SEMESTER LEARNING PLAN

ALGEBRAIC STRUCTURE COURSES
(23H01121403)

TEACHING TEAM

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

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

Vision

The scientific vision is to become a study program with an international reputation in the development of mathematics based on the Indonesian maritime continent by 2030

Vision Strategy

Misson

To fulfill the above vision, the Undergraduate Mathematics Study Program has four missions, namely:

- Organizing innovative and effective mathematics learning to improve the quality and creativity of students in order to compete nationally and internationally.
- Improving a research culture that produces internationally reputable publications.
- Playing an active role in community service activities and collaborating with other academic institutions, government, business, media and society.
- Carry out governance in the Mathematics Study Program that is effective, efficient and transparent based on IT and ISO 9001:2015 standards to achieve the tridharma goals.

Graduate Profiles

Gagal diterjemahkan

PLO charged to courses

CPL-2 (P2) - The students are able to identify objects, techniques, and theorems in fundamental mathematics, and making a connection for solving problems

CPL-3 (KU1) - The students are able to analyse a mathematical problem with logic, analytic, and systematic structure

CPL-4 (KU2) - The students are able to use their sufficiently mathematical critical thinking for abstraction and generalization of a mathematical problem

Course Learning Outcomes (CLO)

CPMK-1: Students will be able to use the concepts of groups and rings to prove theorems in Algebra (CPL2 dan CPL3)

CPMK-2: Students will be able to apply theorems to prove other results in Algebra (CPL2 dan CPL3)

CPMK-3: Students will be able to communicate mathematical ideas both orally and in writing with groups. (CPL4)

Sub-CLO

Sub CPMK-1: Understand well the objectives, uses of course material and its relationship to other coursesKnowing students' initial competencies. (CPMK-1)

Sub CPMK-2: Students can differentiate binary operators from non-binary operators, and can express each binary operation as a function. (CPMK-1)

Sub CPMK-3: Students can distinguish between a set equipped with a binary operator and whether it is a (sub-) group or not a (sub-) group. Can give examples of semi-groups or monoids that are not groups. (CPMK-1 dan CPMK-3)

Sub CPMK-4: Students are able to recognize the properties or characteristics of groups and subgroups through proving theorems. (CPMK-2)

Sub CPMK-5: Students can express cyclic groups in '+' notation or times notation, apply Euclid's Quotient Algorithm to simplify high-rank numbers and are able to give simple examples of commutative rings from sets of numbers. (CPMK-1 dan CPMK-2)

Sub CPMK-6: Students can carry out computations related to permutations and are able to provide examples of permutation groups, especially Sn and An. (CPMK-2)

Sub CPMK-7: Students are able to recognize the properties or characteristics of cyclic groups and permutation groups. (CPMK-2)

Sub CPMK-8: Students can apply the concept of function between two groups to express or compare the many elements of the two groups. (CPMK-1)

Sub CPMK-9: Students are able to express a group of finite extended variables in the form of a group product. (CPMK-2)

Sub CPMK-10: Students are able to recognize the properties or characteristics of coset groups and finite abel groups. (CPMK-1 dan CPMK-3)

Sub CPMK-11: Students can prove the well-defined nature of intercoset operations, able to provide several normal subgroup criteria. (CPMK-1)

Sub CPMK-12: Students can understand the 'similarities' of the structure of two different groups. (CPMK-2)

Sub CPMK-13: Students recognize several consequences of the concepts of simple group, center, centralizer and normalizer. (CPMK-2)

Sub CPMK-14: Students are able to prove and give examples of sets with two binary operators which are rings. (CPMK-1 dan CPMK-3)

Learning Analytics

Algebraic Structure

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Students are able to prove and give examples of sets with two binary operators which are rings. (CPMK-1 dan CPMK-3)

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Students recognize several consequences of the concepts of simple group, center, centralizer and normalizer. (CPMK-2)

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Students can understand the 'similarities' of the structure of two different groups. (CPMK-2)

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Students can prove the well-defined nature of intercoset operations, able to provide several normal subgroup criteria. (CPMK-1)

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Students are able to recognize the properties or characteristics of coset groups and finite abel groups. (CPMK-1 dan CPMK-3)

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Students are able to express a group of finite extended variables in the form of a group product. (CPMK-2)

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Students can apply the concept of function between two groups to express or compare the many elements of the two groups. (CPMK-1)

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Students are able to recognize the properties or characteristics of cyclic groups and permutation groups. (CPMK-2)

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Students can carry out computations related to permutations and are able to provide examples of permutation groups, especially Sn and An. (CPMK-2)

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Students can express cyclic groups in '+' notation or times notation, apply Euclid's Quotient Algorithm to simplify high-rank numbers and are able to give simple examples of commutative rings from sets of numbers. (CPMK-1 dan CPMK-2)

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Students are able to recognize the properties or characteristics of groups and subgroups through proving theorems. (CPMK-2)

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Students can distinguish between a set equipped with a binary operator and whether it is a (sub-) group or not a (sub-) group. Can give examples of semi-groups or monoids that are not groups. (CPMK-1 dan CPMK-3)

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Students can differentiate binary operators from non-binary operators, and can express each binary operation as a function. (CPMK-1)

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Understand well the objectives, uses of course material and its relationship to other coursesKnowing students' initial competencies. (CPMK-1)

Have passed the course Linear Algebra II

HASANUDDIN UNIVERSITY
FAKULTY OF MATHEMATICS AND NATURAL SCIENCES
STUDY PROGRAM OF MATHEMATICS - S1
SEMESTER LEARNING PLAN

Course	Code	Cource Group	Credits	SEMESTER	Compilation Date
Algebraic Structure	23H01121403	Algebra	3	4	10 Agustus 2025

AUTHORITY	SLP Developer Lecturer	Coordinator	Head of Study Program
	Dra. Nur Erawati, M.Si.	Prof. Dr. Amir Kamal Amir, M.Sc.	Dr. Firman, S.Si.,M.Si.

Learning Outcomes Course	**SLOs that are imposed on the course**	
	SLO-2:	Mahasiswa mampu mengidentifikasi objek, teknik, dan sifat dalam matematika dasar, dan membuat koneksi untuk menyelesaikan masalah
	SLO-3:	Mahasiswa mampu menganalisis suatu masalah matematika dengan logika, analitik, dan struktur sistematis
	SLO-4:	Mahasiswa dapat menggunakan pemikiran kritis matematis mereka yang cukup untuk abstraksi dan generalisasi masalah matematika berdasarkan hasil analisis informasi dan data
	SLO ⇒ Course Learning Outcomes	
	After completing this course, it is expected:	
	SLO-2	**CLO-1:** Students will be able to use the concepts of groups and rings to prove theorems in Algebra
		CLO-2: Students will be able to apply theorems to prove other results in Algebra
	SLO-3	**CLO-1:** Students will be able to use the concepts of groups and rings to prove theorems in Algebra
		CLO-2: Students will be able to apply theorems to prove other results in Algebra
	SLO-4	**CLO-3:** Students will be able to communicate mathematical ideas both orally and in writing with groups.
	CLO ⇒ Sub-CLO	
	CLO-1	**Sub-CLO-1:**Understand well the objectives, uses of course material and its relationship to other coursesKnowing students' initial competencies.
		Sub-CLO-2: Students can differentiate binary operators from non-binary operators, and can express each binary operation as a function.
		Sub-CLO-3: Students can distinguish between a set equipped with a binary operator and whether it is a (sub-) group or not a (sub-) group. Can give examples of semi-groups or monoids that are not groups.
		Sub-CLO-5: Students can express cyclic groups in '+' notation or times notation, apply Euclid's Quotient Algorithm to simplify high-rank numbers and are able to give simple examples of commutative rings from sets of numbers.
		Sub-CLO-8: Students can apply the concept of function between two groups to express or compare the many elements of the two groups.

		Sub-CLO-10: Students are able to recognize the properties or characteristics of coset groups and finite abel groups.
		Sub-CLO-11: Students can prove the well-defined nature of intercoset operations, able to provide several normal subgroup criteria.
		Sub-CLO-14: Students are able to prove and give examples of sets with two binary operators which are rings.
	CLO-2	**Sub-CLO-4:**Students are able to recognize the properties or characteristics of groups and subgroups through proving theorems.
		Sub-CLO-5: Students can express cyclic groups in '+' notation or times notation, apply Euclid's Quotient Algorithm to simplify high-rank numbers and are able to give simple examples of commutative rings from sets of numbers.
		Sub-CLO-6: Students can carry out computations related to permutations and are able to provide examples of permutation groups, especially Sn and An.
		Sub-CLO-7: Students are able to recognize the properties or characteristics of cyclic groups and permutation groups.
		Sub-CLO-9: Students are able to express a group of finite extended variables in the form of a group product.
		Sub-CLO-12: Students can understand the 'similarities' of the structure of two different groups.
		Sub-CLO-13: Students recognize several consequences of the concepts of simple group, center, centralizer and normalizer.
	CLO-3	**Sub-CLO-3:**Students can distinguish between a set equipped with a binary operator and whether it is a (sub-) group or not a (sub-) group. Can give examples of semi-groups or monoids that are not groups.
		Sub-CLO-10: Students are able to recognize the properties or characteristics of coset groups and finite abel groups.
		Sub-CLO-14: Students are able to prove and give examples of sets with two binary operators which are rings.

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						
				Case Studies	Written Exam	Presentation	Written Exam			
SLO-4	CLO-3	SUB-CLO-3		15	0	0	0	15		
SLO-3	CLO-2	SUB-CLO-5		20	0	0	0	20		
SLO-3	CLO-2	SUB-CLO-7		0	15	0	0	15		
SLO-3	CLO-2	SUB-CLO-9		16	0	0	0	16		
SLO-3	CLO-1	SUB-CLO-11		17	0	0	0	17		
SLO-4	CLO-3	SUB-CLO-14		0	0	5	12	17		
				68	15	5	12	100		

Course Description	Examine non-empty sets along with one or two given operators, and can utilize the concepts acquired and think logically to solve problems, especially Algebra. The subject matter that will be covered includes groups, subgroups, cyclic groups, finite-range abel groups, cosets, factor groups, homomorphisms, rings.
Learning Materials/Subjects	1. Overview of the concept of function and definition of binary operators as functions 2. Groups and Subgroups 3. Theorems related to the properties of groups, subgroups, and monoids 4. (Sub-)cyclic groups, especially subgroups of integers, application of the Euclidean Quotient Algorithm 5. Permutation, Equivalent relations affected by a permutation, orbit, cycle, transposition, Sn symmetry group and group 6. Theorems related to the properties of cyclic groups and permutation groups 7. Definition of the set of cosets G/H of a subgroup H of group G, Theorem Lagrange 8. Classification of finite extended abel groups and Betti numbers 9. Theorems related to the properties or characteristics of coset groups and finite abel groups 10. (Sub)normal groups and factor groups, well-defined properties of operations between cosets of normal subgroups 11. Homomorphisms, Kernels and Regions Range 12. Simple Groups, centers of groups and subgroups 13. Rings, homomorphisms between rings, fields + examples
Reference	**Main References**
	1. Fraleigh, John B.; A First Course In Abstract Algebra, 5th Edition, Addison Wesley, 1994. 2. Dummit, David S.; Foote, Richard M.; Abstract Algebra, Prentice Hall, 1991. 3. Algebra textbook manuscript abstract
	Additional References
	Textbook, Getting to Know Algebraic Structures; From Theory to examples
Teaching Team	Prof. Dr. Amir Kamal Amir, M.Sc., Dra. Nur Erawati, M.Si.
Course requirement	Linear Algebra 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	Understand well the objectives, uses of course material and its relationship to other coursesKnowing students' initial competencies. (CPMK-1)	**Formative:** Clarity of learning outcomes or competencies desired. **Sumative:**	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Non Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Other Forms:** Cooperative learning (Cooperative learning) Pretest 1x50	**Studying:** Self-Directed Learning Participants take teaching materials None	College Contract, Strategy plan learning	0
2	Students can differentiate binary operators from non-binary operators, and can express each binary operation as a function. (CPMK-1)	**Formative:** Gagal diterjemahkan **Sumative:** Accuracy of explanation with examples; Accuracy of determining binary operators.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Response and Tutorial:** Collaborative learning (Collaborative Learning) Quiz 1x50	**Studying:** Project-Based Learning (Project-based Learning) Lecture participants do assignments None	Overview of the concept of functions and the definition of binary operators as functions.	0

3	Students can distinguish between a set equipped with a binary operator and whether it is a (sub-) group or not a (sub-) group. Can give examples of semi-groups or monoids that are not groups. (CPMK-1, CPMK-3)	**Formative:** Gagal diterjemahkan **Sumative:** Accuracy of examples and proof of whether a set with one binary operator is a (sub-) group, monoid or semi-group. Ability to give group examples.	**Formative Criteria:** **Sumative Criteria:** Case Studies (15) dinilai dengan rubrik 01 **Assessment Technique:** Test and Non-Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Studying:** Group discussion (Small Group Discussion) 1x50	**Studying:** Self-Directed Learning Participants take teaching materials None	Group and subgroup definition + examples. A glance at the definition of se migroups and monoids + examples. The concept of isomorphism as the similarity of the algebraic structure of two groups, especially two groups of size 4	15
4	Students are able to recognize the properties or characteristics of groups and subgroups through proving theorems. (CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Performance accuracy proof	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Studying:** Other methods Practice questions 1x50		Theorems related to the properties of groups, subgroups and monoids	0

5	Students can express cyclic groups in '+' notation or times notation, apply Euclid's Quotient Algorithm to simplify high-rank numbers and are able to give simple examples of commutative rings from sets of numbers. (CPMK-1, CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to express cyclic (sub)groups in '+' notation and in multiplication notation, ability to calculate high powers xn or find x^-1, for a number x elements	**Formative Criteria:** **Sumative Criteria:** Case Studies (20) dinilai dengan rubrik 01 **Assessment Technique:** Non Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Studying:** Group discussion (Small Group Discussion) 1x50	**Studying:** Self-Directed Learning Participants take teaching materials. None	(Sub-)cyclic groups, especially subgroups of integers, application of Euclid's Quotient Algorithm. Examples of applications in the arena, especially in Zn with two binary operators: the sum operator modulo n.	20
6	Students can carry out computations related to permutations and are able to provide examples of permutation groups, especially Sn and An. (CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Computing capabilities with permutations and able to find An, if n is given.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 3x50	**Studying:** Self-Directed Learning Participants take teaching materials None	Permutation, Equivalent Relations affected by a permutation, orbit, cycle, transposition, Sn symmetry group and dihedral group	0
7-8	Students are able to recognize the properties or characteristics of cyclic groups and permutation groups. (CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Accuracy of proof	**Formative Criteria:** **Sumative Criteria:** Written Exam (15) dinilai dengan rubrik 01 **Assessment Technique:** Non Test	**Studying:** Cooperative learning (Cooperative learning) 3x50	**Studying:** Self-Directed Learning Lecture participants complete assignments and collect the results of their work None	Theorems related to the properties of cyclic groups and permutation groups.	15

9	Students can apply the concept of function between two groups to express or compare the many elements of the two groups. (CPMK-1)	**Formative:** Gagal diterjemahkan **Sumative:** The accuracy of the example and proof that |G/H| = |H||G|, if given group G and subgroup H.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Non Test	**Studying:** Collaborative learning (Collaborative Learning) 3x50 **Studying:** Project-Based Learning (Project-based Learning) None	**Studying:** Self-Directed Learning Participants take teaching materials on the internet None	Definition of the set of cosets G/H of a subgroup H of group G, Lagrange's Theorem.	0
10	Students are able to express a group of finite extended variables in the form of a group product. (CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** The accuracy of examples and evidence of presentation of an abel group extends to the product of Zk and k-tuple groups of integers.	**Formative Criteria:** **Sumative Criteria:** Case Studies (16) dinilai dengan rubrik 01 **Assessment Technique:** Non Test	**Studying:** Cooperative learning (Cooperative learning) 3x50	**Studying:** Self-Directed Learning Lecture participants do assignments None	Classification of finite extended abel groups and Betti numbers.	16
11	Students are able to recognize the properties or characteristics of coset groups and finite abel groups. (CPMK-1, CPMK-3)	**Formative:** Gagal diterjemahkan **Sumative:** Accuracy in making calculations, calculating indexes and ordering elements	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 3x50	**Studying:** Self-Directed Learning Lecture participants complete assignments and upload their work None	The theorems related to the properties or characteristics of coset groups and abel groups extend finitely.	0

12	Students can prove the well-defined nature of intercoset operations, able to provide several normal subgroup criteria. (CPMK-1)	**Formative:** Gagal diterjemahkan **Sumative:** The accuracy of proving the well-defined properties of binary operators between cosets of a normal subgroup, the accuracy of proving the equivalence of several different criteria of a normal subgroup.	**Formative Criteria:** **Sumative Criteria:** Case Studies (17) dinilai dengan rubrik 01 **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 3x50	**Studying:** Self-Directed Learning Participants take teaching materials None	Normal subgroups and factor groups, well-defined properties of operations between sets of normal subgroups.	17
13	Students can understand the 'similarities' of the structure of two different groups. (CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to find, state and prove homomorphism between groups, including isomorphism between group.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Test	**Studying:** Cooperative learning (Cooperative learning) 2x50 **Studying:** Group discussion (Small Group Discussion), other methods 1x50		Homomorphism, kernel and range, automorphism, basic theorem of homomorphism.	0
14	Students are able to prove and give examples of sets with two binary operators which are rings. (CPMK-1, CPMK-3)	**Formative:** Gagal diterjemahkan **Sumative:** The accuracy of the example and the accuracy of the proof that a set is a ring or not a ring	**Formative Criteria:** **Sumative Criteria:** Presentation (5) dinilai dengan rubrik 01 **Assessment Technique:** Non Test	**Studying:** Other methods Discussion and Presentation 3x50	**Studying:** Self-Directed Learning Participants take teaching materials and search on the internet None	Ring, homorphism between rings, field + example	5

15-16	Students are able to prove and give examples of sets with two binary operators which are rings. (CPMK-1, CPMK-3)	**Formative:** Gagal diterjemahkan **Sumative:** Gagal diterjemahkan	**Formative Criteria:** **Sumative Criteria:** Written Exam (12) dinilai dengan rubrik 01 **Assessment Technique:** Gagal diterjemahkan			Gagal diterjemahkan	12
							100

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2	CLO-3
CPL-2 (P2)	Case Studies (Weight 15%) Case Studies (Weight 20%) Case Studies (Weight 17%) Presentation (Weight 5%) Written Exam (Weight 12%)	Case Studies (Weight 20%) Written Exam (Weight 15%) Case Studies (Weight 16%)	
CPL-3 (KU1)	Case Studies (Weight 15%) Case Studies (Weight 20%) Case Studies (Weight 17%) Presentation (Weight 5%) Written Exam (Weight 12%)	Case Studies (Weight 20%) Written Exam (Weight 15%) Case Studies (Weight 16%)	
CPL-4 (KU2)			Case Studies (Weight 15%) Presentation (Weight 5%) Written Exam (Weight 12%)

Evaluation Type and Assessment Weight

Type	Assessment Weight
Case Studies	68
Written Exam	15
Presentation	5
Written Exam	12
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						
				Case Studies	Written Exam	Presentation	Written Exam			
SLO-4	CLO-3	SUB-CLO-3		15	0	0	0	15		
SLO-3	CLO-2	SUB-CLO-5		20	0	0	0	20		
SLO-3	CLO-2	SUB-CLO-7		0	15	0	0	15		
SLO-3	CLO-2	SUB-CLO-9		16	0	0	0	16		
SLO-3	CLO-1	SUB-CLO-11		17	0	0	0	17		
SLO-4	CLO-3	SUB-CLO-14		0	0	5	12	17		
				68	15	5	12	100		

Lampiran Rubrik 01 | ASSESMENT TERTULIS

Kriteria Penilaian	Bobot/Skor Penilaian				
	5	4	3	2	1/0
Konsep/ metode yang digunakan	Penjelasan konsep /metode (*) sangat lengkap dan akurat	Penjelasan konsep/metode (*) cukup jelas tetapi beberapa informasi tidak dituliskan secara lengkap.	Penjelasan konsep/metode (*) kurang jelas dan banyak informasi yang tidak dituliskan	Penjelasan yang dituliskan hampir tidak berkaitan dengan konsep/ metode (*)	Tidak memberikan konsep yang dibutuhkan
Sistematika penulisan/ pembuktian	Sistematika penulisan/ pembuktian sangat jelas dan terstruktur	Sistematika penulisan/ pembuktian cukup jelas namun ada langkah yang hilang	Sistematika penulisan/ pembuktian kurang jelas	Sistematika penulisan/ pembuktian tidak jelas	Jawaban tidak benar/ tidak ada
Interpretasi geometri/ kualitatif/ kuantitatif.	Interpretasi geometri/ kualitatif/ kuantitaBtif (*) tepat dan lengkap	Interpretasi geometri/ kualitatif/ kuantitatif (*) cukup lengkap/ tepat	Interpretasi geometri/ kualitatif/ kuantitatif (*) kurang lengkap/ tepat	Interpretasi geometri/ kualitatif/ kuantitatif(*) tidak lengkap/ tepat	Interpretasi geometri/ kualitatif/kuantitatif(*) tidak benar
Perhitungan/kesimpulan	Perhitungan/ kesimpulan sangat akurat/tepat dan disertai alasan yang mendasarinya	Perhitungan/ kesimpulan cukup akurat/tepat dan disertai alasan yang mendasarinya	Kesimpulan cukup tepat, namun tidak disertai alasan yang jelas	Perhitungan/ kesimpulan kurang akurat/tepat dan tidak disertai alasan yang mendasarinya	Perhitungan/kesimpulan salah