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Experiment - 1

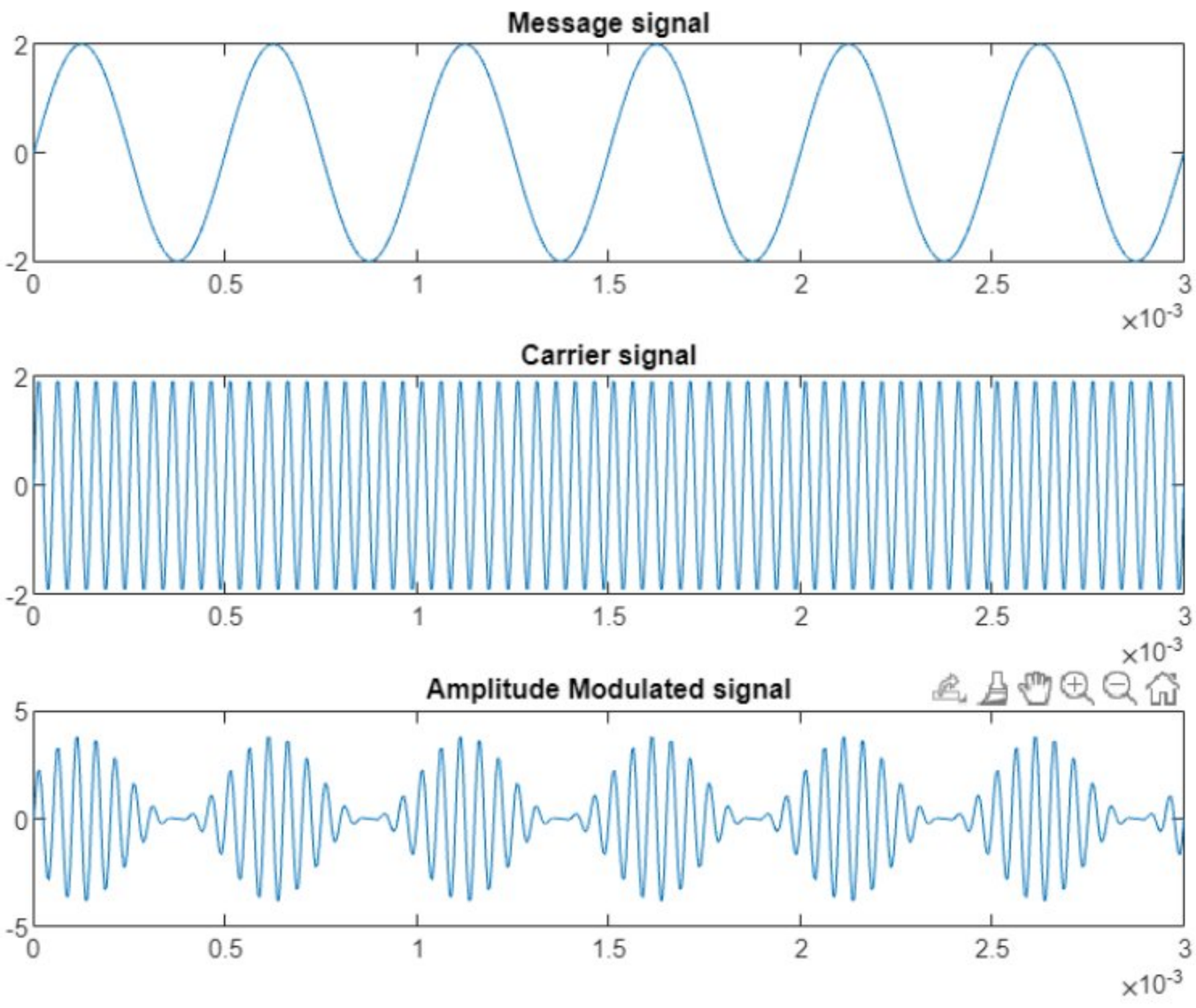
Aim: To study Amplitude Modulation.

Modulation index, k=1

Code:

```
k = 1;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:

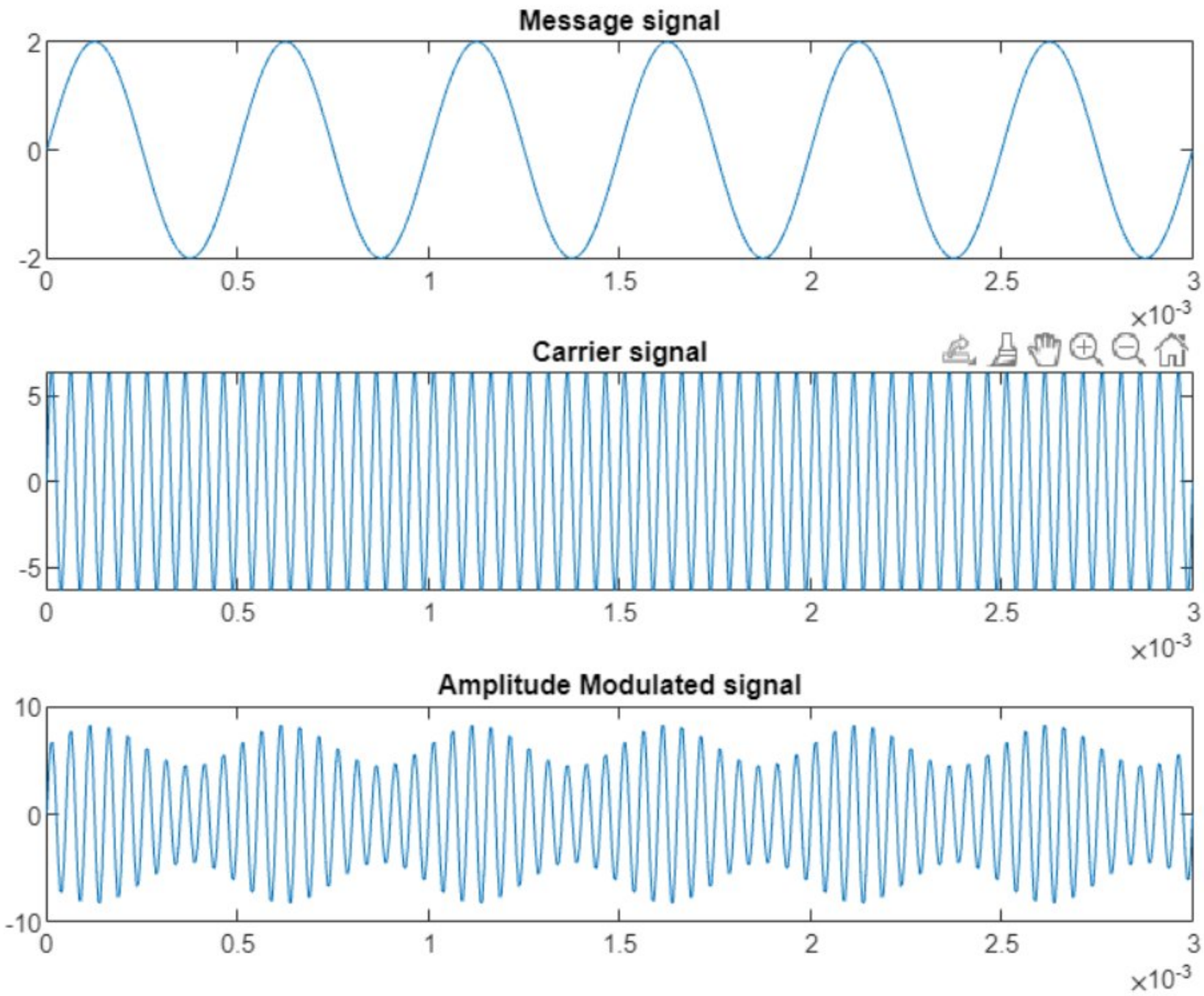


Modulation index, k=0.3

Code:

```
k = 0.3;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:

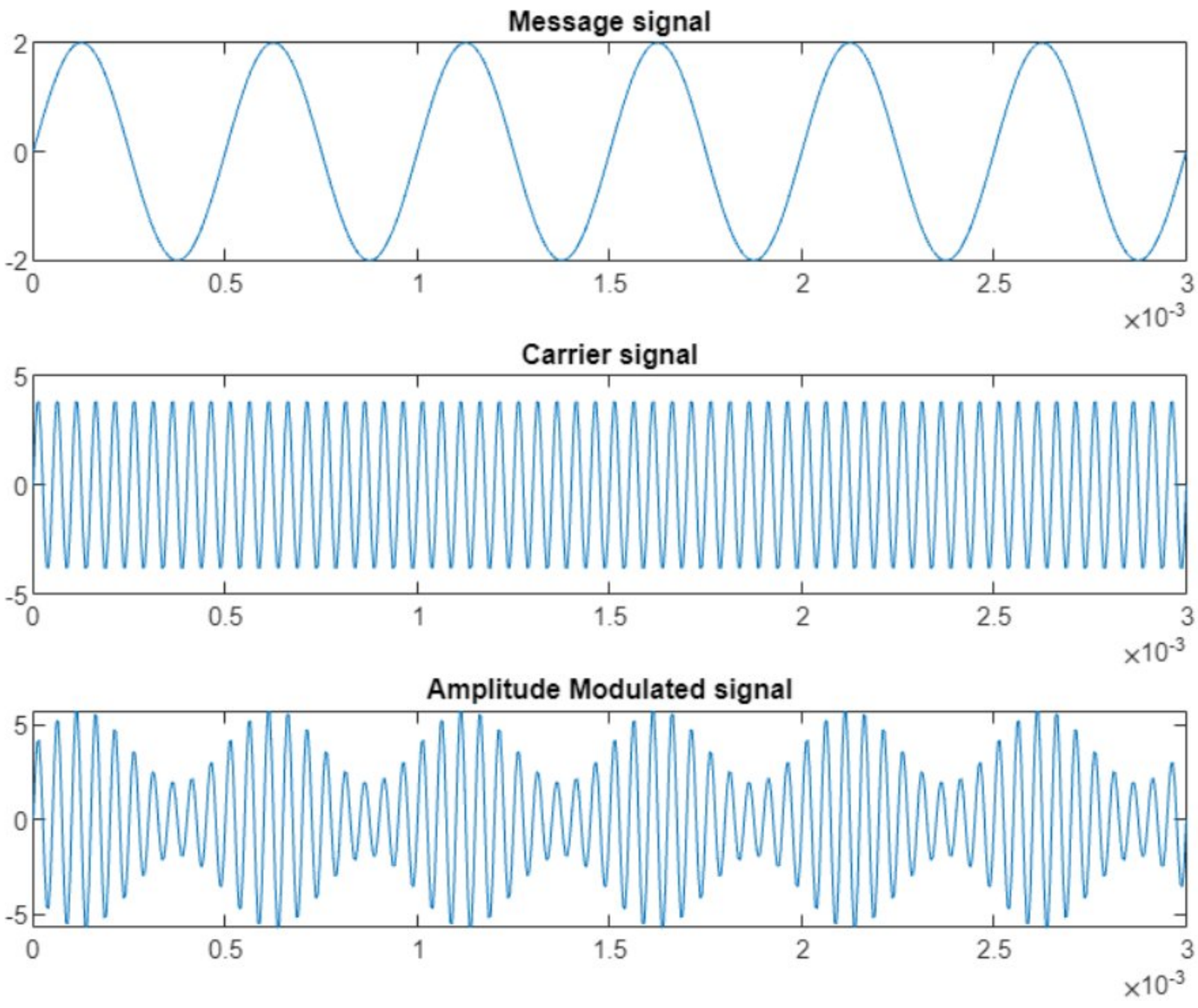


Modulation index, k=0.5

Code:

```
k = 0.5;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:

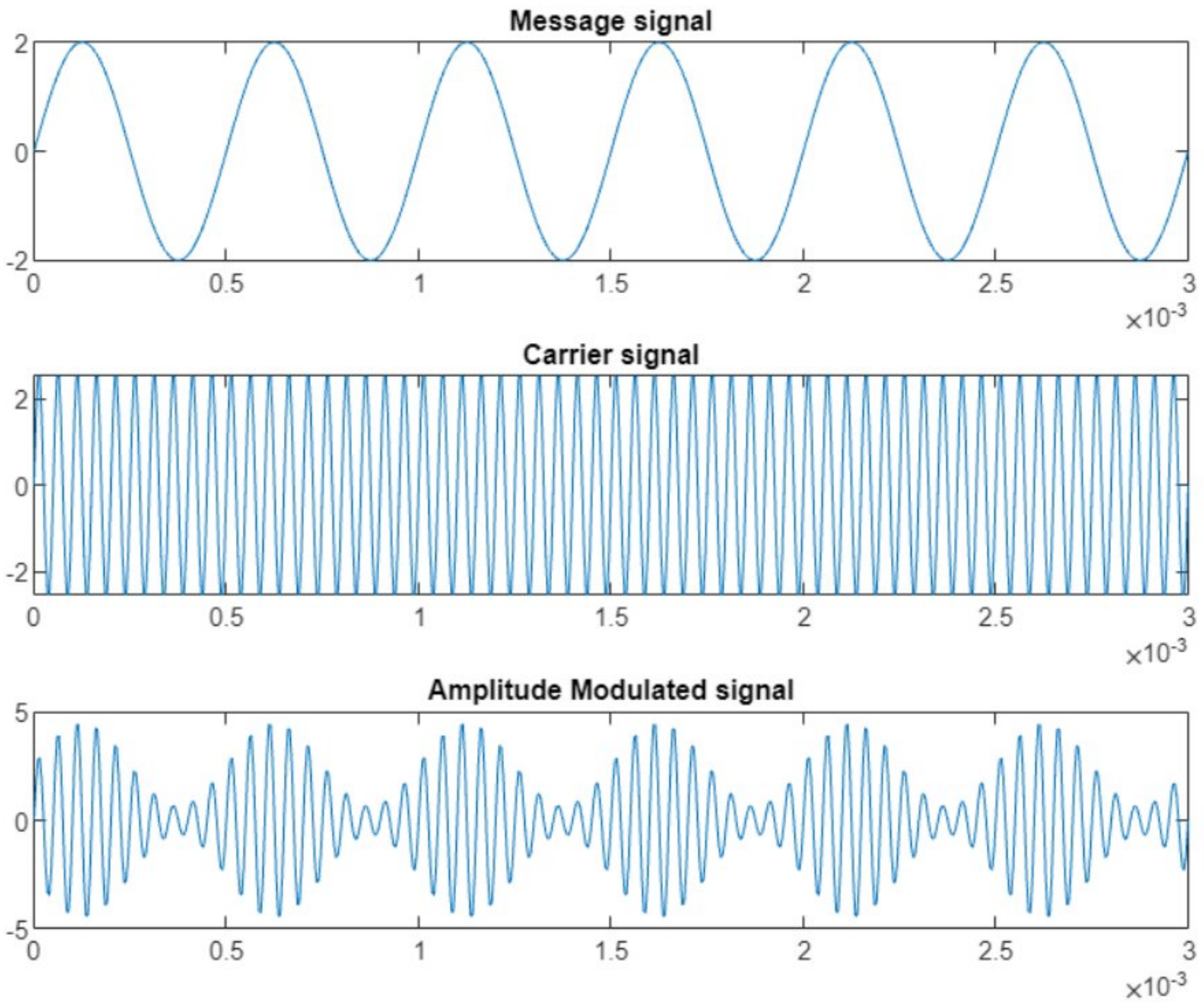


Modulation index, k=0.75

Code:

```
k = 0.75;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:

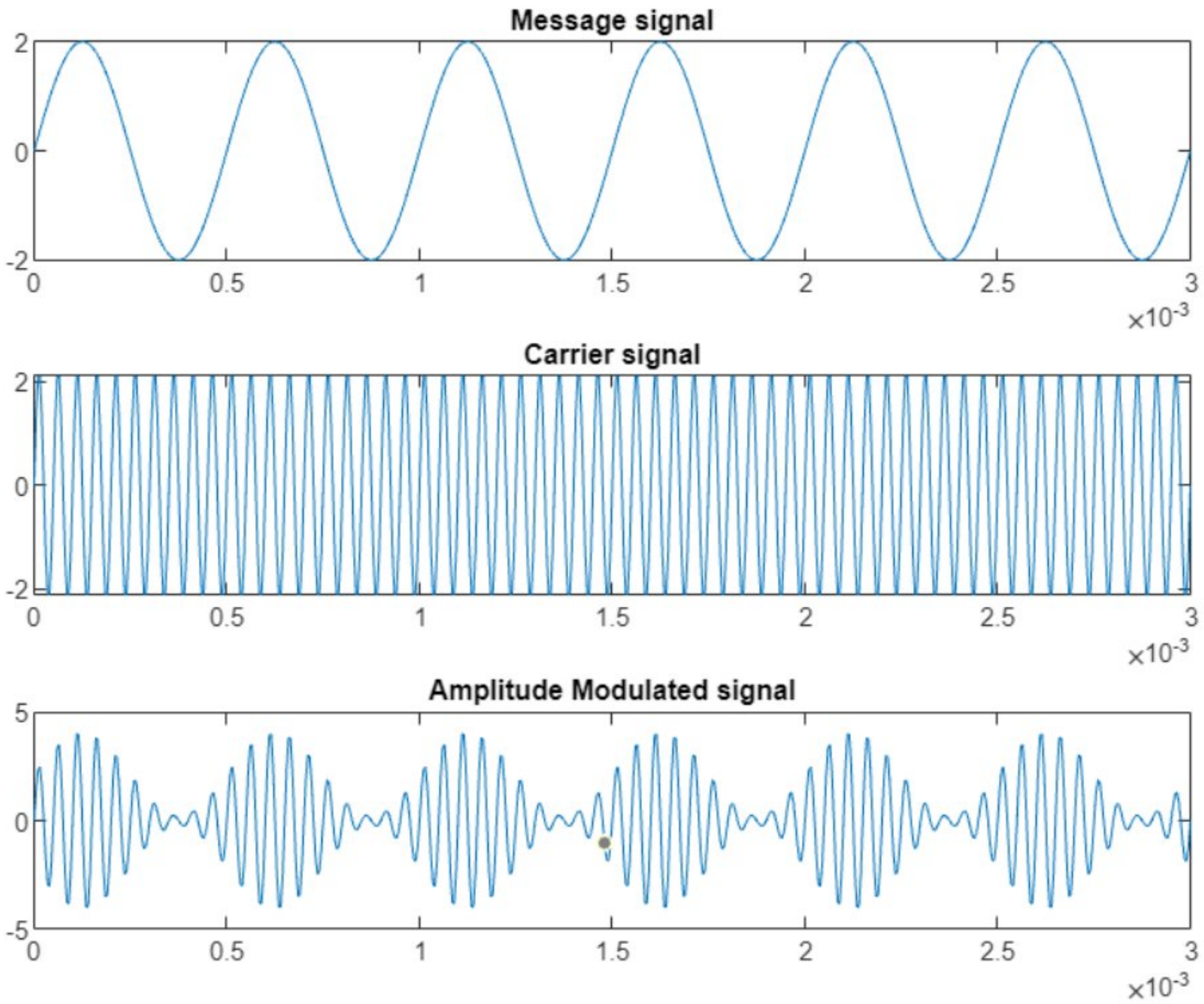


Modulation index, k=0.9

Code:

```
k = 0.9;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:

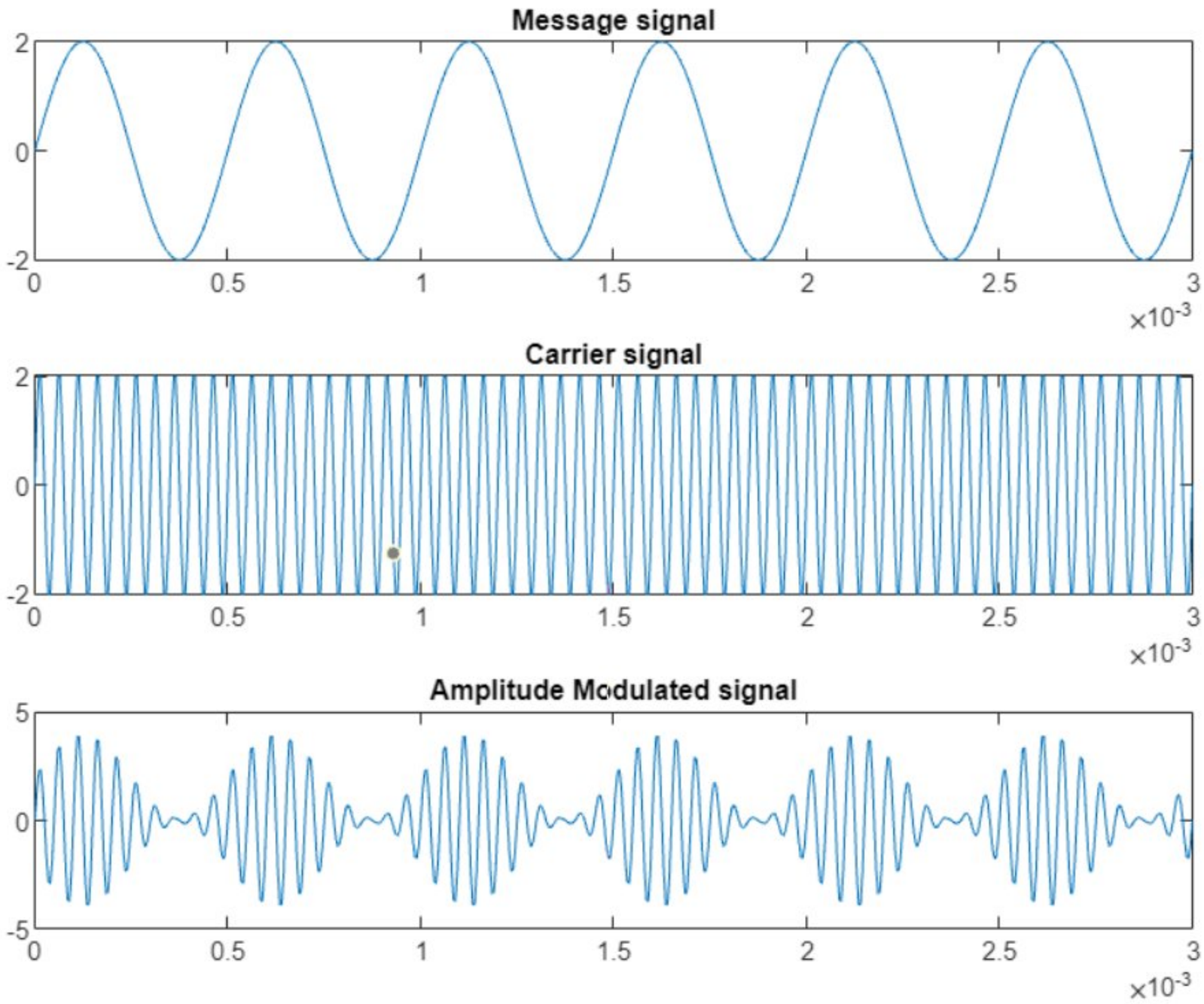


Modulation index, k=0.95

Code:

```
k = 0.95;
Am = 2;
fm=2000;
Tm = 1/fm;
t= 0:Tm/100:6*Tm;
X= Am*sin(2*pi*fm*t);
subplot (3,1,1);
plot(t,X)
title ('Message signal');
fc = fm*10;
Ac = Am/k;
C= Ac*sin(2*pi*fc*t);
subplot (3,1,2);
plot(t,C);
title ('Carrier signal');
AM= Ac*(1+k.*sin(2*pi*fm*t)).*sin(2*pi*fc*t);
subplot (3,1,3);
plot(t,AM);
title ('Amplitude Modulated signal');
```

Output:



CALCULATIONS:

1. Theoretically, $k = 1$

   Experimentally

$$k = \frac{A_{max} - A_{min}}{A_{max} + A_{min}} = \frac{4-0}{4+0} = 1$$

2. Theoretially, $k = 0.3$

   Experimentally,

$$k = \frac{8-4}{8+4} \quad \frac{8.2-4.4}{8.2+4.4} = \frac{3.8}{12.6} = 0.3016$$

3. Theoretically, $k = 0.5$

   Experimentally, $k = \frac{6-2}{6+2} = \frac{4}{8} = 0.5$

4. Theoretically, $k = 0.75$

   Experimentally, $k = \frac{4.5 - 0.75}{4.5 + 0.75} = 0.714$

5. Theoretially, $k = 0.9$

   Experimentally, $k = \frac{4-0.2}{4+0.2} = \frac{3.8}{4.2} = 0.9$

6. Theoretically, $k = 0.95$

   Experimentally, $k = \frac{3.87 - 0.13389}{3.87 + 0.13389} =$

$$= \frac{3.7362}{4.0038} = 0.9332$$

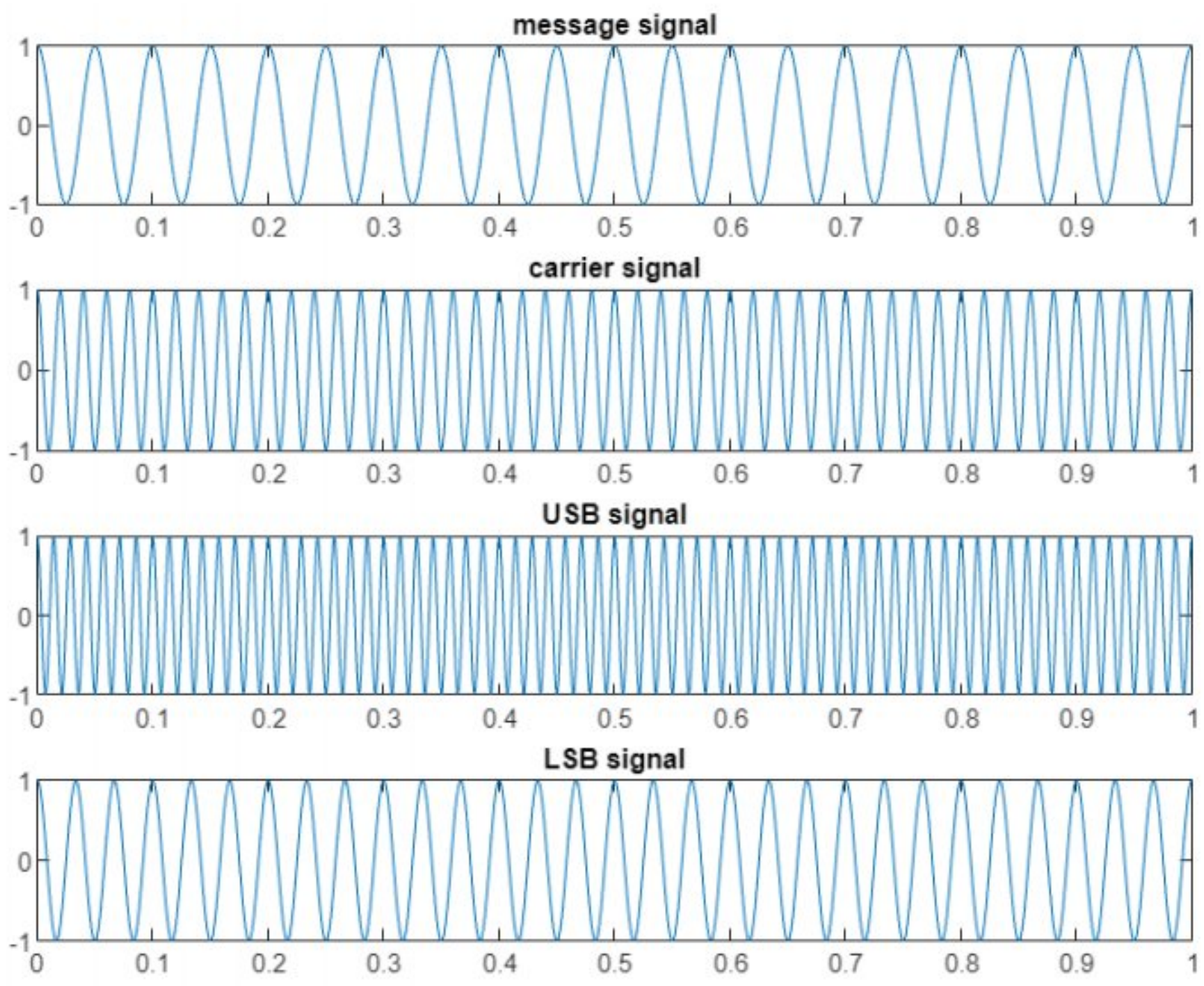
Experiment - 2

Aim: To generate SSB signal.

Code:

```
fm=20;
fc=50;
t1 = 1/fc;
t = 0:0.001:1;
am=1;
ac=1;
m1=am*cos(2*pi*fm*t);
subplot(4,1,1)
plot(t,m1)
title('message signal')
m2=am*sin(2*pi*fm*t);
c1=ac*cos(2*pi*fc*t);
subplot(4,1,2)
plot(t,c1)
title('carrier signal')
c2=ac*sin(2*pi*fc*t);
susb=m1.*c1-m2.*c2;
subplot(4,1,3)
plot(t,susb)
title('USB signal');
slsb=m1.*c1+m2.*c2;
subplot(4,1,4)
plot(t,slsb)
title('LSB signal')
```

Output:



CALCULATIONS:

$f_m = 20Hz$

$f_c = 50Hz$

$f_{LSB} = 50 - 20 = 30Hz$

$f_{USB} = 50 + 20 = 70Hz$

Experimentally,

$f_{LSB} = 6 \times 5 = 30Hz$

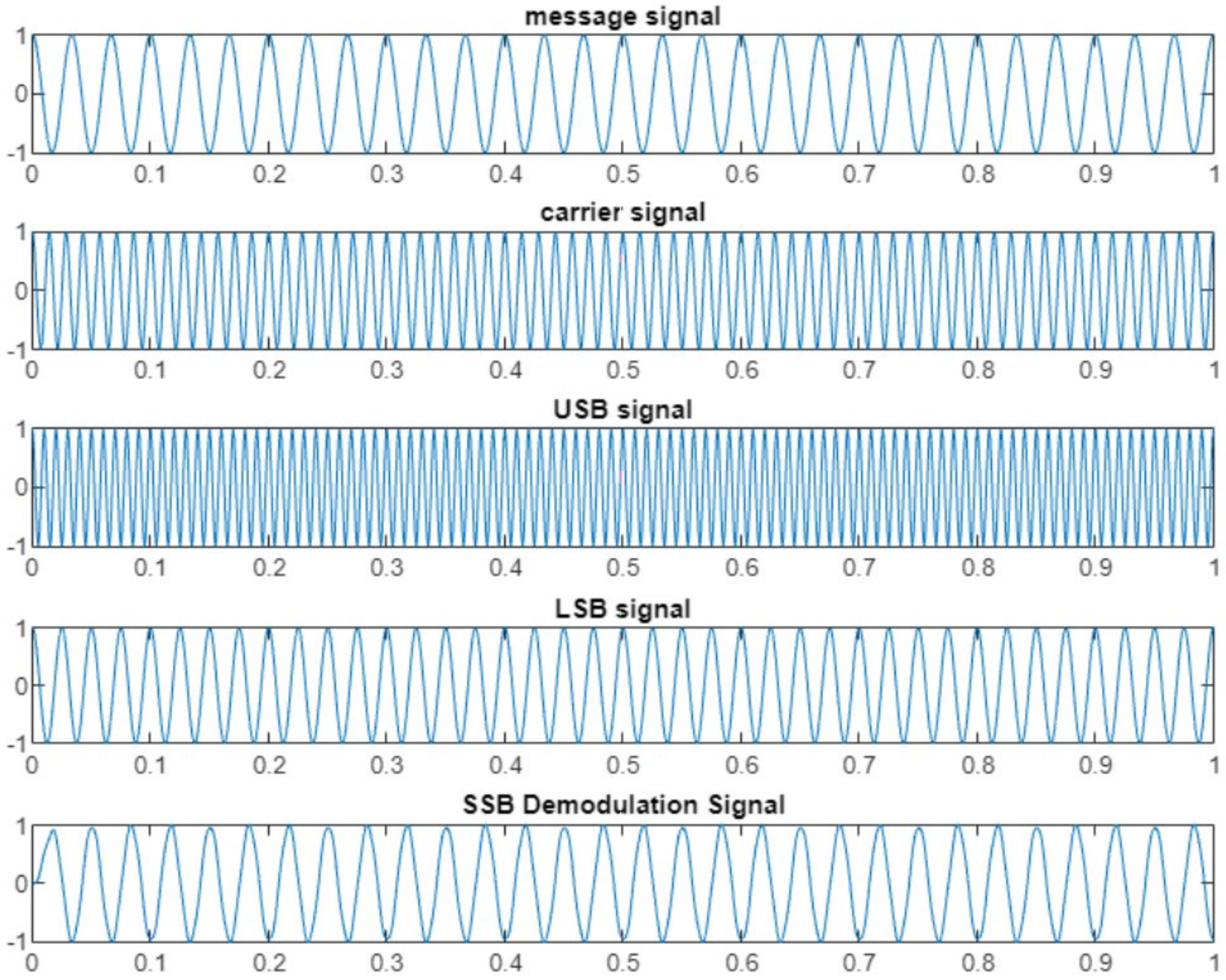
$f_{USB} = 14 \times 5 = 70Hz$

SSB demodulation signal

Code:

```
fm=30;
fc=70;
t = 0:0.001:1;
am=1;
ac=1;
m1=am*cos(2*pi*fm*t);
subplot(5,1,1)
plot(t,m1)
title('message signal')
m2=am*sin(2*pi*fm*t);
c1=ac*cos(2*pi*fc*t);
subplot(5,1,2)
plot(t,c1)
title('carrier signal')
c2=ac*sin(2*pi*fc*t);
usb=m1.*c1-m2.*c2;
subplot(5,1,3)
plot(t,usb)
title('USB signal');
lsb = m1.*c1+m2.*c2;
subplot(5,1,4);
plot(t,lsb);
title('LSB signal');
r = (1/2)*(am+ac)*(sin( 4*pi*fc*t-2*pi*fm*t)+sin(2*pi*fm*t));
[b,a] = butter(4,0.1,'low');
dm = filter(b,a,r);
subplot(5,1,5);
plot(t,dm);
title('SSB Demodulation Signal');
```

Output:



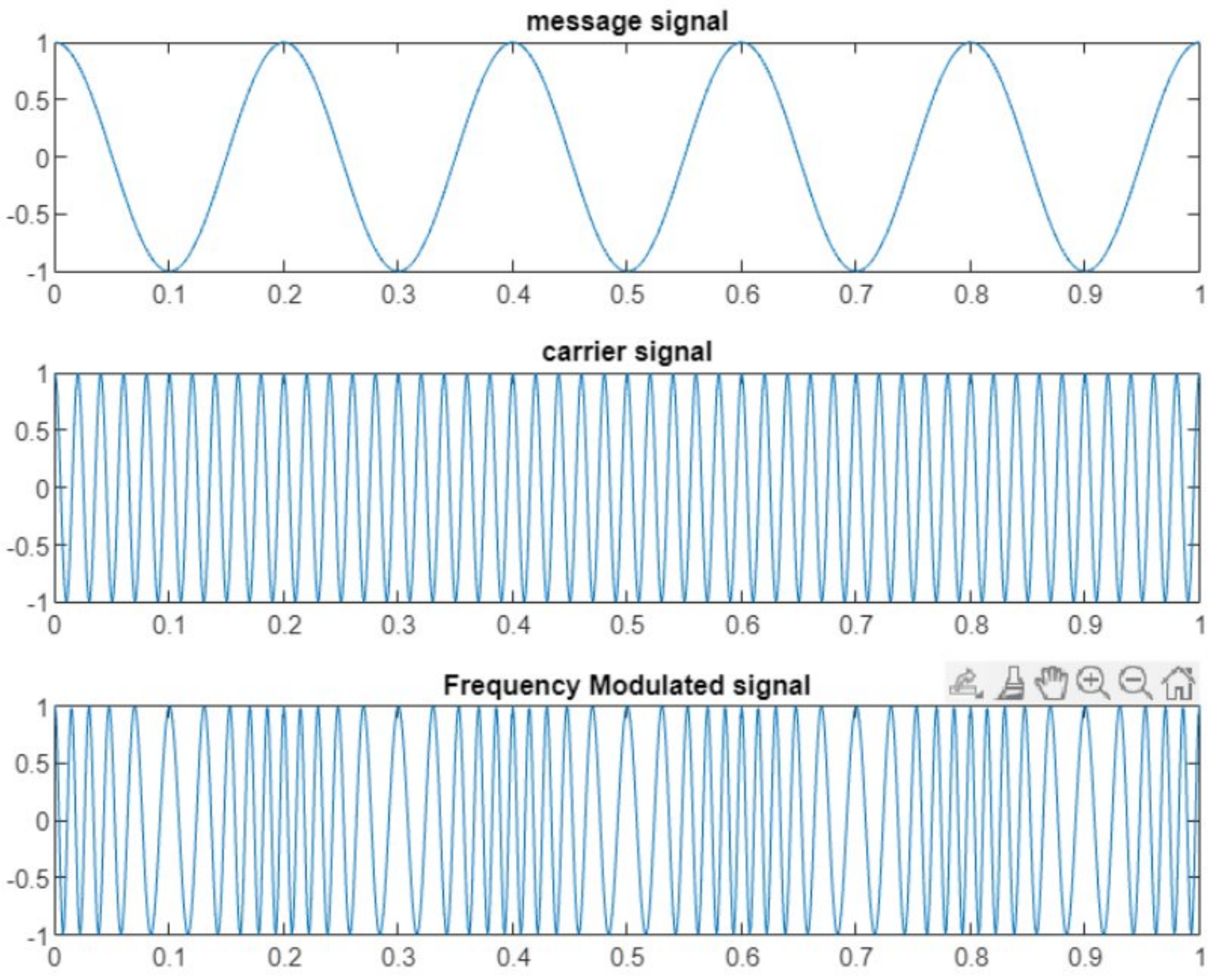
Experiment - 3

Aim: To generate Frequency Modulated signal.

Code:

```
kf = 20;
am = 1;
ac = 1;
fm = 5;
fc = 50;
k = (kf*am)/fm;
t = 0:0.001:1;
sfm = ac*cos(2*pi*fc*t + k*sin(2*pi*fm*t));
mt = am*cos(2*pi*fm*t);
ct = ac*cos(2*pi*fc*t);
subplot(3,1,1)
plot(t,mt);
title('message signal');
subplot(3,1,2)
plot(t,ct);
title('carrier signal');
subplot(3,1,3);
plot(t,sfm);
title('Frequency Modulated signal');
```

Output:

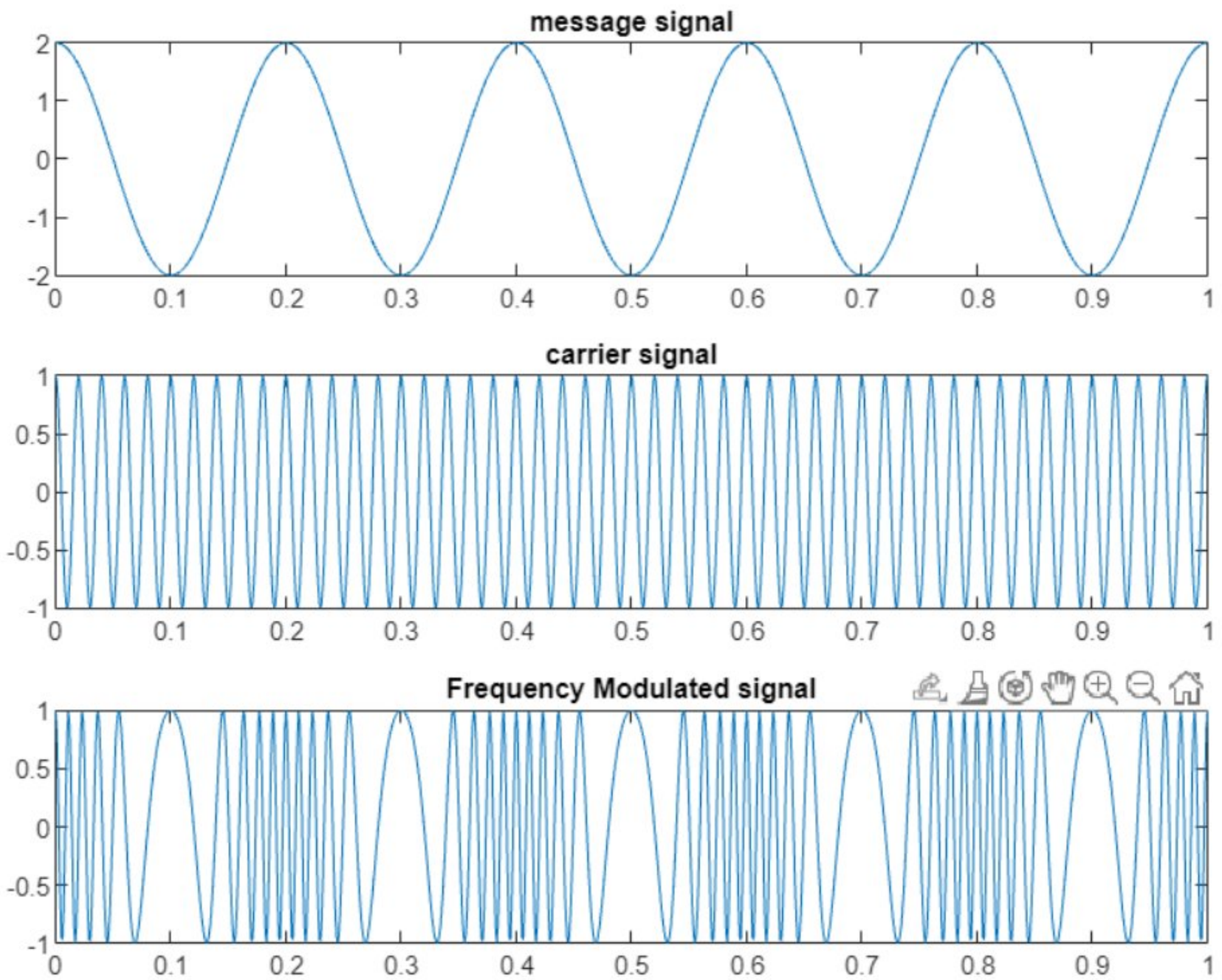


$A_m = 2, f_m = 5$

Code:

```
kf = 20;
am = 2;
ac = 1;
fm = 5;
fc = 50;
k = (kf*am)/fm;
t = 0:0.001:1;
sfm = ac*cos(2*pi*fc*t + k*sin(2*pi*fm*t));
mt = am*cos(2*pi*fm*t);
ct = ac*cos(2*pi*fc*t);
subplot(3,1,1)
plot(t,mt);
title('message signal');
subplot(3,1,2)
plot(t,ct);
title('carrier signal');
subplot(3,1,3);
plot(t,sfm);
title('Frequency Modulated signal');
```

Output:

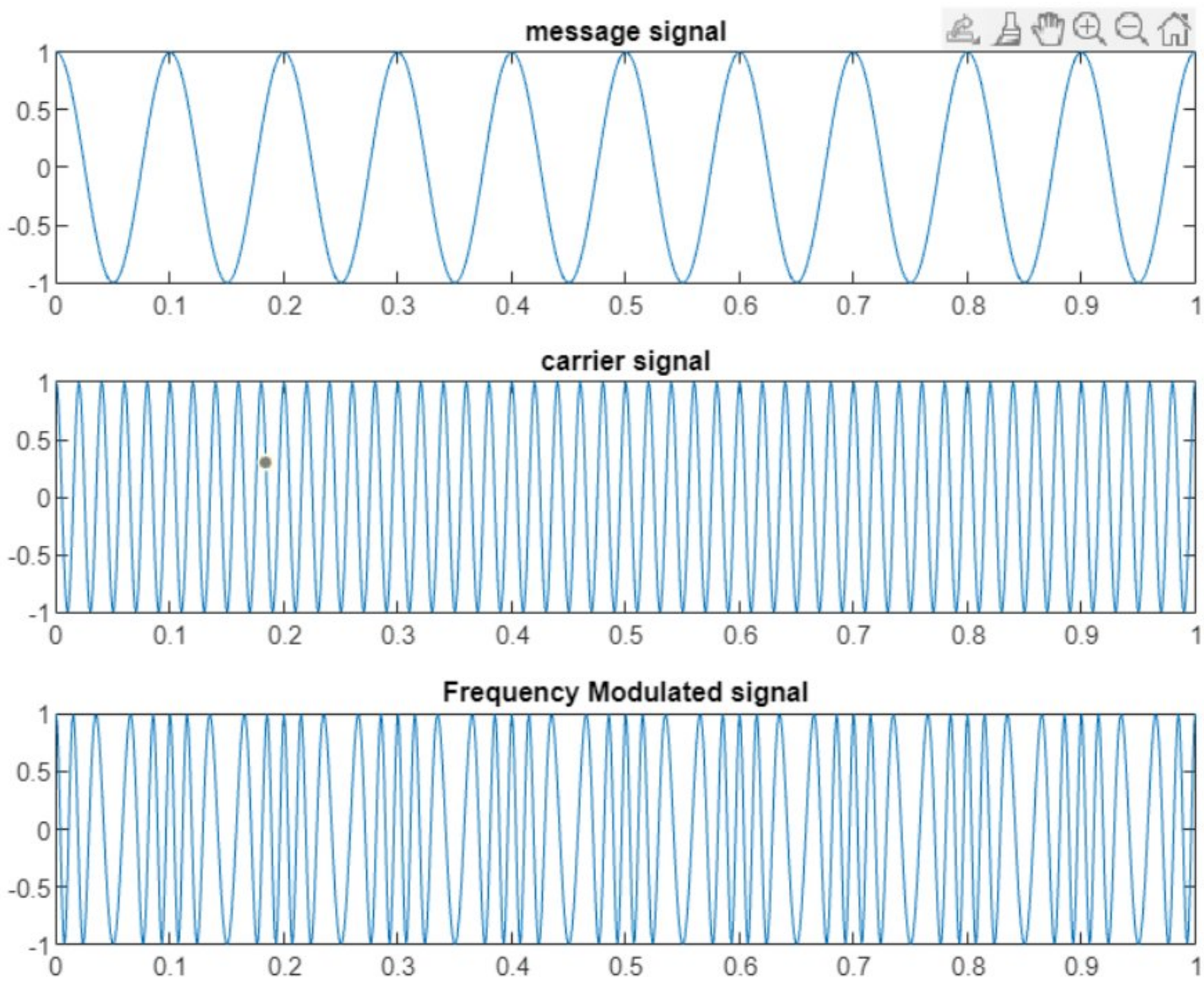


$A_m = 1, f_m = 10$

Code:

```
kf = 20;
am = 1;
ac = 1;
fm = 10;
fc = 50;
k = (kf*am)/fm;
t = 0:0.001:1;
sfm = ac*cos(2*pi*fc*t + k*sin(2*pi*fm*t));
mt = am*cos(2*pi*fm*t);
ct = ac*cos(2*pi*fc*t);
subplot(3,1,1)
plot(t,mt);
title('message signal');
subplot(3,1,2)
plot(t,ct);
title('carrier signal');
subplot(3,1,3);
plot(t,sfm);
title('Frequency Modulated signal');
```

Output:



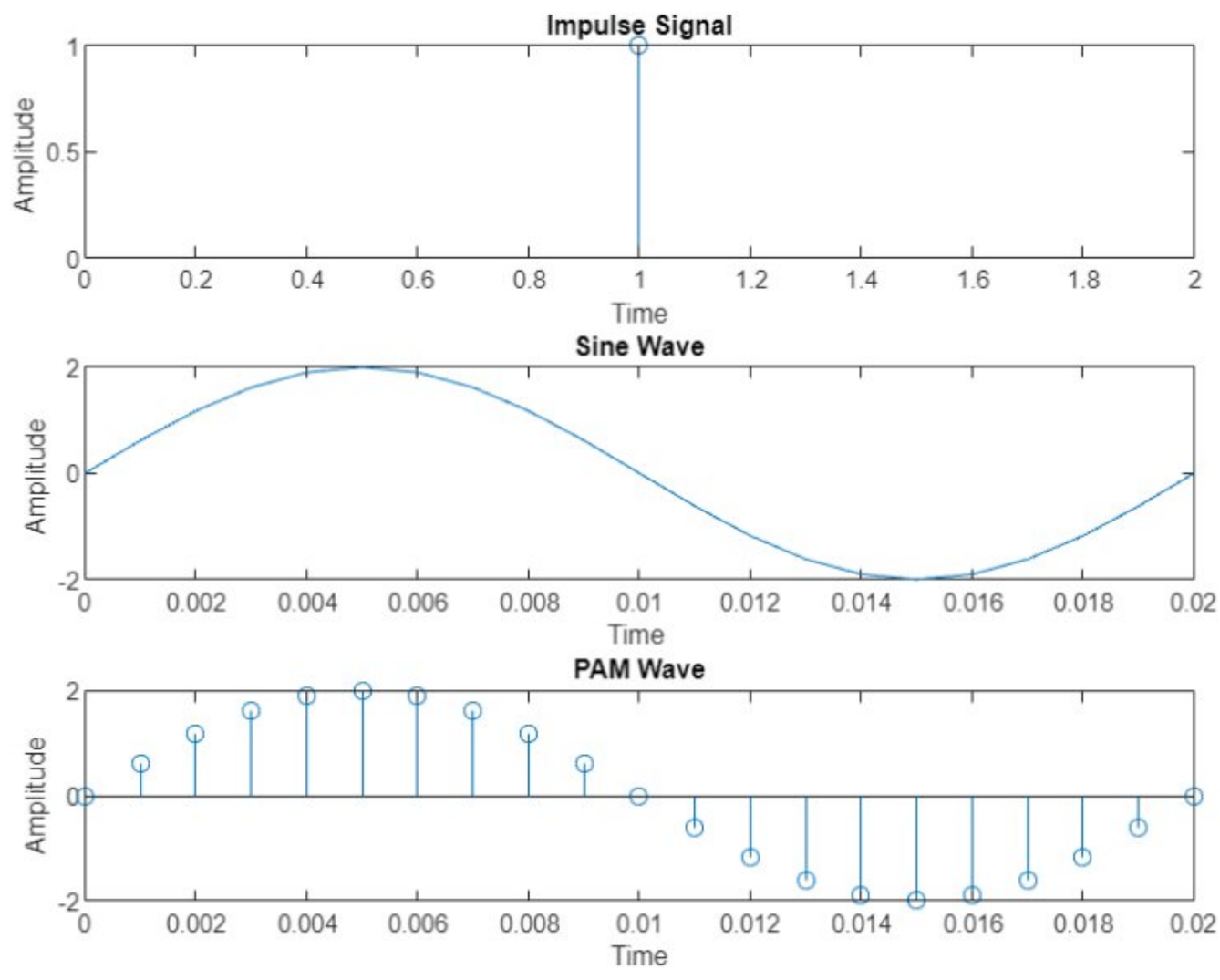
Experiment - 4

Aim: To study Pulse Amplitude Modulation.

Code:

```
a = 2;
f = 50;
t1 = 1/f;
t = 0:t1/20:t1;
x1 = 1;
x2 = a*sin(2*pi*f*t);
y = x1.*x2;
subplot(3,1,1);
stem(x1);
title('Impulse Signal');
xlabel('Time');
ylabel('Amplitude ');
subplot(3,1,2)
plot(t,x2);
title('Sine Wave');
xlabel('Time ');
ylabel('Amplitude ');
subplot(3,1,3)
stem(t,y);
title('PAM Wave');
xlabel('Time');
ylabel('Amplitude');
```

Output:

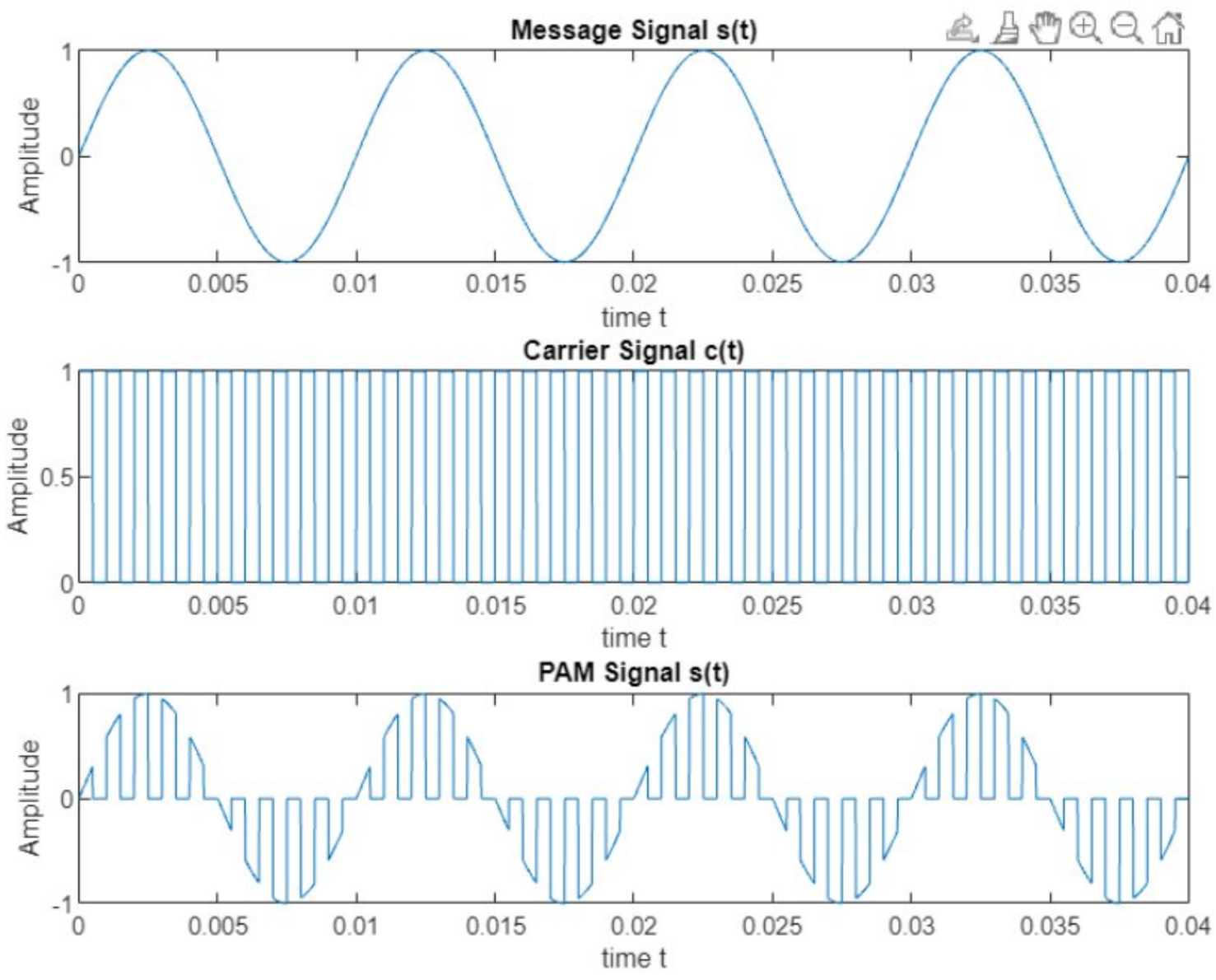


Natural Sampling PAM

Code:

```
fc=1000;
fm=fc/10;
fs=100*fc;
t=0:1/fs:4/fm;
mt=sin(2*pi*fm*t);
ct=0.5*square(2*pi*fc*t)+0.5;
st=mt.*ct;
subplot(3,1,1);
plot(t,mt);
title('Message Signal s(t)');
xlabel('time t')
ylabel('Amplitude');
subplot(3,1,2);
plot(t,ct);
title('Carrier Signal c(t)')
xlabel('time t')
ylabel('Amplitude');
subplot(3,1,3);
plot(t,st);
title('PAM Signal s(t)')
xlabel('time t')
ylabel('Amplitude');
```

Output:



Flat Top PAM

Code:

```
fc=100;
fm=fc/10;
fs=100*fc;
t=0:1/fs:4/fm;
am=1;
mt=am*sin(2*pi*fm*t);
subplot(3,1,1);
plot(t,mt);
xlabel('time t');
ylabel('Amplitude');
title('Message Signal s(t)');
%carrier
ac=1;
ct=ac*square(2*pi*fc*t);
n=length(ct);
for i=1:n
    if(ct(i)<=0)
        ct(i)=0;
    else
        ct(i)=1;
    end
end
st=mt.*ct;
subplot(3,1,2);
plot(t,ct);
title('Carrier Signal c(t)');
for i = 2:length(t)
    if (ct(i)==1&&ct(i-1)==0)
        st(i)=ct(i)*mt(i);
    elseif (ct(i)==1&&ct(i-1)==1)
        st(i)=st(i-1);
    else
        st(i)=0;
    end
end
subplot(3,1,3);
plot(t,st);
xlabel('time t');
ylabel('Amplitude');
title('PAM Signal s(t)');
```

Output: