

Code No: RT41083

R13

Set No. 1

IV B.Tech I Semester Supplementary Examinations, February/March - 2018

PROCESS MODELING AND SIMULATION

(Chemical Engineering)

Time: 3 hours

Max. Marks: 70

Question paper consists of Part-A and Part-B

Answer ALL sub questions from Part-A

Answer any THREE questions from Part-B

PART-A (22 Marks)

1. a) Write the total continuity and component continuity of systems. [3]
- b) For a perfectly mixed CSTR with following reaction (first order, isothermal)
$$A \rightarrow B \rightarrow C$$

Derive the material balance equations. Write down the unsteady state material balance equations, if the reaction occurs in non-isothermal conditions, where heat needed for endothermic reaction is supplied through electrical coil. [4]
- c) Discuss the computational features of direct and iterative methods for the solution of linear Simultaneous equations. [4]
- d) Use the trapezoidal and simpson's rule for with $\Delta x = 0,2$ to evaluate $\int_0^1 \frac{dx}{x}$ and compare your values with analytical result. [4]
- e) What do you mean by simulation? Explain [3]
- f) What are the advantages and disadvantages of non dimensional forms of governing PDE's? [4]

PART-B (3x16 = 48 Marks)

2. a) Define Lumped parameter model and distributed parameter models with examples. [8]
- b) Discuss why modeling assumptions are important in the building of a model. [8]
3. a) Derive modeling equations for batch reactor. [8]
- b) Present the steady state model of single component vaporizer. [8]
4. a) Oxygen is at a temperature of 150 C and pressure of 70 atm. Calculate molar volume from VanderWall's equation using Newton-Raphson method. Present the results for at least 4 iterations and also write the computer program for the solution of the problem.
Data: The values of Van der Wall's constants a& b for O₂ are:
a = 1.360 b = 0.03183 R = 0.082 atm ltr/mol K [8]
- b) With a neat flow chart, discuss the Gauss elimination algorithm. Mention its advantages and limitations. [8]
5. a) A metal ball heated to 75 °C is dropped into a water bath maintained at a temperature of 25° C. The cooling rate is given by $dT/dt = -0.6 (T - T_w)$, dT/dt is in °C/min. Calculate the change in temperature of a metal ball as a function of time using Runge Kutta 4th order method up to 5 minutes and also write the computer program. [8]

- b) For laminar flow, the friction coefficient 'f' is related Reynolds number $f = a Re^b$ Determine a& b by least square fit using following data. Compute deviations at each data point.

F	500	1000	1500	2000
Re	0.0320	0.0160	0.0107	0.008

[8]

6. a) Explain the simulation of three CSTR;s connected in series under the action of PI controller by giving dynamic equations. * [8]
b) Present the simulation steps for counter current heat exchanger. [8]
7. a) Derive expression for temperature profile in radial direction when the heat transfers through a cylindrical conductor. [8]
b) What are the steps needed in applying the finite difference method to solution of PDE models. [8]