						Document Code
	Universitas Negeri Surabaya **Faculty of Mathematics and Natural Sciences** **Biology Undergraduate Study Program**					

SEMESTER LEARNING PLAN

Courses	CODE	Course Family		Credit Weight			SEMESTER	Compilation Date
Microbial Systematics*	4620102162	Study Program Elective Courses		T=2	P=0	ECTS=3.18	5	April 27, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	PLO-5	Able to communicate scientific ideas, both orally and in writing using appropriate communication media according to the target, as a means of lifelong learning for academic self-development.
	PLO-7	Able to work independently and collaboratively, as well as responsibly, in completing various tasks in class, in the laboratory and in the field.
	PLO-10	Able to design and conduct experiments in the field of biology, manage, analyze, interpret, document and store research data, to manage biological natural resources
	Program Objectives (PO)	
	PO - 1	Able to master basic concepts in classification, nomenclature and identification of microbes
	PO - 2	Able to demonstrate the basic principles of software applications and instruments for microbial classification and identification.
	PO - 3	Able to design and carry out simple research related to microbial classification and identification, managing, analyzing, interpreting, documenting and storing research data.
	PO - 4	Able to communicate scientific ideas, both orally and in writing using appropriate communication media according to the target, as a means of lifelong learning for academic self-development.
	PLO-PO Matrix	

P.O	PLO-5	PLO-7	PLO-10
PO-1			
PO-2			
PO-3			
PO-4			

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																

Short Course Description	This course discusses the basic principles and practices in microbial systematics which include identification, classification and nomenclature. This course also studies the methods used to identify microbes as well as the use of software and data bases for classification and identification. Lecture activities are carried out in a student-centered learning manner with discussions, presentations and assignments.

References	**Main :**

1. Holt, J.G., Krieg, N.R., Sneath, P.H.A., Staley, J.T., Williams, S.T. 2000. Bergey's Manual of Determinative Bacteriology. 9th ed. Philadelphia: Lippincott Williams and Wilkins.
2. Madigan, M.T., Martinko, J.M., Stahl, D.A. and Clark, D.P. 2012. Biology of Microorganism. Boston: Pearson.
3. Tortora, G.J., Funke, B.R. and Case, C.L. 2007. Microbiology An Introduction. San Fransisco: Addison Wesley Longman, Inc.
4. Willey, J., Sherwood L., & Woolverton CJ. 2017. Prescott's Microbiology. New York: McGraw-Hill Education.
5. Hillis, D.M., Moritz, C. & Mable, B.K. (Eds). 1996. Molecular Systematics Second Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA.
6. Parker, C.T., Tindall, B.J. & Garrity, G.M. (Eds). 2019. International Code of Nomenclature of Prokaryotes, Prokaryotic Code (2008 Revision). Int J Syst Evol Microbiol volume 69, issue 1A, pages S1–S111, DOI 10.1099/ijsem.0.000778.
7. Krieg, N.R., Staley, J.T., Brown, D.R., Hedlund, B.P., Paster, B.J., Ward, N.L., Ludwig, W. & Whitman, W.B. 2010. Bergey's Manual of Systematic Bacteriology Second Edition Volume Four. Springer New York Dordrecht Heidelberg London.

	Supporters:

1. Vandamme, P. Pot, B., Gillis, M., De Vos, P., Kersters, K. & Swings, J. 1996. Polyphasic Taxonomy, a Consensus Approach to Bacterial Systematics. Microbiological Reviews, Vol. 60, No. 2, June 1996, p. 407–438.
2. Vitorino, L.C. & Bessa, L.A. 2018. Microbial Diversity: The Gap between the Estimated and the Known. Diversity 2018, 10, 46; doi:10.3390/d10020046
3. Idramsa. 2013. Peran Sistematika Mikrobia Dalam Mengungkap Keanekaragaman Mikroorganisme. Jurnal Keluarga Sehat Sejahtera Vol. 11 (22) Des. 2013

Supporting lecturer	MUSLIMIN IBRAHIM Prof. Dr. Mahanani Tri Asri, M.Si. Guntur Trimulyono, S.Si., M.Sc. Lisa Lisdiana, S.Si., M.Si., Ph.D.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Mastering basic knowledge related to the history of the classification of living things, definitions and scope in studying microbial systematics	1. Explain the history of the classification of living things. 2. Explain the definition and scope of studying microbial systematics.	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment** : Participatory Activities	Lectures and discussions 2 X 50	Lectures and discussions 2 x 50	**Material:** Definition and scope of systematics **References:** *Tortora, GJ, Funke, BR and Case, CL 2007. Microbiology An Introduction. San Francisco: Addison Wesley Longman, Inc.* **Material:** History of the development of classification systems for living things. **References:** *Madigan, MT, Martinko, JM, Stahl, DA and Clark, DP 2012. Biology of Microorganisms. Boston: Pearson.* **Material:** Definition and scope of systematics **Library:** *Idramsa. 2013. The Role of Microbial Systematics in Revealing the Diversity of Microorganisms. Journal of Healthy and Prosperous Families Vol. 11 (22) Dec. 2013*	5%
2	Master basic knowledge related to systematics, taxonomy and classification	1. Explain the definitions of systematics, taxonomy and classification 2. Explain the classification system and the basis (approach) of the classification system 3. Explains classification and taxonomic hierarchy	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment** : Participatory Activities	Lectures and discussions 2 X 50	Lectures and discussions 2 x 50	**Material:** 1. Definition of systematics, taxonomy and classification, 2. Classification systems and the basis (approach) of classification systems, 3. Classification and taxonomic hierarchy. **References:** *Willey, J., Sherwood L., & Woolverton CJ. 2017. Prescott's Microbiology. New York: McGraw-Hill Education.*	5%
3	Mastering basic knowledge related to numerical-phenetic classification	1. Explains the definition of numerical-phenetic classification 2. Explain the principles in numerical taxonomy 3. Mastering how to determine the similarity index	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 x 50	**Material:** 1. Definition of numerical-phenetic classification, 2. Principles in numerical taxonomy **References:** *Vandamme, P. Pot, B., Gillis, M., De Vos, P., Kersters, K. & Swings, J. 1996 . Polyphasic Taxonomy, a Consensus Approach to Bacterial Systematics. Microbiological Reviews, Vol. 60, no. 2, June 1996, p. 407–438.* **Material:** 1. Definition of numerical-phenetic classification, 2. Principles in numerical taxonomy, 3. How to determine the similarity index **References:** *Vandamme, P. Pot, B., Gillis, M., De Vos, P., Kersters, K . & Swings, J. 1996. Polyphasic Taxonomy, a Consensus Approach to Bacterial Systematics. Microbiological Reviews, Vol. 60, no. 2, June 1996, p. 407–438.*	10%

No	Sub-CPMK (Ability expected)	Indicators	Criteria & Form of Assessment	Learning Method (Offline)	Learning Method (Online)	Material & References	Weight
4	Master basic knowledge related to molecular-phylogenetic classification	1. Explains the definition of molecular-phylogenetic classification 2. Explaining genomic characterization: nucleic acid analysis 3. Explaining phylogenetic marker molecules	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 x 50	**Material:** 1. Definition of molecular-phylogenetic classification, 2. Genomic characterization: nucleic acid analysis, 3. Phylogenetic marker molecules (Phylogenetic marker molecules) **References:** *Hillis, DM, Moritz, C. & Mable, BK (Eds). 1996. Molecular Systematics Second Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA.* **Material:** 1. Definition of molecular-phylogenetic classification, 2. Genomic characterization: nucleic acid analysis, 3. Phylogenetic marker molecules (Phylogenetic marker molecules) **References:** *Hillis, DM, Moritz, C. & Mable, BK (Eds). 1996. Molecular Systematics Second Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA.*	5%
5	Mastering basic knowledge related to chemical classification (Chemotaxonomy)	1. Explain the definition of chemical classification 2. Explain the chemical analysis of cell composition/components 3. Explain chemical characteristics	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 x 50	**Material:** 1. Definition of chemical classification, 2. Chemical analysis of cell composition/components, 3. Explaining chemical characters. **References:** *Holt, JG, Krieg, NR, Sneath, PHA, Staley, JT, Williams, ST 2000. Bergey's Manual of Determinative Bacteriology . 9th ed. Philadelphia: Lippincott Williams and Wilkins.*	5%
6	Mastering basic knowledge about nomenclature rules for microbes	1. Explain the function of scientific names 2. Explain the concept of species 3. Explain about giving scientific names	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric)	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 x 50	**Material:** Nomenclature (nomenclature) in microbes **References:** *Vandamme, P. Pot, B., Gillis, M., De Vos, P., Kersters, K. & Swings, J. 1996. Polyphasic Taxonomy, a Consensus Approach to Bacterial Systematics . Microbiological Reviews, Vol. 60, no. 2, June 1996, p. 407–438.* **Material:** Nomenclature (nomenclature) in microbes **References:** *Parker, CT, Tindall, BJ & Garrity, GM (Eds). 2019. International Code of Nomenclature of Prokaryotes, Prokaryotic Code (2008 Revision). Int J Syst Evol Microbiol volume 69, issue 1A, pages S1–S111, DOI 10.1099/ijsem.0.000778.*	5%
7	Master basic knowledge related to microbial identification	1. Explain the meaning and purpose of identification 2. Explain the identification system and identification strategy 3. Explain the characteristics of microbes 4. Explain methods of microbial identification	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Microbial identification **References:** *Vitorino, LC & Bessa, LA 2018. Microbial Diversity: The Gap between the Estimated and the Known. Diversity 2018, 10, 46; doi:10.3390/d10020046*	5%
8	UTS according to meeting material 1-7	Sub-CPMK 1 to 7	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Test	Mid-Semester Evaluation/Mid-Semester Examination (UTS) 2 X 50	Mid-Semester Evaluation/Mid-Semester Examination (UTS) 2 X 50		10%

9	Describing microbial diversity: Domain Bacteria	1.Explain the diversity of members of the Bacteria Domain 2.Explain the diversity of colonies, cell shape, and bacterial cell structure 3.Explain the bacterial classification system	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Diversity of members of the Bacteria Domain **References:** *Parker, CT, Tindall, BJ & Garrity, GM (Eds). 2019. International Code of Nomenclature of Prokaryotes, Prokaryotic Code (2008 Revision). Int J Syst Evol Microbiol volume 69, issue 1A, pages S1–S111, DOI 10.1099/ijsem.0.000778.* **Material:** Diversity of members of the Bacteria Domain **References:** *Holt, JG, Krieg, NR, Sneath, PHA, Staley, JT, Williams, ST 2000. Bergey's Manual of Determinative Bacteriology. 9th ed. Philadelphia: Lippincott Williams and Wilkins.*	5%
10	Describing microbial diversity: Domain Archaea	1.Explain the diversity of members of Domain Archaea 2.Explain the diversity of colonies, cell shapes, and cell structures of Archaea 3.Explain the classification system of Archaea	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Diversity of members of the Domain Archaea **Bibliography:** *Krieg, NR, Staley, JT, Brown, DR, Hedlund, BP, Paster, BJ, Ward, NL, Ludwig, W. & Whitman, WB 2010. Bergey's Manual of Systematic Bacteriology Second Edition Volume Four. Springer New York Dordrecht Heidelberg London.*	5%
11	Describing microbial diversity: Kingdom Protista	1.Explain the diversity of members of Kingdom Protista 2.Explain the Protista classification system	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Diversity of members of the Kingdom Protista **References:** *Tortora, GJ, Funke, BR and Case, CL 2007. Microbiology An Introduction. San Francisco: Addison Wesley Longman, Inc.*	5%
12	Describing microbial diversity: Kingdom Fungi	1.Explain the diversity of members of Kingdom Fungi 2.Explain the classification system of Fungi	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Diversity of members of Kingdom Fungi **Bibliography:** *Tortora, GJ, Funke, BR and Case, CL 2007. Microbiology An Introduction. San Francisco: Addison Wesley Longman, Inc.*	5%
13	Mastering basic knowledge related to the use of information technology in the classification and identification of microbes (use of international databases)	Explain the use of information technology in the classification and identification of microbes (use of international databases)	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Participatory Activities	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Use of information technology in the classification and identification of microbes (use of international databases) **References:** *Hillis, DM, Moritz, C. & Mable, BK (Eds). 1996. Molecular Systematics Second Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA.*	5%
14	Mastering basic knowledge related to the use of information technology in the classification and identification of microbes (BLAST, Clustal Omega, Genetyx, BioEdit, MEGA)	1.Skilled in using information technology for the process of identifying and classifying microbes 2.Mastering the use of information technology in the classification and identification of microbes (BLAST, Clustal Omega, Genetyx, BioEdit, MEGA)	**Criteria:** Accuracy and mastery according to assessment indicators (assessment rubric) **Form of Assessment :** Project Results Assessment / Product Assessment	Cased-based learning and peer-interaction 2 X 50	Cased-based learning and peer-interaction 2 X 50	**Material:** Utilization of information technology in the classification and identification of microbes **References:** *Hillis, DM, Moritz, C. & Mable, BK (Eds). 1996. Molecular Systematics Second Edition. Sinauer Associates, Inc. Publishers Sunderland, Massachusetts, USA.*	15%

| 15 | Mastering basic knowledge related to the role of Culture Collection (CC) in the study of microbial systematics | 1. Describe the role of Culture Collection (CC) in the study of microbial systematics
2. Explain the results of classification and identification of microbes resulting from analysis using software | **Criteria:**
Accuracy and mastery according to assessment indicators (assessment rubric) | Cased-based learning and peer-interaction
2 X 50 | Cased-based learning and peer-interaction
2 X 50 | **Material:** The role of Culture Collection (CC) in the study of microbial systematics.
References: *Parker, CT, Tindall, BJ & Garrity, GM (Eds). 2019. International Code of Nomenclature of Prokaryotes, Prokaryotic Code (2008 Revision). Int J Syst Evol Microbiol volume 69, issue 1A, pages S1–S111, DOI 10.1099/ijsem.0.000778.* | 5% |
| 16 | | Accuracy and mastery according to assessment indicators (assessment rubric) | **Criteria:**
Accuracy and mastery according to assessment indicators (assessment rubric)

Form of Assessment :
Test | Final Semester Evaluation/Final Semester Examination (UAS)
2 X 50 | Final Semester Evaluation/Final Semester Examination (UAS)
2 X 50 | | 15% |

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	55%
2.	Project Results Assessment / Product Assessment	20%
3.	Test	25%
		100%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.