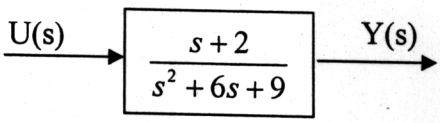
ME134, Midterm Exam, Fall 05

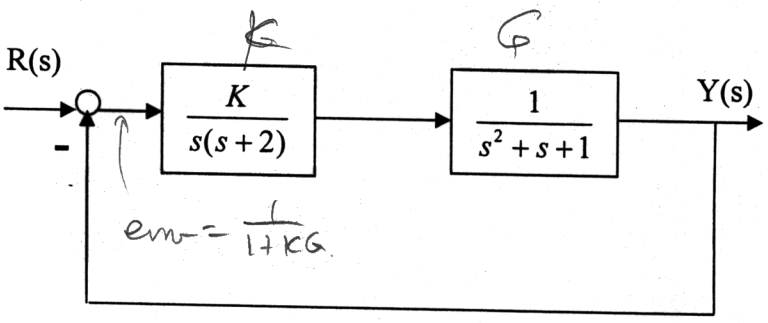
Problem 1.

Given the system shown on the right,
A) Write a differential equation relating input to the output;
B) Calculate and plot the output $y(t)$ if input $u(t) = e^{-2t}$ and initial conditions are $y(0) = 0$, $\dot{y}(0) = -1$.



Problem 2.

In this closed loop system shown on the right, find a K such that y follows r within 2% as when $t \to \infty$ and input is $r(t) = t$

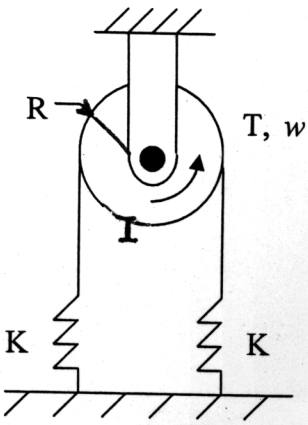


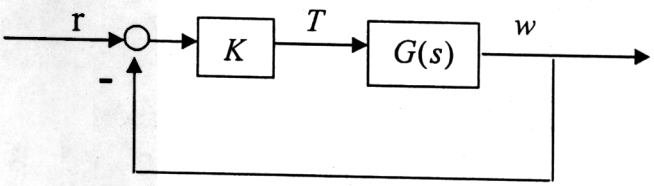
Problem 3.

A. For this pulley and spring system, find the transfer function, G(s), from input torque T to angular speed w. I is the pulley's moment of inertia, R is radius of the pulley.

B. Assuming a constant proportional controller, plot the closed loop root locus.

C. Find the range of K such that the system output, w, will have no complex conjugate poles.





Problem 4.

A. Draw approximately the bode plot of the loop gain of the system shown here.

B. Suppose $r = \cos(wt)$, where $w = 10^4$ rad /sec. What is the approximate steady state value for $y(t)$?