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| **Title** of the subject: **Environmental technologies I. Soil remediation, soil protection, biotechnology in agriculture**  | **ECTS Credit Points: 3** |
| **Type** of the subject: compulsory |
| **Ratio of theory and practice:** (credit%) **70/30** |
| **Type and number of classes per semester**: 28 hour(s) lecture and 14 hour(s) practice per **semester** Number of teaching hours / week : 2+1 (lecture and practice) |
| **Type of exam**: exam |
| **Subject in the curriculum:** semester 2 |
| Preliminary requirements:- |

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| **Summary of content - theory**:  |
| This course reviews the basic knowledge of soil pollution, characterization methods of polluted sites, regulations of remediation in Hungary, contamination transport processes in soils, and biological, chemical, physical, phytoremediation (clean-up) technologies in detail. Introduction of the reasons and consequences of the main soil degradation processes. Introduction of the technical, agronomical, soil protection, chemical, mechanical, complex amelioration and recultivation methods suitable for the moderation of the unfavourable effects.1. Definition of remediation, national and international background and main steps of remediation plans and environmental status assessment2. Requirements of site characterization, regulation for underground water and geological medium in EU3. Sampling methods, impoundment methods for contaminated sites4. Pollution transport in soil and pollution distribution and transformation in soil5. Aspects of appropriate remediation technologies6. In-situ and ex-situ physical remediation methods7. In-situ and ex-situ chemical remediation methods8. In-situ and ex-situ biological remediation methods, Phytoremediation methods9. The soil conservation, land reclamation, environmental and soil acidification, salinization, secondary salinization, soil structure degradation, soil compaction.10. Improving acidic and saline soils.11. Improve sandy soils, improving soil physical properties of deep ploughing.12. Water erosion. technical and agronomic possibilities of protection against erosion.13. Wind Erosion. protection against deflation agronomic possibilities.14. Complex amelioration (soil improvement, drainage, surface drainage and subsurface drainage). |
| **Summary of content - practice**: |
| The aim of the practice is to provide students with the skills they need to explore and interpret at a high level, to analyze complex problems in remediation and soil protection with advanced tools. In addition, they are able to interpret legal issues and plan their management. 1. Field practice: Sampling of a polluted site2-3. Laboratory and GIS practice: Defining underground contaminant transport by measuring and calculating of ground water flow speed and directions based on field survey data4. Laboratory practice: Analyze the basic characteristics and pollutants of soil samples (i.e. with XRF)5. Pollution Distribution Modeling - GIS Applications6. Laboratory Exercise: Preparation of environmental toxicological and bioaccumulation tests7. Measuring the environmental toxicological tests8. Analyzing the results of environmental toxicological tests9. Measuring the bioaccumulation test, dividing roots and shoots and drying it10. Analyzing the results of bioaccumulation 11. Soil Loss Modeling with RUSLE12-14 Field trip: Visiting heavy metal and organic polluted sites with ongoing remediation process |
| **Literature, handbooks in English**  |
| 1. Prasad, MNV. 2005. Trace Elements in the Environment: Biogeochemistry, Biotechnology, and Bioremediation CRC Press/Taylor & Francis Group Boca Raton FL 33487 USA 744 ISBN 978-1-56670-685-8
2. P Lens, T Grotenhuis, G Malina, H Tabak 2005. Soil and Sediment Remediation. IWA Publishing London SW1H 0QS United Kingdom 544 ISBN 9781843391005
3. Neilson, Alasdair H. 2007. Environmental Degradation and Transformation of Organic Chemicals. Taylor & Francis (USA) Philadelphia, PA 19106 USA ISBN 9780849372414
4. Mirsal I.A. 2004. Soil pollution: Origin, Monitoring and Remediation Spreinger 312. ISBN: 978-3-540-70775-5
5. Saligram Bhatt (2004): Environment Protection and Sustainable Development. APH Publishing. 241. p. ISBN 9788176485128
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| **Competencies gained** *(acc. to the Regulation on training and outcome requirements)* |
| 1. **Knowledge:**
* Know, understand and apply the professional vocabulary, expression and formulation of field of expertise in English.
* Have general and specific knowledge of agricultural, food chain safety, natural sciences, environmental protection, nature conservation, technical and economic studies related to its field of specialization.
* Understand the links between the fields to related disciplines, and understand and systematize the relationships.
* Know and understand the different legal policy environments of a given field of activity and the existing relationships.
* Know, understand, and apply the principles of protecting the natural environment,
1. **Skills:**
* capable of identifying special professional problems and exploring the detailed conceptual and practical background needed to solve them.
* able to analyze in detail the different areas, to explore the comprehensive and specific contexts.
* able to formulate a synthetic evaluation of the results of the analysis and produce a report.
* able to use state-of-the-art IT tools to provide professional and effective oral and written communication.
* Able to handle regional and cross-border agrarian and environmental conflicts after obtaining good practice and develop and implement solution proposals.
* Able to provide the necessary conditions for the implementation of the specified activities, to continuously manage and control the implementation and to organize it.
* Able to implement the professional activity within the legal framework
1. **Attitude:**
* Open and responsive to the knowledge and practical application of modern and innovative practices in the field of environmental management.
* Recognizes values, responsive to the application of effective methods and tools.
* Committed to solving problems on a professional basis.
* Recognize and accept the limitations and risks of making decisions about the specialty of the profession.
* Active participant in research and development projects in the field of environmental management
1. **Autonomy and responsibility:**
* Have considerable autonomy in the implementation of a specific activity
* Capable of independent, environmentally-oriented management, and capable of applying and developing modern agricultural technologies.
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| **Responsible lecturer: Dr. habil. Nagy Attila, associate professor, PhD** |

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| **Terms of course completion:** |
| 1. Participation at the field trip and active participation the practical lessons (at least 8)
2. Completing exercises
3. Submitting report at the end of the semester
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| **Form of examination:** |
| written exam  |
| **Requirement(s) to get signature:** |
| A report, including the objective interpretation of roles, methods and the results of field scale and GIS laboratory exercises on the field of remediation and soil conservation. |

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| **Exam questions:** |
| 1. The concept of soil remediation
2. Steps of site assessment
3. Listing and characterization of soil contaminants and pollution sources
4. Direct methods for identification and delineation of contaminated sites. (listing, characterization)
5. Indirect methods for identification and delineation contaminated sites. (listing, characterization)
6. Sampling strategies
7. Comparing the characterization methods of contaminated sites
8. Transport Processes - General Mechanisms
9. Advection, diffusion, dispersion
10. Oil phase movement in soil and in underground water
11. Adsorption - Isotherms
12. The process of exploration and remediation of contaminated media
13. Groupings of remediation technologies (ex-situ, etc.), advantages, disadvantages of physical chemical and biological remediation technologies.
14. Thermal methods.
15. Insulation techniques, groundwater extraction.
16. Vacuum wells, aeration, ventilation.
17. Ex-situ stripping.
18. Soil Washing
19. Adsorption, with particular regard to activated carbon processes.
20. Phase Separation Methods.
21. List the chemical remediation methods + characterize UV + O3 + H2O2 process.
22. Solidification, stabilization.
23. Microbiological transformation and remediation of inorganic micropollutants
24. Bioremediation of organic pollutants with particular emphasis on intensified bioremediation, landfarming, bio-bed restoration, composting, bioreactors.
25. Phytoremediation technologies (phytoextraction, rhizofiltration, phytostabilisation, etc.).
26. Natural attenuation - natural treatment
27. Advantages, disadvantages and applicability criteria of phytoremediation.
28. Factors inhibiting soil fertility
29. Melioration of acid and saline soils.
30. Improvement of sandy soils, improvement of physical properties of soils, deep ploughing.
31. Soil degradation processes
32. Surface erosion forms
33. Deep erosion forms
34. Factors that trigger erosion and influence
35. Agrotechnical tasks of erosion protection
36. Forestry tasks of erosion protection
37. Technical tasks of erosion protection (terrace)
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