

## 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, Risk Assessment and Environmental Security/ master degree

### 2. Information regarding the discipline

2.1 Name of the discipline	<b>NME8121 Management of contaminated sites -</b>						
2.2 Course coordinator	Assist. prof. Ph. D. Radu Mihaiescu						
2.3 Seminar coordinator	Assist. Ph. D. Maria Lucia Bizo						
2.4. Year of study	<b>2</b>	2.5 Semester	<b>3</b>	2.6. Type of evaluation	<b>Ex.</b>	2.7 Type of discipline	<b>Ob.</b>

### 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					25
Additional documentation (in libraries, on electronic platforms, field documentation)					25
Preparation for seminars/labs, homework, papers, portfolios and essays					25
Tutorship					5
Evaluations					4
Other activities: .....					-
3.7 Total individual study hours			84		
3.8 Total hours per semester			126		
3.9 Number of ECTS credits			5		

### 4. Prerequisites (if necessary)

4.1. curriculum	<ul style="list-style-type: none"> <li>Recommended: environmental chemistry, soil science, geology, environmental pollution sources (air, water, soil).</li> </ul>
4.2. competencies	<ul style="list-style-type: none"> <li>Risk assessment knowledge is necessary, but these can be reiterated during the course.</li> </ul>

### 5. Conditions (if necessary)

5.1. for the course	<ul style="list-style-type: none"> <li>Course hall with computer and video projector</li> </ul>
5.2. for the seminar /lab activities	<ul style="list-style-type: none"> <li>Course hall with computer and video projector.</li> <li>The students need to have their phones off.</li> <li>Delay is not accepted.</li> </ul>

### 6. Specific competencies acquired

<b>Professional competencies</b>	<ul style="list-style-type: none"> <li>- Basic knowledge on contaminated sites management.</li> <li>- Understanding the environmental legislation related to contaminated sites.</li> <li>- Acquiring skills in the use of the assessment methodology and remediation of contaminated sites for depollution.</li> <li>- Developing analytical abilities by assessing complex contamination situations and proposal of appropriate solutions for decontamination.</li> <li>- Developing analytical abilities for environmental issues management generated by the presence of contaminated sites.</li> </ul>
<b>Transversal competencies</b>	<ul style="list-style-type: none"> <li>- Developing the ability to make connections with other courses studied.</li> <li>- Development of environmental solutions which gather the interdisciplinary character of contaminated sites management.</li> <li>- Assimilation of specialized working technics for connection with other related fields, such as land-use planning.</li> </ul>

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

7.1 General objective of the discipline	The course <b>Management of contaminated sites</b> provides an overall image regarding the management issues generated by contaminated sites (the investigation methodology, the goal, the politic and regulatory framework and the remediation aspects).
7.2 Specific objective of the discipline	<ul style="list-style-type: none"> <li>- To get knowledge on the main terms used in the field of contaminated sites management and the comparative analysis of them;</li> <li>- To present the current politics and legislation in this field, in Romania, EU and USA.</li> <li>- To present the main management methodologies for contaminated sites applied al national level.</li> <li>- Evaluation of the risk assessment concept in the context of contaminated sites.</li> <li>- Present several decision support systems, which have the goal to provide proper strategies for contaminated sites rehabilitation.</li> <li>- Develop a basic remediation technology for contaminated sites.</li> </ul>

## 8. Content

8.1 Course	Teaching methods	Remarks
1. Introduction <ul style="list-style-type: none"> <li>• General notions</li> <li>• Definitions</li> <li>• Classifications</li> <li>• The analysis of the “contaminated site” concept</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course material</li> </ul>	2 hours
2. Current political and regulatory framework at international and national level	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course material</li> </ul>	2 hours
3. Conceptual site model <ul style="list-style-type: none"> <li>• Sources</li> <li>• Pathways</li> <li>• Receptors</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
4. Contaminated sites investigation strategies	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
5. Contaminated sites risk assessment- generalities	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> </ul>	2 hours

	<ul style="list-style-type: none"> <li>• Use of the course support</li> </ul>	
6. Risk assessment steps: hazard identification, exposure assessment, toxicity assessment, risk characterization	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
7. Decision support systems	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
8. Technologies for rehabilitation of contaminated sites <ul style="list-style-type: none"> <li>• General notions</li> <li>• Classifications</li> <li>• The choice of rehabilitation technology</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
9. Biological treatment technologies <ul style="list-style-type: none"> <li>• In-situ biodegradation</li> <li>• In-situ bioventing</li> <li>• Ex-situ biopiles</li> <li>• Ex-situ land-farming</li> <li>• Ex-situ slurry biodegradation</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
10. Physical treatment technologies <ul style="list-style-type: none"> <li>• In-situ venting</li> <li>• In-situ soil vapor extraction</li> <li>• In situ soil flushing</li> <li>• Ex-situ soil washing</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
11. Chemical treatment technologies <ul style="list-style-type: none"> <li>• In situ soil chemical oxidation</li> <li>• Ex situ solvent extraction</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
12. Thermal treatment technologies <ul style="list-style-type: none"> <li>• In-situ and ex-situ vitrification</li> <li>• Ex situ thermal desorption systems</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
13. Containment technologies <ul style="list-style-type: none"> <li>• Solidification/stabilization</li> <li>• Ex-situ land disposal or landfilling</li> </ul>	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	2 hours
14. Landscape application to the rehabilitation of sites contaminated	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Dialogue</li> <li>• Use of the course support</li> </ul>	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;
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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 Iași și împrejurimi, Editura Universității „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 și echipamente de depoluare a solurilor și 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\*, București, 1998.
17. Mitrea, V., Peisagistică – curs, Volumul 1, Universitatea Tehnică Cluj-Napoca, 2000
18. Stezar I.C., Ozunu A., Barry D.L., 2014, The role of stakeholder attitudes in managing contaminated sites: Survey of Romanian stakeholder awareness, ISSN 0944-1344, Volume 21, Number 1, Environ Sci Pollut Res (2014) 21:787-800, DOI 10.1007/s11356-013-2238-0.

<b>8.2 Seminar / laboratory</b>	Teaching methods	Remarks
<b>The seminar is structured as 2 hours classes every second week</b>		
1. Introduction – Environmental impact generated on soil, subsoil and underground water by anthropic activities	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
2. Environmental legislation related to contaminated sites	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
3. Identification of contaminated sites	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
4. Assessment of contaminated sites	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
5. Decontamination methods for polluted areas	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
6. Remediation technologies for soil and underground water	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	
7. Environmental rehabilitation and monitorization of depolluted sites	<ul style="list-style-type: none"> <li>• Interactive exposure</li> <li>• Explanations</li> <li>• Dialogue</li> </ul>	

### **Bibliography**

1. Bica, I., 2014, Remedierea siturilor contaminate, Orizonturi Universitare Timișoara;
2. CLARINET, 2002, Sustainable Management of Contaminated Land: An Overview, A report from the Contaminated Land Rehabilitation Network for Environmental Technologies;
3. Hotărârea Guvernului României nr. 683 din 31/08/2015 privind aprobarea Strategiei Naționale și a Planului Național pentru Gestionarea Siturilor Contaminate din România;

4. Hotărârea Guvernului României nr. 1408 din 23/11/2007 privind modalitățile de investigare și evaluare a poluării solului și subsolului;
5. Hotărârea Guvernului României nr. 1403 din 19/11/2007 privind refacerea zonelor în care solul, subsolul și ecosistemele terestre au fost afectate;
6. Ordin nr. 184/1997 - Ordin al ministrului apelor, pădurilor și protecției mediului pentru aprobarea Procedurii de realizarea bilanțurilor de mediu;
7. Ordin nr. 756/1997 - Ordin al ministrului apelor, pădurilor și protecției mediului pentru aprobarea Reglementării privind evaluarea poluării mediului.
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10. World Bank, (2010), International experience in policy and regulatory frameworks for brownfield site management, Washington D.C.

**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 of the potential employers, private and public organizations.

**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"> <li>• The interest shown for the aspects presented and the active participation</li> </ul>	Oral- involvement in discussions and the quality of the questions asked.	10%
	<ul style="list-style-type: none"> <li>• The correctness and completeness of the accumulated knowledge, quality of the individual project.</li> </ul>	Oral exam (in the regular session) Project presentation	70%
10.5 Seminar/lab activities	<ul style="list-style-type: none"> <li>• Activity in the seminar: explanation and correlation skills; complete and correct solving of tasks</li> </ul>	Oral – presentation of projects made individual/in teams	20%

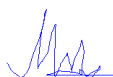
**10.6 Minimum performance standards**

- Each student has to prove that (s)he acquired an acceptable level of knowledge and understanding of the subjects and has the ability to establish certain connections and to use the knowledge in solving different problems.
- The student has to realize a individual project, study case on a contaminate site remediation options
- Presence at 75% of the seminars.
- Successful passing of the exam is conditioned by the final grade that has to be at least 5.

Date  
22.03.2021

Signature of course coordinator  
Assist. prof. PhD Radu Mihaiescu

Signature of seminar coordinator  
Assist. PhD Maria Lucia Bizo




Date of approval

Signature of the head of department  
Assist. prof. PhD Radu Mihaiescu

