

## Module XII: Structure and Functional Microbiology

### 1.1. Module Objectives

On completion of this module, the students will able to:

- implement microbial techniques to study cellular functions of microorganisms
- implement molecular techniques to study structural functions of microorganisms
- analyze and interpret physiological processes within cells
- breakdown problems within the field of microbial physiology by using a mathematical approach
- communicate the basic concept and utilize literature to interpret and evaluate d
- identify the structure and function of cells from a cellular level to a molecular level
- work and communicate in a team
- describe metabolism and factors affecting it

### 1.2. Module Data

Person in charge	Dr. Dea Indriani Astuti
Total Credits	9
Course	BM2201 Cell and Molecular Biology
	BM2202 Microbial Physiology
	BM2203 Projects of Microbial Physiology
	KI-3061 Biochemistry
Module Examination	Written test

#### ▪ Sub-module I: Cell and Molecular Biology

Course Name:	Cell and Molecular Biology
Course Level:	Undergraduate
Abbreviation, if applicable:	BM2201
Sub-heading, if applicable:	
Course included in the module, if applicable:	
Semester/term:	4
Course coordinator(s):	Ernawati A.Giri-Rachman, PhD
Lecturer(s):	to be determined in each semester
Language:	Bahasa Indonesia
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Teaching format / class hours per week during the semester:	3 hours lectures and 3 hours laboratory
Workload:	3 hours lectures, 3 hours laboratory, 3 hours structured activities, 3 hours individual study, 16 weeks per semester, and total 192 hours a semester
Credits points	4 (1)
Learning goals/competencies:	After completion of this course students are expected to be able to:  <div style="background-color: black; color: white; padding: 2px;">Conceptual Knowledge and Competence:</div>

	<ul style="list-style-type: none"> <li>- Describe the difference between eukaryote and prokaryote, it's stucture and functions</li> <li>- Explain the transport system in microorganism cells</li> <li>- Explain the cell cycle and tissue formation in eukaryotic organisms</li> <li>- Distinguish and compare chromosome structure in prokaryotic and eukaryotic cells</li> <li>- Distinguish the process and control of replication in eukaryotic and prokaryotic cells</li> <li>- Differentiate gene expression (processes and control systems) between eukaryotic and prokaryotic cells</li> <li>- Explain the interaction between microorganisms and it's environment</li> <li>■ <u>Laboratory Skills :</u></li> <li>- Apply microbiological laboratory methodologies and the use of appropriate equipment</li> <li>- Apply methods based on molecular biology's concept</li> <li>- Operate standard molecular biology equipment</li> <li>- Apply the principle of work safety by using protective equipment and implementing appropriate emergency procedures</li> <li>■ <u>Scientific Skills:</u></li> <li>- Think scientifically related to cell and molecular biology</li> <li>- Associate the basic concepts of cell biology and molecular with data interpretation to build a conclusion</li> <li>- Prepare scientific reports</li> <li>■ <u>Social Skills:</u></li> <li>- Identify the relationship between science and society</li> <li>- Implement work attitudes and communication effectively in teams both verbal and non-verbal</li> </ul>
Contents (SAP)	<ul style="list-style-type: none"> <li>- Introduction; Structure and Dynamics of Cells</li> <li>- Structure and Function of Eukaryotic Cell Membrane</li> <li>- Endomembrane and Membrane Trafficking</li> <li>- Cytoskeleton</li> <li>- Eukaryotic Cell Cycle and Tissue Formation</li> <li>- Energy</li> <li>- Mid-Term Test</li> <li>- Interaction among The cell</li> <li>- Interaction between Eukaryotic Cell and the Environment</li> </ul>

	<ul style="list-style-type: none"> <li>- Gene and Genome</li> <li>- Replication dan DNA Repair</li> <li>- Gene Expression</li> <li>- Control of Gene Expression</li> <li>- Post-transcription of Gene</li> <li>- Gene translation and post-translation</li> </ul>
Forms of Media:	Slides and LCD projectors, blackboards, lab.
Literature / Sources	<ol style="list-style-type: none"> <li>1. Karp, G. <i>Cell and Molecular Biology: Concepts and Experiments</i>. 7<sup>th</sup> Ed. John Wiley and Sons, Inc. 2013.</li> <li>2. Alberts, B., Bray, D., Hopkin, K., Johnson, A., Lewis, J., Raff, M., Roberts, K. and Walter, P. <i>Essential Cell Biology</i>, 3<sup>rd</sup> ed. Garland Science, 2009.</li> <li>3. Scientific journal and Article Review</li> </ol>
Notes	

▪ **Sub-module II: Microbial Physiology**

Lecturer	Prof. Dr. Pingkan Aditiawati Dr. Intan Taufik
Course Name:	Microbial Physiology
Course Level:	Undergraduate
Abbreviation, if applicable:	BM2202
Sub-heading, if applicable:	
Course included in the module, if applicable:	
Semester/term:	4
Course coordinator(s):	Prof. Dr. Pingkan Aditiawati Dr. Intan Taufik
Lecturer(s):	to be determined in each semester
Language:	Bahasa Indonesia
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Teaching format / class hours per week during the semester:	3 hours lectures
Workload:	3 hours lectures, 3 hours structured activities, 3 hours individual study, 16 weeks per semester, and total 144 hours a semester
Credits	3
Learning goals/competencies:	<p>A. <u>Conceptual Knowledge and Competence:</u></p> <ul style="list-style-type: none"> <li>- Distinguish cell structure and function in microorganism</li> </ul>

	<ul style="list-style-type: none"> <li>- Define microbial regulation and metabolic pathway (such as: central, peripheral, and co-metabolic pathway)</li> <li>- Define the environmental stress response of microorganism</li> <li>- Define and describe cell differentiation mechanism and regulation of cell of microorganism</li> <li>- Define function of bacterial cell unique structure as antibiotics, immunity, and bacteriophage infections targets</li> <li>- Define microorganisms metabolism interaction in the environment</li> <li>- Define the relationship of microorganisms growth ability in certain environments</li> </ul> <p>B. <u>Scientific skills:</u></p> <ul style="list-style-type: none"> <li>- Analyse the problems related to microbial physiology by applying basic the concept of microbial physiology to solved problems from recent scientific article</li> </ul> <p>C. <u>Social Skills:</u></p> <ul style="list-style-type: none"> <li>- Demonstrate working and communication attitude effectively in team to solve problems related on microbial physiology</li> </ul>
Contents (SAP)	<ul style="list-style-type: none"> <li>- Composition and organization of cell structure and function</li> <li>- Structure and function of cellular parts</li> <li>- Central metabolic pathway of carbohydrate I</li> <li>- Central metabolic pathway of carbohydrate II</li> <li>- Energy production and metabolic transport I</li> <li>- Energy production and metabolic transport II</li> <li>- Metabolism of substrate other than glucose</li> <li>- Mid-Term Test</li> <li>- Fermentation pathways</li> <li>- Photosynthesis and inorganic metabolism</li> <li>- Lipid and sterol</li> <li>- Nitrogen metabolism</li> <li>- Biosynthesis amino acid metabolism</li> <li>- The effect of stress respond</li> <li>- Cellular Differentiation</li> </ul>
Literature / Sources	<ol style="list-style-type: none"> <li>1. Moat. A.G. dan J.W. Foster. 2006. Microbial Physiology 4th ed. John Wiley and Sons, NY</li> </ol>

	2. White, David. 2011. The Physiology and Biochemistry of Prokaryotes, 4 <sup>th</sup> ed. Oxford University press, NY
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▪ **Sub-module III: Projects of Microbial Physiology**

Lecturer	Dr. Isty A. Purwasena Dr. Intan Taufik
Course Name:	Projects of Microbial Physiology
Course Level:	Undergraduate
Abbreviation, if applicable:	BM2203
Sub-heading, if applicable:	
Course included in the module, if applicable:	
Semester/term:	4
Course coordinator(s):	Dr. Isty A. Purwasena Dr. Intan Taufik
Lecturer(s):	to be determined in each semester
Language:	Bahasa Indonesia
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Teaching format / class hours per week during the semester:	6 hours of laboratory work
Workload:	6 hours laboratory, 2 hours structured activities, 2 hours individual study, 16 weeks per semester, and total 160 hours a semester
Credits Points	2
Requirements:	-
Learning goals/competencies:	<p><b>Conceptual Knowledge and Competence:</b></p> <ul style="list-style-type: none"> <li>- Understand the response of microorganisms to the substrate and antagonistic composition to growth</li> <li>- Understand the nature of microorganism's resistance to antimicrobial compounds and their response to environmental stress</li> <li>- Understand the chemical and physical factors that influence the formation of biofilms</li> </ul> <p><b>Laboratory skills:</b></p> <ul style="list-style-type: none"> <li>- Understand the methods for isolating protoplast and spheroplast from microorganism cells</li> <li>- Understand the method of screening and isolation of microorganisms using specific compounds that affect its physiology</li> </ul>

	<ul style="list-style-type: none"> <li>- Understand various methods of observing the physiology of microorganisms to clarify their role in life</li> </ul> <p>■ <b>Scientific Skills:</b></p> <ul style="list-style-type: none"> <li>- Apply the methods to understand the physiology of microorganisms associated with their role in life</li> <li>- Understand and think scientifically in quantitative and qualitative data regarding the physiological activities of microorganisms</li> </ul> <p>■ <b>Social Skills:</b></p> <ul style="list-style-type: none"> <li>- Demonstrate working and communication attitude effectively in team.</li> </ul>
Contents (SAP)	<ul style="list-style-type: none"> <li>- Microbial cell structure (protoplast and spheroplast isolation)</li> <li>- Microbial isolation using specific media</li> <li>- Interaction of microbial cell with its environment</li> <li>- (isolation and screening of microorganisms with specific metabolite production ability)</li> <li>- Interaction of microbial cell with its environment</li> <li>- (microbial growth response to specific compounds, effect of antagonist to microbial growth, effect of nutrient deficiency to microbial growth)</li> <li>- Relation of cellular growth with biomolecules production</li> <li>- Extrachromosomal DNA and its effect to microbial survivability</li> <li>- Biofilm formation</li> <li>- Mid-Term Test</li> <li>- Mini project</li>   <li>- Microbial isolation using specific media</li> <li>- Interaction of microbial cell with its environment</li> <li>- (isolation and screening of microorganisms with specific metabolite production ability)</li> <li>- Interaction of microbial cell with its environment</li> <li>- (microbial growth response to specific compounds, effect of antagonist to microbial</li> </ul>

	<p>growth, effect of nutrient deficiency to microbial growth)</p> <p>– Relation of cellular growth with biomolecules production</p>
Literature / Sources	<ol style="list-style-type: none"> <li>1. Griffin, D. H. 1994. Fungal Physiology. 2<sup>nd</sup> ed. Wiley Liss Inc, NY.</li> <li>2. Moat. A.G. dan J.W. Foster 2006. Microbial Physiology 4<sup>th</sup> ed. John Wiley and Sons, NY.</li> <li>3. Neidhardt, FC, J. L. Ingraham, M. S. Schalchter. 1990 Physiology of the bacterial cell. Sinauer. Associates, Inc. USA</li> </ol>

### 1.2.1. Sub-module IV: Biochemistry

Course Name:	Biochemistry
Course Level:	Undergraduate
Abbreviation, if applicable:	KI3061
Sub-heading, if applicable:	
Courses included in the module, if applicable:	
Semester/term:	4
Module coordinator(s):	
Lecturer(s):	Dr. Made Puspasari Widhiastuty
Language:	Bahasa Indonesia
Classification within the curriculum:	General Studies / Compulsory Course/ Elective Course
Teaching format / class hours per week during the semester:	2 hours lectures, 1 hours tutorial
Workload:	2 hours lectures, 1 hours tutorial and structured activities, 2 hours individual study, 2 hours laboratory work per week, 16 weeks per semester, and total 144 hours a semester
Credit Points:	3(1)
Requirements:	-
Learning goals/competencies:	Students will be able to define and describe basic principles about biomolecular structure and define basic chemical reaction in living cell
Content:	This course activities consist of lectures and practice with scope: the structure of biomacromolecules and their monomers. Chemical properties of biomacromolecules, and their related functions, such as protein as an enzymes, kinetics of chemical reactions catalyzed by enzymes. Biomolecules transport processes inside the cell, as well as

	<p>bionergetics aspect. Overview of metabolism, the relationship between carbohydrates, lipids, proteins and nucleic acids metabolism, with focused on carbohydrate metabolism, including glycolysis, alcohol fermentation, lactic acid fermentation, carboxylic acid cycle, and oxidative phosphorylation/ electron transport. While for anabolism, will be discussed on the synthesis of carbohydrates, namely gluconeogenesis and also the photosynthetic reaction, and the regulation of carbohydrate catabolism and anabolism. Discussion of nucleic acid biomolecules function focused on the flow of genetic information.</p>
Study/exam achievements:	<p>Students are considered to be competent and pass if at least get 50% of maximum mark of the exams, homework, laboratory work, and research based learning.</p>
Forms of Media:	<p>Slides and LCD projectors, blackboards, lab.</p>
Literature:	<ol style="list-style-type: none"> <li>1. Berg, JM, Tymoczko, JL, Stryer, L, Biochemistry, 7th ed., WH Freeman and Co., New York, 2012.</li> <li>2. Nelson, DL, Cox, MM, Lehninger Principles of Biochemistry, 6th ed., WH Freeman and Co., New York, 2012.</li> <li>3. Devlin, TM, <i>Textbook of Biochemistry with clinical correlations</i>, 7th ed., Wiley &amp; Sons, New York, 2010</li> <li>4. Voet, DJ, Voet, JG, Pratt, CW, Principles of Biochemistry, John Wiley &amp; Sons, New York, 2013.</li> </ol>
Notes	<p>Difference syllabus between microbiology program and pharmacy program</p> <ol style="list-style-type: none"> <li>i. Microbiology need chemical fotosytnthesis</li> <li>ii. Microbiology no needs understanding about drug interaction with macromolecules</li> <li>iii. Microbiology need similar basic biochemical understanding, which are: structure and function of macromolecule (protein, nucleic acid, carbohidrat, and lipid), metabolism (catabolism and anabolism) and its control, along with genetic process flow of chemical process</li> </ol>