Design and Operation of Water Treatment Systems

Code: 43323
ECTS Credits: 9

2025/2026

Degree	Type	Year
Biological and Environmental Engineering	OB	1

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Teaching groups languages

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

Prerequisites

- Mass balances
- Microbial kinetics

Objectives and Contextualisation

- Identify available wastewater treatments.
- To select alternatives for the biological treatment of urban and industrial wastewater.
- Dimensioning wastewater treatment processes.
- To study and design advanced systems and reactors suitable for each need.
- To identify the available techniques for modeling, monitoring and control of WWTP.
- Design low intensity water treatment systems: green filters, artificial wetlands, lagooning, peat beds, bacterial beds, biodiscs.
- Know the physical-chemical treatments for contaminant elimination, including oxidation and advanced oxidation processes.
- To know the future perspectives in the biological treatment of wastewater.

Learning Outcomes

1. CA04 (Competence) Integrate and appraise different instruments of chemical, environmental and/or biological engineering for the design of typical WWTP processes.
2. CA05 (Competence) Analyse and discuss cases, problems and questions related to different WWTP systems, including the management of excess sludge in a WWTP.
3. KA03 (Knowledge) Identify and select suitable processes for advanced filtration by oxidation depending on the type of pollutant.
4. KA04 (Knowledge) Identify the main existing control loops in a WWTP.
5. SA01 (Skill) Search, compare, critically analyse and summarise information obtained from databases and other sources to solve complex problems in one's specialist area.
6. SA02 (Skill) Prepare technical reports in the field of environmental engineering and/or biological engineering and present the results orally in a clear, concise and unambiguous manner.
7. SA03 (Skill) Plan the different activities related to the resolution of tasks assigned as part of a work group, while appropriately managing time and resources.
8. SA04 (Skill) Calculate, size and optimise wastewater treatment systems.

Content

1. Introduction. Current state of biological treatment of urban and industrial wastewater. Economic and energy balance of a WWTP.
2. Biological nitrogen removal. Urban wastewater: Comparison and design of different configurations. Highly loaded waters: description and design of alternatives to conventional processes.
3. Biological phosphorus removal. Description and design of different configurations for the simultaneous removal of P and N. Comparison with current precipitation processes. Introduction to P recovery.
4. Control and instrumentation of WWTPs. Description of the main equipment of a WWTP.
5. Applications of models for the design and upgrading of WWTPs.
6. Low-intensity water treatment systems: green filters, artificial wetlands, lagooning, peat beds, bacterial beds, biodiscs.
7. Biological treatment of industrial wastewater: Anaerobic digestion. Design of a digester and characterization of its effluents. Case studies.
8. Treatment of poorly biodegradable industrial water. Application of membrane technology. Advanced oxidation processes. Strategies for the coupling of chemical and biological reactors for the mineralization of recalcitrant industrial pollutants.
9. Production and management of WWTP sludge.
10. Prospects for the future in biological wastewater treatment.

Activities and Methodology

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Theoretical classes: master classes on the concepts of the syllabus	56	2.24	
Type: Supervised			
Supervised activities	21	0.84	
Type: Autonomous			
Autonomous student learning	146	5.84	

Master classes/expositions
Problem/case/exercise resolution classes
Tutoring
Preparation of reports/works
Autonomous activity

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
Reports/works submission	40-60%	0	0	CA04, CA05, SA01, SA02, SA03, SA04
Theoretical-practical tests	40-60%	2	0.08	CA04, CA05, KA03, KA04

Evaluation

(a) Scheduled evaluation process and activities

The following are the activities of evaluation of the subject with its percentage of weight on the final grade:

- Activity 1 (16.7%). Themes 1,2. Work

- Activity 2 (23.5%). Themes 3,4,5. Works.

- Activity 3 (3.3%). Theme 7. Work or Classroom activity.

- Activity 4 (24.5 %). Exam with contents of Themes 1,2 (16.6%), 3,4,5 (7.9%)

- Activity 5 (32 %). Exam with contents of Themes 6 (5.6%), 7 (9.7%), 8 (9.3%) and 9,10 (7.4%).

The non-presence in class when evaluation tests are carried out is a zero of the activity, without possibility of recuperation.

b) Programming of evaluation activities

The schedule of evaluation activities will be given on the first day of the course and will be made public through the Moodle.

(c) Recovery process

Students who have an average grade of continuous assessment activities below 5 must take the retake. Students may take the retake provided they have taken a set of activities that represent at least two-thirds of the total grade for the subject. Retakes will consist of an in-person exam that includes content from continuous assessment activities 4 and 5 where the student did not achieve a grade of 5. Continuous assessment activities 1, 2 and 3 are not retaken. The final retake grade will be a weighted grade (according to the same

percentages as continuous assessment) between the grade from the retake exam and the grade from the non-retaken continuous assessment activities.

d) Grade review procedure

For each assessment activity, a place, date and time of review will be indicated where the student can review the activity with the professor. In this context, complaints can be made about the grade of the activity, which will be evaluated bythe professor responsible for the subject. If the student does not submit to this review, this activity will not be reviewed at a later date.

e) Qualifications

Honor plates. Awarding an honor roll grade (MH) is the decision of the faculty responsible for the subject. UAB regulations state that MH can only be awarded to students who have obtained a final grade of 9.00 or more. Up to 5% of the total number of students enrolled may be awarded.
A student will be considered non-assessable (NA) if he has not presented to a set of activities the weight of which equals a minimum of two thirds of the total grade of the subject.

f) Student Irregularities, Copying and Plagiarism

Without prejudice to other disciplinary measures that may be deemed appropriate, irregularities committed by the student that may lead to a variation in the grade of an evaluation act shall be graded with a zero. Therefore, copying, plagiarism, cheating, letting copy, etc. in any of the evaluation activities will involve suspending it with a zero. Evaluation activities graded in this way and by this procedure will not be recoverable.

g) Evaluation of Repeating Students

There are no changes in the evaluation of the repeating students.

UNIQUE ASSESSMENT: This subject does not offer final single assessment

Bibliography

- Metcalf & Eddy Inc. Wastewater Engineering: Treatment and Reuse. 4th Edition. Ed. Mc. Graw-Hill Inc., N.Y. (2003). ISBN: 0071122508.
- M. Henze, editor. Biological Wastewater Treatment: Principles, Modelling and Design. Ed. IWA Publishing (2008).
- Tratamiento biológico de aguas residuales: Principios, modelación y diseño. López-Vázquez, Buitrón-Méndez, García, Cervantes-Carrillo. IWA Publishing (2017). ISBN electronic: 978-1-78040-914-6. https://iwaponline.com/ebooks/book-pdf/248403/wio9781780409146.pdf
- Mark C. M. van Loosdrecht, Per H. Nielsen, Carlos M. Lopez-Vazquez, Damir Brdjanovic. Experimental Methods in Wastewater Treatment. IWA Publishing (2016). ISBN: 9781780404745 (Hardback). ISBN: 9781780404752 (eBook).
https://www.researchgate.net/publication/299830736_Experimental_Methods_in_Wastewater_Treatment
- Vymazal, Jan, Kröpfelová, Lenka. Wastewater Treatment in Constructed Wetlands with Horizontal Sub-Surface Flow. 2008 Springer. ISBN 978-1-4020-8580-2 Robert H. Kadlec,Scott Wallace Treatment
- Wetlands, Second Edition CRC Press; 2 edition (July 22, 2008). ISBN 1566705266

Software

MS Office

MATLAB

Groups and Languages

Please note that this information is provisional until 30 November 2025. You can check it through this link. To consult the language you will need to enter the CODE of the subject.

Name	Group	Language	Semester	Turn
(TEm) Theory (master)	1	Spanish	second semester	afternoon