Last update: 23-04-2019

320071 - CATT - Air Pollution and Treatment Technologies

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
Academic year: 2019
Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
ECTS credits: 6 Teaching languages: English

Teaching staff

Coordinator: Antoni Escalas Cañellas

Others: Antoni Escalas Cañellas

Teaching methodology

The course is divided into three types of sessions:

a) Theoretical classes
b) Problem-based learning, via mostly in-classroom activities (problem solving). This includes also project seminars and project presentation, assessed as part of the project assessment.
c) The project-based learning in which students organized in groups; develop projects based on real situations.

The digital campus of the UPC (Atenea) is used by the professor as a document publication and messaging tool. The students use it to download or deliver documents and tasks, and messaging.

Learning objectives of the subject

The mains goals of the course are:
- To introduce students to the problems of air pollution, especially to the aspects related to industrial activity.
- To familiarize students with the tools to measure any type of pollution in order to predict its behaviour and its basic transport dispersion.
- To introduce the principles and the environmental policy tools for air pollution, with emphasis on pollution prevention.
- To introduce the basic knowledge that allows students to select the appropriate treatment technology depending on the type of pollution (gases, particles, metals, etc.), and also on the relevant environmental regulations.
- To train the students in the basic design calculations of particle and gas cleaning technologies.

Study load

Total learning time: 150h	Hours large group:	30h	20.00%
	Hours medium group:	30h	20.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	90h	60.00%

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Content

TOPIC 1: Introduction

Learning time: 2h
Theory classes: 2h

Description:
The atmosphere, past and present
-The atmosphere layers
-Main constituents
- Climate and Atmosphere

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, climate, etc.

TOPIC 2: Air pollution and legislation

Learning time: 8h
Theory classes: 5h
Self study : 3h

Description:
-Type of pollution
-Air pollutants and their sources
-Concepts of emission, transport and emission
-Primary and secondary pollutants
-Overview of environmental air policies
-Emission levels, legislation
-Air quality legislation

Specific objectives:
At the end of this topic, students will be able to:

Classify the air pollutants by their sources of emission
Identify the types of contaminants and distinguish the maximum permitted levels of emissions and air quality

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TOPIC 3: Effects of air pollution	Learning time: 7h Theory classes: 5h Self study : 2h

Description:
-Global effects: ozone layer depletion, global warming potential
-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
identify the principles that determine the emissions trading

TOPIC 4: Measuring air quality	Learning time: 11h Theory classes: 5h Self study : 6h

Description:
Systems for measuring emissions
-Sampling types
-Selection of methods and instrumentation
-Continuous measurement of the air quality (SO2, CO, NOx, O3 and so on)
-Pollution monitoring network
-Air Quality Index

Specific objectives:
At the end of this topic, students will be able to:

Identify the systems of control and / or measure emissions
Recognize and apply the mechanisms used by the local and international authorities to monitor air quality

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TOPIC 5: Emission inventories	Learning time: 12h Theory classes: 5h Self study : 7h

Description:
Emissions inventory.
European regulation of air emissions inventories. International regulations.
General methodology. Specific methodologies for different types of sources. Error parameters.
Performing an inventory of emissions

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.

TOPIC 6: Atmospheric dispersion	Learning time: 25h Theory classes: 9h Self study : 16h

Description:
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
Software available for modelling

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 modeling 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. .)

To interpret the results obtained from the point of view of air pollution reduction and also of air quality control

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TOPIC 7: Environmental policy measures for air pollution prevention and mitigation

Learning time: 8h

Theory classes: 4h
Self study : 4h

Description:
Several emission reduction measures will be studied, as well as population information and attention measures applied in different countries and regions in order to achieve air quality objectives, especially when general measures do not allow to attain regulation compliance

Specific objectives:
At the end of this topic, students will be able:

- To identify the major preventive applicable measures.
- To make an argument-based discussion of the different measures applicable as a function of given conditions.

TOPIC 8: Treatment and control systems for particles and dust

Learning time: 39h

Theory classes: 13h
Self study : 26h

Description:
Treatment types
Dry treatments (cyclones, settling chambers, etc..)
Wet treatments (scrubbers, etc)
Filtration treatments (fabric filters, etc..)
Electrostatic precipitators

Specific objectives:
At the end of this topic, students will be able:

- To classify technologies according to process parameters (flowrate, particle size distribution)
- To calculate treatment system efficiencies from design parameters and working conditions.

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TOPIC 9: Gas cleaning systems	Learning time: 34h Theory classes: 12h Self study : 22h

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.
- To identify the design parameters for each technology, and to apply them ti real air pollution cases.

Qualification system

Oral and written exams: 40%
- First exam: 20%
- Second exam: 20%
Laboratori practices: 20%. 4-5 assessment activities.
Other deliveries (project): 25%. Divided into 2 project seminars, 2 presentations, and a final project document.
Third language skills (written and spoken English): 15%. It will be evaluated from the final project text (7.5%) and oral presentation (7.5%).

- Practical activities will take place during class time, unless otherwise stated by the professor (pre-deliveries, deferred deliveries).
- Attendance at practical activities is mandatory.
- Authorship of practices/problems will not be recognised to students having failed to attend the corresponding practical classroom session.
- The students will deliver their reports at the end of each session or within the period set by the professor.
- The projects and practices will be developed in teams and delivered on time.
- All team members shall participate fairly equally in the work of problem solution and project development
- Some sessions will be devoted to project seminars and project presentations. Attendance will be mandatory to this sessions, and students will be assessed as part of the project assessment.

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Bibliography

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