Haldia Institute of Technology

Department of Food Technology

COURSE INFORMATION

**Course Code: CHE514**

**Course Name: Unit Operations of Chemical Engineering II**

**Contacts: 4 hrs**

**Credits: 4 hrs**

COURSE OUTCOME

**At the end of this course, the incumbent will be able to:**

CH514.1 Identify, formulate, and review research literature, and analyze complex engineering problems also reaching substantiated conclusions using mathematics, natural science and their applications in food engineering and technology.

CH514.2 Analyze, research, design, develop substantiated solutions of practical chemical engineering based problems related to food industries and design system components or processes that meet specified needs with appropriate consideration for public health and safety & societal considerations.

CH514.3 Understand impact of professional engineering solutions in society in the context of environment, and demonstrate knowledge of and need for sustainability

CH514.4 Design also basic engineering processes and products to meet societal needs within realistic constraints such as economic, environmental, ethical, health and safety, feasibility, and sustainability

CH514.5 Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broad context of technological changes.

CH514.6 Demonstrate knowledge and understanding of engineering and management principles, and apply these in one’s own work taking into consideration the aspects of financial management.

PREREQUISITES

**To understand this course, the incumbent must have idea of:**

* Knowledge on basic units and conversion of unit, dimension,
* definition of steady state and unsteady state operation;
* laws of mass conservation and energy conservation; laws of vapor- liquid phase equilibrium; Laws of Ideal gases,
* fundamental equations of mass balance and energy balance for system
* Basic idea about each kind of unit operations, knowledge about the application of this course in respective professional field.

SYLLABI

Module 1: Introduction to mass transfer: Molecular diffusion in fluids, diffusivity, mass transfer coefficients, interphase mass transfer, gas absorption, countercurrent multistage operation, packed tower.

Module 2: Distillation: Vapor-liquid equilibrium, Rayleigh’s equation, flash and differential distillation, continuous rectification, McCabe-Thiele method, bubble cap and sieve distillation column.

Module 3: Extraction, Drying and Crystallization: Liquid-liquid equilibrium, liquid extraction, stage-wise contact, liquid-solid equilibria, leaching, batch drying and mechanism of batch drying, principle and operation of a spray drier, preliminary idea of crystallization

Module 4: Advanced separation processes: Dialysis, ultrafiltration, reverse osmosis, pervaporation, electro -dialysis and membrane separation.

LECTURE PLAN

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| **LectureNo.** | **Details of coverage** | **Handout, Lecture Notes, Links etc.** |
| 1 | Vapor-liquid equilibrium,Phase rule, Definition of distillation. | [Lecture Note1](file:///C%3A%5CDocuments%20and%20Settings%5CAdmin%5CDesktop%5CLecture%20Note.pdf) |
| 2 | Classification of different types of distillation | Lecture Note 2 |
| 3 | differentapplications of distillation. | Lecture Note 3 |
| 4 | Flash and differential distillation, Rayleigh’s equation | Lecture Note 4 |
| 5 | Problem using Rayleigh’s equation | Exercise /example problems |
| **6** | bubble cap and sieve distillation column, | Lecture Note 5 |
| **7** | effects of feed conditions | Lecture note 6;Visit: [**http://lorien.ncl.ac.uk/ming/distil/dist-tut.htm**](http://lorien.ncl.ac.uk/ming/distil/dist-tut.htm) |
| **8,9,10,11,12** | McCabe-Thiele method, problems | Visit: [**http://lorien.ncl.ac.uk/ming/distil/dist-tut.htm**](http://lorien.ncl.ac.uk/ming/distil/dist-tut.htm),;Exercise /example problems |
| 13 | Reflux, tray efficiencies | Visit: [**http://www.separationprocesses.com/Distillation/DT\_Chp04n.htm**](http://www.separationprocesses.com/Distillation/DT_Chp04n.htm)Lecture Note 6 |
| 14,15 | Molecular diffusion in fluids (gasses and liquids) | Lecture Note 7 |
| 16,17,18,19,20 | diffusivity, problems | Lecture Note 8, Exercise /example problems |
| 21 | mass transfer co-efficients, mass transfer theories in diffusion | Lecture Note 9 |
| 22,23,24,25 | Absorption: countercurrent multistage operation, problems | Lecture Note 10, Exercise /example problems |
| 26 | Absorption packed tower | Lecture Note 11 |
| 27,28 | Drying: Introduction, classification of drying principles; Types of dryers, applications | Lecture Note 12 |
| 29 | Batch drying and mechanism of batch drying | Lecture Note 13 |
| 30 | Principle and operation of a spray drier | Lecture Note 14 |
| 31,32 | Problems on drying |  Exercise /example problems |
| 33 | Liquid-liquid equilibrium, liquid extraction, stage-wise contact, liquid-solid equilibrium, application | Lecture Note 15 |
| 34 | Brief discussion on leaching process and its application | Lecture Note 16 |
| 35 | preliminary idea on crystallization | Lecture Note 17 |
| 36 | Mier’s theory , growth of crystallization | Lecture Note 18 |
| 37 | Problems on crystallization | Lecture Note 19, Exercise /example problems |
| 38 | Introduction: significance, applications, different types of membrane separation process, membrane modules. | Lecture Note 20 |
| 39 | different types of membrane separation process, membrane modules. | Lecture Note 21 |
| 40 | Dialysis,Problems, electrodialysis , problem solving | Lecture Note 22, Exercise /example problems |
| 41 | electrodialysis , problem solving | Lecture Note 23, Exercise /example problems |
| 42,43 | reverse osmosis, mechanism, problem solving, pervaporation | Lecture Note 24, Exercise /example problems |
| 44, | Ideal flow patterns for gas phase separation process. | Lecture Note 25 |
| 45,46,47 | Ultra filtration, gel polarization, problem solving, | Lecture Note 26, Exercise /example problems |

RECOMMENDED READINGS

**TEXT**

1. Transport Processes & Unit operations; Geankopolis; 3rd ed, PHI.

2. Unit Operations of Chemical Engineering; McCabe, Smith &Harriot; 6th ed,TMH..

**REFERENCE**

1. Chemical Engineering, Vol-I & II, Colson & Richardson; Butterworth Heinemann.

2. Chemical Engineer’s Handbook; Perry, Chilton & Green; MGH.

3. Mass Transfer Operations, Treybal, MGH.