Subject Code: 01CH0302
Subject Name: Stoichiometry
B.Tech. Year – II (Semester III)

Objective: To develop mathematical approach amongst the students to solve real life problems of Chemical Engineering.

Credits Earned: 4 Credits

Course Outcomes: After completion of this course, student will be able to:

1. Establish mathematical methodologies for the computation of material balances and energy balances
2. Evaluate the mathematical calculations behind various chemical processes.
3. Develop an in depth understanding of the basic principles of chemical engineering calculations.
4. Understand various material and energy balance problems.

Pre-requisite of course: Basic concepts of Chemistry

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	CSE	Internal (I)	Viva (V)	Term work (TW)	
3	2	0	4	50	20	30	25	25	150

Contents:

Unit	Topics	Contact Hours
1	**Introduction to Basic Chemical Calculations** Units and dimensions, concept of mole, atomic mass & molar mass, density and specific gravity, Equivalent Mass, Mole Fraction, Composition of mixtures, methods of expressing compositions of mixtures and solutions: concentration, Molarity, Normality, Molality, Gases: Vapour Pressure, Dalton's law of partial pressures, Ideal Gas law, Equation of state	4
2	**Material Balances without Chemical Reactions** Fundamentals of Material Balance calculation, Material Balance without chemical reaction: drying, mixing, crystallization, membrane separation, and extraction & distillation. Fundamentals of recycle bypass and purge streams. Material balances of uncreative systems with recycle stream.	8

3	**Material Balances with Chemical Reactions** Fundamentals of Limiting Reactant, Excess Reactant, Conversion, Selectivity, Yield. Material balances for systems involving chemical reactions. Recycling, Parallel & Bypass operations, Combustion as a case of material balance with reactions. Combustion products analysis, Excess air calculation.	8
4	**Energy Balance** Heat capacity, Heat and Latent Heats, Standard Heat of Combustion, Empirical equations for heat capacities; Mean heat capacities of gases, Sensible, Enthalpy calculations. Heat of Formation, Hess's Law, calculation of the standard heat of reaction from heats of formation, Theoretical flame temperature calculation.	8
5	**Fuels and Combustion** Fuel types, Calorific value of fuels, Calculations based on coal combustion, liquid fuels, gaseous fuels, etc., Proximate and ultimate analysis.	4
6	**Humidification & Saturation** Definition of percentage & Relative saturation, dew point, wet bulb and dry bulb temperature, use of Psychometric charts for process calculations.	4
	Total Hours	**36**

References:

Text Books:

1. "Stoichiometry", B.I. Bhatt, S.M. Vora, McGraw Hill Publishing Company Limited, 4th edition, 2004.
2. Introduction to Process Calculations- K.A. Gavhane, Nirali Prakashan.

Reference Books:

1. Basic Principles & Calculations in Chemical Engineering, David M. Himmelblau, James B. Riggs, PHI Learning Pvt. Ltd, 7th edition, 2006.
2. Stoichiometry and Process Calculations, K.V. Narayanan, B. Lakshmikutty, Prentice-Hall of India Pvt. Ltd., 2006.

List of tutorials

1. Numerical based on empirical equations of molarity, molality, normality.
2. Numerical based on mass fraction, mole fraction, unit conversion, volume composition
3. Numerical based on material balance of chemical processes such as drying, mixing, separation processes
4. Numerical based on material balance of chemical reactions, conversion, limiting reactant, excess reactant, yield
5. Numerical based on chemical processes with reaction such as bypass operation, parallel operation

6. Numerical based on empirical equations of heat capacity, latent heat, heat of combustion, heat of formation
7. Numerical based on calorific value of fuels, combustion of fuels, proximate and ultimate analysis of fuels, excess air calculation
8. Numerical based on dew point, wet bulb and dry bulb temperature and Psychometric charts

Suggested Theory distribution:

The suggested theory distribution as per Bloom's taxonomy is as follows. This distribution serves as guidelines for teachers and students to achieve effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
15%	35%	25%	20%	5%	-

Instructional Method:

a. The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

b. The internal evaluation will be done on the basis of continuous evaluation of students in the laboratory and class-room.

c. Practical examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

d. Students will use supplementary resources such as online videos, NPTEL videos, e-courses, Virtual Laboratory.

Online Web Resources:

1. http://www.nptelvideos.in/2012/12/materials-and-energy-balance.html