

# Course guide

## 295110 - 295II025 - Risk Analysis

**Last modified:** 17/01/2025

**Unit in charge:** Barcelona East School of Engineering  
**Teaching unit:** 713 - EQ - Department of Chemical Engineering.  
748 - FIS - Department of Physics.

**Degree:** MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019). (Compulsory subject).

**Academic year:** 2024    **ECTS Credits:** 6.0    **Languages:** English

### LECTURER

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**Coordinating lecturer:** Pastor Ferrer, Elsa

**Others:**

### PRIOR SKILLS

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Programming, probabilistic calculus

### DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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**Specific:**

CEMUEII-08. Evaluate, quantify and manage the industrial risk of the technical solutions adopted in an engineering project.

**General:**

CGMUEII-02. To manage, plan and supervise multidisciplinary teams according to technological creativity, business opportunity, social impact and sustainable development.

CGMUEII-03. Analyze the economic, social and environmental impact of technical solutions to base strategic decisions on criteria of objectivity, transparency and professional ethics.

CGMUEII-04. Transfer technological solutions in the form of products, services, processes or facilities in an efficient and sustainable manner, with an attitude of leadership and entrepreneurial spirit.

**Transversal:**

01 EIN. ENTREPRENEURSHIP AND INNOVATION: Knowing about and understanding how businesses are run and the sciences that govern their activity. Having the ability to understand labor laws and how planning, industrial and marketing strategies, quality and profits relate to each other.

02 SCS. SUSTAINABILITY AND SOCIAL COMMITMENT. Being aware of and understanding the complexity of social and economic phenomena that characterize the welfare society. Having the ability to relate welfare to globalization and sustainability. Being able to make a balanced use of techniques, technology, the economy and sustainability.

03 TLG. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

### TEACHING METHODOLOGY

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- Regular classes
- Hands-on workshops
- Project based learning
- Case studies
- Seminars



## LEARNING OBJECTIVES OF THE SUBJECT

After this course the students should be able to model reliability, availability and maintainability of complex systems, to apply risk identification techniques, to evaluate consequences of accidents, to understand and quantify the concept of risk.

## STUDY LOAD

Type	Hours	Percentage
Hours large group	40,5	27.00
Hours small group	13,5	9.00
Self study	96,0	64.00

**Total learning time:** 150 h

## CONTENTS

### General introduction to risk analysis

**Description:**

- Risk analysis and decision support
- Definition of risk
- Risk acceptance criteria
- Fundamental concepts of risk assessment and management

**Specific objectives:**

To understand the concept of risk. To have a clear picture of the different activities involved in risk assessment and management. To understand the implications of risk analysis in decision support processes.

**Full-or-part-time:** 4h

Theory classes: 4h

### reliability, availability, maintainability and safety (RAMS)

**Description:**

- Fundamental concepts
- Classical hypothesis testing and modelling
- Bayesian data analysis

**Specific objectives:**

To understand the concepts of systems reliability, availability, maintainability and safety. To model RAM by classical and Bayesian approaches.

**Related activities:**

Laboratory session 1: classical hypothesis testing and modelling I (data modelling)  
Laboratory session 2: classical hypothesis testing and modelling II (hypothesis testing and parameter estimation)  
Laboratory session 3: Bayesian data analysis I (Markov Chain Montecarlo Methods)  
Laboratory session 4: Bayesian data analysis II (Genetic algorithms)

**Full-or-part-time:** 16h

Theory classes: 8h

Laboratory classes: 8h

## Hazardous materials

### Description:

- Physical hazards
- Health hazards
- Environmental hazards
- Classification and labelling

### Specific objectives:

To identify hazardous materials. To understand hazmats procedures for registration, classification, handling and labelling.

### Related activities:

Laboratory session 5: Case studies - Identification of hazmats in industrial systems  
Seminar 1: Hazmats handling challenges in energy-efficient technologies

### Full-or-part-time: 6h

Theory classes: 4h

Laboratory classes: 2h

## Quantitative risk analysis

### Description:

- Overview of QRA techniques
- Hazards identification
- Major accidents modelling
- Functional safety

### Specific objectives:

To apply risk identification techniques. To quantify risk of complex systems. To perform LOPA analysis.

### Related activities:

Laboratory session 6: Hazard identification techniques (I)  
Laboratory session 7: Hazard identification techniques (II)  
Laboratory session 8: QRA of complex systems  
Seminar 2: Risk analysis in smart factories

### Full-or-part-time: 18h

Theory classes: 12h

Laboratory classes: 6h

## Prevention and protection systems

### Description:

- Safety barriers identification
- Prevention measures
- Protection and mitigation

### Specific objectives:

To know the different safety barriers (preventive and protective) in industrial environments

### Related activities:

Laboratory session 9: Real case accidents: analysis and safety performance  
Seminar 3: Fire protection industry

### Full-or-part-time: 18h

Theory classes: 12h

Laboratory classes: 6h



## GRADING SYSTEM

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Final exam 60%  
Assignments 40%

The final mark will be calculated considering the mark of a final exam (60%) and a mean mark (40%) from several assignments and projects.

## EXAMINATION RULES.

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Exams are all mandatory and all the documentation of the subject is allowed to be used during the exams.  
All evaluation elements are mandatory

Those students who meet the requirements set by the EEBE in their Assessment and Permanence Regulations will be able to access the re-assessment test (<https://eebe.upc.edu/ca/estudis/estudis-de-master/documents-masters/assessment-and-academic-progress-regulations-for-bachelors-and-masters-degrees-at-the-eebe.pdf>)

## BIBLIOGRAPHY

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### Basic:

- Zio, Enrico. An introduction to the basics of reliability and risk analysis [on line]. Singapore: World Scientific, 2007 [Consultation: 02/11/2022]. Available on: <https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=312287>. ISBN 9789812706393.
- Zio, Enrico. Computational methods for reliability and risk analysis. New Jersey: World Scientific, cop. 2009. ISBN 9812839011.
- Casal Fàbrega, Joaquim. Evaluation of the effects and consequences of major accidents in industrial plants [on line]. 2nd ed. Amsterdam: Elsevier, 2018 [Consultation: 21/04/2020]. Available on: <https://ebookcentral-proquest.com/lib/upcatalunya-ebooks/detail.action?docID=5056836>. ISBN 9780444638922.
- Thomson, J. R. High integrity systems and safety management in hazardous industries. Oxford, UK: Elsevier Inc, 2015. ISBN 9780128020340.