Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PCE5J002

5th Semester Back Examination 2019-20
PROCESS SIMULATION & MODELING
BRANCH : CHEM
Max Marks : 100
Time : 3 Hours
Q.CODE : HB386

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

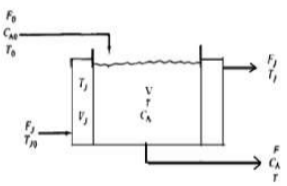
Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Define process modeling.
b) Explain the meaning of following terms for optimization: feasible solution and feasible region.
c) Discuss why modeling assumptions are important in building a model.
d) Derive the energy equation applicable for batch reactor with assumptions.
e) Explain degrees of freedom.
f) Write down the steps involved in digital simulation.
g) Differentiate between Continuous and Discrete Systems.
h) What are advantages And Disadvantages of Simulation?
i) What is Model and Component of the system?
j) Give name of two static and two dynamic simulators.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Explain how mathematical models can be useful in all phases of chemical engineering.
b) Describe the various fundamental laws of chemical engineering in detail.
c) Explain the terms Lumped parameter system and distributed parameter system with examples.
d) What is simulation? Explain in detail.
e) Give the scope of process simulation with examples.
f) Discuss the six steps used to solve optimization problems.
g) Explain mathematical modeling of non-isothermal CSTR.
h) Explain mathematical modeling of ideal binary distillation column.
i) It is required to design a close-topped rectangular tank whose total area is to be 110 m^2. If a maximum volume is required then formulate the problem.
j) Write the various equations of motion for process modeling.
k) An irreversible, exothermic reaction is carried out in a single perfectly mixed CSTR as shown in the figure.



The reaction is nth-order in reactant A and has a heat of reaction λ (Btu/lb mol of A reacted). Negligible heat losses and constant densities are assumed. To remove the heat of reaction, a cooling jacket surrounds the reactor. Cooling water is added to the jacket at a volumetric flow rate FJ, and with an inlet temperature of TJo. The volume of water in the jacket VJ is constant. The mass of the metal walls is assumed negligible so the thermal inertia of the metal need not be considered. Derive the model equations with the assumption of a perfectly mixed cooling jacket.

I) Consider a batch reactor in which the following first-order consecutive reactions are carried out.

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$

Reactant A is charged into the vessel. Steam is fed into the jacket to bring the reaction mass up to a desired temperature. Then cooling water must be added to the jacket to remove the exothermic heat of reaction and to make the reactor temperature follow the prescribed temperature-time curve. This temperature profile is fed into the temperature controller as a set-point signal. Derive the temperature profiles for the process and metal wall for the batch reactor described above.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 Determine the mathematical model for isothermal CSTR with constant hold-up. **(16)**

Q4 Describe any one chemical process simulator and its salient features. **(16)**

Q5
a) List the various equations for chemical kinetics used in modeling. **(5)**
b) Develop a batch reactor model. **(5)**
c) What is sequential modular approach? Explain the steps with diagram. **(6)**

Q6
a) What are the various equations of motion for process modeling? **(5)**
b) Explain black box model. **(5)**
c) Give a detail classification of models. **(6)**