

Unidade Curricular: Waste Management and Materials Resources

Área Científica: ENG

Duração: Semestral

Horas de trabalho: 81

Horas de contacto: 30

ECTS: 3

Docente Responsável: Maria Teresa Loureiro dos Santos

Outros Docentes: Jaime Filipe Borges Puna

Learning outcomes of the curricular unit

The curricular unit (CU) of WMMR aims to give students knowledge concerning:

- 1- waste management, covering the entire waste life cycle, in the technological, economic, regulatory and industrial aspects;
- 2- collection management, transportation and mechanical, chemical and biological treatments, design and implementation of management tasks to minimize environmental, economic and social costs;
- 3- elimination and final disposal of waste through thermal treatment and landfill;
- 4- mass and energy balances of treatment plants;
- 5- material resource management.

After approval the students should be able to: conceptualize and evaluate physical, chemical and biological waste treatments; identify the appropriate processes for waste treatment and valorisation; select the operating conditions that allow to minimize environmental, economic and social costs, with recovery of materials and/or energy; understand and apply the regulatory framework; to assess material resources.

Syllabus

1. Integrated waste management. Wastes classification. Life cycle analysis. Material consumption and waste production.
Wastes production prevention. Circular economy. Sustainable circularity. Legislation.
2. Waste collection and transport. Technical and economic analysis.
3. Mechanical treatment. Sorting. Separation. Compaction. Preparation for recycling.
4. Biological treatment. Anaerobic digestion and composting. Technical characteristics and operative variables. Energy and mass balances. Products – digestate and compost.
5. Thermal treatments. Incineration, pyrolysis and gasification. Technical characteristics and operative variables. Energy and mass balances. Products – slags.
6. Waste disposal. Landfill. Technical and environmental characteristics. Products- leachates and gaseous emissions.
7. Study cases. Efficient use of material resources. Treatment integrated solutions. Wastes and material resources management.

Demonstration of the syllabus coherence with the curricular unit's learning objectives.

Objective 1 is complemented with the knowledge acquired with the content 1 in the syllabus.

Objective 2 is reached through the knowledge got with the contents 2 and 3 in the syllabus.

Objectives 3, 4 and 5 require the contents 4, 5, 6 and 7 in the syllabus.

Knowledge is transferred in theoretical, theoretical-practical classes, complemented with a study visit.

Teaching methodologies (including evaluation)

In the theoretical classes knowledge and essential tools are transferred, real examples of application are presented, e.g. case studies. The theoretical-practical classes are dedicated to practical exercises and governmental web sites consultation. Continuous assessment is performed through one global test (GT) completed with the drafting of two activities/works (W) during the semester. Summative assessment includes 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: 60% grade of GT + 40% of average of grades of W. SUMMATIVE ASSESSMENT: grade of final examination.

Demonstration of the coherence between the teaching methodologies and the learning outcomes

WMMR is a 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 waste management, byproducts and energy consumption. Inducing students to reflect critically on issues is a way to get their active participation during classes. WMMR is taught in two types of classes: theoretical and theoretical-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 classes. Classes are devoted to explanation and debate of the programme topics. Other regular activities will include problem solving and case study analysis. This will allow students to acquire specific knowledge on processes, technologies and equipment for waste management. Selected subjects, within the programme of the course, will be given to the students, for research work. Study tours will be organized to specific waste management installations. 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 two short reports on waste treatments, which may be individual or in a group of two. The students will give a short presentation of this work followed by discussion. The two works 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. The final test and final examination have maximum duration of 2 hours. Students can improve the grade of tests and examination but not of the two monographs. To get approval in WMMR the final grade must be greater or equal to 9.5.

Mandatory consultation/existence bibliography:

1. Wong, J. W. C., Surampalli, R. Y., Zhang, T. C., Tyagi, R. D., Selvam, A., Sustainable Solid Waste Management, USA, ASCE, 2016
2. Prasad, M. N. V., Shih, K., Environmental Materials and Waste, Academic Press, UK, Elsevier, 2016.

3. Piedade, M e Aguiar, P. Opções de gestão de resíduos urbanos, Serie Guias Técnicos, ERSAR, 2010.
4. Keith, F., Tchobanoglous, G., Handbook of solid waste management, 2nd Edition, McGraw-Hill, 2002.