

B. Tech. Sem - VIII (Chemical Engg.) (2014 COURSE) (CBCS) :
SUMMER - 2019
SUBJECT: CHEMICAL PROCESS MODELING AND SIMULATION

Day: Thursday
Date: 30/05/2019

Time: 02.30 PM TO 05.30 PM
Max Marks. : 60

S-2019-2873

N.B. :

- 1) All questions are **COMPULSORY**.
- 2) Figures to the right indicate **FULL** marks.
- 3) Assume suitable data, if necessary.
- 4) Use of non-programmable calculator is allowed.
- 5) Draw neat and labeled diagrams wherever necessary.

-
- Q.1** Illustrate the use of fundamental laws to describe chemical engineering systems write the general form of following fundamental laws. **(10)**
- i) Energy balance equation
 - ii) Law of mass action
 - iii) Equation of motion

OR

- Q.1** A CSTR in which simultaneous first order reactions occur with exothermic heats of reaction λ_1 & λ_2 **(10)**
- $$A \xrightarrow[\lambda_1]{k_1} B$$
- $$A \xrightarrow[\lambda_2]{k_2} C$$
- i) Write total continuity equation
 - ii) Write component continuity equation
 - iii) Write energy equation

- Q.2** Postulate a mathematical model for heat transfer with coil wherein both modes of heat transfer are involved. Write assumptions with justification. **(10)**

OR

- Q.2** Develop model equations for shell and tube heat exchanger. The heat transfer between hot and cold fluid is by convection only. The tube wall metal heat capacity can be neglected. The heat exchanger is single pass type with countercurrent operation. Write assumptions clearly. **(10)**

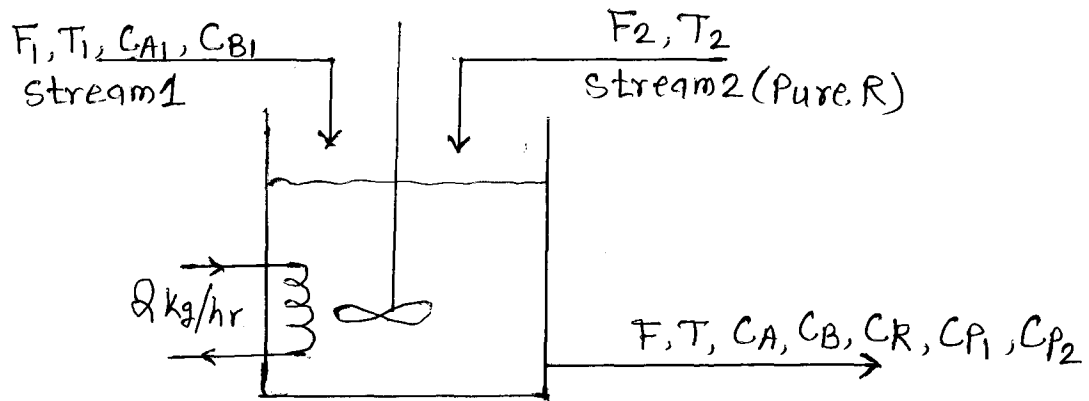
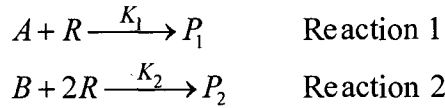
- Q.3 a)** Compare the mathematical modeling of continuous binary distillation in tray and packed column. **(05)**
- b)** Write the equations for flash distillation. **(05)**

OR

- Q.3** Postulate a mathematical model for ideal binary distillation column. Draw the schematic diagram of same. State assumptions clearly. **(10)**

P.T.O.

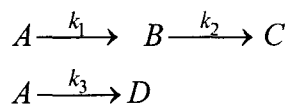
- Q.4 Develop model equations for the following CSTR system with two inlet streams. (10)



Both reactions are endothermic and both have second order Kinetics. Heat is supplied to the reaction mixture by steam which flows through a coil, immersed in the reactor, with heat transfer area A_1 .

OR

- Q.4 Develop the model for batch reactor where the following reactions takes place (10)



All reactions are endothermic and have first order kinetics. The reacting mixture is heated by steam which flows through a jacket around the reactor with a rate of Q kg/min.

- Q.5 Explain the simultaneous modular approach of simulation of chemical engineering systems with flow diagram. (10)

OR

- Q.5 a) List the steps involved in Barkley and Motard tearing algorithm. (05)
 b) Elaborate the features of basic tearing algorithm. (05)
- Q.6 a) Write the simulation algorithm for ideal binary distillation column. (05)
 b) Enumerate the equipment configurations and conditions to be assumed while simulation of multicomponent distillation. (05)

OR

- Q.6 Write the modeling equations for gravity flow tank. Simulate them with following initial conditions using Eulers method. (10)

Initial steady state values

$$F_0 = 35.1 \text{ ft}^2/\text{sec}, \quad h_0 = 4.72 \text{ ft}, \quad v_0 = 4.97 \text{ ft}/\text{sec}$$

Parameters

$$R_e = 1.38 \times 10^4, \quad K_f = 2.8 / \times 10^{-2} \text{ lb} / (\text{ft}/\text{sec})^2 \text{ ft}.$$

$$g_c = 9.8 \text{ m}^2 / \text{sec}.,$$

Specifications for tank

$$\text{Tank: Area} = 113 \text{ ft}^2 \quad \text{height } h = 7 \text{ ft}$$

$$\text{Pipe: Area} = 7.06 \text{ ft}^2 \text{ length } L = 3000 \text{ ft}.$$

* * * * *