**PID Controller:**

pidtune(G,'PID') % for getting the values of Kp, Ki and Kd

clear all;  
s = tf('s');  
G = (-153)/(s^3+27\*s^2-1962\*s-52320); % transfer function  
t = 0:0.002:20;  
[u,t] = gensig("sin",5,20); % generates signal  
[y,t] = gensig("square",5,20);  
Kp = -24.3;  
Ki = -5.97;  
Kd = -24.8;  
H = 1;  
Dc = Kp+Kd\*s+Ki/s;  
T = feedback(600\*G\*Dc,1);  
figure(1);  
step(T);  
grid on  
figure(2)  
pzmap(T);  
a = findobj(gca,'type','line'); % findobj locates graphics objects with specific properties  
for i = 1:length(a)  
 set(a(i),'markersize',12)  
 set(a(i), 'linewidth',2)  
end  
  
figure(3)  
lsim(T,u,t);  
set(findall(gcf,'type','line'),'linewidth',2); % findall returns the objects that have the specified  
 % properties and sets them to the specified values  
title("Sine Wave Tracking")  
ylabel("Amplitude")  
grid on  
figure(4)  
lsim(T,y,t);  
set(findall(gcf,'type','line'),'linewidth',2);  
title("Square Wave Tracking")  
ylabel("Amplitude")  
grid on  
figure(5)  
rlocus(G\*Dc)  
title('Root Locus GDc(s)')  
set(findall(gcf,'type','line'),'linewidth',2);

Chart, histogram

Description automatically generated

Chart, box and whisker chart

Description automatically generated

Chart, line chart

Description automatically generated

Chart, box and whisker chart

Description automatically generated

Chart

Description automatically generated

**PI Controller:**

pidtune(G,'PI') % for getting the values of Kp and Ki

clear all;  
s = tf('s');  
G = (-153)/(s^3+27\*s^2-1962\*s-52320); % transfer function  
t = 0:0.002:20;  
[u,t] = gensig("sin",5,20); % generates signal  
[y,t] = gensig("square",5,20);  
Kp = -696;  
Ki = -341;  
H = 1;  
Dc = Kp+Ki/s;  
T = feedback(2\*G\*Dc,1);  
figure(1);  
pzmap(T);  
a = findobj(gca,'type','line'); % findobj locates graphics objects with specific properties  
for i = 1:length(a)  
 set(a(i),'markersize',12)  
 set(a(i), 'linewidth',2)  
end  
figure(2)  
step(T);  
grid on  
figure(3)  
lsim(T,u,t);  
set(findall(gcf,'type','line'),'linewidth',2); % findall returns the objects that have the specified  
 % properties and sets them to the specified values  
title("Sine Wave Tracking")  
ylabel("Amplitude")  
grid on  
figure(4)  
lsim(T,y,t);  
set(findall(gcf,'type','line'),'linewidth',2);  
title("Square Wave Tracking")  
ylabel("Amplitude")  
grid on  
figure(5)  
rlocus(G\*Dc)  
title('Root Locus GDc(s)')  
set(findall(gcf,'type','line'),'linewidth',2);

Chart

Description automatically generated

A picture containing chart

Description automatically generated

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated

Chart, line chart

Description automatically generated

**Simulink:**

Diagram

Description automatically generated

Graphical user interface, text, application, email

Description automatically generated

Graphical user interface

Description automatically generated with medium confidence

Graphical user interface

Description automatically generated

**Analysis:**

This system is an open loop unstable system. Different controllers were tried to see which one works best. It was observed that a PI controller would not work in this case as it was unstable for all values of K. After that a PID controller was designed, which satisfied the system. The system perfectly tracked the sine and square waves. The values of Kp, Ki and Kd were obtained using the command ‘pidtune’. It was also observed that for a high value of K, the controller tracked reference much better as increasing K reduces the error.