B.TECH SEM – VII (2007 COURSE) (CHEMICAL ENGG.) :

WINTER - 2017

SUBJECT: PROCESS MODELING AND SIMULATION

Day: Monday
Date: 22/01/2018

Time: 02.30 PM TO 05.30 PM
Max. Marks: 80

W-2017-2546

N.B.

1) **Q. No.1** and **Q. No.5** are **COMPULSORY**. Out of the remaining attempt **ANY TWO** questions from each section.
2) Figures to the right indicate **FULL** marks.
3) Answers to both the sections should be written in **SEPARATE** answer book.
4) Assume suitable data if necessary and use of non programmable calculator is allowed.
5) Draw neat and labeled diagrams **WHEREVER** necessary.

SECTION-I

Q.1 **a)** Define process modeling. Elaborate scope of coverage. **(04)**

b) Illustrate the application of energy equation to PFR. **(05)**

c) Write component continuity equations for each component for first order, liquid phase consecutive reaction. **(05)**

$$A \xrightarrow{K_1} B \xrightarrow{K_2} C$$

Q.2 **a)** Compare lumped parameter and distributed parameter systems using suitable examples. **(06)**

b) Define process simulation. Explain the applications of modeling and simulation in chemical fields. **(07)**

Q.3 **a)** How the equation of motion is applied to a macroscopic system? Use the example of gravity flow tank to show the force balance. **(07)**

b) Write the general from of following fundamental laws applied to any chemical engineering system. **(06)**

i) Component continuity equation
ii) Energy equation
iii) Chemical kinetics

Q.4 Develop a mathematical model for ideal binary distillation column. State the assumptions with proper justification. **(13)**

SECTION-II

Q.5 **a)** Write the algorithm for modeling of heat exchanger. **(05)**

b) Elaborate the difficulties involved in modeling of CSTR. **(04)**

c) Define the terms: **(05)**

i) Transient Analysis
ii) Steady state Analysis

P.T.O.

Q.6 A single effect evaporator is to be operated with following data. Feed containing W_1 % solids and leaves with W_2 % solids. **(13)**

Feed rate = 20000 Kg/hr
Initial solids = 5 %
Final solids = 30 %
Feed Temperature = 35 ^{0}C.
Solution boiling point = 70 ^{0}C.
Steam is available at pressure corresponding to saturation temp of 125 ^{0}C.
Latent heat of evaporation of water = 560 Kcal/ kg.
Specific heat of feed = 0.91 Kcal/kg K.
Overall heat transfer coefficient = 3000 Kcal/ hr m^2 ^{0}C)
Develop a model to estimate the steam consumption, economy and heat transfer area of the evaporator. Write the simulation programme using above initial conditions and developed model.

Q.7 Postulate a model for trickle bed reactor based on hydrodesulphurization reaction of petroleum feed stock. State all assumptions with due justification. **(13)**

Q.8 **a)** Elaborate the need of numerical methods for solution of model equations. **(04)**

b) The following differential equation is obtained while modeling of a system. **(09)**

$$\frac{dy}{dx} = -2x^3 + 12x^2 - 20x + 8.5$$

It is required to find the value of y at x = 0.6.
Solve the equation using Euler's integration method.
Data: y = 1 at x = 0.
Take interval h = 0.1.

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