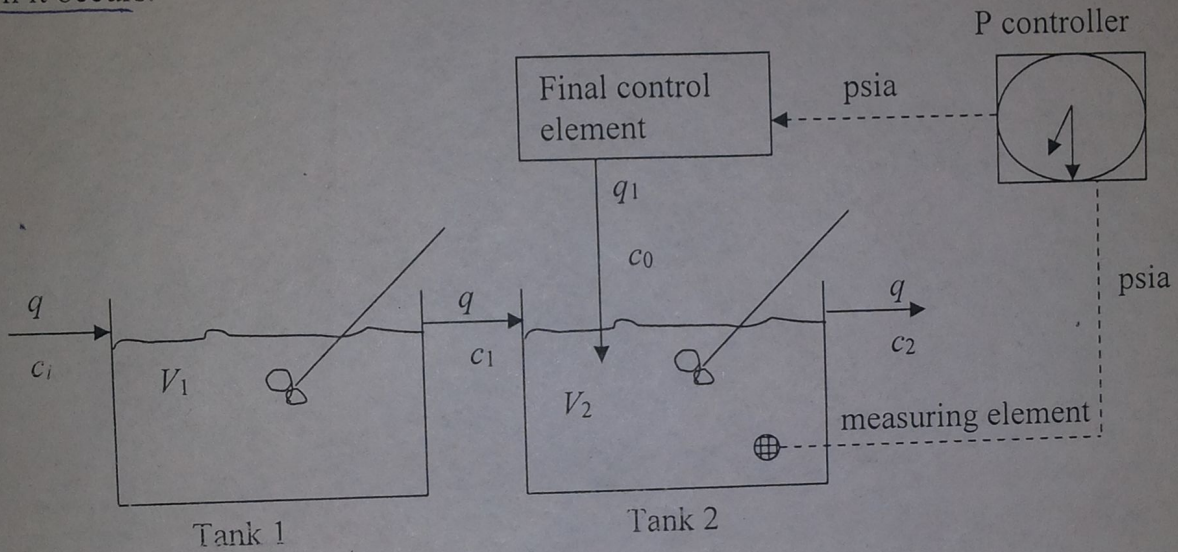
CHL 261 Instrumentation & Process Control: Minor - II (Closed book)

Duration: 1 hr | Max Marks: 20 | 5th Oct 2013

Q1. A two-tank mixing process as shown in figure consists of two well-stirred tanks in series with volumes V_1 and V_2 (V_1=5 ft^3, V_2=10 ft^3). The flow rate entering tank 1 is, q=5 cfm with concentration c_i lbmol/ft^3. A stream of flow rate q_1 cfm (manipulated variable) with fixed concentration c_0 (c_0=5 lbmol/ft^3) can enter tank 2 as and when necessary. Assume $q_1 << q$. The measuring element is a first order system with time constant of 1 min and converts concentration into a pneumatic signal, with a gain of 5 psia per lbmol per ft^3. A proportional controller with K_c=1.6 is used to maintain the concentration in tank 2 at some desired value (c_{2R} psia). An input of 1 psia to the final control element changes flow rate q_1 by 1 cfm. Neglect the dynamic lag in final control element. Develop a block diagram of the control system with appropriate transfer function in each block. Consider a regulatory problem with a step change of 0.8 lbmol/ft^3 in c_i. Determine the ultimate response, offset, overshoot, time period of oscillation, the maximum value of response and the time which it occurs. [12 M]



Q2. The block diagram of a multi-loop control system is shown below. Using the block diagram reduction techniques find the closed loop transfer function for servo problem. Using Routh test determine if the system is stable. [8 M]