Department of Chemical Engineering
Assignment No.6

Subject: Chemical Process Simulation Semester: 7th, Chemical Engineering

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Q1. Develop the equations describing an ñinvertedò batch distillation column. This system has a large reflux drum into which the feed is charged. This material is fed to the top of the distillation column (which acts like a stripper). Vapor is generated in are boiler in the base. Heavy material is withdrawn from the bottom of the column. Derive a mathematical model of this batch distillation system for the case where the tray holdups cannot be neglected.

Q2. Flooded condensers and flooded reboilers are sometimes used on distillation columns. In the sketch below, a liquid level is held in the condenser, covering some of the tubes. Thus a variable amount of heat transfer area is available to condense the vapor. Column pressure can be controlled by changing the distillate (or reflux) drawoff rate. Write the equations describing the dynamics of the condenser (Figure 1)

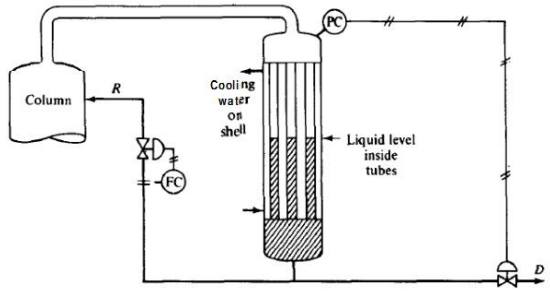

Figure 1

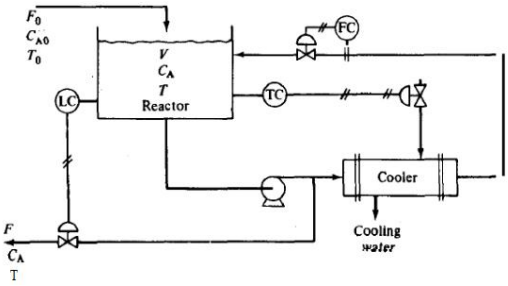

Figure 2

Q3. When cooling jackets and internal cooling coils do not give enough heat transfer area, a circulating cooling system is sometimes used. Process fluid from the reactor is pumped through an external heat exchanger and back into the reactor. Cooling water is added to the shell side of the heat exchanger at a rate F, as set by the temperature controller. The circulation rate through the heat exchanger is constant. Assume that the shell side of the exchanger can be represented by two perfectly mixed ñlumpsò in series and that the process fluid flow countercurrent to the water flow, also through two perfectly mixed stages. The reaction is irreversible and fist-order in reactant A:

$A \xrightarrow{k1} B$

The contents of the tank are perfectly mixed. Neglect reactor and heat-exchanger metal. Derive a dynamic mathematical model of this system Figure 2.