Q4

H2 Controller

```
s = tf("s");
G = (s+1)/(s^2+0.2*s+5);
WI = (10*s+10)/(s+1000);
Wu = 0.01;
Wp = makeweight(100,100,1/2);
systemnames = 'G Wu Wp WI'; %Block name only
inputvar = '[du;r;u]';
outputvar = '[WI;Wp;Wu;r-G-du]'; %Strangely, the system outputs are just the name
input_to_G = '[u]';
input_to_Wp = '[r-G-du]';
input_to_Wu = '[u]';
input_to_WI = '[G]';
cleanupsysic = 'yes';  %This drops all the useless variables from workspace
P = sysic;
[K2,CL,GAM] = h2syn(P,1,1);
```

```
Warning: GAM=Inf because the closed-loop system has a nonzero feedthrough from w to z.
Returning the optimal H2 controller K when ignoring this feedthrough.
```

```
delta = ultidyn('delta',[1,1]);
G_hat = G*(1+WI*delta);

systemnames = 'G_hat Wu Wp';
inputvar = '[r;u]';
outputvar = '[Wp;Wu;r-G_hat]';
input_to_G_hat = '[u]';
input_to_Wp = '[r-G_hat]';
input_to_Wn = '[u]';
cleanupsysic = 'yes';
P_hat = sysic;

N_hat = lft(P_hat,K2);
[STABMARG2,WCU] = robuststab(N_hat);
mu_2 = 1/STABMARG2.LowerBound
```

```
mu_2 = 0.5167
```

mu<1, has robust stability

```
perfmarg_2 = robustperf(N_hat);
mu_2 = 1/perfmarg_2.LowerBound
```

```
mu_2 = 2.1484
```

mu>1, no robust performance

H∞ Controller

```
[Kinf,CL,GAM] = hinfsyn(P,1,1);
N_hat = lft(P_hat,Kinf);
[STABMARGinf,WCU] = robuststab(N_hat);
mu_inf = 1/STABMARGinf.LowerBound
```

```
mu_inf = 0.6972
```

mu<1, has robust stability.

```
perfmarg_inf = robustperf(N_hat);
mu_inf = 1/perfmarg_inf.LowerBound
```

```
mu_inf = 1.6117
```

mu>1, no robust performance.

```
S2 = inv(1+G_hat*K2);
Sinf = inv(1+G_hat*Kinf);
bodemag(S2,Sinf)
legend("S2","Sinf")
```