

Ecologia Industrial**2013/2014**

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 d'idiomes

Llengua vehicular majoritària: anglès (eng)

Prerequisits

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). Eco design and Life Cycle Analysis (LCA). This being one of the most important methods and system analysis of IE, it deserves a block all to itself. The main objectives are:

For product and process ecodesign and LCA

- Understand the concept of ecodesign and LCA Basic theoretical aspects, regulations and legal framework
- Case studies: ecodesign products and processes
- Introduction to SimaPro practices. Definition of objectives, functional unit, and inventory. Impact evaluation and improvement analysis.
- Apply SimaPro software for LCA of sustainability product (solar cooking) and conventional goods (microwave oven)

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

- Understand the opportunities of applying IE tools and methods in urban systems.
- Understand the basic principles of urban metabolism.
- Learn about the process of urban planning of an econeighbourhood.
- Apply GaBi software for the LCA of urban infrastructures (pavements, distribution networks, ...)

Competències

Estudis Interdisciplinaris en Sostenibilitat Ambiental, Econòmica i Social

- 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 de ecología industrial a sistemes independentment de la escala.
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 la ecología 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 de innovació 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). Ecodesign and Life Cycle Analysis. The contents of this block are:

Theory of Ecodesign

- Introduction Ecodesign
- Strategies of Ecodesign
- Eco innovation and Eco label
- Environmental tools. LCA-Ecodesign

- LCA data base. Database Ecotech Sudoe
- Study of cases LCA-ecodesign products

Introduction to SimaPro Software

- SimaPro: Introduction computer tool LCA
- Creation inventory. Introduction of the information programs
- Evaluation impacts in SimaPro. Analysis of sensibility.
- Presentation LCA in SimaPro. Development of cases of study

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
- Case study of LCA of an urban element, led by students

Metodología

Block 1 (3 ECTs). Tools and methods within IE. The 2.5 ECTs of this block are divided the following way:
22 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).

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

- 10 hours Theory and LC data base programs
- 9 hours Computer Lab. SimaPro
- 4 hours Analysis and evaluation prototyping and poster

10 hours of readings paper and another documents and studies outside the classroom (individual and group)
30 hours dedicated to produce the ecodesign prototyping and poster.

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

Work outside the classroom: 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). Sustainable urban systems.

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

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

11.5 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 group projects: during the block project development many tasks will be done by students:

- Determination of the case study
- Research of the urban element
- Determination of objectives and scope of the environmental assessment
- Development and research 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	14	0,56	6, 7
Block 3 - Theory Classes	8	0,32	5
Tipus: Supervisades			
Block 1 - Student activities in class and student presentations	4	0,16	2, 4
Block 2 - Computer Lab	9	0,36	7
Block 3 - Computer Lab	8	0,32	5, 6
Block 3 - Student activities in class and student presentations	6	0,24	3, 5, 8
Tipus: Autònomes			
Block 1 - Final project	11,5	0,46	1, 2, 4
Block 1 - Readings, study, work in groups and preparation for presentations	35	1,4	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	20	0,8	6, 7, 8
Block 3 - Final project	11,5	0,46	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

50% ecoefficiency of solar cooking prototyping. it will consist on a development of a solar cooking . It will be assessed by using SimaPro in order to quantify the environmental impacts and in order to compare with microwave oven

40% scientific poster. Technical ,environmental and economic aspects to relationship solar prototyping-The quality the formal aspects will be evaluation

10% class participation. Continuous effort from part of the students, participation in class activities

Block 3:

Evaluation will be 75% based on a block project and 25% based on participation.

1. (75%) Block project - it will consist on a development of a 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.
2. (25%) Exercises and presentations. There will be either 2 or 3 exercises during the course.

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

Bibliografía

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

Block 2

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

González-García S, García 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.

González-García S, García Lozano R, Buyo P, Pascual RC, Gabarrell X, Rieradevall J, Moreira MT, Feijoo G (2012b) Eco-innovation of a Wooden Based Modular Social Playground: Application of LCA and DfE Methodologies. *J Cleaner Production* 27: 21-31.

González-García S, García Lozano R, Moreira MT, Gabarrell X, Rieradevall J, Feijoo G, Murphy RJ (2012c) Eco-innovation of a Wooden Childhood Furniture Set: An Example of Environmental Solutions in the Wood Sector. *Sci Total Environ* 426: 318-26.

González-García S, Gasol CM, Lozano RG, Moreira MT, Gabarrell X, Rieradevall J, Feijoo G (2011a) Assessing the Global Warming Potential of Wooden Products from the Furniture Sector to Improve Their Eco-design. *Sci Total Environ* 410-411: 16-25.

González-García S, Silva FJ, Moreira MT, Castilla Pascual R, García Lozano R, Gabarrell X, Rieradevall J, Feijoo G (2011b) Combined Application of LCA and Eco-design for the Sustainable Production of Wood Boxes for Wine Bottles Storage. *Int J LCA* 16 (3): 224-237.

González-García S, Salinas-Mañas L, García-Lozano R, Gabarrell X, Rieradevall J, Feijoo G, Moreira MT (2013) The application of ecodesign methodology in SMEs run according to lean management: the case of a furniture publishing company. *Environ Eng Management J* (in press).

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

Rieradevall J, Domenech X, Bala A, Gazulla C (2000) Ecodiseño De Envases. El Sector De La Comida Rápida. Elisava edicions, Barcelona.

Rieradevall J, Domenech X, Milà Canals L, Gazulla C, Bala A (2003) Household Ecoproducts. Environmental Education Guides 16: 23.

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

Oliver-Solà J, Josa A, Arena AP, Gabarrell X, Rieradevall J (2011) The GWP-Chart: An environmental tool for guiding urban planning processes. Application to concrete sidewalks. *Cities* 28(3): 245-250.

Núñez M, Oliver-Solà J, Rieradevall J, Gabarrell X (2010) Water management in integrated service systems: accounting for water flows in urban areas. *Water Resources Management* 24(8):1573-1650.

Oliver-Solà, J., Josa, A., Gabarrell, X., Rieradevall, J., 2009. Environmental optimization of concrete sidewalks in urban areas. *The International Journal of Life Cycle Assessment* 14(4), 302-312.

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.

Oliver-Solà, J., Gabarrell, X., Rieradevall, J., 2009. Environmental impacts of natural gas distribution networks

within urban neighborhoods. *Applied Energy* 86(10), 1915-1924.

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.