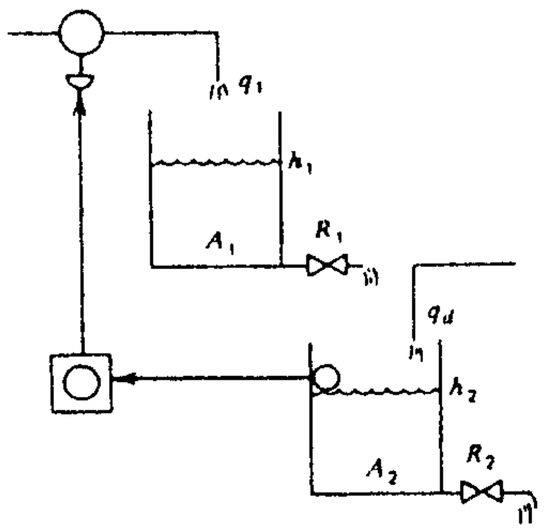
國立臺灣科技大學

八十九學年度碩士班招生考試試題

系所組別： 纖維及高分子工程系丙組

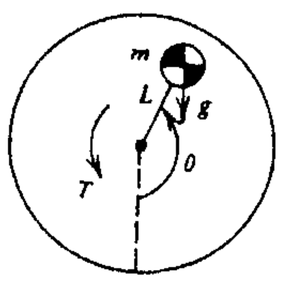
科　目： 控制系統

1. The control variable for the tank system shown is q_1, the flow rate into tank 1. It is desired to control the height h_2 with a measurement of h_2.
Develop a control law that will give a zero steady-state error for a step command h_{2d} and a zero steady-state deviation for a step disturbance q_d. (20%)



2. The problem is to design a controller to position an unbalanced load of mass m. We can represent the unbalance as a pendulum with a point mass m located at the center of mass, a distance L from the center of rotation. The control variable is the torque T to be supplied by a motor whose dynamics we will ignore for now. We will also assume for now that the motor can produce as much torque as needed. Take mg=1 lb, g=32.2 ft/sec^2, and L=0.25ft.

We desire to position the mass m at $\theta=\pi$ rad. Obtain the governing dynamic equations and linearize them. Use the linearized model to design a controller that will position m at $\theta=\pi$ rad exactly at steady state. The transient specifications call for a damping ratio $\zeta \geq 0.707$ and a 2% settling time of no greater than 2 sec. (20%)



國立臺灣科技大學
八十九學年度碩士班招生考試試題

系所組別： 纖維及高分子工程系丙組
科　目： 控制系統

3. A controlled system is represented by the following equations:

$$\frac{dx_1(t)}{dt} = -x_1(t) + 5x_2(t)$$

$$\frac{dx_2(t)}{dt} = -(6 + k_1)x_1(t) - k_2 x_2(t) + r(t)$$

$$y(t) = x_1(t)$$

where k_1 and k_2 are real constants and r(t) is the reference input. (18%)

(a) Find the transfer function Y(s)/R(s).

(b) Find the relationship between k_1 and k_2 such that the system has a damping ratio of 0.707.

(c) Find the values of k_1 and k_2 such that the damping ratio $\zeta = 0.707$ and natural undamped frequency $\omega_n = 10$ rad/sec.

4. A system is represented by $\frac{dx}{dt} = Ax$, where x is the state vector and

$$A = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ -1 & -k & -2 \end{bmatrix}$$

Find the range of k where the system is stable. (12%)

5. Design PD controller for the system shown as follow figure to reduce the settling time by a factor of 4 while continuing to operate the system with 20% overshoot. (30%)