

SEMESTER LEARNING PLAN

**GEOMETRY COURSES
(23H01130103)**



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

Mission

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 are able to identify the properties of real numbers, generalize to higher dimensions and make connections to solve problems (CPL2)

CPMK-2: Students are able to analyze the differences between vectors, bivectors and multivectors (CPL3)

CPMK-3: Students are able to analyze the generalization of real numbers to quaternion numbers (CPL4)

Sub-CLO

Sub CPMK-1: Students master the basic concepts of vectors, dot product, cross product and students are able to differentiate between vectors, bivectors and trivectors (CPMK-1)

Sub CPMK-2: Students are able to define multivector, inverse and give several examples (CPMK-1 dan CPMK-2)

Sub CPMK-3: Students are able to understand the concept of duals and give examples for calculating duals (CPMK-2)

Sub CPMK-4: Students are able to understand the concept of projection and rejection (CPMK-1)

Sub CPMK-5: Students can understand the concepts of reflection and encounter in geometric algebra (CPMK-2)

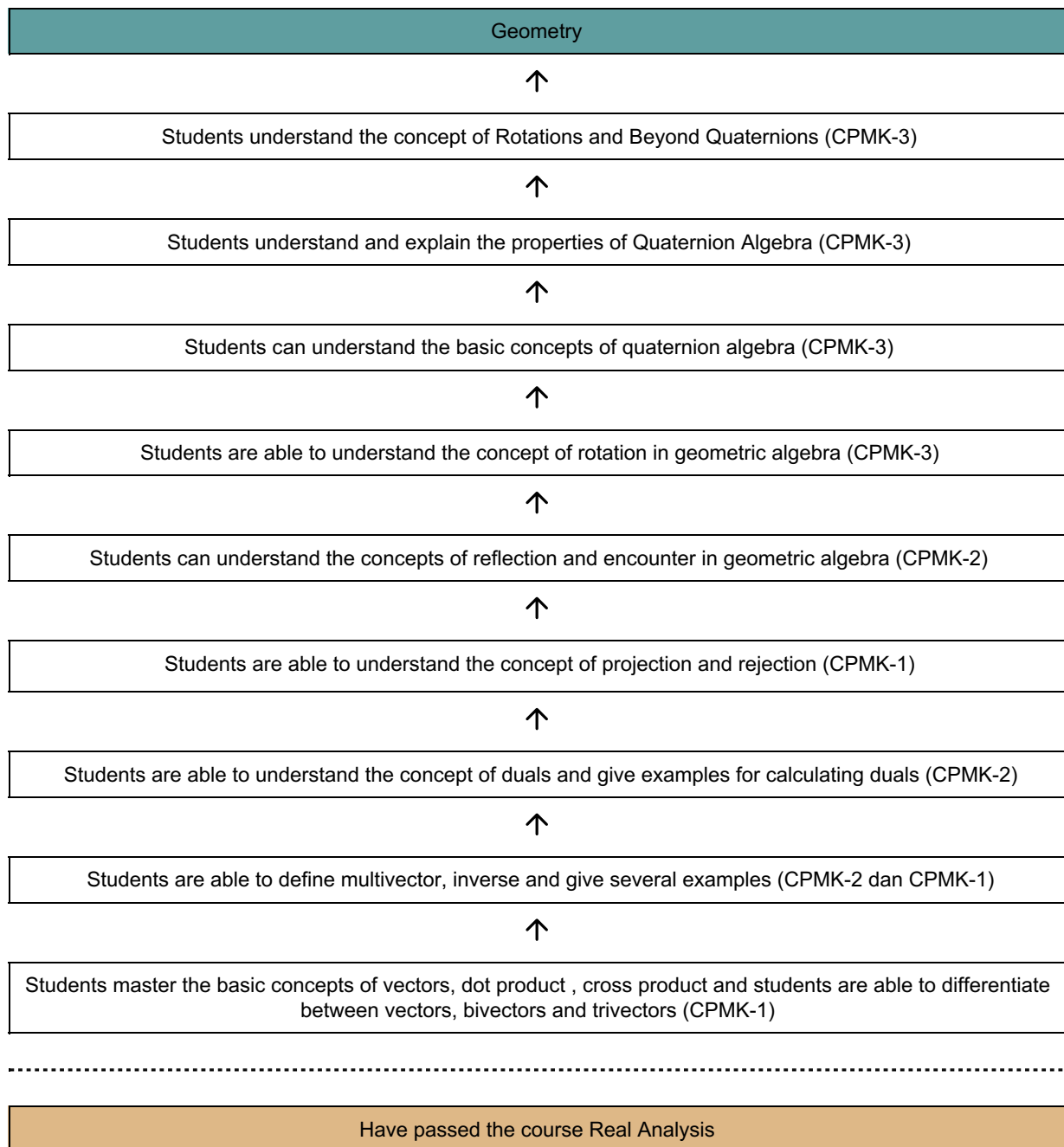
Sub CPMK-6: Students are able to understand the concept of rotation in geometric algebra (CPMK-3)

Sub CPMK-7: Students can understand the basic concepts of quaternion algebra (CPMK-3)

Sub CPMK-8: Students understand and explain the properties of Quaternion Algebra (CPMK-3)

Sub CPMK-9: Students understand the concept of Rotations and Beyond Quaternions (CPMK-3)

Learning Analytics





HASANUDDIN UNIVERSITY

FAKULTY OF MATHEMATICS AND NATURAL SCIENCES

STUDY PROGRAM OF MATHEMATICS - S1

SEMESTER LEARNING PLAN

Course		Code	Course Group	Credits	SEMESTER	Compilation Date
Geometry		23H01130103	Analysis	3	5	11 Agustus 2025
AUTHORITY		SLP Developer Lecturer	Coordinator		Head of Study Program	
		Prof. Dr. Eng. Mawardi, S.Si., M.Si., Dr. Muh. Nur, S.Si., M.Si.	Prof. Dr. Eng. Mawardi, S.Si., M.Si.		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 are able to identify the properties of real numbers, generalize to higher dimensions and make connections to solve problems				
	SLO-3	CLO-2: Students are able to analyze the differences between vectors, bivectors and multivectors				
	SLO-4	CLO-3: Students are able to analyze the generalization of real numbers to quaternion numbers				
	CLO ⇒ Sub-CLO					
	CLO-1	Sub-CLO-1:Students master the basic concepts of vectors, dot product , cross product and students are able to differentiate between vectors, bivectors and trivectors				
		Sub-CLO-2:Students are able to define multivector, inverse and give several examples				
		Sub-CLO-4:Students are able to understand the concept of projection and rejection				
	CLO-2	Sub-CLO-2:Students are able to define multivector, inverse and give several examples				
		Sub-CLO-3:Students are able to understand the concept of duals and give examples for calculating duals				
		Sub-CLO-5:Students can understand the concepts of reflection and encounter in geometric algebra				
		Sub-CLO-6:Students are able to understand the concept of rotation in geometric algebra				

		CLO-3	Sub-CLO-7:Students can understand the basic concepts of quaternion algebra								
			Sub-CLO-8:Students understand and explain the properties of Quaternion Algebra								
			Sub-CLO-9:Students understand the concept of Rotations and Beyond Quaternions								
		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	Written Exam					
SLO-2	CLO-1	SUB-CLO-1	Fill in correct and comprehensive answers			10	0	0	10		
SLO-2	CLO-1	SUB-CLO-2	Appearance in presenting each group's project			10	0	0	10		
SLO-3	CLO-2	SUB-CLO-3	Writing papers according to the template and correct substance content and accuracy in solving the questions given			10	20	0	30		
SLO-4	CLO-3	SUB-CLO-7	The correct way of writing and explaining the substance			10	0	0	10		
SLO-4	CLO-3	SUB-CLO-8	Correct writing and substance			10	0	0	10		
SLO-4	CLO-3	SUB-CLO-9	Correct writing and substance and accuracy in solving the questions given			10	0	20	30		
						60	20	20	100		
Course Description		This course presents the basic concepts of geometric algebra. This course encourages students to practice critical thinking in expanding the nature ofproperties on real numbers to higher dimensions. To achieve the targets above, this course is given with emphasis on providing sufficient time relatively a lot for students to do problem-solving ranging from simple problems to quite complex ones. The presentation of this course includes discussion, presentation of proof of theory to train students to think logically, systematically and correctly. This course material includes: vectors, bivectors, multivectors, translation and rotation of planes with algebraic planes and quaternines.									

Learning Materials/Subjects		1. Properties of real numbers (review on real numbers) 2. Vector Spaces and Inner Product Spaces 3. Outer Multiplication, Bivectors and Trivectors 4. Multivectors and Geometric Multiplication 5. Projection, Reflection, Reflection 6. Applications of Geometric Algebra to the Euclidean Plane 7. Introduction to Algebra Quaternions 8. Quaternion Algebra 9. Rotations and Beyond Quaternions					
Reference		Main References					
		1. Suter, J. (2003), Geometric Algebra Primer , http://www.jaapsuter.com/geometric-algebra/ 2. Doran, C, and Lasenby , A. (2007), Geometric Algebra for Physics, Cambridge University Press. 3. Bahri, M, Hitzer, E. (2007) Clifford algebra Cl3, 0-valued wavelet transformation, Clifford wavelet uncertainty inequality and Clifford Gabor wavelets , International Journal of Wavelets, Multiresolution and Information..					
		Additional References					
		1. Bahri, M, & Ashino, R. (2019). Convolution and Correlation Theorems for Quaternion Fourier Transformation Based on the Orthogonal Planes Split International Conference on Wavelet Analysis and Pattern Recognition. 2. Nur, M., & Idris, M. (2023). A New Notion of Inner Product in A Subspace of n-Normed Spaces. <i>Journal of the Indonesian Mathematics Society</i> , 29(3), 372–381. https://doi.org/10.22342/jims.29.3.1412.372-381 .					
Teaching Team		Prof. Dr. Eng. Mawardi, S.Si., M.Si., Dr. Muh. Nur, S.Si., M.Si.					
Course requirement		Real Analysis					
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 master the basic concepts of vectors, dot product, cross product and students are able to differentiate between vectors, bivectors and trivectors (CPMK-1)	Formative: Accuracy of Understanding Sumative: Students can copy dot product and cross product of two or more vectors	Formative Criteria: Fill in correct and comprehensive answers dinilai dengan rubrik 01 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 01 Assessment Technique: Test and Non-Test	Studying: Group discussion (Small Group Discussion) 150 Minutes		Tuition Contract, Rules addition, dot product and cross multiplication	10
3-4	Students are able to define multivector, inverse and give several examples (CPMK-2, CPMK-1)	Formative: Accuracy in understanding and completion Sumative: Students can give examples geometric multiplication of two vector	Formative Criteria: Appearance in presenting each group's project dinilai dengan rubrik 02 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 02 Assessment Technique: Non Test	Seminar: Case Study (Case Study) 150 Minutes		examples of vectors, bivectors and trivectors	10

5-7	Students are able to understand the concept of duals and give examples for calculating duals (CPMK-2)	Formative: Success and understanding in completing assignments Sumative: Students can give examples multivector, inverse	Formative Criteria: Write papers according to the template and contain the correct substance dinilai dengan rubrik 03 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 03 Assessment Technique: Test and Non-Test	Seminar: Case Study (Case Study) 150 Minutes		multivector and its inverse, projection, projection and dual	10
8	Students are able to understand the concept of duals and give examples for calculating duals (CPMK-2)	Formative: Understanding and effectiveness of work Sumative: Students can work on the test questions given	Formative Criteria: Accuracy in solving the questions given dinilai dengan rubrik 01 Sumative Criteria: Written Exam (20) dinilai dengan rubrik 01 Assessment Technique: Test	Other Forms: Self-Directed Learning 150 Minutes		1. Vector Spaces and Inner Product Spaces 2. Outer Multiplication, Bivectors and Trivectors 3. Multivectors and Geometric Multiplication 4. Projection, Reflection, Reflection 5. Applications of Geometric Algebra to the Euclidean Plane (Supporting [1])	20

9-10	Students can understand the basic concepts of quaternion algebra (CPMK-3)	Formative: Understanding and accuracy Sumative: Students are able to understand and explain the basic concepts of quaternion algebra	Formative Criteria: The correct way of writing and explaining the substance dinilai dengan rubrik 01 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 01 Assessment Technique: Test and Non-Test	Studying: Group discussion (Small Group Discussion), Case Study (Case Study) 150		Introduction to Quaternion Algebra	10
11-13	Students understand and explain the properties of Quaternion Algebra (CPMK-3)	Formative: Understanding and making examples Sumative: Students can derive formulas rotation in geometric algebra	Formative Criteria: Correct writing and substance dinilai dengan rubrik 04 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 01 Assessment Technique: Test and Non-Test	Studying: Group discussion (Small Group Discussion) 150 Minutes		Quaternion Algebra	10
14-15	Students understand the concept of Rotations and Beyond Quaternions (CPMK-3)	Formative: Student understanding and accuracy Sumative: Students can write multiplication from quaternions and their properties	Formative Criteria: Correct writing and substance dinilai dengan rubrik 02 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 03 Assessment Technique: Test and Non-Test	Seminar: Case Study (Case Study) 150 Minutes		Rotations and Beyond Quaternions	10

16	Students understand the concept of Rotations and Beyond Quaternions (CPMK-3)	Formative: Student understanding and accuracy Sumative: Students can work on the test questions given	Formative Criteria: Accuracy in solving the questions given dinilai dengan rubrik 01 Sumative Criteria: Written Exam (20) dinilai dengan rubrik 01 Assessment Technique: Test	Other Forms: Self-Directed Learning 150 Minutes		Introduction to Quaternion Algebra Quaternion Algebra Rotations and Beyond Quaternions	20
							100

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2	CLO-3
CPL-2 (P2)	Case Studies (Weight 10%) Case Studies (Weight 10%)		
CPL-3 (KU1)		Case Studies (Weight 10%) Case Studies (Weight 10%) Written Exam (Weight 20%)	
CPL-4 (KU2)			Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 10%) Written Exam (Weight 20%)

Evaluation Type and Assessment Weight

Type	Assessment Weight
Case Studies	60
Written Exam	20
Written Exam	20
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	Written Exam			
SLO-2	CLO-1	SUB-CLO-1	Fill in correct and comprehensive answers	10	0	0	10		
SLO-2	CLO-1	SUB-CLO-2	Appearance in presenting each group's project	10	0	0	10		
SLO-3	CLO-2	SUB-CLO-3	Writing papers according to the template and correct substance content and accuracy in solving the questions given	10	20	0	30		
SLO-4	CLO-3	SUB-CLO-7	The correct way of writing and explaining the substance	10	0	0	10		
SLO-4	CLO-3	SUB-CLO-8	Correct writing and substance	10	0	0	10		
SLO-4	CLO-3	SUB-CLO-9	Correct writing and substance and accuracy in solving the questions given	10	0	20	30		
				60	20	20	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/ kuantitatif (*) 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

Lampiran Rubrik 02 | ASSESMENT PRESENTASI

Kriteria Penilaian	Bobot/Skor Penilaian				
	5	4	3	2	1
Penguasaan Materi	Mahasiswa sangat menguasai materi	Mahasiswa menguasai materi	Mahasiswa cukup menguasai materi	Mahasiswa kurang menguasai materi	Mahasiswa tidak menguasai materi
Sistematika Penyajian	Mahasiswa menyajikan materi presentasi dengan sangat sistematis	Mahasiswa menyajikan materi presentasi dengan sistematis	Mahasiswa menyajikan materi presentasi dengan cukup sistematis	Mahasiswa menyajikan materi presentasi dengan kurang sistematis	Mahasiswa menyajikan materi presentasi dengan tidak sistematis
Suara dan Ekspresi	Mahasiswa menjelaskan dengan suara yang sangat jelas, volume yang sangat sesuai, pengucapan istilah sangat tepat	Mahasiswa menjelaskan dengan suara yang jelas, volume yang sesuai, pengucapan istilah tepat	Mahasiswa menjelaskan dengan suara yang cukup jelas, volume yang cukup sesuai, pengucapan istilah cukup tepat	Mahasiswa menjelaskan dengan suara yang kurang jelas, volume yang kurang sesuai, pengucapan istilah kurang tepat	Mahasiswa menjelaskan dengan suara yang tidak jelas, volume yang tidak sesuai, pengucapan istilah tidak tepat
Kepercayaan Diri	Mahasiswa berbicara dengan sangat semangat, menularkan semangat dan antusiasme pada pendengar, eye contact ke semua peserta (audience)	Mahasiswa berbicara dengan semangat, menularkan semangat dan antusiasme pada pendengar, eye contact ke semua peserta (audience)	Mahasiswa berbicara dengan cukup semangat, cukup menularkan semangat dan antusiasme pada pendengar, eye contact ke semua peserta (audience)	Mahasiswa berbicara dengan kurang semangat, kurang menularkan semangat dan antusiasme pada pendengar, eye contact yang kurang ke semua peserta (audience)	Mahasiswa berbicara dengan tidak semangat, tidak dapat menularkan semangat dan antusiasme pada pendengar, tidak ada eye contact ke semua peserta (audience)
Kemampuan menjawab pertanyaan	Mahasiswa mampu menjawab semua pertanyaan dengan sangat mendalam (lebih dari yang dibutuhkan), dan sangat tajam	Mahasiswa mampu menjawab semua pertanyaan dengan tepat, mendalam (lebih dari yang dibutuhkan), dan tajam	Mahasiswa mampu menjawab semua pertanyaan dengan cukup tepat, cukup mendalam, dan cukup tajam	Mahasiswa mampu menjawab semua pertanyaan dengan kurang tepat, kurang mendalam, dan kurang tajam	Mahasiswa mampu menjawab semua pertanyaan dengan tidak tepat, tidak mendalam, dan tidak tajam
Kepemimpinan presentasi kelompok)	Mahasiswa sangat mampu menginisiasi, menggerakkan, mengarahkan, mengorganisir jalannya presentasi	Mahasiswa mampu menginisiasi, menggerakkan, mengarahkan, mengorganisir jalannya presentasi	Mahasiswa cukup mampu menginisiasi, menggerakkan, mengarahkan, mengorganisir jalannya presentasi	Mahasiswa kurang mampu menginisiasi, menggerakkan, mengarahkan, mengorganisir jalannya presentasi	Mahasiswa tidak mampu menginisiasi, menggerakkan, mengarahkan, mengorganisir jalannya presentasi

Lampiran Rubrik 03 | ASSESMENT MAKALAH

Kriteria Penilaian	Bobot/Skor Penilaian				
	5	4	3	2	1
Sistematika dan kelengkapan penulisan	Mahasiswa menyusun laporan dengan sistematika yang sangat sesuai dengan format yang diberikan dan sangat lengkap	Mahasiswa menyusun laporan dengan sistematika yang sesuai dengan format yang diberikan dan lengkap	Mahasiswa menyusun laporan dengan sistematika yang cukup sesuai dengan format yang diberikan dan cukup lengkap	Mahasiswa menyusun laporan dengan sistematika yang kurang sesuai dengan format yang diberikan dan kurang lengkap	Mahasiswa menyusun laporan dengan sistematika yang tidak sesuai dengan format yang diberikan dan tidak lengkap
Kebenaran konsep ide yang dipaparkan	Mahasiswa menyusun makalah dengan konsep/ide yang dipaparkan dengan sangat tepat (sesuai dengan teori)	Mahasiswa menyusun makalah dengan konsep/ide yang dipaparkan dengan tepat	Mahasiswa menyusun makalah dengan konsep/ide yang dipaparkan dengan cukup tepat	Mahasiswa menyusun makalah dengan konsep/ide yang dipaparkan dengan kurang tepat	Mahasiswa menyusun makalah dengan konsep/ide yang dipaparkan dengan tidak tepat
Interpretasi metode dengan permasalahan yang dikaji	Mahasiswa sangat mampu mengidentifikasi relevansi metode dengan permasalahan yang dikaji	Mahasiswa mampu mengidentifikasi relevansi metode dengan permasalahan yang dikaji	Mahasiswa cukup mampu mengidentifikasi relevansi metode dengan permasalahan yang dikaji	Mahasiswa kurang mampu mengidentifikasi relevansi metode dengan permasalahan yang dikaji	Mahasiswa tidak mampu mengidentifikasi relevansi metode dengan permasalahan yang dikaji
Validitas Referensi – VR	Mahasiswa menggunakan referensi yang sangat up to date dan sangat relevan	Mahasiswa menggunakan referensi yang up to date dan relevan	Mahasiswa menggunakan referensi yang cukup up to date dan cukup relevan	Mahasiswa menggunakan referensi yang kurang up to date dan kurang relevan	Mahasiswa menggunakan referensi yang tidak up to date dan tidak relevan
Ketepatan waktu	Mahasiswa mengumpulkan makalah tepat waktu atau sebelum batas waktu yang ditentukan.	Mahasiswa mengumpulkan makalah lewat 1 hari dari batas waktu yang ditentukan.	Mahasiswa mengumpulkan makalah lewat 2 hari dari batas waktu yang ditentukan.	Mahasiswa mengumpulkan makalah lewat 3 hari dari batas waktu yang ditentukan.	Mahasiswa mengumpulkan makalah lewat 4 hari atau lebih dari batas waktu yang ditentukan.