Universitat Autònoma de Barcelona

2022/2023

Separation Processes

Code: 106041
ECTS Credits: 6

Degree	Type	Year	Semester
2500897 Chemical Engineering	FB	2	1

Contact

Name: Laura Prat Baiget
Email: laura.prat@uab.cat

Use of Languages

Principal working language: catalan (cat)
Some groups entirely in English: No
Some groups entirely in Catalan: Yes
Some groups entirely in Spanish: No

Teachers

Xavier Mora Gine

Prerequisites

The subject does not officially require any prerequisites, but it is assumed that the student has completed and passed the Mathematis of the first year. It is required to have practice in differentiating and integrating one-variable functions.

Objectives and Contextualisation

It is a basic subject that introduces two of the most important mathematical tools for modeling and solving real problems that appear in engineering: differential equations and vector analysis. At the end of the course, the student:

- will be able to use the basic analytical methods to obtain solutions of differential equations.

- will be able to distinguish the differential equations that can be solved with analytical methods from those that require numerical methods.

- will be able to extract qualitative information of the solutions of a differential equation of the first order from the vector field of directions.

- will be able to understand the role of differential equations in the mathematical modeling of real problems and be able to build this model in simple situations.

- will get familiar dealing with functions of several variables and vector fields.

- will be able to deal with curves and surfaces in space and the equations that describe them.

- will understand the meaning of the basic concepts of vector analysis.

- will learn to use the vectorial analysis tools to identify and calculate physical magnitudes.

- will understand the theorems of vectorial analysis and their use in the formulation of some physical theories.

Competences

- Apply relevant knowledge of the basic sciences, such as mathematics, chemistry, physics and biology, and the principles of economics, biochemistry, statistics and material science, to comprehend, describe and resolve typical chemical engineering problems.
- Develop personal work habits.
- Work in a team.

Learning Outcomes

1. Apply the methods and basic concepts of differential and integral calculus of a variable to the description and calculation of magnitudes.
2. Apply the methods for solving differential equations to the analysis of deterministic phenomena.
3. Make one's own decisions.
4. Work cooperatively.

Content

A. Ordinary differential equations.

1. First-order differential equations. Solutions and initial value problems. Resolution by elemental methods: separable equations, linear equations, solutions by substitution.
2. Linear equations of order 2 (and higher) with constant coefficients. Homogeneous linear equations. Non-homogeneous linear equations. Method of indeterminate coefficients.
3. Systems of differential equations of first order. Homogeneous and non-homogeneous linear systems.

B. Vector analysis.

1. Vector functions. Curves in space. Tangent and normal vectors.
2. Functions of several variables. Curves and level surfaces. Partial derivatives Gradients and directional derivatives. Chain rule. Tangent planes. Maximum and minimum values.
3. Multiple integration. Double integrals on elementary domains. Iterated integrals. Triple integrals Applications of the double and triple integrals. Change of variables.
4. Line and surface integrals. Vector fields. Rotational and divergence. Integral lines. Theorem of Green. Theorem of divergence

Methodology

In the learning process it is fundamental the own work of the student, with the help of the professor.

The hours of class are distributed in:

Theory classes: The teacher introduces the basic concepts corresponding to the subject, showing examples of their application. The student will have to complement the explanations of the professors with the personal study.

Problem sessions: By completing sets of exercises, the comprehension and application of the concepts and tools introduced in the theory class is attained . The student will have lists of problems, a part of which will be solved in the problem classes. Students should work on the remaining ones as part of their autonomous work.

Seminars: to reach a deeper understanding of the subject the students work in group on more practical problems. Some seminars will deal with computer-aid approach to solving problems.

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			
Problem sessions	15	0.6	2, 1
Theory classes	30	1.2	2, 1
Type: Supervised			
Seminars	5	0.2	2, 1, 3, 4
Type: Autonomous			
Personal study	30	1.2	2, 1, 3
Problem solving	64.5	2.58	2, 1, 3

Assessment

A continuous assessment is performed based on three controls:

a) Two written tests combining theory and problems, one P1 related to part A, another P2 related to part B.

b) A grade from the seminars.

Submissions in b) are manadatory, with no resit assesment.

If both P1, P2 have been attended, a grade Q1 is generated according to $Q1=0,2\cdot S+0,4\cdot(P1+P2)$. If Q1 is at least 5, the final grade is Q1.

Students with $Q1<5$ and having submitted b), may attend a resit exam, with grade R.

The final grade Q2 after the resit exam is $Q2=0,20\cdot S+màx\{0,4\cdot(P1+P2),0,8\cdot R\}$.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Mid-term Exam combining theory and problems corresponding to part A	40%	2	0.08	2, 1, 3
Mid-term Exam combining theory and problems corresponding to part B	40%	2	0.08	2, 1, 3
Seminar exams	20%	1.5	0.06	2, 1, 3, 4

Bibliography

Main:

Dennis G. Zill, Michael R. Cullen. Ecuacions diferenciales con problemas de valores en la frontera (sisena edició). International Thompson editores, México 2006.

S. L. Salas, E. Hille. Cálculo de una y varias variables. Ed. Reverté, 1994.

Complementary

R.K. Nagle, E.B. Saff, A.D. Snider. Ecuaciones diferenciales y problemas con valores en la frontera (tercera edició). Addison-Wesley. 2001.

R. Martínez. Models amb equacions diferencials. Materials UAB. 2004.

Software

None is needed.