Course guide
320071 - CATT - Air Pollution and Treatment Technologies

Last modified: 04/07/2023

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering.

Degree: BACHELOR'S DEGREE IN CHEMICAL ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN TEXTILE TECHNOLOGY AND DESIGN ENGINEERING (Syllabus 2009). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Optional subject).
BACHELOR'S DEGREE IN INDUSTRIAL TECHNOLOGY ENGINEERING (Syllabus 2010). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Antoni Escalas Cañellas

Others: Antoni Escalas Cañellas
Gemma Cervantes Torre-marín

TEACHING METHODOLOGY

The course is divided into different types of sessions:

a) Expository classes, given by the teacher with the participation of the students
b) Face-to-face group work sessions. These sessions also include project seminars and project presentations.
c) Mixed expository sessions/student work with or without assessment
d) Problem-based learning (individual and/or collaborative problem solving), to make students find a solution to a question or problem, based on the knowledge acquired in the subject
e) Project-based learning in which students, organized in groups, develop projects based on real situations (non-face-to-face).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 know the main pollutants and emission sources, conducting emission inventories, basic tools to predict their behavior through transport and dispersion models and calculate the emission.
- Air quality regulations and criteria. Introduce the principles and tools of air environmental policy, with an emphasis on 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

Type	Hours	Percentage
Hours large group	30,0	20.00
Hours medium group	30,0	20.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

TOPIC 1: Introduction

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

Full-or-part-time: 6h
Theory classes: 2h
Practical classes: 1h
Self study : 3h

TOPIC 2: Air pollution and legislation

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

Full-or-part-time: 13h
Theory classes: 3h
Practical classes: 2h
Self study : 8h

TOPIC 3: Effects of air pollution

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

Full-or-part-time: 19h
Theory classes: 3h
Practical classes: 4h
Self study : 12h

TOPIC 4: Emission inventories

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.

Full-or-part-time: 19h
Theory classes: 3h
Practical classes: 4h
Self study : 12h

TOPIC 5: Atmospheric dispersion

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

Full-or-part-time: 18h
Theory classes: 4h
Practical classes: 4h
Self study : 10h

TOPIC 6: Environmental policy measures for air pollution prevention and mitigation

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.

Full-or-part-time: 8h
Theory classes: 2h
Practical classes: 1h
Self study : 5h

TOPIC 7: Particle control systems

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.

Full-or-part-time: 33h
Theory classes: 7h
Practical classes: 6h
Self study : 20h

TOPIC 8: Control of gas pollutants

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.

Full-or-part-time: 34h
Theory classes: 6h
Practical classes: 8h
Self study : 20h

GRADING SYSTEM

Oral and written exams: 20%
- 2nd bimester exam: 20%
In-class assessment activities: 52.5%
- 1st bimester activities: 42.5%
- 2nd bimester activities: 10%
Other deliveries (project): 12.5%
- 2nd bimester project 12.5%
Third language skill (written and spoken English): 15%. It will be assessed from the students' oral presentations (7.5%) and written texts (7.5%). Each bimester evaluated separately.

- Assessment activities will take place during class time, unless otherwise stated by the professor (pre-deliveries, deferred deliveries).
- Attendance at assessment activities is mandatory.
- Take note that during the first term, all assessment is done through in-class assessment activities, almost every session, so attendance in class is practically mandatory during the whole first term.
- Authorship of activities/problems will not be recognized 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 activities 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 these sessions, and students will be assessed as part of the project assessment.

BIBLIOGRAPHY

Basic:

- Vallero, Daniel A. Fundamentals of air pollution [on line]. Oxford: Academic, 2007 [Consultation: 14/09/2022]. Available on: https://www-sciencedirect-com.recursos.biblioteca.upc.edu/book/9780123736154/fundamentals-of-air-pollution. ISBN 9780123736154.
- Harrison, Roy M. An introduction to pollution science [on line]. Cambridge: Royal Society of Chemistry, 2006 [Consultation: 10/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=1185658. ISBN 9780854048298.
- Seinfeld, John H. Atmospheric chemistry and physics: from air pollution to climate change. 2n ed. Hoboken: John Wiley, 2006. ISBN 9780471720188.

Complementary:

- Schnelle, Karl B.; Brown, Charles A. Air pollution control technology handbook [on line]. 2nd ed. Boca Raton: CRC Press, 2016 [Consultation: 10/06/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=4009619. ISBN 042915643X.
- Davis, Mackenzie L.; Cornwell, David A.. Introduction to environmental engineering. 5th ed. New York: McGraw-Hill, 2013. ISBN 9780071326247.
- Mycock, John C.; McKenna, John D.; Theodore, L. Handbook of air pollution control engineering and technology. Boca Raton: CRC Press, 1995. ISBN 1566701066.
- Peavy, Howard S.; Rowe, Donald R.; Tchobanoglous, G. Environmental engineering. New York: McGraw-Hill, 1985. ISBN 0070491348.
- Coulson, J. M.; Richardson, J. F. Ingeniería química: unidades SI, vol. 2, Operaciones básicas. Barcelona: Reverté, 1981. ISBN 8429171347.