

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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 | <ul style="list-style-type: none"> • 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 |
|--|---|---------|
| <ul style="list-style-type: none"> • 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. | <ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation • Didactical demonstration | |
| <ul style="list-style-type: none"> • Release and evaporation models: gas, liquefied gas and liquid releases; pool evaporation models. | <ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation • Didactical demonstration | |
| <ul style="list-style-type: none"> • Gas Dispersion modeling: dense gas dispersion models; passive dispersion models. Gaussian models versus Lagrangian models; | <ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation • Didactical demonstration | |
| <ul style="list-style-type: none"> • Modeling of fires: Poolfire models, flash fire models, jetfire models | <ul style="list-style-type: none"> • Interactive exposure • Explanation • Conversation • Didactical demonstration | |

| | | |
|---|---|--|
| <ul style="list-style-type: none"> Modeling of BLEVE phenomena and vessel explosion models; Modeling of explosions: vapour cloud explosion models; dust explosion models; | <ul style="list-style-type: none"> Interactive exposure Explanation Conversation Didactical demonstration | |
| <ul style="list-style-type: none"> Modeling of physical effects of chemical accidents. Model structure and results obtained. | <ul style="list-style-type: none"> Interactive exposure Explanation Conversation Didactical demonstration | |
| <ul style="list-style-type: none"> Consequence modeling: PROBIT functions. Individual and Social Risk estimation. | <ul style="list-style-type: none"> 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. Uijt 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. DeVaul, 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. | <ul style="list-style-type: none"> Explanation Conversation | |
| Modeling and simulation of chemical releases and pool evaporation using ALOHA, EFFETCS. | <ul style="list-style-type: none"> Lab assignment Explanation Conversation | Individual work with simulation software |
| Modeling and simulation of gas dispersions using ALOHA, EFFETCS and SEVEX View software. | <ul style="list-style-type: none"> Lab assignment Explanation Conversation | Individual work with simulation software |
| Modeling and simulation of industrial fires using ALOHA, EFFETCS and SEVEX View software. | <ul style="list-style-type: none"> Lab assignment Explanation Conversation | Individual work with simulation software |
| Modeling and simulation of BLEVE phenomena and vessel explosions using ALOHA, EFFETCS | <ul style="list-style-type: none"> Lab assignment Explanation Conversation | Individual work with simulation software |

| | | |
|---|---|--|
| and SEVEX View software. | | |
| Modeling and simulation of gas explosions using ALOHA, EFFETCS and SEVEX View software. | | |
| Consequence modeling using EFFECTS software. PROBIT calculations. Individual and Social Risk estimation examples. | <ul style="list-style-type: none"> • Lab assignment • Explanation • Conversation | Individual work with simulation software and MS Excel. |
| Presentation of Individual Project | <ul style="list-style-type: none"> • 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.
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. DeVuall, 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.

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 | <ul style="list-style-type: none"> • A theoretical research report on the topic of the Lab Project. | Evaluation of the research report (a written paper of about 10 pages and an oral presentation) | 30% |
| 10.5 Seminar/lab activities | <ul style="list-style-type: none"> • A project developed using the available software | Evaluation of the project (documentation and demonstration) | 60% |
| | <ul style="list-style-type: none"> • 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