

<b>Subject name</b>	<b>Environmental Biotechnology</b>	
<b>Subject code</b>	<b>E.1z.ENB.SC.ECTIE.O (winter)</b> <b>E.11.ENB.SC.ECTIE.O (summer)</b>	
<b>Department</b>	<b>Biochemistry Department, Institute of Plant Biology and Biotechnology</b>	
<b>Faculty</b>	<b>Faculty of Biotechnology and Horticulture</b>	
<b>Subject supervisor/Lecturer</b>	<b>Dr. Pawel Kaszycki / Dr. Pawel Kaszycki, Paulina Supel</b>	
<b>General information</b>	<b>Teaching period</b>	<b>1 semester / winter or summer semester</b>
	<b>ECTS credit</b>	<b>6</b>
	<b>Assessment method</b>	<b>written examination – test; classes: written reports on lab results</b>
	<b>Lectures total</b>	<b>30</b>
	<b>Classes total</b>	<b>15</b>
<b>Objective and general description</b>	<p>The aim of the course is to reveal main ecological aspects of environmental pollution and deterioration as well as to teach methods employed to protect natural resources and restore degraded areas with the application of modern biotechnology, microbiology and biochemistry. The course focuses on anthropogenic threat towards the environment and on the necessity for conserving natural ecosystems and preserving biodiversity. The advantages of the use of biological methods based on xenobiotic bioremediation and biotransformation are shown. The most efficient biotechnologies of wastewater treatment and soil reclamation are presented. Also, current trends in environmental biotechnology are discussed, especially the application of specialized microbial consortia consisting of autochthonous soil and water microorganisms.</p>	
<b>Lectures (hour by hour)</b>	<p>1. 2. Ecological risk as caused by industrial and agricultural activities of man. Examples of industrial injuries, ecological damages and disasters. 3. Classes of anthropogenic environmental pollutants and sources of their emissions. Contamination with heavy metals. 4. 5. Current scientific research topics and application efforts aimed at protection of the environment and recultivation of deteriorated areas and sites – a challenge for modern biotechnology, industrial microbiology and biochemistry. 6. Biological methods as advantageous tools in environmental protection – comparison with the alternative approaches.</p>	

	<p>7. 8. Basic definitions and terms used in environmental biotechnology. Elements of legal regulations regarding the environment, its protection and the sustainable development and growth.</p> <p>9. Preventive actions taken to cease environment degradation and deterioration: ecotones, biogeochemical barriers, protective zones.</p> <p>10. Bioremediation and biodegradation – how to employ enzymatic processes revealed by pro- and eukaryotic organisms.</p> <p>11, 12. Phytotechnologies – phytostabilization and phytoremediation.</p> <p>13. 14. 15. Biological treatment of wastewaters – basics of the nitrogen and phosphorus removal as well as the mineralization process; the application of the activated sludge – its content, biochemical and physiological characteristics; types of wastewater treatment plants and treatment bioreactor systems, the use of constructed wetland plants.</p> <p>16. 17. Anaerobic waste management with bacterial methane fermentation – production of biogas.</p> <p>18. Management of waste sludges and sediments.</p> <p>Biotreatment of waste gases: the use of bioscrubbers and biofilters, membrane bioreactors, immobilized microorganisms, activated sludge.</p> <p>19. Composting of soil, sludges and organic waste – pile and reactor systems; evaluation of composts.</p> <p>20. 21. Methods for reclamation of soil polluted with organic substances – the <i>in situ</i> and <i>ex situ</i> technologies. Biostimulation of autochthonous soil microorganisms and bioaugmentation with specialized microbial consortia.</p> <p>22, 23. Biotransformation of toxic agents and recalcitrant contaminants into environmentally-safe products. Bioconversion of plastics and the concept of bio-based materials.</p> <p>24. Heavy metal decontamination and elements of biohydrometallurgy.</p> <p>25. Bioindicators and biosensing elements used to trace contaminants.</p> <p>26. 27. 28. The problem of climate change and biotechnologies aimed at preventing global warming – the idea of biomass, biofuels and the efforts to biosequester the excess CO<sub>2</sub>: use of plants and microalgae; the green-roof concept.</p> <p>29. 30. Modern trends in environmental biotechnology and biochemistry: construction of complex, highly-specialized biocenoses that reveal synergic effect against xenobiotics.</p>
<p><b>Classes</b></p>	<p>Biological treatment of industrial effluents: the application of methylotrophic yeasts and/or bacteria for formaldehyde and methanol biodegradation in model wastewater systems (5h).</p> <p>Isolation of autochthonous microorganisms from soil contaminated with petroleum products (5 h).</p>

	<p>Selection and adaptation of bacterial isolates to the presence of organic compounds; testing the microorganisms potential to degrade contaminants (5 h).</p>
<p><b>References</b></p>	<ol style="list-style-type: none"> <li>1. Kaszycki P., Kołoczek H. (2000) Formaldehyde and methanol biodegradation with the methylotrophic yeast <i>Hansenula polymorpha</i> in a model wastewater system. <i>Microbiological Research</i> 154: 289-296.</li> <li>2. Kaszycki P., Kołoczek H. (2002) Biodegradation of formaldehyde and its derivatives in industrial wastewater with methylotrophic yeast <i>Hansenula polymorpha</i> and with the yeast-bioaugmented activated sludge. <i>Biodegradation</i> 13: 91-99.</li> <li>3. Kaszycki P., Pawlik M., Petryszak P., Kołoczek H. (2010) Aerobic process for in situ bioremediation of petroleum-derived contamination of soil: a field study based on laboratory microcosm tests. <i>Ecol. Chem. Eng. A</i> 17 (4-5): 405-414.</li> <li>4. Kaszycki P., Petryszak P., Kołoczek H., (2008) Biological treatment of wastewaters generated by furniture industry. 2. Construction of a specialized activated sludge and optimization of bioprocess parameters in semi-technical tests. <i>Ecol. Chem. Eng. A</i> 15 (11): 1257-1272.</li> <li>5. Kaszycki P., Petryszak P., Pawlik M., Kołoczek H. (2011) Ex situ bioremediation of soil polluted with oily waste: use of specialized microbial consortia for process bioaugmentation. <i>Ecol. Chem. Eng. S</i> 18 (1): 83-92.</li> <li>6. Liu W.-T., Jansson J.K. (eds.) Environmental Molecular Microbiology, Caister Academic Press, 2009</li> <li>7. Lovley DR, Coates JD. 1997 Bioremediation of metal contamination. <i>Curr Opin Biotechnol.</i> 8: 285 - 289.</li> <li>8. Macek T., Kotrba P., Svatos A., Novakova M., Demnerova K., Mackova M. (2007) Novel roles for genetically modified plants in environmental protection. <i>Trends in Biotechnology</i> 26 (3): 146-152.</li> <li>9. van Hamme J.D., Singh A., Ward O.P. (2003) Recent advances in petroleum microbiology. <i>Microbiology And Molecular Biology Reviews</i> 67 (4): 503–549.</li> <li>10. Wood T. K. (2008) Molecular approaches in bioremediation. <i>Current Opinion in Biotechnology</i> 19: 572–578.</li> </ol>