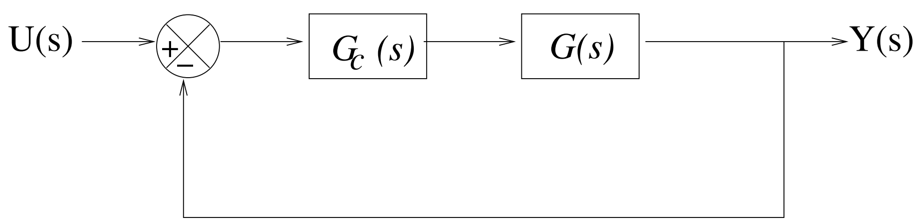
ECE-382: Homework 12

Due April 16, 2007

1. Problems B-8-4, B-8-5 and B-8-7 in textbook.

2. Problems B-8-8, and B-8-14 in textbook. (You are required to sketch the Nyquist plot by hand, but you can use Matlab to check your solutions. **Hint:** you can check the magnitude and phase at $\omega \to 0$, $\omega \to \infty$ and some other key values, e.g., at corner-frequencies.)

3. (This is a past exam question) Consider the following system.



Assume that

$$G(s) = \frac{1}{s(s+2)(s+4)}.$$

(a) Suppose $G_c(s) = K$ with $K > 0$. Determine whether or not it is possible to choose a proper K such that the dominant poles of the closed-loop transfer function $Y(s)/U(s)$ are $p_d = -1 \pm \sqrt{3}j$. Justify your answer.

(b) Find the angle of deficiency so that the dominant poles of the closed-loop transfer function $Y(s)/U(s)$ are $p_d = -1 \pm \sqrt{3}j$.

(c) Design a lead compensator of the form

$$G_c(s) = K\frac{s+2}{s+\alpha},$$

for some constant α so that the closed-loop transfer function of the compensated system can have dominant poles at $p_d = -1 \pm \sqrt{3}j$.

(d) Using the lead compensator obtained above, what is the steady-state error of the closed-loop system when tracking a unit ramp input?

(e) Design a lag-lead compensator $G_c(s)$ so that the closed-loop system has dominant poles at approximately $p_d = -1 \pm \sqrt{3}j$, and that the steady-state error of the closed-loop system when tracking a unit ramp input is 0.01.

(f) Write down the overall open-loop transfer function $G_c(s)G(s)$ of the compensated system using the lag-lead compensator in part (e).