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GIET MAIN CAMPUS AUTONOMOUS GUNUPUR – 765022

B. Tech Degree Examinations, December – 2020

(Seventh Semester)

BCHPC 7010 – Process Modelling and Simulation

(Chemical Engineering)

Time: 2 hrs Maximum: 50 Marks

The figures in the right hand margin indicate marks.

PART – A: (Multiple Choice Questions) (1 x 10 = 10 Marks)

Q.1. Answer ***ALL*** questions

a. How many component continuity equation is sufficient for a system containing N no of components, if total continuity equation is already defined?

(i) N (ii) N-1

(iii) N+1 (iv) N-2

b. What is the product enthalpy of a process simulator if the feed is 15 J, the heat input is 10 J, and the work performed is 5 J?

(i) 10 J (ii) 15 J

(iii) 20 J (iv) 25 J

c. While solving a process simulation, required balance is?

(i) Material balances (ii) Equilibrium relations

(iii) Energy balances (iv) All of the mentioned

d. The input mass in a process simulator is X Kg and output mass is Y Kg. Then at steady state,

(i) X = Y (ii) X > Y

(iii) X < Y (iii) None of the mentioned

e. The condition for a saddle point is

(i) f ’(x)>0 (ii) f ’(x)>0

(iii) f ’’(x)=0 (iv) f’’’(x)=0

f. Process Optimization is a mathematical discipline that focuses on finding:

(i) Maxima points of a process (ii) Maxima and minima points of a process

(iii) Minima points of a process (iv) None of the above

g. The rate of a parameter, x is given by: f (x) = x2 + 3x. Calculate the stationery point of this parameter.

(i) (3/2; 9/2) (ii) (3/2; -9/2)

(iii) (-3/2; 9/2) (iv) (-3/2; -9/2)

h. Process optimization methods can be defined as:

(i) Constrained and unconstrained (ii) Function and unconstrained

(iii) Function and unconstrained (iv)None of the mentioned

i. Shell and Tube heat exchanger is a

(i) Lumped parameter system (ii) Discrete parameter system

(iii) Both i and ii (iv) None of the i and ii

j. What is the degrees of freedom for a system having N number of equations and N-1 number of dependent variable

(i) N (ii) N-1

(iii) 0 (iv) 1

PART – B: (Short Answer Questions) **(2 x 5 = 10 Marks)**

Q.2. Answer ***ALL*** questions

a. What are the units of mass balance, component mass balance and energy balance equation?
b. State the condition for phase equilibrium.
c. What are the limitations of the analytical methods?
d. State Arrhenius temperature dependence.
e. Write density equation from a perfect gas law

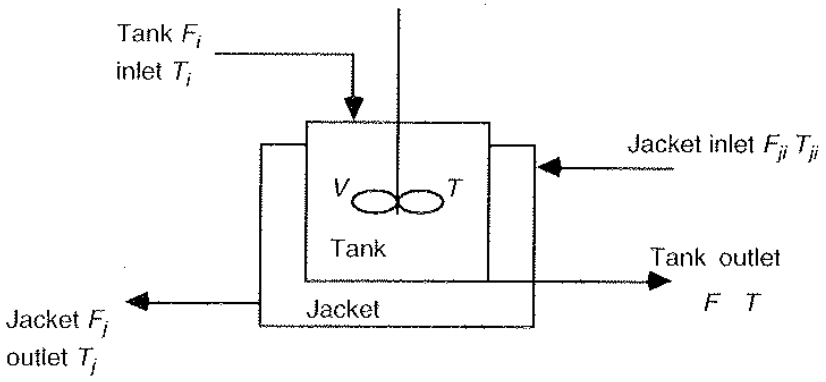
PART – C: (Long Answer Questions) **(6 x 5 = 30 Marks)**

Answer ***ANY FIVE*** questions Marks

3. What is Recycle stream? Explain the procedure to identify recycle sets in an information flow diagram. (6)

4. Explain the fundamental laws of physics and chemistry with their applications to simple chemical systems. (6)

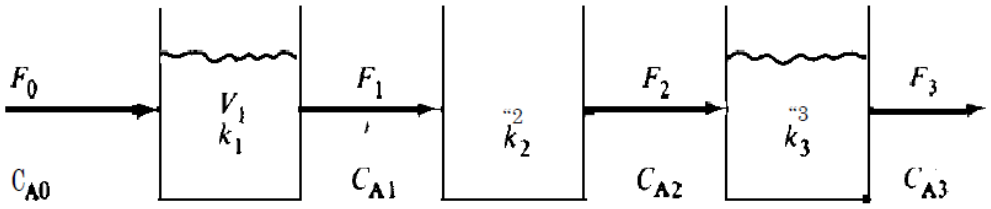
5. Consider a non-isothermal stirred tank heater in which a second order reversible, exothermic chemical reaction A ↔ B is taking place. Feed material containing C_{Af} mol/volume of A enters the reactor. Product is withdrawn from the reactor having composition C_A. Assume constant density (ρ) and heat capacity (C_p) of the reactor liquid. Develop the mathematical models for the stirred tank and the jacket. State all the dependent variables and Find out the degrees of freedom for the system. (6)



6. Explain Lumped and distributed parameter models with example. (6)

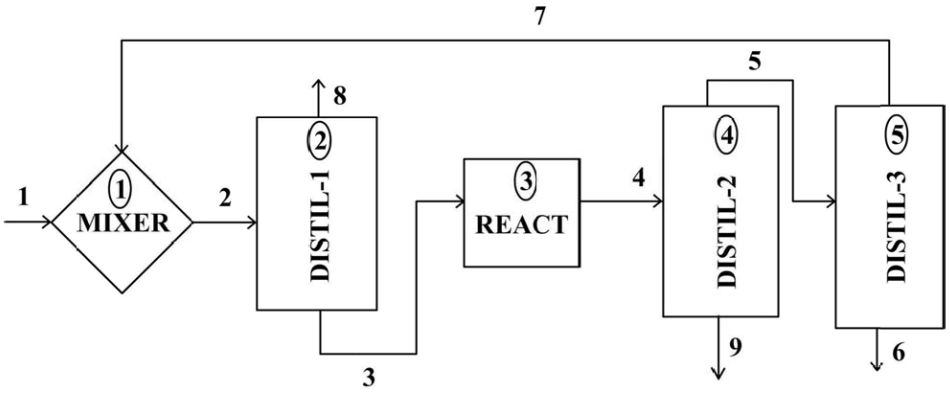
7. Develop the mathematical model for a shell and tube heat exchanger. State all the assumptions. (6)

8. Product B is produced and reactant A is consumed in each of the three perfectly mixed reactors by a first-order reaction occurring in the liquid. For the moment let us assume that the temperatures and holdups (volumes) of the three tanks can be different, but both temperatures and the liquid volumes are assumed to be constant (isothermal and constant holdup). Density is assumed constant throughout the system, which is a binary mixture of A and B. With these assumptions, develop a mathematical model.Write the general forms of mass, energy and momentum balance equations based on the conservation laws. (6)



9. Develop a mathematical model for a compartmental distillation column considering variation in liquid holdups in each tray from the first principles involving dynamic material, component and energy balances. Write down the assumptions used. (6)

10. Explain the four different matrix methods for converting information flow diagram to numerical form. Convert the Information flow diagram given belowto numerical forms using all the matrix methods. (6)



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