

## Course guide

# 240EQ212 - 240EQ212 - Fundamentals of Combustion and Fire Dynamics

Last modified: 26/06/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.  
**Degree:** **Academic year:** 2025 **ECTS Credits:** 4.5  
**Languages:** Catalan

## LECTURER

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**Coordinating lecturer:** EULALIA PLANAS CUCHI  
**Others:** EULALIA PLANAS CUCHI - ELSA PASTOR FERRER

## PRIOR SKILLS

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Fundamentals of chemistry, thermodynamics, mass energy and momentum transfer, ordinary differential equations, numerical calculation.

## DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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### Specific:

3. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.
4. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.
5. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

### Generical:

1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.
2. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

## TEACHING METHODOLOGY

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Subject in process of extinction. There is no teaching, the students that enroll it do so only with the right to an exam.

## LEARNING OBJECTIVES OF THE SUBJECT

The course aims to provide students with the knowledge to interpret and analyze the problems related to fires. At the end of the course the student should be able to:

- OE1. Apply the basic laws governing the phenomenon of combustion and fire
- OE2. Using mathematical models to identify and characterize the different types of fires
- OE3. Using at basic level tools and software to simulate fire behaviour
- OE4. List the various fire protection systems
- OE5. Describe the basics of fire investigation

## STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	36.00
Self study	72,0	64.00

**Total learning time:** 112.5 h

## CONTENTS

### INTRODUCTION. FUNDAMENTAL ASPECTS OF COMBUSTION

#### Description:

The science of fire and combustion. Fuel types and their classification. Physic chemistry of combustion in a fire. Chemical reactions. Heat of combustion. Flame Temperature. Combustion products. Control Volume. The Reynolds theorem. Matter, energy and momentum conservation laws.

#### Specific objectives:

OE1

#### Related activities:

Theory classes. Classes of problems. Self-learning. Assessment activities A1

#### Related competencies :

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

#### Full-or-part-time: 24h

Theory classes: 5h

Practical classes: 3h

Self study : 16h

## FIRE DYNAMICS

### Description:

Pre-mixed flames: reaction rate, ignition, flame speed, quenching, flammability limits. Diffusion flames: laminar and turbulent jet fires, flames of natural fires. Types of fires. Spontaneous ignition, ignition of liquids, ignition of solids. Flame spread phenomena. Fire spread models. Fire propagation on different media. Burning rate of liquid fuels, burning rate of solid fuels, burning rate in complex materials.

### Specific objectives:

OE2

### Related activities:

Theory classes. Classes of problems. Self-learning. Assessment activities A1

### Related competencies :

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

### Full-or-part-time: 32h

Theory classes: 8h

Practical classes: 3h

Self study : 21h

## FIRE MODELLING

### Description:

Phases of fires in enclosures. Fluid dynamics. Heat transfer. Fuel behaviour. Zone modelling and conservation equations. Correlations. Flashover. CFD modelling: mathematical equations, turbulence, combustion, radiation, soot production, pyrolysis. Current simulation tools.

### Specific objectives:

OE3

### Related activities:

Theory classes. Classes of problems. Self-learning. Assessment activities A1, A2, A3

### Related competencies :

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

### Full-or-part-time: 40h

Theory classes: 9h

Practical classes: 8h

Self study : 23h

## FIRE PROTECTION

### Description:

Introduction to fire protection. Basic description of the different methods of passive and active protection. Reference to regulations

### Specific objectives:

OE4

### Related activities:

Theory classes. Classes of problems. Self-learning. Assessment activities A1

### Related competencies :

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

### Full-or-part-time: 8h 30m

Theory classes: 1h 30m

Practical classes: 1h

Self study : 6h

## FIRE INVESTIGATION

### Description:

Methods for carrying out the investigation of a fire. Sources of ignition. Traces of a fire. Professions involved.

### Specific objectives:

OE5

### Related activities:

Theory classes. Classes of problems. Self-learning. Assessment activities A1

### Related competencies :

CEM1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CEM3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEM6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CGM1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGM7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

### Full-or-part-time: 8h

Theory classes: 1h

Practical classes: 1h

Self study : 6h

## ACTIVITIES

### A1-RESOLUTION OF EXERCISES

**Description:**

Deliver one or different exercises to be solved regularly and individually at home

**Specific objectives:**

OE1, OE2, OE3, OE4, OE5

**Material:**

Statement of the exercise, notes from class, slides and bibliography of reference

**Delivery:**

Detailed resolution of the exercise

**Related competencies :**

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

**Full-or-part-time:** 36h

Self study: 36h

## A2-PRACTICES

**Description:**

Realization of the practices in the lab or in a computer lab

**Specific objectives:**

OE1, OE3

**Material:**

Guideline of the practice. Notes from class. Slides. Example solved. Needed program

**Delivery:**

Previous report before carrying out the practice.

Report with the resolution of the problem proposed in the practice

**Related competencies :**

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

**Full-or-part-time:** 2h 30m

Laboratory classes: 2h 30m



### A3-SIMULATION OF A CASE WITH FDS

**Description:**

Resolution in group and with the help of the FDS program in a case set

**Specific objectives:**

OE3

**Material:**

Statement of the case to be solved. Notes from class. Slides. FDS program

**Delivery:**

Report with a pre-defined formal structure in which the resolution of the case is shown and analyse the results obtained

**Related competencies :**

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

**Full-or-part-time:** 10h

Self study: 10h

#### A4-RESOLUTION IN A PRACTICAL CASE

**Description:**

Resolution in group of a set case related to the investigation of a real fire

**Specific objectives:**

OE5

**Material:**

Statement of the case to be solved. Notes from class. Slides

**Delivery:**

Report with a formal pre-defined structure in which the resolution of the case is shown and the results obtained are analysed

**Related competencies :**

CEMQ6. Design, build and implement methods, processes and equipment for the supply and management of waste solids, liquids and gases in industries, capable of assessing their impacts and risks.

CEMQ3. Conceptualize engineering models; apply innovative methods in problem solving and applications suitable for the design, simulation, optimization and control of processes and systems.

CEMQ1. Apply knowledge of mathematics, physics, chemistry, biology and other natural sciences, obtained through study, experience, and practice, critical reasoning to establish economically viable solutions to technical problems.

CGMQ1. Ability to apply the scientific method and the principles of engineering and economics, to formulate and solve complex problems in processes, equipment, facilities and services, in which the material changes its composition, state or energy content, characteristic of chemical industry and other related sectors which include the pharmaceutical, biotechnology, materials, energy, food or environmental.

CGMQ7. Integrate knowledge and handle complexity, making judgments and decisions, from incomplete or limited information, including reflections on the social and ethical responsibilities of professional practice.

**Full-or-part-time:** 10h

Self study: 10h

#### GRADING SYSTEM

Subject in process of extinction. There is only one final test that corresponds to 100% of the final grade of the subject.