

Course: Fermentation and Enzyme Technology

1. **Type** : Specialization's Elective
2. **Code** : PTN 6113
3. **Credit** : 1/1
4. **Semester** : Even
5. **Description** :

Fermentation has such a broad scope, including those related to animal science. By knowing the meaning of the fermentation process, the purpose and its benefits to the farm, will underlie us in improving the development of fermentation technology, including enzyme technology in the animal science, in which it is necessary in handling animal products and waste, production of additives, improving the quality and efficiency of feed utilization and evaluation. Based on this description it is no wonder is students study microbial metabolism in various types of fermentation, learn how to get superior microbial isolates and how to improve fermentation efficiency. With an active learning system that focuses on student involvement in discussions, and supported by practical material that is always related to the lecture unit, its expected that students will easily understand all the topics in lectures. The evaluation system that are agreed by the students are: quiz, midterm, and final exam, as well as paper presentation. Those four-evaluation system are claimed to be effective in giving the right evaluation results.

The course of Fermentation and Enzyme Technology discusses the meaning of fermentation processes, scope, objectives and their relation to enzyme technology, and their application in animal science that includes handling livestock products and wastes, producing additives, improving the quality and efficiency of feed utilization and feed evaluation, explaining about fermentation media, metabolism of nutrients by microbes, microbial growth and analysis of fermentation kinetics. Metabolic regulation is explained to get selected isolates and followed by procedures in microbial preservation as a starter and its application in the industrial world. This course also discusses the mechanism of work and the kinetic of enzymatic reactions, followed by procedures for isolation, enzyme purification, and purification of other fermented products. Applied genetic engineering is studied in order to increase the efficiency of fermentation products, ended by studying various enzyme production and fermentation technologies.

6. Course Outcomes (CO)

- CO 1 : Students can explain the fermentation process and its application in the world of animal science.
- CO 2 : Students can explain the process on producing proteins, especially enzymes and the application of enzyme technology.
- CO 3 : Students are able to design simple research, analyze and report related to fermentation and enzyme technology.

7. The Alignment Between CO and ELO

CO*	ELO**			
	A	B	C	D

	1	2	3	4	1	2	3	1	2	3	4	1	2	3	4	5	6
CO 1					✓	✓			✓								
CO 2					✓	✓			✓								
CO 3			✓	✓											✓	✓	

*CO refers to point 6.

**Expected Learning Outcomes (ELO) are written below,

A. Attitudes and Behaviors	
The graduates are able to behave well, correctly, and culturally as the result of internalization and actualization of values and norms, which is reflected in a spiritual and social life through learning process, experience, research, and/or community development in the animal husbandry.	
1	Piety to God and be able to show religious attitude and maintain the humanity values in carrying the task, which is based on religion, moral, and ethics.
2	Be proud and love the homeland show nationalism, and contribute to the improvement of the life quality in the community, nation and country, and the advancement of civilization according to Pancasila.
3	Showing the social sensitivity and attention to the community and environment by respecting the culture diversity, view, religious, beliefs, and other people's opinion, and also obey the rules.
4	Be accountable in carrying the professional practice that includes ability to accept accountability towards decision and professional action. It shall be according to the scope of the practice under their responsibility and laws.
B. Mastery in Sciences	
Master the theory of the current science in the animal husbandry and its application.	
1	Able to master the current animal science and its application theory.
2	Able to master the livestock production science, animal nutrition and fed science, animal products technology, and the livestock social economics in relation to food security and environment.
3	Able to master the design, management, and development of livestock research.
C. Special Skills	
The graduates are able to develop science, technology, and arts in the animal husbandry through interdisciplinary/multidisciplinary innovative and tested research.	
1	Able to make innovation in the animal husbandry based on the development of science and technology.
2	Able to design interdisciplinary and multidisciplinary research in the animal husbandry.
3	Able to formulate and solve problems in the national development especially in terms of animal husbandry.
4	Able to solve problems and anticipate issues in the development of animal science and industry.
D. General Skills	
The graduates are able to manage resources by utilizing science, technology, and arts to solve problems in the animal husbandry with current science and also conduct research with accountability and full responsibility.	
1	Able to develop logical, critical, systematic, and creative thought through scientific research, creation of design in the science and technology, which pays attention and applies humanity values according to their expertise. The graduates are able to arrange scientific concept and the study result based on the principles, procedures, and scientific ethics.
2	Able to identify the science that becomes their research object and position it to a research map by using information technology in the context of science development and expertise implementation developed through interdisciplinary or multidisciplinary approaches.
3	Able to make a decision in the context of solving problems in the development of science and technology, which pays attention and applies humanity values based on analysis study or experiment towards information and data.
4	Able to communicate the result of reasoning and scientific research in form of thesis and scientific writing responsibly based on academic ethics in the accredited national journal.

5	Able to maintain the academic integrity generally and avoid the plagiarism practice.
6	Able to communicate spoken and written English effectively by using the information technology for the development of animal science and its implementation.

8. Course Content

Week	CO	Topic/Subtopic	Learning Activity	Assessment Tools	Allocated Time	Lecturer
1	CO 1	Introduction	Lecture and discussion (SCL)	Midterm	1	Dr. Ir. Chusnul Hanim, M.Si., IPM
2	CO 1	Metabolism on various fermentation	Lecture and discussion (SCL)	Midterm	1	Dr. Ir. Chusnul Hanim, M.Si., IPM
3	CO 1	Microbes nutrient and fermentation media	Lecture and discussion (SCL)	Midterm	1	Dr. Ir. Chusnul Hanim, M.Si., IPM
4	CO 1	Microbes growth	Lecture and discussion (SCL)	Midterm	1	Prof. Dr. Ir. Lies Mira Yusiati, SU., IPU
5	CO 1	Microbes isolation	Lecture and discussion (SCL)	Midterm	1	Prof. Dr. Ir. Lies Mira Yusiati, SU., IPU
6	CO 1	Microbes preservation and improvement	Lecture and discussion (SCL)	Midterm	1	Prof. Dr. Ir. Lies Mira Yusiati, SU., IPU
7	CO 1	Fermentation kinetics	Lecture and discussion (SCL)	Midterm	1	Dr. Asih Kurniawati, S.Pt., M.Si., IPM
Midterm Examination						
8	CO 1	Sterilization	Lecture and discussion (SCL)	Final Exam	1	Prof. Dr. Ir. Zaenal Bachruddin, M.Sc., IPU

9	CO 1	Fermenter design, instrument and control	Lecture and discussion (SCL)	Final Exam	1	Prof. Dr. Ir. Zaenal Bachruddin, M.Sc., IPU
10	CO 2	Protein biosynthesis and genetic engineering	Lecture and discussion (SCL)	Final Exam	1	Prof. Dr. Ir. Zaenal Bachruddin, M.Sc., IPU
11	CO 2	Recovery and purification of fermentation products, including enzyme	Lecture and discussion (SCL)	Final Exam	1	Dr. Asih Kurniawati, S.Pt., M.Si., IPM
12	CO 2	Kinetics of one-substrate enzymatic reaction and kinetics reaction inhibitor	Lecture and discussion (SCL)	Final Exam	1	Dr. Asih Kurniawati, S.Pt., M.Si., IPM
13	CO 2	Enzyme technology and biotechnology	Lecture and discussion (SCL)	Final Exam	1	Muhlisin, S.Pt., M.Agr., Ph.D
14	CO 3	Students presentation	Lecture and discussion (SCL)	Final Exam	1	Muhlisin, S.Pt., M.Agr., Ph.D
Final Examination						

9. Practicum

Week	Activity	Methods	Total Hours
1	Preparing medium	Group practicum	3
2	Techniques on microbe isolation	Group practicum	4
3	Colony counting	Group practicum	2
4	Cellulolytic microbes selection	Group practicum	3
5	Xilanolytic microbes selection	Group practicum	3

6	Solid and liquid fermentation	Group practicum	4
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10. Assessment

Component	CO	Percentage (%) for final grade	Minimum Satisfactory Level
Midterm	CO 1	25	70
Presentation	CO 3	10	70
Final Exam	CO 2	25	70
Practicum	CO 3	40	70
Total		100	

11. Lecturer

1. Prof. Dr. Ir. Lies Mira Yusiati, SU., IPU
2. Prof. Ir. Zaenal Bachruddin, M.Sc., Ph.D., IPU
3. Dr. Ir. Chusnul Hanim, M.Si, IPM
4. Dr. Ir. Asih Kurniawati, S.Pt., M.Si., IPM
5. Muhlisin, S.Pt., M.Agr., Ph.D

12. Reference