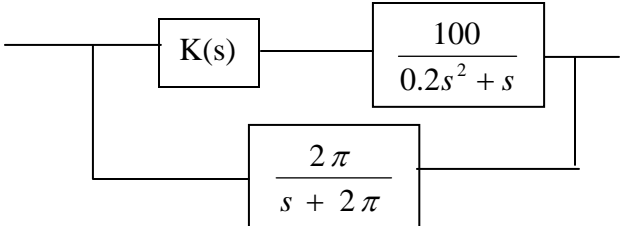


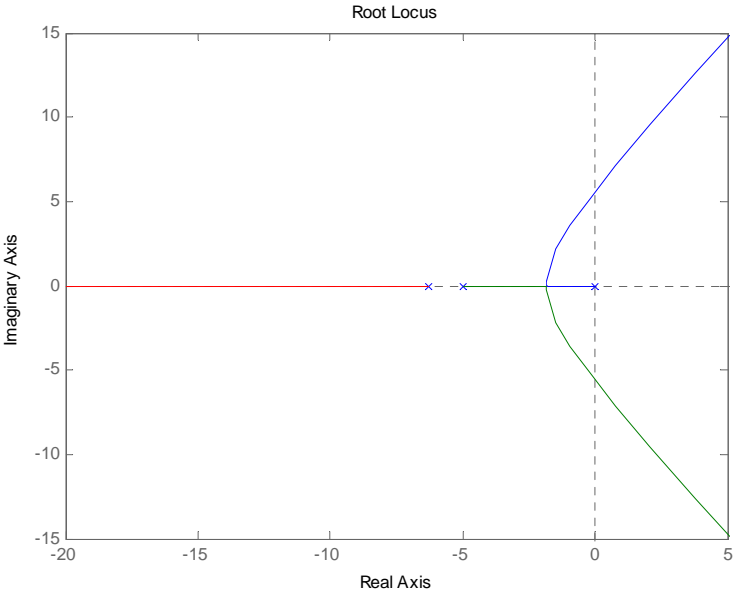
MECH 3140 Homework #10

1.

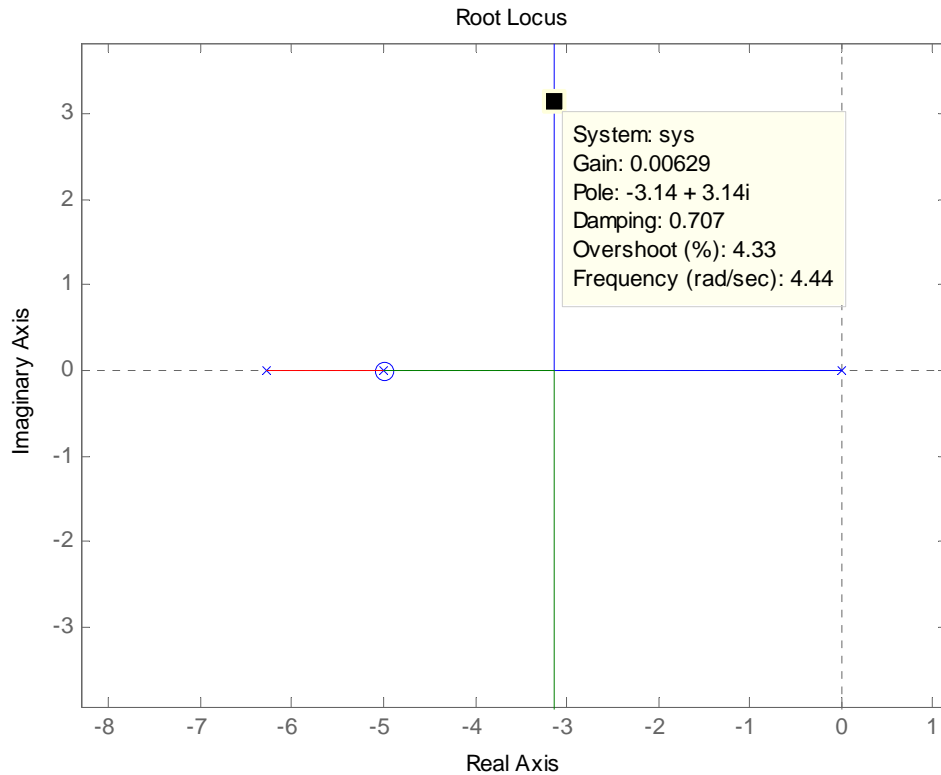


$\zeta\omega_n \geq 4.6 \text{ rad/s}$
 $\zeta \geq 0.7$

Root locus with P control (note you can not achieve goal)



This PD Control comes close. Settle time is 0.87 seconds.



2. Assume we are trying to control the position of a motor using a current input. Sketch the Root Locus and give the control TF and control law for the following controllers. State if the controller will work.
 - a. P - no
 - b. PD (to achieve a Bandwidth of 5 Hz with a damping ratio of 0.707) - yes
 - c. PID - yes
 - d. Lead - yes
 - e. Lead + Lag (Pick a Lag with a Bandwidth of 1 Hz) - yes
 - f. Pure integral control – no

3. Develop a Current Controller for the motor used in HW#3 ($L=0.02$ mH, $R=0.117$ Ohm). Treat the motor back EMF as a disturbance. Develop a PI controller such that the maximum overshoot is less than 5%. Use Root Locus.
 - a. Why use a PI controller?
 - b. What is the maximum achievable bandwidth?
 - c. Is this bandwidth acceptable for current controlling a motor? Why?
 - d. If needed how could you get a higher Bandwidth?
 - e. What are the Controller Gains?

4. Develop a Speed Controller for the motor used in HW#3 (neglect the motor inductance and any gearing).