COURSE'S PORTFOLIO
STORAGE PEST
(COURSE CODE: PPT 46215)

ODD SEMESTER OF 2021

Lecturers:
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STUDY PROGRAM OF PLANT PROTECTION
DEPARTMENT OF PLANT PEST AND DISEASE
FACULTY AGRICULTURE
UNIVERSITAS SRIWIJAYA
2021

I. INTRODUCTION

Storage Pest is one of the courses which is taught in Plant Protection Study Program. This is an elective course offered in the 2015 Curriculum. Students registered as 3rd and 5th Semester students might choose this course which was offered only in Odd Semester, i.e., August to December, in consecutive year. Course Code is 46215 and is designed for 1 Teaching Credit and 1 Laboratory Work Credit in Person**,** and or in Group which is officially written as 2 (1 - 1).

Face-to-face way was applied in classroom for one teaching-hour or one credit which takes 50 minutes. To improve laboratory skills of students, one laboratory-work hour is applied. Students will spend their time in laboratory for 100 minutes.

Lecturers regularly provided students with assignments to train their skills in writing, for example in describing their knowledge by interpreting the information from classroom with the research results scientifically written in articles published in journals. Students were also evaluated or assessed to see their understandings to the contents of lectures delivered by giving them quizzes, mid semester, and final semester examinations, as well.

II. COURSE DESCRIPTION

Course is designated to provide students' basic knowledge and understandings on the roles and existences various species of invertebrates and vertebrates which act as pests attacking agricultural products stored in the storage. This course is also focused on recognition of many pests' species from different orders of vertebrates and invertebrates, such as insects, rats and mites. Students also are taught the influences of climate factors, such as temperature, relative humidity, water content, and many more, on biology and ecology, the growth and development of pests, and behavior of those pests in the storage. How to build the storage which can prevent pests of stored products to enter the storage, and how to manage the pests, were also taught.

III. COURSE IMPLEMENTATION

Teaching Methods

Teaching and Learning Process, due to CoViD-19 Pandemic, has been conducted online, both for delivering course and for Laboratory Work. Universitas Sriwijaya provided Learning Management System (LMS), known as eLearning, where Big Blue Button Online System provided for Teaching and Learning. Semester Learning Plan or SLP was organized to guide that process. **(See Appendix I, Semester Learning Plan)**.

Lecturers assigned Course Learning Outcomes or CLO and Weekly Competence (Sub-CLO) to determine student's progress and achievement organized as written **(See Appendix II and III, CLO Achievement of each Student and Class)** in SLP.

Laboratory Work in Person (**See Appendix IV, Student's Laboratory Work Report: Person**) and in Group (**See Appendix V, Student's Laboratory Work Report: Group**) could not be applied, and students conducted their experiments in their own homes assisted by Lecturers. Online discussions in term of self-independent and groups have been also carried out. Assignments, Quiz, Midterm and Final Semester Examination were implemented and students submitted their assignments and answers online.

The Intended Learning Outcomes proposed were as follow:

CLO-1: Students care about safety food issues, especially for products which are stored in storage, by learning all aspects of pests of stored products, such existence and role, classification, biology and ecology, influences of climate factors, food, competition, and behaviour.

The achievement of the CLO-1 was derived to 5 Sub-CLOs which were driven by weekly learning materials. The Sub-CLOs were as follow:

Sub-CLO 1: Students are expected to be able in explaining the existence and role of pests of stored products

Sub-CLO-2: Students are expected to be able in explaining classification of pests of stored products

Sub-CLO-3: Students are expected to be able in explaining biology and ecology of pests

Sub-CLO-4: Students are expected to be able in explaining the influences of climate on pests of s

Sub-CLO-5: Students are expected to be able in explaining the influences of food, competition and behaviour on pests

CLO-2. Students understand pests of stored products from insect groups which attack agricultural products

The achievement of the **CLO-2** is divided and distributed to 7 as written below:

Sub-CLO-6 Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Hymenoptera and Diptera)

Sub-CLO-7: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Hemiptera dan Lepidoptera)

Sub-CLO-8: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Lepidoptera dan Isoptera)

Sub-CLO-9: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Coleoptera)

Sub-CLO-10: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Coleoptera)

Sub-CLO-11: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Rats, Possums and Bats)

Sub-CLO-12: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Mites and Birds)

CLO3: CLO-3: Students study and integrate science and knowledge, and skill obtained from courses to find alternative solutions in preventing agricultural from the attacks of pests of stored products. (P-3)

The achievement of the **CLO-3** is derived to 2 Sub-CLO as written below:

Sub-CLO-**13:** Students are expected to be able to explain how to prevent pests of stored products in the storage

CLO 4. Students study and integrate science and knowledge, and skill obtained from courses to find the methods and alternative solutions to store agricultural products and to manage pests of stored products (KK-1)

The achievement of the **CLO-4** is derived to 1 Sub-CLO as follow:

Sub-CLO 14: Students are expected to be able to explain how to prevent pests of stored products in the storage

Course Delivery

The course of Storage Pest has Teaching and Learning Processes which is carried out by obeying regulations issued by and in accordance with Indonesian National Standard of Higher Education. Teaching and Learning Processes are organized in Semester Credit Unit or Credit where 1 Credit is equivalent to 50-minute teaching, structured assignment for 60 minutes, and personal learning assignment for 60 minutes. Lectures were given in two ways of lecturing, face-to-face in the classroom and online lecturing via internet.

Two lecturers appointed as the teaching team of the course (Arinafril and Arsi) took part in the lecturing process according to the topics determined in the Semester Lecturing Plan.

Assessment Method

Student's achievements have been evaluated during and after Teaching and Learning Process. This evaluation was proposed and made as parameter to see interconnectedness between Semester Learning Plan and Course Learning Outcome (CLO) and sub-CLOs. Assessment was designated to determine knowledge and skill obtained from lectures taught and laboratory work conducted by students after course or weekly learning process.

The relationship between assessment method and the measurement of achievement of each CLO of the course are presented in the following matrix.

	Course Learning Outcomes (CLO)			
	CLO-1 (S-11)	CLO-2 (P-1)	CLO-3 (P-3)	CLO-4 (KK-1)
CLO-1: Students care about safety food issues, especially for products which are stored in storage, by learning all aspects of pests of stored products, such existence and role, classification, biology and ecology, influences of climate factors, food, competition and behaviour. (S-11)	Assignment 1: Students were asked to answer the questions about current problems people across the globe facing on the reduction of agricultural products stored in the storage, and about how they behave if they meet the same problem in their houses. Questions were taken from lecture notes of Lecture 1, Lecture 2, and Lecture 3. (8%)			
	Questions of Quiz were on the influence of several climate factors, such as temperature, relative humidity, and light intensity, and also inter- and intraspecies to find food, on the development of pests (Sources of			

	question were from Lecture 4 and Lecture 5. (4%)			
	Assignment 2: Students were ordered to prepare videos on various orders of insect pests of stored products, all stages of life, from eggs, larvae or nymphs or maggot, pupae, and adults, and then videos were uploaded onto Social Media. Sources from Lecture 6, Lecture 7, Lecture 8, Lecture 9, Lecture 10, Lecture 11, Lecture 12. (8%)			
CLO-2: Students understand pests of stored products from insect groups which attack agricultural products. (P-1)	Questions for Mid-Semester Examination were randomly taken from Lecture 1, Lecture 2, Lecture 3, lecture 4, Lecture 5, and Lecture 6. They were about symptoms of damage which were caused by various species of pests of insect orders; behavior of pests under abnormal conditions based on temperature and water content; and biology aspects of pests in different stored products. (20%)			

CLO-3: Students study and integrate science and knowledge, and skill obtained from courses to find alternative solutions to prevent agricultural from the attacks of pests of stored products. (P-3)			Assignment 3: Students were asked to prepare slides on all aspects in the storage and how to manage pests in the storage. Slides were presented later in the classroom. Source of assignment were from topics of Lecture 13 and Lecture 14. (12%)	
CLO-4: Students study and integrate science and knowledge, and skill obtained from courses to find the methods and alternative solutions to store agricultural products and to manage pests of stored products (KK-1)		Final Semester Examination were based on topics which were taught on Lecture 9, Lecture 10, Lecture 11, Lecture 12, Lecture 13, and Lecture 14. (38%)		

Figure 1. Matrix showing the relationship between assessment method and the measurement of each CLO achievement

Teaching team considered process for marking or grading which was based on university marking system regulation as could be seen in Table 1 below.

Table 1. Marking or Grading Regulation

No	Numerical Grade	Letter Grade	Grade Point
1	86-100	A	4
2	71-85	B	3
3	56-70	C	2
4	40-55	D	1
5	<40	E	0

Marking or grading was proposed based on component of marks from several tasks, such as Assignments (3 times), Quiz, Laboratory Work reports, Mid-Semester Examination, and Final Semester Examination, as detailed described as follow:

1. Assignment 1.

   Students were asked to answer the questions about current problems people across the globe facing on the reduction of agricultural products stored in the storage, and about how they behave if they meet the same problem in their houses. Questions were taken from lecture notes of Lecture 1, Lecture 2, and Lecture 3.

2. Quiz

   Questions of Quiz were on the influence of several climate factors, such as temperature, relative humidity, and light intensity, and also inter- and intraspecies to find food, on the development of pests. Sources of question were from Lecture 4 and Lecture 5.

3. Assignment 2

   Students were ordered to prepare videos on various orders of insect pests of stored products, all stages of life, from eggs, larvae or nymphs or maggot, pupae, and adults, and then videos were uploaded onto Social Media. Sources from Lecture 6, Lecture 7, Lecture 8, Lecture 9, Lecture 10, Lecture 11, Lecture 12.

4. Laboratory Work Reports

   Introduce pests from Orders of Hymenoptera, Diptera, Hemiptera, Lepidoptera, Isoptera and Coleoptera Laboratory Works. Source of assignment were from topics of Lecture 13 and Lecture 14.

5. Mid-Semester Examination

Questions for Mid-Semester Examination were randomly taken from Lecture 1, Lecture 2, Lecture 3, Lecture 4, Lecture 5, and Lecture 6. They were about symptoms of damage which were caused by various species of pests of insect orders; behavior of pests under abnormal conditions based on temperature and water content; and biology aspects of pests in different stored products.Assignment 3

Students were asked to prepare slides on all aspects in the storage and how to manage pests in the storage. Slides were presented later in the classroom. Source of assignment were from topics of Lecture 13 and Lecture 14.

6. Final examination

Final Semester Examination were based on topics which were taught on Lecture 9, Lecture 10, Lecture 11, Lecture 12, Lecture 13, and Lecture 14. Lecturing Evaluation

1. Attendance evaluation

Attendance of Lecturers and Students regularly was taken and then at the end of lecture was counted. Number of attendance of Lecturers and Students was presented in the following table.

Table 2. Lecturer and students' attendance

Class	**Lecturer attendance**	**Student attendance**
A	16	21
B	16	21

2. Teaching evaluation

Questionnaire was delivered to students to evaluate Teaching and Learning Process at the end of the semester. In general, the students' opinion about the learning process can be summarized as follow:

a. Suitability of Topic with Semester Learning Plan
b. Ease of Getting Textbook Reference
c. Teaching Way
d. Mastering classroom
e. Punctuality
f. Communication Way
g. Suitability of Questions with Contents Taught in Examination
h. Difficulty Level of Question in Examination
i. Suitability of Mark with what Student's Expectation
j. Availability of Lecture Notes Uploaded onto E-Learning Prior to Lecturing
k. Suitability of Assignment with Topic in Semester Learning Plan
l. Midterm and Final Examinations are on schedule as written in Semester Learning Plan and University Academic Calendar
m. Frequency of Lectures Conducted and Frequency of Lectures as Planned in Semester Learning Plan (16 times, Midterm and Final Examinations included)

3. Result Evaluation

a. Student grade achievement

Final mark and grade achieved by students which were derived from proportional accumulation of various assessment method conducted to evaluate the achievement of learning outcome of the lecture and also of each learning subject. Methods of assessment and contribution weight of each method are presented in Table 3.

Table 3. Assessment Method and Weight

No	Assessment Method	Weight (%)
1	Assignment 1	8
2	Quiz	4
3	Assignment 2	8
4	Laboratory Work Reports	10
5	Midterm Examination	20
6	Assignment 3	12
7	Final Semester Examination	38

The distribution of grades obtained by students in the class of Storage Pest as listed in Table 4.

Table 4. Distribution of grades achievement of the students

No	Letter grade	Numerical students
1	A	21
2	B	0
3	C	0
4	D	0
5	E	0

b. Student Grade Achievement

Final score and grade achieved by students at the end of semester derived from proportional accumulation of various assessment method conducted to evaluate the achievement of learning outcome of the lecture and also of each learning subject. Methods of assessment and contribution weight of each method are presented in Table 5.

Table 5. Distribution of Students Achievement Grade

No	Letter grade	Number of Students
1	A	21
2	B	0
3	C	0
4	D	0
5	E	0

c. CLO Achievement

Achievement of students was evaluated as written on Course Learning Objectives (CLO) consisted of CLO-1, CLO-2, CLO-3, and CLO-4. The CLO achievement was calculated and evaluated individually for each student and achievement of the class. Similar to the fact that all students (100%) gained grade A.

d. Reflection

Based on the evaluation results, the grade achieved by Students attending Storage Pest course in Odd Semester 2021 was very good, where all students got A. The CLO achievement also satisfying and the failure of some students to achieve some CLOs was understandable

because the passing grade for CLO achievement was set high, 85 or higher. However, based on learning process, grade, and CLO evaluation, it is clear that there is something did not work as expected and needs correction that all lecturers should aware of.

e. Follow-up Action

Based on the evaluation results, some improvements were required in relation to the preparation, delivery and evaluation of the course of Storage Pest. The correction was necessary to get rid of similar situation re-occurred again in the future, and to reduce the failure of CLO achievement. Lecturers should improve their course material and strictly obey SPL. The lecturers needed to pay more attention on their punctuality, since some students complained the unpunctuality of lecturer when they entered and left classroom. Learning materials should be uploaded in e-Learning system at least three 3 days before course to give students more time to read before attending the lecture.

Furthermore, students wanted the lecturers to return the answer sheet back despite the lecturer had announced the marks of the exams. All teaching team members were involved in the learning process of Storage Pest had to update and upgrade course contents- They also had to improve their teaching ways so that students might get better marks and high CLO achievement in line with current advance of knowledge and technology on Storage Pest.

Appendix I. Semester Learning Plan (SLP)

	PLANT PROTECTION STUDY PROGRAM **DEPARTMENT OF PLANT PEST AND DISEASE** **FACULTY OF AGRICULTURE** **UNIVERSITAS SRIWIJAYA**
SEMESTER LEARNING PLAN (SLP)	

A. Course Information

Course	Storage Pest	Course Code: PPT 46215	Semester: 3rd or 5th	Credits: 2 (1-1)
Study Substance Group	Plant Disruptive Organism			
Course Description	Course includes definition, scope of study, importance of pests of stored products, insect and vertebrate pest taxonomy and classification; storage or warehouse constructions; biology, ecology, physiology, and behavior of pests of stored products; pests of stored products on agricultural products, damage and economic loss; pests of stored products management			
Course Learning Objective (CLO)	CLO-1: Students care about safety food issues, especially for products which are stored in storage, by learning all aspects of pests of stored products, such existence and role, classification, biology and ecology, influences of climate factors, food, competition and behaviour. (S-11) CLO-2: Students understand pests of stored products from insect groups which attack agricultural products. (P-1) CLO-3: Students study and integrate science and knowledge, and skill obtained from courses to find alternative solutions to prevent agricultural from the attacks of pests of stored products. (P-3) CLO-4: Students study and integrate science and knowledge, and skill obtained from courses to find the methods and alternative solutions to store agricultural products and to manage pests of stored products (KK-1)			
Lecturers	: Dr.-phil. Ir. ARINAFRIL (AN) Arsi, SP., M.Si. (AS)	Responsible Lecturer : Dr.-phil. Ir. Arinafril (AN)		

B. LEARNING PROGRAM

Course Learning Objective (CLO)	End results which are expected at the end of each Learning Tier (Sub-CLO)	Teaching Topic	Reference	Teaching Method and Duration	Self-Assignment Description and Duration	Achievement Indicator	Weight (%)	Lecturer Initial
CLO-1	Sub-CLO-1: Students are expected to be able in explaining the existence and role of pests of stored products	Existence and role pests	**1,2,3,4,6,7,10**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class		Students are able to discuss and answer all aspects of the existence and role of pests of stored product.	5	**AN**
	Sub-CLO-2: Students are expected to be able in explaining classification of pests of stored products	Pests of stored products classification based on taxonomy	**1,2,3,8,9, 11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class		Students are able to taxonomically discuss and answer classification of pests of stored products.	7.5	**AS**
	Sub-CLO-3: Students are expected to be able in explaining biology and ecology of pests	Biology and Ecology of pests of stored products	**1,2,3,8,9, 11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class	Writing articles in the form of essays and also journal reading, independently and or in group, according to the topic	Students are able to discuss and answer all aspects of biology and ecology of pests of stored products	7.5	**AS**

					taught for 2 X 60 minutes			
	Sub-CLO-4: Students are expected to be able in explaining the influences of climate on pests of stored products	Climate influence on pests of stored products	**1,2,3,8,9, 11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class		Students are able to discuss and answer all aspects of the impacts of climate on pests of stored products	7.5	**AS**
	Sub-CLO-5: Students are expected to be able in explaining the influences of food, competition and behaviour on pests	Food, competition and behavior of pests	**1,5,6,9,11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class. Biology and Ecology of Pests of Stored products Lab Work (2 X 60 minutes)		Students are able to discuss and answer all aspects of influences of food, competition and behaviour on pests of stored product	7.5	**AS**
CLO-2	Sub-CLO-6 Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Hymenoptera, Diptera)	Insects from orders of Hymenoptera and Diptera, as pests of stored products	**1,5,6,9,11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.	Writing structured assignments in group in audio-visual form according to the subject taught for 3 X 60 minutes, then students should upload them to Social	Students are able to discuss and answer any insects' species from the orders Hymenoptera and Diptera which act as pests of stored products.	7.5	**AS**

					Media			
	Sub-CLO-7: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Hemiptera, Lepidoptera)	Insects from orders of Hemiptera and Lepidoptera, as pests of stored products	**1,5,6,9,11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class		Students are able to discuss and answer any insects'species from the orders Hemiptera and Lepidoptera which act as pests of stored products.	7.5	**AS**
Midterm Examination (100 Minutes)								
	Sub-CLO-8: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Lepidoptera, Isoptera)	Insects from orders of Lepidoptera and Isoptera as pests of stored products	**1,5,6,9,11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.		Students are able to discuss and answer any insects' species from the orders Lepidoptera and Isoptera which act as pests of stored products.	7.5	**AS**
	Sub-CLO-9: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Coleoptera)	Insects from orders of Coleoptera, as pests of stored products	**1,5,6,9,11**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.		Students are able to discuss and answer any insects' species from the order of Coleoptera which act as pests of stored products.	7.5	**AS**
	Sub-CLO-10: Students are expected to be able to explain on insect pests in association with	Insects from orders of Coleoptera, as pests of stored products	**1,2,3,4,6,8,10**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among		Students are able to discuss and answer any insects' species from the order of Coleoptera which act as pests of	7.5	**AN**

	agricultural products which are stored. (Coleoptera)			students in group for 2 X 60 minutes outside class. Introduce pests from Orders of Hymenoptera, Diptera, Hemiptera, Lepidoptera, Isoptera and Coleoptera Laboratory Works (each Sub-CLO 2 X 60 minutes)		stored products.		
	Sub-CLO-11: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Rats, Possums, Bats)	Insects from group of rats, possums, and bats, as pests of stored products	**1,2,3,4,6,8,10**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.		Students are able to discuss on rats, possums and bats as pests of stored products.	7.5	**AN**
	Sub-CLO-12: Students are expected to be able to explain on insect pests in association with agricultural products which are stored. (Mites, Birds)	Insects from groups of mites and birds as pests of stored products	**4,13**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.		Students are able to discuss on mites and birds species as pests of stored products.	7.5	**AN**
CLO-3	**Sub**-CLO-**13:** Students are expected to be able to explain how to prevent pests of stored products in the storage	Prevention methods of attack on pests of stored products	**1,3,5,6,7,8,9,1011,12**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for	Writing articles in the form of essays and also journal reading, independently and or in	Students are able to apply methods how to prevent pests of stored products in the storage by applying with various prevention	7.5	**AN**

				2 X 60 minutes outside class.	group, according to the topic taught for 2 X 60 minutes	techniques.		
CLO-4	**Sub-CLO-14:** Students are expected to be able to explain how to prevent pests of stored products in the storage	Management of combatting pests of stored products by applying management methods	**1,3,5,6,7,8,9 ,1011,12**	Lecture is delivered in face-to-face method for 2 X 50 minutes in class, and Discussion among students in group for 2 X 60 minutes outside class.		Students are able to apply methods how to manage pests of stored products in the storage by applying with various management methods.	**7.5**	**AN**
Final Semester Examination (100 Minutes)								

Workload: Face-to-face lecture: 1400 minutes; Structured discussions in person and or in group: 1680 minutes; Assignments in person and or in group: 1800 minutes; Laboratory work in groups, respectively: 1320 minutes; Midterm and Final Semester Examinations: 200 minutes. Total: 6400 minutes or 106.67 hours or equivalent to 4.27 ECTS

References:

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Appendix II. CLO Achievement of each Student

ACADEMIC YEAR : 2021/2022 (ODD SEMESTER)
COURSE NAME: STORAGE PEST
COURSE CODE: 46215
CREDITS: 2 (LECTURE: 1, LABORATORY WORK: 1
ROOM : BAKRY HAMID ROOM
LECTURERS: Dr.-phil. ARINAFRIL as COORDINATOR and TEAM MEMBER, ARSY as TEAM MEMBER
LECTURE'S SCHEDULE: FRIDAY from 13.20 – 15.00

NO.	STUDENT ID NUMBER	STUDENT'S NAME	Assign-ment 1	Quiz	Assign-ment 2	Assignment 3	Practical works	Mid term	Final term	Final score	Grade	CLO achievement			
												CLO1	CLO2	CLO3	CLO4
			8%	4%	8%	12%	10%	20%	38%	100%					
1	05081282025026	FAISAL ARISANDI	87	86	86	87	85.65	92	86	87.37	A	Yes	Yes	Yes	Yes
2	05081282025027	SARIPUDIN	88	86	87	88	89.35	93.33	87	88.66	A	Yes	Yes	Yes	Yes
3	05081282025036	APRILLIYAH MAWARNI	86.65	86.35	86	87	88.65	93.33	87	88.30	A	Yes	Yes	Yes	Yes
4	05081282025038	WENTI OKTAPIANI	87	87	88	86.25	90.1	85.67	86	86.65	A	Yes	Yes	Yes	Yes
5	05081282025042	SAKHA P. MADYA	88	86	87	88	82.04	85.67	85	85.64	A	Yes	Yes	No	No
6	05081282025054	RIKI S. SEMBIRING	87	85	88	87	83.17	85.33	85	85.52	A	Yes	Yes	No	No
7	05081282025056	AKSEL SANTOSO	87	85	86	86.55	86.17	85	86	85.92	A	Yes	Yes	Yes	Yes
8	05081282025060	IVANA SEPTA MARIANA	87	85	86	86.55	86.17	85.67	86	86.06	A	Yes	Yes	Yes	Yes
9	05081381621049	ENDI DARMAWAN	88	86.25	87	86.45	82.5	86.67	86	86.09	A	Yes	Yes	No	Yes
10	05081382025067	ALFIAN BUSTOMMI	87	85	86	86.55	86.17	86.33	85	85.81	A	Yes	Yes	Yes	No
11	05081382025075	NANDA RIANA	88.5	87.5	86	87.5	93.335	91.67	86	88.31	A	Yes	Yes	Yes	Yes
12	05081382025078	REZA D. MIRANDA	87	85	86	86.55	86.17	93.33	90	89.11	A	Yes	Yes	Yes	Yes

13	05081382025081	YUNITA NURFADILA	**87.5**	**88.5**	**86.5**	**88.5**	**79.74**	**84.33**	**87**	**85.98**	**A**	Yes	Yes	No	Yes
14	05081182025018	M. AKBAR SATRIAWAN	**90.5**	**90.5**	**89**	**90.5**	**92.5**	**92.67**	**90**	**90.82**	**A**	Yes	Yes	Yes	Yes

15	05081282025043	ADE GILANG RHOMADON	**87.5**	**88**	**86**	**86**	**87**	**87**	**87.67**	**87.135**	**A**	Yes	Yes	Yes	Yes
16	05081282025046	HANNY LIA ANGGRAINI	**88**	**88.5**	**89**	**89**	**89.4**	**86.6**	**92**	**89.6**	**A**	Yes	Yes	Yes	Yes
17	05081282025050	DESI FITRIYANI	**92.5**	**92.5**	**94**	**90**	**95.95**	**90.33**	**100**	**95.08**	**A**	Yes	Yes	Yes	Yes
18	05081381722053	HUMAIROH	**90.5**	**93**	**92**	**94**	**91.24**	**87.33**	**100**	**94.19**	**A**	Yes	Yes	Yes	Yes
19	05081382025064	NURIL AZMI PURWITASARI	**89.5**	**89**	**89**	**89.8**	**73.74**	**84.33**	**87**	**85.92**	**A**	Yes	Yes	No	Yes
20	05081382025074	FIGO ARDATHA SUTARMA	**87.5**	**89**	**86**	**89**	**80.52**	**86.67**	**86**	**86.19**	**A**	Yes	Yes	No	Yes
21	05081382025077	MUHAMMAD AZIZ	**88.5**	**86.5**	**86**	**91**	**78.26**	**92.67**	**90**	**88.9**	**A**	Yes	Yes	No	Yes

Appendix III. Student and Class CLO Achievement

1. FAISAL ARISANDI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	86	3.44	86			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	87	10.44		87		
Assignment 3	Lecture 11 & 12	0.1	85.65	8.565			85.65	
Mid-Semester Exam	Lecture 1-8	0.2	92	18.4	46	46		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				87.365	305	158.8	111.45	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				87.365	87.14	88.22	85.73	86.00
Grade				A	YES	YES	YES	YES

2. SARIPUDIN

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88	7.04	88			
Quiz	Lecture 3	0.04	86	3.44	86			
Assignment 2	Lecture 4 & 5	0.08	87	6.96	87			
Laboratory Work Report	Lecture 7 & 8	0.12	88	10.56		88		
Assignment 3	Lecture 11 & 12	0.1	89.35	8.935			89.35	
Mid-Semester Exam	Lecture 1-8	0.2	93.33	18.666	46.665	46.665		
Final Semester Exam	Lecture 11-14	0.38	87	33.06		26.1	26.1	34.8
Final Score				88.661	307.665	160.765	115.45	34.8

Maximum Score	100	350	180	130	40
CLO Achievement	88.661	87.90	89.31	88.81	87.00
Grade	A	YES	YES	YES	YES

3. APRILLIYAH MAWARNI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	86.65	6.932	86.65			
Quiz	Lecture 3	0.04	86.35	3.454	86.35			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	87	10.44		87		
Assignment 3	Lecture 11 & 12	0.1	88.65	8.865			88.65	
Mid-Semester Exam	Lecture 1-8	0.2	93.33	18.666	46.665	46.665		
Final Semester Exam	Lecture 11-14	0.38	87	33.06		26.1	26.1	34.8
Final Score				88.297	305.665	159.765	114.75	34.8
Maximum Score				100	350	180	130	40
CLO Achievement				88.297	87.33	88.76	88.27	87.00
Grade				A	YES	YES	YES	YES

4. WENTI OKTAPIANI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	87	3.48	87			
Assignment 2	Lecture 4 & 5	0.08	88	7.04	88			
Laboratory Work Report	Lecture 7 & 8	0.12	86.25	10.35		86.25		
Assignment 3	Lecture 11 & 12	0.1	90.1	9.01			90.1	

Mid-Semester Exam	Lecture 1-8	0.2	85.67	17.134	42.835	42.835		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				86.654	304.835	154.885	115.9	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				86.654	87.10	86.05	89.15	86.00
Grade				A	YES	YES	YES	YES

5. SAKHA PAWIRA MADYA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88	7.04	88			
Quiz	Lecture 3	0.04	86	3.44	86			
Assignment 2	Lecture 4 & 5	0.08	87	6.96	87			
Laboratory Work Report	Lecture 7 & 8	0.12	88	10.56		88		
Assignment 3	Lecture 11 & 12	0.1	82.04	8.204			82.04	
Mid-Semester Exam	Lecture 1-8	0.2	85.67	17.134	42.835	42.835		
Final Semester Exam	Lecture 11-14	0.38	85	32.3		25.5	25.5	34
Final Score				85.638	303.835	156.335	107.54	34
Maximum Score				100	350	180	130	40
CLO Achievement				85.638	86.81	86.85	82.72	85.00
Grade				A	YES	YES	NO	NO

6. RIKI SURANTA SEMBIRING

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	85	3.4	85			
Assignment 2	Lecture 4 & 5	0.08	88	7.04	88			

Laboratory Work Report	Lecture 7 & 8	0.12	87	10.44		87		
Assignment 3	Lecture 11 & 12	0.1	83.16	8.316			83.16	
Mid-Semester Exam	Lecture 1-8	0.2	85.33	17.066	42.665	42.665		
Final Semester Exam	Lecture 11-14	0.38	85	32.3		25.5	25.5	34
Final Score				85.522	302.665	155.165	108.66	34
Maximum Score				100	350	180	130	40
CLO Achievement				85.522	86.48	86.20	83.58	85.00
Grade				A	YES	YES	NO	NO

7. AKSEL SANTOSO

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	85	3.4	85			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	86.55	10.386		86.55		
Assignment 3	Lecture 11 & 12	0.1	86.17	8.617			86.17	
Mid-Semester Exam	Lecture 1-8	0.2	85	17	42.5	42.5		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				85.923	300.5	154.85	111.97	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				85.923	85.86	86.03	86.13	86.00
Grade				A	YES	YES	YES	YES

8. IVANA SEPTA MARIANA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			

Quiz	Lecture 3	0.04	85	3.4	85			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	86.55	10.386		86.55		
Assignment 3	Lecture 11 & 12	0.1	86.17	8.617			86.17	
Mid-Semester Exam	Lecture 1-8	0.2	85.67	17.134	42.835	42.835		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				86.057	300.835	155.185	111.97	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				86.057	85.95	86.21	86.13	86.00
Grade				A	YES	YES	YES	YES

9. ENDI DARMAWAN

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88	7.04	88			
Quiz	Lecture 3	0.04	86.25	3.45	86.25			
Assignment 2	Lecture 4 & 5	0.08	87	6.96	87			
Laboratory Work Report	Lecture 7 & 8	0.12	86.45	10.374		86.45		
Assignment 3	Lecture 11 & 12	0.1	82.5	8.25			82.5	
Mid-Semester Exam	Lecture 1-8	0.2	86.67	17.334	43.335	43.335		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				86.088	304.585	155.585	108.3	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				86.088	87.02	86.44	83.31	86.00
Grade				A	YES	YES	NO	YES

10. ALFIAN BUSTOMI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	85	3.4	85			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	86.55	10.386		86.55		
Assignment 3	Lecture 11 & 12	0.1	86.17	8.617			86.17	
Mid-Semester Exam	Lecture 1-8	0.2	86.33	17.266	43.165	43.165		
Final Semester Exam	Lecture 11-14	0.38	85	32.3		25.5	25.5	34
Final Score				85.809	301.165	155.215	111.67	34
Maximum Score				100	350	180	130	40
CLO Achievement				85.809	86.05	86.23	85.90	85.00
Grade				A	YES	YES	YES	NO

11. NANDA RIANA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88.5	7.08	88.5			
Quiz	Lecture 3	0.04	87.5	3.5	87.5			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	87.5	10.5		87.5		
Assignment 3	Lecture 11 & 12	0.1	93.335	9.3335			93.335	
Mid-Semester Exam	Lecture 1-8	0.2	91.67	18.334	45.835	45.835		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				88.3075	307.835	159.135	119.135	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				88.3075	87.95	88.41	91.64	86.00
Grade				A	YES	YES	YES	YES

12. REZA DEMAILA MIRANDA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	85	3.4	85			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	86.55	10.386		86.55		
Assignment 3	Lecture 11 & 12	0.1	86.17	8.617			86.17	
Mid-Semester Exam	Lecture 1-8	0.2	93.33	18.666	46.665	46.665		
Final Semester Exam	Lecture 11-14	0.38	90	34.2		27	27	36
Final Score				89.109	304.665	160.215	113.17	36
Maximum Score				100	350	180	130	40
CLO Achievement				89.109	87.05	89.01	87.05	90.00
Grade				A	YES	YES	YES	YES

13. YUNITA NURFADILA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87.5	7	87.5			
Quiz	Lecture 3	0.04	88.5	3.54	88.5			
Assignment 2	Lecture 4 & 5	0.08	86.5	6.92	86.5			
Laboratory Work Report	Lecture 7 & 8	0.12	88.5	10.62		88.5		
Assignment 3	Lecture 11 & 12	0.1	79.74	7.974			79.74	
Mid-Semester Exam	Lecture 1-8	0.2	84.33	16.866	42.165	42.165		
Final Semester Exam	Lecture 11-14	0.38	87	33.06		26.1	26.1	34.8
Final Score				85.98	304.665	156.765	105.84	34.8

Maximum Score	100	350	180	130	40
CLO Achievement	85.98	87.05	87.09	81.42	87.00
Grade	A	YES	YES	NO	YES

14. M. AKBAR SATRIAWAN

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	90.5	7.24	90.5			
Quiz	Lecture 3	0.04	90.5	3.62	90.5			
Assignment 2	Lecture 4 & 5	0.08	89	7.12	89			
Laboratory Work Report	Lecture 7 & 8	0.12	90.5	10.86		90.5		
Assignment 3	Lecture 11 & 12	0.1	92.5	9.25			92.5	
Mid-Semester Exam	Lecture 1-8	0.2	92.67	18.534	46.335	46.335		
Final Semester Exam	Lecture 11-14	0.38	90	34.2		27	27	36
Final Score				90.824	316.335	163.835	119.5	36
Maximum Score				100	350	180	130	40
CLO Achievement				90.824	90.38	91.02	91.92	90.00
Grade				A	YES	YES	YES	YES

15. ADE GILANG RHOMADHON

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87	6.96	87			
Quiz	Lecture 3	0.04	86	3.44	86			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	87	10.44		87		
Assignment 3	Lecture 11 & 12	0.1	85.65	8.565			85.65	

Mid-Semester Exam	Lecture 1-8	0.2	92	18.4	46	46		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				87.365	305	158.8	111.45	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				87.365	87.14	88.22	85.73	86.00
Grade				A	YES	YES	YES	YES

16. HANNY LIA ANGGRAINI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88	7.04	88			
Quiz	Lecture 3	0.04	88.5	3.54	88.5			
Assignment 2	Lecture 4 & 5	0.08	89	7.12	89			
Laboratory Work Report	Lecture 7 & 8	0.12	89	10.68		89		
Assignment 3	Lecture 11 & 12	0.1	89.4	8.94			89.4	
Mid-Semester Exam	Lecture 1-8	0.2	86.6	17.32	43.3	43.3		
Final Semester Exam	Lecture 11-14	0.38	92	34.96		27.6	27.6	36.8
Final Score				89.6	308.8	159.9	117	36.8
Maximum Score				100	350	180	130	40
CLO Achievement				89.6	88.23	88.83	90.00	92.00
Grade				A	YES	YES	YES	YES

17. DESI FITRIYANI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	92.5	7.4	92.5			
Quiz	Lecture 3	0.04	92.5	3.7	92.5			

Assignment 2	Lecture 4 & 5	0.08	94	7.52	94			
Laboratory Work Report	Lecture 7 & 8	0.12	90	10.8		90		
Assignment 3	Lecture 11 & 12	0.1	95.95	9.595			95.95	
Mid-Semester Exam	Lecture 1-8	0.2	90.33	18.066	45.165	45.165		
Final Semester Exam	Lecture 11-14	0.38	100	38		30	30	40
Final Score				95.081	324.165	165.165	125.95	40
Maximum Score				100	350	180	130	40
CLO Achievement				95.081	92.62	91.76	96.88	100.00
Grade				A	YES	YES	YES	YES

18. HUMAIROH

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	90.5	7.24	90.5			
Quiz	Lecture 3	0.04	93	3.72	93			
Assignment 2	Lecture 4 & 5	0.08	92	7.36	92			
Laboratory Work Report	Lecture 7 & 8	0.12	94	11.28		94		
Assignment 3	Lecture 11 & 12	0.1	91.24	9.124			91.24	
Mid-Semester Exam	Lecture 1-8	0.2	87.33	17.466	43.665	43.665		
Final Semester Exam	Lecture 11-14	0.38	100	38		30	30	40
Final Score				94.19	319.165	167.665	121.24	40
Maximum Score				100	350	180	130	40
CLO Achievement				94.19	91.19	93.15	93.26	100.00
Grade				A	YES	YES	YES	YES

19. NURIL AZMI PURWITASARI

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	89.5	7.16	89.5			
Quiz	Lecture 3	0.04	89	3.56	89			
Assignment 2	Lecture 4 & 5	0.08	89	7.12	89			
Laboratory Work Report	Lecture 7 & 8	0.12	89.8	10.776		89.8		
Assignment 3	Lecture 11 & 12	0.1	73.74	7.374			73.74	
Mid-Semester Exam	Lecture 1-8	0.2	84.33	16.866	42.165	42.165		
Final Semester Exam	Lecture 11-14	0.38	87	33.06		26.1	26.1	34.8
Final Score				85.916	309.665	158.065	99.84	34.8
Maximum Score				100	350	180	130	40
CLO Achievement				85.916	88.48	87.81	76.80	87.00
Grade				A	YES	YES	NO	YES

20. FIGO A. SUTARMA

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	87.5	7	87.5			
Quiz	Lecture 3	0.04	89	3.56	89			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	89	10.68		89		
Assignment 3	Lecture 11 & 12	0.1	80.52	8.052			80.52	
Mid-Semester Exam	Lecture 1-8	0.2	86.67	17.334	43.335	43.335		
Final Semester Exam	Lecture 11-14	0.38	86	32.68		25.8	25.8	34.4
Final Score				86.186	305.835	158.135	106.32	34.4
Maximum Score				100	350	180	130	40
CLO Achievement				86.186	87.38	87.85	81.78	86.00

Grade	A	YES	YES	NO	YES

21. MUHAMMAD AZIZ

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88.5	7.08	88.5			
Quiz	Lecture 3	0.04	86.5	3.46	86.5			
Assignment 2	Lecture 4 & 5	0.08	86	6.88	86			
Laboratory Work Report	Lecture 7 & 8	0.12	91	10.92		91		
Assignment 3	Lecture 11 & 12	0.1	78.26	7.826			78.26	
Mid-Semester Exam	Lecture 1-8	0.2	92.67	18.534	46.335	46.335		
Final Semester Exam	Lecture 11-14	0.38	90	34.2		27	27	36
Final Score				88.9	307.335	164.335	105.26	36
Maximum Score				100	350	180	130	40
CLO Achievement				88.9	87.81	91.30	80.97	90.00
Grade				A	YES	YES	NO	YES

CLO Achievement Average for Class

Assessment	Source	Weight	Score	Weight * Score	Score of each CLO			
					CLO-1	CLO 2	CLO 3	CLO4
Assignment 1	Lecture 1 & 2	0.08	88.08	7.046285714	88.07857			
Quiz	Lecture 3	0.04	87.31	3.492571429	87.31429			
Assignment 2	Lecture 4 & 5	0.08	87.45	6.996190476	87.45238			
Laboratory Work Report	Lecture 7 & 8	0.12	88.20	10.584		88.2		
Assignment 3	Lecture 11 & 12	0.1	86.02	8.602214286			86.02214	
Mid-Semester Exam	Lecture 1-8	0.2	88.62	17.72314286	44.30786	44.30786		

Final Semester Exam	Lecture 11-14	0.38	88.24	33.53047619		26.47143	26.47143	35.29524
Final Score				87.97488095	307.1531	158.9793	112.4936	35.29524
Maximum Score				100	350	180	130	40
CLO Achievement				87.97488095	87.76	88.32	86.53	88.24
Grade				A	YES	YES	YES	YES

Appendix IV. Student's Laboratory Work Report: Person

LAPORAN TETAP

HAMA GUDANG BIOEKOLOGI

Judul : Bioekologi *Sitophilus zeamais* Motschulsky (Coleoptera: Curculionidae) sebagai hama pada produk simpanan

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1. Waktu dan Tempat

Adapun waktu dan tempat pelaksanaan praktikum ini dilakukan pada tanggal 28 September 2021, di Indralaya, Ogan Ilir, kota Palembang, Provinsi Sumatera Selatan.

2. Alat dan Bahan

Adapun alat yang digunakan pada praktikum hama gudang ini yaitu: 1) Timbangan dan 2) Wadah Plastik

Adapun bahan yang digunakan pada praktikum hama gudang ini yaitu: 1) *Sitophilus zeamais* 10 ekor dan 2) Biji Jagung Kering 10 gram.

3. Cara Kerja

Adapun cara kerja yang dilakukan dalam praktikum ini adalah:

1. Siapkan wadah plastik bersih berisi biji jagung kering yang sebelumnya ditimbang seberat 10 gram
2. Masukkan 10 ekor *Sitophilus zeamais* ke dalam wadah tersebut dan tutup wadah dengan menyisakan beberapa lubang kecil sebagai sirkulasi udara dalam wadah.
3. Amati aktivitas *Sitophilus zeamais* dalam wadah tersebut selama 14 hari.
4. Catat dan dokumentasikan hasil pengamatan pada hari 1, Hari ke 4, hari ke 8 dan hari ke 14.

4. Hasil dan Pembahasan

a. Hasil

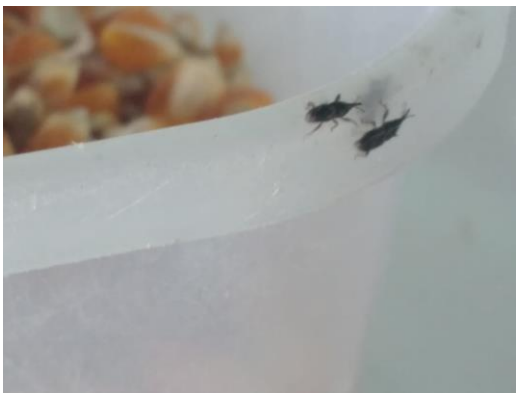
Pemeliharaan *Sitophilus zeamais*

Pemeliharaan *Sitophilus zeamais* berlangsung selama 14 hari dengan melihat perkembangan morfologi dan reproduksi *S. oryzae.*

1. Pengamatan hari ke 1

Pengamatan


2. Pengamatan hari ke 4

Pengamatan


3. Pengamatan hari ke 8

Pengamatan


4. Pengamatan hari ke 14

Pengamatan


b. Pembahasan

Berdasarkan hasil pengamatan terhadap pemeliharaan *Sitophilus zeamais* selama 14 hari, diperoleh hasil yang menunjukkan adanya peningkatan jumlah *S. zeamais.* Peningkatan jumlah *S. zeamais* pada proses pemeliharaan ini tidak menunjukkan nilai yang signifikan. Hal ini dapat dilihat dari aktivitas *S. zeamais* saat berada di dalam wadah hanya mengalami sedikit perubahan. Perubahan yang menjadi acuan dalam mengamati aktivitas serangga ini terdapat pada gejala yang ditimbulkan pada biji jagung yang terdapat pada wadah. Gejala yang ditimbulkan pada biji jagung tidak terlalu menunjukkan perubahan yang signifikan meskipun

bila diamati secara teliti, terjadi perubahan bentuk dari biji jagung sebagai akibat dari aktivitas *S. zeamais.*

Dalam pengamatan perkembangbiakan *S. zeamais*, praktikan mengalami sedikit kendala saat mengamati dan mendokumentasikan fase telur, larva dan pupa *S. zeamais* di dalam wadah. Hal ini dikarenakan ukuran serangga pada fase tersebut tergolong kecil dan sulit diamati menggunakan mata secara langsung. Telur *S. zeamais* berwarna putih bening, berbentuk lonjong, lunak dan licin, berukuran 0,7 mm x 0,3 mm (Grist dan Lever 1969; Anonymous 2014 dalam Nonci, 2015). Panjang larva berkisar antara 1,5–4 mm dan larva berjalan dengan mengerutkan badannya (Kartasapoetra 1987). Selain itu, terbatasnya peralatan pada saat pengamatan menjadi salah satu kendala dalam mendokumentasikan tiap fase perkembangbiakan. Namun, fase perkembangbiakan serangga ini dapat diamati secara langsung melalui gejala yang ditimbulkan pada biji jagung. Pupa berkembang di dalam biji jagung, yaitu pada lubang bekas gerekan larva (Nonci, 2015).

Aktivitas *S. zeamais* pada biji jagung dalam jangka waktu yang lama dan intensitas serangan yang tinggi adalah salah satu hal yang perlu untuk diwaspadai. Deteksi awal serangan S. zeamais sulit diketahui karena larva merusak/menggerek bagian dalam biji jagung. Serbuk hasil gerekan larva bercampur dengan kotoran larva di dalam biji (Anonymous 2014). Jika kerusakannya berat, dalam satu biji bisa terdapat lebih dari satu lubang gerekan. Salah satu indikasi biji jagung terserang hama bubuk yaitu bila biji tersebut dimasukkan ke dalam air maka biji akan terapung (Nonci, 2015). Untuk itu, perlu dilakukan upaya pencegahan untuk mengendalikan keberadaan *S. Zeamais* pada gudang penyimpanan. Upaya yang dapat dilakukan adalah dengan menjaga kebersihan dan suhu gudang, serta optimalisasi kualitas biji jagung saat penyimpanan.

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Appendix V. Student's Laboratory Work Report: Group

PRAKTIKUM HAMA GUDANG

KELOMPOK 4

I. Judul Praktikum

Pengaruh Ektrak Serai (*Cymbopogon citratus*) Terhadap Mortalitas *Sitophilus oryzae* Menggunakan Olfaktometer.

II. Waktu dan Tempat

Adapun waktu dan tempat pelaksanaan praktikum ini dilakukan pada tanggal 5 Oktober 2021, di Indralaya Utara, Ogan Ilir, Provinsi Sumatera Selatan.

III. Pelaksanaan Praktikum

A. Alat dan Bahan

Adapun alat yang digunakan pada praktikum hama gudang ini yaitu: 1) Pipa, 2) Gergaji Besi, 3) Plastik, dan 4) Penghubung T-pipa. Adapun bahan yang digunakan pada praktikum hama gudang ini yaitu: 1) 50 ekor *Sitophilus oryzae*, 2) Beras, dan 3) Ektrak serai (*Cymbopogon citratus)* dengan berbagai konsentrasi (25%, 20%, 15%, 10% dan 5%).

B. Cara Kerja

Adapun cara kerja pada praktikum hama gudang ini adalah dengan menggunakan Olfaktometer:

Alat:

1. Siapkan alat dan bahan yang digunakan
2. Potong pipa menjadi 3 bagian dengan ukuran 0.5 inch dan Panjang kurang lebih 20 cm, dan rangkai menggunakan penghubung T sehingga menjadi bentuk T.
3. Potong bagian atas pipa supaya memudahkan untuk mengamati perilaku *S. oryzae*.
4. Tutup pipa menggunakan plastik agar pergerakan *S. oryzae* dapat terlihat
5. Masukan Beras masing-masing ke lubang yang berada di sisi olfaktometer dengan kiri (kontrol) dan kanan (perlakuan).
6. Masukan *S. oryzae* kedalam olfaktometer melalui lubang bagian bawah kemudian tutup.

7. Amati pergerakan *S. oryzae*, apakah menuju perlakuan atau kontrol.
8. Pindahkan *S. oryzae* ke dalam wadah yang telah diisi beras dalam tiap konsentrasi yang telah ditentukan dari hasil maserasi.
9. Amati dan catat berapa *S. oryzae* yang mati pada berbagai perlakuan.

Bahan:

1. Siapkan serai lalu diiris - iris supaya memudahkan untuk menghaluskan serai.
2. Letakan di tempat datar kemudia tumbuk sampai hancur.
3. Peras ektraks lalu
4. Siapkan botol kemudian masukan ekstrak serai yang telah di tumbuk dan diamkan selama 24 jam.
5. Bagi cairan ke dalam 5 wadah berbeda, lalu encerkan sesuai konsentrasi yang telah ditentukan (25%, 20%, 15%, 10%, dan 5%)
6. Rendam beras selama 5 detik dalam setiap konsentrasi yang berbeda
7. Masukkan masing-masing 10 *S. oryzae* dalam setiap wadah pada beras yang telah direndam dalam konsentrasi yang telah ditentukan.

IV. Hasil Dan Pembahasan

A. Hasil Pengaplikasian

Berdasarkan praktikum yang telah dilakukan, saat melakukan pengujian menggunakan olfaktometer, dari 10 serangga uji, 6 di antaranya menuju ke arah perlakuan kontrol, sedangkan 4 diantaranya mengarah ke beras yang telah diberi perlakuan ekstrak serai (*Cymbopogon citratus*) Adapun hasil pengaplikasian dengan ektraks 25%, 20%, 15%, 10%, 5% dan 0% (kontrol) dapat dilihat pada tabel berikut.

Tabel 1. Hasil pengamatan pengaruh ekstrak serai(*Cymbopogon citratus*) terhadap *S. oryzae*

Perlakuan	Pengamatan
Perlakuan Ekstrak Serai 25%	9 Ekor
Perlakuan Ekstrak Serai 20%	7 Ekor
Perlakuan Ekstrak Serai 15 %	5 Ekor
Perlakuan Ekstrak Serai 10%	5 Ekor
Perlakuan Ekstrak Serai 5%	2 Ekor
Perlakuan 0%	0

Berdasarkan pengamatan yang dilakukan selama 12 jam pada setiap perlakuan, diketahui bahwa mortalitas tertinggi dialami oleh *S. oryzae* pada perlakuan ekstrak dengan konsentrasi tertinggi yaitu 25%, dari 10 serangga uji, 9diantaranya mengalami kematian (Tabel 1). Semakin rendah konsentrasi yang digunakan, tingkat kematian serangga *S. oryzae* akan semakin rendah.

B. Pembahasan

Prinsip kerja atau mekanisme pemanfaatan ekstrak tumbuhan sebagai pengendali pada serangga hama berkaitan dengan metabolit sekunder. Serangga memiliki organ sensorik yang peka pada beberapa aroma. Serai sebagai salah satu komoditas hortikultura terkenal dengan aroma nya yang khas dan pekat, senyawa yang terkandung di dalamnya sangat berpengaruh terhadap pertumbuhan dan perkembangan serangga. Kandungan metabolit sekunder dari tanaman serai meliputi alkaloid, flavonoid, polifenol, dan minyak atsiri (Abidin, *et al*. 2015).

Kandungan dari daun serai terutama minyak atsiri dengan komponen sitronelal 35,9%, geraniol 20,9%, sitronelol 5,2%, geranil asetat 4,0%, sitronelil asetat 2,9%, cubenol 1,0, geranial 1,5%. Minyak serai mengandung 3 komponen utama yaitu sitronelal, geraniol dan sitronelol. Abu dari daun dan tangkai serai mengandung 45% silika yang merupakan penyebab desikasi (keluarnya cairan tubuh secara terus menerus) pada kulit serangga sehingga serangga akan mati kekeringan. Sitronelol dan geraniol merupakan bahan aktif yang tidak disukai dan sangat dihindari serangga (Abidin, *et al*. 2015). Adapun menurut hasil penelitian oleh Santoso (2007), Serai juga mempunyai tipe mekanisme pengendalian anti-insektisida, *antifeedant, repelen, antifungal dan antibakterial*. Minyak atsiri serai terdiri

atas sitral, sitronela, geraniol, mirsena, nerol, farnesol, metil heptenol, dan dipentena. Kandungan yang paling besar adalah sitronela yaitu 35% dan geraniol 35-40%. Senyawa sitronela mempunyai sifat racun dehidrasi (*desiccant*) dan racun kontak. Serangga yang terkena racun ini akan mati karena kekurangan cairan.

Hasil penelitian Santoso (2007), menunjukkan bahwa perlakuan toples kaca memberikan pengaruh nyata terhadap persentase mortalitas hama sebesar 51,7%, persentase efektivitas sebesar 51%, dan jumlah turunan pertama 81 ekor. Bentuk sediaan serai tidak berpengaruh nyata terhadap persentase mortalitas, persentase efektivitas, dan jumlah turunan pertama. Persentase mortalitas makin menurun seiring lamanya waktu aplikasi, yakni sekitar 6% pada pengamatan hari kelima dan menurun menjadi kurang dari 1% pada hari ke-25. Adapun hasil yang didapatkan dari pengamatan yang dilakukan berdasarkan perlakuan yang diamati bahwa pada perlakuan control (perlakuan 0%) setelah diamati selama 12 jam, kutu beras masih hidup seperti pada awal perlakuan. Pada perlakuan 5% , 10%, 15%, 20%, dan 25% sitophilus mengalami kematian secara bertahap maksudnya sitophilus mengalami kematian secara berturut-turut 2, 5, 5, 7, dan 9 ekor kumbang beras pada perlakuan setelah dilakukan pengamatan selama 12 jam diamati.

Pada perlakuan alat olfaktormeter didapatkan kumbang beras (*Sithopilus oryzae*) mengalami tingkat preferensi tertinggi pada perlakuan (ekstrak serai) perlakuan di lakukan ekstrak sebanyak 6 ekor dari 10 ekor kumbang beras mengarah pada kontrol, sedangkan 4 sisanya menuju kontrol. Hal tersebut didukung oleh Kadir, *et al*. (2014) yang menyatakan, daun serai berpotensi bersifat penolak (*repellent*) serta sebagai insektisida, bakterisida, dan nematisida untuk menekan serangan hama kutu jagung (*Sitophilus* spp.) pada beberapa wadah.

V. Penutup

A. Kesimpulan

Adapun kesimpulan yang didapatkan dari hasil praktikum yang dilakukan bahwa :

1. Pada perlakuan kontrol, kumbang beras tidak mengalami perubahan populasi.
2. Setiap perlakuan 5%, 10%, 15%, 20%, dan 25% kumbang beras mengalami kekurangan populasi berbanding lurus dengan tingkat kematian kumbang beras.
3. Pada perlakuan olfaktometer, tingkat preferensi tertinggi terdapat pada perlakuan kontrol. Ekstrak serai berpotensi sebagai *repellent* atau penolak pada serangga *S. oryzae*.

B. Saran

Adapun saran yang dilakukan pada praktikum hama gudang ini adalah praktikan sebaiknya memahami dan mempelajari terlebih dahulu sistem sensorik pada serangga ujiserta pengaruhnya terhadap senyawa pada tanaman yang akan diujikan.

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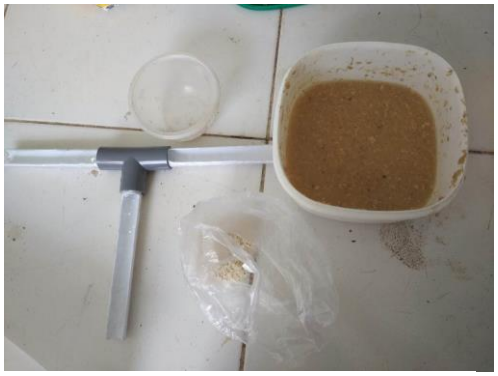
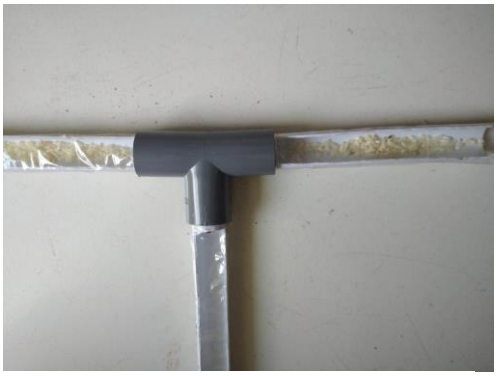
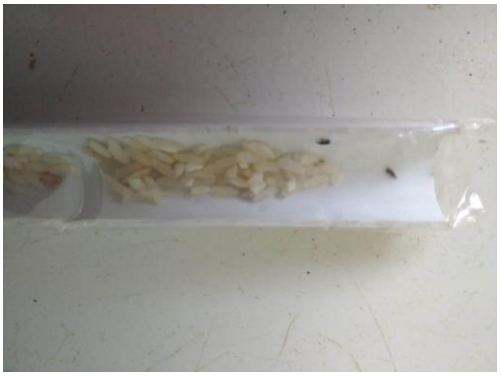
LAMPIRAN



Gambar 1. Alat dan Bahan praktikum



Gambar 2. Pengujian menggunakan olfaktometer



Gambar 3. *S. oryzae* yang mengarah ke perlakuan kontrol

Gambar 4. *S. oryzae* yang mengarah ke perlakuan ekstrak serai

Gambar 5. *S. oryzae* pada perlakuan beras rendaman 25% ekstrak serai

Gambar 6. *S. oryzae* pada perlakuan beras kontrol