

Course guide

480012 - ENSD - Fundamentals of Engineering, Sustainability and Development

Last modified: 22/05/2025

Unit in charge:	Barcelona School of Civil Engineering	
Teaching unit:	748 - FIS - Department of Physics. 717 - DEGD - Department of Engineering Graphics and Design.	
Degree:	MASTER'S DEGREE IN SUSTAINABILITY SCIENCE AND TECHNOLOGY (Syllabus 2013). (Compulsory subject).	
Academic year: 2025	ECTS Credits: 5.0	Languages: Spanish

LECTURER

Coordinating lecturer: BARBARA SUREDA CARBONELL

Others: Alcaraz Sendra, Olga
Sureda Carbonell, Barbara

PRIOR SKILLS

Are not required

REQUIREMENTS

Are not required

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:

3. The ability to critically analyse and assess theories, strategies and policies on development and sustainability; perspectives on the sustainability paradigm, discussions within the field and its environmental, social, cultural and economic implications; the particularities of and differences between environmental and ecological economics; and the problems of valuing goods, services, resources and externalities economically.

CE02. The ability to apply knowledge of societies' evolution, their impact on the environment, urban transition and the principal defining characteristics of present-day societies, as well as techniques and lessons related to socio-environmental conflict.

CE07. The ability to design, develop and apply, in an integrated and coordinated manner, the theories and analytical techniques of the social, economic and Earth sciences, as well as management and research-action techniques and approaches based on sustainability science and technology in the fields of biodiversity and natural resources, the built environment and services, and production systems and information.

CE03. The ability to critically analyse theories and perspectives on the traits and properties of the geosphere and biosphere that facilitate and frame the development of socio-environmental systems, as well as the main challenges posed by climate change.

Generical:

CG03. The ability to analyze, evaluate and synthesize, critically, new and complex ideas and promote, within academic and professional, scientific, technological, social or cultural knowledge society contexts.

Transversal:

1. SUSTAINABILITY AND SOCIAL COMMITMENT: Being aware of and understanding the complexity of the economic and social phenomena typical of a welfare society, and being able to relate social welfare to globalisation and sustainability and to use technique, technology, economics and sustainability in a balanced and compatible manner.

Basic:

CB7. That students can apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field d'study.

CB8. Students should be able to integrate knowledge and handle complexity, and formulate judgments based on information that was incomplete or limited, include reflecting on social and ethical responsibilities linked to the application of its conocimientos and judgments.

CB9. That students can communicate their conclusions-and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.

CB10. That students have the learning skills to allow them to continue studying in a way that will have to be largely autodirigido or autonomous.

TEACHING METHODOLOGY

During the development of the subject the following teaching methodologies will be used:

Master class (EXP): presentation of knowledge by teachers through master classes.

Practical Work (TP): solving practical exercises and case studies individually or in small groups.

Evaluation activities (EV).

During the development of the subject, the following training activities will be used:

- In person:

Theoretical classes (CTC): know, understand and synthesize the knowledge presented by the teaching staff through master classes.

Classes of practical work (CTP): participate in solving exercises and different case studies. Discussion of the conclusions with the teacher and other students in the classroom.

- Non-face-to-face:

Autonomous study (EA): study or expand the content of the subject individually or in a group, understanding, assimilating, analyzing and synthesizing knowledge.

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the subject, the students:

- Must be able to develop and apply personal and interpersonal dynamics (sensitivity, empathy, cooperation, ...), for the analysis and resolution of conflicts and also for decision making.
- Must know and understand the state of the world from the point of view of the existence of limits and imbalances.
- Must know, understand and analyze, with a local and global vision, the significant problems that hinder sustainable development and contextualize them.
- Must know and analyze the concept of sustainable development and develop the capacity to apply it to achieve a more sustainable world.
- Must be able to analyze the role of technoscience and the social and environmental impact of technology.
- Must know and analyze with a critical spirit, existing systems and current and future issues in decision making worldwide.
- Must know the main international agendas that work towards sustainability.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	10,0	7.99
Hours small group	6,7	5.36
Hours large group	20,0	15.99
Self study	88,4	70.66

Total learning time: 125.1 h

CONTENTS

Dynamics of change: personal and interpersonal

Description:

Sensitivity, empathy, cooperation, analysis and resolution of conflicts, decision making ...

This is a transversal theme that will be developed throughout the course with various tools and methodologies that aim to work and facilitate the development of personal and interpersonal change dynamics.

Full-or-part-time: 3h

Theory classes: 3h

Development model: growth dynamics

Description:

Pressures: population, imbalances, economic growth, consumption growth (material resources, energy consumption, food resources ...)

Related activities:

BaU Variables (population, GDP, energy consumption, ...).

Agro-food model and land use.

Full-or-part-time: 9h

Theory classes: 9h

Development model: impacts and conflicts

Description:

Impacts on natural cycles, impacts at the local level, global impacts.

External debt.

Urbanization process

Environmental conflicts.

Related activities:

Analysis of atmospheric pollution.

Case study (environmental conflicts).

Full-or-part-time: 6h

Theory classes: 6h

Sustainability paradigm

Description:

Historical introduction

Systemic paradigm vs. mechanistic paradigm

Concept of sustainable development and its evolution (carrying capacity, needs vs. capacities, ...)

Concept interpretations

Sustainable Human Development

Indicators and indices of sustainability

Large couplings and decoupling challenges

Related activities:

Needs vs. Capabilities

Gapminder

Full-or-part-time: 6h

Theory classes: 6h

Concretion of the sustainability paradigm

Description:

Sustainability alternatives to the current development model: theory of decrease / Guaranteed Basic Income / green economy / economy of the common good

Sustainable production: circular economy

Ethical dimension in decision making

Sustainable consumption

Sustainable management resources (water, energy, ...)

Related activities:

Circular economy.

Ethics.

Sustainable consumption activity: fair trade, proximity consumption cooperatives, energy cooperatives, Zero Waste,

Full-or-part-time: 9h

Theory classes: 9h

International organizations and Agenda for development

Description:

Bretton Woods organizations

UN

Other organizations

From the MDGs to the SDGs

Other agendas

Related activities:

International organizations

Evolution and goals ODS

Full-or-part-time: 6h

Theory classes: 6h

GRADING SYSTEM

EV1 Partial written or oral knowledge control test (PE): 30%

EV2 Partial written or oral knowledge control test (PE): 30%

EV3 Work done throughout the course (TR): 40%

EXAMINATION RULES.

The rules of implementation and the dates will be communicated together with the statement of the activities.

BIBLIOGRAPHY

Basic:

- De Vries, B.J.M. Sustainability science. Cambridge: Cambridge University Press, 2013. ISBN 9780521184700.
- Costanza, R.; Cumberland, J.H.; Daly, H.; Goodland, R.; Norgaard, R.B.; Kubiszewski, I.; Franco, C. An introduction to ecological economics. Second edition. Raton, Fla: CRC Press, Taylor & Francis Group, 2015. ISBN 9781566706841.
- Dresner, S. The principles of sustainability. 2nd ed. London: Earthscan, 2008. ISBN 9781844074969.
- Mulder, K. (ed.). Sustainable development for engineers: a handbook and resource guide. Sheffield: Greenleaf, 2006. ISBN 1874719195.
- Meadows, D.; Randers, J.; Meadows, D. The limits to growth: the 30-year update. White River Junction, Vt: Chelsea Green Pub., 2004. ISBN 1931498512.

Complementary:

- Diamond, J.M. Collapse: how societies choose to fail or succeed. New York: Penguin, 2011. ISBN 9780143117001.
- Weiner, R.F.; Matthews, R.A. Environmental engineering [on line]. 4th ed. Amsterdam: Butterworth Heinemann, 2003 [Consultation: 15/02/2021]. Available on: <https://www.sciencedirect.com/science/book/9780750672948>. ISBN 9780750672948.
- Davis, M.L.; Cornwell, D.A. Introduction to environmental engineering. 5th ed. New York: McGraw-Hill, 2013. ISBN 9780071326247.

RESOURCES

Hyperlink:

- Nakicenovic, N.; Rockström, J.; Gaffney, O. and Zimm, C. (2016) Global commons in the anthropocene: world development on a stable and resilient planet. IIASA Working Paper WP-16-019. Laxenburg, Austria : International Institute for Applied Systems Analysis.. pure.iiasa.ac.at/14003/
- United Nations Education, Scientific and Cultural Organization (2010), Engineering: issues challenges and opportunities for development: UNESCO report. 396 p. ISBN: 978-9231041563.. unesdoc.unesco.org/images/0018/001897/189753e.pdf
- World Bank Group. World Development Report, (annual report).. openknowledge.worldbank.org/handle/10986/2124
- United Nations Development Program. Human Development Reports, (annual report).. hdr.undp.org
- Haughton, J.; Khandker, S.R. (2009) Handbook on poverty and inequality. Washington, DC: World Bank. © World Bank. ISBN: 978-0821376133. License: CC BY 3.0 IGO. hdl.handle.net/10986/11985
- Kates, R.W., ed. (2010), Readings in sustainability science and technology - an introduction to the key literature of sustainability science, CID Working Paper No. 213. Center for International Development, Harvard University.. www.hks.harvard.edu/var/ezp_site/storage/fckeditor/file/pdfs/centers-programs/centers/cid/publications/faculty/wp/213.pdf
- World Bank Group (2016) Monitoring global poverty: report of the commission on global poverty. The World Bank. ISBN: 978-1464809620. DOI: 10.1596/978-1-4648-0961-3.. openknowledge.worldbank.org/bitstream/handle/10986/25141/9781464809613.pdf
- EUROSTAT. <https://ec.europa.eu/eurostat/data/database>- FAOSTAT (Food and agriculture data). <http://www.fao.org/faostat/en/#home>- GAPMINDER. [https://www.gapminder.org/tools/#\\$chart-type=bubbles](https://www.gapminder.org/tools/#$chart-type=bubbles)- IEA (International Energy Agency). <https://www.iea.org/statistics/?country=WORLD&year=2016&category=Energy%20supply&indicator=TPESbySource&mode=chart&dataTable=BALANCES>- IMF Data (IMF - International Monetary Fund). <https://www.imf.org/en/Data>- UN DESA (United Nations. Department of Economic and Social Affairs). <https://www.un.org/en/development/desa/categories/statistics>
- UN ODS (United Nations. Objetivos de Desarrollo Sostenible). <https://www.un.org/sustainabledevelopment/es/objetivos-de-desarrollo-sostenible/>- WRI (World Resources Institute). https://www.wri.org/resources/data_sets- WB (World Bank). <https://data.worldbank.org/>- Engineering for sustainable development: guiding principles / The Royal Academy of Engineering. London : The Royal Academy of Engineering, 2005. ISBN: 1-903496-21-7. <https://www.raeng.org.uk/publications/reports/engineering-for-sustainable-development>