KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

Practical 1

1 A

(i) Addition

```
clc()
//Define complex numbers
a1 = 2;
b1 = 1;
a2 = 1;
b2 = 2;
z1 = complex(a1, b1);
z2 = complex (a2, b2);

//mathematical operation
z3 = z1 + z2;
a3 = real(z3);
b3 = imag(z3);

//plot
figure(0)
clf()
hf.background = 2;
ha = gca()
ha.data_bounds = [-5, -5, 5, 5];
xgrid();
plot([0 a1], [0 b1], 'b', 'LineWidth', 3)
plot([0 a2], [0 b2], 'r', 'LineWidth', 3)
plot ([0 a3], [0 b3], 'g', 'Line Width', 3)
xlabel('Real axis(Re)', 'FontSize', 2)
ylabel('Imaginary axis (Im)', 'Fontsize', 2)
legend('$\Large{z_{1})$', '$\Large{z_{2}}$', '$\Large{z_{3}}$')
plot(0, 0, 'sk')
```

```
plot (a1, b1, 'sk')
plot (a2, b2, 'sk')
plot (a3, b3, 'sk')
xstring (a1, b1, '$\Large{z_{1}=2+i}$')
xstring (a2, b2, '$\Large{z_{2}=1+2i}$')
xstring (a3, b3, '$\Large{z_{3}=3+3i}$')

//calculate exp form
r1 = sqrt (a1^2 + b1^2);
r2 = sqrt (a2^2 + b2^2);
r3 = sqrt (a3^2 + b3^2);
phi1 = atan(b1/a1)* 180/%pi;
phi2 = atan(b2/a2)* 180/%pi;
phi3 = atan(b3/a3)* 180/%pi;

//display polynomial and polar parameters
mprintf('%s\t %s\t %s\t %s\n', 'a', 'b', 'r', 'phi')
mprintf('%4.2f \t %4.2f \t %4.2f \t %4.2f\n', a1, b1, r1, phi1)
mprintf('%4.2f \t %4.2f \t %4.2f \t %4.2f\n', a2, b2, r2, phi2)
mprintf('%4.2f \t %4.2f \t %4.2f \t %4.2f\n', a3, b3, r3, phi3)
```

(ii) Subtraction

```
clc()
//Define complex numbers
a1 = 2;
b1 = 1;
a2 = 1;
b2 = 2;
z1 = complex(a1, b1);
z2 = complex(a2, b2);

//mathematical operation
z3 = z1 + z2
a3 = real(z3);
b3 = imag(z3);

//plot
figure(0)
clf()
hf.background = 2;
ha = gca()
ha.data_bounds = [-5, -5, 5, 5];
xgrid();
plot([0 a1], [0 b1], 'b', 'LineWidth', 3)
plot([0 a2], [0 b2], 'r', 'LineWidth', 3)
plot([0 a3], [0 b3], 'g', 'LineWidth', 3)
xlabel('Real axis (Re)', 'FontSize', 2)
ylabel('Imaginary axis (Im)', 'Fontsize', 2)
legend('$\Large{z_{1}}$', '$\Large{z_{2}}$', '$\Large{z_{3}}$')
plot(0, 0, 'sk')
plot(a1, b1, 'sk')
plot(a2, b2, 'sk')
```

```
plot(a3, b3, 'sk')
xstring(a1, b1, '$\Large{z_{1} = 2+i} $')
xstring(a2, b2, '$\Large{z_{2} = 1+2i} $')
xstring(a3, b3, '$\Large{z_{3}= 3+3i} $')

//calculate exp from
r1= sqrt(a1^2 + b1^2);
r2= sqrt(a2^2 + b2^2);
r3 = sqrt(a3^2 + b3^2);
phi1 = atan(b1/a1)* 180/ %pi;
phi2 = atan(b2/a2)* 180/ %pi;
phi3= atan(b3/a3)* 180/ %pi;

//display polynomial and polar parameters
mprintf('%s \t %s \t %s\t %s\n', 'a', 'b', 'r', 'phi')
mprintf('%4.2f \t %4.2f\t %4.2f \t %4.2f\n', a1, b1, r1, phi1)
mprintf('%4.2f \t %4.2f \t %4.2f \t %4.2f\n', a2, b2, r2, phi2)
mprintf('%4.2f \t %4.2f \t %4.2f\t %4.2f\n', a3, b3, r3, phi3)
```

(iii) Multiplication

```
clc()
//Define complex numbers
a1 = 2;
b1 = 1;
a2 = 1;
b2 = 2;
z1 = complex(a1, b1);
z2 = complex(a2, b2);

//mathematical operation
z3 = z1 * z2;
a3 = real(z3);
b3 = imag(z3);

//plot
figure(0)
clf()
hf.background = 2;
ha = gca()
ha.data_bounds = [-5,-5,5,5];
xgrid();
plot([0 a1], [0 b1], 'b', 'LineWidth', 3)
plot([0 a2], [0 b2], 'r', 'LineWidth', 3)
plot([0 a3], [0 b3], 'g', 'LineWidth', 3)
xlabel('Real axis(Re)', 'FontSize', 2)
ylabel('Imaginary axis (Im)', 'FontSize', 2)
legend('$\Large{z_{1}}$', '$\Large{z_{2}}$', '$\Large{z_{3}}$')
plot(0, 0, 'sk')
plot(a1, b1, 'sk')
plot(a2, b2, 'sk')
```

```
plot(a3, b3 'sk')
xstring(a1, b1, '$\Large{z_{1}=2+i}$')
xstring(a2, b2, '$\Large{z_{2}=1+2i}$')
xstring(a3,b3, '$\Large{z_{3}=3+3i}$')

//calculate exp form
r1= sqrt (a1^2 + b1^2);
r2= sqrt (a2^2 + b2^2);
r3= sqrt(a3^2 + b3^2);
phi1 = atan(b1/a1)* 180/%pi;
phi2 = atan (b2/a2)* 180/%pi;
phi3 = atan(b3/a3)* 180/%pi;

//display polynomial and polar parameters
mprintf('%s\t %s\t %s\t %s\n','a', 'b', 'r', 'phi')
mprintf('%4.2f \t %4.2f \t %4.2f \t %4.2f\n', a1, b1, r1, phi1)
mprinf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a2, b2, r2, phi2)
mprintf('%42f \t %4.2f\t %4.2f \t %4.2f\n', a3, b3, r3, phi3)
```

(iv) Division

```
clc()
//Define complex numbers
a1=2;
b1=1;
a2=1;
b2=2;
z1= complex(a1, b1);
z2= complex(a2,b2);

//mathematical operation
z3= z1/z2;
a3 = real(z3);
b3= imag(z3);

//plot
figure(0)
clf()
hf.background=2;
ha=gca()
ha.data_bounds =[-5,-5,5,5];
xgrid();
plot([0 a1],[0 b1],'b','LineWidth',3)
plot([0 a2],[0 b2],'r','LineWidth',3)
plot([0 a3],[0 b3],'g','LineWidth',3)
xlabel('Real axis(Re)','FontSize',2)
ylabel('Imaginary axis (Im)','FontSize',2)
legend('$\large{z-{1}}$','$\large{z-{2}}$','$\large{z-{3}}$')
plot(0,0,'sk')
plot(a1,b1,'sk')
plot(a2,b2,'sk')
```

```
plot(a3, b3, 'sk')
xstring(a1, b1, '$\large{z_{1}=2+i}$')
xstring(a2, b2, '$\Large{z_{2}=1+2i}$')
xstring(a3, b3, '$\Large{z_{3}= 3+3i}$')

//calculate exp form
r1= sqrt(a1^2 + b1^2);
r2 = sqrt(a2^2 + b2^2);
r3 = sqrt(a3^2 + b3^2);
phi1 = atan(b1/a1)* 180/%pi;
phi2 = atan(b2/a2)* 180/%pi;
phi3 = atan(b3/a3)* 180/%pi;

//display polynomial and polar parameters
mprintf('%s\t %s\t %s\t %s\n', 'a', 'b', 'r', 'phi')
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a1, b1, r1, phi1)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a2, b2, r2, phi2)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a3, b3, r3, phi3)
```

ISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

```
clc()
a1=1; b1=2; a2=1; b2=-1; a3=1; b3=2; a4=1; b4=1;
z1= complex (a1, b1);
z2= complex(a2, b2);
z3= complex(a3, b3);
z4= complex(a4, b4);
n1=2;
n2=1;
n3=-1;
n4=1;
z11= z1^n1;
z22=z2^n2;
z33=z3^n3;
z44=z4^n4;
z=(z11*z22)/(z33*z44);
disp(z11);
disp(z22);
disp(z33);
disp(z44);
disp(z);
a=real(z);
b= imag(z);
r1= sqrt (a1^2 + b1^2);
r2=sqrt (a2^2 + b2^2);
r3= sqrt (a3^2 + b3^2);
r4= sqrt (a4^2 + b4^2);
r=sqrt(a^2 +b^2).
phi1 = atan (b1/a1);
phi2 = atan (b2/a2);
phi3 = atan(b3/a3);
```

```
phi4 = atan(b4/a4);
phi = atan(b/a)
r11 = r1^n1
r22 = r2^n2
r33 = r3^n3
r44 = r4^n4
phi11 = phi1 * n1
phi22 = phi2 * n2
phi33 = phi3 * n3
phi44 = phi4 * n4
p11 = r11 * (cos(phi11) + %i * sin(phi11));
p22 = r22 * (cos(phi22) + %i * sin(phi22));
p33 = r33 * (cos(phi33) + %i * sin(phi33));
p44 = r44 * (cos(phi44) + %i * sin(phi44));
p = (p11 * p22) / (p33 * p44);
disp(p);
mprintf('%s\t %s\t %s\t %s\n', 'a', 'b', 'r', 'phi')
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a1, b1, r1, phi1)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a2, b2, r2, phi2)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a3, b3, r3, phi3)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a4, b4, r4, phi4)
mprintf('%4.2f\t %4.2f\t %4.2f\t %4.2f\n', a, b, r, phi)
```

IN

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

PRACTICAL 2

A] Laplace Transform

1. e^{-t}

$e^{-at} = \frac{1}{s+a}$

$\therefore e^{-t} = \frac{1}{s+1}$

2. $\sin t$

$\sin at = \frac{a}{s^2+a^2}$

$\sin t = \frac{1}{s^2+1}$

3. $\cosh 2t$

$\cosh at = \frac{s}{s^2-a^2}$

$\therefore \cosh 2t = \frac{s}{s^2-4}$

4. t^2

$t^n = \frac{n!}{s^{n+1}}$

$t^2 = \frac{2!}{s^{2+1}} = \frac{2}{s^3}$

5 $1-e^{-t}$

$1 = \frac{1}{s}$

$e^{-at} = \frac{1}{s+a}$

$$1 - e^{-t} = \frac{1}{s} - \frac{1}{s+1}$$

6. $1 + e^{-t}$

$$1 = \frac{1}{s}$$

$$e^{-at} = \frac{1}{s+a}$$

$$1 + e^{-t} = \frac{1}{s} + \frac{1}{s+1}$$

B] Inverse Laplace Transform

1. $\dfrac{s^2-3s+4}{s^3}$

$$\frac{s^2-3s+4}{s^3} = \frac{s^2}{s^3} - \frac{3s}{s^3} + \frac{4}{s^3} = \frac{1}{s} - \frac{3}{s^2} + \frac{4}{s^3}$$

$$L^{-1}\left[\frac{s^2-3s+4}{s^3}\right] = 1 - 3t + 2t^2$$

2. $\dfrac{s+2}{(s^2-4s+13)}$

$$= \frac{s+2}{(s-2)^2+3^2}$$

$$= \frac{s+2}{(s-2)^2+9} = \frac{s-2+4}{(s-2)^2+9} = \frac{s-2}{(s-2)^2+9} + \frac{4}{(s-2)^2+9}$$

$$\therefore L^{-1}\left[\frac{s-a}{(s-a)^2+b^2}\right] = e^{at}.\cos(bt)$$

$$L^{-1}\left[\frac{b}{(s-a)^2+b^2}\right] = e^{at}.\sin(bt)$$

Here $a=2$, $b=3$

$\therefore$ [illegible]

$$\therefore \frac{s-2}{(s-2)^2+9} = e^{2t}.\cos(3t)$$

$$\therefore \frac{4}{(s-2)^2+9} = 4e^{2t}.\frac{\sin(3t)}{3}$$

$$\therefore L^{-1}\left[\frac{s+2}{s^2-4s+13}\right] = e^{2t}.\cos(3t) + \frac{4}{3}e^{2t}.\sin(3t)$$

mhai - 20.

3) $\dfrac{(s^2-6s+5)}{(s^3-6s^2+11s-6)}$

$\therefore \dfrac{s^2-6s+5}{(s-1)(s-2)(s-3)} = \dfrac{A}{s-1} + \dfrac{B}{s-2} + \dfrac{C}{s-3}$

$\therefore s^2-6s+5 = A(s-2)(s-3) + B(s-1)(s-3) + C(s-1)(s-2)$

When $\boxed{s=1}$

$1^2-6(1)+5 = A(1-2)(1-3)$

$\therefore 1-6+5 = 2A$

$\therefore A = 0$

When $\boxed{s=2}$

$2^2-6(2)+5 = B(2-1)(2-3)$

$4-12+5 = -B$

$\therefore B = 3$

When $\boxed{s=3}$

$3^2-6(3)+5 = C(3-1)(3-2)$

$9-18+5 = 2C$

$\therefore C = -2$

$\therefore \dfrac{s^2-6s+5}{s^3-6s^2+11s-6} = \dfrac{3}{s-2} \cancel{+} - \dfrac{2}{s-3}$

$= 3e^{2t} - 2e^{3t}$

4) $\dfrac{s}{(2s-1)(3s-1)}$

$\therefore \dfrac{s}{(2s-1)(3s-1)} = \dfrac{A}{2s-1} + \dfrac{B}{3s-1}$

$\therefore s = A(3s-1) + B(2s-1)$

$3A + 2B = 1 \rightarrow$ Coefficient of s

$-A - B = 0 \rightarrow$ constant term

$-A \mp B = 0$

$\therefore -A = B.$

Substitue $B = -A$ in $3A + 2B = 1$

$3A + 2(-A) = 1$

$\therefore 3A - 2A = 1$

$A = 1$

$\therefore B = -1, A = 1$

$$\frac{s}{(2s-1)(3s-1)} = \frac{1}{2s-1} - \frac{1}{3s-1}$$

$$= L^{-1}\left(\frac{1}{2s-1}\right) - L^{-1}\left(\frac{1}{3s-1}\right)$$

$$= \frac{1}{2}e^{\frac{1}{2}t} - \frac{1}{3}e^{\frac{1}{3}t}$$

5) $\frac{s}{(s^2-1)^2}$

$\therefore \frac{s}{((s-1)(s+1))^2}$

$$L^{-1}\left(\frac{s}{s^2-1}\right) = \cosh(t)$$

$$L[t.\cosh(t)] = -\frac{d}{ds}\left[\frac{s}{s^2-1}\right]$$

$$\frac{d}{ds}\left(\frac{s}{s^2-1}\right) = \frac{(s^2-1)-s(2s)}{(s^2-1)^2} = \frac{-s^2-1}{(s^2-1)^2} = \frac{-(s^2+1)}{(s^2-1)^2}$$

$$\frac{s}{(s^2-1)^2} = \frac{-1}{2}\frac{d}{ds}\left(\frac{s}{s^2-1}\right)$$

$$L^{-1}\left[\frac{-1}{2}\frac{d}{ds}\left(\frac{s}{s^2-1}\right)\right\} = \frac{1}{2}t\cosh(t)$$

$$\therefore L^{-1}\left[\frac{s}{(s^2-1)^2}\right] = \frac{1}{2} t\cosh(t)$$

6. $\dfrac{s}{s^4+s^2+1}$

$$s^2 = \frac{-1 \pm \sqrt{3}i}{2}$$

$$L^{-1}\left(\frac{s}{s^4+s^2+1}\right) = \frac{1}{3}\left(e^{-1/2} \cos\left(\frac{\sqrt{3}}{2}t\right) + \cos(t)\right)$$

7. $\dfrac{s+2}{s^2(s+1)(s-2)}$

$$\therefore \frac{s+2}{s^2(s+1)(s-2)} = \frac{A}{s} + \frac{B}{s^2} + \frac{C}{s+1} + \frac{D}{s-2}$$

$$\therefore s+2 = As(s+1)(s-2) + B(s+1)(s-2) + C s^2(s-2) + D\, s^2(s+1)$$

$s = 0$

$2 = 0 + -2B + 0 + 0$

$$\boxed{B = -1}$$

$s = -1$

$1 = 0 + 0 + -3C + 0$

$$\boxed{C = -1/3}$$

$4 = 0 + 0 + 0 + 12D$

$$\boxed{D = 1/3}$$

$s = 1$

$3 = -2A - 2B - C + 2D$

$3 = -2A + 2 + \frac{1}{3} + \frac{2}{3}$

$3 = -2A + 2 + \cancel{3}/\cancel{3}$

$$\therefore \boxed{A = 0}$$

$$F(s) = 0 + \frac{-1}{s^2} - \frac{1/3}{s+1} + \frac{1/3}{s-2}$$

KISHINCHAND CHELLARAM COLLEGE, Mum

FY / SY / TY B. Sc. (I. T.) Semester

$$f(t) = -t - \frac{1}{3}e^{-t} + \frac{1}{3}e^{2t}$$

8. $$\frac{1}{(s^2+1)(s^2+9)} = As + B$$

Practical 3 - Differential Equation

1.
```
x0=0 ; xinc = 0.001 ; xf = 1 ; x=x0 ; xinc: xf;
// Define x
// calculate analytic solution
y=Sqrt (x^2+2*x+0.01);
// Plot analytic solution
Subplot (2,1,1), plot(x,y), xgrid
ylabel ('y(x)', 'fontsize', 2)
title ('Analtic Solution', 'fontsize', 2)
//Define differential equation
deff ('yprim= f(x,y)', 'yprim=(x+1)/y');
// Solve differential equation
y0-0.1;
Subplot (2,1,2), plot(x, ydiff, 'r'), xgrid
title ('Numeric Solution', 'fontsize', 2)
ylabel ('y(x)', 'fontsize', 2)
ydiff = ode (y0, x0, x, f); //Plot numberic Solution
xlabel ('x', 'fontsize', 2)
```

2.
```
function ydot = f(t, y)
ydot = y^2 - y* sin(t) + cos(t)
endfunction
y0 = 0;
t0 = 0;
t - 0:0.1 : %pi;
y= ode(y0, t0, t, f);
plot (t, y)
```

3)
```
function xdot=linear(t,x,A,u,B,omega)
    xdot=A*x+B*u(t,omega)
endfunction
function ut=u(t,omega)
    ut=sin(omega*t)
endfunction
A-[1 1:0 2];
B=[1;1];
omega=5;
y0=[1;0];
t0=0;
t=[0.1,0.2,0.5,1];
ode(y0,t0,t,list(linear,A,u,B,omega))
plot(t,u);
```

4)
```
function y=u(t)
    y=(sign(t)+1)/2
endfunction
L=0.001
R=10
C=0.000001
function zdot=f(t,y)
    zdot(1)=y(2);
    zdot(2)=(u(t)-y(1)-L*y(2)/R)/(L*C);
endfunction
y0=[0;0];
t0=0;
t=0:0.000001:0.001;
out=ode(y0,t0,t,f);
clf();
plot(out);
function y=u(t)
```

```
    y=(sign(t)+1)/2
endfunction
L=0.001
R=10
C=0.000001
function zdot=f(t,y)
    zdot=[y(2);(v(t)-y(1)-L*y(2)/R)/(L*C)];
endfunction
y0=[0;0];
t0=0;
t=0:0.000001:0.001;
out=ode(y0,t0,t,f);
clf();
subplot(211)
plot(t,out(1,:),"r.--");
subplot(212)
plot(t,out(2,:),"b-..");
```

5)
```
function dx=f(t,x)
    dx(1)=x(2);
    dx(2)=1/(t+1)+sin(t)*sqrt(t);
endfunction
t=0:0.01:5*%pi;
t0=min(t);
y0=[0;-2];
y=ode(y0,t0,t,f);
plot(t,y(1,:),'LineWidth',2)
plot(t,y(2,:),'r',LineWidth',2)
xgrid();
xlabel('$t\quad[s]$','FontSize',3)
ylabel('$f(t,x)$','FontSize',3)
title(['Integration of''$\frac{d^2 x}{dt^2}=\frac{1}{t+1}+sint(t)
```

\sqrt{t}$'], 'fontsize', 3}
legend (['$\Large {x} $' '$\Large {dx/dt} $'], 2}

6)
```
funcprot(0)
clf;
function dx = f(x, y)
    dx = exp(-x0);
endfunction
y0 = 0;
x0 = 0;
x = [0:0.5:10];
sol = ode (y0, x0, x, f);
plot2d (x, sol, 5)
xlabel('x');
ylabel('y(x)');
xtitle('y(x) vs. x')
```

7)
```
funcprot (0)
clf;
function dx = f(x, y)
    dx = x^2 - exp(-x)* y
endfunction
y0 = 0;
x0 = 0;
x [0:0.5:10];
sol = ode (y0, x0, x, f);
plot2d (x, sol, 5)
xlabel ('x');
ylabel ('y(x)');
xtitle ('y(x) vs. x')
```

vt = sin (omega * t)

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

Practical 5

A) Z Transform.

1.
```
clear;
//z transform of [2 -1 3 2 1 0 2 3 -1]
clear; clc;
close;
function [za]= ztransfer (sequence, n)
    z = poly(0, 'z', 'r')
    za = sequence * (1/z)^n'
endfunction
x1 = [2 -1 3 2 1 0 2 3 -1]
n = 4:4
zz = ztransfer (x1, n);
//Display the result in command window
disp (zz, "Z- transform of sequence is: ")
disp ('ROC is the entire plane except z=0 and z=%intf;')
```

⇒ $x_1 = [2, -1, 3, 2, 1, 0, 2, 3, -1]$

$n = 4:4$

$$X(z) = \sum_{n=-\infty}^{\infty} x[n] \cdot z^{-n}$$

$$X(z) = 2z^4 - z^3 + 3z^2 + 2z + 1 + 0 + \frac{2}{z} + \frac{3}{z^2} + \frac{1}{z^3}$$

For a finite length sequence, the ROC is entire z-plane except at z=0 and z=∞. Therefore

ROC = The entire z-plane except z=0 and z=∞

2.
```
clear;
//z Transform of [1,2,3,4,5,6,7]
clc;
function [za]= ztransfer(sequence, n)
    z=poly(0,'z','r')
    za=sequence*(1/z)^n'
endfunction
x=[1,2,3,4,5,6,7];
n1 = 0:length(x)-1;
X= ztransfer(x,n1);
disp('X(z)= ');
disp(X)
funcprot(0);
```

$\Rightarrow$ $x=[1,2,3,4,5,6,7]$

length is 0 to 6

$$X(z) = \sum_{n=0}^{6} x[n] z^{-n}$$

$$X(z) = 1\cdot z^0 + 2\cdot z^{-1} + 3z^{-2} + 4\cdot z^{-3} + 5\cdot z^{-4} + 6z^{-5} + 7z^{-6}$$

$$= 1 + \frac{2}{z} + \frac{3}{z^2} + \frac{4}{z^3} + \frac{5}{z^4} + \frac{6}{z^5} + \frac{7}{z^6}$$

3.
```
clear;
//z transform of [1,2,3,4,5,6,7] with different range
clc;
function [za]= ztransfer(sequence,n)
    z=poly(0,'z','r')
    za=sequence*(1/z)^n'
endfunction
x=[1,2,3,4,5,6,7]
n1=2:length(x)-3
```

```
x = ztransfer(x, n1)
disp(x, 'x(z)= ')
funcprot(0);
```

$\Rightarrow$ $x = [1, 2, 3, 4, 5, 6, 7]$
$n1 = -2 : \text{length}(x) - 3$ i.e $-2, -1, 0, 1, 2, 3, 4$

$$X(z) = \sum_{n=-2}^{4} x(n) \cdot z^{-n}$$

$$= 1 \cdot z^{2} + 2 \cdot z^{1} + 3z^{0} + 4z^{-1} + 5z^{-2} + 6z^{-3} + 7z^{-4}$$

$$= 1 \cdot z^{2} + 2z + 3 + \frac{4}{z} + \frac{5}{z^{2}} + \frac{6}{z^{3}} + \frac{7}{z^{4}}$$

4.
```
clear;
//z Transform of [1,2,3,4,5,0,7]
clc;
function [za] = ztransfer (sequence, n)
    z = poly(0, 'z', 'r')
    za = sequence * (1/z)^n'
endfunction
x = [1, 2, 3, 4, 5, 0, 7]
n1 = 0: length(x) - 1;
X = ztransfer (x, n1)
disp(x);
funcprot (0);
```

$\Rightarrow$ $x = [1, 2, 3, 4, 5, 0, 7]$
$n1 =$ ~~[illegible]~~ $0 : \text{length}(x) - 1$ ie $0:6 = 0, 1, 2, 3, 4, 5, 6$

$$X(z) = \sum_{n=0}^{6} x(n) z^{-n}$$

$$= 1z^{0} + 2z^{-1} + 3z^{-2} + 4z^{-3} + 5z^{-4} + 6z^{-5} + 7z^{-6}$$

$$= 1 + \frac{2}{z} + \frac{3}{z^2} + \frac{4}{z^3} + \frac{5}{z^4} + \frac{6}{z^5} + \frac{7}{z^6}$$

5. //z Transform of [4, 2, -1, 0, 3, -4]

```
clc;
function [za] = ztransfer (sequence, n)
    z = poly (0, 'z', 'r')
    za = sequence * (1/z)^n'
endfunction
x = [4, 2, -1, 0, 3, -4]
n1 = -2 : length (x) - 3
X = ztransfer (x, n1);
disp (X, 'X(z) = ');
funcprot (0);
```

$\Rightarrow$ x = [4, 2, -1, 0, 3, -4]

n1 = -2 : length(x) - 3 i.e -2, -1, 0, 1, 2, 3

$$X(z) = \sum_{n=-2}^{3} x(n) \cdot z^{-n}$$

$$= 4 \cdot z^{-2} + 2 \cdot z - 1 + 0 \cdot \frac{1}{z} + \frac{3}{z^2} + - \frac{4}{z^3}$$

$$= 4z^2 + 2z - 1 + \frac{3}{z^2} - \frac{4}{z^3}$$

6 //Convolution of two signals x1 and x2

```
clc;
function [za] = ztransfer (sequence, n)
    z = poly (0, 'z', 'r')
    za = sequence * (1/z)^n'
endfunction;
x1 = [1, -3, 2];
```

```
n1 = 0: length(x1)-1;
X1 = ztransfer (x1, n1);
x2 = [1, 2, 1];
n2 = 0: length (x2) - 1;
X2 = ztransfer (x2, n2);
X = X1 * X2;
disp (X, 'X(z) = ');
z = poly(0, 'z');
X = [1; -z^-1; -3*z^-2; z^-3; 2*z^-4];
n = 0:4;
Z1 = z^n';
x = (X * Z1);
disp (x, 'x[n] = ');
```

$\Rightarrow$ $x1 = [1, -3, 2]$ $\quad$ $n1 = [0, 1, 2]$

$x2 = [1, 2, 1]$ $\quad$ $n2 = [0, 1, 2]$

$\therefore X_1(z) = 1 - \frac{3}{z} + \frac{2}{z^2}$ & $X_2(z) = 1 - \frac{2}{z} + \frac{1}{z^2}$

$$\therefore X_1 * X_2 = \left(1 - \frac{3}{z} + \frac{2}{z^2}\right) * \left(1 + \frac{2}{z} + \frac{1}{z^2}\right)$$

$$= 1 + \frac{2}{z} + \frac{1}{z^2} + \left(\frac{-3}{z} - \frac{6}{z^2} - \frac{3}{z^3}\right) + \left(\frac{2}{z^2} + \frac{4}{z^3} + \frac{2}{z^4}\right)$$

$$= 1 + 2z^{-1} + 1z^{-2} - 3z^{-1} - 6z^{-2} - 3z^{-3} + 2z^{-2} + 4z^{-3} + 2z^{-4}$$

$$= 1 + (2z^{-1} - 3z^{-1}) + (z^{-2} - 6z^{-2} + 2z^{-2}) + (-3z^{-3} + 4z^{-3}) + 2z^{-4}$$

$$= 1 - z^{-1} - 3z^{-2} + z^{-3} + 2z^{-4}$$

$x(n) = 1$	-1	-3	1	2	0
where $n = 0$	1	2	3	4	otherwise

```
vt = sin (omega * t)
```

B] Inverse Z Transform.

1. //Find the inverse Z-tranform using long division method

```
clc;
clear;
z = poly(0,'z')
x = ldiv(z^3-10*z^2-4*z+4, 2*z^2-2*z-4, 4);
disp(x,'x[n] = ');
```

$$\Rightarrow X(z) = \frac{z^3-10z^2-4z+4}{2z^2-2z-4}$$

$$= \frac{z^3-10z^2-4z+4}{2(z-2)(z+1)} = \frac{A}{z-2} + \frac{B}{z+1} = \frac{A(z+1)+B(z-2)}{z(z-2)(z+1)}$$

$$\therefore z^3-10z^2-4z+4 = A(z+1)+B(z-2)$$

i) When $z=2$

$$2^3-10(2)^2-4(2)+4 = A(3)$$

$$-36 = 3A$$

$$\boxed{A=-12}$$

ii) When $z=-1$

$$(-1)^3-10(-1)^2-4(-1)+4 = B(-3)$$

$$-3 = -3B$$

$$\boxed{B=1}$$

$$\therefore \frac{z^3-10z^2-4z+4}{2(z-2)(z+1)} = \frac{-12}{z-2} + \frac{1}{z+1}$$

$$= -12 \cdot 2^n \cdot u(n) + (-1)^n \cdot u(n).$$

2. //Find the inverse Z-transform

```
clc;
clear;
z = poly(0,'z');
x = ldiv((z+1),(z-1/3), 4);
disp(x,'x[n] = ');
```

$$\Rightarrow X(z) = \frac{z+1}{z-\frac{1}{3}} = \frac{z-\frac{1}{3}+\frac{4}{3}}{z-\frac{1}{3}} = \frac{z-\frac{1}{3}}{z-\frac{1}{3}} + \frac{\frac{4}{3}}{z-\frac{1}{3}}$$

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

$$x(z) = \frac{1 + \frac{4}{3}}{z - \frac{1}{3}}$$

$$x(n) = \quad + \frac{4}{3} \cdot \left(\frac{1}{3}\right)^n \cdot u(n)$$

3.
```
clear;
//Inverse z-transform using long division method.
clc;
clear;
z = poly(0,'z');
x = ldiv(z,(z-0.5),4);
disp(x,'x[n]=');
```

$$\Rightarrow x(z) = \frac{z}{z-0.5}$$

$$= \frac{z-0.5+0.5}{z-0.5} = \frac{z-0.5}{z-0.5} + \frac{0.5}{z-0.5}$$

$$x(z) = 1 + \frac{0.5}{z-0.5} \quad \Big| \quad x(n) = 1 + \frac{0.5}{z-0.5} = 1 + 0.5(0.5)^n \cdot u(n)$$

4
```
clear.
//To find input x(n)
//x(z) = 1/(2*z^(-2)+2*z^(-1)+1);
clear;
clc;
close;
z=%z;
a = (2+2*z+z^2);
b = z^2;
h = ldiv(b,a,6);
disp(h,"First six values of h(n)=")
```

$$\Rightarrow H(z) = \frac{1}{2z^{-2}+2z^{-1}+1} \times \frac{z^2}{z^2}$$

$$= \frac{z^2}{2+2z+z^2} = \frac{z^2}{z^2+2z+2}$$

For z^2+2z+2 $\quad a=1,\ b=2,\ c=2$

$$z = \frac{-2 \pm \sqrt{2^2-4(1)(2)}}{2(1)} = \frac{-2 \pm \sqrt{4-8}}{2} = \frac{-2 \pm \sqrt{-4}}{2} = \frac{-2 \pm 2i}{2}$$

$$z_1 = \frac{-2+2i}{2} \quad \text{or} \quad z_2 = \frac{-2-2i}{2}$$

$$z_1 = -1+i \qquad z_2 = -1-i$$

$$H(z) = \frac{z^2}{(z-(-1+i))(z-(-1-i))} = \frac{A}{z-(-1+i)} + \frac{B}{z-(-1-i)}$$

i) $z = -1+i$

$(-1+i)^2 = A2i$ $\qquad \therefore A = \frac{1-2i}{2i} = -i$ $\qquad \boxed{A = -i}$

ii) $z = -1-i$

$(-1-i)^2 = A(0) + B(-2i)$ $\qquad 1+2i = -2Bi$ $\qquad \therefore B = \frac{-1+2i}{2i} = i$

$$\therefore \frac{z^2}{(z-(-1+i))(z-(-1-i))} = \frac{i}{(z-(-1+i))} + \frac{i}{2-(-1-i)}$$

$$x(n) = -i\,(-1+i)^n \cdot u(n) + i\,(-1-i)^n \cdot u(n)$$

Practical 6

1. $e^{2t} \cdot \cos 3t$

let $f(t) = \cos 3t$

$$f(s) = \frac{s}{s^2+9}$$

$L[e^{2t} \cdot \cos 3t] = F(s-2)$ ... First Shifting Property.

$$\therefore L[e^{2t} \cdot \cos 3t] = \frac{s-2}{(s-2)^2+9}$$

2. $e^{-t} \cdot \sin t$

let $f(t) = \sin t$

$$F(s) = \frac{a}{s^2+1}$$

$L[e^{-t} \cdot \sin t] = F(s+1)$ ... First Shifting Property

$$\therefore L[e^{-t} \cdot \sin t] = \frac{s+1}{(s+1)^2+1}$$

3 $t \cdot \cos t$

let $f(t) = \cos t$

$$F(s) = \frac{s}{s^2+1}$$

By multiplication by t property

$$L[t f(t)] = (-1)^1 \frac{d^1}{ds^1} \cdot \frac{s}{s^2+1}$$

$$= \frac{-d}{ds}\left(\frac{s}{s^2+1}\right)$$

$$= -\left[\frac{(s^2+1) \cdot \frac{ds}{ds} - s \cdot \frac{d}{ds}(s^2+1)}{(s^2+1)^2}\right]$$

$$= \left[\frac{s^2+1-2s^2}{(s^2+1)^2}\right]$$

4 $\frac{\sin t}{t}$

Let $f(t) = \sin t$

$F(s) = \frac{1}{s^2+1}$

$L\left[\frac{\sin t}{t}\right] = \int_s^\infty \frac{1}{u^2+1}\, du$ [Division by t property]

$= \left(\tan^{-1} \frac{1}{u}\right)_s^\infty$

$= \tan^{-1} \frac{1}{\infty} - \tan^{-1} \frac{1}{s}$

$= \tan^{-1} 0 - \tan^{-1} 1/s$

$= \frac{\pi}{2} - \tan^{-1} \frac{1}{s}$

5 $t^2 \cdot e^{-2t}$

$f(t) = t^2$

$F(s) = \frac{2!}{s^3} = \frac{2}{s^3}$

$L[e^{2t} \cdot t^2] = \frac{2}{s^3} \Big|_{s = s+2}$

$= \frac{2}{(s+2)^3}$

Kishinchand Chellaram College, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

$\cos t \cdot \sin 2t$

$\cos t \cdot \sin 2t = \sin 2t \cdot \cos t = \dfrac{\sin(2t+t) + \sin(2t-t)}{2}$

$= \dfrac{\sin 3t + \sin t}{2}$

$F(s) = \dfrac{1}{2}\left[\dfrac{3}{s^2+9} + \dfrac{1}{s^2+1}\right]$

$= \dfrac{1}{2}\left[\dfrac{3}{s^2+9}\right] + \dfrac{1}{2}\left[\dfrac{1}{s^2+1}\right]$

7. $t \cdot e^{-t} \cdot \cos t$

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

Practical 7 - System Response Using Laplace Transform

1)
```
clear;
clc;
clear;
close;
s=poly(0,'s')
N=(s+1)*(s+3);
D=(s+2)*(s+4);
F=N/D;
disp(F,'Given Transfer Function:');
zero=roots(N);
pole=roots(D);
disp(zero,'Zeros of transfer function:');
disp(pole,'Poles of transfer function:');
plzr(F)
```

2)
```
Clear;
clc;
Clear;
close;
s=poly(0,'s');
L=3*s/(s+2)/(s+4)
disp(L,'Given Transform function:');
zero=roots(3*s);
pole=roots((s+2)*(s+4));
disp(zero,'Zeros of transfer function:');
disp(pole,'Poles of transfer function:');
plzr(L)
```

3)
```
clear;
clc;
clear;
close;
s=poly(0,'s')
F=10*s/(s^2+2*s+2);
disp(F,'Given Transfer Function:');
zero=roots(10*s);
pole=roots(s^2+2*s+2);
disp(zero,'Zeros of transfer function:');
disp(pole,'Poles of transfer function:');
plzr(F)
```

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

5] System Response Using Laplace Transform

1.
```
clear;
clc;
s = %s;
N = 0.1*s^2 + 0.35*s
D = s^2 + 3*s + 2;
G = syslin('c', N, D);
t = linspace(6, 8, 200);
u = ones(1, 200);
y = csim(u, t, G);
plot(t, y);
~~x(title)~~
xtitle('Respons to Initial Condition', 'tsec', 'Response');
xgrid(color('gray'));
```

2.
```
clear;
clc;
s = %s;
G = syslin('c', 1, s^2+0.2*s+1);
t = 0:0.5:50;
y = csim('impuls', t, G);
plot(t, y);
xtitle('Impulse Respons of 1/(s^2+0.2*s+1)', 'tsec', 'Respons
xgrid(color('gray'));
```

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

Practical 8

System Response using z Transform

A] // to plot the response of the system analytically and using scilab.

```
clear;
clc;
close;
n=0:1:20;
x=[1 zeros(1,20)];
b=[1 -1 3/16];
yanaly=0.5*(0.75)^n+0.5*(0.25)^n; //Analytical Solution.
ymat=filter(b,a,x);
subplot(3,1,1);
plot2d3(n,x);
xlabel('n');
ylabel('x(n)');
title('INPUT SEQUENCE (IMPULSE FUNCTION)');
subplot(3,1,2);
plot2d3(n,yanaly);
xlabel('n');
ylabel('y(n)');
title('OUTPUT SEQUENCE yanaly');
```

B] //To plot the response of system analytically and using scilab.

```
clear;
clc;
close;
n=0:1:20;
x=n;
b=[0 1 1];
a=[1 -0.7 0.12];
yanaly=38.89*(0.4)^n-26.53*(0.3)^n-12.36+4.76*n;
```

```
ymat = filter (b, a, x);
subplot (3, 1, 1);
plot2d3 (n, x);
xlabel ('n');
ylabel ('x(n)');
title('INPUT SEQUENCE (RAMP FUNCTION)');
subplot (3, 1, 2);
plot2d3(n, yanaly);
xlabel ('n');
ylabel('y(n)');
title('OUTPUT SEQUENCE yanaly');
subplot (3, 1, 3);
plot2d3(n, ymat);
xlabel ('n');
ylabel ('y(n)');
title('OUTPUT SEQUENCE ymat');
```

c] // To plot the response of system analytically and using scilab.

```
clear;
clc;
close;
n = 0:1:20;
x = ones (1, length (n));
b = [0 1];
a = [1 -1 -1];
yanaly = 0.447*(1.618)^n - 0.447*(-0.618)^n;   //Analytical Solution.
[ymat, zf] = filter (b, a, x);
subplot (3, 1, 1);
plot2d3(n, x);
xlabel ('n');
ylabel ('x(n)');
title('Input Sequence (Step Function)');
```

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

```
subplot (3,1,2);
plot2d3 (n, yanaly);
xlabel ('n');
ylabel ('y(n)');
title('Output Sequence yanaly');
Subplot (3,1,3);
plot2d3(n, ymat, zf);
xlabel('n');
ylabel('y(n)');
title('Output Sequence ymat')
```

D

```
clear;
//To find input h(n)
// x(z) = (z+0.2)/((z+0.5)(z-1))
clear;
clc;
close;
z=%z;
a=(z+0.5)*(z-1);
b=z+0.2;
h=ldiv(b,a,4)
disp(h,"h(n)=")
```

B] Plot Zero Plot using Z Transform

1.

```
//to draw the pole-zero plot
clear;
clc;
close;
z = %z;
H1Z = ((z)*(z+1) / (z^2 - z + 0.5));
plzr = (H1Z)
```

2.

```
// to draw pole-zero plot
clear;
clc;
close;
Z = %z;
H1Z = (z)/(z^2-z-1);
plzr(H1Z);
```

3

```
// to draw pole-zero plot
clear;
clc;
close;
z = %z
H1Z = ((z)*(z-1)) / ((z-0.25) * (z-0.5));
plzr(H1Z);
```

KISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester______

4)
```
clear;
clc;
close;
z=poly(0,'z');
H=(1+z)/(1+3/4*z+1/8+z^2);
pole=roots(1+z);
zero=roots(1+3/4*z+1/8+z^2);
disp(H,'System Transfer Function H(z)=');
disp(zero,'System zeros are at');
disp(pole,'System poles are at');
plzr(H);
```

⇒ $\frac{1+z}{1+0.75z+0.125z^2}$

'System Transfer function H(z)='

-4 + 0i
-2 + 0i

'System zero are at'

-1

'System poles are at'

5)
```
//Pole-Zero plots
clear;
z=%z;
az=2*z*(z+1);
bz=(z-1/3)*(((z^2)+1/4)+4*z+5);
poles=roots(bz);
zeros=roots(az);
h=az/bz*
plzr(h)
```

Practical 4 - Fourier Transform

A] Continuous Time Fourier Transform

1.
```
clear;
//x(t) = A* cos w0 * gate(t/T)
// T - 1/2 * fo
// fo = 0.5 Hz
clear;
clc;
//fourier Transform
A=1;
T=0.5;
fo = 1/(2*T);
Wo = 2* %pi * fo;
for f = 20:1:20;
    x(f+21) = A* integrate('cos(wo*t)* cos(2* %pi *f *t)',
        't', -0.25, 0.25);
end
disp(x, 'x(0) -> x(20)');
t = 0.25:0.01:0.25;
q = cos(Wo*t);
a = gca();
a.y_location = "origin"
a.x_location = "origin";
plot(t, q);
xlabel("Time in seconds");
title('Signal x(t)');
figure(1);
a = gca();
a.y_location = "origin"
a.x_location = "origin";
f = 20:1:20;
```

```
plot (f, x);
xlabel ("Frequency in Hz");
title ('Continuos Time Fourier Transform X(jw)');
```

2) clear;

```
//Fourier Transform of x(t) = exp(-a*t)* cos(wc*t)*u(t)
clear;
clc;
a=1;
wc=1;
Dt = 0.005;
t = 0:Dt:10;
xt = (exp(t*(-a+wc)) + exp (t* (-a-wc)))/2;
Wmax = 2* %pi* 1;
K=4;
k = 0:(K/1000):K;
W= k* Wmax/K;
XW= xt* exp(-sqrt (-1)*t' *W)* Dt;
XW_Mag=abs(XW);
[XW_Phase, db] = phasemag (XW);
//Plotting Continuous Time Signal
figure (1)
Plot (t, xt);
ylabel ('x(t)')
title ('continuous time signal')
figure(2)
//Plotting Magnitude Response of CTS
subplot (2,1,1);
plot (W, XW_Mag);
xlabel ('Frequency in Radians/Seconds > W');
ylabel ('abs (X(jW))')
title ('Magnitude response (CTFT)')
```

```
//Ploting phase response of CTS
subplot(2,1,2);
plot(W, XW_Phase*%pi/180);
xlabel('Frequency in radians/seconds > W');
ylabel('<W(jW)')
title('Phase Response(CTFT) in radians');
```

3) //Continuous time fourier transform of sinusoidal waveforms
//(a) sin(Wot) (b) cos(Wot)

```
clear;
clc;
close;
//CTFT
T1=2;
T2=2;
T=4*T1;
Wo=2*%pi/T;
W=[-Wo,0,Wo];
ak=[2*%pi*Wo*T1/%pi)/sqrt(-1);
XW=[-ak,0,ak];
ak1=(2*%pi*Wo*T1/%pi);
XW1=[ak1, 0, ak1];
figure
a=gca();
a.ylocation="origin";
a.x-location="origin";
plot2d3('gnn', W, imag(XW),2);
poly1=a.children(1).children(1);
poly1.thickness=3;
xlabel(' W');
title('CTFT of sin(Wot)')
figure
```

```
a=gca();
a.y-location = "origin";
a.x-location = "origin";
plot2d3('gnn', W, XW1, 2);
poly1 = a.children(1).children(1);
poly1.thickness=3;
xlabel('   W');
title('CTFT of cos(Wot)')
```

4)
```
clear; //Continuous Time Fourier of a Signal x(t) = exp(-A*t) u(t)
clc;
close;
//Analog Signal
A = -1;        //Amplitude
T= 1;
Dt = 0.005;
t=0:Dt:10;
xt = A*exp(-t/T);
// CTFT
Wmax = 2* %pi * 1;
K = 4;
k = 0:(K/1000):K;
W=k * Wmax /K;
XW=xt * exp(-sqrt(-1)*t'*W) * Dt;
XW_Mag = abs(XW);
[XW_Phase, db] =phasemag (XW);
//Plotting Continuous Time Signal
a=gca();
a.y-location="origin";
plot (t,xt);
xlabel ('t in sec.');
ylabel ('x(t)');
```

```
title ('Continuous Time Signal')
figure
//Plotting Magnitude Response of CTS
subplot(2,1,1);
a=gca();
a.y-location="origin";
plot(W,XW-Mag);
xlabel('Frequency in Radians/Seconds --> W');
ylabel('abs(x(jw))')
title('Magnitude Response((TFT)')
//Plotting Phase Response of CTS
subplot(2,1,2);
a=gca();
a.y-location="origin";
a.x-location="origin";
plot(W,XW_Phase*%pi/180);
xlabel('  Frequency in Radians/Seconds --> W');
ylabel('       <X(jw)')
title('Phase Response((TFT) in Radians')
```

5)
```
clear;
//Fourier Transform of x(1)=exp(-t)*sin(wc*t)*u(t)
clear;
clc;
wc=1;
Dt=0.005;
t=0:Dt:10;
xt=(exp(t*(-1+wc))-exp(t*(-1-wc)))/(2*%i);
Wmax=2*%pi*1;
K=4;
k=0:(K/1000):K;
```

```
W = k * Wmax / K;
XW = xt * exp(-sqrt(-1)*t'*W)*Dt;
XW_Mag = abs(XW);
[XW_Phase, db] = phasemag(XW);
figure(1)
plot(t, xt);
xlabel('t in sec.');
ylabel('x(t)');
title('Continuous time Signal')
figure(2)
subplot(2,1,1);
plot(W, XW_Mag);
xlabel('Frequency in Radians/Seconds >W');
ylabel('abs(x(jW))')
title('Magnitude Respons((TFT)')
subplot(2,1,2);
plot(W, XW_Phase*%pi/180);
xlabel('Frequency in Radians/Seconds >W');
ylabel('<X(jW)')
title('Phase Response((TFT) in Radians')
```

B] Inverse CTFT

```
//Inverse CTFT
// X(jW) = 1, from -TI to TI
clear;
clc;
close;
//CTFT
A = 1;        //Amplitude
Dw = 0.005;
W1 = 4;       //Time in seconds
w = -W1/2 : Dw : W1/2;
for i=1:length(w)
    XW(i)=A;
end
XW = XW';
~~plot (w, XW)~~;
~~xlabel('        w in radians')~~;
~~title ('Continuous Time fourier Transform x(t)')~~
t= 3* %pi : %pi/length(w): 3 * %pi;
xt = (1/(2* %pi)) * XW * exp(sqrt(-1)* w'* t)* Dw;
xt = real(xt);
figure
plot (t, xt);
figure
plot (t, xt);
xlabel('  t sec');
title('Time domain signal x(t)')
```

2. clear;

```
//Inverse Continuous Time Fourier Transform
clear;
clc;
close;
//CTFT
A=1;
Dw=0.005;
W1=4;
Wo=2           //Assume Wo=2
w=W1/2:Dw:W1/2;
for i=1:length(w)
    if w(i)==Wo then
        XW(i)=2*%pi
    else
        XW(i)=0;
    end
XW=XW';
//Inverse CTFT
t=3*%pi:%pi/length(w):3*%pi;
xt=(1/(2*%pi))*XW*exp(sqrt(-1)*w'*t)*Dw;
xt=real(1+xt);
plot(t,xt);
xlabel(' t sec');
title('Time domain signal x(t)')
```

SHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

```
clear;
//Inverse CTFT
// x(jW)=2*pi, at W=0
clear;
clc;
close;
//CTFT
A=1;
Dw=0.005;
W1=4;
w=W1/2:Dw:W1/2
for i=1:length(w)
    if w(i)==0 then
        xW(i)=2*%pi;
    else
        xW(i)=0;
    end
end
xW=xW';
subplot(2,1,1)
plot(w,xW);
//Inverse CTFT
t=3*%pi:%pi/length(w):3*%pi;
xt=(1/2*%pi))*xW*exp(sqrt(-1)*w'*t)*Dw;
xt=real(1+xt)
subplot(2,1,2)
plot(t,xt)
xlabel(' t Sec')
title('Time domain Signal x(t)')
```

C] Discrete time Fourier Transform

1.
```
//Discreate time fourier transform of discreate sequence
//x[n]=(a^n).u[n]. a>0 and a<0
clear;
clc;
close;
//DTS signal
a1=0.5;
a2=-0.5;
max_limit=10;
for n=0:max_limit-1
    x1(n+1)=(a1^n);
    x2(n+1)=(a2^2);
end
n=0:max_limit-1;
//discrete time fourier transform
Wmax = 2*%pi;
K=4;
k=0:(K/1000):K;
W=k*Wmax/K;
x1=x1';
x2=x2';
XW1=x1*exp(-sqrt(-1)*n'*W);
XW2=x2*exp(-sqrt(-1)*n'*W);
XW1_Mag = abs(XW1);
XW2_Mag = abs(XW2);
[XW1_Phase, db]= phasemag(XW1);
[XW2_Phase, db] = phasemag(XW2);
//plot for a>0
figure
Subplot(3,1,1);
```

```
plot2d3('gnn', n, x1);
xtitle('Discrete Time Sequence x[n] for a>0')
Subplot (3,1,2);
a=gca();
a.y-location = "origin";
a.x-location = "origin";
Plot2d (W, xW1-Mag);
title('Magnitude Response abs (x(jw))')
Subplot (3,1,1);
a=gca();
a.y-location = "origin";
a.x-location = "origin";
Plot2d (W, xW1-Phase);
title('Phase Response < (x(jw))')
// plot for a<0
figure
subplot (3,1,1);
plot2d3('gnn', n, x2);
xtitle('Discrete Time Sequence x[n] for a>0')
subplot (3,1,2);
a=gca();
a.y-location = "origin"
a.x-location = "origin"
plot2d(W, xW2-Phase);
title('Magnitude Response abs (x(jw))')
subplot (3,1,3);
a=gca();
a.y-location = "origin";
a.x-location = "origin";
Plot2d (W, xW2-Phase);
title('Phase Response < (x(jw))')
```

```
//discreate Time Fourier Transform of x[n]=1, abs(n)<=N1
clear;
clc;
close;
//DTS Signal
N1=2;
n=-N1:N1;
x=ones(1,length(n));
//Discrete time Fourier Transform
Wmax = 2*%pi
K=4;
k=0:(K/1000):K;
W= k* Wmax/K
XW=x* exp(-sqrt(-1)*n'*W);
XW_Mag= real(XW);
//plot for abs(a)<1
figure
Subplot(2,1,1);
a=gca();
a.y_location="origin";
a.x_location="origin";
plot2d3('gnn',n,x);
xtitle('Discrete Time Sequence x[n]')
Subplot(2,1,2);
a=gca();
a.y_location="origin";
a.x_location="origin";
plot2d3(W,XW_Mag);
title('Discrete Time Fourier Transform X(exp(jW))')
```

3) //Discreate Time Fourier Transform : $x[n] = \cos(nW_o)$

```
Clear;
clc;
close;
N= 5;
Wo = 2* %pi/N;
W = [-Wo, 0, Wo];
XW = [%pi, 0, %pi];
figure
a=gca();
a.y-location = "origin";
a.x-location="origin";
plot2d3('gnn', W, XW, 2);
poly1 = a.children(1). children(1);
poly1.thickness = 3;
xlabel(' W');
title('DTFT of cos(nWo)')
disp(Wo)
```

4) //Discreate Time Fourier Transform of discreate sequence

// $x[n] = (n)*(a^n).u[n]$

⇒ $a>0$ and $a<0$

```
clc;
close;
a1 = 0.5;
a2= 0.5;
max_limit = 10;
for n= 0: max_limit -1
    x1(n+1)= (n)* (a1^n);
    x2(n+1)= (n)*(a2^n);
end
n=0: max_limit-1;
```

SHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

```
Wmax = 2*%pi;
k=4;
k= 0:(K/1000):K;
W= k*Wmax/K;
x1= x1';
x2= x2';
xw1= x1*exp(-sqrt(-1)*n'*w);
xw2= x2*exp(-sqrt(-1)*n'*w);
xw1_Mag = abs(xw1);
xw2_Mag=abs(xw2);
[xw1_Phase, db]= phasemag(xw1);
[xw2_Phase, db]= phasemag(xw2);
figure
subplot(3,1,1);
plot2d3('gnn', n, x1);
xtitle('Discrete Time Sequence x[n] for a>0')
subplot(3,1,2);
a=gca();
a.y_location= "origin";
a.x_location= "origin";
plot2d(W, xw1_Mag);
title('Magnitude Response abs(x(jw))')
subplot(3,1,3);
a=gca();
a.y_location="origin";
a.x_location= "origin";
plot2d(W, xw1_Phase);
title('Phase Response <(x(jw))')
figure
subplot(3,1,1);
plot2d3('gnn', n, x2);
xtitle('Discrete Time Sequence x[n] for a>0')
```

subplot (3,1,2)

ISHINCHAND CHELLARAM COLLEGE, Mumbai - 20.

FY / SY / TY B. Sc. (I. T.) Semester

D] Inverse DTFT.

```
clear; clc;
wc=1;
y=1;
for n=-%pi:%pi/80:%pi
    if n<-wc | n>wc then
        x(1,y)=1;
        y=y+1;
    else x(1,y)=0;
        y=y+1;
    end
end
n=-%pi:%pi/80:%pi;
a=gca();
a.y-location="origin";
a.x-location="origin";
plot(n,x);
xlabel('frequency in Radians/Seconds');
title('x(e^jw)) at w=1');
A=1/%pi;
for k=10:10
    x(K+11)=A*integrate('cos(w*k)','w',wc,%pi);
end
figure(1);
k=10:10;
a=gca();
a.y-location="origin";
a.x-location="origin";
plot2d3(K,x);
xlabel('Time in Seconds');
title('x(n) at wc=1');
```

2 clear ; clear;

```
clc;
wc = 1;
y= 1;
for n= - %pi: %pi/80: %pi
    if n<-wc  | n>wc  then
            x(1,y) = 1;
            y = y+1;
    end x(1,y) = 0;
            y= y+1;
    end
end
n = - %pi : %pi/80 : %pi
a=gca();
 a.y_location = "origin";
 a.x_location= "origin";
plot(n, x);
xlabel ('Frequency  in Radians /Seconds');
title ('x (e^gw))  at  wc=1');
 A = 1/%pi;
for  K=10:10.
        x (K+11 = A* integrate ('cos(w*K)', 'w', wc,%pi);
end
figure(1);
k = -10:10;
a=gca();
a.y_location  = "origin";
a.x_location= 'origin";
plot2d3(k, x);
xlabel ('Time   in  Seconds');
title('x(n)  at  wc=1');
```