Chapter 2: Signals

1)

```
t=-5:.1:10;
r5=(t+5).*heaviside(t+5);
r3=(t+3).*heaviside(t+3);
r2=(t+2).*heaviside(t+2);
r=t.*heaviside(t);
u=heaviside(t);
u2=heaviside(t-2);
u5=heaviside(t-5);
u8=heaviside(t-8);
x=r5-r3-r2+r+u+u2+u5-3*u8;
plot(t,x)
ylim([-.1 3.1])
```

2) $\Omega = 2 \Rightarrow \mathrm{T} = 2\pi / \Omega = \pi$

```
T=pi;
t=0:.1:3*T;
x=3*exp(-j*2*t);
plot(t,real(x),t,imag(x));
legend('Re[x(t]','Im[x(t)]')
```

3) $\Omega_1 = 2\pi \Rightarrow \mathrm{T}_1 = 1$ and $\Omega_2 = 3\pi \Rightarrow \mathrm{T}_2 = 2/3$. For k=2 and m=3 , $\mathrm{T} = k\mathrm{T}_1 = m\mathrm{T}_2 = 2$.

```
T=2;
t=0:.1:4*T;
x=cos(2*pi*t)+sin(3*pi*t);
plot(t,x)
grid
```

4)

```
t=0:.1:20;
x=t.*exp(-0.1*t).*cos(t);
x_t=-t.*exp(0.1*t).*cos(-t);
xe=(x+x_t)/2;
xo=(x-x_t)/2;
y=xe+xo;
subplot(221);
plot(t,x)
subplot(222)
plot(t,xe);
subplot(223)
plot(t,xo);
subplot(224)
plot(t,y)
```

5)

```
 syms n
 x=0.9^n;
 E=symsum(x,n,0,inf)
```

6)

```
 t1=0:.1:2;
 x1=t1;
 t2=2:.1:4;
 x2=4-t2;
 t=[t1 t2];
 x=[x1 x2];
 plot(t,x)
 plot(-t,x)
 plot(2*t,x)
 plot(-(1/4)*(2+t),x)
```

7)

```
function u=unitstep(t0);
t1=t0-10:.1:t0;
t2=t0:.1:t0+10;
u1=zeros(size(t1));
u2=ones(size(t2));
t=[t1 t2];
u=[u1 u2];
plot(t,u);
ylim([-.1 1.1]);
```

8)

```
function d=unitdirac(t0);
t1=t0-10:.1:t0-.1;
t2=t0;
t3=t0+.1:.1:t0+10;
d1=zeros(size(t1));
d2=1; % or u2 =inf
d3=zeros(size(t3));
t=[t1 t2 t3];
d=[d1 d2 d3];
plot(t,d);
ylim([-.1 1.1]);
```

9)

```
function r=unitramp(t0);
t1=t0-10:.1:t0;
t2=t0:.1:t0+10;
r1=zeros(size(t1));
r2=t2-t0;
t=[t1 t2];
r=[r1 r2];
plot(t,r);
```

10)

```
function p=unitrect(T);
t1=-T:.01:-T/2;
t2=-T/2:.01:T/2;
t3=T/2:.01:T;
p1=zeros(size(t1));
p2=ones(size(t2));
p3=zeros(size(t3));
t=[t1 t2 t3];
p=[p1 p2 p3];
plot(t,p);
ylim([-.1 1.1]);
```

11)

```
function p=unitrect2(T,t0);
t1=t0-T:.01:t0-T/2;
t2=t0-T/2:.01:t0+T/2;
t3=t0+T/2:.01:t0+T;
p1=zeros(size(t1));
p2=ones(size(t2));
p3=zeros(size(t3));
t=[t1 t2 t3];
p=[p1 p2 p3];
plot(t,p);
ylim([-.1 1.1]);
```

12)

```
function u=unitstep2(n0);
n1=n0-10:n0-1;
n2=n0:n0+10;
u1=zeros(size(n1));
u2=ones(size(n2));
n=[n1 n2];
u=[u1 u2];
stem(n,u);
ylim([-.1 1.1]);
```

13)

```
function d=unitdelta(n0);
n1=n0-10:n0-1;
n2=n0;
n3=n0+1:n0+10;
d1=zeros(size(n1));
d2=1; % or u2 =inf
d3=zeros(size(n3));
n=[n1 n2 n3];
d=[d1 d2 d3];
stem(n,d);
ylim([-.1 1.1]);
```

14)

```
function [y,ny]=shift(x,n,n0);
ny=n+n0;
y=x;
stem(ny,y)
```

15)

```
function [y,ny]=scaled(x,a,n)


if a>1
%     Downsampling- only the integer quotients survive
    j=1;
    for i=1:length(n)
    if mod(n(i),a)==0
        ny(j)=n(i)/a;
        y(j)=x(i);
        j=j+1;
    end
    end

else if a<1
%     Upsampling
        y=upsample(x,1/a);
        ny=upsample((1/a)*n,1/a);

    else
        y=x;
        ny=y;
    end
end
stem(ny,y);
```

16)

```
function x=complexp(r,w,n)
x=(r.^n).*exp(j*w*n);
subplot(221);
stem(n,real(x));
title('Real')

subplot(222);
stem(n,imag(x));
title('Imag')

subplot(223);
stem(n,abs(x));
title('Magnitude')

subplot(224);
stem(n,phase(x));
title('Phase')
```