

## SYLLABUS

### 1. Information regarding the programme

1.1 Higher education institution	University "Babes-Bolyai"
1.2 Faculty	Faculty of 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 / Master's Degree

### 2. Information regarding the discipline

2.1 Name of the discipline	Risk factors evaluation, safety and security - CME7321						
2.2 Course coordinator	Assoc.Prof.Eng Anghel I. Calin Ioan Ph.D.eng.						
2.3 Seminar coordinator	Assoc.Prof.Eng Anghel I. Calin Ioan Ph.D.eng.						
2.4. Year of study	I	2.5 Semester	II	2.6. Type of evaluation	Exam	2.7 Type of discipline	Compulsory

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

3.1 Hours per week	3	Of which: 3.2 course	2	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	42	Of which: 3.5 course	28	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					28
Additional documentation (in libraries, on electronic platforms, field documentation)					28
Preparation for seminars/labs, homework, papers, portfolios and essays					46
Tutorship					3
Evaluations					3
Other activities: .....					
3.7 Total individual study hours			108		
3.8 Total hours per semester			150		
3.9 Number of ECTS credits			6		

### 4. Prerequisites (if necessary)

4.1. curriculum	<ul style="list-style-type: none"> <li>Not necessary</li> </ul>
4.2. competencies	<ul style="list-style-type: none"> <li>Not necessary</li> </ul>

### 5. Conditions (if necessary)

5.1. for the course	<ul style="list-style-type: none"> <li>Not necessary</li> </ul>
5.2. for the seminar /lab activities	<ul style="list-style-type: none"> <li>Not necessary</li> </ul>

## 6. Specific competencies acquired

<b>Professional competencies</b>	<ul style="list-style-type: none"> <li>Defining notions, concepts, theories and models in chemistry and depth chemical engineering process and their appropriate use in professional communication</li> <li>Using thorough knowledge of chemistry and chemical engineering process for explanation and interpretation of chemical processes</li> <li>Identifying and applying concepts, methods and theories advanced troubleshooting new complex chemical process engineering</li> <li>Critical analysis and use of principles, methods and techniques so advanced quantitative and qualitative evaluation processes of chemical engineering process</li> <li>Application of advanced concepts and theories of chemical engineering and drafting process for problem solving</li> <li>Identify concepts, theories specific resource management and quality process engineering for sustainable development</li> <li>Application expertise for effective management of resources to improve product quality and compliance with the principles of sustainable development</li> <li>Using the criteria and methods of evaluation of risk factors and management and operational safety</li> <li>Using qualitative and quantitative methods in developing new projects and quality management resources</li> </ul>
<b>Transversal competencies</b>	<ul style="list-style-type: none"> <li>Tasks required under specified requirements and the deadlines imposed, in compliance with professional ethics and moral conduct, following a predetermined work plan</li> <li>Calls solving tasks in accordance with the general objectives established by integrating the working group</li> <li>Permanent information and documentation in the field</li> <li>Concern for improving professional activity by engaging in activities</li> </ul>

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

7.1 General objective of the discipline	<ul style="list-style-type: none"> <li>To introduce and apply the criterias and methods of evaluation of risk factors and management and operational safety, understanding professional and ethical responsibility.</li> </ul>
7.2 Specific objective of the discipline	<ul style="list-style-type: none"> <li>To introduce basic principles, general elements, procedures and norms for risk and safety assessment in process industries.</li> <li>To provide with the elementary needed tools to solve practical quantitative risk assessment (QRA) problems.</li> <li>To ground a rational approach of risk factors and safety for engineers from process industries necessary to ensure both of long-standing development and environmental security.</li> </ul>

## 8. Content

8.1 Course	Teaching methods	Remarks
1. Definitions, glossary of the meaning of terms and basic principles for making risk based decisions and safety assessment.	Lecture; Explanation; Conversation; Description;	
2. Simulations and reality. Models and framework.	Lecture; Explanation; Conversation; Description;	
3. Review and basic notions on events and their probability.	Lecture; Explanation; Conversation; Description;	

4. Elements and principles of deterministic methods. Elements and principles of probabilistic methods. Random and epistemic uncertainties.	Lecture; Explanation; Conversation; Description;	
5. Safety and risk. Risk factors, safety and security. Basic elements and principles in safety assessment. Safety and Reliability.	Lecture; Explanation; Conversation; Description;	
6. Risk and nature of risk, Hazards and threats. Hazards, assessment and ranking. Risk index and hazards ranking.	Lecture; Explanation; Conversation; Description;	
7. Consequence of failure. Preliminary hazard analyse. Basic elements of HAZOP and HAZAN. Stages in basic risk assessment. Elements of risk managements.	Lecture; Explanation; Conversation; Description;	
8. Procedures and Techniques for Qualitative assessment in system safety analyses. Risk matrix. Cause Consequence Analysis. Chains of events - Logical tree methods (fault tree and events tree).	Lecture; Explanation; Conversation; Description;	
9. Procedures and Techniques for Qualitative assessment in system safety analyses. Chains of events - Logical tree methods (fault tree and events tree). Markov chains. Failure Modes and Effects Analysis.	Lecture; Explanation; Conversation; Description;	
10. Basic elements and principles for quantitative risk assessment by probabilistic assessment. The principle of limit state function. Random sampling methods.	Lecture; Explanation; Conversation; Description;	
11. Basic elements and principles for quantitative risk assessment by probabilistic assessment. Probabilistic approximate analytical techniques.	Lecture; Explanation; Conversation; Description;	
12. Semi-quantitative risk assessment. Models and preliminary hazards analyses. Risk index and ranking. Semi-quantitative case study into a suppositional pressure system.	Lecture; Explanation; Conversation; Description;	
13. Procedures and techniques for integrated risk analysis and case studies. Risk assessment and consequence analyse. RIMAP european assessment by DIN EN ISO/IEC 17020	Lecture; Explanation; Conversation; Description;	
14. Case study of risk based inspection practice.	Lecture; Explanation; Conversation; Description;	
Bibliography		
1. Al Ozunu, C.I.Anghel, <i>Evaluarea riscului tehnologic si securitatea mediului</i> , Ed.Accent, 2007;		
2. N. J. Bahr, <i>System Safety Engineering and Risk Assessment</i> , Editors: Waldemar Karwowski, 2002;		
3. Pat L. Clemens, Rodney J. Simmons, <i>System safety and risk management. A guide for engineering educators</i> . NIOSH instructional module. US Department of health and human services, Cincinnati, Ohio, 1998.		
4. *** <a href="http://www.riskworld.com/BOOKS/BK5BK001.HTM">http://www.riskworld.com/BOOKS/BK5BK001.HTM</a> .		
8.2 Seminar / laboratory	Teaching methods	Remarks

1. Simulations models, based on deterministic principles.	Explanation;Conversation; Description; Questioning.	
2. Simulations models, based on probabilistic principles.	Explanation;Conversation; Description; Questioning.	
3. Hazards identifying	Explanation;Conversation; Description; Questioning.	
4. Risk factors evaluation.	Explanation;Conversation; Description; Questioning.	
5. Elementary quantitative risk assessment based on probabilistic principles with random sampling methods	Explanation;Conversation; Description; Questioning.	
6. Elementary quantitative risk assessment based on probabilistic principles with random sampling methods	Explanation;Conversation; Description; Questioning.	
7. Elementary quantitative risk assessment based on probabilistic principles with approximate analytical techniques	Explanation;Conversation; Description; Questioning.	
8. Elementary quantitative risk assessment based on probabilistic principles with approximate analytical techniques	Explanation;Conversation; Description; Questioning.	
9. Elementary scenario for hazards analyses	Explanation;Conversation; Description; Questioning.	
10. Elementary safety assessment of technological systems	Explanation;Conversation; Description; Questioning.	
11. Elementary safety assessment of technological systems	Explanation;Conversation; Description; Questioning.	
12. Complex safety assessment of technological systems from process industries	Explanation;Conversation; Description; Questioning.	
13. Complex safety assessment of technological systems from process industries	Explanation;Conversation; Description; Questioning.	
14. Complex safety assessment of technological systems from process industries	Explanation;Conversation; Description; Questioning.	

#### Bibliography

1. Pavel, *Siguranta in functionare a utilajelor petrochimice*, Ed. Tehnică București 1987;
2. Lloyd E. Brownell, Edwin H. Young, *Process Equipment Design*, New York: Wiley&Sons, 2000;
3. \*\*\* *Process Safety Management: Complying with the OSHA PSM and EPA RMP Regulations*.
4. \*\*\* <http://www.riskworld.com/BOOKS/BK5BK001.HTM>.
5. Holger Schütz, Peter M. Wiedemann, Wilfried Hennings, Johannes Mertens, and Martin Clauberg, *Comparative Risk Assessment : Concepts, Problems and Applications*, 2006; ISBN 3527316671;
6. *Safety, Reliability and Risk Analysis, Theory, Methods and Applications*, Edited by Sebastián Martorell, Carlos Guedes Soares, Julie Barnett, CRC Press, 2008, ISBN: 978-0-415-48513-5.
7. C.I. Anghel, extended electronic course support-CD.

**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 learning the fundamental theoretical concepts and practical addressing elements included in Risk factors evaluation, safety and security discipline students acquire knowledges consistent with partial competencies required for possible occupations mentioned in Grid 1 – NRQHE.
- The broad education necessary to understand the impact of engineering solutions in a global and societal context.

**10. Evaluation**

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	It will assess the existence of fundamental concepts, correctness, thinking, reasoning and use.	Exam - the exam presentation condition: the fulfillment of all the obligations applied and the presence of at least 90%. The students will either develop a homework problem or the course instructor will assign them homework. The homework should be worked out and submitted to the instructor in a professional format at the beginning of the exam. Tutorial sessions will be conducted, one to two days before exam. Precise times and locations will be announced approximately one week in advance. Depending on demand, additional tutorial sessions may also be scheduled during the semester. The letter grade for this course will be based on the student's overall performance on seminar, exam and homework. The intention of fraud or fraud is punishable by removal from the examination supporting consequences of UBB Regulation ECST.	75%
10.5 Seminar/lab activities	Acquiring and understanding of issues addressed at the seminar, correct responses and an active attitude.	Will evaluate each seminar. Final grade as a weighted average of these evaluations.	25%

<b>10.6 Minimum performance standards</b>			
➤ Note 5 (five) both at work seminar and exam according to scale. Knowledge of fundamental concepts and their rational use in a practical application.			

Date

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Signature of course coordinator

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Signature of seminar coordinator

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Date of approval

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Signature of the head of department

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