HW#3

Due: February 10th, 2017

CBE470: Process Dynamics and Control - Spring 2017

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`http://zavalab.engr.wisc.edu/teaching/cbe470spring2017`

Problem 1: Textbook Problem 6.9 (a) and (b)

Problem 2: The Curious Case of the Bode Diagram

By default, Matlab's function `bode` returns a Bode diagram with an amplitude ratio AR reported in decibels (dB) and in logarithmic scale. In class, however, we define AR in absolute units that are consistent with those of the gain K. For a first-order system we have seen that:

$$AR = \frac{K}{\sqrt{(\omega\tau)^2 + 1}} \tag{1}$$

where K is the steady-state gain and τ is the time constant of the system:

$$g(s) = \frac{K}{\tau s + 1} \tag{2}$$

Address the following:

1. How can we convert the y-axis values reported by the default Matlab's Bode plot to AR as defined in class? Provide the conversion formula.
2. How can we get Maltab to construct the Bode plot with y-axis values that equal those of AR? For the first-order transfer function (2) with $K = 1, \tau = 1$, provide a Bode plot reported in default dB units and Bode plot reported in AR units.
3. Compute AR using (1) for $\omega = 10^0$ (rad/s), $K = 1$ and $\tau = 1$ and transform this value of AR using your formula of question 1. Locate the ω, AR pairs in the corresponding Matlab Bode plots.

Hint: The commands `doc bode`, `doc bodeplot`, and `doc bodeoptions` are quite useful.