Universitat Autònoma de Barcelona

2023/2024

Experimentation in Chemical Engineering III

Code: 102394
ECTS Credits: 3

Degree	Type	Year	Semester
2500897 Chemical Engineering	OB	3	2

Contact

Name: Maria Eugenia Suarez Ojeda

Email: mariaeugenia.suarez@uab.cat

Teaching groups languages

You can check it through this link. To consult the language you will need to enter the CODE of the subject.
Please note that this information is provisional until 30 November 2023.

Teachers

Felicitas Vazquez Lima

Laura Talens Peiro

Daniel Gonzalez Ale

Arnau Sala Marti

Lluc Olmo Cerdà

Oscar Enrique Romero Ormazabal

Meilyn Gonzalez Cortes

Prerequisites

To have completed the subjects: Balances in chemical engineering balances, separation operations, heat transfer and chemical reactors.
To be enrolled in the subject control and instrumentation. Level B2 (European reference framework) of Catalan or Spanish.

Objectives and Contextualisation

To put into practice concepts acquired in compulsory subjects of the Degree in Chemical Engineering such as: Mass and energy balances, separation operations, chemical reactors and control and instrumentation.
To familiarize yourself with analytical techniques and experimental rigs.
To consolidate the theoretical foundations acquired in the subjects previously studied.
To apply the statistical analysis of experimental measures, including sensitivity analysis, significant figures and so.
To acquire, to process, to analyse and to correlate experimental data using the appropriate tools. To critically assess the results obtained.

To efficiently communicate,in written form, the knowledge, the results and their analysis and the conclusions related to experiments performed.

Competences

- Analyse, evaluate, design and operate the systems or processes, equipment and installations used in chemical engineering in accordance with certain requirements, standards and specifications following the principles of sustainable development.
- Apply scientific method to systems in which chemical, physical or biological transformations are produced both on a microscopic and macroscopic scale.
- Assume the values of professional responsibility and ethics required in chemical engineering.
- Demonstrate knowledge of the different reaction, separation and processing operations for materials, and transport and circulation of fluids involved in the industrial processes of chemical engineering.
- Demonstrate understanding of the main concepts for controlling chemical engineering processes.
- Develop personal attitude.
- Develop personal work habits.
- Develop thinking habits.
- Observe ethics and professionalism.
- Understand and apply the basic principles on which chemical engineering is founded, and more precisely: balances of matter, energy and thermodynamic momentum, phase equilibrium and kinetic chemical equilibrium of the physical processes of matter, energy and momentum transfer, and kinetics of chemical reactions
- Work in a team.

Learning Outcomes

1. Adapt to unforeseen situations.
2. Apply matter and energy balances to continuous and discontinuous systems.
3. Apply numerical methods to resolve empirical cases.
4. Apply temperature and level PID control.
5. Assume social, ethical, professional and legal responsibility, if applicable, derived from professional exercise.
6. Critically evaluate the work done.
7. Develop scientific thinking.
8. Generate innovative and competitive proposals in professional activity.
9. Identify, manage and resolve conflicts.
10. Manage information by critically incorporating the innovations of one's professional field and analyse future trends.
11. Operate common equipment used in the chemical industry.
12. Perform a critical analysis of experimental results and of the overall work done.
13. Perform experiments.
14. Perform separation operations.
15. Practice the fundamental laws of thermodynamics.

Content

The planned contents are as follows, but possible operational restrictions may require prioritization or reduction of such contents.
A) Laboratory sessions (supervised activity) 15 sessions of 3 hours, at laboratory Q6/0006.
The presentation of the subject will be held on the first day of the second semester and it is compulsory the assistance. In these 15 sessions, the following experiments are carried out:

1.- Reactors. To study the behavior of an irreversible second-order reaction in ideal chemical reactors (DSTR, CSTR and FPR). To determine the variation of the kinetic constant with the temperature. To analyse the reliability of applying theoretical design equations in an CSTR and PFR.
2.- Distribution of the residence time in reactors. To analyse the real behavior of a system of chemical reactors (CSTR, FPR and CSTR+FPR) from the distribution of residence time (DTR) of each system.
3.- Control. To analyse of the response for both open and closed loop in two processes (temperature and level).
4.- Valves. To study the response of different control valves for different control signals and in different operating conditions. To prepare the characteristic curves for each of the three valves available in the experimental rig.
5.- Heat exchangers with Aspen Exchanger Design and Rating (EDR). Designing a heat exchanger of shell and tubes from the data obtained using the Kern method. To study of different configurations of exchanger.
6.- Rectification. Calculation of the number of plates from the column at total reflux. Checking the equations of Rayleigh and Block. Calculation of the necessary useful power. Calculation of the cooling water needs. Checking the mass balance.
B) Practical reports (autonomous activity)
Preparation of lab reports based on the data obtained in the laboratory, analysis and discussion of thedata obtained and comparison with the appropriate bibliography, calculation of the propagation of errors and/or sensitivity analysis. Preparation of detailed calculation examples.

Methodology

It is a compulsory the attendance to the subject due to its hands-on character in the laboratory.
Depending on the number of students, the academic calendar and the number of experimental facilities available, students will be divided into shifts and each shift in work teams of 2 or 3 persons as maximum.
Safety and hygiene measures should be followed all the time.

Annotation: Within the schedule set by the centre or degree programme, 15 minutes of one class will be reserved for students to evaluate their lecturers and their courses or modules through questionnaires.

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Carrying out the experiments and consolidatidation of working habits in the laboratory and in handling the equipment	45	1.8	1, 4, 5, 6, 7, 13, 14, 8, 10, 9, 11, 15
Presentation of the lab experiments to be done and their operation. Distribution of groups and shifts.	3	0.12	1, 9
Type: Supervised			
Preparation and completion of the exam	4	0.16	
Type: Autonomous			
Preparation of practical reports	23	0.92	1, 2, 6, 7, 12, 9

Assessment

Student's assessment may experience some modifications depending on the restrictions to face-to-face activities enforced by health authorities.

The specific details of the assessment of this subject can be found in the Catalan version of this document. If necessary, you can contact the faculty responsible for the subject.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Attitude in the laboratory. Attendance, organization and time management. Cleaning and care of the work area, punctuality, following of safety regulations. (It will be calculated as: 50% peer assessment and 50% professors assessment).	20%	0	0	1, 2, 4, 3, 5, 6, 7, 13, 14, 12, 8, 10, 9, 11, 15
Final exam (individual)	30%	0	0	2, 3, 7, 12, 9
Reports of experiments performed (in group)	50%	0	0	1, 2, 3, 5, 6, 7, 12, 8, 10, 9, 15

Bibliography

• Aspen Technology, Inc. https://www.aspentech.com/en/products/pages/aspen-exchanger-design-and-rating-edr. Consultat per última vegada el 03/07/2021.
• Aris R. Análisis de reactores. Ed. Alhambra. Madrid, 1973.
• Coulson, J. M., Richardson, J. F. Ingenieria química. Vol. 2 Operaciones unitarias. Ed. Reverté. Barcelona, 2002. Accés restringit als usuaris de la UAB http://www.sciencedirect.com/science/book/9780080490649. Consultat per última vegada el 09/07/2021.
• Henley, E. J., Seader, J. D. Operaciones de separación por etapas de equilibrio en ingenieria química. Ed. Reverté. Barcelona, 1988.
• McCabe, W. L., Smith, J. C., i Harriot, P. Operaciones unitarias en ingeniería química. Ed. McGraw-Hill. Mèxic, 2007.
• King, C. J. Procesos de separación. Ed. Reverté. Barcelona, 1980.
• Levenspiel O. Ingenieria de las reacciones químicas. Ed. Limusa Wiley. México, 2004.
• Levenspiel O. The Chemical reactor omnibook. Ed. Corvallis-Oregon State University. Oregon, 2002.
• Perry, R. H., Chilton, C. H. Perry's chemical engineers' handbook. 9a ed. Ed. McGraw-Hill. New York, 2018.
• Ollero de Castro, P., Fernández, E. Control e instrumentación de procesos químicos. Ed. Síntesis. Madrid (Espanya), 1997.
• Romagnoli J. A., Palazoglu, A. Introduction to Process Control. Ed. CRC Taylor and Francis. Boca Ratón (EUA), 2006.
• Scott Fogler, H. Elementos de ingeniería de las reacciones químicas. Ed. Pearson Educación. México, 2008.
• Seborg, D. E., Edgar, T.; Mellichamp, D. A. Process Dynamics and Control. 2a edició. Ed. John Wiley & Sons. Nova York, 2004.
• Stephanopoulos, G. Chemical Process Control: An Introduction to Theory and Practice. Ed. Prentice-Hall. New Jersey, 1984.

Electronic references

Ravi,R. Vinu, R. Gummadi, S. N.. (2017). *Coulson and Richardson's Chemical Engineering, Volume 3A - Chemical and Biochemical Reactors and Reaction Engineering (4th Edition).* Elsevier. Retrieved from https://app.knovel.com/hotlink/toc/id:kpCRCEVAC1/coulson-richardsons-chemical/coulson-richardsons-chemical

Rohani, Sohrab. (2017). *Coulson and Richardson's Chemical Engineering, Volume 3B - Process Control (4th Edition).* Elsevier. Retrieved from https://app.knovel.com/hotlink/toc/id:kpCRCEVBP8/coulson-richardsons-chemical/coulson-richardsons-chemical

Software

MS Excel and MS Word

Matlab

Polymath

Aspen Hysys

Labview

Armfield equipment software

Tailor-made software for control of equipments