University of Massachusetts Lowell
EECE 4130 Problem Set #5

1. The open-loop transfer functions for three unity negative-feedback control systems are given. Determine and compare the unit step, impulse and ramp responses. Which of these systems is best with respect to the speed of response and maximum overshoot in the step response.

a. $G(s) = \dfrac{5}{s(5s+1)}$

b. $G(s) = \dfrac{5(1+0.8s)}{s(5s+1)}$

c. $G(s) = \dfrac{1}{s(s+1)}$

2. Determine the solution of the ODE

$$\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 3y = 0$$

given that $y(0) = 2$ and $dy(0)/dt = -1$.

3. A thermometer requires 1 min to indicate 98% of the response to a step input. Assuming the thermometer behaves like a first-order system

a. Find the time constant.

b. If the thermometer is placed in a water bath which changes linearly at a rate of 10^o/min, how much error does the thermometer show.

4. Obtain the unit-step response of the unity feedback system whose open loop transfer function is

$$G(s) = \frac{4}{s(s+5)}$$

5. Given

$$\frac{C}{R} = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2}$$

where the input $c(t) = u(t)$. Determine ζ and ω_n such that $M_p = 0.05$ and $t_s = 2sec$ (2%).