Module XXVI: Microbial System IIB

1.1. Module Objectives

On completion of this module, the students will:

Students will be able to define the life cycle, role and growth of fungi and its apllication for daily activities

- Understand the basis for bacteria classification and the role of bacteria in life and the environment
- Competence to classify types of bacteria and describe their roles in various fields of application.
- Understand algae as a pro/eukaryotic organism with its characteristic, classify algae, and also understand the vegetative and generative structures of algae as well as various characteristics of algae
- Understand the reproductive system, habitat, distribution; algae interaction with the environment
- Understand the role of algae as an indicator of ecosystem quality, applications in industry, as a biological and microcosmic model.
- Distinguish between the different types of plant-microorganisms interactions
- Explain the physiological and cellular/molecullar processes underlying the best characterized plant-microorganisms interactions
- Demonstrate an understanding of the principal factors underlying plant-microorganisms interactions and the importance of plant-microorganisms symbiotic relationships in the life of plants
- Demonstrate an understanding of the principles of plant pathogenesis and its defense response mechanism leading to plant survival
- draw connections between the biology of plant-microorganisms relationships and the impacts of these relationships on plant and human society
- Understand the structure, function, and role of bacteriophages in the environment
- Possess a basic competence about bacteriophages that can increase knowledge about viruses and to develop virus-based biocontrol agents in their final project
- Understand the management and manipulation of microorganisms (control of nutrition, water quality and diseases in aquaculture production).

1.2. Module Data

Person in charge	Prof. Dr. I Nyoman P Aryantha
Credits	14
Course	BM 3106 Mycology
	BM 3108 Bacteriology
	BM 3109 Phycology
	BM 3111 Microorganisms-plant interaction
	BM 3207 Microbiomic
	BM 3208 Bacteriophage
	BM 4109 Aquaculture Microbiology
Modules Examination	Written Test

1.2.1. Sub-module I: Mycology

Lecturer	Prof. Dr. I Nyoman P Aryantha
Semester	6
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	Paper reading assignment, group discussion, presentation, paper review, small exhibition
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	Students will be able to define the life cycle, role and growth of fungi and its apllication for daily activities
Teaching methods	Interactive Teaching
Contents (SAP)	
1	Introduction of mycology
2	Class of fungi
3	Character and role of Zygomycota as class of fungi
4	Character and role of Basidiomycota as class of fungi
5	Character and role of Deuteromycota as class of fungi
6	Difference between fresh and preserve fungi specimen
7	Mid-Term Test
8	the growth and cultivation of fungi
9	type of reproduction part of fungi (Spore) and its related aspect
10	the interaction between fungi and animal
11	the interaction between fungi and plant
12	the mutuallistic symbiosis between fungi and plant
13	type of secondary metabolites of fungi
14	study review: persentation
15	
16	Final Test
Literature / Sources	1. Landecker, E.M. 1996. Fundamental of Fungi. Prentice Hall Inc., New Jersey 2. Wicklow, D.T. and B.E.Soderstrom. 1997. The Mycota. Springer Verlag, New York.

	3. Pointing, S.P. & K. D. Hyde, 2001, Bio-exploitation of filamentous fungi, Fungal Divesity Press, Hongkong 4. Kendrick, B., 1985, The Fifth Kingdom, Mycologue Publication, Waterloo
Other specialties	

1.2.2. Sub-module II: Bacteriology

Lecturer	Prof. Dr. Pingkan Aditiawati; Dr. Magdalena L. Situmorang
Semester	6
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	Paper reading assignment, group discussion, presentation, paper review, small exhibition
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	A. Conceptual Knowledge and Competence: - Understand the basis for bacteria classification and the role of bacteria in life and the environment - Competence to classify types of bacteria and describe their roles in various fields of application. B. Scientific Skill: - Scientific thinking in understanding bacteriology data in quantitative and qualitative C. Social Skills: Able to work in teams and communicate well in groups.
Teaching methods	Interactive Teaching
Contents (SAP)	
1	Bacterial cell composition, structures, and function
2	Baterial Growth
3	Bacteria cell differentiation
4	Metabolism energy in different type of bacteria
5	Carbon metabolism pathway in different type of bacteria
6	Cell communication in bacteria cell
7	Mid-Term Test

8	Gene regulation in bacteria
9	Bacteriophage
10	Bacteria systematic
11	
12	The role of bacteria in environment
13	The role of bacteria in industry
14	The role of bacteria in medical
15	
16	Final Test
Literature / Sources	1. Singleton, P. 2004. Bacteria in Biology, Biotechnology and Medicine. John Wiley & Sons, Ltd. 2. Madigan, M. T., J. M. Martinko & J. Parker, 2006. Brock Biology of Microorganisms, 11th ed. Pearson Prentice Hall International, Inc., New Jersey 3. Sokatch, J. R. dan L. N. Ornston, 1986. The Bacteria, a treatise on structure and function, Akademic Press, Inc. 4. 4. Goodfellow, M. dan A. G. O'Donnell, 1993, Handbook of New Bacterial Systematics, Academic Press, Inc.
Other specialties	

1.2.3. Sub-module III: Phycology

Lecturer	Dr. Magdalena L. Situmorang
Semester	6
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	Paper reading assignment, group discussion, presentation, paper review, small exhibition
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	Conceptual Knowledge and Competence: - Understand algae as a pro/eukaryotic organism with its characteristic, classify algae, and also understand the vegetative and generative structures of algae as well as various characteristics of algae - Understand the reproductive system, habitat, distribution; algae interaction with the environment

	- Understand the role of algae as an indicator of ecosystem quality, applications in industry, as a biological and microcosmic model.
Teaching methods	Interactive Teaching
Contents (SAP)	
1	Introduction
2	
3	
4	Generatif and vegetative structure of Alga
5	
6	
7	Reproduction system of Alga
8	Mid-Term Test
9	
10	
11	
12	Ecology of alga
13	
14	Role of alga in human life and environment
15	
16	Final Test
Literature / Sources	• Barsanti, L and Gualtieri, P. 2005. Algae: Anatomy, Biochemistry, and Biotechnology. CRC • Brock, T. D., Madigan, M. T., Martinko, J. M., Parker, J. 1997. Biology of Microoraganisms. Prentice Hall International Inc. New Jersey. • Prud'homme van Reine, W.F. & Trono Jr, G.C. (eds). 2002. Plant Resources of South-East Asia. no 15 (1). Cryptogams ; Algae. Prosea Foundation, Bogor, Indonesia • Hubert, L.E. 1984. Algae as Ecological Indicators. Academic Press. Inc. London.
Other specialties	

i. Sub-module IV: Microorganisms-plant interaction

Lecturer	Dr. Rizkita Rachmi Esyanti
Semester	5
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	Paper reading assignment, group discussion, presentation, paper review, small exhibition
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	A. Conceptual Knowledge and Competence: - Distinguish between the different types of plant-microorganisms interactions - Explain the physiological and cellular/molecullar processes underlying the best characterized plant-microorganisms interactions - Demonstrate an understanding of the principal factors underlying plant-microorganisms interactions and the importance of plant-microorganisms symbiotic relationships in the life of plants - Demonstrate an understanding of the principles of plant pathogenesis and its defense response mechanism leading to plant survival - draw connections between the biology of plant-microorganisms relationships and the impacts of these relationships on plant and human society - B. Scientific Skills: - Analyze and predict objectively the results of various case studies in plant microorganisms interaction
Teaching methods	Interactive Teaching
Contents (SAP)	
1	Microbial interaction: type and general mechanism
2	Interaction between microorganisms and plant
3	Requirement and mechanism in microorganism-plant interaction
4	Mycorrhiza: interaction and mechanism
5	

6	rhizobium-plant interaction and its benefits
7	Mid-Term Test
8	Plant infection by enzyme
9	Plant infection by toxin
10	Plant disease
11	Genetic defense in plant
12	Passive and active defense mechanism
13	Nature-based commercial development of palnt-microorganisms interaction
14	Biotechnology commercial aplication of palnt-microorganisms interaction
15	
16	Final Test
Literature / Sources	Arora NK. 2014. Plant Microorganismss Symbiosis: Applied Facets, Springer Agrios, G.N. 2005. Plant Pathology, 5th Ed., Academic Press, San Diego Sharma AK & AVarma (ed), 2017. Modern Tools to Understand Microorganismss, Springer
Other specialties	

ii. Sub-module V: Bacteriophage

Lecturer	Dr. Eng. Kamarisima
Semester	6
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	Paper reading assignment, group discussion, presentation, paper review,
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	A. Conceptual Knowledge and Competence - Understand the structure, function, and role of bacteriophages in the environment - Possess a basic competence about bacteriophages that can increase knowledge about viruses and to develop virus-based biocontrol agents in their final project B. Scientific Skills: - Analyze the potential applications of bacteriophages in everyday life for the environment, industry, and health

Teaching methods	Interactive Teaching
Contents (SAP)	
1	Introduction of bacteriophage
2	Bacteriophage structure and function
3	Bacteriophage classification and identification
4	Bacteriophage classification and identification
5	Life cycle of bacteriophage
6	Ecology of bacteriophage
7	Phage infection
8	Mid-term test
9	Bacteriophage cultivation technique and growth analysis
10	The role of bacteriophage in aquatic environment
11	The role of bacteriophage in food industry
12	The role of bacteriophage in agriculture industry
13	The role of bacteria in medical industry
14	The role of bacteriophage in general environment
15	Phage theraphy and control agent
16	Final Test
Literature / Sources	Kurtboke, Ipek. 2012. Bacteriophage. Croatia: InTech Abedon, Stephen T. 2008. Bacteriophage Ecology. New York: Cambridge University Press 5. Birge, Edward. 2006. Bacterial and Bacteriophage Genetic. USA: Springer
Other specialties	

1.2.4. Sub-module V: Aquaculture Microbiology

Lecturer	Prof. Dr. Gede Suantika, Dr. Magdalena L. Situmorang
Semester	6
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	Paper reading assignment, group discussion, presentation, paper review
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Type of examination	Written test
Language	Bahasa Indonesia
Course Target / Outcome	- Understand the microbiological aspects in aquaculture production

	- Understand the interaction of microorganisms and their role in aquaculture production - Understand the management and manipulation of microorganisms (control of nutrition, water quality and diseases in aquaculture production).
Teaching methods	Interactive Teaching
Contents (SAP)	
1	General aspects and problems in aquaculture production related to microbes
2	Basics of aquatic systems
3	Types of aquatic systems for aquaculture production
4	Microbial interactions
5	Microbial interactions
6	
7	Microbial-animal interactions
8	Mid-Term Test
9	examples of microbial interactions with aquaculture animals
10	Microbial management and manipulation for water quality control
11	
12	
13	
14	Microbial management and manipulation for disease control
15	
16	Final Test
Literature / Sources	- Didier Montet and Ramesh C. Ray. 2017. Aquaculture Microbiology and Biotechnology, Vol. 1. CRC Press, Taylor & Francis Group, USA. - Gede Suantika, Magdalena Lenny Situmorang, Pingkan Aditiawati, Dea Indriani Astuti, Fahma Fiqhiyyah Nur Azizah, and Harish Muhammad. 2018. Closed Aquaculture System: Zero Water Discharge for Shrimp and Prawn Farming in Indonesia. In: Biological Resources of Water. InTechOpen. - Mikkel Bentzon-Tilia,* Eva C. Sonnenschein and Lone Gram. 2016. Monitoring and managing microorganismss in aquaculture – Towards a sustainable industry. Microbial Biotechnology 9(5): 576–584.
Other specialties	