



**Universitas Negeri Surabaya**  
**Faculty of Mathematics and Natural Sciences**  
**Chemistry Masters Study Program**

**Document Code**

### SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date																																																																																																														
Biodiversity and Biosynthesis of Natural Compounds	4710202018	Study Program Elective Courses	T=2	P=0	ECTS=4.48	2	December 25, 2023																																																																																																														
<b>AUTHORIZATION</b>	<b>SP Developer</b>		<b>Course Cluster Coordinator</b>			<b>Study Program Coordinator</b>																																																																																																															
	Prof. Dr. Tukiran, M.Si		Prof. Dr. Suyatno, M.Si			Prof. Dr. Nuniek Herdyastuti, M.Si.																																																																																																															
<b>Learning model</b>	<b>Project Based Learning</b>																																																																																																																				
<b>Program Learning Outcomes (PLO)</b>	<b>PLO study program that is charged to the course</b>																																																																																																																				
	<b>PLO-2</b>	Demonstrate the character of being tough, collaborative, adaptive, innovative, inclusive, lifelong learning and entrepreneurial spirit																																																																																																																			
	<b>PLO-3</b>	Develop logical, critical, systematic and creative thinking in carrying out specific work in their field of expertise and in accordance with work competency standards in the field concerned																																																																																																																			
	<b>PLO-10</b>	Able to carry out studies according to their field of expertise in solving problems in society or relevant industry through developing their knowledge and expertise																																																																																																																			
	<b>PLO-13</b>	Mastering the theory of structure and properties, energetics, kinetics, analysis, synthesis of micro and macromolecules and their applications																																																																																																																			
	<b>Program Objectives (PO)</b>																																																																																																																				
	<b>PO - 1</b>	Able to master the concept of biodiversity which includes the study level of ecosystem diversity, species diversity and genetic diversity.																																																																																																																			
	<b>PO - 2</b>	Mastering the basic concepts of secondary metabolite compounds and their biosynthesis.																																																																																																																			
	<b>PO - 3</b>	Make decisions based on the results of analysis of the biosynthesis of secondary metabolite compounds.																																																																																																																			
	<b>PO - 4</b>	Have a responsible attitude in developing secondary metabolite biosynthesis.																																																																																																																			
	<b>PLO-PO Matrix</b>																																																																																																																				
		<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th>P.O</th> <th>PLO-2</th> <th>PLO-3</th> <th>PLO-10</th> <th>PLO-13</th> </tr> </thead> <tbody> <tr> <td>PO-1</td> <td></td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>PO-2</td> <td></td> <td></td> <td></td> <td>✓</td> </tr> <tr> <td>PO-3</td> <td>✓</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>PO-4</td> <td></td> <td>✓</td> <td></td> <td></td> </tr> </tbody> </table>						P.O	PLO-2	PLO-3	PLO-10	PLO-13	PO-1				✓	PO-2				✓	PO-3	✓		✓		PO-4		✓																																																																																							
	P.O	PLO-2	PLO-3	PLO-10	PLO-13																																																																																																																
	PO-1				✓																																																																																																																
	PO-2				✓																																																																																																																
	PO-3	✓		✓																																																																																																																	
PO-4		✓																																																																																																																			
<b>PO Matrix at the end of each learning stage (Sub-PO)</b>																																																																																																																					
	<table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">P.O</th> <th colspan="16">Week</th> </tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th> </tr> </thead> <tbody> <tr> <td>PO-1</td> <td>✓</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>✓</td><td>✓</td><td></td><td></td><td></td><td>✓</td> </tr> <tr> <td>PO-2</td> <td></td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-3</td> <td></td><td></td><td></td><td></td><td></td><td></td><td>✓</td><td>✓</td><td>✓</td><td></td><td></td><td></td><td>✓</td><td></td><td></td><td></td> </tr> <tr> <td>PO-4</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>✓</td><td></td><td></td><td></td><td>✓</td><td></td><td>✓</td> </tr> </tbody> </table>																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										✓				✓		✓
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										✓				✓		✓																																																																																																					
<b>Short Course Description</b>	Study of the concept of biodiversity which includes the level of study of ecosystem diversity, species diversity, and genetic diversity, biosynthesis of secondary metabolite compounds terpenoids, steroids, phenolics, phenyl propanoids, flavonoids, alkaloids, saponins, and the benefits of each product.																																																																																																																				
<b>References</b>	<b>Main :</b>																																																																																																																				

1. 1. Tukiran (2015). Kimia Bahan Alam (KBA) Berbasis Field Study dan Pendekatan Chemo-Entrepreneurship. Surabaya: Unesa University Press
2. 2. Leny Heliawati (2018). KIMIA ORGANIK BAHAN ALAM. Pascasarjana – UNPAK Jl. Pakuan PO Box 452, Bogor, 16143
3. 3. Tatang Shabur Julianto (2019). Fitokimia: Tinjauan Metabolit Sekunder dan Skrining Fitokimia, Universitas Islam Indonesia, Yogyakarta.

**Supporters:**

1. 4. Dewick, P.M., 2009. Medicinal Natural Product: A Biosynthetic Approach, 3rd Ed., John Wiley & Sons, Inggris
2. 5. Andersen, O.M., and Markham, O.M., 2006, Flavonoid: Chemistry, Biochemistry and Applications, CRC Press, Taylor and Francis Group
3. 6. Cordell, G.A., 2002. The Alkaloid: Chemistry and Pharmacology, Academic Press Inc.
4. 7. Saputri, R.D., 2024. Xanthine Oxidase Inhibitory Activity of Xanthones from Calophyllum pseudomole P. F. Stevens.

**Supporting lecturer**

Prof. Dr. Suyatno, M.Si.  
 Prof. Dr. Tukiran, M.Si.  
 Dr. Ratih Dewi Saputri, S.Si., M.Si.

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	Explains the concept of biodiversity which includes the level of study of ecosystem, species and genetic diversity	1.1. Explain the RPS, lecture system, assessment system, determination of graduation, and rules for Natural Materials Chemistry lectures 2.2. Able to explain the concept of biodiversity which includes the level of ecosystem diversity studies	<b>Criteria:</b> essay test 25% while summative and performance assessment 75%  <b>Form of Assessment :</b> Participatory Activities		online 2x55 minutes	<b>Material:</b> biodiversity <b>References:</b> 1. Tukiran (2015). Natural Materials Chemistry (KBA) Based on Field Study and Chemo-Entrepreneurship Approach. Surabaya: Unesa University Press  <b>Material:</b> biodiversity <b>References:</b> 2. Leny Heliawati (2018). ORGANIC CHEMISTRY OF NATURAL MATERIALS. Postgraduate – UNPAK Jl. Pakuan PO Box 452, Bogor, 16143	2%
2	Explains the concept of biodiversity which includes the level of study of ecosystem, species and genetic diversity	1.1. Explain the RPS, lecture system, assessment system, determination of graduation, and rules for Natural Materials Chemistry lectures 2.2. Able to explain the concept of biodiversity which includes the level of ecosystem diversity studies	<b>Criteria:</b> essay test 25% while summative and performance assessment 75%  <b>Form of Assessment :</b> Participatory Activities		online 2x55 minutes	<b>Material:</b> biodiversity <b>References:</b> 1. Tukiran (2015). Natural Materials Chemistry (KBA) Based on Field Study and Chemo-Entrepreneurship Approach. Surabaya: Unesa University Press  <b>Material:</b> biodiversity <b>References:</b> 2. Leny Heliawati (2018). ORGANIC CHEMISTRY OF NATURAL MATERIALS. Postgraduate – UNPAK Jl. Pakuan PO Box 452, Bogor, 16143	2%

3	Explain the meaning of terpenoid secondary metabolite compounds and their biosynthesis	Able to explain the meaning of terpenoid secondary metabolite compounds and their biosynthesis	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities, Portfolio Assessment</p>		Presentation, discussion and question and answer 2x50 minutes	<p><b>Material:</b> terpenoids <b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p> <hr/> <p><b>Material:</b> terpene screening test <b>References:</b> 3. Tatang Shabur Julianto (2019). <i>Phytochemistry: Review of Secondary Metabolites and Phytochemical Screening</i>, Islamic University of Indonesia, Yogyakarta.</p>	2%
4	Explain the meaning of terpenoid secondary metabolite compounds and their biosynthesis	Able to explain the meaning of terpenoid secondary metabolite compounds and their biosynthesis	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities, Portfolio Assessment</p>		Presentation, discussion and question and answer 2x50 minutes	<p><b>Material:</b> terpenoids <b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p> <hr/> <p><b>Material:</b> terpene screening test <b>References:</b> 3. Tatang Shabur Julianto (2019). <i>Phytochemistry: Review of Secondary Metabolites and Phytochemical Screening</i>, Islamic University of Indonesia, Yogyakarta.</p>	2%
5	Explain the meaning of secondary metabolite compounds of the steroid type and their biosynthesis	Able to explain the meaning of steroid-type secondary metabolite compounds and their biosynthesis			Presentation, discussion and question and answer 2x50 minutes	<p><b>Material:</b> steroids <b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p> <hr/> <p><b>Material:</b> phytochemical steroids <b>References:</b> 3. Tatang Shabur Julianto (2019). <i>Phytochemistry: Review of Secondary Metabolites and Phytochemical Screening</i>, Islamic University of Indonesia, Yogyakarta.</p>	2%

6	Explain the meaning of phenolic secondary metabolite compounds and their biosynthesis	Able to understand phenolic secondary metabolite compounds and their biosynthesis.	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities, Portfolio Assessment</p>		Presentation, discussion and question and answer 2x50 minutes	<p><b>Material:</b> phenolic</p> <p><b>References:</b> 5. Andersen, OM, and Markham, OM, 2006, <i>Flavonoids: Chemistry, Biochemistry and Applications</i>, CRC Press, Taylor and Francis Group</p> <hr/> <p><b>Material:</b> phenolic compounds</p> <p><b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p>	2%
7	Explain the meaning of secondary metabolite compounds such as phenyl propanoid and their biosynthesis.	Able to explain the meaning of secondary metabolite compounds such as phenyl propanoid and their biosynthesis.	<p><b>Form of Assessment :</b> Portfolio Assessment</p>		Presentation, discussion and question and answer 2 x 50 minutes	<p><b>Material:</b> phenyl propanoid</p> <p><b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p> <hr/> <p><b>Material:</b> phytochemical test of phenyl propanoid</p> <p><b>References:</b> 3. Tatang Shabur Julianto (2019). <i>Phytochemistry: Review of Secondary Metabolites and Phytochemical Screening</i>, Islamic University of Indonesia, Yogyakarta.</p>	2%
8	UTS	Able to complete UTS	<p><b>Form of Assessment :</b> Participatory Activities</p>		2 X 50 MINUTE TESTS	<p><b>Material:</b> screening test for secondary metabolite compounds</p> <p><b>References:</b> 3. Tatang Shabur Julianto (2019). <i>Phytochemistry: Review of Secondary Metabolites and Phytochemical Screening</i>, Islamic University of Indonesia, Yogyakarta.</p> <hr/> <p><b>Material:</b> secondary metabolite compounds</p> <p><b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p>	20%

9	Explain the meaning of flavonoid secondary metabolite compounds and their biosynthesis	Able to explain the meaning of secondary metabolite compounds such as flavonoids and their biosynthesis.	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities, Portfolio Assessment</p>		<p>Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES</p>	<p><b>Material:</b> flavonoids <b>References:</b> 5. <i>Andersen, OM, and Markham, OM, 2006, Flavonoids: Chemistry, Biochemistry and Applications, CRC Press, Taylor and Francis Group</i></p> <hr/> <p><b>Material:</b> flavonoids and biosynthesis <b>References:</b> 4. <i>Dewick, PM, 2009. Medicinal Natural Products: A Biosynthetic Approach, 3rd Ed., John Willey &amp; Sons, England</i></p>	2%
10	Explain the meaning of flavonoid secondary metabolite compounds and their biosynthesis	Able to explain the meaning of secondary metabolite compounds such as flavonoids and their biosynthesis.	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities</p>		<p>Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES</p>	<p><b>Material:</b> flavonoids <b>References:</b> 5. <i>Andersen, OM, and Markham, OM, 2006, Flavonoids: Chemistry, Biochemistry and Applications, CRC Press, Taylor and Francis Group</i></p> <hr/> <p><b>Material:</b> flavonoids and biosynthesis <b>References:</b> 4. <i>Dewick, PM, 2009. Medicinal Natural Products: A Biosynthetic Approach, 3rd Ed., John Willey &amp; Sons, England</i></p>	10%
11	Explain the meaning of alkaloid secondary metabolite compounds and their biosynthesis.	Able to explain the structural characteristics of Alkaloids, as well as their classification, biosynthesis and distribution in plants.			<p>Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES</p>	<p><b>Material:</b> alkaloids <b>Bibliography:</b> 6. <i>Cordell, GA, 2002. The Alkaloids: Chemistry and Pharmacology, Academic Press Inc.</i></p> <hr/> <p><b>Material:</b> alkaloids <b>References:</b> 2. <i>Leny Heliawati (2018). ORGANIC CHEMISTRY OF NATURAL MATERIALS. Postgraduate – UNPAK JI. Pakuan PO Box 452, Bogor, 16143</i></p> <hr/> <p><b>Material:</b> alkaloid biosynthesis <b>References:</b> 4. <i>Dewick, PM, 2009. Medicinal Natural Products: A Biosynthetic Approach, 3rd Ed., John Willey &amp; Sons, England</i></p>	6%

12	Explain the meaning of alkaloid secondary metabolite compounds and their biosynthesis.	Able to explain the structural characteristics of Alkaloids, as well as their classification, biosynthesis and distribution in plants.	<b>Form of Assessment :</b> Participatory Activities		Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES	<p><b>Material:</b> alkaloids <b>Bibliography:</b> 6. Cordell, GA, 2002. <i>The Alkaloids: Chemistry and Pharmacology</i>, Academic Press Inc.</p> <hr/> <p><b>Material:</b> alkaloids <b>References:</b> 2. Leny Heliawati (2018). <i>ORGANIC CHEMISTRY OF NATURAL MATERIALS</i>. Postgraduate – UNPAK JI. Pakuan PO Box 452, Bogor, 16143</p> <hr/> <p><b>Material:</b> alkaloid biosynthesis <b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p>	6%
13	Stilbenoid secondary metabolite compounds (basic framework, oxygenation patterns, diversity and biosynthesis) Uses of stilbenoid compounds in life and science	1.1. Able to explain the meaning of isolation and isolation methods/techniques. 2.2. Able to identify isolated compounds through chemical tests (phytochemical screening).	<b>Form of Assessment :</b> Participatory Activities		Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES	<p><b>Material:</b> xanthenes group compounds <b>Reference:</b> 7. Saputri, RD, 2024. <i>Xanthine Oxidase Inhibitory Activity of Xanthenes from Calophyllum pseudomole PF Stevens</i>.</p> <hr/> <p><b>Material:</b> xanthon biosynthesis <b>References:</b> 4. Dewick, PM, 2009. <i>Medicinal Natural Products: A Biosynthetic Approach</i>, 3rd Ed., John Willey &amp; Sons, England</p>	10%

14	Able to review journals about biodiversity and biosynthesis of secondary metabolite compounds and the benefits of their products	Able to review journals about biodiversity and biosynthesis of secondary metabolite compounds and the benefits of their products.	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Participatory Activities</p>		Method: Discussion, question and answer, problem solving, assignment Model: case method 2 X 50 MINUTES	<p><b>Material:</b> entrepreneurial application of biodiversity and biosynthesis of natural materials. <b>References:</b> 1. <i>Tukiran (2015). Natural Materials Chemistry (KBA) Based on Field Study and Chemo-Entrepreneurship Approach. Surabaya: Unesa University Press</i></p> <p><b>Material:</b> biodiversity <b>References:</b> 2. <i>Leny Heliawati (2018). ORGANIC CHEMISTRY OF NATURAL MATERIALS. Postgraduate – UNPAK JI. Pakuan PO Box 452, Bogor, 16143</i></p>	10%
15	Students are able to apply MK on biodiversity and biosynthesis of secondary metabolite compounds in the form of a portfolio	Able to present portfolio results	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Portfolio Assessment</p>		portfolio of biodiversity applications and biosynthesis of secondary metabolite compounds 2 X 50 MINUTES	<p><b>Material:</b> entrepreneurial application of biodiversity and biosynthesis of natural materials. <b>References:</b> 1. <i>Tukiran (2015). Natural Materials Chemistry (KBA) Based on Field Study and Chemo-Entrepreneurship Approach. Surabaya: Unesa University Press</i></p>	15%
16	skills in biodiversity and secondary metabolite biosynthesis courses	skills in secondary metabolite biosynthesis courses	<p><b>Criteria:</b> essay test 25% while summative and performance assessment 75%</p> <p><b>Form of Assessment :</b> Project Results Assessment / Product Assessment</p>		portfolio assessment 2 X 50 MINUTES	<p><b>Material:</b> entrepreneurial application of biodiversity and biosynthesis of natural materials. <b>References:</b> 1. <i>Tukiran (2015). Natural Materials Chemistry (KBA) Based on Field Study and Chemo-Entrepreneurship Approach. Surabaya: Unesa University Press</i></p>	15%

#### Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	64%
2.	Project Results Assessment / Product Assessment	15%
3.	Portfolio Assessment	21%
		100%

#### Notes

- 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.
- 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.