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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Biotechnology	4720102020		T=2	P=0	ECTS=3.18	7	July 18, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	Dr. Amaria, M.Si.

Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

Program Objectives (PO)

PLO-PO Matrix

P.O

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

Short Course Description: Study of microorganisms in industry, metabolic products, regulation of metabolism in microorganisms, fermentation processes, genetic engineering technology and its use in human life carried out through discussions and presentations

References

Main :

1.

1. Brown, T.A., 1989, **Genetics : A Molecular Approach**, London : Van Nostrand Reinhold (International) Co. Ltd.

2. Glick, B.R., and Pasternak, J.J., 1994, **Molecular Biotechnology : Principles and Application of Recombinant DNA**, Washington, D.C : ASM Press.

3. Mousdale, D.M. 2008. Biofuels Biotechnology, Chemistry and Sustainable Development, Taylor & Francis Group, LLC

4. Judoamidjojo, Darwis dan Said, 1992, **Teknologi Fermentasi**, Jakarta : C.V. Rajawali Pers.

5. Aehle W, 2007, Enzyme in industry : Production and Application, 3rd edition, Wiley-VCH Verlag GMBH & Co. KgaA Netherland

6. Stanlury and Whitaker, 1984, **Principles of Fermentation Technology**, New York : Pergamon Press Ltd.

Supporters:

Supporting lecturer: Prof. Dr. Nuniek Herdyastuti, M.Si.
Mirwa Adiprahara Anggarani, 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	Understand the scope of Biotechnology in general and the fields of science related to it.	1. Biotechnology according to several experts 2. Explain the relationship between Bitechnology and other branches of science 3. Explain the beginning of the development of Biotechnology Explain the revolution in the development of Biotechnology and its benefits	**Criteria:** 1. The assessment is carried out on the following aspects: 2. 1. Participation during lectures and practicums is carried out through observation 3. 2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 4. 3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 5. The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, Questions and answers 2 X 50			0%
2	Understand treatment techniques for microorganisms and the resulting metabolic products			Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

3	Understand treatment techniques for microorganisms and the resulting metabolic products	1. Mention sources of microorganisms 2. Explain techniques for isolating microorganisms from different sources 3. Explain how to select microorganisms 4. Mention methods for measuring microorganisms 5. Explain the stages of measuring microorganisms 6. Explain counting microorganisms 7. Mention methods for storing microorganisms 8. Explain the stages of storage of microorganisms 9. Explain the phases in the growth curve 10. Explain how to make a growth curve 11. Explain the factors that influence the growth of micro-organisms 12. Explain the requirements for micro-organisms used in industry 13. Mention examples of industrial microorganisms and the products produced 14. Mention metabolic products 15. Explain the differences between primary and secondary metabolites 16. Explain how primary metabolites or secondary metabolites are produced	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

4	Understand the concept of several types of metabolic regulation in microorganisms	1. Explain the differences between induction and repression processes with examples 2. Name molecules that function as inducers and repressors 3. Explain the meaning of feedback regulation 4. Explain examples of feedback regulation 5. Explain the differences in various types of branching pathway regulation 6. Explain examples various types of branching pathway regulation 7. Explain catabolic regulation with examples	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%
5	Understand the concept of several types of metabolic regulation in microorganisms	1. Explain the differences between induction and repression processes with examples 2. Name molecules that function as inducers and repressors 3. Explain the meaning of feedback regulation 4. Explain examples of feedback regulation 5. Explain the differences in various types of branching pathway regulation 6. Explain examples various types of branching pathway regulation 7. Explain catabolic regulation with examples	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

6	Understand the fermentation process	1. Explain the meaning of fermentation 2. Explain the stages of fermentation 3. explain the factors that influence fermentation 4. Mention the types of fermentation 5. Explain the differences between Batch culture, culture continue Feed-Batch Culture 6. Explain the kinetics of Batch culture, culture continue Feed- Batch Culture 7. Explain the advantages and disadvantages of Batch culture, culture continue Feed-Batch Culture 8. Explain the application of Batch culture, culture continue Feed-Batch Culture 9. Explain the criteria for media that are suitable for industry 10. Explain the media components that meet the requirements for the growth of microorganisms 11 . Mention examples of media for several products	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

7	Understand the fermentation process	1. Explain the meaning of fermentation 2. Explain the stages of fermentation 3. explain the factors that influence fermentation 4. Mention the types of fermentation 5. Explain the differences between Batch culture, culture continue Feed-Batch Culture 6. Explain the kinetics of Batch culture, culture continue Feed- Batch Culture 7. Explain the advantages and disadvantages of Batch culture, culture continue Feed-Batch Culture 8. Explain the application of Batch culture, culture continue Feed-Batch Culture 9. Explain the criteria for media that are suitable for industry 10. Explain the media components that meet the requirements for the growth of microorganisms 11 . Mention examples of media for several products	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%
8	Understand the scope of biotechnology	Explain biotechnology	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Giving a 2 X 50 Sub-summative written test			0%

9	Understand the basic concepts of genetic engineering / gene cloning, cloning vectors and restriction enzymes.	1. Be able to explain the meaning of genetic engineering / gene cloning. 2. Be able to explain the definition of recombinant DNA. 3. Be able to explain the stages in genetic engineering techniques. 4. Be able to mention the types of cloning vectors in genetic engineering. 5. Be able to explain the requirements for cloning vectors. 6. Be able to explain how to obtain DNA fragments. 7. Be able to explain the advantages of using restriction enzymes in obtaining specific DNA fragments. 8. Be able to state the definition of a restriction enzyme. 9. Be able to explain the history of the discovery of restriction enzymes. 10. Be able to name the known types of restriction enzymes. 11. Be able to differentiate between each type of restriction enzyme. 12. Be able to explain the advantages of using type II restriction enzymes. 13. Be able to explain the system for naming type II restriction enzymes. 14. Be able to explain different restriction enzyme naming systems, but come from the same organism. 15. Be able to explain the recognition area for restriction enzymes. 16. Be able to explain the meaning of paliandromes. 17. Be able to explain two models of restriction enzyme cutting. 18. Be able to explain several examples of typical restriction enzymes in the recognition area and their cutting results.	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

10	Understand the basic concepts of genetic engineering / gene cloning, cloning vectors and restriction enzymes.	1. Be able to explain the meaning of genetic engineering / gene cloning. 2. Be able to explain the definition of recombinant DNA. 3. Be able to explain the stages in genetic engineering techniques. 4. Be able to mention the types of cloning vectors in genetic engineering. 5. Be able to explain the requirements for cloning vectors. 6. Be able to explain how to obtain DNA fragments. 7. Be able to explain the advantages of using restriction enzymes in obtaining specific DNA fragments. 8. Be able to state the definition of a restriction enzyme. 9. Be able to explain the history of the discovery of restriction enzymes. 10. Be able to name the known types of restriction enzymes. 11. Be able to differentiate between each type of restriction enzyme. 12. Be able to explain the advantages of using type II restriction enzymes. 13. Be able to explain the system for naming type II restriction enzymes. 14. Be able to explain different restriction enzyme naming systems, but come from the same organism. 15. Be able to explain the recognition area for restriction enzymes. 16. Be able to explain the meaning of paliandromes. 17. Be able to explain two models of restriction enzyme cutting. 18. Be able to explain several examples of typical restriction enzymes in the recognition area and their cutting results.	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, ask questions, answer 2 X 50 practice questions			0%

11	Understand gene cloning strategies using plasmid vectors, especially pBR322 and pUC8 and identify recombinant clones.	1. Be able to explain the basic characteristics of plasmids. 2. Be able to explain the requirements for a plasmid as a cloning vector. 3. Be able to name two examples of plasmids that are often used as cloning vectors. 4. Be able to explain the genetic organization of the pBR322 plasmid. 5. Be able to explain the advantages of pBR 322 as a plasmid vector. 6. Be able to mention the stages of gene cloning with the pBR322 plasmid. 7. Be able to explain the ligation process in pBR322. 8. Able to explain how to overcome problems that arise during the ligation process. 9. Be able to explain the screening and selection system for the pBR322 plasmid. 10. Be able to explain the genetic organization of the pUC8 plasmid. 11. Be able to explain the advantages of using the pUC8 plasmid as a plasmid vector. 12. Be able to mention the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the ligation process in pUC8 14. Be able to explain the screening and selection system for the pUC8 plasmid	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Studying material from mandatory books, questions and answers, summarizing 2 X 50			0%

12	Understand gene cloning strategies using plasmid vectors, especially pBR322 and pUC8 and identify recombinant clones.	1. Be able to explain the basic characteristics of plasmids. 2. Be able to explain the requirements for a plasmid as a cloning vector. 3. Be able to name two examples of plasmids that are often used as cloning vectors. 4. Be able to explain the genetic organization of the pBR322 plasmid. 5. Be able to explain the advantages of pBR 322 as a plasmid vector. 6. Be able to mention the stages of gene cloning with the pBR322 plasmid. 7. Be able to explain the ligation process in pBR322. 8. Able to explain how to overcome problems that arise during the ligation process. 9. Be able to explain the screening and selection system for the pBR322 plasmid. 10. Be able to explain the genetic organization of the pUC8 plasmid. 11. Be able to explain the advantages of using the pUC8 plasmid as a plasmid vector. 12. Be able to mention the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the ligation process in pUC8 14. Be able to explain the screening and selection system for the pUC8 plasmid	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Studying material from mandatory books, questions and answers, summarizing 2 X 50			0%

13	Understand how to identify genes produced in the cloning process.	1. Be able to mention methods of gene identification. 2. Be able to explain the general meaning of these methods. 3. Be able to explain the basic concepts of hybridization. 4. Be able to mention the components needed in hybridization. 5. Be able to explain the steps of hybridization. 6. Be able to explain how to detect hybridization results. 7. Able to explain the basic concepts of sequencing. 8. Be able to mention the components needed for sequencing. 9. Be able to explain the stages of a sequencing reaction. 10. Able to interpret sequencing results.	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Study material from mandatory books, questions and answers, practice questions 2 X 50			0%
14	Understand in vitro cloning (PCR), as well as several applications of genetic engineering techniques	1. Able to explain the basics of PCR techniques. 2. Be able to explain the components needed for PCR. 3. Able to explain PCR requirements. 4. Be able to explain the stages of the PCR reaction in each PCR cycle. 5. Be able to explain PCR amplification with a certain number of cycles. 6. Be able to explain the advantages of the PCR technique. 7. Able to explain the application of PCR in several aspects of life. 8. Be able to explain the basic concepts of therapeutic cloning. 9. Be able to explain the stages of therapeutic cloning. 10. Be able to explain the uses of therapeutic cloning. 11. Be able to explain in general the molecular structure of the insulin hormone. 12. Be able to explain the stages of cloning the insulin hormone gene.	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Studying material from mandatory books, questions and answers, making 2 X 50 papers			0%

15	Understand the basic concepts of Bioinformatics and the science related to it, as well as its applications in various fields.	1. Able to explain the meaning of Bioinformatics. 2. Able to explain the relationship between Bioinformatics and other branches of science. 3. Be able to explain the beginning of the development of Bioinformatics. 4. Able to explain the main applications of Bioinformatics. 5. Be able to explain biological sequence databases. 6. Be able to explain database searches on the internet. 7. Able to do BLAST. 8. Able to carry out the sequence alignment process	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	Studying material from mandatory books, questions and answers, making 2 X 50 papers			0%
16	Understand the scope of biotechnology	Understanding biotechnology	**Criteria:** 1.1. Participation during lectures and practicums is carried out through observation 2.2. Subsummative test, carried out twice, assessing all relevant indicators through a written exam, averaged 3.3. Performance and product assessments in the form of practical reports and papers are considered assignments, the scores are averaged 3x the UAS score, given a weight of (3) 4.The final NA is (participation value x2) (assignment value x 3) (UTS value x 2) UAS value (3) divided by 10	- 2 X 50			0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
		0%

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.