COURSE DESCRIPTION

Risk Factors Assessment, Safety and Security

Academic year 2026 - 2027

1. Programme-related data

1.1. Higher Education Institution	Babeș-Bolyai University
1.2. Faculty	Faculty of Chemistry and Chemical Engineering
1.3. Department	Department of Chemical Engineering
1.4. Field	Chemical Engineering
1.5. Level of study	Master
1.6. Degree programme / Qualification	Advanced Process Chemical Engineering / Master
1.7. Form of education	Full time education

2. Course-related data

2.1. Course title	**Risk Factors Assessment, Safety and Security**			Course code	**CME7321**
2.2. Course coordinator	Assoc. Prof. dr. eng. Alexandra Ana CSAVDARI				
2.3. Seminar coordinator	Assoc. Prof. dr. eng. Alexandra Ana CSAVDARI				
2.4. Year of study	II	2.5. Semester	3	2.6. Type of assessment	Exam
2.7. Course status	Compulsory			2.8. Course type	Specialisation subject

3. Total estimated time (hours per semester of teaching activities)

3.1. Number of hours per week	**4**	of which: 3.2. course	**2**	3.3. seminar/ laboratory	**1/1**
3.4. Total of hours in the curriculum	56	of which: 3.5. course	28	3.6. seminar/ laboratory	**14/14**
Time allocation for individual study (IS) and self-taught activities (ST)					**hours**
Learning from textbooks, course materials, bibliography, and notes (IS)					7
Additional research in the library, on subject-specific electronic platforms, and on-site					28
Preparing seminars/ laboratories/ projects, assignments, reports, portfolios, and essays					28
Tutoring (professional guidance)					4
Examinations					2
Other activities					-
3.7. Total hours of individual study (IS) and self-taught activities (ST)				**69**	
3.8. Total hours per semester				**125**	
3.9. Number of credits				**5**	

4. Prerequisites (where applicable)

4.1. curriculum-related	Not the case
4.2 skills-related	Not the case, yet previous engineering / chemical engineering studies are of advantage.

5. Specific conditions (where applicable)

5.1. course-related	• Students will punctually join the class and follow the sanitary regulations in place. • 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. • During class, students will keep their mobile phones and any other gadgets on silent mode and out of sight.
5.2. seminar/laboratory-related	• Students will punctually join the class and follow the sanitary regulations in place. • Students will bring adequate writing and computing devices.

	• 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. • During class, students will keep their mobile phones and any other gadgets on silent mode and out of sight.

6.1. Competencies resulting from the completion of the degree programme *(as referred to in the curriculum)*[1]

Professional competencies	
Competency code	**Competency**
PC2	Technological design of processes, equipment and apparatus specific to process engineering for the improvement of performances of biochemical and chemical processes by using computer-assisted instruments (CAD) and principles of long-term development.
PC6	Quality and resource management in process engineering by applying the systemic approach and the principles of long-term development.
Transversal competencies	
Competency code	**Competency**
TC1	Independent execution of complex professional assignments and autonomous development of project-research activities by using computer-assisted techniques and by observing the norms of professional ethics and moral conduct.
TC2	Planning, monitoring, and assuming the duties of a subordinate professional group. Demonstrating the capacity of coordination, analytical thinking, adaptability and flexibility, collaboration with team members.

6.2. Learning outcomes relevant to the degree programme (as referred to in the curriculum)[2]

Learning outcomes targeted by the subject		
Competency code	**Knowledge and comprehension**	**Specific academic skills**
PC2 **TC1**	1. Performing a critical analysis based on CAD tools, to identify possible solutions to complex problems of designing equipment and plants in a chemical process.	1. Development of integrated projects, based on CAD tools, for the creative development of the design of devices, equipment and plants in the chemical process industries.
PC6 **TC2**	2. Knowledge of concepts and theories specific to resources and quality management for process engineering, in the context of sustainable development.	2. Use of qualitative and quantitative methods for assessing risk factors, operational safety and management, in the development of new projects for resources and quality management.

7. Subject-specific learning outcomes

Knowledge and comprehension
1. The student/graduate knows (understands, defines and explains) the hazards specific to chemical/biochemical processes of industrial importance.
2. The student/graduate knows (understands, defines and explains) the consequences of events originating from various hazard sources in the case of chemical/biochemical processes of industrial importance.
3. The student/graduate knows (understands, defines and explains) the fundamental principles of estimating/assessing risks associated with chemical/biochemical processes of industrial importance.

[1] The professional and/or transversal skills targeted by the subject for which the course description is prepared will be copied from the curriculum of the degree programme. For each competency, the complete entry, including the competency code, will be copied with the exact wording that appears in the curriculum, without any changes. If no competency is copied from either of the two categories, the row corresponding to that category is deleted from the table.

[2] The learning outcomes relevant for the degree programme and targeted by the subject for which the course description is prepared will be listed. The entries, copied without any changes from the Curriculum by subject type (Core Subject/Specialisation Subject/Complementary Subject), are listed under the corresponding competency.

4. The student/graduate knows (understands, defines and explains) the principles of reducing/eliminating hazards and risks associated with chemical/biochemical processes of industrial importance.
Specific academic skills
1. The student/graduate correctly identifies and classifies the hazards specific to chemical/biochemical processes of industrial importance.
2. The student/graduate correctly identifies, classifies and evaluates the consequences of events originating from various hazard sources in the case of chemical/biochemical processes of industrial importance.
3. The student/graduate correctly applies the fundamental principles of estimating/assessing risks associated with chemical/biochemical processes of industrial importance.
4. The student/graduate correctly applies the principles of reducing/eliminating hazards and risks associated with chemical/biochemical processes of industrial importance.

8. Contents

8.1. Course	**Teaching and learning methods**	**Remarks[3]**
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 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.	Presentation; Explanation, Conversation; Description; Debate	Alocated 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. 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	Presentation; Explanation,	Alocated time = 2 hours

[3] For example, organisational aspects, recommendations for students, specific aspects relating to the course/seminar, such as inviting experts in the field, etc.

assessment: Preliminary hazard list; Preliminary hazard analysis; Hazard and operability (HAZOP) studies. The use of risk matrixes.	Conversation; Description; Debate	
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. 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. Institutional measures for individual risk mitigation.	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

Bibliography

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*). Note: The examples are prepared by the students in work groups and discussed by all during class activities.	**Teaching and learning 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

<table>
<tr><td colspan="3">Bibliography
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, „Aplicații de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanțe periculoase”, Editura EFES, Cluj-Napoca, 2011.
3. Th. Meyer, G. Reniers, „Engineering Risk Management”, DeGruyter, Berlin, 2013.</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td>8.3. Practical works (in modules of 2 hours).
<u>Note</u>: The examples are prepared by the students in work groups and discussed by all during class activities.</td><td>Teaching methods</td><td>Remarks</td></tr>
<tr><td>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.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>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 legislation outcomes; methods that might have prevented the event – Part 2.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>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.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>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.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>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.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>8.3.6. Case studies about financial, social, political, economic, and environmental risk.</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
<tr><td>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).</td><td>Explanation, Conversation; Debate; Problem solving</td><td>Alocated time = 2 hours</td></tr>
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2. Specific references for each case study.

9. Evaluation

Type of activity	9.1 Evaluation criteria[4]	9.2 Evaluation methods[5]	9.3 Percentage in the final grade
9.4. Course	Correctness of answers – proper understanding and learning of concepts discussed during lectures. Correct use of learned concept within new contexts.	**<u>Summative evaluation</u>**: 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. Evaluation is based on requirements announced at the beginning of the semester. Proven or intended fraud is treated according to the ECST rules of UBB.	50 %
9.5. Seminar/ laboratory	Correctness of answers – proper understanding and learning of concepts discussed during class; Correct use of learned concept within new contexts. **Presentations of case studies during seminar / practical works is compulsory.**	**<u>Formative evaluation</u>**: - **<u>Seminar</u>**: Presentation of examples (individually or in work groups) regarding aspects discussed during the lectures. Evaluation is carried out on the spot. - **<u>Practical works</u>**: 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. Proven or intended fraud is treated according to the ECST rules of UBB.	20% 30%
9.6 Minimum standard for passing			
• Satisfying the requirements of seminar and practical works (formative evaluation) as well as obtaining 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. • Adequate knowledge and usage of discussed concepts and methods.			

10. SDG labels (Sustainable Development Goals)[6]

[4] The evaluation criteria must directly reflect the learning outcomes targeted at the level of the degree programme respectively at the level of the subject. More specifically, the learning outcomes set out in the expected learning outcomes are assessed.

[5] Both final evaluation methods and ongoing evaluation strategies should be established.

[6] Select a single label which, according to the *Implementation of SDG labels in the academic process*, best matches the subject. If the subject addresses sustainable development in a generic manner (i.e. by presenting/introducing the general framework of sustainable development, etc.), then the Sustainable Development generic label may be applied. If none of the labels describe the subject, select the last option: *"No label applies."*

	○	Sustainable Development Generic Label

								
○	○	○	◉	○	○	○	○	○
								No label applies
○	○	○	○	○	○	○	○	○

Date of entry:
4.05.2026

Signature of course coordinator

Assoc. Prof. dr. eng. Alexandra Ana Csavdari

Signature of seminar coordinator

Assoc. Prof. dr. eng. Alexandra Ana Csavdari

Date of approval in the department:
4.05.2026

Signature of the head of department

Prof. Habil. Dr. Eng. Graziella Liana Turdean