%Name: Devashish Dewalkar

%Roll. no: 32117

clc;

clear all;

close all;

%Design 2nd order digital filter

b=1;

a = [1 sqrt(2) 1];

disp('Hs= ');

tf(b,a)

T=1;

%Impulse invariance

[bz,az] = impinvar(b,a,T);

disp('Impulse invariance H(z)= ');

tf(bz,az,T)

[Ha,Wa] = freqs(b,a,512);

[Hz,Wz] = freqz(bz,az,512);

subplot(4,2,1);

plot(Wa/(2\*pi),20\*log(abs(Ha)));

hold all;

xlabel('w');

ylabel('gain in db');

title('Impulse Invariance');

plot(Wz/(2\*pi),20\*log(abs(Hz)));

legend('analog', 'digital', 'southeast');

subplot(4,2,2);

zz = roots(bz);

pp = roots(az);

zplane(zz,pp);

%Bilinear Tx

[bz,az] = bilinear(b,a,T); %Hz

disp('Hz= ');

tf(bz,az,T)

[Ha,Wa] = freqs(b,a,512);

[Hz,Wz] = freqz(bz,az,512);

subplot(4,2,3);

plot((Wa/(2\*pi)),(20\*log(abs(Ha))));

hold all;

xlabel('w');

ylabel('gain in db');

title('Bilinear Invariance');

plot((Wz/(2\*pi)),(20\*log(abs(Hz))));

legend('analog', 'digital', 'southeast');

subplot(4,2,4);

zz = roots(bz);

pp = roots(az);

zplane(zz,pp);

%Design 2nd order digital filter

[b,a]= butter(2, 0.5);

disp('Hs= ');

tf(b,a)

T=1;

%Impulse invariance

[bz,az] = impinvar(b,a,T);

disp('Impulse invariance H(z)= ');

tf(bz,az,T)

[Ha,Wa] = freqs(b,a,512);

[Hz,Wz] = freqz(bz,az,512);

subplot(4,2,5);

plot(Wa/(2\*pi),20\*log(abs(Ha)));

hold all;

xlabel('w');

ylabel('gain in db');

title('Impulse Invariance');

plot(Wz/(2\*pi),20\*log(abs(Hz)));

legend('analog', 'digital', 'southeast');

subplot(4,2,6);

zz = roots(bz);

pp = roots(az);

zplane(zz,pp);

%Bilinear Tx

[bz,az] = bilinear(b,a,T); %Hz

disp('Hz= ');

tf(bz,az,T)

[Ha,Wa] = freqs(b,a,512);

[Hz,Wz] = freqz(bz,az,512);

subplot(4,2,7);

plot((Wa/(2\*pi)),(20\*log(abs(Ha))));

hold all;

xlabel('w');

ylabel('gain in db');

title('Bilinear Invariance');

plot((Wz/(2\*pi)),(20\*log(abs(Hz))));

legend('analog', 'digital', 'southeast');

subplot(4,2,8);

zz = roots(bz);

pp = roots(az);

zplane(zz,pp);