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**SECOND SEMESTER 2021-2022**

# Course Handout Part II

Date: 15/01/2022

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 F343**

## Course Title : **Process Design Principles-II**

Instructor-in-Charge : **Dr. Pankaj Kumar**

**Scope and Objective of the Course:**

Process Design Decisions/Principles is about coupling chemical engineering principles to the principles of economics. The economics success is important for the viability of any chemical industry. The purpose of this course is to introduce the students to the detailed design and economical aspects of chemical engineering processes and operations. After a few topics covering the detailed design procedures and sizing of chemical engineering equipments, a thorough description of costing and profitability analysis would be covered and finally optimization of flow sheets would be dealt with.

**Textbooks:**

1. Seider W.D., Seader J.D. & Lewin D.R., “Product and Process Design principles: Synthesis, Analysis and Evaluation”, John Wiley & Sons, Inc., 2nd edition.

**Reference books**

1. S. B. Thakore, B. I. Bhatt, “ Introduction to Process Engineering & Design”, McGraw Hill Publications
2. Mc Cabe and Smith., ‘Unit Operation of Chemical Engineering’, McGraw Hill Publications
3. Max. Peters, K Timmerhaus and Ronal West, “Plant Design and Economics for Chemical Engineers” McGraw Hill

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapter in the Text Book** |
| 1-2 | Introduction to Course | Introduction to process synthesis | Chapter 1 TB |
| 3-6 | Design of Heat Exchangers | Introduction, HE equipment, Heat transfer coefficients & Pressure Drop calculations, Shell & tube HE design | Chap 13 TB  Chap 6 Ref 1 |
| 7-10 | Design of Separation towers (Distillation, Absorption and Extraction) | Distillation systems: principles, and shortcut methods, rigorous methods with simulator, Tower design: Plate efficiency, HETP, Tower diameter, pressure drop | Chapter 19 TB  Chapter 8, 9 Ref 1 |
| 11-13 | Process design of piping | Optimum pipe size calculation, recommended fluid velocities in pipe pressure drop in pipes, fittings and valves, fluid moving devices flow meters | Chapter 5 Ref 1 |
| 14-15 | Process design of fluid moving devices | Process design of flow meters orifice/venturi and rotameters | Chapter 5 Ref 1 |
| 16-19 | Process design of Pumps, Compressors & Expanders | Centrifugal pumps, positive displacement pumps, characteristic curves, NPSH and power requirement, pump models in simulator, compressors and expanders | Chapter 15 TB  Chapter 5 Ref 1 |
| 20-21 | Flow diagrams in process synthesis | Process flow diagrams, Piping and Instrumentation diagrams | Reading material will be provided |
| 22-24 | Introduction to costing, Cost indexes | Cost indexes, six-tenths factor, capital investment for commodity chemicals | Chapter 16 TB  Chapter 6 Ref 3 |
| 25-27 | Capital investment costs, estimating Total Capital Investment | Direct, indirect and other investment costs, Different Estimation methods for TCI. | Chapter 16 TB  Chapter 6 Ref 3 |
| 28-31 | Purchase costs of process Equipments and other processing equipments | Purchase costs of pumps, fans, compressors, heat exchangers and pressure vessels, purchase costs of adsorption , agitators, evaporators, extractors, etc. | Chapter 16 TB  Chapter 6 Ref 3 |
| 32-35 | Annual costs and annual revenues, Working capital and capital investment | Estimate cost of feedstock and utilities, waste processing, overhead costs, depreciation to estimate total production cost, Estimation of working capital | Chapter 17 TB |
| 36-39 | Profitability measures, Cash flows and depreciation | Return on investments, payback period, annualized costs, estimate selling price of products, Time value of money, Interest rates, Compute cash flows to project net present value and investors rate of return, inflation | Chapter 17 TB  Chapter 8 Ref 3 |
| 40-42 | Optimization of flow sheets & Product Design | Introduction ,general formulation, linear programming, non -linear programming with single variable, NLP for more variables, optimization algorithms, case studies for flow sheet optimizations | Chapter 18 & 19 TB |

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration (minutes)** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| Midsemester Test | 90 | 35 | 16/03 3.30pm to5.00pm | Open Book |
| Assignments | - | 10 | Throughout the semester | Open Book |
| Quizzes/ Viva  (3) | - | 15 | Throughout the semester | Closed book |
| Comprehensive Exam | 120 | 40 | 23/05 FN | Open Book/Closed book |

**Chamber Consultation Hour:**

To be announced in the class.

**Notices:**

Notices, if any, concerning the course will be displayed on the CMS website

**Make-up Policy:**

Make-up is granted only for genuine cases with valid justification and only with prior permission of Instructor-in-charge.

**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. Pankaj Kumar**

**INSTRUCTOR-IN-CHARGE**