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	Ecologic restoration of contaminated sites						
2.2 Course coordinator	Associate professor PhD Radu Mihăiescu						
2.3 Seminar coordinator	University assistant Maria Lucia Bizo, PhD						
2.4. Year of study	**2**	2.5 Semester	**3**	2.6. Type of evaluation	**E**	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					17
Additional documentation (in libraries, on electronic platforms, field documentation)					7
Preparation for seminars/labs, homework, papers, portfolios and essays					15
Tutorship					3
Evaluations					3
Other activities:					-

3.7 Total individual study hours	45
3.8 Total hours per semester	87
3.9 Number of ECTS credits	5

4. Prerequisites (if necessary)

4.1. curriculum	
4.2. competencies	Risk assessment knowledge is necessary, but these can be reiterated during the course.

5. Conditions (if necessary)

5.1. for the course	Course hall with computer and video projector
5.2. for the seminar /lab activities	Course hall with computer and video projector

6. Specific competencies acquired

Professional competencies	• Understanding the concepts regarding contaminated sites management. • Understanding and applying the detailed assessment and remediation methodology for a correct land-use planning. • Operating with notions from different scientific fields of expertise. • Formation of analytic capacities by evaluating complex issues and elaborating adequate solutions for these.
Transversal competencies	• The ability to make connections between other studied courses. • Understanding the interdisciplinary character of environmental science. • Promoting the awareness regarding the importance of contaminated sites assessment in the context of land-use planning.

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

7.1 General objective of the discipline	• The course "Ecologic restoration of contaminated sites" offers the overall image of discussing the contaminated sites management issue (the investigation methodology, its scope, the politic and regulatory framework and the remediation aspects).
7.2 Specific objective of the discipline	• To define the main terms used in contaminated sites management field and the comparative analysis of them; • To present the current politics and legislation in the field, in USA, EU and Romania. • To present the main management methodologies for contaminated sites applied worldwide. • To analyze the risk assessment concept in the context of contaminated sites. • To present several decision support systems, meant to implement proper strategies for contaminated sites rehabilitation. • To present the main technologies for rehabilitation of contaminated sites • To choice based on technical and economic criteria the appropriate rehabilitation technology

8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction • General notions • Definitions • Classifications • The analysis of the "contaminated site" concept	• Interactive exposure • Dialogue • Use of the course material	2 hours
2. Current political and regulatory framework at international and national level	• Interactive exposure • Dialogue • Use of the course material	2 hours
3. Conceptual site model • Sources • Pathways • Receptors	• Interactive exposure • Dialogue • Use of the course support	2 hours
4. Contaminated sites investigation strategies	• Interactive exposure • Dialogue • Use of the course support	2 hours
5. Contaminated sites risk assessment- generalities	• Interactive exposure • Dialogue • Use of the course support	2 hours
6. Risk assessment steps: hazard identification, exposure assessment, toxicity assessment, risk characterization	• Interactive exposure • Dialogue • Use of the course support	2 hours
7. Decision support systems	• Interactive exposure • Dialogue • Use of the course support	2 hours
8. Technologies for rehabilitation of contaminated sites • General notions • Classifications • The choice of rehabilitation technology	• Interactive exposure • Dialogue • Use of the course support	2 hours
9. Biological treatment technologies • In-situ biodegradation • In-situ bioventing • Ex-situ biopiles • Ex-situ land-farming • Ex-situ slurry biodegradation	• Interactive exposure • Dialogue • Use of the course support	2 hours
10. Physical treatment technologies • In-situ venting • In-situ soil vapor extraction • In situ soil flushing • Ex-situ soil washing	• Interactive exposure • Dialogue • Use of the course support	2 hours
11. Chemical treatment technologies • In situ soil chemical oxidation • Ex situ solvent extraction	• Interactive exposure • Dialogue • Use of the course support	2 hours

12. Thermal treatment technologies • In-situ and ex-situ vitrification • Ex situ thermal desorption systems	• Interactive exposure • Dialogue • Use of the course support	2 hours
13. Containment technologies • Solidification/stabilization • Ex-situ land disposal or landfiling	• Interactive exposure • Dialogue • Use of the course support	2 hours
14. Landscape application to the rehabilitation of sites contaminated	• Interactive exposure • Dialogue • Use of the course support	2 hours

Bibliography

1. EC, (European Commission), 2006, Proposal for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC, Brussels, 22.9.2006;
2. EC, (European Commission), 2006, European Commission. Thematic Strategy for Soil Protection Communication (COM(2006) 231;
3. US-EPA, United States Environmental Protection Agency, 1989, Risk assessment guidance for superfund Vol 1, Human health evaluation manual, Washington DC: EPA/540//1-89/002. Final Report; 1989;
4. CLARINET, 2002, Sustainable Management of Contaminated Land: An Overview, A report from the Contaminated Land Rehabilitation Network for Environmental Technologies;
5. Marcomini A, Suter GW II, Critto A (Eds), 2009, Decision Support Systems for Risk Based Management of Contaminated Sites. New York, Springer Verlag;
6. Anicăi, L., Bâsceanu, C., Duțu, M., Chineață, S., Anicăi, O., Stăniloae, D., Dumitrache, R., (2010), Managementul integrat al solurilor contaminate, Ed. Printech, Bucureşti, ISBN 978-606-521-546-7, 201 p.,
7. Bardos, P., Lewis, A., Nortcliff, S., Mariotti, C., Marot, F., and Sullivan, T., (2001a), Review of Decision Support Tools and their Use in Europe: Report of Clarinet Working Group 2, CLARINET WG2 Final Report, 192 p.,
8. Iancu, O. G., Buzgar, N., (ed.), (2008), Atlasul geochimic al metalelor grele din solurile municipiului Iaşi şi împrejurimi, Editura Universităţii „Alexandru Ioan Cuza", ISBN 978-973-703-329-1, 34 pag.,
9. NRC, (National Research Centre), (2009), Science and Decision: Advancing Risk Assessment, Committee on Improving Risk Analysis Approaches Used by the U.S. EPA, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, National Research Council of the National Academies, The National Academies Press, Washington, D.C., ISBN-13: 978-0-309-12047-0, 424 pp.,
10. World Bank, (2010), International experience in policy and regulatory frameworks for brownfield site management, Washington D.C.
11. Lye, A., Ludwig, R., Wardlaw, C., Les technologies d'assainissement des lieux contaminés: Manuel de référence, Document préparé par la Société Water Technology International Corp., Burlington (Ontario)/ Canada, Mars 1997.
12. Micle, V., Refacerea ecologică a zonelor degradate, Editura UTPRES, Cluj-Napoca, 2009.
13. Micle,V., Neag,G., Procedee şi echipamente de depoluare a solurilor şi apelor subterane, Editura UTPRES, 2009.
14. Micle, V., Sur, I., Stiinta solului – Indrumator de laborator, Editura UT Pres, Cluj-Napoca, 2012.
15. Neag, G., Depoluarea solurilor si a apelor subterane, Editura Casa Cartii de Stiinta, Cluj-Napoca, 1997.
16. Bica, I., Poluarea acviferelor. Tehnici de remediere, Editura *H*G*A*, Bucureşti, 1998.
17. Mitrea, V., Peisagistică – curs, Volumul 1, Universitatea Tehnică Cluj-Napoca, 2000

8.2 Seminar / laboratory	Teaching methods	Remarks
		The seminar is structured as 2 hours classes every second week
1. Introduction. Project themes.	• Interactive exposure • Explanations • Dialogue	
2. Acceptable concentration calculations on a given site based on toxicological, exposure, physico-chemical parameters	• Interactive exposure • Explanations • Dialogue	
3. Use of a contaminated sites management decision support system	• Interactive exposure • Explanations • Dialogue	
4. Project presentation	• Interactive exposure • Explanations • Dialogue	
5. Case study: rehabilitation of a contaminated site - Site characterization	• Interactive exposure • Explanations • Dialogue	
6. Choice based on technical and economic criteria the appropriate rehabilitation technology	• Interactive exposure • Explanations • Dialogue	
7. Establishment of parameters rehabilitation technology and choosing appropriate equipment	• Interactive exposure • Explanations • Dialogue	

Bibliography

1. EC, (European Commission), 2006, Proposal for a Directive of the European Parliament and of the Council establishing a framework for the protection of soil and amending Directive 2004/35/EC, Brussels, 22.9.2006;
2. EC, (European Commission), 2006, European Commission. Thematic Strategy for Soil Protection Communication (COM(2006) 231;
3. Marcomini A, Suter GW II, Critto A (Eds), 2009, Decision Support Systems for Risk Based Management of Contaminated Sites. New York, Springer Verlag;
4. World Bank, (2010), International experience in policy and regulatory frameworks for brownfield site management, Washington D.C.
5. Micle, V., Refacerea ecologică a zonelor degradate, Editura UTPRES, Cluj-Napoca, 2009.
6. Micle,V., Neag,G., Procedee şi echipamente de depoluare a solurilor şi apelor subterane, Editura UTPRES, 2009.
7. Micle, V., Sur, I., Stiinta solului – Indrumator de laborator, Editura UT Pres, Cluj-Napoca, 2012.

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 content of the discipline is consistent with the similar disciplines from other Romanian universities and universities from abroad, as well as with the requirements that potential employers would have in the distributed artificial intelligence field.

10. Evaluation

Type of activity	10.1 Evaluation criteria	10.2 Evaluation methods	10.3 Share in the grade (%)
10.4 Course	• The interest shown for the aspects presented and the active participation	Oral- involvement in discussions and the quality of the questions asked.	10%
	• The correctness and completeness of the accumulated knowledge.	Written exam (in the regular session)	70%
10.5 Seminar/lab activities	• Elaboration of given assignments.	Written- the correctness of the approach and solution ingenuity.	20%
10.6 Minimum performance standards			
• Each student has to prove that (s)he acquired an acceptable level of knowledge and understanding of the Distributed Artificial Intelligence domain, that (s)he is capable of stating these 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.			

Date	Signature of course coordinator	Signature of seminar coordinator
29.09.2017	Assoc. professor PhD Radu Mihăiescu	Univ. assist. Maria Lucia Bizo, PhD

Date of approval Signature of the head of department