Due W 10/08

1. Show the region where a dominant pole-pair should be placed to meet the step response criteria $t_r \leq \frac{1}{3}$sec, $t_s \leq 1$sec, and $P.O. \leq 15\%$.

2. Use root-locus to design a PID controller (you can use simpler versions such as P, PI, PD) for the pendulum that will meet the criteria provided above at the two equilibria $((0,0,0), (\frac{\pi}{2}, 0, mgl))$. Assume we want the steady-state error small (say less than 1%) and that our motor can provide a peak input torque of 1Nm. Test your controller (through simulation) on the nonlinear system remembering that the linearization process changes the variables to $\Delta u = u - u_o$ and $\Delta y = y - y_o$, so you'll have to include the operating point in your controller. Try a reference signal of $\Delta r = r - r_o = 0.2$rad. Does your controller meet all the specifications?

3. Use root-locus to design a PID controller (you can use simpler versions such as P, PI, PD) for the magnetic-ball-suspension system that will meet the criteria provided above at the equilibria $(0.5m, 0m/s, -2.215A, 2.215V)$. Assume we want the steady-state error small (say less than 1%) and that our voltage supply can provide a peak input voltage of 24V. Test your controller (through simulation) on the nonlinear system remembering that the linearization process changes the variables to $\Delta u = u - u_o$ and $\Delta y = y - y_o$, so you'll have to include the operating point in your controller. Try a reference signal of $\Delta r = r - r_o = -0.02$m. Does your controller meet all the specifications?