| | Universitas Negeri Surabaya<br>Faculty of Mathematics and Natural Sciences<br>Biology Undergraduate Study Program | Document Code |
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# SEMESTER LEARNING PLAN

| Courses | CODE | Course Family | Credit Weight | | | SEMESTER | Compilation Date |
|---|---|---|---|---|---|---|---|
| Ecotoxicology | 4620102054 | | T=2 | P=0 | ECTS=3.18 | 5 | July 17, 2024 |

| AUTHORIZATION | SP Developer | Course Cluster Coordinator | Study Program Coordinator |
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| | Dra. Herlina Fitrihidajati, M.Si. | Prof. Dr. Fida Rachmadiarti, M.Kes. | Dr. H. Sunu Kuntjoro, S.Si., M.Si. |

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| **Learning model** | **Case Studies** |

**Program Learning Outcomes (PLO)**

**PLO study program that is charged to the course**

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| **PLO-6** | Able to apply logical, critical, systematic and innovative thinking in the context of developing or implementing science and/or technology according to their field of expertise. |
| **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-15** | Able to demonstrate the basic principles of software applications and instruments, standard analysis methods, and synthesis in biology |

**Program Objectives (PO)**

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| **PO - 1** | Able to apply ecotoxicological knowledge and technology to solve natural resource and environmental problems both in the laboratory and in real practice that supports profession and/or entrepreneurship |
| **PO - 2** | Able to demonstrate basic principles of instrument applications and software, standard analysis methods, and synthesis in ecotoxicology |
| **PO - 3** | Able to design and conduct experiments in the field of ecotoxicology, manage, analyze, interpret, document and store research data, and manage biological natural resources |
| **PO - 4** | Able to apply transferable skills in Ecotoxicology to develop ecopreneurship (eco-innovation, eco-opportunity, eco-commitment) |
| **PO - 5** | Able to apply logical, critical, systematic and innovative thinking in the context of developing or applying science and/or technology according to their field of expertise. |
| **PO - 6** | Able to work independently and collaboratively, as well as responsibly, in completing various tasks in class, in the laboratory and in the field |

**PLO-PO Matrix**

| P.O | PLO-6 | PLO-7 | PLO-15 |
|---|---|---|---|
| PO-1 | | | |
| PO-2 | | | |
| PO-3 | | | |
| PO-4 | | | |
| PO-5 | | | |
| PO-6 | | | |

**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 | | | | | | | | | | | | | | | | |
| PO-5 | | | | | | | | | | | | | | | | |
| PO-6 | | | | | | | | | | | | | | | | |

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| **Short Course Description** | Study the scope of environmental toxicology through understanding the basic concepts of toxicology, toxicometry, ecological and toxicological pathways, dynamics of toxic materials in the environment, biotransformation and toxicity tests, and toxicological research. The material is presented in the form of theory and practice |
| **References** | **Main :** |


1. Frank C. Lu. 2006. . Basic Toxicology. Washington : Hemisphere Publishing Corporation.
2. Koesnoputranto, H. 2005 . Toksikologi Lingkungan . Jakarta : FKM dan PPSML UI
3. Sembel, Dantje T., 2015. Toksikologi Lingkungan. Yogyakarta : Andi Press
4. Soemirat, Juli dan Herto Dwi Ariesyadi, 2015. Toksikologi Lingkungan. Yogyakarta : UGM Press
5. Mukono, H. J. 2006. Toksikologi Lingkungan. Surabaya : Airlangga University Press.
6. Rachmadiarti, dkk. 2016. Pemetaan Asam Amino dan Rhizobakteri Semanggi dan Kiambang yang Terpapar Logam Pb. Surabaya: LPPM Unesa.
7. Walker, C.H, R.M. Sibly, S.P.Hopkin, D.B. Peakall. 2015. Principles of Ecotoxicology. London : CRC Press
8. Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017.Ekotoksikologi. Surabaya : Unesa University Press.


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| **Supporters:** | |
| **Supporting lecturer** | Dra. Herlina Fitrihidajati, M.Si.<br>Prof. Dr. Fida Rachmadiarti, M.Kes. |

| **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** | Understand the basic principles of ecotoxicology | 1.Explain the basis of ecotoxicology<br>2.Explain the meaning of ecotoxicology<br>3.Explain the terms in ecotoxicology<br>4.Analyze the dose response relationship | **Criteria:**<br>1.Written test: Essay form<br>2.Indicators 1, 2, and 3 are achieved through tests<br>3.indicator 4 is achieved through tests<br><br>**Form of Assessment** :<br>Participatory Activities | Discussions, presentations, demonstrations | Explaining the outline of the lecture<br><br>Discussion, presentation, demonstration<br>2 x 50 minutes | **Material:**<br>Introduction to Ecotoxicology: Foundations of ecotoxicology, Definition of ecotoxicology, Terms in ecotoxicology, Dose-Response Relationship.<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 3% |
| **2** | Understand the classification of toxic materials in the environment | 1.Explain the basis of ecotoxicology<br>2.Explain the meaning of ecotoxicology<br>3.Explain the terms in ecotoxicology | **Criteria:**<br>1.Written test in essay form<br>2.Indicator 2 is achieved through discussion tasks<br>3.Indicator 1 is achieved through tests<br><br>**Form of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment | | Implementing PjBL with products (1) Proposals, (2) Project implementation and monitoring, (3) Project results reports.<br><br>Discussion, presentation and demonstration<br>2 X 50 | **Material:**<br>Classification of toxic substances based on (1) toxicity, (2) physical form (3) biotic - abiotic properties<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |
| **3** | Understanding the dynamics of toxic materials in the environment | 1.Identify the factors that cause toxic materials to be in the environment<br>2.Analyze the mechanisms of distribution of toxic materials in the environment | **Criteria:**<br>1.Written test: essay form,<br>2.Indicator 1 is achieved through discussion tasks<br>3.Indicator 2 is achieved through tests<br><br>**Form of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment | | PjBL discussion, presentation and demonstration<br><br>Step 1. Introducing the problem / determining basic questions<br>2 x 50 | **Material:**<br>Dynamics of toxic substances in the environment (1) toxic substances in the environment, (2) conditions causing the spread of toxic substances in the environment (3) dynamics of toxic substances in the environment<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 8% |

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| **4** | Understand the mechanisms of toxic substances in the body of organisms | 1. Describe the concepts of absorption, distribution and excretion of toxicants<br>2. explain the mechanism of distribution of toxic substances in the body of organisms<br>3. explain information about toxic effects | **Criteria:**<br>1. Written test in essay form<br>2. Indicators Numbers 1 and 3 are achieved through discussion tasks<br>3. Indicator number 2 is achieved through a written test<br><br>**Form of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment | | PjBl discussion, presentation and demonstration<br><br>Step 2. Preparation of Bioremediation Project Design<br>2 x 50 minutes | **Material:** (1) Flow of toxicants in the environment, (2) Flow of toxicants in the body, (3) Travel of chemicals in the environment, (4) Processes experienced by toxicants in an organism, (5) Examples of toxicants that can be absorbed by living creatures<br>**Library:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 8% |
| **5** | Understand the factors that influence the level of poisoning and toxic effects | 1. Identify factors that influence the level of poisoning and toxic effects<br>2. Explain the toxic effects on the body<br>3. Explain the mechanism of action of toxic effects | **Criteria:**<br>1. Written test in essay form<br>2. Indicator number 1 is achieved through a written test<br>3. indicators number 2 and 3 are achieved through discussion tasks<br><br>**Form of Assessment** :<br>Project Results Assessment / Product Assessment | PjBL Step 3: Preparation of 2 X 50 Project Proposal | Demonstration, Discussion and Presentation<br><br>PjBL step 3: Project proposal preparation stage regarding bioremediation of detergent waste and toxicity testing or bioremediation of contaminated soil<br>2 x 50 | **Material:** Factors that influence the level of poisoning (1) physical factors of chemicals (2) chemical factors of chemicals (3) dose / concentration factors (4) individual characteristic factors (5) exposure factors<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.*<br><br>**Material:** Toxic effects on the body<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.*<br><br>**Material:** Mechanism of action of toxic effects<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |

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| **6** | Understand the stages and designs in testing procedures in toxicity tests | 1. Identify the stages in the testing procedure<br>2. Explain the stages in the toxicity test testing procedure<br>3. Plan preparation for the acclimatization stage toxicity test independently<br>4. Skilled in planning the orientation, preliminary and experimental stage toxicity test designs independently<br>5. Skilled in conducting orientation, preliminary and experimental stage toxicity tests honestly | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1, 2 are achieved through discussion tasks<br>3. Indicator 3 is achieved through performance tasks<br>4. Indicator 4 is achieved through the task of making a proposal<br>5. Indicator 5 is achieved through practical toxicity testing through observation<br><br>**Form of Assessment** :<br>Project Results Assessment / Product Assessment | PjBL step 4. Practical activity / research project on bioremediation of detergent waste and its toxicity test or bioremediation on contaminated soil<br>2 X 50 | | **Material:** Toxicity Test Testing Procedure Stages in a toxicity test; Acclimatization, introduction, orientation, and experiments<br>**References:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |
| **7** | Make reports on the results of toxicity test activities | 1. Write reports on the results of toxicity testing activities which include problem formulation, objectives, data presentation, data analysis and drawing honest conclusions<br>2. Skilled in communicating reports on the results of toxicity test activities independently | **Criteria:**<br>1. The performance task is to make a practicum results report<br>2. Rubric for assessing observations and project assignments<br>3. Indicator 1 is achieved through the task of making a practicum results report<br>4. Indicator 2 is achieved through assessing the presentation of practicum report results<br><br>**Forms of Assessment** :<br>Project Results Assessment / Product Assessment, Practical Assessment | PjBL: Discussion with the lecturer about writing the results of the bioremedia project report and the toxicity test<br><br>PjBL Step 4. Monitoring the bioremediation project<br>2 X 50 | | **Material:** Report results. II Testing stage: Orientation, introduction, experiments<br>**References:** | 5% |
| **8** | U.S.S | Meeting materials 1 - 7 | **Criteria:**<br>Midterm exam<br><br>**Forms of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment, Tests | | 2 x 50 | **Material:** Lecture material from meetings 1 - 7<br>**Reader:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 15% |
| **9** | Explain various diseases as a toxic effect on organisms | 1. Compare various diseases as a result of toxic effects on organisms<br>2. Analyze the mechanisms of disease caused by toxicants<br>3. Conclude the relationship between toxicants and disorders in organisms<br>4. Presentation | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1, 2, and 4 are achieved through discussion and presentation assignments<br>3. Indicator 3 is achieved through tests (UAS)<br><br>**Form of Assessment** :<br>Project Results Assessment / Product Assessment, Test | | Discussion and presentation of<br><br>PjBL material step 5. Complete the project report on bioremediation and toxicity tests<br>2 x 50 minutes | **Material:** Toxic effects on organisms (1) carcinogenesis in mutagenesis, (2) teratogenesis in umunotoxicology<br>**References:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 2% |

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| **10** | Explain the various target organs in organisms as a result of toxicants. | 1. Comparing the differences in target organs from toxicant targets<br>2. Analyze the relationship between toxicants and target organs<br>3. Communicate the process of toxic effects on target organs | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1 and 3 are achieved through discussion tasks<br>3. Indicator 2 is achieved through tests<br><br>**Form of Assessment** :<br>Project Results Assessment / Product Assessment | | Discussion and Presentation of<br><br>PjBL material Step 5. Completion of the project results report on Bioremediation and toxicity tests<br>2 x 50 minutes | **Material:** Target organs (1) respiratory organs, (2) liver toxicology, (3) kidney toxicology, (4) skin toxicology (5) eye toxicology (6) nervous system toxicology (7) reproductive and cardiovascular toxicology<br>**References:** *Rachmadiarti, Fida ., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |
| **11** | Understand the impact of toxicity through risk assessment | 1. Identify the stages in risk assessment<br>2. Compare the stages in risk assessment<br>3. Summarize the stages in risk assessment<br>4. Carrying out honest experiments on toxic substances, for example metals, pesticides on an organism (for example plants or animals) | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1,2,3 are achieved through discussion tasks<br>3. Indicator 4 is achieved through practicum (experiments), observations and preparation of reports and presentations<br><br>**Forms of Assessment** :<br>Project Results Assessment / Product Assessment, Practical Assessment | | Discussion and presentation of<br><br>PjBL material Step 5. Completion of project results report on bioremediation and toxicity tests<br>2 x 50 minutes | **Material:** Toxic substances and risk assessment<br>**References:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |
| **12** | Understanding the toxicity of Pesticides to Organisms and the Environment | 1. Describe the toxicity of pesticides in the environment independently<br>2. Analyze the role of pesticides in the environment<br>3. Summarize the role of pesticides in the environment<br>4. Communicating pesticide toxicity | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1 and 2 are achieved through discussion tasks<br>3. Indicator 3 is achieved through tests<br>4. Indicator 4 is achieved through presentation assignments<br><br>**Form of Assessment** :<br>Project Results Assessment / Product Assessment | | Discussion and presentation of<br><br>PjBL Material Step 5. Completion of the project results report on Bioremediation and toxicity tests<br>2 x 50 minutes | **Material:** Toxicity of pesticides in the environment<br>**References:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 5% |
| **13** | Understanding metal toxicity | 1. Describe the role of metals in the environment based on literature<br>2. Analyze the toxicity of metals in the environment<br>3. Inferring the toxicity of metals in the environment<br>4. Communicates metal toxicity | **Criteria:**<br>1. Written test in essay form<br>2. Indicators 1 and 3 are achieved through discussion tasks<br>3. Indicator 2 is achieved through a written test<br>4. Indicator 4 is achieved through presentation assessment<br><br>**Form of Assessment** :<br>Assessment of Project Results / Product Assessment, Practices / Performance | | Discussion and Presentation of<br><br>PjBL Material Step 5. Completion of Project Results Report on Bioremediation and Toxicity Test<br>2 x 50 minutes | **Subject:** Metal Toxicity. □ Introduction □ General characteristics □ Important metals in toxicology □ Consideration of benefits or risks<br>**References:** *Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 6% |

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| **14** | Explain the stages in toxicological evaluation. | 1. Identify the stages in a toxicology evaluation<br>2. Compare the specifications of each stage in the toxicology evaluation<br>3. Summarize the stages in the toxicology evaluation procedure | **Criteria:**<br>1. Written test in essay form<br>2. Performance tasks<br>3. Report and presentation assessment rubric<br>4. Indicators 1 and 3 are achieved through assignments and discussions<br>5. Indicator 2 is achieved through a written test<br><br>**Form of Assessment** :<br>Assessment of Project Results / Product Assessment, Practices / Performance | | PjBL Steps 5 and 6 (presentation and evaluation)<br>Presentation and discussion of research project results reports on Bioremediation and Toxicity Tests / Bioremediation of contaminated soil<br>2 x 50 minutes | **Material:** Stages in the toxicant evaluation procedure<br>**References:**<br>*Rachmadiarti, Fida., Fitrihidajati, Herlina. 2017. Ecotoxicology. Surabaya: Unesa University Press.* | 4% |
| **15** | Communicating Project Research Results 1.. | Presenting PjBL results reports | **Criteria:**<br>1. Performance tasks<br>2. Report and presentation assessment rubric<br><br>**Form of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment | | PjBL Steps 5 and 6.<br>Presentation and discussion of the Bioremediation and Toxicity Test Project results report<br>2 x 50 minutes | **Material:**<br>Seminar on project research results on the effect of phytoremediation and toxicity on lethal doses of organisms.<br>**References:** | 4% |
| **16** | UAS | UAS | **Criteria:**<br>UAS<br><br>**Forms of Assessment** :<br>Participatory Activities, Project Results Assessment / Product Assessment, Tests | | UAS<br>2 x 50 minutes | | 15% |

**Evaluation Percentage Recap: Case Study**

| No | Evaluation | Percentage |
|---|---|---|
| 1. | Participatory Activities | 25.5% |
| 2. | Project Results Assessment / Product Assessment | 53.5% |
| 3. | Practical Assessment | 5% |
| 4. | Practice / Performance | 5% |
| 5. | Test | 11% |
| | | 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.