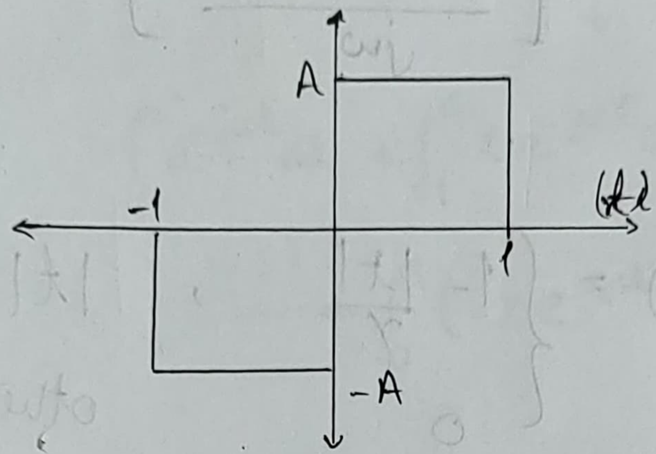
$$= \frac{e^{a-j\omega}}{a-j\omega}\Bigg|_{-\infty}^{0} + \frac{e^{-(a+j\omega)t}}{-(a+j\omega)}\Bigg|_{0}^{\infty}$$

$$= \left(\frac{1}{a-j\omega}\right) + \left(\frac{1}{a+j\omega}\right)$$

$$= \frac{a+j\omega+a-j\omega}{a^2+\omega^2}$$

$$= \frac{2a}{a^2+\omega^2}$$

Q3



$X(j\omega) = ?$

given $A = 2$

$$\Rightarrow x(t) = \begin{cases} A & 0 < t \leq 1 \\ -A & -1 \leq t < 0 \end{cases}$$

where $A = 2$

$$\Rightarrow X(j\omega) = -2\int_{-1}^{0} e^{-j\omega t}\,dt + 2\int_{0}^{1} e^{-j\omega t}\,dt$$

$$= 2\left[\left.\frac{e^{-j\omega t}}{j\omega}\right|_{-1}^{0} + \left.\frac{e^{-j\omega t}}{-j\omega}\right|_{0}^{1} \right]$$

$$= 2\left[\frac{1 - e^{j\omega}}{j\omega} - \frac{(e^{-j\omega} - 1)}{j\omega} \right]$$

$$\Rightarrow X(j\omega) = 2\left[\frac{2 - e^{j\omega} - e^{-j\omega}}{j\omega}\right]$$

Q4 $x(t) = \begin{cases} 1 - \frac{|t|}{\gamma}, & |t| \leq \gamma \\ 0 & \text{otherwise} \end{cases}$

Given $\gamma = 1$

Since $\gamma = 1$,

$$x(t) = \begin{cases} 1 + \frac{t}{\gamma} & \text{for } -\gamma \leq t < 0 \\ 1 - \frac{t}{\gamma} & \text{for } 0 < t \leq \gamma \\ 0 & \text{otherwise} \end{cases}$$

$$\Rightarrow x(t) = \begin{cases} 1 + t & -1 \leq t < 0 \\ 1 - t & 0 \leq t \leq 1 \\ 0 & \text{otherwise} \end{cases}$$

* $X(j\omega) = \int_{-1}^{0} (1+t)\, e^{-j\omega t}\, dt + \int_{0}^{1} (1-t)\, e^{-j\omega t}\, dt + 0$

$$= \int_{-1}^{0} e^{-j\omega t}\, dt + \int_{-1}^{0} t\, e^{-j\omega t}\, dt + \int_{0}^{1} e^{-j\omega t}\, dt + \int_{0}^{1} (-t\, e^{-j\omega t})\, dt$$

$$\int t\, e^{-j\omega t}\, dt = t\,\frac{e^{-j\omega t}}{-j\omega} + \int \frac{d(t)}{dt} \left(\frac{e^{-j\omega t}}{+j\omega}\right) dt$$

$$= \frac{t\, e^{-j\omega t}}{-j\omega} \times \frac{j\omega}{j\omega} + \frac{e^{-j\omega t}}{-j^2\omega^2}$$

$$= \frac{j\omega t\, e^{-j\omega t} + e^{-j\omega t}}{\omega^2}$$

$$\int t\, e^{-j\omega t}\, dt = \cancel{\frac{e^{-j\omega t}(1+j\omega t)}{\omega^2}}$$

$$\Rightarrow \cancel{X(j\omega) = \frac{e^{-j\omega t}}{-j\omega}\Big|_{-1}^{0}} + \frac{e^{-j\omega t}}{-j\omega}\Big|_{0}^{1}$$

$$X(j\omega) = \frac{e^{-j\omega t}}{-j\omega}\Big|_{-1}^{0} + \frac{e^{-j\omega t}}{-j\omega}\Big|_{0}^{1} + \frac{e^{-j\omega t}(1+j\omega t)}{\omega^2}\Big|_{-1}^{0}$$

$$- \frac{e^{-j\omega t}(1+j\omega t)}{\omega^2}\Big|_{0}^{1}$$

$$= \frac{1-e^{j\omega}}{-j\omega} + \frac{e^{-j\omega}-1}{-j\omega}$$

$$+ \frac{1-e^{j\omega}(1-j\omega)}{\omega^2} \cancel{- e^{-j\omega}(}$$

$$- \frac{e^{-j\omega}(1+j\omega)-1}{\omega^2}$$

$$\cancel{= \frac{e^{-j\omega}-e^{j\omega}}{-j\omega}} \cancel{+ \frac{2(}{\omega^2}}$$

$$X(j\omega) = \frac{j\omega}{j\omega}\left(\frac{e^{-j\omega} - e^{j\omega}}{-j\omega}\right) + \frac{1 - e^{j\omega} + j\omega e^{j\omega}}{\omega^2}$$

$$- \frac{e^{-j\omega} + j\omega e^{-j\omega} - 1}{\omega^2}$$

$$= \frac{\left(e^{-j\omega} - e^{j\omega}\right)j\omega}{\omega^2} + \cancel{\frac{2 - e^{-j\omega} - e^{j\omega} + j\omega(e^{j\omega} - e^{-j\omega})}{\omega^2}}$$

$$+ \frac{2 - e^{-j\omega} - e^{j\omega} + j\omega\left(e^{j\omega} - e^{-j\omega}\right)}{\omega^2}$$

$$= \frac{2 - e^{j\omega} - e^{-j\omega}}{\omega^2}$$

Q5 $x(t) = u(t-2) - e^{-2t}u(t)$

$$X(j\omega) = \int_{-\infty}^{\infty} x(t)\, e^{-j\omega t}\, dt$$

$$= \int_{2}^{\infty} e^{-j\omega t}\, dt - \int_{0}^{\infty} e^{-2t}\, e^{-j\omega t}\, dt$$

$$= \left.\frac{e^{-j\omega t}}{-j\omega}\right|_{2}^{\infty} - \int_{0}^{\infty} e^{-(2+j\omega)t}\, dt$$

$$= \frac{e^{-j\omega(2)}}{j\omega} + \left(\frac{e^{-(2+j\omega)t}}{-(2+j\omega)} \right)\Bigg|_0^{\infty}$$

$$= \frac{e^{-2j\omega}}{j\omega} - \frac{1}{2+j\omega}$$

S20210010027

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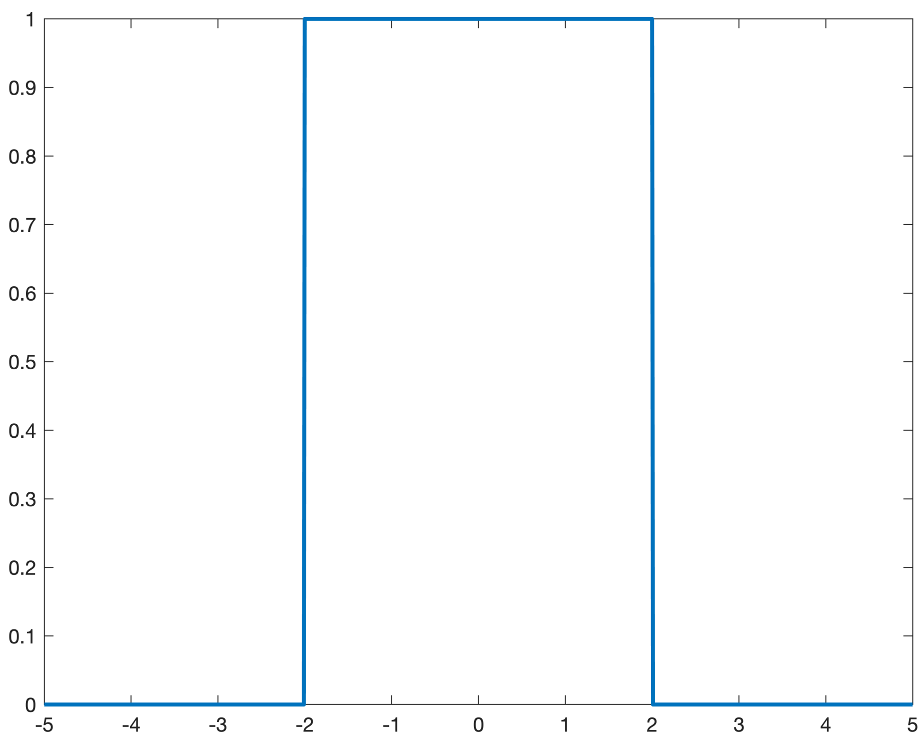
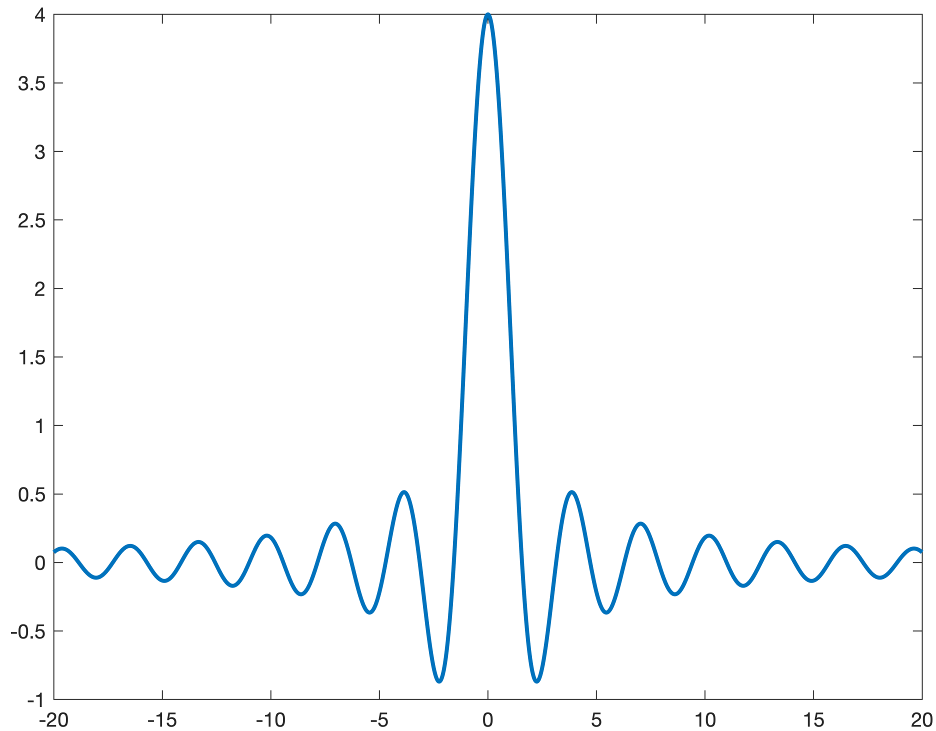
```
close all;
clear;
clc;
warning("off");
t = -5:0.01:5;
x = [];
count = 1;
for n = t
    if n >= -2 && n <= 2
        x(count) = 1;
    else
        x(count) = 0;
    end
    count = count + 1;
end
plot(t, x, 'LineWidth', 2);
```

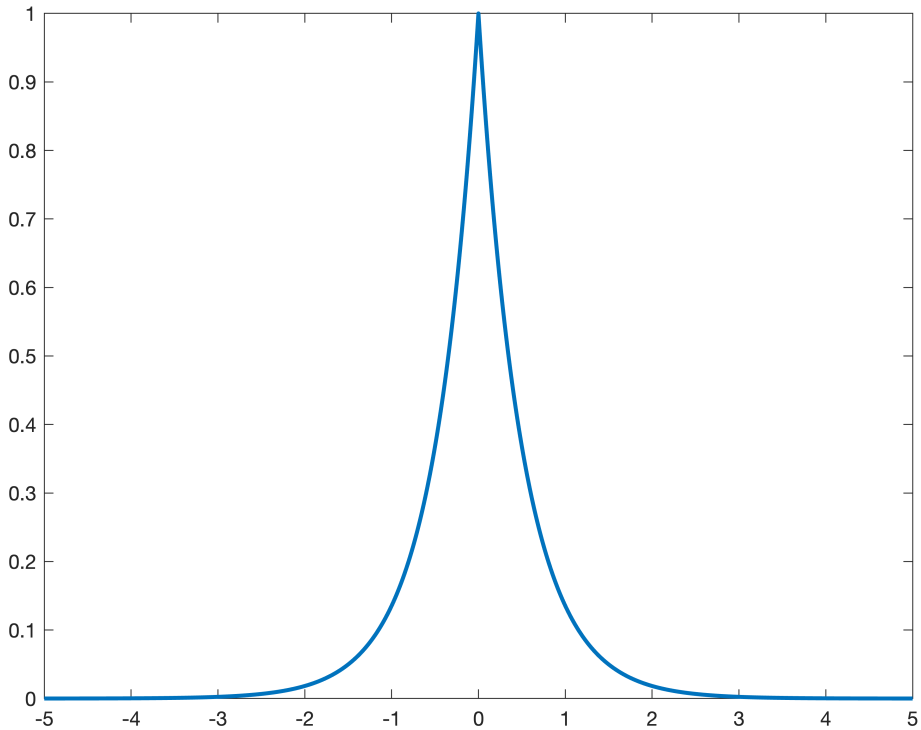



```
xjw = [];
clear count;
count = 1;
w = -20:0.01:20;
```

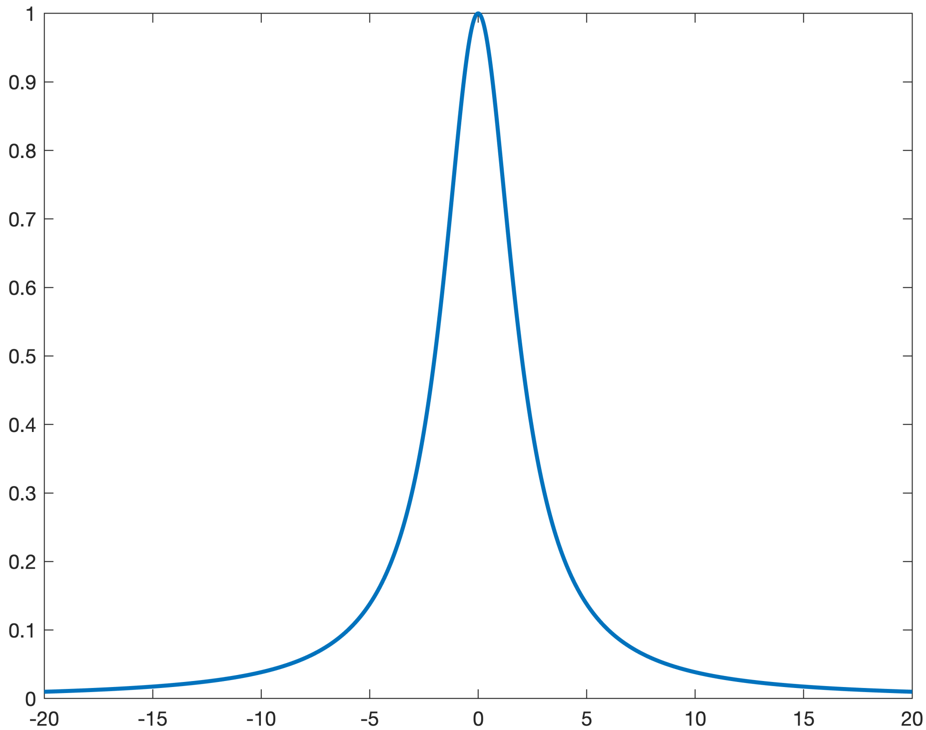
```
for k = w
    coeff = @(t) exp(-1i*k*t);
    xjw(count) = integral(coeff, -2, 2);
    count = count + 1;
end
plot(w, xjw, 'LineWidth', 2);
```



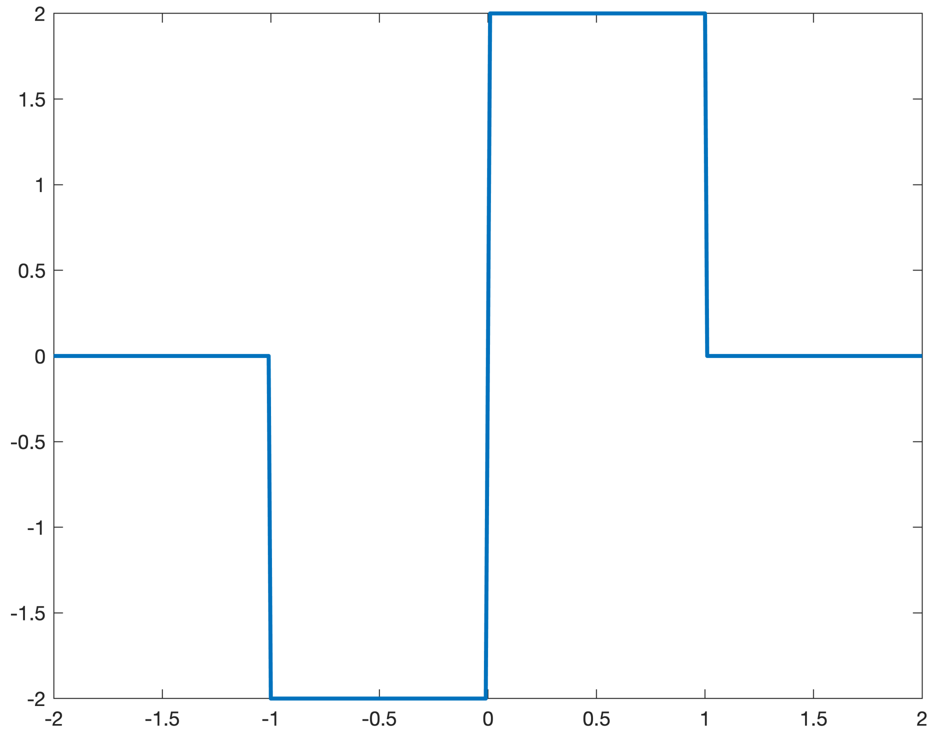

```
clear count;
clear x;
a = 2;
x = [];
count = 1;
for n = t
    x(count) = exp(-1*a*abs(n));
    count = count + 1;
end
plot(t, x, 'LineWidth', 2);
```



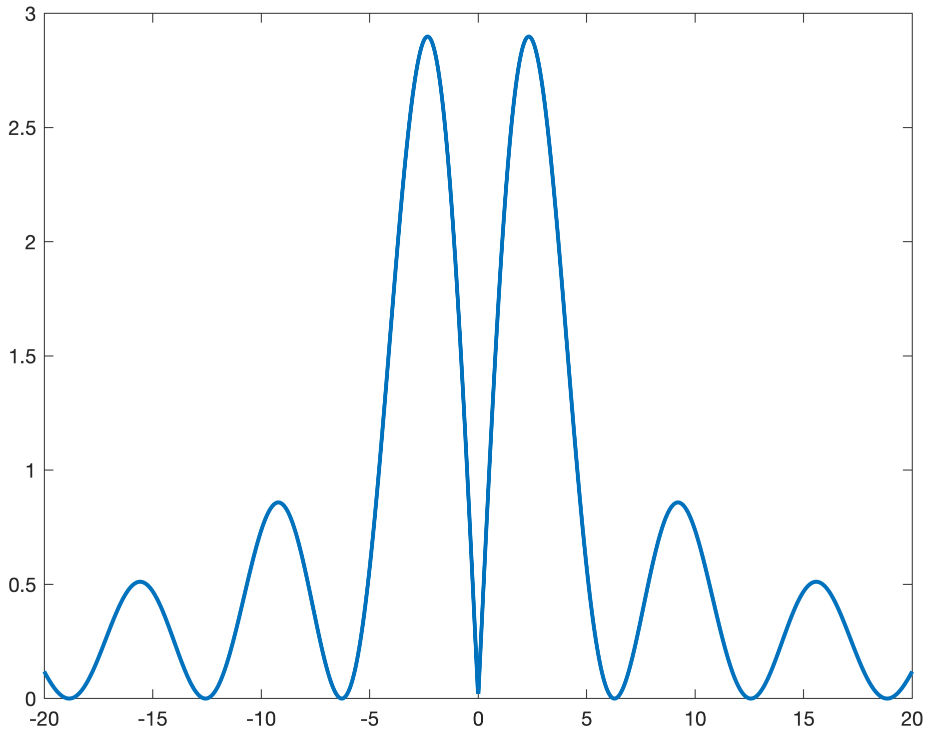

```
clear xjw;
clear count;
count = 1;
xjw = [];
for k = w
    coeff1 = @(t) exp(a*t) .* exp(-1j*k*t);
    coeff2 = @(t) exp(-1*a*t) .* exp(-1j*k*t);
    xjw(count) = integral(coeff1, -inf, 0) + integral(coeff2, 0, inf);
    count = count + 1;
end
plot(w, xjw, 'LineWidth', 2);
```



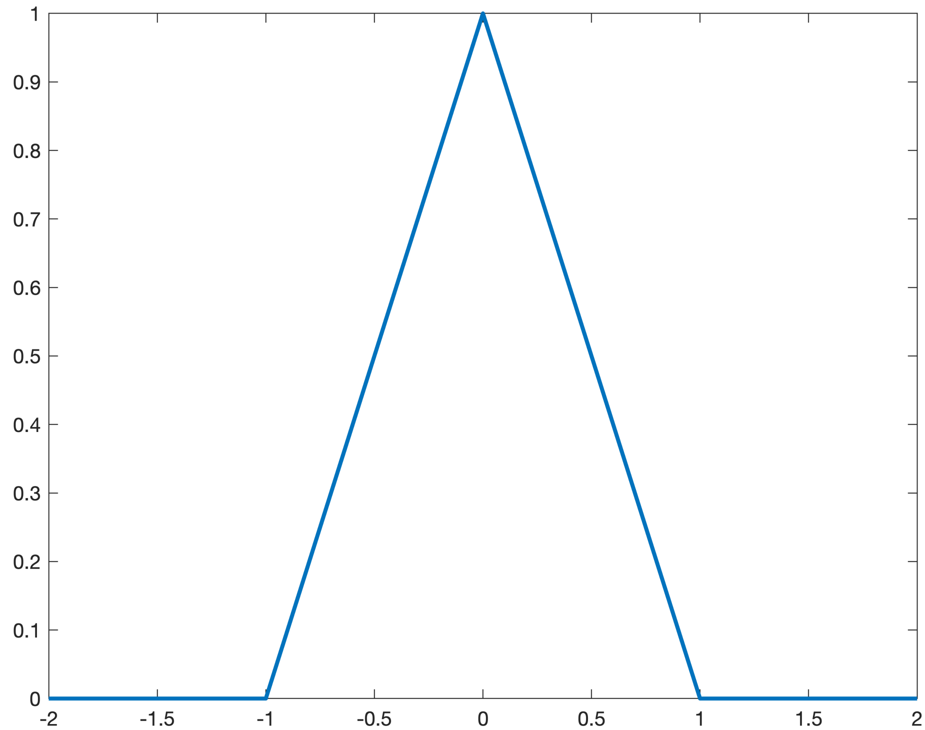

```
clear;
count = 1;
x = [];
A = 2;
t = -2:0.01:2;
for n = t
    if n >= -1 && n < 0
        x(count) = -1 * A;
    elseif n > 0 && n <= 1
        x(count) = A;
    else
        x(count) = 0;
    end
    count = count + 1;
end
plot(t, x, 'LineWidth', 2);
```



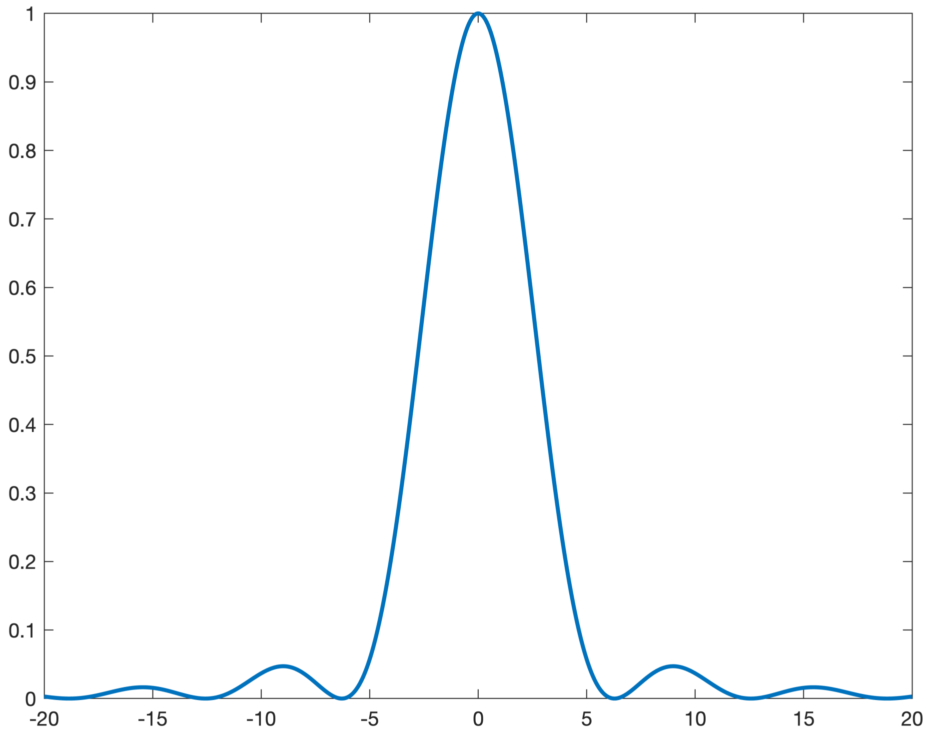

```
clear count;
xjw = [];
count = 1;
w = -20:0.01:20;
for k = w
    xjw(count) = abs((2/(1j*k)) * (2 - exp(1j*k) - exp(-1j*k)));
    count = count + 1;
end
plot(w, xjw, 'LineWidth', 2);
```



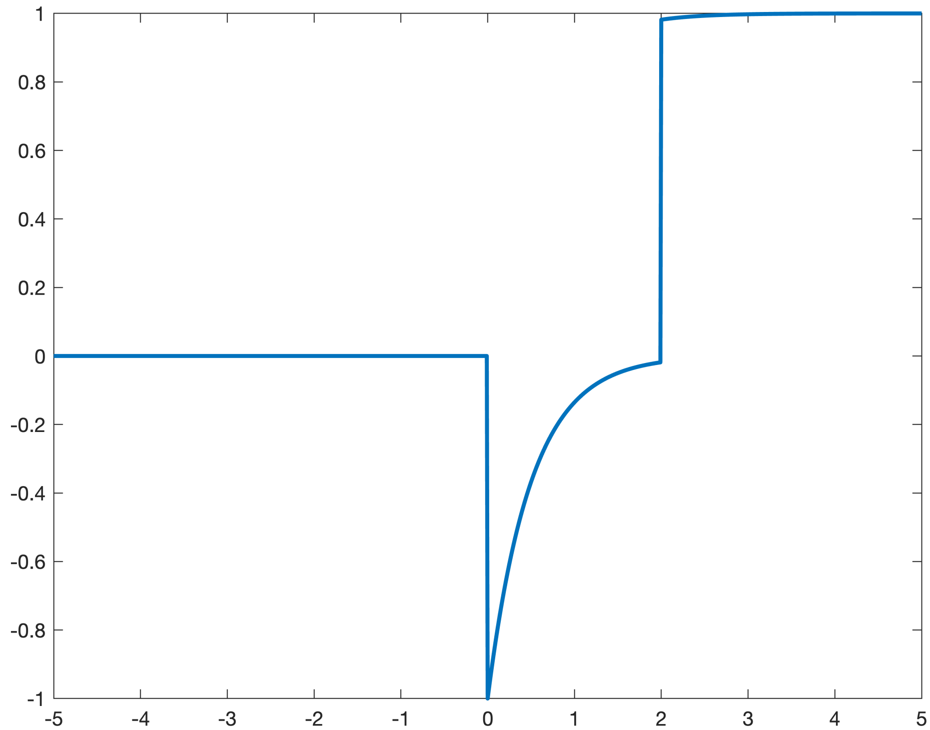

```
clear x;
clear count;
count = 1;
gamma = 1;
x = [];
xjw = [];
for n = t
    if n >= −1*gamma && n <= gamma
        x(count) = 1 − abs(n)/gamma;
    else
        x(count) = 0;
    end
    count = count + 1;
end
plot(t, x, 'LineWidth', 2);
```



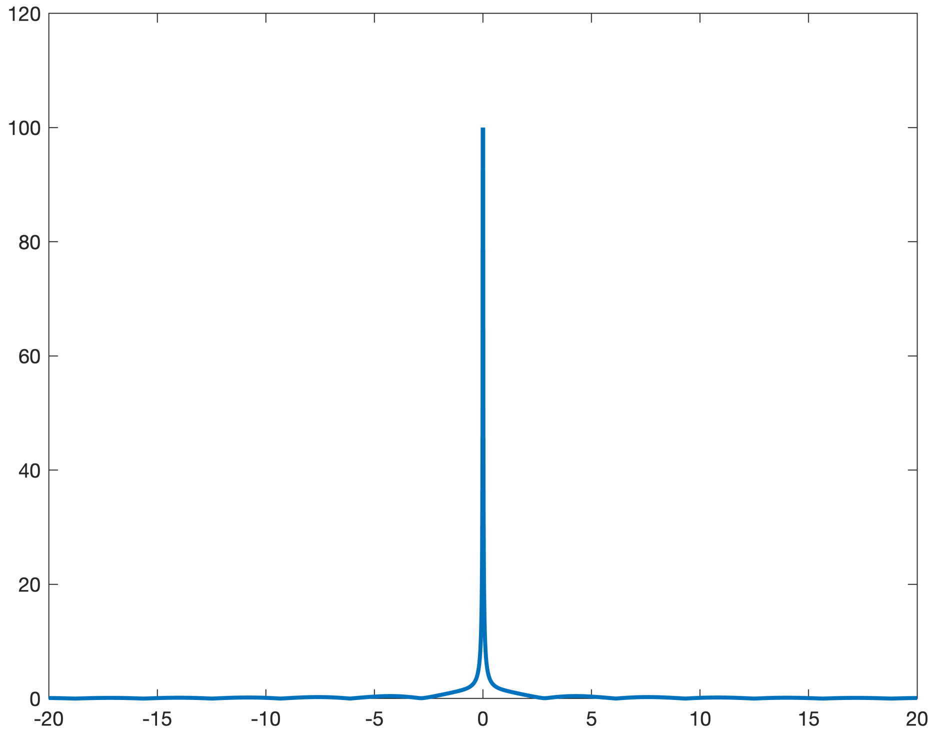

```
clear count;
clear xjw;
count = 1;
xjw = [];
for k = w
    coeff = @(t) (1 - abs(t)/gamma) .* exp(-1j*k*t);
    xjw(count) = integral(coeff, -gamma, gamma);
    count = count + 1;
end
plot(w, xjw, 'Linewidth', 2);
```




```
clear count;
clear x;
clear t;
t = -5:0.01:5;
count = 1;
x = [];
u = [];
u2 = [];
for n = t
    if n >= 2
        u2(count) = 1;
    else
        u2(count) = 0;
    end
    if n >= 0
        u(count) = 1;
    else
        u(count) = 0;
    end
    count = count + 1;
end
x = u2 - exp(-2.*t).*u;
plot(t, x, 'LineWidth', 2);
```




```
clear xjw;
clear count;
count = 1;
xjw = abs(exp(-2*1j.*w)./(1j.*w) - 1./(2+(1j.*w)));
plot(w, xjw, 'LineWidth', 2);
```



120
100
80
60
40
20
0
-20
-15
-10
-5
0
5
10
15
20