```
clc
close all
clear all

%DC Motor Position: PID Controller Design
J = 3.2284E-6;
b = 3.5077E-6;
K = 0.0274;
R = 4;
L = 2.75E-6;
s = tf('s');
P_motor = K/(s*((J*s+b)*(L*s+R)+K^2));J = 3.2284E-6
b = 3.5077E-6;
K = 0.0274;
R = 4;
L = 2.75E-6;
s = tf('s');
P_motor = K/(s*((J*s+b)*(L*s+R)+K^2));

%Proportional control
Kp = 1;
for i = 1:3
    C(:,:,i) = pid(Kp);
    Kp = Kp + 10;
end
sys_cl = feedback(C*P_motor,1);
t = 0:0.001:0.2;
figure(1)
step(sys_cl(:,:,1), sys_cl(:,:,2), sys_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Response to a Step Reference with Different Values of K_p')

legend('Kp = 1',  'Kp = 11',  'Kp = 21')
dist_cl = feedback(P_motor,C);
figure(2)
step(dist_cl(:,:,1), dist_cl(:,:,2), dist_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Response to a Step Disturbance with Different Values of K_p')
legend('Kp = 1', 'Kp = 11','Kp = 21')

%PI control
Kp = 21;
Ki = 100;
for i = 1:5
    C(:,:,i) = pid(Kp,Ki);
    Ki = Ki + 200;
end

sys_cl = feedback(C*P_motor,1);
t = 0:0.001:0.4;
figure(3)
step(sys_cl(:,:,1), sys_cl(:,:,2), sys_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Response to a Step Reference with K_p = 21 and Different Values of K_i')
legend('Ki = 100', 'Ki = 300', 'Ki = 500')

dist_cl = feedback(P_motor,C);
figure(4)
step(dist_cl(:,:,1), dist_cl(:,:,2), dist_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Response to a Step Disturbance with K_p = 21 and Different Values of K_i')
legend('Ki = 100',  'Ki = 300',  'Ki = 500')

%PID control
Kp = 21;
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```
Ki = 500;
Kd = 0.05;

for i = 1:3
    C(:,:,i) = pid(Kp,Ki,Kd);
    Kd = Kd + 0.1;
end

sys_cl = feedback(C*P_motor,1);
t = 0:0.001:0.1;
figure(5)
step(sys_cl(:,:,1), sys_cl(:,:,2), sys_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Step Response with K_p = 21, K_i = 500 and Different Values of K_d')
legend('Kd = 0.05', 'Kd = 0.15',' Kd = 0.25')

dist_cl = feedback(P_motor,C);
t = 0:0.001:0.2;
figure(6)
step(dist_cl(:,:,1), dist_cl(:,:,2), dist_cl(:,:,3), t)
ylabel('Position, \theta (radians)')
title('Step Response with K_p = 21, K_i = 500 and Different values of K_d')
legend('Kd = 0.05', 'Kd = 0.15', 'Kd = 0.25')
stepinfo(sys_cl(:,:,2))
```