Course No.	Course Name	L-T-P-Credits	Year of Introduction
CH201	CHEMICAL PROCESS CALCULATIONS	3-1-0-4	2016

Prerequisite : Nil

Course Objectives

1. To familiarise the conversion of units in different systems of units
2. To understand the basic concepts of concentration and other physical parameter.
3. To perform material and energy calculations for different Chemical Engineering processes.

Syllabus

Introduction to Chemical Engineering, Chemical process Industry, Unit Operations and Unit Processes, Units and Dimensions, Conversion of units, Conversion of equations.

Concepts of atomic weight, equivalent weight and mole, Composition of solids, liquids and solutions.

Ideal gas laws, gaseous mixtures, real gas laws, Average molecular weight, Compressibility factor, compressibility factor charts, Critical properties, pseudo critical properties.

Vapour Pressure: Effect of temperature on vapour pressure. Application of Clausius Clapeyron equation. Vapour pressure plots, Henry's law, Raoult's law, vapour pressure of immiscible liquids.

Material Balance without chemical reactions, material balance for unit operations- distillation, drying, evaporation, absorption etc. Recycling and bypass operations.

Material Balance with chemical reactions, Combustion of solid, liquid and gaseous fuels, Calorific value, proximate and ultimate analysis of coal, Orsat analysis, Material Balance problems for different unit Operations.

Energy Balance: Heat capacity, work, internal energy, heat capacities, Latent heat, enthalpy changes, energy balance for flow and non-flow processes, Standard heats of reaction, combustion, and formation- effect of temperature and pressure on heat of reaction. Hess law of constant heat summation, temperature of reaction, adiabatic reaction temperature.

Expected Outcome

At the end of the course students will be able to

1. Use the basic principles of chemical engineering and calculation of composition and other physical quantities.
2. Calculate different variables using state equations
3. Develop and solve material and energy balance equations
4. Compute the saturation temperature, relative humidity and wet bulb temperature

References Books:

1. K. V. Narayanan and B. Lakshmikutty, " Stochiometry and Process Calculations", Prentice Hall of India.
2. Bhatt and Vora, Stochiometry, T. M. H.
3. Himmelblau David M., "Basic Principles and Calculations in Chemical Engineering", Prentice Hall of India.

Course plan			
Module	**Contents**	**Hours**	**Sem. Exam Marks**
I	Introduction to Chemical Engineering, Chemical process Industry, Unit Operations and Unit Processes. Units and Dimensions: System of Units, Basic and Derived quantities, Conversion of units, Conversion of equations- problems. Specific gravity scales Concepts of atomic weight, equivalent weight and mole. Composition of solids, liquids and solutions (weight percent, mole percent, molarity, normality etc.), other expressions for concentration.	8	15%
II	Ideal gas laws, gas constant, gaseous mixtures, real gas laws, Vander Waals equation, Redlich- Kwong equation, Benedict- Web- Rubin Equation, Average molecular weight and density. Compressibility factor, compressibility factor charts, Critical properties, pseudo critical properties-problems.	8	15%
FIRST INTERNAL EXAMINATION			
III	Vapour Pressure: Effect of temperature on vapour pressure. Application of Clausius-Clapeyron equation. Vapour pressure plots, Cox charts, Duhrings Lines, Ideal Solutions and non-ideal solution - Henry's law, Raoult's law, Bubble point, Flash Vapourization, vapour pressure of immiscible liquids. Humidity, Dew point, Dry and Wet bulb Temperature, Adiabatic saturation, Humidity charts	9	15%
IV	Material Balance without chemical reactions- Introduction, key component, steps for solving material balance problems, material balance for unit operations- distillation, drying, evaporation, absorption etc. Recycling and bypass operations.	9	15%
SECOND INTERNAL EXAMINATION			
V	Material Balance with chemical reactions; definition of terms (limiting reactant, percentage yield etc.) Combustion of solid, liquid and gaseous fuels, Calorific value, proximate and ultimate analysis of coal, Orsat analysis. Material Balance problems for oxidation, chlorination, nitration, hydrogenation and related processes. Recycling, bypass and purging operations.	10	20%
VI	Energy Balance: Thermophysics. Heat capacity, work, internal energy, heat capacity of solids, liquids and gaseous mixtures, Latent heat, enthalpy changes, energy balance for flow and non-flow processes.	12	20%

	Thermochemistry: Standard heats of reaction, combustion, and formation- effect of temperature and pressure on heat of reaction. Hess law of constant heat summation, temperature of reaction, adiabatic reaction temperature.		
END SEMESTER EXAMINATION			

Evaluation Scheme

- **Internal Evaluation: Total Marks: 50**
  (i) *Total Marks for Assignment/Seminar/Project/Case study or any other appropriate tool used for the evaluation of the course outcomes:* **10**
  A minimum of above two tools shall be used. If more than 2 tools are used, proportionate change shall be made in the marks so that the total contribution of marks for item (i) above remains at 10.
  (ii) Marks for Tests: Two tests each carrying 40% weightage shall be conducted with total contribution of **40 marks**.

- **External Evaluation :** University Examination
  Maximum Marks : 100
  Exam Duration : 3 Hours

Question Paper Pattern:

There shall be **Three questions** uniformly covering Modules 1 and 2, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 3 and 4, each carrying 15 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 15 marks for all the subdivisions put together.
(2 x15= 30 Marks)

There shall be **Three questions** uniformly covering Modules 5 and 6, each carrying 20 marks, of which the student has to answer any **Two questions**. At the most 4 subdivisions can be there in one main question with a total of 20 marks for all the subdivisions put together.
(2 x20= 40 Marks)