SYLLABUS

1. Information regarding the programme

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

2.1 Name of the discipline	**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)/Obl.

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

3.1 Hours per week	4	Of which: 3.2 course	2	3.3 seminar/laboratory	1/1
3.4 Total hours in the curriculum	56	Of which: 3.5 course	28	3.6 seminar/laboratory	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					-

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)

4.1. curriculum	• Not the case
4.2. competencies	• Not the case • Graduation form an Engineering programme is an advantage.

5. Conditions (if necessary)

5.1. for the lecture	• Students will punctually join the class (either *on-site* or *on-line*) • If *on-site*: Students will 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.
5.2. for the seminar / laboratory activities	• Students will punctually join the class (either *on-site* or *on-line*) • If *on-site*: Students will 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.

6. Specific competencies acquired

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. • 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. • Identification and proper usage of concepts, method and theories for solving new complex problems of risk management within chemical process engineering. • Critical analysis and usage of principles, methods and advanced work techniques for quantitative and qualitative assessment of chemical process engineering.
Transversal competencies	• Independent execution of complex professional duties and research projects using computer-aided techniques and comply with professional ethics and moral. • Planning, monitoring and assuming professional duties of underline group. Proving the coordination capabilities, analytical thinking, adaptability and flexibility, collaboration with team members. • Auto-evaluation of professional performances and establish the needs of continuous learning, documentation in the work fields in correlation with the labour market.

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

7.1 General objective of the discipline	• Introduction and evaluation of risk and operational safety factors.
7.2 Specific objective of the discipline	• Ability to qualitatively and quantitatively assess de risk and operational safety factors within a process • Ability of management and operational solution proposal for avoiding as well as coping with risky situations

8. Content

8.1 **Lecture**	Teaching methods	Remarks
8.1.1. Introduction. Presentation of real cases (examples) of major accidents in chemical industry. The importance of risk studies.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.2. Aspects of legislation regarding the safety and security in chemical industry,	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours	Alocated time = 2 hours
8.1.4. Technological risk analysis. Methods and	Presentation; Explanation,	Alocated

techniques of hazard identification and analysis. Examples. The structure of technological risk analysis.	Conversation; Description; Debate	time = 2 hours
8.1.5. Qualitative risk analysis: Sheets for dangerous chemicals; Depositing / Safekeeping of various chemicals. Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.6. Qualitative risk analysis: Preliminary hazard analysis (PHA); Risk matrix, risk levels and necessary actions; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.7. Qualitative risk analysis: Hazard and operability study (HAZOP); Risk matrix; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.8. Qualitative risk analysis: Fault mode and their effect analysis (FMEA); Risk matrix, risk levels and necessary actions; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.9. Layer of protection analysis (LOPA) at micro and macro level.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.10. Elements of quantitative risk analysis: Error tree (AG) – Gate after gate method; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.11. Elements of quantitative risk analysis: Event tree (AE) - pre- and post-accident situations; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.12. Elements of quantitative risk analysis: Analysis of effects and consequences of technological accidents; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.13. Estimation and presentation of technological risk: Individual risk; Examples.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours
8.1.14. Recap. Preparation for the exam. Case studies.	Presentation; Explanation, Conversation; Description; Debate	Alocated time = 2 hours

Bibliografie

1. Gheorghe Maria: Evaluarea cantitativă a riscului proceselor chimice şi modelarea consecinţelor accidentelor, Ed. Printech, Bucureşti, 2007.
2. Alexandru Ozunu, Călin Anghel: Evaluarea riscului tehnologic şi securitatea mediului, Ed. Accent, Cluj-Napoca, 2007.
3. Török Zoltán, Ajtai Nicolae, Ozunu Alexandru: Aplicaţii de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanţe periculoase, Ed. EFES, Cluj-Napoca, 2011.
4. Meyer Thierry, Reniers Genserik: Engineering Risk Management, DeGruyter, Berlin, 2013.
5. Maria Gavrilescu: Estimarea si managementul riscului, Editura Ecozone, Iaşi, 2008.

8.2 **Seminar**	Teaching methods	Remarks
8.2.1. Structure of technological risk analysis in chemical industry. Necessary information to its layout; sources and ways of obtaining information.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours
8.2.2. Qualitative risk analysis (part 1): Dangerous chemicals; Preliminary hazard analysis.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours
8.2.3. Qualitative risk analysis (part 2): Hazard and operability study; Analysis of errors and their effects.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours
8.2.5. Quantitative risk analysis (part 1): Error tree; Event tree.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2

		hours
8.2.5. Quantitative risk analysis (part 2): Analysis of effects and consequences	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours
8.2.6. Estimation and presentation of technological risk. Individual and social risk.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours
8.2.7. Legislation aspects (Romania and European Union). Scenarios and case studies.	Explanation, Conversation; Description; Debate; Problem solving	Alocated time = 2 hours

Bibliography

1. Török Zoltán, Ajtai Nicolae, Ozunu Alexandru: Aplicaţii de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanţe periculoase, Ed. EFES, Cluj-Napoca, 2011.
2. Meyer Thierry, Reniers Genserik: Engineering Risk Management, DeGruyter, Berlin, 2013.
3. Various materials provided by the teacher during the semester.

8.3. **Individual project** (Practical work) – The project topic refers to an installation used in chemical industry, that was designed by the student himself either in hers/his diploma thesis or in hers/his master thesis. It applies all concepts discussed during the seminar	Teaching methods	Remarks
8.3.1. Structure of technological risk analysis in chemical industry. Collecting necessary information for its layover.	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.2. Qualitative risk analysis (part 1): Dangerous chemicals; Preliminary hazard analysis.	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.3. Qualitative risk analysis (part 2): Hazard and operability study; Analysis of errors and their effects.	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.5. Quantitative risk analysis (part 1): Error tree; Event tree.	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.5. Quantitative risk analysis (part 2): Analysis of effects and consequences	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.6. Estimation and presentation of technological risk. Individual and social risk.	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours
8.3.7. Legislation aspects (Romania and European Union).	Explanation, Conversation; Debate; Problem solving	Alocated time = 2 hours

Bibliography

1. Török Zoltán, Ajtai Nicolae, Ozunu Alexandru: Aplicaţii de calcul pentru evaluarea riscului producerii accidentelor industriale majore ce implică substanţe periculoase, Ed. EFES, Cluj-Napoca, 2011.
2. Each students own graduation project.

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 (%)
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 (Exam): ✓ Written semester project based on the individual graduation thesis of each student. ✓ 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.	70 %
10.5 Seminar / Individual project (Practical works)	Correctness of answers – proper understanding and learning of concepts discussed during class; Correct use of learned concept within new contexts. Correctness od calculus and aspects presented within the individual project topic.	Formative evaluation: ✓ Presentation of a case study (individually or in teams) regarding a major incident 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.	30%

10.6 Minimum performance standards
➢ At least the grade 5 (five) at the written exam (individual semester project). The final grade will be calculated by weighting (see above) the formative and summative evaluation results. ➢ Adequate knowledge and usage of discussed concepts and methods.

Date	Signature of course coordinator	Signature of seminar coordinator
April 15, 2021	Assoc. Prof. Dr. Eng. Alexandra Csavdári	Assoc. Prof. Dr. Eng. Al. Csavdári

Date of approval	Signature of the Head of department
April 16, 2021	Prof. Habil. Dr. Eng. Graziella Liana Turdean