**BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE, PILANI**

**HYDERABAD CAMPUS**

**FIRST SEMESTER 2020-2021**

**Course Handout (Part II)**

Date: 17/08/2020

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 F313**

***Course Title* : SEPARATION PROCESSES II**

***Instructor‑in‑charge* :Balaji Krishnamurthy**

# **Tutorial Instructors** :Balaji Krishnamurthy

1. **Scope and Objective of the Course:**

This course deals with chemical engineering unit operations which are used to separate solids from solids or solids from liquid or solids from gas in many of the chemical and pharma industries. These operations include size reduction followed by sieve analysis, mechanical separations such as filtration, crystallization, drying, adsorption, humidification and membrane separation process. There are many physical operations that are common to many industrial processes. Each of these processes is classified according to their function without regard to the industry. Each such operation is studied as a unit operation in this course.

**2. Learning Outcomes:**

1. The students should be familiar and have gained some expertise with aspects of particulate solids and particle dynamics that is commonly encountered in chemical, ceramic, metallurgical, mining, pharmaceutical, food and biotechnology industries.
2. Since the course covers a large number of unit operations of Chemical Engineering, the students should attempt to solve mass transfer/separation based industry related issues in a confident and feasible manner with combination of conceptual, numerical and design based solutions learnt during the course of the semester.
3. The students should have learnt the skill of coupling micro and macro aspects of a separation process, to combine both materials and processes involved and to apply interdisciplinary skills of science and engineering in problem-solving.
4. Finally, the students should be comfortable and skillful in handling real-world case studies that they would encounter in their future endeavors of practice school, placements and higher education.

2. **Text Book:**

McCabe W. L., and Smith J. M., & Harriott P., *Unit Operations of Chemical Engineering*, Seventh Edition., McGraw-Hill International Edition, 2005.

3. **Reference Books:**

R1*Mechanical Operations*, Anup Swain, Hemalatha Patra, GK Roy . McGraw Hill Education, 2011.

R2 *Separation Process Principles*, JD Seader and Ernest J. Henley, 2nd Edition, John Wiley & Sons, 2001.

R3 *Principles of Unit Operations*, Foust A. N. & others, 2nd Edition, John Wiley & Sons, 1980.

**4. Course Plan:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Let.No.** | **Learning Objectives** | **Topics to be covered** | **TB/Ref. Book** |
| 1. | Properties and Handling of particulate solids | Characterization of Solid particles,  Particle size distribution, Screen analysis | Ch. 28 (TB) |
| 2 | Mixing of solids | Mixers for cohesive/non-cohesive solids | Ch. 28 (TB) |
| 3-4 | Size reduction | Size reduction, equipment for size  Reduction, Ultrafine grinders | Ch. 28 (TB), Ch. 2 (R1) |
| 5 | Mechanical separation | Screening, screening equipment | Ch. 29 (TB), Ch. 5 (R1) |
| 6-7 | -do- | Filtration (Plate and frame filter press, rotary drum vacuum filtration, Centrifugal filters) | Ch. 29 (TB), Ch. 6 (R1) |
| 8-9 | -do- | Principles of cake filtration, Filtration calculations | Ch. 29 (TB) |
| 10-11 | -do- | Gravity sedimentation processes ( clarifier, classifier and thickeners, flocculation) | Ch. 29 (TB) |
| 12 | -do- | Centrifugal sedimentation processes | Ch. 29 (TB) |
| 13-14 | Drying of Solids | Principles of Drying | Ch. 24 (TB), Ch. 18 (R1) |
| 15-16 | -do- | Cross circulation drying | Ch. 24 (TB) |
| 17-18 | -do- | Through circulation drying, Freeze drying, Drying equipment | Ch. 24 (TB) |
| 19-21 | Fixed Bed separation | Adsorption, adsorption equipment | Ch. 25 (TB), Ch. 15 (R2) |
| 22-23 | -do- | Ion-exchange | Ch. 25 (TB), Ch. 15 (R2) |
| 24-25 | -do- | Chromatography | Ch. 25 (TB), Ch. 15 (R2) |
| 26-28 | Membrane separation | Separation of gases | Ch. 26(TB), Ch. 14 (R2) |
| 29-31 | -do- | Separation of liquids (Dialysis, Pervaporation, Reverse osmosis) | Ch. 26 (TB) |
| 32-33 | Crystallization | Introduction, Crystal geometry, Equilibria, Super saturation | Ch. 27 (TB), Ch. 10 (R1), Ch. 17(R2) |
| 34-37 | -do- | Nucleation, Crystal growth &crystallization equipment and Crystallizer design | Ch. 27 (TB) |
| 38-42 | Lab tour | Ball mill, sieving, jaw crushing, sedimentation, blending/extrusion, sonication, high speed homeginizers, electrospinning, freeze drying, centrifugation, humidification and crystallization. | Notes |

**5. Evaluation Scheme:**

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| --- | --- | --- | --- | --- |
| **Component** | **Duration** | **Weightage** | **Date & Time** | **Remarks** |
| Test I | 30min | 15% | September 10 –September 20 (During scheduled class hour) | OB |
| Test II | 30 min | 15% | October 09 –October 20 (During scheduled class hour) | OB |
| Test III | 30 min | 15% | November 10 – November 20 (During scheduled class hour) | OB |
| Quizzes, Assignments | TBA | 20% |  | OB |
| Comprehensive Exam | 2 hours | 35% | TBA | OB |

**7**. **Chamber Consultation Hour:** To be announced later. **(Chamber: D 217)**

**8**. **Notice:** Notice will be displayed on Chemical Engineering Notice Board or CMS

**9. Make-up policy**: Make-up will be granted after he /she maintains minimum 60 % attendance in the class (Biometric attendance). Certificate from authenticated doctor from the Medical Center must accompany make-up application and follow the ID guidelines for midterm and compre exams.

**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.

Instructor‑in‑charge

CHE F313