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**FIRST SEMESTER 2023-2024**

# Course Handout Part II

Date: 11-08-2023

In addition to part-I (General Handout for all courses appended to the time table) this portion gives further specific details regarding the course.

*Course No.* : CHE F211

Course Title : Chemical Process Calculations

## Instructor-in-Charge : **Iyman Abrar**

**Scope and Objective of the Course:**

Chemical Process Calculations is one of the most fundamental courses of Chemical Engineering and serves as an introduction to the entire field. The course will introduce concepts, equations, processes and systematic problem solving techniques that the students will require and revisit while learning several other courses of Chemical Engineering and while solving various practical problems.

At the end of the course, the student should be able to:

* Solve material balance problems with or without chemical reaction for single and multiple units
* Using the concepts of recycle, bypass and purge in material balances
* Solve energy balance problems with and without chemical reactions using thermodynamic tables, psychrometric charts and basic thermodynamic principles
* Solve material and energy balance problems simultaneously
* Develop relationships between process variables for individual process units and some complex real-world processes common in chemical engineering.
* Present calculations and problem solutions in a professional manner.

**Textbooks:**

1. D. M. Himmelblau & J. B. Riggs, “Basic principles & calculations in chemical Engg”, PHI, 8th ed., 2012.

**Reference books**

1. R. M. Felder, R. W. Rousseau & L. G. Bullard, “Elementary Principles of Chemical Processes”, John Wiley & Sons, Inc., 4th ed., 2016.

**Course Plan:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1 | Introduction to Chemical Engineering | Brief history and contributions, current prospects, future research and directions | Ch 1 |
| 2, 3 | Units, Dimensions and their conversion, Dimensional consistency in equations | Units and Dimensions | Ch 2 (2.1-2.5) |
| 4, 5 | Mole, density and concentration, Choosing a basis | Density, specific gravity, mole fraction and mass fraction, concentration, how to choose a basis | Ch 2 (2.6-2.9) |
| 6 | Different units of temperature, pressure | Temperature and Pressure | Ch 2 (2.10-2.12) |
| 7-10 | Introduction to material balances | Concept of material balance, open and closed systems, steady state/unsteady state | Ch 3 |
| 11-12 | Solving material balance problems without chemical reactions | Material balances without chemical reactions | Ch 4 |
| 13-14 | Stoichiometry | Chemical reaction equations and stoichiometry | Ch 5 (5.1, 5.2) |
| 15-17 | Solving material balances with chemical reactions | Material balances with chemical reactions | Ch 5 (5.3-5.5) |
| 18-19 | Material balances involving multiple subsystems | Solving material balance problems involving multiple subsystems | Ch 6 (6.1, 6.2) |
| 20-23 | Material balances with recycle and bypass | Recycle bypass and purge calculations | Ch 6 (6.3-6.5) |
| 24-25 | Calculation procedures for ideal gas systems | Ideal gas law calculations, ideal gas mixtures and partial pressure | Ch 7 |
| 26-27 | Two phase systems | Vapor pressure, saturation, phase diagrams | Ch 8 |
| 28-30 | General energy balances for open and closed systems without chemical reactions | The general energy balance | Ch 9 |
| 31-32 | Calculation of enthalpy changes using heat capacity equations and enthalpy tables | Calculation of enthalpy changes | Ch 9 |
| 33-35 | Enthalpy balances with chemical reaction | Energy balances that account for chemical reactions | Ch 10 |
| 36-37 | Calculation of heat of mixing and heat of solution | Heats of solution and mixing | Ch 13 |
| 38-39 | Humidity chart and its use in determining the properties of moist air | Humidity charts and their use | Ch 11 |
| 40-42 | Solving simultaneous material and energy balances | Miscellaneous Examples | - |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration (minutes)** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Mid semester Test | 90 | 30 | 14/10 - 2.00 - 3.30PM | CB |
| Class Test (Min. 2) | - | 20 | Evenly spaced throughout the semester | OB |
| Assignment (Min. 1) | - | 10 | OB |
| Comprehensive Exam. | 180 | 40 | 21/12 FN | CB |

**Chamber Consultation Hour:** To be announced in the class.

**Notices:** Notices concerning the course will be displayed on the CMS.

**Make-up Policy:** Make-up for mid-semester and comprehensive examinations will be granted only for genuine cases with valid justification and only with a prior permission of the Instructor-in-charge. No make-up will be given for class tests and assignments.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Dr. Iyman Abrar**

**Instructor-in-charge**

**Chemical Process Calculations**