**Code:**

%% 12.1 Step response of Underdamped,Critically damped and Over damped of Second order system

clc;clear

wn = 5

% Underdamped System

g = 0.5;

num = [wn\*wn];

den = [1 2\*g\*wn wn\*wn];

sys = tf(num,den)

figure(1)

step(sys);

% Critically damped System

g = 1;

num = [wn\*wn];

den = [1 2\*g\*wn wn\*wn];

sys = tf(num,den)

figure(2)

step(sys);

% Over damped System

g = 1.5;

num = [wn\*wn];

den = [1 2\*g\*wn wn\*wn];

sys = tf(num,den)

figure(3)

step(sys);

%% 12.2 Effect of addition of poles and zeroes'

% Adding poles

s = tf('s')

G = 25/(s\*(s+3))

F = feedback(G,1)

Fp1 = F/(s+1)

Fp10 = F/(s+10)

Fp100 = F/(s+100)

figure(4)

step(Fp1),grid

hold on

step(Fp10),grid

hold on

step(Fp100),grid

% Adding zeroes

s = tf('s')

G = 25/(s\*(s+3))

F = feedback(G,1)

Fz1 = F\*(s+1)

Fz10 = F\*(s+10)

Fz100 = F\*(s+100)

figure(5)

step(Fz1),grid

hold on

step(Fz10),grid

hold on

step(Fz100),grid

%% 12.3 Evaluation of effect of pole location on stability

s = tf('s')

G = 25/(s\*(s+3))

Fc = feedback(G,1)

Fc1pl4 = Fc/(s+4)

Fc2pl2 = Fc/(s+2)

figure(6)

step(Fc),grid

hold on

step(Fc1pl4),grid

hold on

step(Fc2pl2),grid

figure(7)

pzplot(Fc),grid

hold on

pzplot(Fc1pl4),grid

hold on

pzplot(Fc2pl2),grid

figure(8)

bode(Fc),grid

hold on

bode(Fc1pl4),grid

hold on

bode(Fc2pl2),grid

%% 12.4 Effect of loop gain of a negative feedback system on stability

z=[]

p=[-0.5+i -0.5-i -1];

k1=1;

k2=2;

k3=3;

sys1=zpk(z,p,k1)

sys2=zpk(z,p,k2)

sys3=zpk(z,p,k3)

t=[0:0.01:20];

[y1,t]=step(sys1,t)

[y2,t]=step(sys2,t)

[y3,t]=step(sys3,t)

plot(t,y1,t,y2,t,y3)

legend('k=1', 'k=2', 'k=3')

grid