

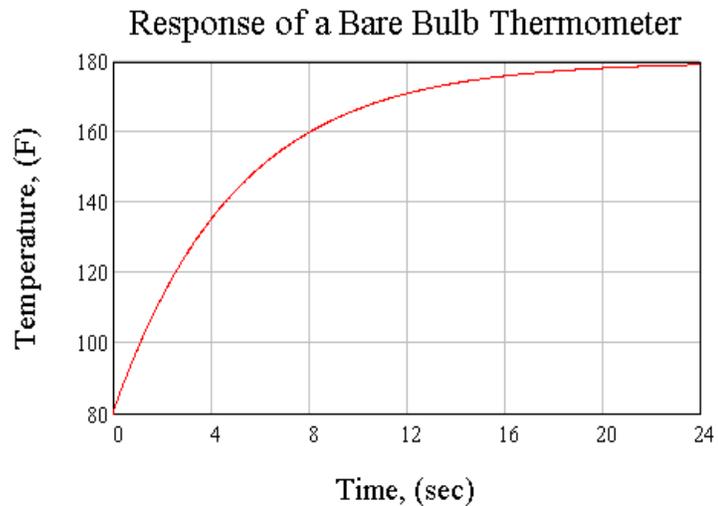
HVA 240
Principles of Process Control
Assignment 3
September 8, 2006

Solve the following problems on a separate sheet of paper. In the case of problems requiring computation, show the steps in your work to obtain your answer. Remember to reference the source of your data.

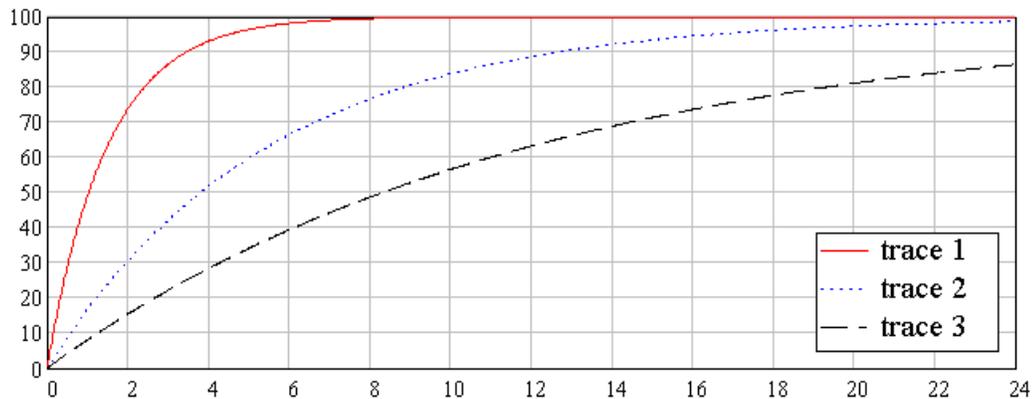
1. Estimate whether or not the dynamic characteristics of each of the individual following items of hardware would be significant when taken with respect to the total dynamics of a feedback control loop:

- The input elements in a controller
- An electronic transmission system
- A 2,000 foot pneumatic transmission system
- A large pneumatically operated control valve
- A pneumatic controller
- An electronic controller
- A bare thermocouple
- A thermocouple immersed in a heavy, oil-filled thermowell
- An orifice meter

2. Assume the graph shown represents the response of the thermocouple. How would the process response curve be different if the thermometer bulb were not bare but instead encased in a protective thermowell? Sketch the graph shown to the right, then sketch a possible response curve for the thermowell encased sensor to show a comparison.

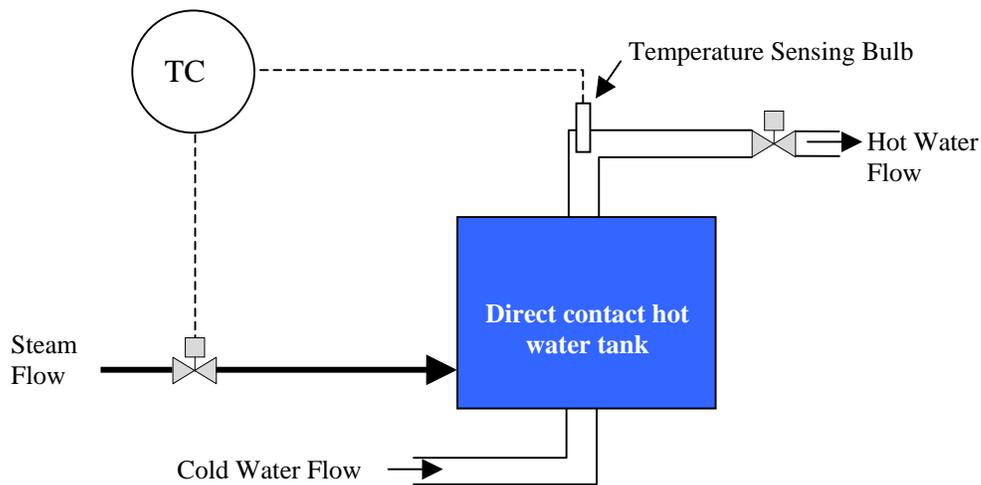


3.



Determine the time constant for each of the three traces shown in the above graph. Assume the time scale along the bottom is in minutes.

4. What happens in a feedback control loop as you increase the controller gain? Assume all other parameters are held constant.
5. What happens in a feedback control loop as you introduce more and more dead time? Assume all other parameters are held constant.
- 6.



Water flows through the hot water tank shown at a volume rate of $6 \text{ ft}^3/\text{min}$. The tank has a total volume of 28 ft^3 . Assume the temperature sensing bulb in the system shown above is installed 16 ft down the exit pipe and the flow velocity in the pipe is 21 fpm. Determine the dead time due to sensor location and the time constant of the tank.