Paper code:ECH-701	Roll No.										

B.TECH
(SEM VII) ODD SEMESTER EXAMINATION, 2015-16
PROCESS MODELING AND SIMULATION

Time: 3 Hours Max. Marks:100

Note: **Attempt all questions. All questions carry equal marks.Assume suitable data if missing.**

1. Attempt any four parts of the followings: (4x5=20)
   (a) Define the term mathematical modeling. Give suitable examples also.
   (b) Give the classifications of different models.
   (c) What are the advantages and limitations of models?
   (d) Differentiate between lumped parameter and distributed parameter models.
   (e) What are various conservation law used in mathematical modeling?
   (f) Write the algorithm or stepwise procedure for the development of a process model.
2. Attempt anytwo parts of the followings: (4x5=20)
   (a) What are difference between steady state and dynamic models? Explain with examples.
   (b) What are the difficulties in modeling? Explain with suitable examples.
   (c) Develop a model for continuous mixing tank initially filled with water. A salt solution of density ρ_f (kg/m^3)is added to tank with a flow rate q_f(m3/s). The solution in the tank leaves the tank at a rate of q m^3/shaving density ρ.The volume of the solution in the tank is V(m^3). Mention all assumptions clearly if any.
   (d) What are the various differential equations used in mathematical modeling. Explain in brief.
   (e) Discuss and develop steady state model of flash vessel with neat sketch.
   (f) What are the various assumptions used in modeling of ideal binary distillation column.
3. Attempt any two parts of the followings: (2x10=20)
   (a) A tank of constant cross section, initially filled with some liquid to a height h_0, is emptied by a flow through a small hole or orifice at the bottom of the tank. The density of liquid is $\rho$and the cross sectional area of tank and that of the orifice are A and A_0 respectively. The volumetric flow rate from the tank is q. The physical situation is shown in Figure 1. Develop a model showing (i) how long it take to drain the tank (ii) how does the height of liquid vary with the time and (iii) how does the flow rate through the orifice vary with the depth of liquid.

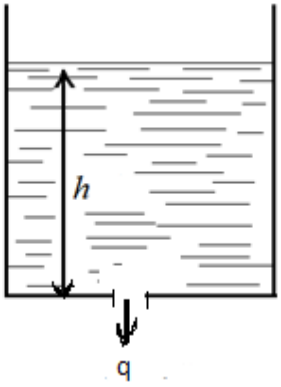

Figure 1

(b) Develop a dynamic model for aCSTR as shown in Figure 2.Theinlet stream have a flow rate of q_f (m3/s) and leaves the tank at a flow rate of q (m^3/s). The concentrationof inlet and outlet streams are C_{Af} and$C_A$respectively and the volume of the reaction mixture in the tank is V. Make all your assumptions clearly.

$A \rightarrow P$; $(-r_A) = kC_A$; $(-r_A)$[=] moles A/m^3s

Figure 2

(c) Write down the modeling equation of packed bed reactor and suggest the strategy to solve these equations.

4. Attempt any two parts of the followings: (2x10=20)

a. Derive the modeling equation for batch reactor considering following consecutive reactions $A \xrightarrow{K_1} B \xrightarrow{K_2} C$ where both $A \rightarrow B$ and $B \rightarrow C$ have first order kinetics. The reaction mixture is heated by a saturated steam with a rate Q(mass/time) through the jacket around the reactor.

b. Develop a dynamic model for an ideal plug flow reactor for the isothermal conditions. The following homogeneous reaction takes place in the reactor:

$A \rightarrow B$; $-r_A$ = mol A/m^3 s

c. Apply Newtons's method to determine a real root of the equation

$$f(x) = x^3 - 5x + 1 = 0$$

Take the initial approximation as $x_0 = 0.5$.

5. Write any two of the followings: (2 x10 = 20)

(a) Discuss the role of partitioning and tearing in process plant simulation with examples.
(b) Compare the sequential modular approach and equation oriented approach of simulation.
(c) Write the various available numerical software libraries used in modeling for solving complex equations. Explain in brief.

iabnayp.in