

SEMESTER COURSE PLAN

**GEOPHYSICAL INVERSION METHODS (P1) COURSES
(23H06122002)**



TEACHING TEAM

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STUDI PROGRAM OF GEOPHYSICS - S1
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
HASANUDDIN UNIVERSITY
MAKASSAR
2025

**STUDY PROGRAM OF GEOFISIKA - S1
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
HASANUDDIN UNIVERSITY**

Vision

Become a program Reliable studies in the field of geophysics to produce superior graduates and mastering science, technology, arts and culture based on BMI in 2030.

Vision Strategy

Mission

Based on the Vision above, the Geophysics Study Program has a mission:

1. Improving the quality of education to produce graduates who are competitive, able to work independently and in groups in implementing and developing BMI science and technology;
2. Carrying out research to produce reliable and competitive scientific work oriented towards the scientific development of solid geophysics, marine geophysics, geoinformatics and hydro-meteorology;
3. Disseminate the results of applied research, action studies and appropriate technology packages in synergistic and accelerated productive activities to improve the quality of life of the community.

Graduate Profiles

Educators in the Field of Geophysics; meteorologist; geomaths; oceanographer; exploration geophysicist; seismologist ; geophysical entrepreneur.

PLO charged to courses

- CPL-4 (P1) - Mastering theoretical concepts of land, sea and geophysics atmosphere, principles of exploration, and design exploration necessary for identification and mapping natural resources and natural disaster mitigation;
- CPL-8 (KU1) - Able to apply logical, critical, systematic and innovative thinking in developing or applying geophysical science by considering human values, and able to analyze and communicate case studies and research results using geophysical tools through scientific reports, international presentations and article publications, as well as uploading them on the university website.
- CPL-11 (KK1) - Able to apply the principles of mathematics and earth science, as well as the principles of Exploration and Mitigation to solve natural resource exploration and disaster mitigation problems (Exploration natural resources and natural disaster mitigation)
- CPL-13 (KK3) - Able to formulate alternative solutions to solve disaster mitigation problems by taking into account public safety, social and environmental factors

Course Learning Outcomes (CLO)

- CPMK-1: Students are able to detail inversion variables (quantities and processes) from various geophysical data inversion principles correctly (CPL4)
- CPMK-2: Students are able to analyze inverted geophysical data correctly (CPL8)
- CPMK-3: Students are able to analyze model parameters and modeling results correctly. (CPL11 dan CPL13)

Sub-CLO

- Sub CPMK-1: Students explain the scope of the inverse method on geophysical data correctly (CPMK-1)

Sub CPMK-2: Students describe the quantities and process of the inversion method to obtain model parameters correctly (CPMK-1)

Sub CPMK-3: Students apply the inversion method to geophysical data (CPMK-1)

Sub CPMK-4: Students can inverse geophysical data to obtain physical parameters (CPMK-2)

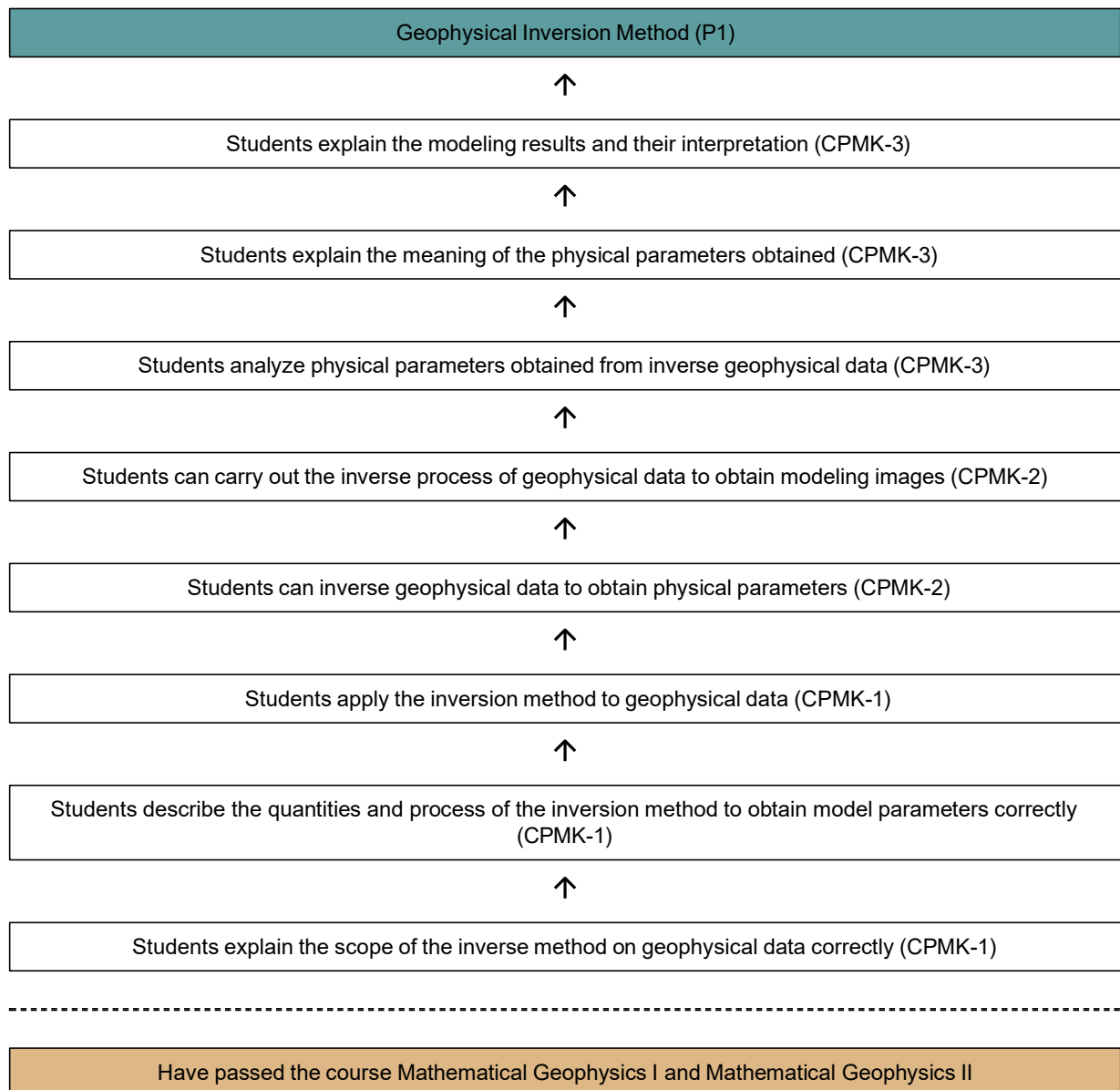
Sub CPMK-5: Students can carry out the inverse process of geophysical data to obtain modeling images (CPMK-2)

Sub CPMK-6: Students analyze physical parameters obtained from inverse geophysical data (CPMK-3)

Sub CPMK-7: Students explain the meaning of the physical parameters obtained (CPMK-3)

Sub CPMK-8: Students explain the modeling results and their interpretation (CPMK-3)

Learning Analytics





HASANUDDIN UNIVERSITY

FAKULTY OF MATHEMATICS AND NATURAL SCIENCES

STUDY PROGRAM OF GEOPHYSICS - S1

SEMESTER LEARNING PLAN

Course		Code	Course Group	Credits	SEMESTER	Compilation Date
Geophysical Inversion Method (P1)		23H06122002		2	4	1 Juli 2025
AUTHORITY		SLP Developer Lecturer		Coordinator		Head of Study Program
		Dr. Muhammad Hamzah S., S.Si.,MT., Sabrianto Aswad, S.Si., MT		Dr. Muhammad Hamzah S., S.Si.,MT.		Dr. Muhammad Alimuddin, Eng.
Learning Outcomes Course	SLOs that are imposed on the course					
	SLO-4:	Menguasai konsep teoritis Geofisika darat, laut dan atmosfer, prinsip-prinsip eksplorasi, dan perancangan eksplorasi yang diperlukan untuk identifikasi dan pemetaan SDA serta mitigasi bencana alam;				
	SLO-8:	Mampu menerapkan pemikiran logis, kritis, sistematis, dan inovatif dalam mengembangkan atau menerapkan ilmu geofisika dengan mempertimbangkan nilai-nilai kemanusiaan, serta mampu menganalisis dan mengkomunikasikan studi kasus dan hasil penelitian menggunakan perangkat geofisika melalui laporan ilmiah, presentasi internasional, dan publikasi artikel, serta mengunggahnya pada laman universitas.				
	SLO-11:	Mampu menerapkan prinsip-prinsip matematika dan sains kebumian, serta prinsip Eksplorasi dan Mitigasi untuk menyelesaikan masalah eksplorasi SDA dan mitigasi bencana (Exploration natural resource and natural disaster mitigation)				
	SLO-13:	Mampu merumuskan alternatif solusi untuk menyelesaikan masalah mitigasi bencana dengan memperhatikan faktor-faktor keselamatan publik, sosial dan lingkungan				
	SLO ⇒ Course Learning Outcomes					
	After completing this course, it is expected:					
	SLO-4	CLO-1: Students are able to detail inversion variables (quantities and processes) from various geophysical data inversion principles correctly				
	SLO-8	CLO-2: Students are able to analyze inverted geophysical data correctly				
	SLO-11	CLO-3: Students are able to analyze model parameters and modeling results correctly.				
	SLO-13	CLO-3: Students are able to analyze model parameters and modeling results correctly.				
	CLO ⇒ Sub-CLO					
	CLO-1	Sub-CLO-1:Students explain the scope of the inverse method on geophysical data correctly				
		Sub-CLO-2:Students describe the quantities and process of the inversion method to obtain model parameters correctly				
		Sub-CLO-3:Students apply the inversion method to geophysical data				

	CLO-2	Sub-CLO-4:Students can inverse geophysical data to obtain physical parameters							
		Sub-CLO-5:Students can carry out the inverse process of geophysical data to obtain modeling images							
	CLO-3	Sub-CLO-6:Students analyze physical parameters obtained from inverse geophysical data							
		Sub-CLO-7:Students explain the meaning of the physical parameters obtained							
		Sub-CLO-8:Students explain the modeling results and their interpretation							
Correlation between SLOs/CLOs to Sub-CLOs									

SLOs that are charged on the Course	CPMK	SUB CPMK	Form of Assessment*				Weight	Value	Student Score
			Formative	Sumative					
				Project/Case Study	Formative Test	Practicum			
SLO-4	CLO-1	SUB-CLO-1	Participation	10	0	0	10		
SLO-4	CLO-1	SUB-CLO-2	Participation	5	0	0	5		
SLO-4	CLO-1	SUB-CLO-3	Participation	5	0	0	5		
SLO-8	CLO-2	SUB-CLO-4	Participation	20	5	0	25		
SLO-8	CLO-2	SUB-CLO-5	Participation	15	5	0	20		
SLO-13	CLO-3	SUB-CLO-6	Participation	10	0	0	10		
SLO-13	CLO-3	SUB-CLO-7	Participation	0	0	10	10		
SLO-13	CLO-3	SUB-CLO-8	Participation	10	5	0	15		
				75	15	10	100		

Course Description	Geophysical Data inversion methods are very necessary in processing geophysical data. Because Geophysics is a science that studies subsurface models of the earth based on physics formulations. So an inversion method is needed to solve physical formulas to obtain a model of Earth's physical parameters. Geophysics is built on the physical parameters of mechanics, electricity, magnetism, electromagnetism, heat, radiation and other parameters which are constantly being developed to be applied in order to understand everything that is below the earth's surface, both solid and liquid.
Learning Materials/Subjects	Mathematical formulation of geophysical inversion problems, Geophysical data inversion, Model physical parameters, Image of modeling results 1D linear inversion, 1D niolinier inversion, 2D linear inversion. 2D nonlinear inversion
	Main References

Reference		[1] Meju, A Max., Geophysical Data Analysis: Understanding Inverse Problem Theory and Practice,(1994), Society of Exploration Geophysicists (SEG) [2] W. Menke, Geophysical Data Analysis: Discrete Inverse Theory, Academic Press, 1989. [3] A. Tarantola, Inverse Problem Theory: Methods for Data Fitting and Model Parameter Estimation, Elsevier, 1987. [4] M.K. Sen, P.L. Stoffa, Global Optimization Methods in Geophysical Inversion, Elsevier, 1995. [5] Grandis, H. Introduction to Geophysical Inversion Modeling, HAGI, 2009 [6] Muhammad Hamzah, Geophysical Inversion Practical Mode, Department of Geophysics Unhas, 2018					
		Additional References					
		Geophysical Inversion Software, Computer, LCD					
Teaching Team		Dr. Muhammad Hamzah S., S.Si.,MT., Sabrianto Aswad, S.Si., MT					
Course requirement		Mathematical Geophysics I, Mathematical Geophysics II					
Week	Sub CPMK (End-of-stage learning ability)	Penilaian (Assesment)		Learning Forms and Methods [time estimate]		Content	Weight of Assessment (%)
		Indicator	Techniques & Criteria	Offline	Online		
1	2	3	4	5	6	7	8
1-2	Students explain the scope of the inverse method on geophysical data correctly (CPMK-1)	Formative: inverse geophysics,scope of study, inverse data geophysics Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (10) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Project-Based Learning (Project-based Learning) 2 x 1 x 50"	Other Forms: Self-Directed Learning • Reading module/PPT • Watching Videos 2 x 1 x 60" Other Forms: Other methods Create a resume and answer practice questions 2 x 1 x 60"	• Contract Lectures • Concept Geophysical Inversion • Definition Geophysical Inversion • Modeling	10

3	Students describe the quantities and process of the inversion method to obtain model parameters correctly (CPMK-1)	Formative: Accuracy in deciphering data one dimensional and two dimensional geophysics and mathematical modeling Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (5) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Project-Based Learning (Project-based Learning) 1 x 1 x 50"	Other Forms: Self-Directed Learning - Reading module/PPT - Watching Videos 1 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 1 x 1 x 60"	- Data 1D Geophysics - Data 2D Geophysics - Modelling Mathematics - Formulation Inversion	5
4	Students apply the inversion method to geophysical data (CPMK-1)	Formative: Precision in describing one-dimensional and two-dimensional geophysical data and modeling mathematics Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (5) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Project-Based Learning (Project-based Learning) 1 x 1 x 50"	Other Forms: Self-Directed Learning - Reading module/PPT - Watching Videos 1 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 1 x 1 x 60"	- Data 1D Geophysics - Data 2D Geophysics - Modelling Mathematics - Formulation Inversion	5

5-7	Students can inverse geophysical data to obtain physical parameters (CPMK-2)	Formative: Accuracy in carrying out mathematical modeling and formulation inversion Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 1 Sumative Criteria: Project/Case Study (20) dinilai dengan rubrik 1 Formative Test (5) dinilai dengan rubrik 1 Assessment Technique: Non Test	Studying: Project-Based Learning (Project-based Learning) 3 x 1 x 50"	Other Forms: Self-Directed Learning - Reading module/PPT - Watching Videos 3 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 3 x 1 x 60"	- Modeling Mathematics - Formulation Inversion	25
8-9	Students can carry out the inverse process of geophysical data to obtain modeling images (CPMK-2)	Formative: Accuracy in performing forward and inverse modeling nonlinear with linear approximation Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 4 Sumative Criteria: Formative Test (5) dinilai dengan rubrik 1 Project/Case Study (15) dinilai dengan rubrik 4 Assessment Technique: Non Test	Practicum, Studio Practice, Workshop Practice, Field Practice: Project-Based Learning (Project-based Learning) 2 x 1 x 170"	Other Forms: Self-Directed Learning Reading modules/PPT 2 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 2 x 1 x 60"	- Forward Modeling - Non-linear inversion with linear approximation	20

10-12	Students analyze physical parameters obtained from inverse geophysical data (CPMK-3)	Formative: Precision in inverse parabola model and inverse data boding model SP Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 4 Sumative Criteria: Project/Case Study (10) dinilai dengan rubrik 4 Assessment Technique: Non Test	Practicum, Studio Practice, Workshop Practice, Field Practice: Project-Based Learning (Project-based Learning) 3 x 1 x 170"	Other Forms: Self-Directed Learning Reading module/PPT 3 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 3 x 1 x 60"	- Gravity Data Inversion - Linear SP Data Inversion	10
13-14	Students explain the meaning of the physical parameters obtained (CPMK-3)	Formative: Accuracy in calculating water discharge and bulk frequency rain in a watershed area Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 4 Sumative Criteria: Practicum (10) dinilai dengan rubrik 4 Assessment Technique: Non Test	Practicum, Studio Practice, Workshop Practice, Field Practice: Project-Based Learning (Project-based Learning) 2 x 1 x 170"	Other Forms: Self-Directed Learning Reading module/PPT 2 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 2 x 1 x 60"	Nonlinear inversion	10

15-16	Students explain the modeling results and their interpretation (CPMK-3)	Formative: Accuracy in calculating water discharge and bulk frequency rain in a watershed area Sumative: -	Formative Criteria: Participation dinilai dengan rubrik 4 Sumative Criteria: Formative Test (5) dinilai dengan rubrik 1 Project/Case Study (10) dinilai dengan rubrik 4 Assessment Technique: Non Test	Practicum, Studio Practice, Workshop Practice, Field Practice: Project-Based Learning (Project-based Learning) 2 x 1 x 170"	Other Forms: Self-Directed Learning Reading module/PPT 2 x 1 x 60" Other Forms: Other methods Make a resume and answer practice questions 2 x 1 x 60"	Nonlinear inversion	15
							100

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2	CLO-3
CPL-4 (P1)	Project/Case Study (Weight 10%) Project/Case Study (Weight 5%) Project/Case Study (Weight 5%)		
CPL-8 (KU1)		Project/Case Study (Weight 20%) Formative Test (Weight 5%) Formative Test (Weight 5%) Project/Case Study (Weight 15%)	
CPL-11 (KK1)			Project/Case Study (Weight 10%) Practicum (Weight 10%) Formative Test (Weight 5%) Project/Case Study (Weight 10%)
CPL-13 (KK3)			Project/Case Study (Weight 10%) Practicum (Weight 10%) Formative Test (Weight 5%) Project/Case Study (Weight 10%)

Evaluation Type and Assessment Weight

Type	Assessment Weight
Project/Case Study	75
Formative Test	15
Practicum	10
Total	100

Assessment and Evaluation of Student Achievement of CLOs

SLOs that are charged on the Course	CLO	SUB CLO	Form of Assessment*				Weight	Value	Student Score
			Formative	Sumative					
				Project/Case Study	Formative Test	Practicum			
SLO-4	CLO-1	SUB-CLO-1	Participation	10	0	0	10		
SLO-4	CLO-1	SUB-CLO-2	Participation	5	0	0	5		
SLO-4	CLO-1	SUB-CLO-3	Participation	5	0	0	5		
SLO-8	CLO-2	SUB-CLO-4	Participation	20	5	0	25		
SLO-8	CLO-2	SUB-CLO-5	Participation	15	5	0	20		
SLO-13	CLO-3	SUB-CLO-6	Participation	10	0	0	10		
SLO-13	CLO-3	SUB-CLO-7	Participation	0	0	10	10		
SLO-13	CLO-3	SUB-CLO-8	Participation	10	5	0	15		
				75	15	10	100		

Lampiran Rubrik 1 | Rubrik Holistik

Tabel 6. 1 Rubrik Holistik		
Grade Capaian	Skor	Uraian
Sangat Baik	≥ 85	Memperlihatkan pemahaman yang lengkap tentang permasalahan. Semua metode dan persyaratan tentang tugas terdapat dalam jawaban
Baik	71 - 84	Memperlihatkan cukup pemahaman tentang permasalahan. Semua persyaratan tentang tugas terdapat dalam jawaban
Cukup Baik	61 - 70	Memperlihatkan hanya sebagian pemahaman tentang permasalahan. Kebanyakan persyaratan tentang tugas terdapat dalam jawaban
Kurang	51 - 60	Memperlihatkan sedikit pemahaman tentang permasalahan. Banyak persyaratan tugas yang tidak ada
Sangat kurang	< 51	Memperlihatkan tidak ada pemahaman tentang permasalahan

Lampiran Rubrik 4 | Rubrik Praktikum

Tabel 6. 4 Rubrik Praktikum

Kegiatan	:	Mahasiswa mampu melaksanakan kegiatan Praktikum sesuai Modul Percobaan yang diberikan.	
Kriteria Penilaian	:	1. Penyediaan alat dan bahan	10 %
		2. Merangkai alat dan bahandengan benar, rapi dan memperhatikan keselamatan kerja	10 %
		3. Pengamatan/Pengambilan Data percobaan	20 %
		4. Pengolahan data hasil percobaan	20 %
		5. Menyimpulkan hasil percobaan	10 %
		6. Penyusunan laporan hasil percobaan dalam bentuk tulisan yang rapi	30 %

Kriteria/ Dimensi	Penilaian mahasiswa				
	Sangat Baik	Baik	Cukup	Kurang	Sangat kurang
	Skor ≥ 85	Skor 71 - 84	Skor 61 - 70	Skor 51 – 60	Skor 41 - 50
Penyediaan alat dan bahan	Menyiapkan alat dan bahan dengan rapi dan lengkap serta mengembalikannya dalam keadaan lengkap dan baik	Menyiapkan alat dan bahan dengan rapi dan lengkap serta mengembalikannya dengan lengkap namun keadaannya kurang rapi	Menyiapkan alat dan bahan dengan lengkap dan rapi, namun tidak mengembalikannya dalam keadaan lengkap dan baik	Menyiapkan alat dan bahan dengan lengkap namun tidak rapi serta mengembalikannya dalam keadaan tidak lengkap dan dalam keadaan kurang baik	Tidak menyiapkan alat dan bahan praktikum
Merangkai alat dan bahan dengan benar, rapi dan memperhatikan keselamatan kerja	Rangkaian alat benar, rapi, dan memperhatikan keselamatan	Rangkaian alat benar, rapi, dan memperhatikan keselamatan kerja	Rangkaian alat benar, rapi namun tidak memperhatikan keselamatan kerja	Rangkaian alat benar, tetapi tidak rapi	Rangkaian alat tidak benar
Pengamatan/Pengambilan Data	cermat, tepat dan bebas interpretasi	cermat, tidak mengandung tidak tepat	cermat, tepat tetapi mengandung interpretasi	tidak cermat, kurang tepat	tidak cermat, tidak tepat (salah)
Pengolahan data hasil percobaan					
Menyimpulkan hasil percobaan	Kesimpulan sesuai tujuan, singkat, dan logis	Kesimpulan sesuai tujuan, singkat, ada kesimpulan yang tidak sesuai tujuan	Kesimpulan sesuai tujuan, sebagian kesimpulan tidak sesuai tujuan, terlalu panjang	Tidak benar atau tidak sesuai tujuan	Tidak menyimpulkan hasil percobaan
Penyusunan laporan hasil percobaan dalam bentuk tulisan yang rapi	Laporan disajikan/tersusun sistimatis, jelas, dan lengkap serta rapi	Laporan disajikan/tersusun sistimatis, jelas, dan lengkap namun tidak rapi	Laporan disajikan/tersusun kurang sistimatis, kurang jelas namun lengkap	Laporan disajikan/tersusun tidak sistimatis, tidak jelas, dan tidak lengkap	Tidak membuat laporan