Module Handbook of Introduction to Biodegradation and Bioremediation

Module designation	The Introduction of Biodegradation and Bioremediation is a course intended for students from Agricultural Microbiology study program, Department of Agricultural Microbiology, Faculty of Agriculture. The basic principles of biodegradation and bioremediation of pollutants or xenobiotic compounds are discussed in this course, along with the biodegradation and bioremediation processes, such as chemical structure, biodegradation pathways and kinetics, heavy metal transformation, biodegradation and bioremediation of halogenated compounds, and phytoremediation. The role of microorganisms in biodegradation and bioremediation processes also discussed in this course.
Semester(s) in which the module is taught	Fourth/Sixth Semester
Person responsible for the module	Ir. Ngadiman, M.Si., Ph.D.
Language	Bahasa Indonesia/Indonesian Language
Relation to curriculum	*Elective Course*
Teaching methods	Lecture are conducted in the class with 30-40 students. In every meeting, there will be delivered interactive lecture and discussion. In some topics there will be quizzes, individual and/or group assignment. Details: 1. Lectures 2. Assignment (Individual and Group) 3. Discussion 4. Midterm 5. Final Exam
Workload (incl. contact hours, self-study hours)	- Lectures = 2 SKS x 50 minutes x 16 meetings = 1.600 minutes = 26,67 hours = 26,67 hours/30hours = 0,89 ECTS - Assignment = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS - Self Study = 2 SKS x 60 minutes x 16 meetings = 1.920 minutes = 32 hours = 32 hours/30hours = 1,07 ECTS Total Workload = 3,03 ECTS
Credit points	*2/0 Credit Points*
Required and recommended prerequisites for joining the module	*None*

Module objectives/intended learning outcomes	*Program Learning Outcomes (PLO):* *PLO1: Able to explain theoretical concepts regarding plant production technology by giving attention to economic and social-humanitarian aspects to achieve quality, sustainable and profitable agriculture.* *PLO2: Able to explain theoretical concepts of biology microorganism and develop microbial-based technology to increase plant production and environmental services.* *PLO3: Able to identify, design, implement, and solve problems that arise in the implementation of agricultural businesses.* *Course Learning Outcomes (CLO):* *CLO1: Students can explain the biodegradation and bioremediation principles, chemical structure, degradation of pollutant compounds, and biodegradation kinetics.* *CLO2: Students can explain the biodegradation and bioremediation processes of halogenated compounds, heavy metals, and phytoremediation.* *CLO3: Students can explain about ex situ and in situ bioremediation technology and capable to implement regulations on laboratory waste treatment.*
Content	1. *Introduction of Biodegradation and Bioremediation (1 meeting)* 2. *Xenobiotic Compounds and Microbes Involved in Degradation Process (1 meeting)* 3. *The Principles of Biodegradation (1 meeting)* 4. *Chemical Structure and Biodegradation (1 meeting)* 5. *Pollutant Compounds Degradation Pathways and Biodegradation Kinetic (1 meeting)* 6. *Catabolic Genes in Bacterial Systems (1 meeting)* 7. *Biodegradation and Bioremediation of Halogenated Compounds (1 meeting)* 8. *Heavy Metal Transformation and Bioremediation (1 meeting)* 9. *Phytoremediation (1 meeting)* 10. *Overview of Bioremediation Technology (1 meeting)* 11. *Bioremediation Technology (2 meetings)* 12. *Group Presentation (1 meeting)* 13. *Materials Review (1 meeting)*
Examination forms	*High Order Thinking Skills Examination*
Study and examination requirements	*To be able to take the final exams, the minimum of student attendance is 70% out of effective meetings. From 14 meetings, students must take a minimum of 10 meetings to take the exam.*
Reading list	*Main References:* 1. *Ansari, A. A., S. S. Gill, R. Gill, G. R. Lanza, and L. Newman. 2015. Phytoremediation. Springer, New York.* 2. *Chamy, R., F. Rosenkranz, and L. Soler. 2015. Biodegradation and Bioremediation of Polluted Systems. InTech, Croatia.* 3. *Das, S and H. R. Dash. 2021. Microbial Biodegradation and Bioremediation: Techniques and Case Studies for Environmental Pollution 2nd Edition. Elsevier Science, United States of America.* 4. *Shiomi, N. 2018. Advances in Bioremediation and Phytoremediation. InTech, Croatia.*