820732 - EMAM - Energy and Environment (DRAFT VERSION)

Coordinating unit: 820 - EUETIB - Barcelona College of Industrial Engineering

Teaching unit: 713 - EQ - Department of Chemical Engineering

Academic year: 2014

Degree: ERASMUS MUNDUS MASTER IN ENVIRONOMICAL PATHWAYS FOR SUSTAINABLE ENERGY SYSTEMS (Syllabus 2012). (Teaching unit Compulsory)
MASTER IN ENERGY ENGINEERING (Syllabus 2013). (Teaching unit Compulsory)

ECTS credits: 5 Teaching languages: English

Teaching staff

Coordinator: Valderrama Angel César A.

Others: Casas Pons Ignasi
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.

Teaching methodology

The course is divided into three types of sessions:
a) Theoretical classes
b) Problem-based learning usually by practical applications
c) The project-based learning in which students organized in groups; develop projects based on real situations.

Learning objectives of the subject

The general objective of the course is to introduce students to the problems associated with energy management in our society and the consequences and effects on the environment in terms of pollution with special emphasis on air pollution. The course aims to Identify the effects of energy production and to introduce principles and tools, especially those aimed at preventing and minimizing gas emissions. Familiarize students with the tools to predict the behaviour of contaminants using basic models of transport and dispersion and to determine the air quality at a specific point. Introducing the basic knowledge that allows selecting the most appropriate technology for a treatment according to the type of pollutant, environment, and relevant environmental laws and regulations.The general objective of the course is to introduce students to the problems associated with energy management and the consequences and effects this has on our environment in terms of pollution with special emphasis on air pollution. The course aims to Identify the effects of energy production and to introduce principles and tools, especially those aimed at preventing and minimizing gas emissions. Familiarize students with the tools to predict the behaviour of contaminants using basic models of transport and dispersion and to determine the air quality at a specific point. Introducing the basic knowledge that allows selecting the most appropriate technology for a treatment according to the type of pollutant, environment, and relevant environmental laws and regulations.

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Study load

Total learning time: 125h	Hours large group:	30h	24.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	15h	12.00%
	Self study:	80h	64.00%

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Content

Sustainability, Energy and Environment

Learning time: 10h

Large group/Theory: 4h
Guided activities: 2h
Self study : 4h

Description:
Sustainable development
Sustainable use of resources
Energy efficiency

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

Air Pollution

Learning time: 13h

Large group/Theory: 2h
Medium group/Practical: 3h
Guided activities: 4h
Self study : 4h

Description:
Air pollutants resulting from energy generation processes
Primary and secondary pollutants
Overview of environmental policy and legislation relevant to air pollution

Specific objectives:
At the end of this topic, students will be able to:
Identify the most important constituents of the atmosphere and their importance for living organisms, climate, etc.
Classify the most representative pollutants and their emission sources arising from energy production
Identify the types of pollutants and distinguish the maximum permitted levels of emissions and air quality legislation

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Effects of air pollution	Learning time: 14h Large group/Theory: 4h Medium group/Practical: 2h Guided activities: 4h Self study : 4h

Description:
Global effects: ozone layer depletion
Local and regional effects: acid rain, photochemical smog,
Climate change. Global energy balance and radiative forcing, International agreements, commitments within the EU.
Prevention measures and international emissions trading system

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 on climate change and identify the principles that determine the emissions trading

Emission inventories and Carbon Footprint	Learning time: 14h Large group/Theory: 2h Medium group/Practical: 2h Guided activities: 4h Self study : 6h

Description:
Emissions inventory.
European regulation of air emissions inventories. International regulations.
General methodology. Specific methodologies for different types of sources
Carbon Footprint Methodology

Specific objectives:
At the end of this topic, students will be able to:
Identify standards and methodologies for emissions inventories
Develop a basic inventory from an industrial process, from a natural or urban system.

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Treatment and control systems for particles and dust	Learning time: 5h Large group/Theory: 1h Medium group/Practical: 1h Guided activities: 1h Self study : 2h

Description:
Treatment types
Dry treatments
Wet treatments
Filtration treatments

Specific objectives:
At the end of this topic, students will be able to:
Classify technologies according to process parameters (flowrate, particle size distribution)
Calculate treatment system efficiencies from design parameters and working conditions.

Gas cleaning systems	Learning time: 8h Large group/Theory: 2h Medium group/Practical: 0h Guided activities: 2h Self study : 4h

Description:
Prevention systems: low emission burners, chemical reduction methods
Absorption, adsorption, condensation, biofiltration.
Thermal oxidation.
Catalytic an non-catalytic combustion
CO2 capture and sequestration technologies

Specific objectives:
At the end of this topic, students will be able to:
Distinguish among different treatment and cleaning technologies, and to identify the most suitable technology for each pollutant in a given regulation environment.
Identify the design parameters for each technology, and to apply them to real air pollution cases.

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Atmospheric dispersion

Learning time: 20h

Large group/Theory: 4h
Medium group/Practical: 2h
Guided activities: 4h
Self study : 10h

Description:
Emission, transport and receptor point concepts
Meteorological factors influencing the dispersion.
Point and linear sources of pollution.
Characteristics of a contaminant plume.
Inversion.
Overview of dispersion models and reaction of pollutants in the atmosphere
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

Management of radioactive waste

Learning time: 6h

Large group/Theory: 2h
Medium group/Practical: 0h
Guided activities: 0h
Self study : 4h

Description:
Management of low and intermediate level radioactive waste
Management of high level radioactive waste
Multi-barriers system description
Long-term performance assessment analysis

Specific objectives:
At the end of this topic, students will be able to:
Identify the management criteria for safe disposal of low, intermediate and high level radioactive wastes
Recognize the technological challenges associated to the management of this type of waste

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Qualification system

Written test control of knowledge: 50%
Work done individually or in groups during the course: 25%
Attendance and participation in practical activities: 15%
Quality and performance of group work: 10%

Bibliography

Basic:

Vallero, D.A.. Fundamentals of Air Pollution. Cambridge: Elsevier, 2008.

Sioshansi, F.P.. Energy, Sustainability and the Environment: Technology, Incentives, Behaviour. Amsterdam: Elsevier, 2011.

Abhishek Tiwary and Jeremy Colls. Air Pollution: Measurement, modelling and mitigation. Third edition. New York, USA: Routledge is an imprint of the Taylor & Francis Group, 2010.

James A. Fay and Dan S. Golomb. Energy and the Environment. New York, USA: OXFORD UNIVERSITY PRESS, 2002.

Complementary:

Hill, M.K. . Understanding Environmental Pollution. Cambridge: Cambridge University Press, 2004.

Sankaranarayanan, K., van der Kooi, H.J., and de Swaan Arons, J. . Efficiency and sustainability in the chemical industries: Scientific Principles and Case Studies. Second. Boca Raton, FL: CRC Press Taylor & Francis Group, 2010.

Schnelle, K.C., Brown, C.A.. Air pollution control technology handbook. Boca Ratón, Florida: CRC Press, 2002.