LOK JAGRUTI UNIVERSITY (LJU)

INSTITUTE OF ENGINEERING & TECHNOLOGY

Department of Chemical Engineering (708)

Bachelor of Engineering (B.E.) – Semester – IV

Course Code:	**017083401**
Course Name:	**Material & Energy Balance Computations**
Category of Course:	Professional Core Course (PCC)
Prerequisite Course:	----

Teaching Scheme				
Lecture (L)	**Tutorial (T)**	**Practical (P)**	**Credit**	**Total Hours**
4	**1**	**0**	**5**	**50**

Syllabus

Unit No.	Topic	Prerequisite Topic	Successive Topic	Teaching Hours
01	**Units and Dimensions**			**4 (8%)**
	1.1 Dimensions and Systems of Units			
	1.2 Fundamental and Derived Units			
	1.3-Dimensional Consistency and Dimensional Equations			
	1.4 Conversions of Units and its Significance			
02	**Basic Chemical Calculations**			**4 (8%)**
	2.1 Mole, Atomic Mass, and Molar Mass			
	2.2 Equivalent Mass			
	2.3 Solids			
	2.4 Liquids and			
03	**Important Physical Properties**			**4 (8%)**
	3.1 Solutions: Vapour pressure using Raoult's law	Vapour-Liquid Equilibrium: Raoult's Law (017083301-Unit-2.5) Raoult's Law and Ideal Solution (017083301-Unit-7.2)		
	3.2 Gases: Ideal Gas Law and Vander Waals Equations of State			
	3.3 Gas Mixtures, Gas-Liquid Mixtures using Henry's Law	Gas Mixtures, Gas-Liquid Mixtures using Henry's Law ((017083301-Unit-7.3)		
04	**Material Balances Without Chemical Reaction**			**6 (12%)**
	4.1 Classification of Material Balance Problems		Mass and energy balances for steady state and unsteady state reactors (017083601-Unit-3.1)	
	4.2 Methods of Solving Material Balance			
	4.3 Solving Material Balance Problems without Chemical Reactions in Mixing/Blending, Drying			
	4.4 Solving material balance problems without Chemical Reactions in Evaporation and crystallization			
05	**Stoichiometry and Unit Operations**			**8 (16%)**
	5.1 Solving material balance problems without Chemical Reactions of Unit Operation: Distillation		Simple Distillation (017083503-Unit-1.4)	
	5.2 Solving material balance problems without Chemical Reactions of Unit Operation: Extraction and Leaching			
	5.3 Solving material balance problems without Chemical Reactions of Unit Operation: Absorption and Stripping		Material Balance and Liquid-Gas Ratio for Absorption and Stripping (017083402-Unit-5.4)	
	5.4 Material balance with and without recycle; Bypass and Purge streams			
06	**Material Balances Involving Chemical Reactions**			**7 (14%)**
	6.1 Equations for Chemical Reactions			
	6.2 Definitions of Terms: Limiting and Excess Reactants, Percentage Conversion, Selectivity, Yield			
	6.3 Generalized Approach for Solving Material Balance Problems Involving Chemical Reactions			
	6.4 Recycling & Bypassing Operations with Chemical Reactions			
07	**Energy Balance**			**5 (10%)**
	7.1 Heat Capacity			
	7.2 Sensible Heat Changes in Gases at Constant Pressure			

	7.3 Sensible Heat Changes in Liquids and Solids			
	7.4 Heat Capacity of Gaseous and Liquid Mixtures			
	7.5. Latent Heats Calculations: Watson Equation, Riedel Equation			
	7.6 Enthalpy Changes for pure substances			
08	**Enthalpy Changes Accompanying Chemical Reactions**			**3 (6%)**
	8.1 Standard Heat of Formation and Standard Heat of Combustion			
	8.2 Standard Heat of Reaction			
	8.3 Effect of Temperature on Heat of Reaction & formation		Heat of reaction ((017083601-Unit-4.1)	
09	**Introduction to Fuels**			**2 (4%)**
	9.1 Classification of Fuels			
	9.2 Calorific Values of Fuels			
	9.3 Calorific Values calculations			
10	**Combustion**			**7 (14%)**
	10.1 Air requirement and Flue gases			
	10.2 Theoretical Oxygen and Excess Oxygen Requirement			
	10.3 Theoretical Air and Excess Air Requirement			

Proposed Theory + Practical Evaluation Scheme by Academicians
(% Weightage Category Wise and it's Marks Distribution)

L:	4	T:	1	P:	0

Note: In Theory Group, Total 4 Test (T1+T2+T3+T4) will be conducted for each subject.
Each Test will be of 25 Marks.
Each Test Syllabus Weightage: Range should be 20% - 30%

Group (Theory or Practical)	Group (Theory or Practical) Credit	Total Subject Credit	Category	% Weightage	Marks Weightage
Theory	5	5	MCQ	20%	20
Theory			Theory Descriptive	00%	00
Theory			Formulas and Derivation	00%	00
Theory			Numerical	80%	80
Expected Theory %	**100%**		**Calculated Theory %**	**100%**	**100**
Practical	0		Individual Project	0%	0
Practical			Group Project	0%	0
Practical			Internal Practical Evaluation (IPE)	0%	0
Practical			Viva	0%	0
Practical			Seminar	0%	0
Expected Practical %	**0%**		**Calculated Practical %**	**0%**	**0**
Overall %	**100%**			**100%**	**100**

Course Outcome	
	Upon completion of the course students will be able to
1	To identify different unit systems and dimensions through conversion. They will also learn essential chemical calculations like stoichiometry and molarity, as well as an understanding of important physical properties like density, viscosity, and solubility for practical application and experimental interpretation.
2	Develop a thorough understanding of material balances, enabling them to analyze and solve problems related to mass conservation in various processes, including non-reactive systems.
3	Integrate material balances with energy balances to analyze and design chemical processes effectively, ensuring both mass and energy conservation, and optimizing process efficiency and sustainability.
4	To evaluate fuel quality and to device requirement of gases in combustion.
Suggested Reference Books	
1	"Stoichiometry," B.I. Bhatt, S B Thakore, McGraw Hill Publishing Company Limited, 5th edition,2010
2	"Basic Principles & Calculations in Chemical Engineering," David M. Himmelblau, James B. Riggs, PHI Learning Pvt. Ltd, 7th edition, 2006.
3	"Elementary Principles of Chemical Processes," Richard M. Felder, Ronald W. Rousseau, Wiley, 3rd edition, 2004.
4	"Chemical Process Principles Part-I: Material and Energy Balances," O.A. Hougen, K.M. Watson, R.A. Ragatz, CBS Publishers New Delhi, 2nd edition, 2004.
5	"Stoichiometry and Process Calculations," K.V. Narayanan, B. Lakshmikutty, Prentice-Hall of India Pvt. Ltd., 2006.
6	"Industrial Stoichiometry: Chemical Calculations of Manufacturing Processes," H.C. Lewis, W.K. Lewis, A.H. Radasch, McGraw-Hill, 2nd edition, 1954.

List of Open-Source Software/Learning Website

1	https://nptel.ac.in
2	https://www.coursera.org