# Material Flows and Water Cycle

Code: 106925
ECTS Credits: 6

2024/2025

| Degree | Type | Year |
|---|---|---|
| 2503743 Management of Smart and Sustainable Cities | FB | 1 |

## Contact

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## Teachers

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## Teaching groups languages

You can view this information at the end of this document.

## Prerequisites

Maths knowledge at high school level: algebraic operations, solving equations and systems of equations including inequalities, polynomial, exponential, irrational, rational, logarithmic, trigonometric and piecewise functions to model quantitative relationships in various contexts, regressions. It is recommended to take the preparatory mathematics courses if you do not have the required level. Basic concepts of chemistry and physics are required.

## Objectives and Contextualisation

- Describe the mathematical models of material flow systems.
- Develop and solve steady-state mass balances of simple and multicomponent systems.
- Explain the main causes and consequences of global and local environmental impacts.
- Describe and analyze the most important air pollutants in cities.
- Describe and interpret all the elements of the urban water cycle.
- Contextualize the technologies, tools and techniques of environmental engineering related to the urban water cycle and atmospheric pollution

## Learning Outcomes

1. CM04 (Competence) Make decisions that take into account sustainability and the ethical responsibility they entail.

2. KM05 (Knowledge) Describe mathematical models of electronic systems and flows of electricity and matter.
3. SM05 (Skill) Develop material and energy balances in steady and dynamic states.

## Content

- Theme 1: Previous concepts and knowledge: change of units between the different systems of units. Principle of conservation of mass and energy.
- Theme 2: Macroscopic mass balances without reaction in steady state. Terms of the mass balance equation. Total mass balance. Mass balances applied to a one component and multicomponents systems. Systems with recirculation, purging and bypass. The generation term.
- Theme 3. Environmental impacts. Cycle of materials, pollution and impacts of human activity. Linear model and circular model; Concepts and challenges of the circular economy.
- Theme 4. Urban water cycle. Consumption water and wastewater. Potabilization, treatment and reuse systems.
- Theme 5: Air pollution and types of pollutants. Air pollution control. The atmosphere. Sources of pollutants. Air quality.

## Activities and Methodology

| Title | Hours | ECTS | Learning Outcomes |
|---|---|---|---|
| Type: Directed | | | |
| Problems, case studies and reports | 28 | 1.12 | CM04, KM05, SM05, CM04 |
| Theoretical lectures | 28 | 1.12 | KM05, SM05, KM05 |
| Type: Supervised | | | |
| Tutoring | 3 | 0.12 | KM05, SM05, KM05 |
| Type: Autonomous | | | |
| Autonomous learning | 40 | 1.6 | CM04, KM05, SM05, CM04 |
| Collaborative learning: preparation of assignments and reports | 42 | 1.68 | CM04, CM04 |

1) Theoretical lectures. Students acquire the specific knowledge of the subject by attending lectures and supplementing them with personal study of the topics explained. In addition, the case study method or problem-based learning will be applied to reinforce knowledge in theoretical classes.
2) Problem workshops. The knowledge worked on in the theoretical classes is worked through solving problems and/or practical cases. In these classes there must be a strong interaction between students and professors in order to complete and deepen the understanding of the knowledge worked on in the theoretical classes. You can work individually or in groups depending on the professor's criteria.
3) Tutoring: Tutorial sessions of one hour (up to a maximum of 3) will be scheduled to review the progress of the project and the problems that have arisen.
4) Elaboration of a final report and partial reports: case studies will be developed and solved in groups by the students. Two partial progress reports (written and/or multimedia) and a final report has to be delivered at the appropiatted dates set by professors.
5) The course has a Moodle classroom, within the UAB Virtual Campus platform, where you can find the contents and statements of the exercises, as well as complementary material and suggested activities.

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.

## Assessment

## Continous Assessment Activities

| Title | Weighting | Hours | ECTS | Learning Outcomes |
|---|---|---|---|---|
| 1) First written exam (individual activity) | 35% | 2.5 | 0.1 | CM04, KM05, SM05 |
| 2) Second written exam (individual) | 35% | 2.5 | 0.1 | CM04, KM05, SM05 |
| 3) First partial report (group activity) | 5% | 1 | 0.04 | CM04, KM05 |
| 4) Second partial report (group activity) | 5% | 1 | 0.04 | CM04, KM05 |
| 5) Final report (group activity) | 20% | 2 | 0.08 | CM04, KM05 |

Continuous Assessment:

1. Two partial tests (70% of the course grade in equal parts). Part 1: themes 1, 2 and 3. Part 2: themes 4, 5 and 6. These tests will consist of theoretical questions and practical problem solving. Minimum grade in each test to average: 3.5 (out of 10).
2. Submission of partial reports and the final report (30% of the course grade).

Recovery Test:
Students who do not pass the course (5 out of 10) by the continuous assessment, can recover only the partials they have failed (grade below 5 out of 10). Partial reports and the final report are not recoverable. The recovery test for each partial will count the same percentage as in the continuous assessment. The grades of the approved partial tests and the grade of the partial reports and the final report will be kept. Students approved by continuous assessment cannot take the recovery test to raise their grade.
Repeating students will have the same continuous assessment system.
Dates of the partials: To be confirmed on the School's website. Under no circumstances will exams (evaluative tests) be held on days and times other than those officially published on the School's website.
To pass the subject, a minimum final grade of 5 (out of 10) is required.
Important observation: Without any prejudice to other disciplinary measures that are deemed appropriate, and in accordance with current academic regulations, irregularities committed by the student that may lead to a variation in the qualification of a evaluation act like plagiarizing, copying or allowing an assessment activity to be copied, or falsifying any assessment activity will result in failing it with a zero and cannot be recovered in the same academic year. If thisactivity has a minimum grade associated with it, then the subject will be suspended.
Qualification review procedure
For each assessment activity, a review place, date and time will be indicated in which the student can review the activity with the professors. In this context, claims can be made about the grade of the activity, which will be evaluated by the professors responsible for the subject. If the student does not appear for this review, this activity will not be reviewed later.
Degrees
Honours grade. Awarding an honours grade is the decision of the faculty responsible for the subject, UAB regulations indicate that MH can only be granted to students who have obtained a final grade equal to or higher than 9.00. Up to 5% of MH of the total number of enrolled students can be awarded. A student will be considered non-evaluable (NA) if he has not taken part in a set of activities whose weight is equivalent to a minimum of two-thirds of the subject's total grade.

## Bibliography

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- HIMMELBLAU, D. M., (1997). "Principios Básicos y Cálculos en Ingenieria Química" (2a ed.), Ed. Prentice Hall.
- FELDER R.M. I ROUSSEAU R.W., (1991). "Principios Elementales de los Procesos Químicos", (2a ed.) Ed. Addison-Wesley Iberoamericana.
- IZQUIERDO J.F. i col (2011). "Introducción a la Ingenieria Química: Problemas resueltos de Balances de Materia y Energia" Ed. Reverté
Electronic Books
- Chemical engineering: solution to the problems in chemical engineering [Recurs electrònic] / by J. R. Backhurst and J. H. Harker ; with J. F. Richardson
- Basic principles and calculations in chemical engineering / David M. Himmelblau, James B.Riggs
- Carlos Javier Velásquez Muñoz. Ciudad y desarrollo sostenible. 1st ed. Barranquilla, Colombia: Editorial Universidad del Norte, 2012.
https://bibcercador.uab.cat/permalink/34CSUC_UAB/15r2rl8/cdi_perlego_books_1911401
- Smol, Marzena, Majeti Narasimha Vara Prasad, and Alexandros I Stefanakis. Water in Circular Economy. 1st ed. Cham: Springer International Publishing, 2023.
https://bibcercador.uab.cat/permalink/34CSUC_UAB/15r2rl8/cdi_askewsholts_vlebooks_9783031181658

## Software

MS Office (word, power point, excel)

## Language list

| Name | Group | Language | Semester | Turn |
|---|---|---|---|---|
| (PAUL) Classroom practices | 611 | Catalan | first semester | morning-mixed |
| (PAUL) Classroom practices | 612 | Catalan | first semester | morning-mixed |
| (TE) Theory | 61 | Catalan | first semester | morning-mixed |