

UCH301: MATERIAL AND ENERGY BALANCES

L	T	P	Cr
3	1	0	3.5

Course Objective:

To understand and apply the basics of calculations related to material and energy flow in the processes.

Introduction: Units and dimensions, Stoichiometry of chemical equations, Mole and weight fractions, Unit operations and unit processes with reference to material and energy balance calculations.

Behaviour of Gas and Liquid Mixtures: Gas laws, Raoult's law, Henry's law, Duhring's plot, Saturation, Partial saturation, Relative saturation, Real gases, Bubble point and dew point temperatures.

Material Balance Calculations: Law of conservation of mass, General material balance equation, Material balance calculations without chemical reactions, Material balance calculations with chemical reactions, Recycling, Bypass, Purge, Analysis of degrees of freedom.

Energy Balance Calculations: General energy balance equation, Internal energy, Enthalpy, Heat capacity of gases, liquids, and solids, Latent heats, Heats of formation, combustion, reaction and dissolution, Enthalpy-concentration chart, Fuel heating value, Theoretical flame temperature, Energy balance calculations in unit operations and systems with and without chemical reactions, Humidity and psychrometric chart, Energy balance calculations in humidification and adiabatic cooling.

Sample List of Micro-Projects

Students in a group of 4/5 members will be assigned a micro project.

1. Complete material balances on a process flow sheet
2. Energy balances on a complete process flow sheet
3. Analyze the degrees of freedom for a complete process

Course Learning Outcomes (CLO)

Upon completion of this course, the students will be able to:

1. perform material balance for problems without chemical reactions.
2. perform material balance for problems involving chemical reactions.
3. perform energy balance for problems without chemical reactions.
4. perform energy balance for problems involving chemical reactions.

Text Books:

1. Himmelblau, D.M. and Riggs, J.B., *Basic Principles and Calculations in Chemical Engineering*, Prentice Hall of India (2003).
2. Bhatt, B.I. and Vora, S.M., *Stoichiometry*, Tata McGraw Hill (2004).

Reference Books:

1. Hougen, O.A., Watson, K.M. and Ragatz, R.A., *Chemical Process Principles, Volume-I*, C.B.S. Publications (2004).
2. Felder, R.M, and Rousseau, R.W., *Elementary Principles of Chemical Processes*, C.B.S. Publications (2000).

Evaluation Scheme:

S. No.	Evaluation Elements	Weightage (%)
1	MST	30
2	EST	45
3	Sessional (may be tutorials/ quizzes/ assignments/ project)	25