Q. Code:393597

M.E. / M.TECH. DEGREE EXAMINATIONS, DEC 2020 (Held during April, 2021)

First Semester

CL18103- Process Modeling and Simulation

(Chemical Engineering)

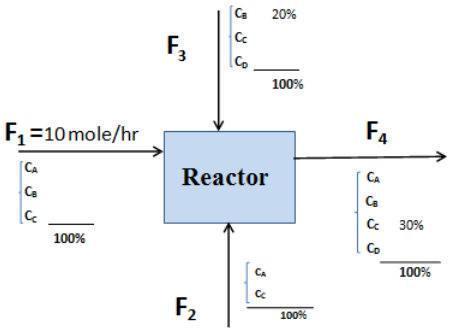
(Regulation 2018)

Time: Three hours Maximum : 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. Models are used
   (a) To test a system without having to create the system for real
   (b) To predict what might happen to a system in the future
   (c) To investigate a system in great detail
   (d) All the above
2. If the degree of freedom is negative that means the unit operation is
   (a) Under-specified
   (b) Over-specified
   (c) Exactly determined
   (d) None of the above
3. Water is stored at atmospheric pressure and distributed by gravity flow in a down feed system and the tank is usually elevated above the roof of a building and is filled by a house pump then the system called as
   (a) Liquid level tank
   (b) Gravity flow tank
   (c) Stirred tank heater
   (d) Flash drum
4. An ---------- is one where the structure is determined by the observed statistical relationship among experimental data is named as
   (a) Stochastic model
   (b) Theoretical model
   (c) Empirical model
   (d) Semi-empirical model
5. Mention the levels of physicochemical description on topical designation for mathematical modeling.
6. Analysis degree-of-freedom for the reactor operation and to determine whether the system has sufficient information to solve for the unknown variables.



7. List the fundamental assumptions developed for the analysis of compressible flow.
8. Elucidate the steady state distributed system distinguished from unsteady state lumped system.

PART B - (4 X16 = 64 marks)

9. (a) Classify various mathematical models based on availed opposite pairs and mathematical complexity in detail with examples. **(16)**

(OR)

   (b) (i) Discuss briefly about the Conservation laws and auxiliary relations used in mathematical modeling of chemical process. **(12)**
   (ii) List out the various steps involved in developing simulation models **(4)**

10. (a) (i) Elucidate the structural components of general purpose of sequential modular and equation oriented approach for steady state simulation. **(12)**

(ii) Discuss the significance of developing modeling assumptions for building a model. **(4)**

(OR)

(b) (i) Recovery of acetone from air-acetone mixture is achieved using an absorber and a flash separator. A model for this system is developed under following conditions are all acetone is absorbed in water, air entering the absorber contains no water vapor and air leaving the absorber contains 3 mass % water vapor. **(12)**

The flash separator acts as a single equilibrium stage such that acetone mass fraction in vapor and liquid leaving the flash separator is related by relation **y = 20.5x**

where y mass fraction of the acetone in the vapor stream and x mass fraction of the acetone in the liquid stream. Operating conditions of the process are as follows Air in flow is 600 lb/hr with 8 mass % acetone and Water flow rate is 500 lb/hr. The waste water should have acetone content of 3 mass %. Determine the concentration of acetone in the vapor stream and flow rates of the product streams with proper flow diagram.

(ii) Discuss about the degrees of freedom analysis and how to overcome under/over determined problems **(4)**

11. (a) (i) Develop a mathematical model for Non-isothermal CSTR in Which an exothermic reaction A⟶B takes place. The reactor is provided with a Cooling jacket for the removal of heat. Assume constant holdup in the reaction vessel. **(12)**

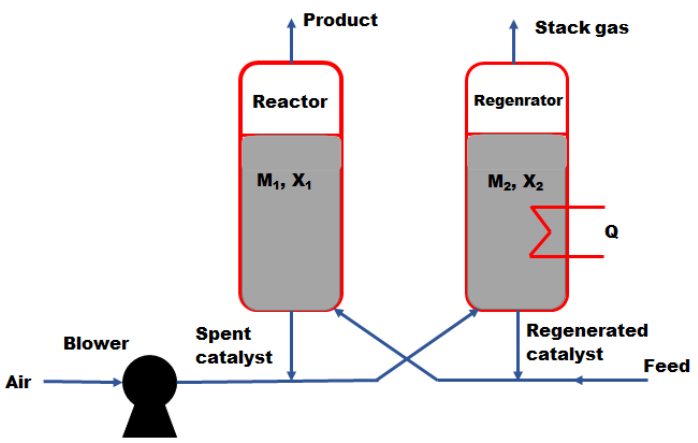
(ii) Perform the model equation for Liquid storage tank. **(4)**

(OR)

(b) (i) A tank contain 8 L of water in which is dissolved 33 g of chemicals. A solution containing 5 g/L of chemical flow into the tank at a flow rate of 4 L/min and well stirred mixture flow out at rate of 2 L/min. Calculate the amount of chemical after 20 minute and predict the concentration of chemical in the tank after 30 minute. **(12)**

(ii) Derive the mathematical model for an ideal binary distillation column. **(4)**

12. (a) **(16)**



Perform the unsteady state distributed model for the above process with assumptions and label the process parameters.

(OR)

(b) Develop the steady state, liquid phase dynamics, liquid and vapor phase dynamics and thermal equilibrium model for a LPG Vaporizer. **(16)**