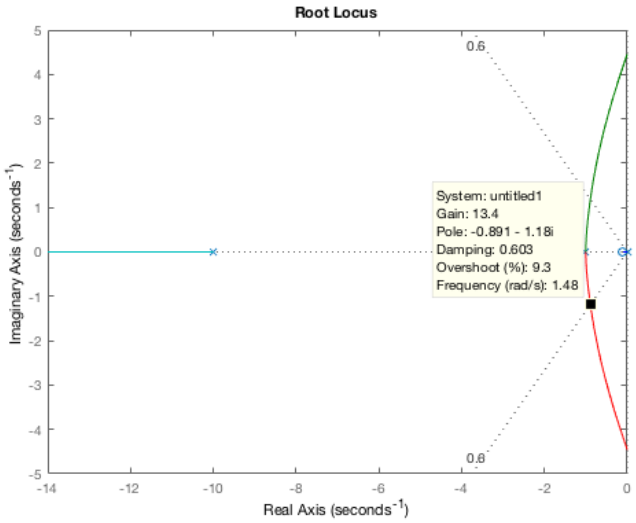
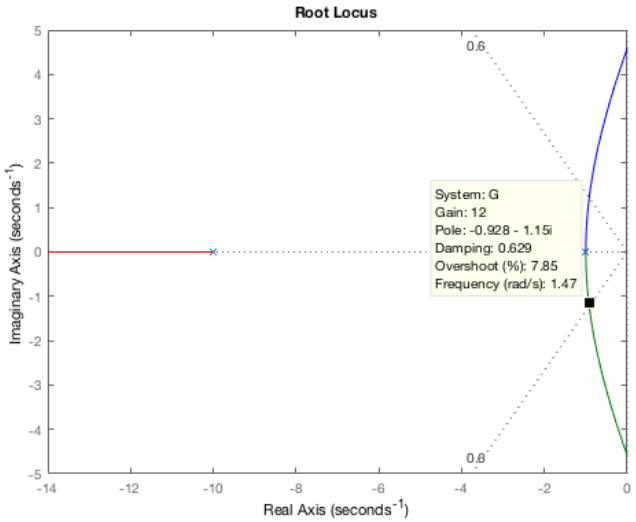
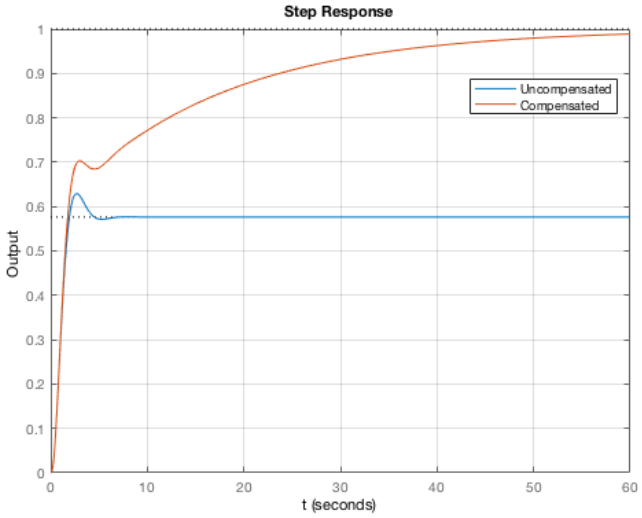
Problem 1



Root locus plot of uncompensated system generates dominant poles at $s_{1,2}$= -0.891± j1.18 with a gain of 13.4



Root locus plot of compensated system. Adding a zero at -0.1 creates pole zero cancellation that moves the dominant pole pair to -0.928 ± j1.15 with a corresponding gain of 12. Since the higher order pole stays at s=-10, the approximation is valid.



The step response for the compensated and uncompensated systems with the PI controller at a zero steady state error. PI controller for step response is $G(s) = \frac{K(s+0.1)}{s(s+1)^2(s+10)}$

```
G = zpk([], [-1 -1 -10],1);
rlocus(G);
sgrid(0.6, 0);
axis([-14 0 -5 5])

Gc = zpk([-0.1],[0],1);
rlocus(Gc*G);
sgrid(0.6,0);
axis([-14 0 -5 5])

syms t
t = 0:0.0001:60;
G2 = zpk([],[-1 -1 -10],13.6);
G2c = zpk([-0.1], [0 -1 -1 -10],13.4);
step(feedback(G2,1),t);
hold on
step(feedback(G2c,1),t);
grid
xlabel t
ylabel Output
legend('Uncompensated','Compensated')
```