



**SECOND SEMESTER 2020-2021**

Course Handout Part II

Date: 16/01/2021

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., 2<sup>nd</sup> 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:**

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	Distillation systems: principles, and shortcut methods, rigorous methods with simulator, Tower design: Plate efficiency,	Chapter 19 TB Chapter 8, 9 Ref 1



	Extraction)	HETP, Tower diameter, pressure drop	
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:



Component	Duration (minutes)	Weightage (%)	Date & Time	Nature of Component
Midsemester Test	90	35	04/03 11.00 -12.30PM	OB
Assignments (1)	-	10	Will be announced in class	OB
Quizzes/ Viva (3)	-	15	Throughout the semester	OB
Comprehensive Exam	120	40	10/05 AN	OB

**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 academic integrity Policy:**

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

**Dr. Pankaj Kumar**  
**INSTRUCTOR-IN-CHARGE**

