295110 - 295I025 - Risk Analysis

Coordinating unit: 295 - EEBE - Barcelona East School of Engineering
Teaching unit: 713 - EQ - Department of Chemical Engineering
748 - FIS - Department of Physics

Academic year: 2019
Degree: MASTER'S DEGREE IN INTERDISCIPLINARY AND INNOVATIVE ENGINEERING (Syllabus 2019).
(Teaching unit Compulsory)
ECTS credits: 6
Teaching languages: English

Teaching staff

Coordinator: Pastor Ferrer, Elsa
Others: Segon quadrimestre:
LUIS CARLOS PARDO SOTO - T11, T12
ELSA PASTOR FERRER - T11, T12
EULALIA PLANAS CUCHI - T11, T12
GLÒRIA SALA CLADELLAS - T11, T12

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.

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.
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.

### 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

<table>
<thead>
<tr>
<th>Total learning time: 150h</th>
<th>Hours large group: 34h</th>
<th>22.67%</th>
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<tr>
<td></td>
<td>Hours medium group: 0h</td>
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<td></td>
<td>Hours small group: 20h</td>
<td>13.33%</td>
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<td>Guided activities: 0h</td>
<td>0.00%</td>
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<td>Self study: 96h</td>
<td>64.00%</td>
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## Content

<table>
<thead>
<tr>
<th>General introduction to risk analysis</th>
<th>Learning time: 4h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>- Risk analysis and decision support</td>
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<tr>
<td>- Definition of risk</td>
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<td>- Risk acceptance criteria</td>
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<tr>
<td>- Fundamental concepts of risk assessment and management</td>
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**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.

<table>
<thead>
<tr>
<th>reliability, availability, maintainability and safety (RAMS)</th>
<th>Learning time: 16h</th>
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<tbody>
<tr>
<td><strong>Description:</strong></td>
<td>Theory classes: 8h</td>
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<tr>
<td>- Fundamental concepts</td>
<td>Laboratory classes: 8h</td>
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<td>- Classical hypothesis testing and modelling</td>
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<td>- Bayesian data analysis</td>
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**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)

**Specific objectives:**

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

<table>
<thead>
<tr>
<th>Learning time: 6h</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
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<tr>
<td>Laboratory classes: 2h</td>
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</tbody>
</table>

**Description:**
- Physical hazards
- Health hazards
- Environmental hazards
- Classification and labelling

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

**Specific objectives:**
To identify hazardous materials. To understand hazmats procedures for registration, classification, handling and labelling.

### Quantitative risk analysis

<table>
<thead>
<tr>
<th>Learning time: 18h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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<tr>
<td>Laboratory classes: 6h</td>
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</tbody>
</table>

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

**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

**Specific objectives:**
To apply risk identification techniques. To quantify risk of complex systems. To perform LOPA analysis.


**Prevention and protection systems**

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<tr>
<th><strong>Learning time:</strong> 18h</th>
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<tbody>
<tr>
<td>Theory classes: 12h</td>
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<tr>
<td>Laboratory classes: 6h</td>
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**Description:**
- Safety barriers identification
- Prevention measures
- Protection and mitigation

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

**Specific objectives:**
To know the different safety barriers (preventive and protective) in industrial environments

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**Qualification 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.

**Regulations for carrying out activities**

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:**


