ChE381 Process Dynamics & Control **Jan-Apr 2013**

Quiz 2 Paper **A** **30 minutes; 20 points**

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1. The crossover frequency associated with a feedback loop employing a proportional controller to control the process described by the transfer function

$$G(s) = \frac{2\exp[-s]}{(\tau s+1)^2}$$

is found to be 0.6 rad/min (units of time is in minutes in the above equation). Assume the valve and measurement transfer functions are unity.

Determine (a) the value of the time constant τ in minutes, and (b) if the feedback loop is to operate at a gain margin of 2, determine the value of the gain of the proportional controller.

2. The open-loop transfer function of a system is given by

$$G(s) = \frac{10\exp[-3s]}{4s+1}$$

Determine whether the closed-loop system is stable or not.

3. Determine the number of roots of the characteristic equation below that lie on the right-half plane.

$$s^2 + 4s^3 + s^2 + 6s + 1$$

4. What does the Bode stability criterion tell us about the stability of systems with first order and second order open loop responses. Justify your answer.

5. Consider a process which has pure integrating action. This process is to be controlled using feedback with proportional control. What is the closed-loop transfer function, and what is the closed-loop gain. What is the offset in the closed-loop system ?