SYLLABUS

1. Information regarding the programme

1.1 Higher education institution	**Babeş-Bolyai University of Cluj-Napoca**
1.2 Faculty	**Faculty of Environmental Science and Engineering**
1.3 Department	**Department of Environmental Analysis and Engineering**
1.4 Field of study	**Environmental Engineering**
1.5 Study cycle	**Master**
1.6 Study programme / Qualification	**Sustainable Development and Environmental Management**

2. Information regarding the discipline

2.1 Name of the discipline	**Modeling and simulation of chemical accidents**						
2.2 Course coordinator	**Lect. Dr. Eng. Zoltán Török**						
2.3 Seminar coordinator	**Lect. Dr. Eng. Zoltán Török**						
2.4. Year of study	**1**	2.5 Semester	**2**	2.6. Type of evaluation	**C**	2.7 Type of discipline	**Optional**

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

3.1 Hours per week	2	Of which: 3.2 course	1	3.3 seminar/laboratory	1
3.4 Total hours in the curriculum	28	Of which: 3.5 course	14	3.6 seminar/laboratory	14
Time allotment:					hours
Learning using manual, course support, bibliography, course notes					35
Additional documentation (in libraries, on electronic platforms, field documentation)					35
Preparation for seminars/labs, homework, papers, portfolios and essays					98
Tutorship					-
Evaluations					4
Other activities:					-

3.7 Total individual study hours	168
3.8 Total hours per semester	196
3.9 Number of ECTS credits	4

4. Prerequisites (if necessary)

4.1. curriculum	Basics of environmental engineering: chemical processes, transport and transfer processes, risk assessment Mathematics and chemistry
4.2. competencies	Technical: use of computer software, modeling and simulation tools

5. Conditions (if necessary)

5.1. for the course	Necessity of digital projector and computer (laptop)
5.2. for the seminar /lab activities	Laboratory with computers and specific software;

6. Specific competencies acquired

Professional competencies	• Understanding the concepts and models, to work with them for simulation of chemical accidents. • Learning to develop specific environmental studies: impact and risk assessment studies for process industries.
Transversal competencies	• Ability to conduct literature research in all existing formats; • Knowledge of using specific computer software in the field of environmental studies; • Acquiring knowledge of developing a research project; • Teamwork;

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

7.1 General objective of the discipline	• study and knowledge of models, techniques and procedures for chemical accident modelling, quantitative environmental risk and impact assessment;
7.2 Specific objective of the discipline	• knowledge of mathematical models used for the estimation of physical effects of chemical accidents and release of dangerous substances • knowledge of using specific software in the field of environmental risk and impact assessment • knowledge of developing an environmental risk or impact study

8. Content

8.1 Course (structured in 2 hours long courses)	Teaching methods	Remarks
• Backgrounds and scope of mathematical modelling. Conditions under which chemical accident models can be applied. Historical background of chemical accident modelling. • Modelling theory. The conceptual model. The quantitative model. Model evaluation. Model application.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Release and evaporation models: gas, liquefied gas and liquid releases; pool evaporation models.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Gas Dispersion modeling: dense gas dispersion models; passive dispersion models. Gaussian models versus Lagrangian models;	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Modeling of fires: Poolfire models, flash fire models, jetfire models	• Interactive exposure • Explanation • Conversation	

	• Didactical demonstration	
• Modeling of BLEVE phenomena and vessel explosion models; • Modeling of explosions: vapour cloud explosion models; dust explosion models;	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Modeling of physical effects of chemical accidents. Model structure and results obtained.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	
• Consequence modeling: PROBIT functions. Individual and Social Risk estimation.	• Interactive exposure • Explanation • Conversation • Didactical demonstration	

Bibliography

1. Van den Bosch, C. J. H., Weterings R.A.P.M: „Yellow Book”: Methods for the Calculation of Physical Effects, Third edition, Committee for the Prevention of Disasters, Netherlands, 1997.
2. P.A.M. Uijit de Haag, B.J.M. Ale: „Purple Book”: Guidelines for Quantitative Risk Assessment, First edition, Committee for the Prevention of Disasters, Hague, 1999.
3. Frank P. Lees: Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, Second edition, United Kingdom, 1996.
4. A. J. Jakeman, A.A. Voinov, A.E. Rizzoli, S.H. Chen (Eds.): Environmental Modelling, Software And Decision Support. State of the Art and new perspectives. Elsevier, 2008.
5. G.E. DeVaull, J.A. King, R. J. Lantzy, D. J. Fontaine (Eds.): Understanding Atmospheric Dispersion of Accidental Releases, AIChE, New York, 1995.
6. ***American Institute of Chemical Engineers (AIChE): *Guidelines for Chemical Process Quantitative Risk Analysis*, Second Edition, New York, 2000.
7. S-E Gryning, F.A. Schiermeier (Eds.): Air pollution modeling and its applications XIV, Kluwer Academic Publishers, New York, 2004.
8. C. Borrego, G. Schayes (Eds.): Air pollution modeling and its applications XV, Kluwer Academic Publishers, New York, 2004.
9. S.R. Hanna, R.E. Britter (Eds.): Wind flow and Vapour Cloud Dispersion at Industrial and Urban Sites, AIChE, New York, 2002.
10. W.E., Grant, T.M., Swannack, Ecological Modeling. A common-sense approach to theory and practice, Blackwell Publishing, 2008.
11. S.E., Jorgensen, G., Bendoricchio, Fundamentals of Ecological Modelling, Third Edition, Elsevier, 2001.
12. F., Jopp, H., Reuter, B., Breckling, Editors, Modelling Complex Ecological Dynamics, Springer, 2011.

8.2 Seminar / laboratory (structured in 2 hours long laboratories)	Teaching methods	Remarks
Presentation of available modeling and simulation tools: ALOHA, EFFETCS, RISKCURVES and SEVEX View software. Limitation of software.	• Explanation • Conversation	
Modeling and simulation of chemical releases and pool evaporation using ALOHA, EFFETCS.	• Lab assignment • Explanation • Conversation	Individual work with simulation software
Modeling and simulation of gas dispersions using ALOHA, EFFETCS and SEVEX View software.	• Lab assignment • Explanation • Conversation	Individual work with simulation software
Modeling and simulation of industrial fires using ALOHA, EFFETCS and SEVEX View software.	• Lab assignment • Explanation • Conversation	Individual work with simulation software

Modeling and simulation of BLEVE phenomena and vessel explosions using ALOHA, EFFETCS and SEVEX View software. Modeling and simulation of gas explosions using ALOHA, EFFETCS and SEVEX View software.	• Lab assignment • Explanation • Conversation	Individual work with simulation software
Consequence modeling using EFFECTS software. PROBIT calculations. Individual and Social Risk estimation examples.	• Lab assignment • Explanation • Conversation	Individual work with simulation software and MS Excel.
Presentation of Individual Project	• Conversation	Lab Exam

References

1. Van den Bosch, C. J. H., Weterings R.A.P.M: „Yellow Book”: Methods for the Calculation of Physical Effects, Third edition, Committee for the Prevention of Disasters, Netherlands, 1997.
2. P.A.M. Uijit de Haag, B.J.M. Ale: „Purple Book”: Guidelines for Quantitative Risk Assessment, First edition, Committee for the Prevention of Disasters, Hague, 1999.
3. Frank P. Lees: Loss Prevention in the Process Industries: Hazard Identification, Assessment and Control, Second edition, United Kingdom, 1996.
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9. S.R. Hanna, R.E. Britter (Eds.): Wind flow and Vapour Cloud Dispersion at Industrial and Urban Sites, AIChE, New York, 2002.
10. W.E., Grant, T.M., Swannack, Ecological Modeling. A common-sense approach to theory and practice, Blackwell Publishing, 2008.
11. S.E., Jorgensen, G., Bendoricchio, Fundamentals of Ecological Modelling, Third Edition, Elsevier, 2001.
12. F., Jopp, H., Reuter, B., Breckling, Editors, Modelling Complex Ecological Dynamics, Springer, 2011.

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

The knowledge acquired during the course can be used in the next domains: environment protection, process industries: chemical, pharmaceutical, petrochemical, food industry etc. and academic domains; The graduates of this course can contribute in the development of technological risk studies, a safety reports
or a major industrial accidents prevention policies and to work in consultancy in the field of risk assessment.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	• A theoretical research report on the topic of the Lab Project.	Evaluation of the research report (a written paper of	30%

		about 10 pages and an oral presentation)	
10.5 Seminar/lab activities	• A project developed using the available software	Evaluation of the project (documentation and demonstration)	60%
	• Student activity	Scoring	10%

10.6 Minimum performance standards

- Each student has to prove that (s)he acquired an acceptable level of knowledge and understanding of the studied domain, that (s)he is capable of stating this knowledge in a coherent form, that (s)he has the ability to establish certain connections and to use the knowledge in solving different problems.
- Successful passing of the exam is conditioned by the final grade that has to be at least 5.
- Minimum 80% presence at seminar/lab activities.

Date	Signature of course coordinator	Signature of seminar coordinator
11.04.2018	Lect. Dr. Eng. Zoltán Török	Lect. Dr. Eng. Zoltán Török

Date of approval

Signature of the head of department