INSTRUCTION DIVISION
SECOND SEMESTER 2015-2016
Course Handout (Part II)

Date:12/01/2016

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

Course No.	**:**	**CHE G551**
Course Title	**:**	**Advanced Separation Techniques**
Instructor-in-Charge	**:**	**SURESH GUPTA**

1. Course Description

A brief review of the existing separation technologies such as adsorption-based separation, membrane separation, cryogenic separation, and biotechnology-based separation. Recent advancements on the above areas and new concepts such as simulated moving bed adsorption, thermally coupled pressure swing adsorption, reactive distillation, bio-filtration, supercritical fluid extraction *etc*. This course will terminate with several design projects on real life problems.

2. Scope and Objective

Continuous research and developmental activities across the world have enhanced the scope of chemical engineering application in the field of separation technology. This course gives the basic overview of the existing technologies such as adsorption, membrane separation, cryogenic separation and biotechnological separation. It also covers upcoming topics such as reactive distillation, supercritical fluid extraction *etc.* Another interesting feature of this course is that it gives the students a perspective of the application of these technologies via projects related to recent research topics.

3. Text Book (TB)

1. Seader, J. D. and E. J. Henley, " Separation Process Principles", *John Wiley & Sons, Inc. (Wiley India (P) Ltd.,* New Delhi), 2nd Ed., 2006.

4. Reference Books (RB)

1 Gupta, R. K. and A. K, Ghoshal "Advanced Separation Technology", *EDD Notes* *, BITS, Pilani, 2000.

* Need revision. They will be supplemented and the relevant material will be provided as and when required. Be prepared to think and work out of the box too.

2. Ruthven, D. M., S. Farooq and K. S. Knaebel, "Pressure Swing Adsorption", *VCH Publishers*, NY, 1994.
3. Barron, R., "Cryogenic Systems", *Oxford University Press*, NY, 2nd Ed. 1985.
4. Bailey, J. E. and D. V. Ollis, "Biochemical Engineering Fundamentals", *Mc-Graw Hill*, 1986.

5. Ruthven, D. M. "Principles of Adsorption and Adsorption Processes", John Wiley and Sons, 1984.
6. Mukhopadhyay M., "Natural Extracts using Supercritical Carbon Dioxide", *CRC Press*, LLC, Boca Raton, Florida, USA, 2000.
7. Research Papers from Refereed Journals / Resources.
8. Dynamic addition of reference material will be shared.

5. Course Plan

Lecture No.	Learning Objectives	Topics to be covered	Reference
1	Introduction to the topic	-	Ch.1 TB
2-3	Concept of adsorption	Types of adsorption; type of isotherm; adsorption kinetics; adsorbent	Ch. 15 TB
4-5	Concept of adsorber design	Basic modeling approach with suitable boundary condition	
6 – 9	Concept of advanced adsorption and adsorber design	Upcoming adsorption techniques and their modeling approach; application of adsorption in different areas	
10 – 11	Concept of cryogenics	Introduction to cryogenic systems; low temperature properties and phenomena; application as separation and purification technique	Ch. 2 (Sec. 2.1-2.2 and 2.9) RB1
12 – 14	Liquefaction techniques	Gas liquefaction, different air liquefaction cycles	Ch. 2 (Sec. 2.6 to 2.8) RB1
15 – 18	Cryogenic separation	Cryogenic distillation; refrigeration systems, techniques for storage and transportation	Ch. 2 (Sec. 2.3 to 2.5, 2.10 to 2.12) RB1
19 – 21	Concept of membrane	Classification of membrane based on structures, flow, fabrication *etc.*	Ch. 14 TB
22 – 23	Membrane separation	Gas and liquid phase separation; pervaporation; liquid membrane; membrane reactor	
24 – 26	Design of membrane based separator	Modeling approach; design considerations and applications	
27	Concept of biotechnology	Introduction to bio-kinetics	Ch. 4 (Sec. 4.1 to 4.2) RB1
28 – 30	Biotechnological separation	Types of bio-reactors and different techniques for bio-separation	Ch. 4 (Sec. 4.3) RB1
31 – 34	Biotechnology based separator design	Modeling approach, design considerations and applications	Ch. 4 (Sec. 4.2 to 4.3) RB1
35 – 38	Other advanced techniques and concepts	Concept of reactive distillation; supercritical fluid extraction	Ch. 5 (Sec. 5.1) RB1
39 – 41	Design	Modeling approach, design considerations and applications	Ch. 5 (Sec. 5.1) RB1

Evaluation Scheme

Evaluation Component	Duration	Weightage	Date & Time	Nature of Component
Mid semester test	90 min.	25%	18/3 4:00- 5:30 PM	CB
Project	-	10%		OB
Surprise tests (5 out of 6)	-	10%		CB/OB
Assignments	-	20%		OB
Comprehensive Examination	3 hr.	35%	13/5 AN	CB/OB

- Chamber consultation hours will be announced in the class.
- The notices will be displayed on the Chemical Engineering Group notice board and on Nalanda.
- Make-up will be granted for genuine cases only. Prior permission of IC is compulsory.

Instructor–in-Charge
CHE G551