Course guide
295110 - 295II025 - Risk Analysis

Last modified: 26/06/2025

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: 2025 **ECTS Credits:** 6.0 **Languages:** English

LECTURER

Coordinating lecturer: Pastor Ferrer, Elsa

Others:

PRIOR SKILLS

Programming, probabilistic calculus

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

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

Generical:
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

- 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, mantainability and safety (RAMS)

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

Specific objectives:
To understand the concepts of systems reliability, availability, manteinability 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

Final exam 60%
Assignements 40%

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

EXAMINATION RULES.

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

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.