**SYLLABUS**

**1. Information regarding the programme**

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| 1.1 Higher education institution | Babes-Bolyai University |
| 1.2 Faculty | Chemistry and Chemical Engineering |
| 1.3 Department | Chemical Engineering |
| 1.4 Field of study | Chemical Engineering |
| 1.5 Study cycle | Master |
| 1.6 Study programme / Qualification | Advanced Chemical Process Engineering |

**2. Information regarding the discipline**

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| 2.1 Name of the discipline | **Risk Factors Assessment, Safety and Security (Assessment of risk, safety and security factors) – CME7321** | | | | | | |
| 2.2 Course coordinator | Assoc. Prof. Dr. Eng. Alexandra Csavdári | | | | | | |
| 2.3 Seminar / laboratory work coordinator | Assoc. Prof. Dr. Eng. Alexandra Csavdári | | | | | | |
| 2.4. Year of study | II | 2.5 Semester | 3 | 2.6. Type of evaluation | E | 2.7 Type of discipline | DS (Speciality discipline) |

**3. Total estimated time** (hours/semester of didactic activities)

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| 3.1 Hours per week | 4 | Of which: 3.2 course | 2 | 3.3 Seminar / Practical works | 1/1 |
| 3.4 Total hours in the curriculum | 56 | Of which: 3.5 course | 28 | 3.6 Seminar / Practical works | 14/14 |
| Time allotment: | | | | | hours |
| Learning using manual, course support, bibliography, course notes | | | | | 14 |
| Additional documentation (in libraries, on electronic platforms, field documentation) | | | | | 12 |
| Preparation for seminars/labs, homework, papers, portfolios and essays | | | | | 28 |
| Tutorship | | | | | 12 |
| Evaluations | | | | | 3 |
| Other activities: not the case | | | | | - |

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| 3.7 Total individual study hours | 69 |
| 3.8 Total hours per semester | 125 |
| 3.9 Number of ECTS credits | 5 |

**4. Prerequisites** (if necessary)

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| 4.1. curriculum | • Not the case |
| 4.2. competencies | • Not the case<br>• Graduation form (Chemical) Engineering programs is an advantage. |

**5. Conditions** (if necessary)

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| 5.1. for the lecture | • Students will punctually join the class (either *on-site* or *on-line*). |

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| | • If *on-site*: Students will follow the sanitary regulations in place.<br>• Rules of good practice will be explained by the lecturer at the beginning of the semester, and will be followed accordingly by all participants to the class. |
| 5.2. for the seminar / laboratory activities | • Students will punctually join the class (either *on-site* or *on-line*).<br>• If *on-site*: Students will follow the sanitary regulations in place.<br>• Rules of good practice will be explained by the lecturer at the beginning of the semester, and will be followed accordingly by all participants to the class. |

**6. Specific acquired competencies**

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| **Professional competencies** | • Definition of notions, concepts, theories and advanced models in the field of chemistry and chemical process engineering, as well as their adequate use within the professional community.<br>• Use of advanced knowledge in the field of chemistry and chemical process engineering to explain and interpret chemical processes, as well as their elements of risk and safety.<br>• Identification and proper usage of concepts, method and theories for solving new complex problems of risk management within chemical process engineering.<br>• Critical analysis and usage of principles, methods and advanced work techniques for qualitative and semi-quantitative assessment of chemical process engineering. |
| **Transversal competencies** | • Independent execution of complex professional duties and research projects by both using computer-aided techniques, and complying with professional ethics and moral.<br>• Planning, monitoring and assuming professional duties of underline group. Proving the coordination capabilities, analytical thinking, adaptability and flexibility, collaboration with team members.<br>• Auto-evaluation of professional performances and establishing the needs of continuous learning, documentation in the work fields in correlation with the labour market. |

**7. Objectives of discipline** (outcome of the acquired competencies)

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| 7.1 General objective of the discipline: | • Qualitative and semi-quantitative evaluation of risk and operational safety factors. |
| 7.2 Specific objectives of the discipline: | • Ability to qualitatively and quantitatively assess de risk and operational safety factors within a process, as applied to the chemical industry.<br>• Ability of management and operational solution proposal for avoiding as well as coping with risky situations, as applied to the chemical industry. |

**8. Content**

| 8.1 **Lecture** | Teaching methods | Remarks |
|---|---|---|
| 8.1.1. Introduction. The importance of risk studies. The concepts of hazard, risk and layer of protection analysis. Examples of daily life (Covid 19). | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.2. Hazard and risk studies as part of "green" engineering and sustainability in chemical industries. Legal aspects of safety and security in chemical industry. Principles of inherently safer design. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.3. Identification and analysis of hazard by | Presentation; Explanation, | Alocated |

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| chemical species – part 1: Hazard by chemical species. Greenhouse gases. Waste. Labelling of chemical species and waste. Analysis sheet of hazardous chemicals. Risk and security phrases. | Conversation; Description; Debate | time = 2 hours |
| 8.1.4. Identification and analysis of hazard by chemical species – part 2: Storage, manipulation and transport of chemicals; labelling for these purposes. Aspects of European and Romanian legislation with respect to chemicals. Data bases for chemicals. Classification and inventory of chemical species.<br><br>Individual protection equipment for workers. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.5. Identification and analysis of hazard by technology and industrial equipment. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.6. Event scenario identification: fault tree analysis. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.7. Event scenario identification: event tree analysis. The "bow-tie" diagram. Identification and importance of protection layers at local and broader level. Inherently safer design. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.8. Evaluation of event frequency and consequences. The risk matrix. Risk levels, their classification and description. The concept of tolerable risk. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.9. Methods of qualitative risk assessment: Preliminary hazard list; Preliminary hazard analysis; Hazard and operability (HAZOP) studies. The use of risk matrixes. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.10. Methods of semi-quantitative risk assessment: the indicator based approach. The hazard index, the vulnerability index and the risk index. Case study.<br><br>Comparison among methods of qualitative and semi-quantitative risk assessment methods. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.11. Stages of risk management. Stages of risk assessment. Steps and means of event prevention and risk mitigation (al local and broader level). | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.12. Methods of risk mitigation as a function of involved hazard types. Layer of protection analysis. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.13. Political, financial, social and environmental hazard. Methods of risk mitigation in case of these types of hazard. Individual risk. | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |
| 8.1.14. Soft instruments available on the market. Legal aspects (Romania and the European Union). | Presentation; Explanation, Conversation; Description; Debate | Alocated time = 2 hours |

**References**


1. Class notes in electronic format, as well as various materials provided by the teacher during the semester.
2. Gh. Maria, „*Evaluarea cantitativă a riscului proceselor chimice şi modelarea consecinţelor*

*accidentelor*", Editura Printech, Bucureşti, 2007.
3. A. Ozunu, C. Anghel, „*Evaluarea riscului tehnologic şi securitatea mediului*", Editura Accent, Cluj-Napoca, 2007.
4. Z. Török, N. Ajtai, A. Ozunu, „*Aplicaţii de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanţe periculoase*", Editura EFES, Cluj-Napoca, 2011.
5. Th. Meyer, G. Reniers, „*Engineering Risk Management*", DeGruyter, Berlin, 2013.
6. M. Gavrilescu, „*Estimarea şi managementul riscului*", Editura Ecozone, Iaşi, 2008.

| 8.2 **Seminar** (*in modules of 2 hours each*).<br>Note: The examples are prepared by the students in work groups and discussed by all during class activities. | Teaching methods | Remarks |
|---|---|---|
| 8.2.1. Identification and analysis of hazard by chemical species. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.2. Identification and analysis of hazard by technology and industrial equipment. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.3. Event scenario identification: fault tree analysis. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.5. Event scenario identification: event tree analysis. "Bow-tie" diagrams. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.5. Evaluation of event frequency and consequences. The risk matrix. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.6. Hazard and operability studies. Methods of risk mitigation. Layer of protection analysis. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |
| 8.2.7. Indicator based risk assessment. Social, economic, financial, political and individual risk. Examples. | Explanation, Conversation; Description; Debate; Problem solving | Alocated time = 2 hours |

**References**

1. Class notes in electronic format, as well as various materials provided by the teacher during the semester.
2. Z. Török, N. Ajtai, A. Ozunu, „*Aplicaţii de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanţe periculoase*", Editura EFES, Cluj-Napoca, 2011.
3. Th. Meyer, G. Reniers, „*Engineering Risk Management*", DeGruyter, Berlin, 2013.

| 8.3. **Practical works** (*in modules of 2 to 4 hours*).<br>Note: The examples are prepared by the students in work groups and discussed by all during class activities. | Teaching methods | Remarks |
|---|---|---|
| 8.3.1. Case study about a major incident related to chemical industry: identification of hazard triangle; presentation of risk; presentation of the event, its consequences, of mitigation actions and possible legislation outcomes; methods that might have prevented the event – Part 1. | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| 8.3.2. Case study about a major incident related to chemical industry: identification of hazard triangle; presentation of risk; presentation of the event, its consequences, of mitigation actions and possible | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |

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| legislation outcomes; methods that might have prevented the event – Part 2. | | |
| 8.3.3. Case study about a major incident related to chemical industry: identification of hazard triangle; presentation of risk; presentation of the event, its consequences, of mitigation actions and possible legislation outcomes; methods that might have prevented the event – Part 3. | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| 8.3.4. Case study about a major incident related to chemical industry: identification of hazard triangle; presentation of risk; presentation of the event, its consequences, of mitigation actions and possible legislation outcomes; methods that might have prevented the event – Part 4. | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| 8.3.5. Case study about a major incident related to chemical industry: identification of hazard triangle; presentation of risk; presentation of the event, its consequences, of mitigation actions and possible legislation outcomes; methods that might have prevented the event – Part 5. | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| 8.3.6. Case studies about financial, social, political, economic, and environmental risk. | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| 8.3.7. Case studies about individual risk. Measures of work safety and security in chemical industry. Some legal aspects (Romania and the European Union). | Explanation, Conversation; Debate; Problem solving | Alocated time = 2 hours |
| **References**<br>1. Class notes in electronic format, as well as various materials provided by the teacher during the semester.<br>2. Specific references for each case study. | | |

**9. Corroborating the content of the discipline with the expectations of the epistemic community, professional associations and representative employers within the field of the program**

- By instructing the theoretical and practical concepts of **"Assessment of risk, safety and security factors"** course, the students will get the knowledge in accordance with the competencies requested by possible employment sectors stetted by RNCIS.

**10. Evaluation**

| Type of activity | 10.1 Evaluation criteria | 10.2 Evaluation methods | 10.3 weight in final grade (%) |
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| 10.4 Course | Correctness of answers – proper understanding and learning of concepts discussed during lectures; Correct use of learned concept within new contexts. | Summative evaluation:<br>Exam that consists in the written presentation of a qualitative risk assessment study for an equipment of the chemical industry, which has been designed by the student as part of her/his graduation thesis.<br><br>Evaluation is based on requirements announced at the beginning of the semester. | 60 % |

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| | | Proven or intended fraud is treated according to the ECST rules of UBB. | |
| 10.5 Seminar / Practical works | Correctness of answers – proper understanding and learning of concepts discussed during class; Correct use of learned concept within new contexts. | Formative evaluation:<br>- Seminar: Presentation of examples (individually or in work groups) regarding aspects discussed during the lectures. Evaluation is carried out on the spot.<br><br>- Practical works: Presentation of a case study (individually or in work groups) regarding a major event in chemical industry. Evaluation is based on requirements announced at the beginning of the semester.<br><br>Proven or intended fraud is treated according to the ECST rules of UBB. | 10%<br><br>30% |

| 10.6 Minimum performance standards |
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| ➢ At least the grade 5 (five) at the end of semester, when the final grade of this discipline is calculated as a weighted average (see above for weights) between the formative and summative evaluation results.<br>➢ Adequate knowledge and usage of discussed concepts and methods. |

| Date | Signature of course coordinator | Signature of seminar coordinator |
|---|---|---|
| April 15, 2022 | Assoc. Prof. Dr. Eng. Alexandra Csavdári | Assoc. Prof. Dr. Eng. A. Csavdári |

| Date of approval | Signature of the Head of department |
|---|---|
| April 26, 2022 | Prof. Habil. Dr. Eng. Graziella Liana Turdean |