Ecologia Industrial 2014/2015

Codi: 42405
Crèdits: 9

Titulació	Tipus	Curs	Semestre
4313784 Estudis Interdisciplinaris en Sostenibilitat Ambiental, Econòmica i Social	OT	0	1

Professor de contacte

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Utilització de llengües

Llengua vehicular majoritària: anglès (eng)
Grup íntegre en anglès: No
Grup íntegre en català: Sí
Grup íntegre en espanyol: No

Equip docent

Joan Rieradevall Pons
Esther Sanye Mengual

Equip docent extern a la UAB

Anna Petit
Carles Martinez
David Sanjuan
Jesus Rives

Prerequisits

If not native English speaker: valid IELTS (with a minimum score of 6.5) or TOEFL (minimum 550 paper based, 213 computer based, 79 web-based) score report or a Cambridge Certificate of Proficiency in English or Cambridge Certificate in Advanced English.

The students must hold an undergraduate degree with relevance to environmental studies, with knowledge in both engineering sciences and management. Thus it is understood that the students will come to class with undergraduate level knowledge of natural science, engineering, economics, and management.

Objectius

This course is an introduction to the field of Industrial Ecology (IE) as a multidisciplinary effort to evaluate anthropogenic systems, minimizing their negative effect on our planet. The students are taught the methods, tools, and strategies within IE, aimed to recreate our industrial system in such a way that it can be sustainable and in harmony with the rest of the natural ecosystem. To achieve this general objective, the module is divided in three blocks:

Block 1 (3 ECTs). Tools and methods within IE. The objectives of this block are:

- Understand the concepts of IE, its framework as a multidisciplinary area of research based on system theory; resources: environmental goods and services, externalities.

- Understand how thermodynamics is a conceptual framework for IE, and be able to apply thermodynamics at different scales for system evaluation.
- Understand Material Flow Analysis (MFA), and be able to apply this tool to different systems, such as a product, process, or region.
- Understand the concepts of urban metabolism, carbon footprint, including differences in scope, results, and policy implications.
- Understand both process-based approach, MFA-LCA (or Material Flow Analysis coupled with Life-Cycle Assessment) and EIO-LCA (or Economic Input-Output coupled with Life-Cycle Assessment); apply the fundamentals of these approaches to be used for various analyses (e.g., GHG, pollution, water, land, toxics, materials use, etc.)

Block 2 (3 ECTs). Life Cycle Assessment (LCA). The main objectives are:

- Understand the concept of LCA, its applications and the global framework for its use.
- Understand the main steps of LCA (i.e., goal and scope definition, inventory analysis, impact assessment and interpretation) and be able to apply them to different real-life cases, such as products or services.
- Learn how to evaluate and interpret the results, assumptions and uncertainties in case studies from a critical point of view.
- Learn how to use the SimaPro software and its basic functionalities and be able to calculate the environmental impacts of a system by means of it.
- Apply the SimaPro software to compare a sustainability product (solar cooking) and a conventional good (microwave oven) from a life cycle perspective and represent its results in a poster.

Block 3 (3 ECTs). Eco-design and sustainable urban systems. The objectives of this block are:

- Understand the concept of eco-design and the role of LCA, as well as the basic theoretical aspects, regulations and legal framework.
- Learn about the application of IE tools and methods to urban systems for increasing its environmental sustainability.
- Learn the basic principles of sustainable urban planning and understand its process.
- Learn how to use the Gabi software and its basic functionalities and be able to calculate the environmental impacts of a system by means of it.

Apply the GaBi software to assess urban infrastructures (pavements, distribution networks, …) from a life cycle perspective.

Competències

- Analitzar, sintetitzar, organitzar i planificar projectes relacionats amb la millora ambiental de productes, processos i serveis.
- Aplicar la metodologia de recerca, les tècniques i els recursos específics per a investigar i produir resultats innovadors en l'àmbit dels estudis ambientals.
- Tenir coneixements que aportin la base o l'oportunitat de ser originals en el desenvolupament o l'aplicació d'idees, sovint en un context de recerca
- Treballar en un context internacional i multidisciplinari

Resultats d'aprenentatge

1. Analitzar els resultats de recerca per obtenir nous productes o processos i valorar-ne la viabilitat industrial i comercial per a transferir-los a la societat.
2. Aplicar els coneixements de les diferents eines decologia industrial a sistemes independentment de lescala.
3. Aplicar la metodologia de recerca, les tècniques i els recursos específics per a investigar i produir resultats innovadors en l'àmbit dels estudis ambientals.
4. Conèixer els principals elements de lecologia industrial: teoria de sistemes, termodinàmica, anàlisi de flux de materials i consum de recursos.
5. Conèixer els sistemes urbans i els seus indicadors per avaluar-los.

6. Conèixer les eines decoinnovació aplicables a entorns urbans.
7. Interpretar i desenvolupar anàlisis de cicle de vida per a productes i processos.
8. Treballar en un context internacional i multidisciplinari

Continguts

Block 1 (3 ECTs). Tools and methods within IE. The contents of this block are:

- Industrial Ecology and Technological change.
- System Theory, economic valuation, externalities.
- Introduction to thermodynamics; Thermodynamics as a conceptual framework for IE.
- Introduction to material flow analysis.
- Introduction to urban metabolism, carbon footprint and case studies.
- Introduction to process-based approach, MFA-LCA (or Material Flow Analysis coupled with Life-Cycle Assessment), using actual energy use data to model systems; and EIO-LCA (or Economic Input-Output coupled with Life-Cycle Assessment), which adopts IO tables to study the inter-dependencies of economies. The fundamentals of these approaches will be used for various analyses (e.g., GHG, pollution, water, land, toxics, materials use, etc.)

Block 2 (3 ECTs). Life Cycle Analysis. The contents of this block are:

Development of LCA

- Introduction to LCA
- Environmental tools
- Interpretation and uncertainty
- Case studies

Introduction to SimaPro Software

- SimaPro: Introduction to the software
- Inventory creation. Introduction of the information programs
- Impact assessment in SimaPro. Analysis of sensibility.
- Presentation LCA in SimaPro. Development of case of studies, led by students

Block 3 (3 ECTs). Sustainable urban systems. The contents of this block are:

- Theory of eco-neighborhoods and evaluation of a case study
- Introduction to GaBi + practical exercises + student case study

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Metodologia

Block 1 (3 ECTs). Tools and methods within IE. The 2.5 ECTs of this block are divided the following way:

18 hours of class, this includes theory and computer lab.

35 hours of readings and studies outside the classroom (individual and group)

11.5 hours dedicated to individual class project.

Class time: The theory classes will provide the students with the knowledge necessary to understand the readings and be able to do exercises outside the classroom. Time will be allotted for questions, interaction, and debate. At the beginning of each class, there will be a 10 to 15 minute quiz based on the previous class and the readings due that day.

Work outside the classroom: The reading assignments will be used both as a preparation for understanding the theory class (very basic, general audience readings), and to go further in-depth with more specific and technical readings. Most of these will be done in group to motivate team work and improve communication skills within a multidisciplinary, multicultural environment.

Individual class project: This will give the student the opportunity to apply the knowledge acquired during the course to a specific case study assigned in class.

Block 2 (3 ECTs). Life Cycle Analysis.

18 hours of class. This includes theory and computer lab.

- 12 hours of LCA theory and applied theory to case studies
- 6 hours of computer Lab (SimaPro)

25 hours of readings (papers and case studies) and studies outside the classroom (individual and group)

23.5 hours dedicated to produce the LCA of a solar oven and a poster.

Class time: The theory classes will provide the students with the knowledge necessary to understand the application of LCA tools in the analysis and design of sustainable products.

Work outside the classroom: The solar cooking will be carried out of the classroom in order to ensure that students have understood theory classes, and to put concepts in practice.

Individual and group projects: Research of the solar cooking experience; determination of objectives and scope of the environmental assessment; development inventories; modelization of the solar cooking SimaPro; Interpretation of environmental outcomes and selection of the environmental indicators and validation of the ecodesign.

Block 3 (3 ECTs). Eco-design and sustainable urban systems.

The 3 ECTs of this block are divided in the following way:

18 hours of class. This includes theory and computer lab:

- 6h of eco-design
- 6 h of sustainable urban systems

13,5 hours of readings and studies outside the classroom (individual and group)

35 hours dedicated to group class projects.

Class time: The theory classes will provide the students with the knowledge necessary to understand the application of IE tools and methods in the analysis and design of sustainable urban systems.

Work outside the classroom: Some exercises will be carried out of the classroom in order to ensure that students have understood theory classes, and to put concepts in practice.

Individual project: Design and construction of a solar oven. The inventory data used to produce this device will be later used to carry out an LCA with SimaPro in Block 2. The design, the materials and the heating temperature will be tested.

Group project: during the block project development many tasks will de done by students:

- Determination of the case study
- Research of the urban element
- Determination of objectives and scope of the environmental assessment
- Development and reserach of inventories, and bibliography research.
- Modelization of the urban element in GaBi
- Environmental assessment of the urban element
- Interpretation of environmental outcomes and selection of the environmental indicators to focus on to the re-design of the urban element according to environmental briefing
- validation of the re-design of the urban element

Activitats formatives

Títol	Hores	ECTS	Resultats d'aprenentatge
Tipus: Dirigides			
Block 1 - Theory Classes	18	0,72	2, 4, 5
Block 2 - Theory Classes	12	0,48	6, 7
Block 3 - Theory Classes	12	0,48	5
Tipus: Supervisades			
Block 2 - Computer Lab	6	0,24	7
Block 3 - Computer Lab	6	0,24	5, 6
Tipus: Autònomes			
Block 1 - Final project	15,5	0,62	1, 2, 4
Block 1 - Readings, study, work in groups and preparation for presentations	37	1,48	1, 2, 4, 5, 8
Block 2 - Ecodesign project	30	1,2	3, 5, 6, 7, 8
Block 2 - Readings, study, work in groups and preparation for presentations	24	0,96	6, 7, 8
Block 3 - Final project	14,5	0,58	3, 5, 6, 8
Block 3 - Readings, study, work in groups and preparation for presentations	35	1,4	5, 6

Avaluació

The grade of the module is made up of the following percentages:

-34 % block 1

-33 % block 2

-33 % block 3,

To pass the module, the student must have at least a grade of 4.0 in each block, the combined grade must be greater than 5. If the student fails the module, he or she will have to register again for the entire module.

Block 1: Evaluation will be 50% based on participation and 50% based on a final exam.

The participation grade is composed of:

1. Quizzes (Individual). Each class will begin with a 10-15 minute quiz based on the previous class and the assigned readings. Apart from ensuring a continuous effort from part of the students, this will also motivate them to arrive punctually to class, already in thinking mode. Also included in "participation" are the. Both the quizzes and small presentations have equal weight.
2. Presentations (group). There will be either 2 or 3 presentation assignments during the course.
3. Class activities (group). There will be either 1 or 2 activities during the course, after which the students must be able to communicate results.
4. Final project to be announced in class- individual or group.

Block 2:

Evaluation will be 50% theory and 50% lab activities.

Block 3:

Evaluation will be 50% **eco-design** and 50% **urban systems.**

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1. **Block project (group) - 70%.** It will consist on the development of an urban element case study. It will be assessed by using GaBi in order to quantify the environmental impacts and in order to re-design it considering environmental issues. Students will present the results of the case study assessment in a presentation.
2. **GaBi exercises (individual) - 10%.** A short assignment will be conducted by the students.
3. **LCI of the urban element (group) - 10%.** The inventory of materials used by the students to conduct the LCA of their urban element must be ready on the assigned date.

1. Attendance and participation - 10%.

Activitats d'avaluació

Títol	Pes	Hores	ECTS	Resultats d'aprenentatge
Block 1 - Final Exam	17%	2	0,08	1, 2, 4
Block 1 - Individual Quizzes, Group Presentation, Project	17%	1,5	0,06	1, 2, 4, 8
Block 2 - Project	16.5%	0	0	1, 2, 3, 6, 7
Block 2- Participation	3.3%	0	0	1, 6, 7, 8
Block 3 - Final Class Project	24.8%	11,5	0,46	1, 3, 5
Block 3- participation	8.2%	0	0	3, 6, 8
block 2- poster	13.2%	0	0	1, 2, 7, 8

Bibliografia

Block 1. Available with syllabus, given at the beginning of class.

Block 2. Available with syllabus, given at the beginning of class.

Block 3

Farreny R, Oliver-Solà J, Montlleó M, Escribà E, Gabarrell X, Rieradevall J (2011) Transition Towards Sustainable Cities: Opportunities, Constraints and Strategies in Planning. A Neighbourhood Eco-Design Case Study in Barcelona (Spain). Environment and Planning A 43(5) 1118 - 1134

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Oliver-Solà, J., Rieradevall, J., Gabarrell, X., 2009. Environmental impacts of the infrastructure for district heating in urban neighbourhoods. Energy Policy 37(11): 4711-4719.

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Oliver-Solà, J., Núñez, M., Gabarrell, X., Boada, M., Rieradevall, J., 2007. Service Sector Metabolism: Accounting for Energy Impacts of the Montjuïc Urban Park in Barcelona. Journal of Industrial Ecology 11(2): 83-98.

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Mendoza JMF, Oliver-Solà J, Gabarrell X, Rieradevall J, Josa A (2012) Life cycle assessment of granite application in sidewalks. The International Journal of Life Cycle Assessment, 17(5): 580-592.

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Ceron-Palma I, Oliver-Solà J, Sanyé-Mengual E, Montero JI, Rieradevall J (2012) Barriers and opportunities regarding the implementation of Rooftop Greenhouses (RTEG) in Mediterranean cities of Europe. Journal of Urban Technology, in press

Ceron-Palma I, Sanyé-Mengual E, Oliver-Solà J, Montero JI, Rieradevall J. (2012) Towards a green sustainable strategy for social neighbourhoods in Latin America: Case from social housing in Merida, Yucatan, Mexico. Habitat International 38 (2013) 47-56

Fundació La Caixa (2007) Ecodiseño. Área de Medio Ambiente y Ciencia - Fundació La Caixa, Barcelona.

González-García S, Garcia Lozano R, Estévez J, Pascual R, Moreira MT, Gabarrell X, Rieradevall J, Feijoo G (2012a) Environmental Assessment and Improvement Alternatives of a Ventilated Wooden Wall from LCA and DfE Perspective. Int J LCA 17 (4): 432-443.

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Rieradevall J, Bala A, Domenech X, Gazulla C, Milà Canals L (2005) Ecoproducte Ecodisseny. Vol. 4. Barcelona: Museu de les Arts Decoratives. Institut de Cultura. Departament d'Imatge i Producció Editorial, Barcelona.

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