Universitat Autònoma de Barcelona

2019/2020

Environmental Sustainability in Processes and Products

Code: 43328
ECTS Credits: 6

Degree	Type	Year	Semester
4314579 Biological and Environmental Engineering	OB	1	2

Contact

Name: Gara Villalba Mendez

Email: Gara.Villalba@uab.cat

Use of Languages

Principal working language: spanish (spa)

Prerequisites

Students must have a solid foundation of the following subjects: - Energy and material balances - Knowledge of the most important processes of organic and inorganic chemistry - Knowledge of the physicochemical and toxicological properties of chemical substances. - Knowledge of thermodynamics.

Objectives and Contextualisation

The main objective of the module is that students combine knowledge and tools to evaluate processes and products to optimize resources (materials and energy) and also to minimize their environmental impacts. The methods, tools and strategies to quantify the environmental impacts in the life cycle are studied. The application of thermodynamic principles is included as a tool to quantify the use of resources in chemical processes, as well as the efficiency in the transformation of raw materials to products. The concepts are explained with examples and case studies to illustrate the applicability of these evaluation tools.

Competences

- Apply methods, tools and strategies to develop biotechnological processes and products with energy-saving and sustainability criteria.
- Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.
- Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
- Continue the learning process, to a large extent autonomously.
- Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
- 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.
- Use IT tools to acquire further knowledge in the field of biological and environmental engineering.

Learning Outcomes

1. Analyse, summarise, organise and plan projects related to the environmental sustainability of products, processes and services
2. Apply specific methodologies, techniques and resources to conduct research and produce innovative results in the area of biological and environmental engineering.
3. Communicate and justify conclusions clearly and unambiguously to both specialist and non-specialist audiences.
4. Continue the learning process, to a large extent autonomously.
5. Integrate knowledge and use it to make judgements in complex situations, with incomplete information, while keeping in mind social and ethical responsibilities.
6. Interpret and develop life-cycle analyses for products and processes.
7. Know bibliographic sources, calculation diagrams and databases needed to apply risk-quantification methodologies.
8. Know current methodologies for quantifying industrial and environmental risk as a consequence of accidents.
9. Know the main elements of industrial ecology: systems theory, thermodynamics, material flow analysis and resource and energy consumption.
10. 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.
11. Solve problems in new or little-known situations within broader (or multidisciplinary) contexts related to the field of study.
12. Use IT tools to acquire further knowledge in the field of biological and environmental engineering.

Content

The main objective of the module is that the student has the knowledge and tools to know how to evaluate processes and products to optimize resources (materials and energy) and also minimize environmental impacts and risks. The methods, tools, and strategies to quantify environmental impacts based on the life cycle are studied. The application of thermodynamic principles is included as a tool to quantify the use of resources in chemical processes, as well as the efficiency in the transformation of raw materials into products. The concepts are explained with examples and case studies to illustrate the applicability of these evaluation tools.

Introduction to environmental energy problems, global warming, ozone Depletion; air quality: pollution and toxic; water quality. Introduction to Green Engineering, Pollution Prevention, Industrial Ecology. Analysis of material and energy flows (MFA, EFA), systems analysis. Application to substances, products, processes, industry, regions. Introduce and start teamwork: develop an MFA through an industrial chemistry process. Use of Gabi software.
Introduction to the use of thermodynamics to evaluate the efficiency of resource use. MFA, together with LCA, gives us an idea of the environmental impacts of the processes, but they do not give us any indication if we are using the resources efficiently and what room for improvement. That is why we analyze the systems with the two laws of thermodynamics - energy is conserved, but it is degraded. How to evaluate a process / product based on chemical structure. We learn to calculate "bioconcentration", biodegrability, atmospheric life, risks to ecosystems, and other important factors to be able to make evaluations, also using software such as EPA EPISUITE; and we put them into practice with some problems.

Methodology

Combination of:

- Master classes

- Classroom practices

- Preparation of reports and / or works.

- readings and activities of scientific interest.

- Resolution of exercises and / or activities at home

- Personal study

Activities

Title	Hours	ECTS	Learning Outcomes
Type: Directed			
Supervised work in the classroom	12	0.48	
Theory lecture	26	1.04	
Type: Supervised			
Supervised work	15	0.6	
Type: Autonomous			
Individual and team work	89	3.56	

Assessment

There is no final exam in this subject. The grade is based on a project developed throughout the subject, evaluated as follows:

35% presentation (will also be evaluated by the rest of the classmates with a 50% weight), 35% written work (the delivery date will be notified in class), 30% in two tests during the course based on the project and theory given in class.

The recovery of the subject will be done as follows: the student can present the work and the presentation again, and will obtain the passing or suspended grade. The maximum grade will be 5 out of 10 if approved.

For each evaluation activity, a place, date and time of review will be indicated in which the student can review the activity with the teaching staff. In this context, claims may be made regarding the grade of the activity, which will be evaluated by the faculty responsible for the subject. If the student does not appear in this review, this activity will not be reviewed later.

Honor plates (MH). Granting an honors degree qualification is the decision of the teaching staff responsible for the subject. The regulations of the UAB indicate that MH may only be granted to students who have obtained a final grade equal to or greater than 9.00. Up to 5% of MH of the total number of students enrolled can be granted.

A student will be considered non-evaluable (NA) if he has not submitted the project (oral or written) and has not done any of the theoretical and practical tests.

Without prejudice to other disciplinary measures deemed appropriate, the irregularities committed by the student that may lead to a variation in the qualification of an evaluation act will be graded a zero. Therefore, copying, plagiarism, deception, copying, etc. in any of the evaluation activities it will imply suspending it with a zero.

Assessment Activities

Title	Weighting	Hours	ECTS	Learning Outcomes
Final Project, oral presentation	35%	1	0.04	1, 2, 10, 9, 7, 8, 6, 5, 3, 11, 4, 12
Final Project, written submission	35%	1	0.04	1, 2, 10, 9, 7, 8, 6, 5, 3, 11, 4, 12

Theory-practical evaluations	30%	6	0.24	9, 7, 6, 5, 11

Bibliography

BULLOCK, A.; WALSH, M. The Green Design and Print Production Handbook

BREZET, H.; VAN HEMEL, 1997. C. Ecodesign. A promisingapproach to sustainableproductionandconsumption.

Brower, C., Mallory, R.m., Ohlman, Z. 2005. Experimental Eco>Design.

DOUGHERTY, B. 2008. Green graphicdesign.

LEWIS, L.; GERTSAKIS, J. 2001. Designandenvironment. A global guide to designinggreenergoods.

REIS, D. Product Design in the Sustainable Era

SHEDROFF, N. 2009. Design Is the Problem: The Future of Design Must be Sustainable

TISCHNER, U. et al. 2000. How to do EcoDesign? A guide for environmentallyandeconomicallysoundDesign.

EUROSTAT 2002: Material use in theEuropean Union 1980-2000. IndicatorsandAnalysis. Working Papers andStudies. Eurostat. (preparedby Weisz, H.; Fischer-Kowalski, M.; Amann, C.; Eisenmenger, N.; Erb, K.-H.; Hubaceck, K.; Krausmann, F.)

EUROSTAT 2005: Development of material use in the EU-15: 1970-2001. Material composition, crosscountrycomparison, and material flowindicators. Working Papers andStudies. Eurostat (preparedby Weisz, H.; Krausmann, F. Eisenmenger, N.; Hubaceck, K.; Amann, C.)

Matthews, Emily, Amann, Christof, Fischer-Kowalski, Marina, Bringezu, Stefan, Hüttler, Walter, Kleijn, René, Moriguchi, Yuichi, Ottke, Christian, Rodenburg, Eric, Rogich, Don, Schandl, Heinz, Schütz, Helmut, van der Voet, Ester, and Weisz, Helga 2000: TheWeight of Nations: Material Outflowsfrom Industrial Economies. WorldResourcesInstitute.

Schandl, Heinz, Grünbühel, Clemens M., Haberl, Helmut, and Weisz, Helga(2002): Handbook of Physical Accounting. Measuring bio-physical dimensions ofsocio-ecomonicactivities. MFA - EFA - HANPP. Vienna: Federal Ministry of AgricultureandForestry, EnvironmentandWater Management, 1-75.

Curran, M.A. (ed.) (1996) EnvironmentalLifeCycleAssessment, McGraw-Hill, ISBN 0-07-015063-X.

Curran, M. A. (2008). HumanEcology: LifeCycleAssessment. 8 PP; Encyclopedia of Ecology, Five-Volume Set, ISBN-13: 978-0-444-52033-3; ISBN-10: 0-444-52033-3; Elsevier.

Finkbeiner, M., Hoffmann, R., Ruhland, K., Liebhart, D., & Stark, B. (2006). Application of lifecycleassessment for theenvironmentalcertificate of themercedes-benz S-class. International Journal of LifeCycleAssessment, 11(4), 240-246.

Flake, M., Fleissner, T., & Hansen, A. (2002). Ecologicalassessment of natural fibrereinforced components andthermoplastics for automotive parts. Progress in RubberPlasticsRecycling Technology, 18(4), 219-246.

Guinee, J., Ed. (2001). LifeCycleAssessment: AnOperationalGuide to the ISO Standards. Society of EnvironmentalToxicologyandChemistry, SETAC (1990). A TechnicalFramework for LifeCycleAssessments.

HorneR, Grant T, andVerghese K. (2009). LifeCycleAssessment: Principles, PracticeandProspects. ISBN: 9780643094529; 160PP; CSIRO Publishing, Australia.

ISO 14040 (2006). Environmental Management - LCA - PrinciplesandFramework. International Standards Organization, Geneve, Switzerland.

Kaniut, C., Cetiner, H., & Franzeck, J. (1996). Ecologicalassessment in theautomotiveindustry - shownbytheexample of a car component madefromdifferent materials. VDI Berichte, (1307), 301-329.

U.S. EnvironmentalProtectionAgency, EPA (2006). LifeCycleAssessment: PrinciplesandPractice, EPA/600/R-06/060, available on-line, www.epa.gov.

Wötzel, K., & Flake, M. (2001). Renewable materials as analternative to plastics: A comparativelifecycleanalysis of a hampfibrereinforced component andan ABS-mouldedcarrier. UmweltwissenschaftenundSchadstoff-Forschung, 13(4), 237-247.