Universitat Autònoma de Barcelona

2019/2020

Design and Operation of Water Treatment Systems

Code: 43323
ECTS Credits: 9

Degree	Type	Year	Semester
4314579 Biological and Environmental Engineering	OB	1	1

Contact

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Use of Languages

Principal working language: spanish (spa)

Teachers

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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.

Competences

- Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.
- Continue the learning process, to a large extent autonomously.
- Design and operate systems of purification of urban and industrial waste waters.
- Integrate and use chemical, environmental and biological engineering tools to design biological systems for the sustainable processing of waste and for industrial biotechnological processes.

- Integrate knowledge of kinetics, thermodynamics, transport phenomena and numerical methods to analyse, design, model and optimise different types of biological reactors and their operating strategy.
- Organise, plan and manage projects
- Seek out information in the scientific literature using the appropriate channels and integrate this information, showing a capacity for synthesis, analysis of alternatives and critical debate.
- Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

Learning Outcomes

1. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.
2. Construct mathematical models of a steady-state waste-water treatment plant for the water and sludge line.
3. Continue the learning process, to a large extent autonomously.
4. Design and operate anaerobic degradation systems for high-intensity waste-water treatment.
5. Design and operate systems of biological purification of low-intensity waste waters.
6. Design and operate systems of biological purification of urban waste waters.
7. Identify and design the processes of sludge management in a waste-water treatment plant (EDAR).
8. Identify and select the appropriate processes of purification by advanced oxidation for each contaminant.
9. Identify choose appropriate processes for the purification of industrial waters.
10. Identify the advantages and disadvantages of the different processes proposed for waste-water treatment.
11. Identify the main control loops in a waste-water treatment plant
12. Organise, plan and manage projects
13. Seek out information in the scientific literature using the appropriate channels and integrate this information, showing a capacity for synthesis, analysis of alternatives and critical debate.
14. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.

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.

Methodology

Master classes/expositions
Problem/case/exercise resolution classes
Tutoring

Preparation of reports/works
Autonomous activity

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Collaborative learning	42	1.68	
Theoretical classes: master classes on the concepts of the syllabus	56	2.24	
Type: Supervised			
Supervised activities	23	0.92	
Type: Autonomous			
Autonomous student learning	84	3.36	

Assessment

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 1,2,10 (JC). Work/s.
- Activity 2 (23.5%). Themes 3,4,5 (JB+AG). Works.
- Activity 3 (5.6%). Theme 6 (XF). Work.
- Activity 4 (3.3%). Theme 7 (TV+XF). Work.
- Activity 5 (9.3%). Theme 8 (JP). Work.
- Activity 6 (41.6%). Final examination with contents of Themes 1,2,10 (JC, 16.6%), 3,4,5 (JB+AG, 7.9%), 7 (TV+XF, 9.7%) and 9 (TV, 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 may apply for make-up as long as they have submitted to a set of activities that represent at least two-thirds of the total grade for the subject. Of these, those students who have a grade of more than 3 on average for all subject activities may be subject to make-up.

The make-up process will consist of an exam with all the contents of the subject. The maximum grade that can be obtained using this procedure will be 6.0.

According to the coordination of the Grade and the direction of the School of Engineering, evaluative activities of any type in which the student has committed an irregularity (copy, plagiarize, let copy ...) cannot be recovered.

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 by the 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.

h) Evaluation of Repeating Students

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

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Reports/works submission	40-60%	16	0.64	1, 13, 2, 4, 6, 5, 10, 11, 7, 9, 8, 12, 14, 3
Theoretical-practical tests	40-60%	4	0.16	1, 13, 2, 4, 6, 5, 10, 11, 7, 9, 8, 12, 14, 3

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