Signals and Systems Final Project

(Matlab)

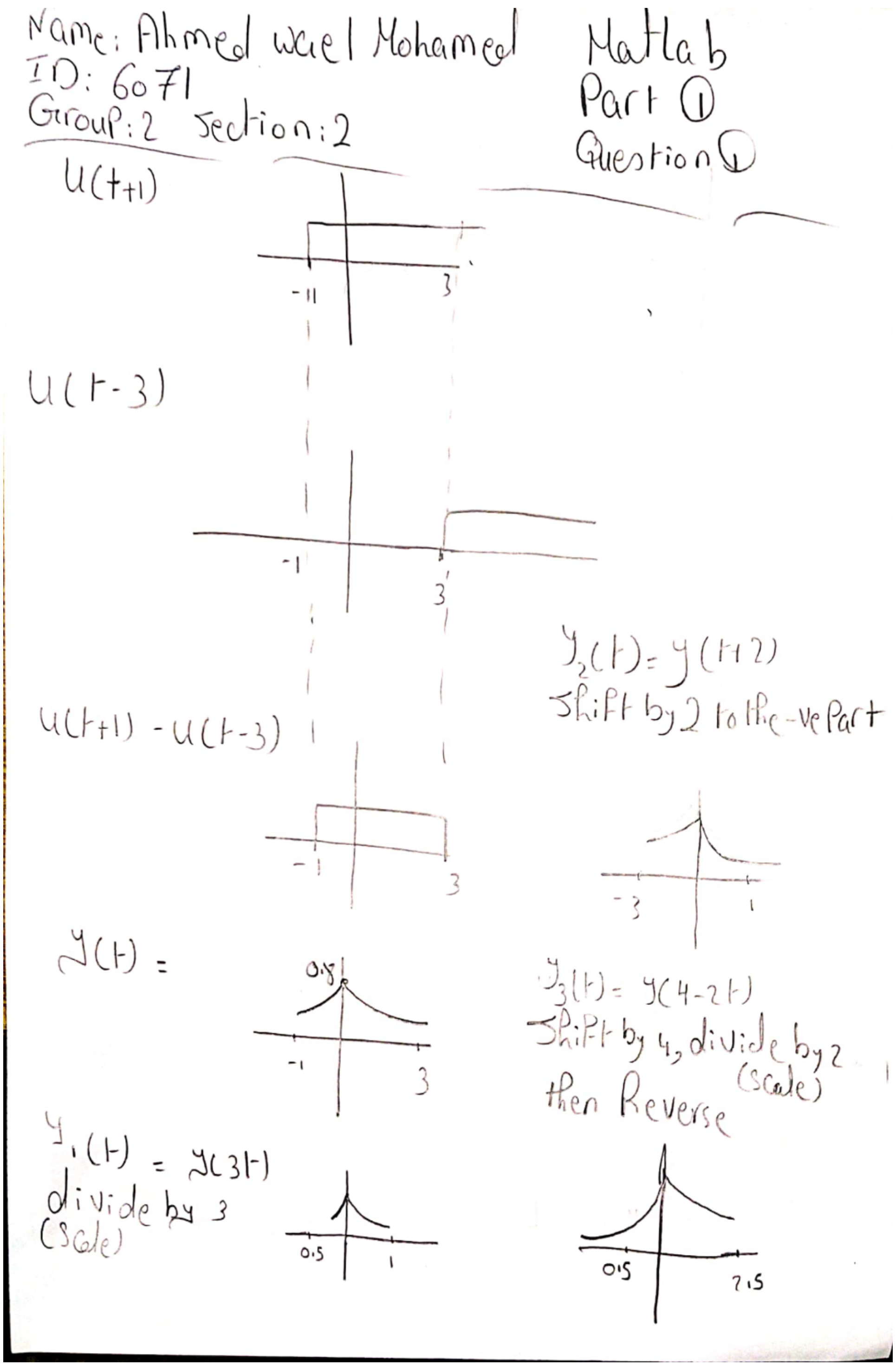
Part 1

Name: Ahmed Wael Mohamed

ID: 6071

Question 1

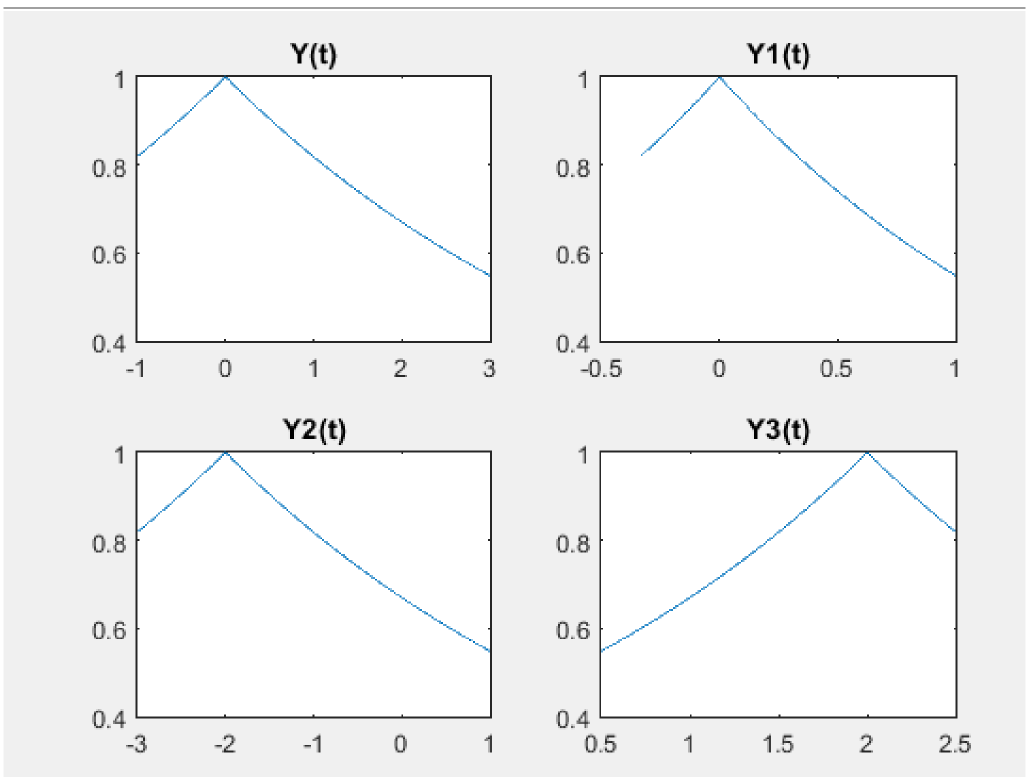
Handwritten Analysis



Source Code

```
t = linspace(-1, 3, 2000);
X = exp(-1/5 * abs(t));
subplot (2,2,1);
plot (t,X);
title ( ' Y(t) ');
subplot (2,2,2);
plot (t/3,X);
title ( ' Y1(t) ');
subplot (2,2,3);
plot (t - 2,X);
title ( ' Y2(t) ');
subplot (2,2,4);
plot ((-t/2) + 2,X);
title ( ' Y3(t) ');
```

Figures



Question 2

Handwritten Analysis

Name: Ahmed wael Mohamed
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Group 2 Section: 2

Matlab
Question ②
Part ①

$m(t) = \text{sinc}^2(10^{-3}t)$

$r(t) = m(t)\cos(2\pi 10^5 t)$

$m(t) \Rightarrow M(\omega) = \int_{-\infty}^{\infty} m(t)\, e^{-j\omega t}\, dt$

From table

$\frac{W}{2\pi}\text{sinc}^2\left(\frac{Wt}{2}\right) \Rightarrow \Delta\left(\frac{\omega}{2W}\right)$

$\therefore \frac{W}{2} = 10^{-3}$

$W = 2\times10^{-3}$

$M(\omega) = \frac{2\pi}{2\times10^{-3}} \cdot \Delta\frac{\omega}{4\times10^{-3}}$

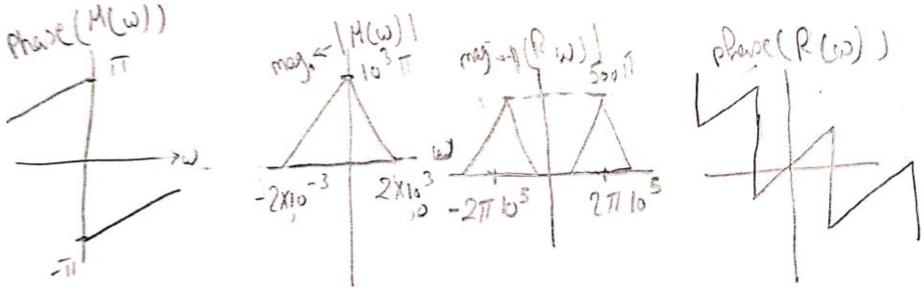
$\frac{2\times10^{-3}}{2\pi} M(\omega) = \Delta\left(\frac{\omega}{2W}\right)$

$R(\omega) = M(\omega)\, F(\cos 2\pi 10^5 t)$

$m(t)\cos(\omega_0 t) = \frac{1}{2}[M(\omega-\omega_0)+M(\omega+\omega_0)]$ ⇐ Property of Fourier transform in case of Frequency shift

$R_\omega = 500\pi\,[\Delta(250(\omega - 2\pi\times10^5)) + \Delta(250(\omega + 2\times\pi\times10^5))]$

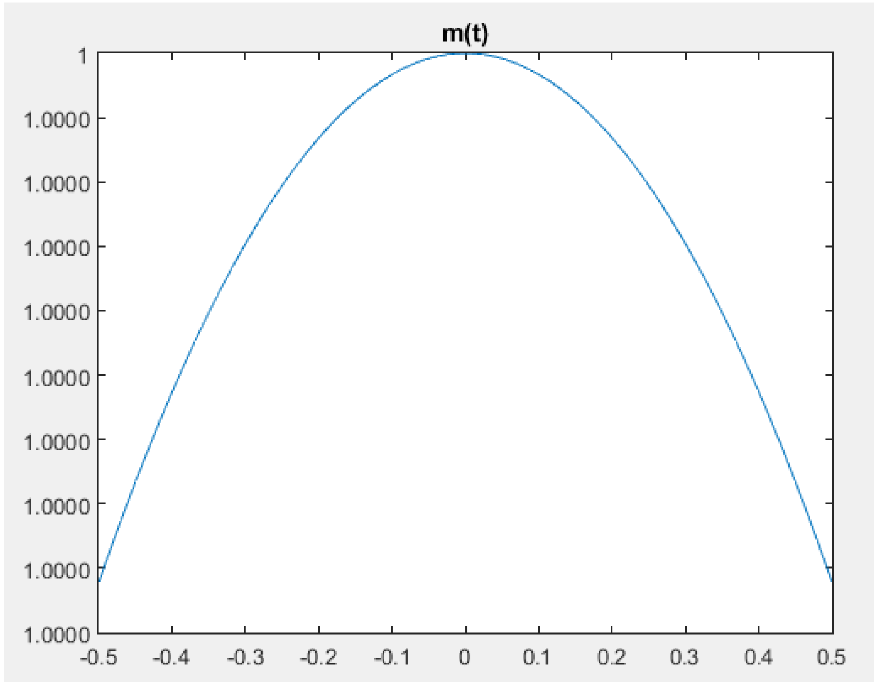
$R(\omega)$ is the result of the Frequency shift by $M(\omega)$

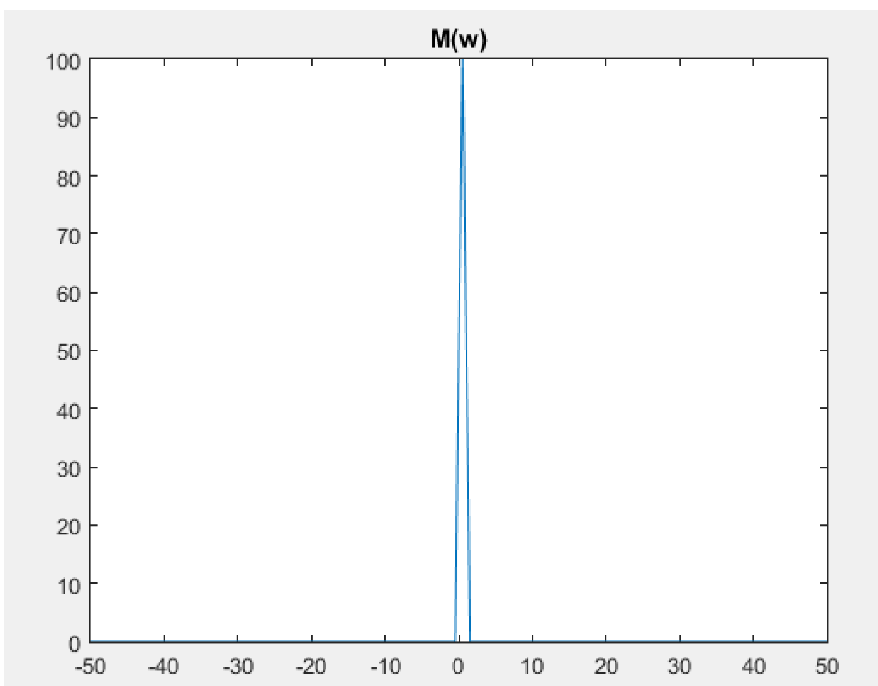


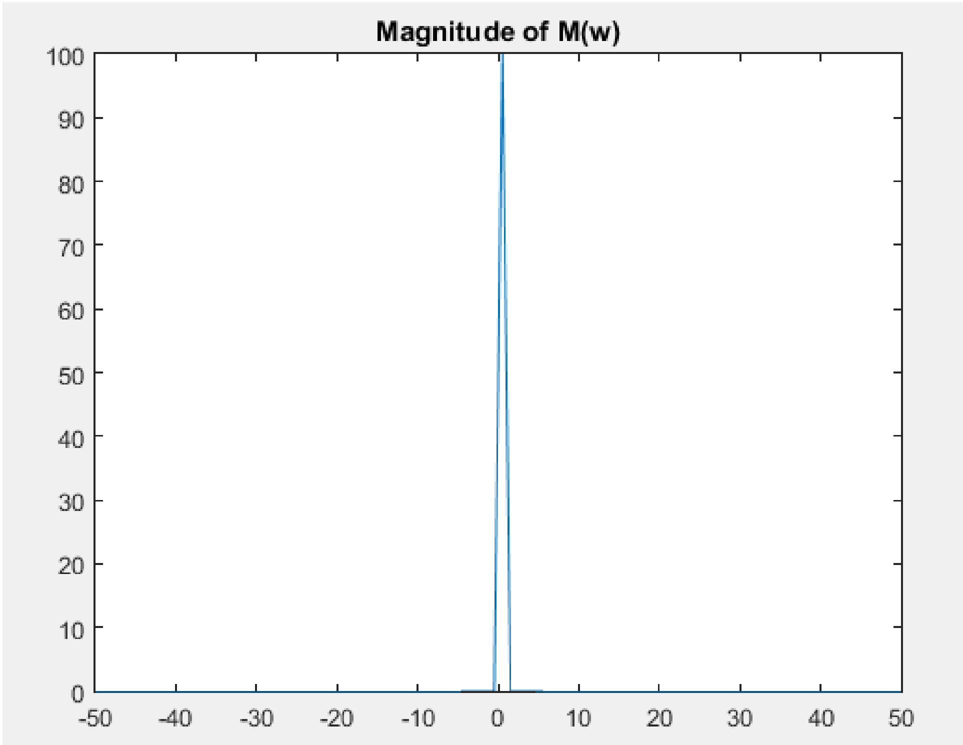
Source Code

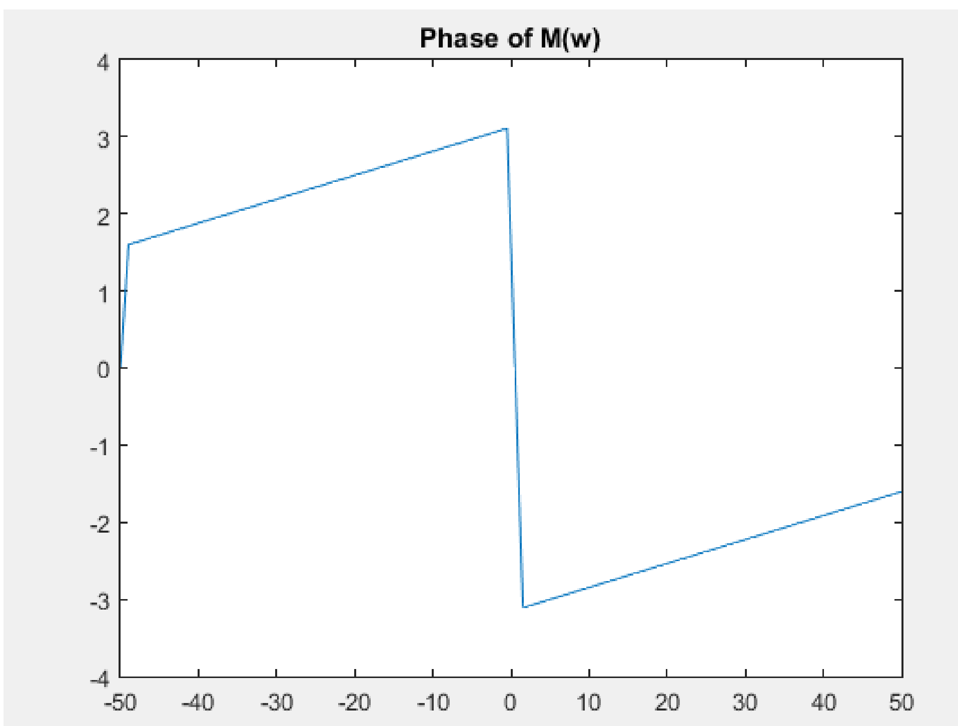
```
t = linspace(-0.5,0.5,100)
m = (sinc(10.^(-3) * t)).^2;
figure;
plot(t,m)
title ( ' m(t) ' );
M = fftshift(fft(m));
Fvec = linspace (-50,50,100);
figure;
plot(Fvec,M)
title ( ' M(w) ' );
Mmag = abs(M);
figure
plot (Fvec,Mmag);
title ( ' Magnitude of M(w) ' );
Mphase = angle (M);
figure;
plot (Fvec,Mphase);
title ( ' Phase of M(w) ' );
r = cos(2*pi*10.^5*t) .* m;
figure;
plot(t,r)
title( ' r(t) ' );
R = fftshift(fft(r));
figure;
plot(Fvec,R)
title( ' R(w) ' );
Rmag = abs(R);
figure;
plot(Fvec,Rmag)
title ( ' Magnitude of R(w) ' );
Rphase = angle(R);
figure;
plot(Fvec,Rphase);
title ( ' Phase of R(w) ' );
```

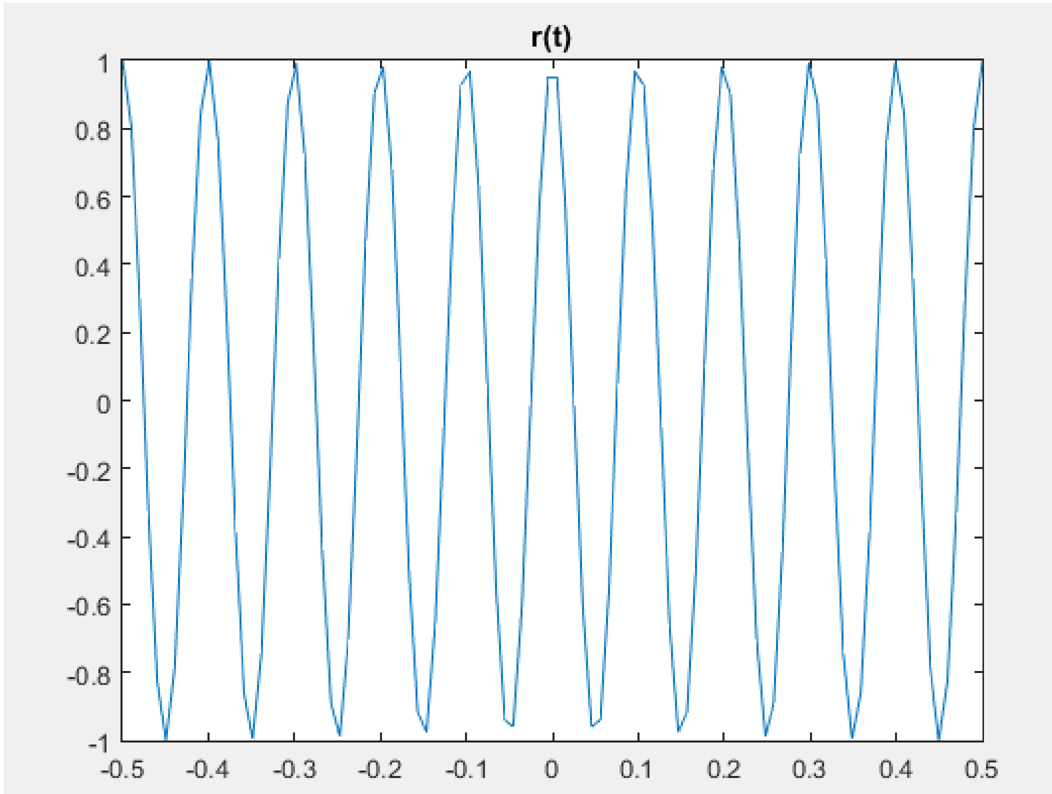
Figures

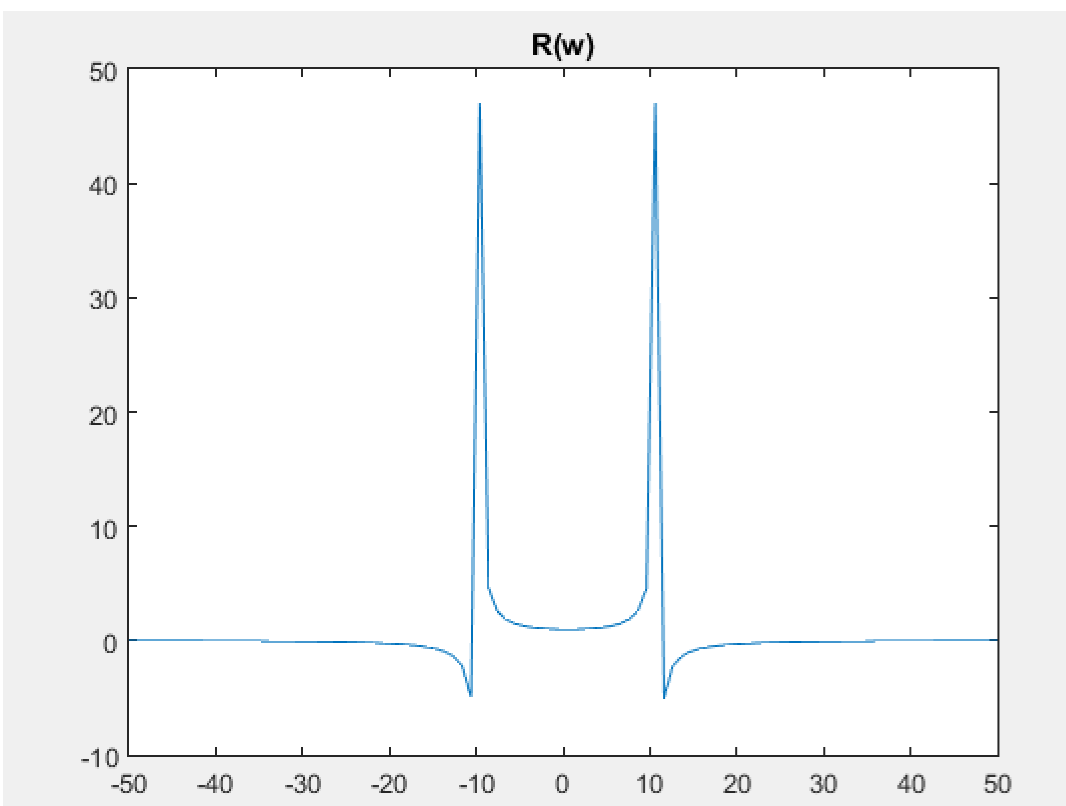

m(t)
1
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
1.0000
-0.5
-0.4
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5

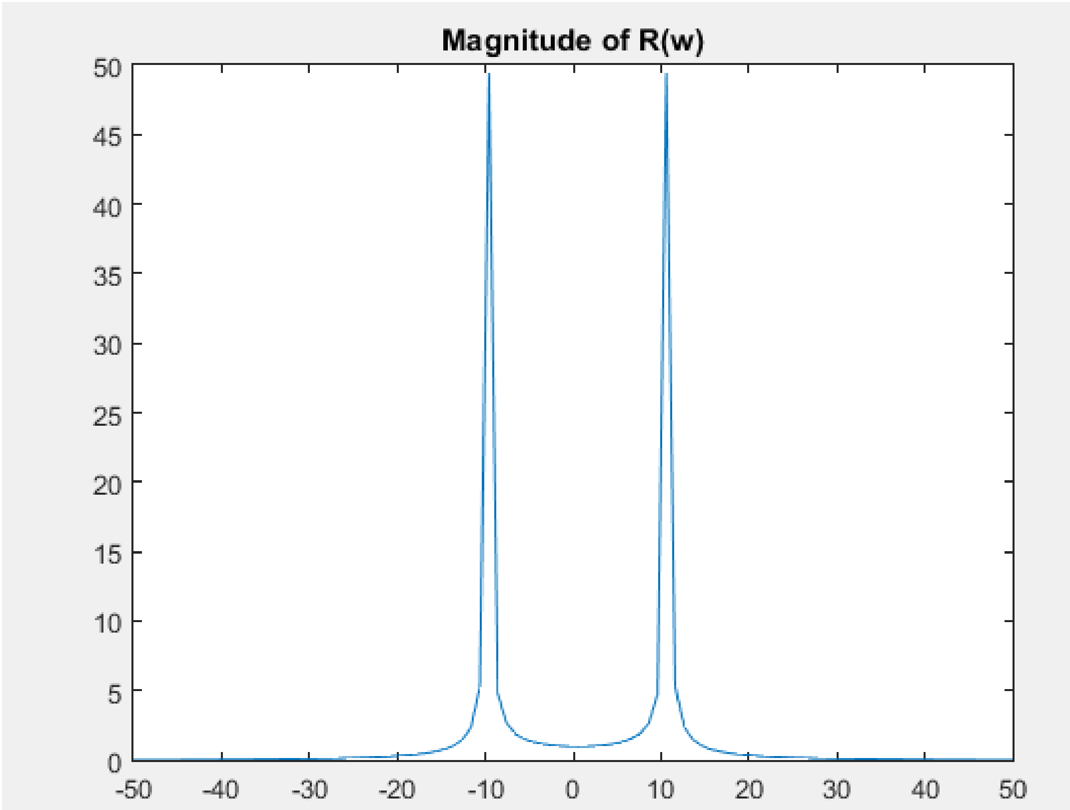

M(w)
100
90
80
70
60
50
40
30
20
10
0
-50
-40
-30
-20
-10
0
10
20
30
40
50


Magnitude of M(w)
100
90
80
70
60
50
40
30
20
10
0
-50
-40
-30
-20
-10
0
10
20
30
40
50

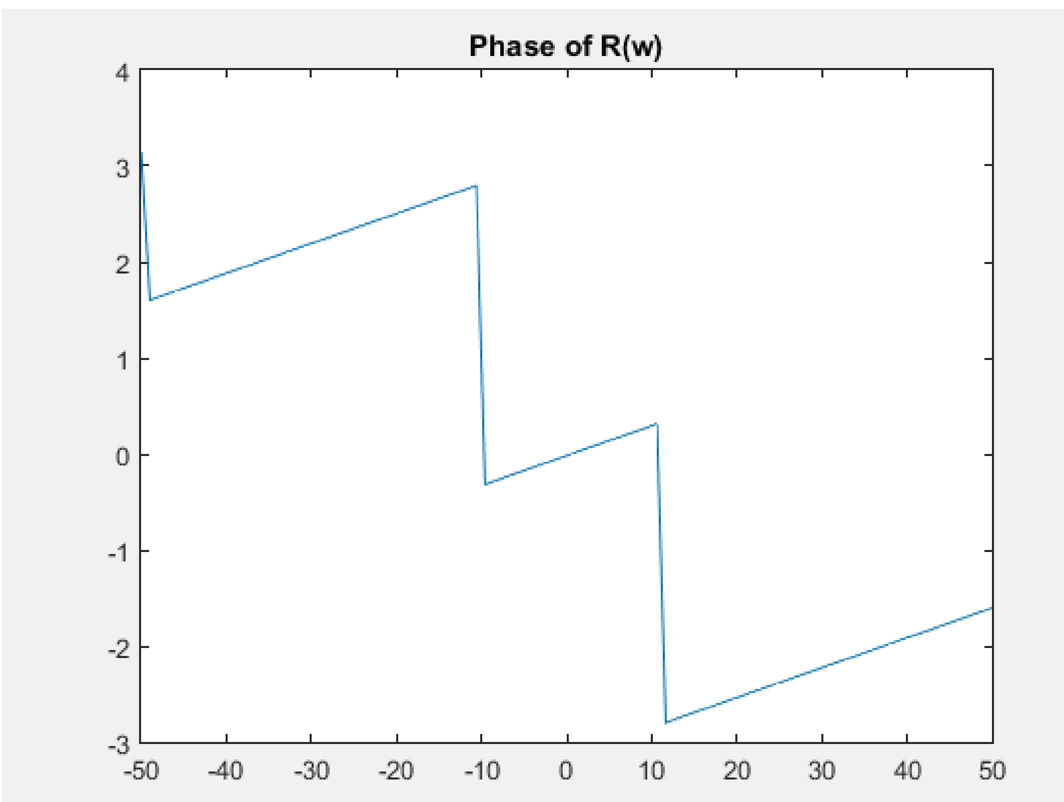

Phase of M(w)
4
3
2
1
0
-1
-2
-3
-4
-50
-40
-30
-20
-10
0
10
20
30
40
50


r(t)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-0.5 -0.4 -0.3 -0.2 -0.1 0 0.1 0.2 0.3 0.4 0.5


R(w)
50
40
30
20
10
0
-10
-50 -40 -30 -20 -10 0 10 20 30 40 50



Magnitude of R(w)
50
45
40
35
30
25
20
15
10
5
0
-50
-40
-30
-20
-10
0
10
20
30
40
50



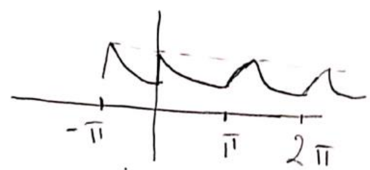
Phase of R(w)
4
3
2
1
0
-1
-2
-3
-50
-40
-30
-20
-10
0
10
20
30
40
50

Question 3

Handwritten Analysis

Name: Ahmed Wael Mohamed   Matlab
ID: 6071   Part (1)
Group 2 Section: 2   Question (3)

$x(t) = e^{-t}$



$$F_n = \frac{1}{\pi}\int_0^{\pi} e^{-t} e^{-jn\omega t}\, dt \quad , \omega = \frac{2\pi}{T} = \frac{2\pi}{\pi} = 2$$

$$= \frac{1}{\pi}\int_0^{\pi} e^{-t} e^{-j2nt}\, dt = \frac{1}{\pi}\int_0^{\pi} e^{-t-j2nt}$$

$$\boxed{F_n = \frac{1}{\pi}\int_0^{\pi} e^{-t(1+j2n)}\, dt}$$

$$F_0 = \frac{1}{\pi}\int_0^{\pi} e^{-t(1+0)}\, dt = \frac{1}{\pi}\int_0^{\pi} e^{-t} = \frac{1}{\pi}\left[-e^{-t}\right]_0^{\pi}$$

$$\boxed{F_0 = 0.305} \qquad F_0 = \frac{1}{\pi}(-e^{-\pi}+1) = 0.305$$

$$F_n = \frac{-1}{\pi(1+j2n)}\left[e^{-t(1+j2n)}\right]_0^{\pi} \qquad \boxed{F_n = \frac{1}{\pi(1+j2n)}\left(1-e^{-\pi(1+j2n)}\right)}$$

$$F_n = \frac{-1}{\pi(1+j2n)}\left[e^{-\pi(1+j2n)} - 1\right]$$

Source Code

```
nneg = -10:-1;
npos = 1:10;
Fnneg = (1./(pi*(1+(2*1i*nneg)))).*(1-exp(-pi*(1+1i*2*nneg)));
Fnpos = (1./(pi*(1+(2*1i*npos)))).*(1-exp(-pi*(1+1i*2*npos)));
F0 = 0.305;
Fn = [Fnneg F0 Fnpos];
n = [nneg 0 npos];
figure;
stem(n, abs(Fn))
title( ' Magnitude Spectrum ' );
figure;
stem(n, angle(Fn))
title ( ' Phase Spectrum ' );
```

Figures