Course guide
820732 - EMAM - Energy and Environment

Last modified: 16/04/2024

Unit in charge: Barcelona School of Industrial Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2013). (Compulsory subject).
MASTER'S DEGREE IN INDUSTRIAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN ENERGY ENGINEERING (Syllabus 2022). (Compulsory subject).

Academic year: 2024 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Valderrama Angel César A.

Others: Valderrama Angel César A.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEMT-3. Assess the economic, social and environmental impact of the production, use and management of energy, with a holistic view of the life cycle of the different systems, and recognise and value the most remarkable developments in the fields of energy efficiency and the rational use of energy.

Transversal:
CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

TEACHING METHODOLOGY

The course is divided into four types of sessions:
a) Theoretical Lectures
b) Project-based learning
c) Case studies
d) Conferences and Webinars

LEARNING OBJECTIVES OF THE SUBJECT

At the end of the course the student will be able to:
•Distinguish between the concepts of the use of energy resources and energy efficiency in terms of sustainable development
•Demonstrate a good knowledge and understanding of the tools used for emissions assessment with emphasis on carbon footprint and Life cycle assessment.
•Determine the sources of pollution and the effects on the environment caused by energy systems and their environmental impact.
•Identify and assess the factors that determine the transport and dispersion of atmospheric pollutants.
•Evaluate the technological, environmental and economic feasibility of an energy system through the life cycle perspective

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Hours small group	15,0	12.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Sustainability, Energy and Environment

Description:
Sustainability conceptual introduction
Sustainability assessment
Sustainability and Energy
Energy Efficiency
Sustainability integrated into current public policy making
Energy Efficiency in EU
EU Green deal

Specific objectives:
At the end of this topic, students will be able to:
Identify the elements of the sustainable development and the social, economic and environmental challenges related to the energy management
Distinguish between the concepts of the use of energy resources and energy efficiency in terms of sustainable development

Full-or-part-time: 10h
Theory classes: 4h
Guided activities: 2h
Self study : 4h

Life Cycle Assessment

Description:
Standards and guidelines
Life Cycle Thinking
Types of analysis
Framework
Inventory analysis
Allocation
Impact assessment
Carbon Footprint

Full-or-part-time: 16h
Theory classes: 6h
Guided activities: 4h
Self study : 6h

Life Cycle Costing

Description:
LCC as a complement to LCA
LCC Methodology
Key concepts of LCC
Working flow for an LCC

Full-or-part-time: 8h 30m
Theory classes: 4h
Guided activities: 2h
Self study : 2h 30m

Social Life Cycle Assessment

Description:
Background and aim of Social LCA
Technical framework
Databases
Social impacts screening
Hotspot’s identification

Full-or-part-time: 8h 30m
Theory classes: 4h
Guided activities: 2h 30m
Self study : 2h

Air Pollution and Atmospheric Dispersion

Description:
Types and sources of outdoor air pollution
Overview of environmental air policies
Meteorological factors affecting transport and dispersion
Atmospheric stability
Dispersion modelling
Gaussian model

Characteristics of a contaminant plume.
Inversion.
The Gaussian dispersion model

Specific objectives:
At the end of this topic, students will be able to:
Identify concepts, dispersion, transport and the effects of meteorological parameters on the dilution of pollutants
Identify the different levels of complexity in modelling the dispersion of pollutants
Apply mathematical representations (Gaussian model) to describe the process of dispersion of pollutants under different situations (Inversion, linear source pollution, etc. .)
Interpret the results obtained from the point of view of air pollution reduction and also of air quality control

Full-or-part-time: 11h 20m
Theory classes: 3h
Guided activities: 3h
Self study : 5h 20m

Effects of air pollution and Gas Treatment

Description:
Ozone layer depletion
Acid deposition
Photochemical smog
Gas cleaning systems
NOx control technologies
Flue Gas Desulfurization
VOCs Thermal oxidation and Catalytic combustion
Environmental prices for air pollution

Specific objectives:
At the end of this topic, students will be able to:
Distinguish between local and global effects of air pollution
Recognize the implications of air pollution

Full-or-part-time: 7h
Theory classes: 3h
Guided activities: 2h
Self study : 2h

Climate Change and Carbon Capture and Utilization

Description:
Earth's energy balance
Radiative forcing
Forcings vs Feedbacks
Paris agreement
Climate change effects
Environmental carbon price
Carbon capture systems
Cost of carbon capture and storage
Carbon capture and utilization

Full-or-part-time: 7h
Theory classes: 3h
Guided activities: 2h
Self study : 2h

Circular Economy and Technological Challenges

Description:
Circular Economy Framework
Urban Minining
Waste to Enegy/Resources
Tehnological Challenges for the Energy Transition

Full-or-part-time: 7h
Theory classes: 3h
Guided activities: 2h
Self study : 2h

GRADING SYSTEM

Written exams: 35%
Work done individually or in groups during the course: 15%
Project progress through the course: 40%
Quality and performance of project: 10%

BIBLIOGRAPHY

Basic:
- Vallero, Daniel A. Fundamentals of air pollution [on line]. 5th ed. Waltham, MA: Academic Press, cop. 2014 [Consultation: 19/04/2023]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780124017337/fundamentals-of-air-pollution. ISBN 9780124017337.
- Sioshansi, F.P. Energy, sustainability and the environment: technology, incentives, behaviour. Amsterdam: Elsevier/Butterworth-Heinemann, cop. 2011. ISBN 9780128103760.
- Tiwary, Abhishek; Willians, Ian. Air pollution: measurement, modelling and mitigation [on line]. 4th ed. Boca Raton: CRC Press, 2019 [Consultation: 25/09/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4634085. ISBN 9781138503663.
- Fay, James A. ; Golomb, D. Energy and the environment. New York: Oxford University Press, 2002. ISBN 0195150929.

Complementary:
- Hill, Marquita K. Understanding environmental pollution. 4th ed. Cambridge ; New York: Cambridge University Press, 2020. ISBN 9781108423083.
- Arons, Jakob de Swaan; Kooi, Hedzer van der; Sankaranarayanan, Krishnan. Efficiency and sustainability in the Efficiency and sustainability in the energy and chemical industries [on line]. New York; London: Marcel Dekker, 2014 [Consultation: 19/09/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=216130. ISBN 9781280096815.
- Schnelle, Karl B.; Russell Dunn, Jr.; Ternes, Mary Ellen. Air pollution control technology handbook [on line]. 2nd ed. Boca Raton: Taylor & Francis, 2016 [Consultation: 25/09/2024]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4009619. ISBN 042915643X.