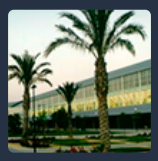

REACTOR DESIGN I

Universitat d'Alacant
Universidad de Alicante

34524 - REACTOR DESIGN I (2024-25)

General

Code: 34524
Lecturer responsible:
ARACIL SAEZ, IGNACIO

Credits ECTS:	**6,00**
Theoretical credits:	1,32
Practical credits:	1,08
Distance-base hours:	3,60

Departments involved

- **Dept:** CHEMICAL ENGINEERING
  Area: CHEMICAL ENGINEERING
  Theoretical credits: 1,32
  Practical credits: 1,08
  This Dept. is responsible for the course.
  This Dept. is responsible for the final mark record.

Study programmes where this course is taught

- DEGREE IN CHEMICAL ENGINEERING
  Course type: COMPULSORY (Year: 3)
- UNIVERSITY MASTER'S DEGREE IN CHEMICAL ENGINEERING
  Course type: COMPLEMENTARY TRAINING (Year: 1)
  Course type: COMPLEMENTARY TRAINING (Year: 9)

Competencies and objectives

Course context for academic year 2024-25

This is a compulsory subject that is taught in the first semester of the third year of the Chemical Engineering Degree after students have studied certain subjects in which they must have acquired the basic knowledge required to address this subject, which are:

- Macroscopic mass and energy balances on reactive systems

- Introduction to the thermodynamics and kinetics of chemical reactions

- Numerical solutions of integral and differential equations systems

- Use of software for numerical computation (Matlab and Excel or similar)

The training of students is conducted through lectures, computer lessons and group tutorials. In addition, training will be expanded and enhanced in the subjects “Reactor Design II” and “Experimentation in Chemical Engineering II”.

This subject is taught in the third grade, so students should come after acquiring the previous basics and having developed the skills to handle with ease calculation tools for problem solving, literature search and, where appropriate, to communicate in English. They all will be continued to progress in.

IMPORTANT: The course is offered in both English and Spanish in all its activities (lectures, group tutorials and computer lessons). The students will choose in which language they want to attend but in any case, the restrictions may be based on the number of students in each group.

Course content (verified by ANECA in official undergraduate and Master's degrees) for academic year {0}

Specific Competences (CE)

- **CE19 :** Coneixements sobre balanços de matèria i energia, biotecnologia, transferència de matèria, operacions de separació, enginyeria de la reacció química, disseny de reactors, i valorització i transformació de matèries primeres i recursos energètics.
- **CE20 :** Capacitat per a l'anàlisi, disseny, simulació i optimització de processos i productes.

Skills/Skills

- **CB1 :** Que los estudiantes hayan demostrado poseer y comprender conocimientos en un área de estudio que parte de la base de la educación secundaria general, y se suele encontrar a un nivel que, si bien se apoya en libros de texto avanzados, incluye también algunos aspectos que implican conocimientos procedentes de la vanguardia de su campo de estudio.
- **CB2 :** Que los estudiantes sepan aplicar sus conocimientos a su trabajo o vocación de una forma profesional y posean las competencias que suelen demostrarse por medio de la elaboración y defensa de argumentos y la resolución de problemas dentro de su área de estudio.
- **CB3 :** Que los estudiantes tengan la capacidad de reunir e interpretar datos relevantes (normalmente dentro de su área de estudio) para emitir juicios que incluyan una reflexión sobre temas relevantes de índole social, científica o ética.
- **CB4 :** Que los estudiantes puedan transmitir información, ideas, problemas y soluciones a un público tanto especializado como no especializado.
- **CB5 :** Que los estudiantes hayan desarrollado aquellas habilidades de aprendizaje necesarias para emprender estudios posteriores con un alto grado de autonomía.

UA Basic Transversal Competences

- **CT1 :** Competències en un idioma estranger.
- **CT2 :** Competències informàtiques i informacionals.
- **CT3 :** Competències en comunicació oral i escrita.

General Competences:>>Instrumental

- **CG1 :** Capacitat d'anàlisi i síntesi.
- **CG2 :** Coneixements generals i bàsics de la professió.
- **CG3 :** Coneixement d'informàtica en l'àmbit d'estudi.
- **CG4 :** Resolució de problemes.
- **CG5 :** Presa de decisions.

General Competences:>>Interpersonal

- **CG10 :** Capacitat per a comunicar-se amb experts d'altres àrees.
- **CG11 :** Raonament crític.
- **CG6 :** Planificar, ordenar i supervisar el treball en equip.
- **CG9 :** Habilitat en les relacions interpersonals.

General Competences:>>Systematic

- **CG13 :** Capacitat d'aplicar els coneixements en la pràctica.
- **CG14 :** Capacitat d'aprenentatge autònom.
- **CG15 :** Capacitat d'adaptació a noves situacions.
- **CG16 :** Habilitat per a treballar de manera autònoma.
- **CG17 :** Creativitat en tots els àmbits de la professió.

- **CG20 :** Motivació per la qualitat.
- **CG21 :** Sensibilitat cap a temes mediambientals.

Regulated Professional Competences

- **CPR1 :** Capacitat per a la redacció, signatura i desenvolupament de projectes en l'àmbit de l'enginyeria industrial, que tinguen per objecte, dins de l'especialitat de química industrial, la construcció, reforma, reparació, conservació, demolició, fabricació, instal·lació, muntatge o explotació d'estructures, equips mecànics, instal·lacions energètiques, instal·lacions elèctriques i electròniques, instal·lacions i plantes industrials i processos de fabricació i automatització.
- **CPR3 :** Coneixement en matèries bàsiques i tecnològiques, que els capacite per a l'aprenentatge de nous mètodes i teories, i els dote de versatilitat per a adaptar-se a noves situacions.
- **CPR4 :** Capacitat de resoldre problemes amb iniciativa, presa de decisions, creativitat, raonament crític i de comunicar i transmetre coneixements, habilitats i destreses en el camp de l'Enginyeria Industrial.
- **CPR5 :** Coneixements per a la realització de mesuraments, càlculs, valoracions, taxacions, peritatges, estudis, informes, plànols de labors i altres treballs anàlegs.
- **CPR6 :** Capacitat per al maneig d'especificacions, reglaments i normes d'obligat compliment.

Exclusive skill taught in this course

No data

Learning outcomes (Training objectives)

No data

Specific objectives stated by the academic staff for academic year 2024-25

The students in this subject should acquire the basic knowledge and skills to design, simulate and optimize the most common homogeneous reactors: batch stirred tank reactor, continuous plug flow reactor and continuous stirred tank reactor, as well as the association of continuous reactors.

They will also learn to model a homogeneous reactor when it deviates from the ideal behavior.

Content and bibliography

Content for academic year 2024-25

Chapter 1. TYPES OF REACTORS

Introduction. Defining reaction rate. Batch reactor. Continuous reactors: PFR, CSTR. Space time and residence time in continuous systems. Industrial reactors.

Chapter 2. BASIC CONCEPTS IN THE ANALYSIS OF REACTORS

Introduction. Extent of reaction. Conversion. Expansion factor. Reversible reactions.

Chapter 3. COLLECTION AND ANALYSIS OF KINETIC DATA

Introduction. Reaction rate and kinetic equation: basic concepts. Obtention of kinetic data: integral method.

Chapter 4. IDEAL HOMOGENEOUS REACTOR DESIGN

Batch Stirred Tank Reactor

Mole balance. Energy balance. Optimal operating conditions.

Plug Flow Reactor

Mole balance. Energy balance. Momentum balance. Example. Optimal operating conditions.

Continuous Stirred Tank Reactor

Mole balance. Energy balance. Optimal operating conditions. Multiplicity of states. Dynamic behavior.

Chapter 5. OTHER REACTORS

Semibatch reactor. PFR with recycling. Reactors in series.

Chapter 6. SELECTION OF OPERATING CONDITIONS

Design for systems with one reaction. Design for multiple reactions: yield and selectivity, reactions in series and parallel reactions, effect of concentration and temperature.

Chapter 7. NON IDEAL REACTORS

Introduction. Residence time distribution function (RTD). The RTD in ideal reactors. Modelling the reactor with the RTD. Models without adjustable parameters. Models with parameters. Diagnostics of the non ideality of a reactor: other models combining CSTR and PFR.

Related links

http://umich.edu/~elements/5e/
Libro online interactivo: Elements of Chemical Reactor Engineering

http://www.learncheme.com/screencasts/kinetics-reactor-design
Kinetics & reactor design screencasts

http://www.learncheme.com/simulations/kinetics-reactor-design
Kinetics & reactor design simulations

http://www.youtube.com/playlist?list=PL25CBC8287575CFB4
Kinetics/Reactor Design Review (LearnChemE, Engineering Screencasts)

http://canal.etsin.upm.es/web_cnum/main_matlab.pdf
Tutorial introducción Matlab

http://ocw.mit.edu/courses/chemical-engineering/10-37-chemical-and-biological-reaction-engineering-spring-2007/index.htm
Chemical and Biological Reaction Engineering (MIT OpenCourseWare)

http://ocw.mit.edu/courses/mathematics/18-s997-introduction-to-matlab-programming-fall-2011/library/videos/
Vídeos con tutoriales de Matlab del MIT

http://levenspiel.com/
página web Octave Levenspiel

https://personal.ua.es/es/fernandez/material.html
web con vídeos de problemas de exámenes resueltos

Bibliography

Elementos de ingeniería de las reacciones químicas, cuarta edición	
Author(s):	Fogler, H. Scott
Issue:	México : Pearson Education, 2008;
ISBN:	978-970-26-1198-1
Category:	Básico

Elements of chemical reaction engineering	
Author(s):	Fogler, H. Scott
Issue:	Upper Saddle River : Pearson Education, 2020;
ISBN:	9781292416663
Category:	Básico

Elements of chemical reaction engineering	
Author(s):	Fogler, H. Scott
Issue:	Upper Saddle River : Pearson Education, 2020;
ISBN:	9781292416663
Category:	Básico

Ingeniería de las reacciones químicas	
Author(s):	Levenspiel, Octave
Issue:	México : Limusa-Wiley, 2004;
ISBN:	978-968-18-5860-5
Category:	Básico

Chemical reaction engineering	
Author(s):	LEVENSPIEL, Octave
Issue:	New York : John Wiley, 1999;
ISBN:	0-471-25424-X
Category:	Básico

Chemical reactor analysis and design	
Author(s):	FROMENT, Gilbert F. ; BISCHOFF, Kenneth B.
Issue:	New York : John Wiley & Sons, 1990;
ISBN:	0-471-51044-0
Category:	Complementario

Assessment

Assessment procedures and criteria 2024-25

In order to pass the subject, the students must have final average marks equal to or greater than 5, and greater than 3.5 on the final exam. The marks from parts of the final exam will not be saved from one exam period to another in the same academic year. In the same way, the marks from the continuous assessment will not be saved from an academic year to another.

Both at the ordinary and the extraordinary calls, the marks of the activities of the continuous assessment can be recovered with the corresponding part in the final exam.

The lecturers will take into account the interest and participation of each student during the course when it comes to establishing the final marks, studying each particular case.

The justified absence of a student to a continuous assessment test will not mean postponing the test to another the day, since the final exam allows its recovery. Simply, that test will not count to him/her for the average of that part of the continuous evaluation.

The attendance at group tutorials and computer lessons is mandatory, except for justified absences.

Detecting copy in any evaluation test will entail the qualification of "0" in the corresponding test. The direction of the Department and the EPS will be informed about this issue, as stated in the Regulation for the Evaluation of Learning at the University of Alicante (BOUA 9/12/2015), in its article 14. The repetition in behavior in this or any other subject will entail notifying to the corresponding Vice Presidency of the misconduct to study the case and punish according to the law (Regulation of academic discipline of the Official Centers for Higher Education and Technical Education under the Ministry of Education, BOE 10/12/1954).

Description	Criteria	Type	Weighting system
Tests of questions for reasoning	Tests along the semester about questions for reasoning related to the concepts seen in class. The tests will take place after finishing the corresponding chapters in a later theory lecture. These will be of short duration and will be announced in advance.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	17,5
Computer sessions assessment	Short tests along the semester in computer sessions using Moodle, UACloud Questionnaires or similar. The tests will be conducted at the beginning of some of the computer sessions, will be announced in advance and will consist of solving short questions related to a problem already seen in class. After finishing the test, the practical session will continue normally.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	10
Group tutorials assessment	The problem(s) to be solved in each session will be published well in advance. The intention is that the students have completely solved the problems before the group tutorial sessions and clarified all doubts. To do this, before the session they will work individually or in groups, as well as make specific consultations with teachers. During each group tutorial, some students will be evaluated about the detailed resolution of the problems on the board (using computer if necessary) and about answers given to questions asked during the session related to the corresponding problem. The students will not be allowed to bring the problem solved to the board with the intention of just copying it.	ACTIVITIES OF EVALUATION DURING THE SEMESTER	22,5
Final exam	The final exam will consist of: 1) A part of questions for reasoning (35%) 2) A part of problems (65%), which will consist of: a) A part of problems like those of the group tutorials (45%), which will be solved both by using the software used in the subject and by developing the approach and the solving strategy on paper b) A part of problems like those of the computer sessions (20%), which will be solved with the software used in the subject	FINAL TEST	50

Official exam dates for academic year 2024-25

Exam session	Date	Time	Group - Classroom(s) allocated	Comments
(C2) Periodo ordinario para asignaturas de primer semestre	09/01/2025			Prácticas
(C4) Pruebas extraordinarias para asignaturas de grado y máster	30/06/2025			Prácticas

Academic staff

ARACIL SAEZ, IGNACIO
Lecturer responsible

THEORY CLASS: Groups: 1 , 2
COMPUTER PRACTICALS: Groups: 1 , 2 , 3

FERNANDEZ TORRES, M. JOSE

THEORY CLASS: Groups: 2
COMPUTER PRACTICALS: Groups: 1 , 2 , 3
GROUP TUTORIALS: Groups: 1 , 2 , 3

RUIZ FEMENIA, JOSE RUBEN

THEORY CLASS: Groups: 1
COMPUTER PRACTICALS: Groups: 1 , 2 , 3

Groups

THEORY CLASS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. 1 (THEORY CLASS) : 1	1S	Morning	Spanish	42
Gr. 2 (THEORY CLASS) : 2 ENGLISH	1S	Morning	English	21

COMPUTER PRACTICALS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. 1 (COMPUTER PRACTICALS) : 1	1S	Morning	Spanish	24
Gr. 2 (COMPUTER PRACTICALS) : 2	1S	Morning	Spanish	18
Gr. 3 (COMPUTER PRACTICALS) : 3 ENGLISH	1S	Morning	English	21

GROUP TUTORIALS

Group	Semester	Morning or afternoon session	Language	No. of enrolled students
Gr. 1 (GROUP TUTORIALS) : 1	1S	Morning	Spanish	24
Gr. 2 (GROUP TUTORIALS) : 2	1S	Morning	Spanish	18
Gr. 3 (GROUP TUTORIALS) : 3 ENGLISH	1S	Morning	English	21

Timetables

THEORY CLASS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	09/09/2024	11/09/2024	LUN	12:00	13:00	A2/D04
1	09/09/2024	11/09/2024	MAR	13:00	14:00	A2/D04
1	09/09/2024	11/09/2024	MIE	12:00	14:00	0039PB004
1	12/09/2024	12/09/2024	JUE	14:00	15:00	A2/D04
1	13/09/2024	18/09/2024	LUN	12:00	13:00	A2/D04
1	13/09/2024	18/09/2024	MAR	13:00	14:00	A2/D04
1	19/09/2024	19/09/2024	JUE	14:00	15:00	A2/D04
1	20/09/2024	20/09/2024	VIE	10:00	11:00	A2/C02
1	21/09/2024	25/09/2024	LUN	12:00	13:00	A2/D04
1	21/09/2024	25/09/2024	MAR	13:00	14:00	A2/D04
1	26/09/2024	26/09/2024	JUE	14:00	15:00	A2/D04
1	27/09/2024	01/10/2024	LUN	12:00	13:00	A2/D04
1	27/09/2024	01/10/2024	MAR	13:00	14:00	A2/D04
1	03/10/2024	03/10/2024	JUE	14:00	15:00	A2/D04
1	08/10/2024	09/12/2024	LUN	12:00	13:00	A2/D04
1	08/10/2024	09/12/2024	MAR	13:00	14:00	A2/D04
2	09/09/2024	10/09/2024	LUN	12:00	13:00	A2/A11
2	09/09/2024	10/09/2024	MAR	13:00	14:00	A2/B02
2	11/09/2024	11/09/2024	MIE	12:00	14:00	EP/0-22M
2	12/09/2024	12/09/2024	JUE	14:00	15:00	A2/B02
2	13/09/2024	19/09/2024	LUN	12:00	13:00	A2/A11
2	13/09/2024	19/09/2024	MAR	13:00	14:00	A2/B02
2	13/09/2024	19/09/2024	JUE	14:00	15:00	A2/B02
2	20/09/2024	20/09/2024	VIE	10:00	11:00	A2/B22
2	21/09/2024	25/09/2024	LUN	12:00	13:00	A2/A11
2	21/09/2024	25/09/2024	MAR	13:00	14:00	A2/B02
2	26/09/2024	26/09/2024	JUE	14:00	15:00	A2/B02

Group	Start date	End date	Day	Start time	End time	Lecture room
2	27/09/2024	01/10/2024	LUN	12:00	13:00	A2/A11
2	27/09/2024	01/10/2024	MAR	13:00	14:00	A2/B02
2	03/10/2024	03/10/2024	JUE	14:00	15:00	A2/B02
2	08/10/2024	09/12/2024	LUN	12:00	13:00	A2/A11
2	08/10/2024	09/12/2024	MAR	13:00	14:00	A2/B02

COMPUTER PRACTICALS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	18/09/2024	18/09/2024	MIE	13:00	14:00	0016P2006
1	26/09/2024	26/09/2024	JUE	09:00	11:00	0016P2006
1	03/10/2024	03/10/2024	JUE	09:00	11:00	0016P2006
1	17/10/2024	17/10/2024	JUE	09:00	11:00	0016P2006
1	31/10/2024	31/10/2024	JUE	09:00	11:00	0016P2006
1	08/11/2024	08/11/2024	VIE	12:00	14:00	0016P1007
1	21/11/2024	21/11/2024	JUE	09:00	11:00	0016P2006
1	05/12/2024	05/12/2024	JUE	09:00	11:00	0016P2006
2	18/09/2024	18/09/2024	MIE	12:00	13:00	0016P2006
2	25/09/2024	25/09/2024	MIE	12:00	14:00	A3/INF2
2	02/10/2024	02/10/2024	MIE	12:00	14:00	A3/INF2
2	16/10/2024	16/10/2024	MIE	12:00	14:00	A3/INF2
2	30/10/2024	30/10/2024	MIE	12:00	14:00	A3/INF2
2	08/11/2024	08/11/2024	VIE	09:00	11:00	0016P2006
2	20/11/2024	20/11/2024	MIE	12:00	14:00	A3/INF2

Group	Start date	End date	Day	Start time	End time	Lecture room
2	04/12/2024	04/12/2024	MIE	12:00	14:00	A3/INF2
3	20/09/2024	20/09/2024	VIE	12:00	13:00	0016P2006
3	27/09/2024	27/09/2024	VIE	09:00	11:00	0016PB064
3	04/10/2024	04/10/2024	VIE	09:00	11:00	0016PB064
3	18/10/2024	18/10/2024	VIE	09:00	11:00	0016PB064
3	30/10/2024	30/10/2024	MIE	12:00	14:00	0016P2006
3	08/11/2024	08/11/2024	VIE	09:00	11:00	0016PB064
3	22/11/2024	22/11/2024	VIE	09:00	11:00	0016PB064
3	04/12/2024	04/12/2024	MIE	12:00	14:00	0016P2006

GROUP TUTORIALS

Group	Start date	End date	Day	Start time	End time	Lecture room
1	10/10/2024	10/10/2024	JUE	09:00	11:00	0016P1008
1	24/10/2024	24/10/2024	JUE	09:00	11:00	0016P1008
1	14/11/2024	14/11/2024	JUE	09:00	11:00	0016P1008
1	28/11/2024	28/11/2024	JUE	09:00	11:00	0016P1008
1	12/12/2024	12/12/2024	JUE	09:00	11:00	0016P1008
1	17/12/2024	17/12/2024	MAR	12:00	14:00	A2/D04
2	10/10/2024	10/10/2024	JUE	12:00	14:00	0016P1008
2	23/10/2024	23/10/2024	MIE	12:00	14:00	0016P1008
2	13/11/2024	13/11/2024	MIE	12:00	14:00	0016P1008
2	27/11/2024	27/11/2024	MIE	12:00	14:00	0016P1008

Group	Start date	End date	Day	Start time	End time	Lecture room
2	10/12/2024	10/12/2024	MAR	12:00	14:00	0016P1008
2	18/12/2024	18/12/2024	MIE	12:00	14:00	0016P1008
3	11/10/2024	11/10/2024	VIE	09:00	11:00	0016P1001
3	25/10/2024	25/10/2024	VIE	09:00	11:00	A2/B22
3	15/11/2024	15/11/2024	VIE	09:00	11:00	A2/B22
3	29/11/2024	29/11/2024	VIE	09:00	11:00	A2/B22
3	13/12/2024	13/12/2024	VIE	09:00	11:00	A2/B22
3	19/12/2024	19/12/2024	JUE	12:00	14:00	0016P1008