BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI

**First Semester 2023-2024**

**Course Handout (Part-II)**

**11-08-2023**

**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 F314**

**Course Title :** **Process Design Principles I**

**Instructor-in-Charge (IC) : Dr. Arnab Dutta**

**Office No. of IC : D216**

**Scope & Objective:**

The course as a whole, Process Design Principles, is designed to bring together the concepts of engineering and economics for chemical plant design and optimization. In the first part of this course (i.e., **Process** **Design Principles I**) in this semester will combine the individual aspects of chemical engineering such as fluid mechanics, mass transfer, heat transfer, chemical reaction engineering, chemical process calculations, thermodynamics, etc. for designing different chemical processes. Knowledge of different process heuristics followed by the design of separation trains, reactor networks, heat exchanger networks, and process integration will be discussed. The students will be exposed to process simulation via hands-on sessions in Aspen HYSYS, which is a commonly used process simulator in chemical engineering domain spanning both academia and industries.

On completion of this course, students should be able to appreciate the following **learning outcomes**:

* Understand different heuristics pertaining to process synthesis
* Develop process flowsheet simulations using Aspen HYSYS
* Synthesize separation trains
* Design heat exchanger networks for maximizing energy recovery
* Apply process design and synthesis concepts in the chemical engineering domain

**Text Book:**

T1 Warren D. Seider, J. D. Seader, and Daniel R. Lewin, “**Product & Process Design Principles: Synthesis, Analysis, and Evaluation**”, John Wiley & Sons, New York, 3rd Edition, I.S.V.   
[Reprint: 2017]

**Reference Book:**

R1 Robin Smith, “**Chemical Process: Design and integration**”, John Wiley & Sons, New York, 2nd Edition [2016].

**Course Plan:**

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| --- | --- | --- | --- |
| **Lecture No.** | **Learning objectives** | **Topics to be covered** | **Chapters in the Text Book** |
| 1-4 | Introduction | Product design  Process synthesis | Ch.: 1, 2, & 4 (T1) |
| 5-6 | Block  Flow Diagram | Formulation  Calculations | Reference Materials will be provided |
| 7-10 | Process Simulation | Introduction to process simulator: Aspen HYSYS  Basic Simulations using Aspen HYSYS | Ch.: 5 (T1)  Reference materials will be provided |
| 11-16 | Process Simulation | Heat Exchanger Simulations using Aspen HYSYS  Reactor Simulations in Aspen HYSYS  Distillation Column Simulations in Aspen HYSYS | Ch.: 5 (T1)  Reference materials will be provided |
| 17-18 | Process Synthesis: Heuristics | Heuristics associated with different unit operations | Ch.: 6 (T1) |
| 19-23 | Separation Train Synthesis | Sequencing of distillation columns for separating near ideal fluid mixtures | Ch.: 8 (T1)  Ch.: 11 (R1) |
| 24-25 | Reactor Networks | Reactor network design | Ch. 7 (T1) |
| 26-31 | Heat Exchanger Networks (HEN)-I: Energy Target | Maximum energy recovery (Minimum utility consumption)  Pinch analysis  Temperature-Interval method  Composite curve method | Ch.: 9 (T1)  Ch.: 16 (R1) |
| 32-35 | Heat Exchanger Networks (HEN)-II: Total cost Target | Minimizing annual (capital & operational) costs  Reduce number of Heat Exchangers: Breaking heat loops  Reduce number of Heat Exchangers: Stream splitting | Ch.: 9 (T1)  Ch.: 17, 18 (R1) |
| 36-37 | Process Integration | Data extraction  Heat-Integration | Ch.: 9 (T1)  Ch.: 19, 21 (R1) |
| 38-40 | Research Applications | Use of Aspen HYSYS in Research  Experiential learning through research papers | Reference materials will be provided |

**Note:** Weekly tutorial sessions will be based on using **Aspen HYSYS** as the process simulator, which will take place in the **CAD Lab.**

**Evaluation Scheme:**

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| --- | --- | --- | --- | --- | --- |
| **EC No.** | **Evaluation Component** | **Duration** | **Weightage (%)** | **Date & Time** | **Nature of Component** |
| 1. | Midterm | 90 min | 25 | 12/10 - 11.30 - 1.00PM | Open Book |
| 2. | Comprehensive | 180 min | 35 | 14/12 AN | Closed Book (15) + Open Book (20) |
| 3. | Assignments (2) | TBA | 20 | Equally-spaced out | Open Book |
| 4. | Continuous Assessment | TBA | 15 | Throughout the semester | Open Book (10) + Closed Book (5) |
| 5. | Viva (1) | TBA | 5 | Tentatively towards the end of semester | Closed Book |

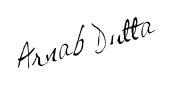
**Chamber Consultation Hour:** TBA

**Notices:** All notices concerning this course will be displayed on the Chemical Engineering Notice Board

**Make-up Policy:** Make-up is granted only for genuine cases with valid justifications at the discretion of the IC. A prior permission from the Instructor-in-charge is required. Decision of the IC will be final.

There will be NO provision for Make-up w.r.t. assignments, continuous assessments, and viva components.

**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

###### (Dr. Arnab Dutta)

###### CHE F314