

GUJARAT TECHNOLOGICAL UNIVERSITY

CHEMICAL TECHNOLOGY (36)

MATERIAL & ENERGY BALANCE CALCULATIONS

SUBJECT CODE: 2133606

B.E. 3RD SEMESTER

Type of Course: Chemical Technology

Prerequisite: Basics of linear algebra, chemistry

Rationale: The main objective of this subject is to study the basic chemical calculations applied in various unit operations in chemical industries. This subject provides fundamental knowledge of how to carry out material and energy of a chemical process plant.

Teaching and Examination Scheme:

Teaching Scheme			Credits C	Examination Marks						Total Marks
L	T	P		Theory Marks			Practical Marks			
			ESE (E)	PA (M)		PA (V)		PA (I)		
PA	ALA	ESE		OEP						
3	1	0	4	70	20	10	30	0	20	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1.	Units & Dimensions: Applications of Laws of Conservation of Mass & Energy to single & multistage processes. Material & Energy balances for Unit Operations & Processes.	02	20
2.	Integrated Balances for manufacturing Processes: Machine Computation Techniques. System of Equations, Mole concept & composition relationship	03	
3	Stoichiometry: Behavior of gases & vapors. Simple material balances without chemical reactions. Material balance for unit operations like absorption, distillation, extraction, drying and evaporation. Humidification operation and calculation of properties of air-water system.	09	40
4.	Material balances with chemical reaction: Concept of limiting and excess reactants, percentage conversion and yield. Material balance involving reactions with special reference to fertilizers, petrochemicals, dyestuffs, electrochemical industries. Complex material balances	09	
5.	Energy balances: Heat capacity of gases and gaseous mixtures, liquids & solids, Sensible heat change in liquid & gases, enthalpy changes during phase transformation, enthalpy changes accompanied by chemical reactions, standard heat of reaction, adiabatic reactions, thermo-chemistry of mixing process, dissolution of solids etc. Liquid-liquid	10	40

	mixtures, heat of solution by partial molar quantities.		
6.	Combined material & energy balances: Combustion balances. Balances in stage wise unit operations. Unsteady state balances. Differential balances. Balances in chemical processes		

Reference Books:

1. Basic Principles & Calculations in Chemical Engineering ,D.M.Himmelblau.,6th Ed., 2004
2. Stoichiometry, B.I.Bhatt&Thakore ,Tata McGraw Hill Book Company, 5th Ed ,2010
3. Chemical Process Principles, Vol.1, O.A.Hougen, K.M.Watson, R.A.Ragatz., Indian print, CBS Publishers,2nd Ed., 1995
4. Stoichiometry & Process Calculations, Narayanan K.V., &Lakshmikutti B., Prentice Hall, 2006
5. Process Calculations, V Venkataramani and N Anantharaman, PHI Learning, 2004
6. Chemical Process Calculations Manual, David Carr Igbino ghene, McGraw Hill Professional,2004
7. Optimization of Chemical Processes, T F Edgar, D M Himmelblau and L S Lasden, Tata McGraw Hill, 2001

Course Outcomes:

At the end of this course students will be able to:

1. To express concentration of pure component & mixture of gases and liquids.
2. To carry out material and energy balance calculations of relevance processes taking place in the industry.
3. To be able to utilize these techniques in problem solving in process plant.
4. To be able to apply this knowledge in order to propose possibility of energy conservation of a particular unit operation.
5. To build a bridge between theoretical and practical concept used in industry.

List of Open Source Software/learning website:

- 1) NPTEL
- 2) MIT Open course lecture available on Internet etc...
- 3) Delnet

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.