

## 1. Module XXVI: Impact and Application I B (Environment)

### 1.1. Module Objectives

On completion of this module, the students will:

- Describe and define character of bacteria, fungi, protozoa, algae and viruses are and describe roles they play in the environments
- Students will know several methods that are used to identify and enumerate microorganisms in natural environments and also how specific microbial activities in the environment can be measured.
- Students will know the strategic approach to use microorganisms as the basic tools of environmental technology.

### 1.2. Module Data

Person in charge	Dr. Sri Harjati Suhardi
Credits	9
Course	BM 4202-Aquatic Microbial Ecology BM4108-Bioremediation BM3003- Current Topics on Microbiology
Course Examination	Written Test

#### 1.2.1. Sub-module I: Aquatic Microbial Ecology

Lecturer	Dr. Gede Suantika
Semester	8
Type of submodule / course	Elective Course
Credits	2
Workload	2 hours lectures, 2 hours structured activities, 2 hours individual study, 16 weeks per semester, and total 96 hours a semester
Workload Detail	textbook reading assignment, group discussion, presentation, paper review, Field work
Classification within the curriculum:	<del>General Studies / Compulsory Course</del> / Elective Course
Type of assessment/examination	Written Test : Midterm exam, Final exam, Assignments Presentation
Language	Bahasa Indonesia
Course Target / Outcome	Knowledge Students will be able to : <ul style="list-style-type: none"><li>- Definethe general aspects and key concept of microbial aquatic ecology</li></ul>

	<p>Scientific</p> <p>Students will be able to:</p> <ul style="list-style-type: none"> <li>- Define and discover the Interaction among aquatic microorganisms</li> <li>- Define and discover the Interaction between aquatic microorganisms and plant</li> <li>- Define and discover the Interaction between aquatic microorganisms and animal</li> <li>- Define The influence of abiotic factor to aquatic microorganisms</li> <li>- Define and describe role of aquatic microorganisms in biogeochemical cycle</li> <li>- Define and describe microorganisms ecology in environmental management</li> </ul>
Teaching methods	Interactive Lecture
Contents (SAP)	
	1 Introduction: Background of aquatic microbial ecology
	2 Interaction among aquatic microb
	3
	4 Interaction between aquatic microorganisms and plant
	5
	6 Interaction between aquatic microorganisms and animal
	7
	8 Mid-Term Test
	9 Abiotic factor impact in life of aquatic microorganisms
	10 Aquatic microorganisms natural habitat
	11 Roles of aquatic microorganisms in carbon cycle
	12 Roles of aquatic microorganisms in nitrogen, sulphur, phosphorus, iron, and other element
	13
	14 Microbial ecology in environment process
	15 Topic Presentation
	16 Final Test
Literature / Sources	<ul style="list-style-type: none"> <li>• Sigeo, D.C. 2004. Freshwater Microbiology. John Wiley and Sons. Ltd.</li> <li>• Atlas, R.M &amp; R. Bartha, 1993, Microbial Ecology, The Benjamin/Cummings Publishing Company, INC, San Juan</li> <li>• Madigan, M.T.; J.M. Martinko 2006, Brock Biology of Microorganisms, Prentice Hall International, Inc. New Jersey</li> </ul>

### 1.2.2. Sub-module II: Bioremediation

Lecturer	Dr. Sri Harjati Suhardi
Semester	7
Type of submodule / course	Elective
Credits	2
Workload	2 hours lectures, 2 hours structured activities, 2 hours individual study, 16 weeks per semester, and total 96 hours a semester
Workload Detail	textbook reading assignment, group discussion, presentation, paper review
Classification within the curriculum:	<del>General Studies / Compulsory Course</del> / Elective Course
Type of assessment/examination	Written Test : Midterm exam, Final exam, Quizess, Assignments Presentation
Language	Bahasa Indonesia
Course Target / Outcome	<p>Knowledge Students will be able to :</p> <ul style="list-style-type: none"> <li>- Define and describe the concept and application of bioremeduatiion</li> </ul> <p>Scientific Students will be able to:</p> <ul style="list-style-type: none"> <li>- Assescontaminants susceptible to bioremediation and mechanisms of contaminant biodegradatiion by microbial cells</li> <li>- Define and list environmental factor that affect bioremediation process</li> <li>- Design and demonstrate the bioremediation work design</li> <li>- Demonstrate the application of bioremediation in order to treat environmental problems</li> <li>- Demostrate the strength and weakness various type of bioremediation technology</li> <li>- Interpret the national environmental law and regulation in bioremediation</li> </ul> <p>Skills Students will be able to write and present the scitific article about bioremediation</p>
Teaching methods	Interactive Lecture
Contents (SAP)	
	1 Understanding of remediation and bioremediation
	2 Fate of pollutant in the environment
	3 Role of microbial in bioremediation process of organic and inorganic
	4 Treatability study I

5	Tratibility study II
6	Field Characterisation
7	Bioremediation technique
8	Mid-Term Test
9	Solid-phase bioremediation
10	Liquid-phase bioremediation
11	Slurry-phase bioremediation
12	Monitoring
13	Regulation in bioremediation
14	Safety in bioremediation
15	Topic presentation
16	Final Test
Literature / Sources	<ul style="list-style-type: none"> <li>- Sheehan, D. 1997. Bioremediation Protocols. Humana Press. Totowa. New Jersey.</li> <li>- Eweis, J.B., Ergas, S.J., Chang, D.P.Y. and Schroeder, E.D. (1998) "Bioremediation Principles", McGraw-Hill.</li> <li>- Cookson JR, J.T (1995)"Bioremediation Engineering", McGraw-Hill, Inc</li> <li>- Committee on In Situ Bioremediation, Water Science and Technology Board, Commission on Engineering and Technical Systems, and National Research Council (1993) "In Situ Bioremediation" National Academy Press, Washington, USA.</li> <li>- International Journals of: Applied and Environmental Microbiology, Environmental Science and Technology, Bioresource Technology, Environment International, Marine &amp; Pollution Bulletin, Marine Environmental Research, International Biodeterioration &amp; Biodegradation</li> </ul>

### 1.2.3. Sub-module III: Kapita Selektta of Applied microbiology

Lecturer	
Semester	6/7
Type of submodule / course	Compulsory
Credits	2
Workload	2 hours lectures, 2 hours structured activities, 2 hours individual study, 16 weeks per semester, and total 96 hours a semester
Workload Detail	textbook reading assignment, group discussion, presentation, paper review

Classification within the curriculum:	<del>General Studies</del> / Compulsory Course/ <del>Elective Course</del>
Type of assessment/examination	Written Test : Midterm exam, Final exam, Quizess, Assignments Presentation
Language	Indonesia
Course Target / Outcome	Knowledge Students will be able to : - Define and describe commercial value of microorganism in its application in small industry (entrepreneurship) and bigger industry
Teaching methods	Interactive Lecture
Contents (SAP)	
	1 History of microbial industry development
	2 Scope of microbial industry
	3 Microorganism agent in microbial industry
	4 Source substrat in microbial industry
	5 Fermentation
	6 Downstream processing in microbial industry
	7 Mid-term Test
	8 Biomass product
	9 Metabolic product
	10 Microorganisms in mining industry
	11 Microorgansms in waste treatment
	12
	13
	14
	15
	16 Final Test
Literature / Sources	<ul style="list-style-type: none"> <li>- Malik, V. S., P. Sridhar, M. C. Sharma &amp; H. Polasa, 1992, Industrial Biotechnology, Oxford &amp; IBH Publishing Co. PVT. LTD. New Delhi</li> <li>- Crueger, W &amp; A. Crueger, 1990, Biotechnology A textbook of Industrial Microbiology, Sinauer Association, Inc. Sunderland, MA</li> <li>- Waites, M.J., Morgan N.L., Rockey, J.S. dan Higton, G. 2001. Industrial Microbiology: An Introduction. Blackwell Science</li> <li>- Pointing, S. P. &amp; K. D. Hyde, 2001, Bio-exploitation of filamentous fungi, Fungal Divesity Press, Hongkong.</li> <li>- Smith, J. E., 1996, Biotechnology, Cambridge University Press, Melbourne</li> <li>- Kavanagh, K., 2005, Fungi: Biology and Applications</li> </ul>

	- Arora, D.K., 2003, Handbook of Fungal Biotechnology, 2nd Edition, Revised and Expanded (Mycology, 20)
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