Unidade Curricular: Water and Wastewater Treatment Plants

Área Científica: ENG
Duração: Semestral
Horas de trabalho: 162
Horas de contacto: 60
ECTS: 6

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Learning outcomes of the curricular unit
The curricular unit (CU) of Water and Wastewater Treatment Plants aims to give students knowledge concerning:
1 - operations and processes units applied in drinking water and wastewater treatments;
2 - design, operation and maintenance of water treatment plants (WTP) and wastewater treatment plants (WWTP);
3 - treatment/valorisation and final disposal of screenings, oils and grease, grits and sludge;
4 - odours and biogas treatments;
5 - energy balance and carbon footprint of WTP and WWTP.
After approval in CU the students should be able: to conceptualise and evaluate studies to support the design, operation and maintenance of WTP and WWTP; to assess the operations and processes units application on water and wastewater treatment; select and apply the treatments and final disposal of by-products and to account and evaluate energy consumption on WTP and WWTP.

Syllabus
1. Intake systems of surface and groundwaters.
2. Water Treatment. Treatment system on WTP.
3. Operations and processes units. Screening, coagulation/flocculation, sedimentation, filtration, aeration, adsorption, ion exchange and disinfection systems.
4. Water safety plans.
5. Collecting systems for sewage and rainwater.
6. Wastewater treatment. Treatment system on WWTP.
7. Preliminary and primary treatment. Screening, grit removal, flotation, neutralization, equalization, sedimentation and coagulation/flocculation.
8. Secondary treatment. Trickling filters, rotating biological contactors, stabilization ponds, activated sludge and membrane biological reactors
9. Tertiary treatment. Chemical oxidation, biofiltration and disinfection.
10. Sludge Treatment. Thickening, stabilization, anaerobic digestion, conditioning, dewatering and final disposal.
11. Deodorization and biogas treatment/valorisation.
12. Energy balances and carbon footprint on WTP and WWTP

Demonstration of the syllabus coherence with the curricular unit's learning objectives.
Objective 1 is complemented with the knowledge acquired with the contents 1 to 9 in the syllabus.

Objective 2 and 3 are reached through the knowledge got with the contents 2, 3, 6 to 10 in the syllabus.
Objectives 4 and 5 require the contents 10, 11 and 12 in the syllabus.
Knowledge is transferred in theoretical, theoretical-practical and laboratorial practical classes, complemented with a study visit.

Teaching methodologies (including evaluation)
1. In the theoretical classes knowledge and essential tolls are transferred, real examples of application are presented, e.g. case studies.
2. The theorical-practical and laboratory practical classes are dedicated to practical exercises, governmental web sites consultation, application of a calculation tool and realization of a laboratory experiment.
Continuous assessment is performed through one global test (GT) completed with the drafting of one work (W) during the semester.
Summative assessment includes a continuous assessment component and a final examination.
It is necessary to have a higher grade than 9.5 on each component of the assessment. The student will be approved when the resulting classification of the two components of assessment are greater than 9.5.
CONTINUOUS ASSESSMENT: 65% grade of GT + 35% grade of W.
SUMMATIVE ASSESSMENT: 65% grade of final examination +35% grade of W.

Demonstration of the coherence between the teaching methodologies and the learning outcomes
WWWTP is curricular unit where it aims to harmonise the teaching methodology and the course objectives both from the scientific point of view and the practical application along the professional life. The way of teaching aims to: (a) stimulate the interest and curiosity of students for knowledge as the eternal motor of the technical and scientific development; (b) to induce their perspective of practical application of knowledge as a tool for socio-economic development; (c) to stimulate students will for the study of issues related to water and wastewater treatments, by-products and energy consumption. Inducing students to reflect critically on issues is a way to get their active participation during classes. WWWTP is taught in three types of classes: theoretical, theoretical-practical and laboratorial practical. The scientific background of theory is presented in the theoretical classes together with practical examples of professional experience whenever pertinent. Some theoretic aspects are further developed in the TP classes. Practical exercises, design and laboratorial experiment are conducted during the theoretical-practical and laboratorial practical classes. Practical exercises are close to real professional life situations. Tutorial supervision out of classes allows the professor to assess the dedication and ability of students in acquiring knowledge and skills as well as to detect issues to improve the teaching methodology. The assessment includes a short report on design of water and wastewater treatment facilities, which may be individual or in a group of two. The students will give a short presentation of this work followed by discussion. This work will allow the student: to apply some of the knowledge in an environment closer to real professional life; to work within a team (very important in engineering practice); and to develop his competences concerning presentation and argumentation. Mid-term and final tests and final examination have maximum duration of 2 hours. Students can improve the grade of tests and examination but not of the monograph. To get approval in WWWTP the final grade must be greater or equal to 9.5.

Mandatory consultation/existence bibliography:

1. Alves, Célia, Tratamento de Águas de Abastecimento. 3ª Ed, Publindústria, Edições Técnicas, Porto, 2010.
2. Davis, M. L., Water and Wastewater Engineering – Design Principles and Practice. McGraw-Hill Companies, 2010.
3. Marecos do Monte, H., Santos, M. T., Barreiros, A: B., Albuquerque, A., Tratamento de Águas Residuais - Operações e processos de tratamento físico e químico, Série CURSOS TÉCNICOS da ERSAR CT5, Livro, 2016.
4. Marecos do Monte, H., Santos, M. T., Barreiros, A. M., Tratamento de Águas Residuais – Processos de Tratamento Biológico, Série CURSOS TÉCNICOS CT6 da ERSAR, Livro, 2018.
5. Tchobanouglos, G., Burton, F. L., Stensel, H. D., Wastewater Engineering Treatment and Reuse. 5th Ed., METCAL&EDDY, McGraw Hill, 2013.
6. Droste, R. L., Gehr, R. L., Theory and Practice of Water and Wastewater Treatment, 2nd Edition, Wiley, 2018.