	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
Biochemical Research Techniques	4720102172	Study Program Elective Courses	T=2	P=0	ECTS=3.18	7	July 21, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

Program Objectives (PO)

PO - 1	Able to make appropriate decisions in the context of solving problems in the field of chemistry
PO - 2	Able to solve science, technology and art problems in the general field of chemistry and within a simple scope and have skills in isolating and identifying enzymes, proteins and DNA from various sources as well as applying relevant technology
PO - 3	Master theoretical concepts about techniques or methods for isolating enzymes, proteins and DNA from various sources, purifying and characterization of proteins and DNA, PCR and Sequencing techniques and understanding the basic techniques of recombinant DNA and their applications
PO - 4	Able to show cooperation

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3
PO-4

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																

Short Course Description: Study of techniques or methods for isolating enzymes, proteins and DNA from various sources, purification and characterization of proteins and DNA, PCR and sequencing techniques as well as basic recombinant DNA techniques carried out through discussions, presentations and practicums

References

Main :

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. Bollag D. 1996.Protein Method. New York: John Willey and Sons. Inc
4. Boyer R, 2000. Modern Experimental Biochemistry. San Francisco: Addison Wesley Longman
5. Alexander R. R. and Griffiths J. M. , 1993, Basic Biochemical Methods, New York : John Willey and Sons. Inc6. Aehle W, 2007, Enzyme in industry : Production and Application, 3rd edition, Wiley-VCH Verlag GMBH & Co. KgaA Netherland

Supporters:

Supporting lecturer: Prof. Dr. Hj. Rudiana Agustini, M.Pd.
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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 nature of proteins and environmental factors that can influence the results of protein or enzyme isolation	1. Explain the basic properties of proteins 2. Explain buffer solutions and how to make them 3. Explain how to store proteins with buffer solutions	**Criteria:** Participation, assignments **Form of Assessment** : Participatory Activities	Lecture, Question and answer, 2 X 50			5%
2	Understand the nature of proteins and environmental factors that can influence the results of protein or enzyme isolation	1. Mention several examples of salts and metal ions 2. Explain the properties of salts or metal ions and their effects on proteins 3. Define detergent compounds and examples 4. Explain the effect of detergent on proteins or enzymes	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Study material from mandatory books, ask questions, answer 2 X 50 practice questions	Explore examples of the effects of salt, metal ions and detergents on proteins	**Material:** the effect of salts, metal ions, and detergents on proteins. **Reference:** *Alexander RR and Griffiths JM, 1993, Basic Biochemical Methods, New York: John Willey and Sons. Inc6. Aehle W, 2007, Enzymes in industry : Production and Application, 3rd edition, Wiley-VCH Verlag GMBH & Co. KGAA Netherlands*	5%
3	Understand protein or enzyme isolation techniques, protein identification and concentration	1. Explain the types of cells as sources of protein 2. Explain extracellular and intracellular proteins or enzymes 3. Explain the physical techniques for breaking down proteins or enzymes 4. Explain techniques for enzymatic breakdown of proteins or enzymes	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Case method Presentation/group discussion 2 X 50	Explore examples of protein or enzyme isolation techniques, identification and concentration	**Material:** Isolation of proteins or enzymes: cell breakdown techniques, determination of protein concentration, protein concentration, dialysis **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	0%
4	Have protein or enzyme isolation skills from various sources	1. Explain the technique of breaking down proteins or enzymes using the lysis method 2. Explain the determination of protein concentration using the Bradford method 3. Explain the technique of concentrating proteins with polyethylene glycol (PEG)	**Criteria:** Criteria: Participation with a weight of 20%; Tasks with a weight of 30%; UTS with a weight of 20%; UAS with a weight of 30%; UTS and UAS use Essay questions; Performance assessment is carried out in an integrated manner with learning **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Case method Presentation/group discussion 2 X 50	Explore examples of protein or enzyme isolation techniques, protein identification and concentration	**Material:** Isolation of proteins or enzymes: cell breakdown techniques, determination of protein concentration, protein concentration, dialysis **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	5%

5	Have skills in concentrating proteins or enzymes from various sources	1. Explain the determination of protein concentration using the Lowry method 2. Explain the determination of protein concentration using the BCA (Bicinchoninic Acid) method 3. Explain the concentration of proteins by adding ammonium sulfate 4. Explain the advantages and disadvantages of using ammonium sulfate in protein concentration	**Criteria:** Criteria: Participation with a weight of 20%; Tasks with a weight of 30%; UTS with a weight of 20%; UAS with a weight of 30%; UTS and UAS use Essay questions; Performance assessment is carried out in an integrated manner with learning **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Case method Presentation/group discussion 2 X 50	Explore examples of protein or enzyme isolation techniques, protein identification and concentration	**Material:** Isolation of proteins or enzymes: cell breakdown techniques, determination of protein concentration, protein concentration, dialysis **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	5%
6	Understand the technique of determining molecular weight using SDS-PAGE (Sodium Dodecyl Sulphate - polyacrylamide gel electrophoresis)	1. Explain the concentration of proteins by adding several organic solutions 2. Explain the advantages and disadvantages of using organic solutions for protein concentration 3. Explain protein concentration using the ultrafiltration method 4. Explain the dialysis process	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities	Case method Presentation/group discussion 2 X 50	Explore examples of protein or enzyme isolation techniques, protein identification and concentration	**Material:** Isolation of proteins or enzymes: cell breakdown techniques, determination of protein concentration, protein concentration, dialysis **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	5%
7	Have skills in determining the molecular weight of proteins or enzymes using SDS-PAGE	Perform skills in determining the molecular weight of proteins or enzymes using SDS-PAGE	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Group assignments, presentations and questions and answers 2 X 50	Explore examples of techniques for determining molecular weight using SDS-PAGE (Sodium Dodecyl Sulphate - polyacrylamide gel electrophoresis)	**Material:** Determination of molecular weight by electrophoresis **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	5%
8	Midterm exam		**Criteria:** UTS value **Form of Assessment** : Test	Giving written test 2 X 50			20%

9	Understand protein or enzyme purification methods	1. Explain the meaning of pure protein or enzyme 2. Describes several ways to purify proteins or enzymes 3. Explain the immunoblotting method 4. Explain the purification of proteins or enzymes using the ion exchange chromatography method 5. Explains the purification of proteins or enzymes using the gel filtration method 6. Explain the purification of proteins or enzymes using the affinity chromatography method	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities	Case method Presentation/group discussion 2 X 50	Explore examples of protein and enzyme purification	**Material:** Purification of proteins or enzymes **References:** *Bollag D. 1996. Protein Method. New York: John Willey and Sons. Inc*	10%
10	Understand cell breakdown techniques to obtain DNA from various sources and DNA identification	1. Explain cell breakdown techniques 2. Explains the determination of DNA concentration at l 260 nm 3. Explains determining DNA concentration using the nanodrop method 4. Explain the DNA identification method 5. Describe the compound ethidium bromide 6. Explain the determination of base size in the presence of standard DNA 7. Explains several examples of DNA sizes from various sources	**Criteria:** Criteria: Participation with a weight of 20%; Tasks with a weight of 30%; UTS with a weight of 20%; UAS with a weight of 30%; UTS and UAS use Essay questions; Performance assessment is carried out in an integrated manner with learning **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, questions and answers, presenting videos, answering 2 X 50 practice questions	The group assignment discussed techniques for breaking cells to obtain DNA	**Material:** DNA Isolation **Bibliography:** *Boyer R, 2000. Modern Experimental Biochemistry. San Francisco: Addison Wesley Longman*	10%
11	Understand the technique of separating and determining the size of DNA by electrophoresis	1. Explain the mechanism of electrophoresis 2. Explain the use of electrophoresis 3. Explain the meaning of feedback regulation 4. Explain the ingredients needed to make gel 5. Explain DNA electrophoresis equipment	**Criteria:** Participation **Form of Assessment** : Participatory Activities	Lectures, questions and answers, presenting videos, answering 2 X 50 practice questions	Group assignment on DNA electrophoresis	**Material:** DNA Electrophoresis **Bibliography:** *Boyer R, 2000. Modern Experimental Biochemistry. San Francisco: Addison Wesley Longman*	5%

12	Have the skills to isolate DNA from various sources	1. Mention the type of gel and gel concentration 2. Explain how to make gel 2. Explain how to make gel 3. Explain the ingredients for sample preparation 4. Explain how to run a sample on a gel 5. Explain how to identify electrophoresis results	**Criteria:** Criteria: Participation with a weight of 20%; Tasks with a weight of 30%; UTS with a weight of 20%; UAS with a weight of 30%; UTS and UAS use Essay questions; Performance assessment is carried out in an integrated manner with learning **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, questions and answers, presenting videos, answering 2 X 50 practice questions	Group assignment on how to separate DNA	**Material:** DNA Electrophoresis **Bibliography:** *Boyer R, 2000. Modern Experimental Biochemistry. San Francisco: Addison Wesley Longman*	10%
13	Understand PCR and Sequencing methods	1. Explain the basics of PCR techniques. 2. Explain the components required for PCR. 3. Explain PCR requirements. 4. Explain the stages of the PCR reaction in each PCR cycle. 5. Identify PCR results 6. Explain the basic techniques of Sequencing 7. Explain the components required for Sequencing 8. Explain the stages of the sequencing process 9. Identify sequencing results 10. Explain the application of PCR and sequencing in several example problems	**Criteria:** Tasks and participation **Form of Assessment** : Participatory Activities	Case method Presentation/group discussion 2 X 50	Group assignments about PCR	**Material:** Identification of gene cloning results: Basic principles of PCR, PCR cycle, sequencing, PCR applications and sequencing **References:** *Boyer R, 2000. Modern Experimental Biochemistry. San Francisco: Addison Wesley Longman*	5%

14	Understand the basic concepts of genetic engineering / gene cloning, restriction enzyme cloning vectors and competent cells	1. Explain the meaning of genetic engineering / gene cloning. 2. Explain the definition of recombinant DNA 3. Explain the stages in genetic engineering techniques 4. Mention the types of cloning vectors in genetic engineering. 5. Explain the requirements for cloning vectors. 6. Explain how to obtain DNA fragments. 7. Explain the advantages of using restriction enzymes in obtaining specific DNA fragments 8. State the definition of a restriction enzyme. 9. Explain the history of the discovery of restriction enzymes. 10. Mention the known types of restriction enzymes.	**Criteria:** Tasks and participation **Form of Assessment** : Participatory Activities	2 X 50 group presentations/discussions	Group assignments related to basic concepts of genetic engineering	**Material:** Gene cloning **References:** *Glick, BR, and Pasternak, JJ, 1994, Molecular Biotechnology: Principles and Application of Recombinant DNA, Washington, D. C: ASM Press.*	5%
15	Understand the basic concepts of genetic engineering / gene cloning, restriction enzyme cloning vectors and competent cells	1. 1. Differentiate between each type of restriction enzyme 2. 2. Explain the advantages of using type II restriction enzymes. 3. 3. Explain the system for naming type II restriction enzymes. 4. 4. Explain the different naming systems for restriction enzymes, but come from the same organism. 5. 5. Explain the recognition area for restriction enzymes. 6. 6. Explain the two models of restriction enzyme cleavage 7. 7. Explain several examples of restriction enzymes that are typical in the recognition area and cutting results.	**Criteria:** Participation and tasks **Form of Assessment** : Participatory Activities	2 X 50 group presentations/discussions	Group assignment on genetic engineering	**Material:** Gene cloning **References:** *Glick, BR, and Pasternak, JJ, 1994, Molecular Biotechnology: Principles and Application of Recombinant DNA, Washington, D. C: ASM Press.*	5%
16	UAS		**Criteria:** UAS scores **Form of Assessment** : Test	2 X 50			0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	60%
2.	Project Results Assessment / Product Assessment	20%
3.	Test	20%
		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.