

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

Document Code

Courses			CODE		Cou	rse Fan	nily		Cre	edit W	eight		SEN	IESTER	Compilatio Date
Biotechnolog	у		4720102020						T=2	2 P=(EC.	rs=3.18		7	July 18, 202
AUTHORIZAT	ION		SP Developer				•	Course Cluster Coordinator			Study Program Coordinator				
												Dr. Amaria, M.Si.			
Learning model	Project Based Lea	arning	1												
Program	PLO study progr	dy program that is charged to the course													
Learning Outcomes	Program Objectiv	m Objectives (PO)													
(PLO)	PLO-PO Matrix	-	-												
		P.O													
	PO Matrix at the	end o	of each learning	j stage	(Sub-	PO)									
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			1 2	3 4	5	6	7	8	9	10	11	12	13	14	15 16
Short Course Description	Study of microorga genetic engineering													ermentat	on processe
References	Main :														
	1.														
	1. Browi (Internati	n, T. ional	.A., 1989, Ge i) Co. Ltd.	netics	: A	Mole	cular	Арр	oroa	ch,	Lond	on : N	/an	Nostrar	d Reinhol
	2. Glick, of Reco r	B.R. mbin	., and Pasterna ant DNA, Was	ak, J.J shingto	., 199 on, D.	94, Mo C : AS	lecula SM Pr	ar Bi ess.	oteo	chno	logy	: Prine	ciple	s and a	Applicatio
	3. Mouso Francis (D.M. 2008. Bio p, LLC	ofuels	Bioteo	chnolo	ogy, C	hem	istry	' and	Sust	ainable	e Dev	/elopme	ent, Taylor
	4. Judoa	midjo	ojo, Darwis dar	n Said,	1992	2, Tekr	nolog	i Fer	mer	ntasi	Jaka	arta : C	.V. F	Rajawal	Pers.
			2007, Enzyme KgaA Netherla		istry :	: Prod	luctior	n and	l Ap	plica	ion,	3rd edi	tion,	Wiley-	/CH Verla
	6. Stanlu Press Lto		nd Whitaker, 1	.984, F	rinci	ples (of Fe	rmen	ntati	on T	echn	ology,	Nev	v York	: Pergamo
	Supporters:														
Supporting lecturer	Prof. Dr. Nuniek He Mirwa Adiprahara A														

Week-	Final abilities of each learning stage	Ev	aluation	Lear Stude	elp Learning, ning methods, nt Assignments, stimated time]	Learning materials [References	Assessment Weight (%)
	(Sub-PO)	Indicator	Criteria & Form	Offline(offline)	Online (<i>online</i>)]	
(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%

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

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 examples of branching pathway regulation 7. Explain examples of branching pathway regulation 7. Explain examples 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,	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	Study material from mandatory books, ask questions, answer 2 X 50 practice questions		0%
		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	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 3) (UTS value x 2) UAS value (3) divided by 10			

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 7. Explain the advantages and disadvantages of Batch culture 7. Explain the advantages and disadvantages of Batch culture 7. Explain the application of Batch culture 8. Explain the culture, culture continue Feed-Batch Culture 7. Explain the advantages of Batch culture 7. Explain the application of Batch culture 8. Explain the 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 x3) (UTS value (3) divided by 10	Giving a 2 X 50 Sub- summative written test		0%

9	Understand the basic concepts of genetic engineering	1. Be able to explain the meaning of	Criteria: 1.1. Participation	Study		0%
	ľ gene cloning,	genetic	during lectures	material from		
	cloning vectors and restriction	engineering / gene cloning. 2.	and practicums is carried out	mandatory		
	enzymes.	Be able to	through	books, ask		
		explain the definition of	observation	questions,		
		recombinant	2.2. Subsummative	answer 2 X 50 practice		
		DNA. 3. Be able to explain the	test, carried out	questions		
		stages in	twice, assessing all relevant			
		genetic engineering	indicators through			
		techniques. 4.	a written exam,			
		Be able to mention the	averaged 3.3. Performance			
		types of cloning vectors in	and product			
		genetic	assessments in			
		engineering. 5. Be able to	the form of			
		explain the	practical reports and papers are			
		requirements for cloning	considered			
		vectors. 6. Be able to explain	assignments, the			
		how to obtain	scores are averaged 3x the			
		DNA fragments. 7. Be able to	UAS score, given			
		explain the	a weight of (3)			
		advantages of using restriction	4.The final NA is (participation			
		enzymes in obtaining	value x2)			
		specific DNA	(assignment			
		fragments. 8. Be able to state	value x 3) (UTS value x 2) UAS			
		the definition of a restriction	value (3) divided			
		enzyme. 9. Be	by 10			
		able to explain the history of				
		the discovery of				
		restriction enzymes. 10.				
		Be able to name the				
		known types of				
		restriction enzymes. 11.				
		Be áble 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.				

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10	Understand the basic concepts of genetic engineering / gene cloning, cloning vectors and restriction	1. Be able to explain the meaning of genetic engineering / gene cloning. 2.	Criteria: 1.1. Participation during lectures and practicums is carried out	Study material from mandatory		0%
	enzymes.	Be able to explain the definition of recombinant	through observation 2.2. Subsummative	books, ask questions, answer 2 X		
		DNA. 3. Be able to explain the stages in	test, carried out twice, assessing	50 practice questions		
		genetic engineering techniques. 4.	all relevant indicators through a written exam,			
		Be able to mention the types of cloning vectors in	averaged 3.3. Performance and product			
		genetic engineering. 5. Be able to	assessments in the form of practical reports			
		explain the requirements for cloning	and papers are considered			
		vectors. 6. Be able to explain how to obtain DNA fragments.	assignments, the scores are averaged 3x the			
		7. Be able to explain the advantages of	UAS score, given a weight of (3) 4.The final NA is			
		using restriction enzymes in obtaining specific DNA	(participation value x2) (assignment			
		fragments. 8. Be able to state the definition of	value x 3) (UTS value x 2) UAS value (3) divided			
		a restriction enzyme. 9. Be able to explain the history of	by 10			
		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.				

11 Understand gene wetchs, especiality wetchs, especiality understand pRR222 and pU/G and diabuly understand pRR222 and pU/G and diabuly understand pRR222 and pU/G and diabuly understand pRR222 and pU/G based to the problem to common the to common the problem to common the prob	rr						
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a written exam, a strenged 3.3. Performance a strenged assessments in the advantages of pBR 322 as a plasmid writtin te writtin te writtin te writtin te writtin te the stages of process in process in							
 verteriors: A. Be averaged and the genetic organization of the pBR-322 and product assessments in the form of the pBR-322 as and papers are considered vertor. 6. Be able to explain the advantages of pBR-322 as and papers are considered gene of considered assessments, the scores are the gene of constrained assessments in the scores are the gene of constrained assessments in the scores are the gene of constrained assessments are considered assessments are considered assessments. The scores are the gene of constrained assessments are considered assessments are considered assessments. The scores are the gene of constrained assessments are considered assessments are considered assessments. The scores are the gene of constrained assessments are considered as a plasmid assessments. The scores are the gene of constrained assessments are considered as a plasmid and selection assessments are considered as a plasmid at 11. Be able to explain the scores in the scores in the scores in the score of the pUCS plasmid the score of the pUCS plasmid assesses and the score of the pUCS plasmid the score of the score of the score of the p							
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bit able to explain the advantages of pBR 322 as a plasmid vector. 6. Be able to memory adults to memory able to explain the davantages of pBR 322 assessments in practical reports and papers are considered assignments, the assignments, the able to explain the ligation pBR 322 plasmid. 7. Be able to explain the ligation process. 0. Be able to explain the genetic organization of uplasmid. 10. Be able to explain the advantages of using the pUCB plasmid as a plasmid the genetic process in process in			the genetic				
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the advantages of pBR 322 as a plasmid vector. 6. Be able to mention the stages of with the pBR322 plasmid. 7. Be able to explain the ligation process in process. 9. Be able to explain the screening and selection system for the pBR322. 8. Able to explain the screening and selection system for the pBR322. 9. blue to explain the screening and selection system for the pDCS plasmid. 13. Be able to explain the ligation process in system for the pBR322. 8. Able to explain the genetic organization of the pUCS plasmid. 13. Be able to explain the ligation process in system for the pDCS plasmid and selection system for the pDCS plasmid the screening and selection system for the screening and selection system for the screening and selection system for the screening and selection system for the							
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the stages of gene cloning with the pBR322 plasmid. 7. Be averaged 3x the UAS score, given a weight of (3) able to explain the ligation process in pBR322, 8, Able to explain the screening and selection system for the pBR322 plasmid. 11. Be 4. The final NA is (participation value x2) UAS value x2) UAS value x2) UAS value x2) UAS value x2) UAS value x2) UAS process. 9. Be able to explain the screening and selection system for the pBR322 plasmid. 11. Be able to explain the devantages of using the pUCS plasmid as a plasmid as a plasmid as a plasmid as a plasmid and selection system for the pUCS plasmid as a plasmid as plasmid as a plasmid as a plasmid as a plasmid			able to mention	. ,			
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a weight of (3) plasmid. 7. Be plasmid. 7. Be plasmid. 7. Be plasmid. 7. Be plasmid. 7. Be plasmid. 10. Be able to explain the ligation process. 9. Be able to explain the screening and selection system for the plasmid. 11. Be able to explain the stages of gene cloing with the pUC28 plasmid. 13. Be able to explain the stages of gene cloing with the pUC3 plasmid. 13. Be able to explain the stages of gene cloing with the pUC3 plasmid. 13. Be able to explain the stages of gene cloing with the pUC4 plasmid. 13. Be able to explain the stages of gene cloing with the pUC3 plasmid. 13. Be able to explain the stages of gene cloing with the pUC3 plasmid. 13. Be able to explain the stages of gene cloing with the pUC3 plasmid. 13. Be able to explain the stages of gene cloing with the pUC4 plasmid. 13. Be able to explain the stages of gene to mention the stages of gene				0			
plasmid 7. Be 4. The final NA is able to explain (participation pBF322. 8. (assignment Able to explain value x2) overcome value x3) (UTS value x2) value x3) (UTS value x3) value x3) (UTS value (3) divided by 10 problems that arise during the and selection yalue (3) divided pBF322 plasmid. 10. Be able to explain the genetic organization of the genetic organization of the advantages pUC8 plasmid as aplasmid a plasmid. 13. Be able to explain the stages of genetic genetic organization the stages of genetic process in pUC8 plasmid public to explain the stages of genetic plasmid able to explain the stages of plasmid able plasmid able plasmid able plasmid able 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 quetic organization of the pUC8 plasmid the able to explain the advantages of using the pUC8 plasmid as a plasmid the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the stages of gene cloning with the pUC8 plasmid. 13. Be able to explain the ligation process in pUCC8 14. Be able to explain the screening and selection system for the							
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 genetic organization of the advantages of using the pUCS plasmid as a plasmid vector. 12. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of gene cloning with the pUCS plasmid. 13. Be able to explain the stages of system for the				(participation			
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12	Understand gene cloning strategies	1. Be able to explain the	Criteria:	Studying		0%
	using plasmid	basic	1.1. Participation	material		
	vectors, especially	characteristics	during lectures	from		
	pBR322 and pUC8	of plasmids. 2.	and practicums is	mandatory		
	and identify	Be able to	carried out	books,		
	recombinant	explain the	through	questions		
	clones.	requirements for a plasmid as	observation	and		
		a cloning	2.2. Subsummative	answers, summarizing		
		vector. 3. Be	test, carried out	2 X 50		
		able to name	twice, assessing	2 \ 50		
		two examples	all relevant			
		of plasmids that are often used	indicators through			
		as cloning	a written exam,			
		vectors. 4. Be	averaged			
		able to explain	3. 3. Performance			
		the genetic	and product			
		organization of the pBR322	assessments in			
		plasmid. 5. Be	the form of			
		able to explain	practical reports			
		the advantages	and papers are			
		of pBR 322 as a plasmid	considered			
		vector. 6. Be	assignments, the			
		able to mention	scores are			
		the stages of	averaged 3x the			
		gene cloning	UAS score, given			
		with the pBR322	a weight of (3)			
		plasmid. 7. Be	4.The final NA is			
		able to explain	(participation			
		the ligation	value x2)			
		process in pBR322. 8.	(assignment			
		Able to explain	value x 3) (UTS			
		how to	value x 2) UAS			
		overcome	value (3) divided			
		problems that	by 10			
		arise during the ligation	59 10			
		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				
		POCO plasifild				

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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 (2) UAS value (2) 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 advantages of the PCR technique. 7. Able to explain the 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 the use of therapeutic cloning. 12. Be able to explain the stages of therapeutic cloning. 12. Be able to explain the uses of therapeutic cloning. 12. Be able to explain the uses of therapeutic cloning. 12. Be able to explain the uses of therapeutic cloning 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.	 Able to explain the meaning of Bioinformatics. Able to explain the relationship between Bioinformatics and other branches of science. 3. Be able to explain the beginning of the development of Bioinformatics. Able to explain the main applications of Bioinformatics. Be able to explain biological sequence databases 6. Be able to explain databases 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 x 2) (UTS value x 2) UAS value (2) UAS value (2) UAS	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%
 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.
- 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.
- 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.