Module syllabus: ***Environmental biotechnology***

1. Overall information

Module coordinator	dr hab. Katarzyna Hupert-Kocurek
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ECTS	**6**
Method for the verification of learning outcomes	The final grade for the module is weighted on the average of the following student activities: - Active participation in laboratory classes (0.6) - Written final exam (0.4) The final grade for the active participation in the laboratory classes is weighted on the average of the continuous evaluation of knowledge (0.4), practical skills (0.2) and reports (0.4). To be awarded a final grade, the student must have passed each activity of the module. Grades: below 51% – fail (F); 52-60% – with minimum academic criteria (E); 61-65% – satisfactory (D); 66-75% – good (C); 76-85% – very good (B), ≥ 85% – excellent (A)

2. Description of student activity and work

Lecture/discussion sessions	
Responsible instructors	dr hab. Katarzyna Hupert-Kocurek, dr Katarzyna Kasperkiewicz, dr Bożena Nowak
Content	**The main objective of this module** is (1) to acquaint students with a detailed knowledge of environmental biotechnology and the computational methods that are used for estimating the degradation potential; (2) to acquaint them with various ways of applying microorganisms and plants in the bioremediation of environments that have been contaminated with heavy metals and aliphatic and aromatic hydrocarbons and (3) to develop their skills for critically interpreting published data on environmental biotechnology. **Lectures/discussion sessions** comprise the core subjects in environmental biotechnology, including the methods used to determine the degradation activity of microorganisms, the computational methods evaluating the degradation potential of microorganisms, the genetic modification of microorganisms aimed at improving their catabolic activity and the improvement of the enzymes used in environment protection. **Lecture/discussion session content:** Biocells. Production of biofuels. Biotechnology in environmental protection. Molecular background of bacterial resistance to heavy metals and their ability to aromatic hydrocarbons degradation. Genetic modification of microorganisms and enzymes that have applications in environmental biotechnology and environmental protection. Selected computational methods used to evaluate the degradation potential of microorganisms – the effects, advantages and disadvantages.

Number of didactic hours (contact hours)	**15**
Literature	Martínez R., Schwaneberg U. 2013. A roadmap to directed enzyme evolution and screening systems for biotechnological applications. Biological Research, 46: 395-405 George K. W., Hay A. G. 2011. Bacterial Strategies for Growth on Aromatic Compounds. Advances in Applied Microbiology, 74, 1-33 Glazer A.N., Nikado H. 1995. Microbial Biotechnology: fundamentals and applied microbiology. W.H. Freeman and Company, New York

Laboratory	
Responsible instructors	Staff of the Department of Biochemistry and the Department of Microbiology
Laboratory projects	Department of Biochemistry Project 1: Studying the microorganisms used in the bioremediation of contaminated environments – introduction. Preparing media and reagents. Project 2: Identification of genes encoding extradiol dioxygenases and heavy metal resistance genes in bacteria. Project 3: Cloning the wild type and mutagenised gene for catechol 2,3-dioxygenase in the expression vector. Project 4. Determination of catechol 2,3-dioxygenase activity in the obtained transformants. Project 5: Presenting, analysing and discussing the results. Department of Microbiology Project 1: Isolation of bacteria that are able to degrade aromatic compounds, heavy metal resistant bacteria and endophytic bacteria. Preparing media and reagents. Project 2: Isolation of genomic and plasmid DNA from selected bacteria. Assessing the plant growth promoting traits of selected bacterial strains, part 1 – inoculation. Project 3: Assessing the plant growth promoting traits of selected bacterial strains, part 2 – results. Project 4: Presenting, analysing and discussing the results.
Methodology of laboratory classes	Experiments will be performed in small groups under the supervision of the instructors and will include: • Designing and accomplishing the procedure • Calculating and presenting the results • Protocols commitment and presentation
Number of didactic hours (contact hours)	45
Literature	Glick B. 2012. Plant growth-promoting bacteria: mechanisms and applications. Hindawi Publishing Corporation Scientifica, Article ID 963401 Compant S., Clément C., Sessitsch A. 2010. Plant growth-promoting bacteria in the rhizo- end endosphere of plants: their role, colonization, mechanisms involved and prospects for utilization. Soil Biology & Biochemistry, 42, 669-678 Padmanabhan S.S., Banerjee S., Mandi N. Screening of Bacterial Recombinants: Strategies and Preventing False Positives. www.intechopen.com

3. Forms of verification

Continuous evaluation of knowledge, activity and practical skills	
Grades	Grades are awarded on a scale: A-F, where A is the best and F is a fail. An excellent performance (A) – the student actively participates in laboratory work, demonstrates an excellent understanding of the experimental procedures (its aims, sequence and outcomes) is engaged and creative in solving current problems and in an assessment and presentation of experimental results. A very good performance (B) – the student actively participates in laboratory work, demonstrates a very good knowledge and understanding of the aims of the project, draws the conclusions and discusses the results. A good performance (C) – the student demonstrates a good judgment and knowledge, correctly provides an experiment, correctly exhibits a sense of an experimental procedure, properly provides an assessment and presentation of experimental results. A satisfactory performance (D) – the student demonstrates a satisfactory judgment and knowledge, is poorly engaged and needs additional help to finish the experiment and final assessment of the experimental results correctly, present satisfactory presentation of experimental results. A performance that meet the minimum academic criteria (E) – the student demonstrates poor knowledge, is poorly engaged in laboratory work and needs additional help to finish the experiment, draw the conclusions and discuss the results, present poor presentation of experimental results. A performance that does not meet the minimum academic criteria (F) – the students is not engaged in experiment, did not exhibit sense of experimental procedures, poorly interprets and presents experimental results.

Reports from realised laboratory projects	
Evaluation	Evaluation comprises judgment and knowledge related to the sense and methods of the laboratory project, engagement in realisation, quality of assessing and presenting the experimental results, use of reference materials. Grades for reports are awarded on a scale: A-F, where A is the best and F is a fail. An excellent report (A) – without any essential errors Fail (F) – no report

Final exam	
Grades	The written final exam consists of questions on the aspects of environmental biotechnology that were presented during the Lecture/discussion sessions and Laboratory. Up to two points are awarded for each correct answer. The final score is the basis for the final assessment. Grades: below 51% – fail (F); 52-60% – with minimum academic criteria (E); 61-65% – satisfactory (D); 66-75% – good (C); 76-85% – very good (B), ≥ 85% – excellent (A).