

SEMESTER LEARNING PLAN

**DYNAMIC SYSTEMS COURSES
(23H01121603)**



TEACHING TEAM

Prof. Dr. Syamsuddin Toaha, M.Sc.
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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-4 (KU2) - The students are able to use their sufficiently mathematical critical thinking for abstraction and generalization of a mathematical problem

CPL-5 (KK1) - The students are able to construct mathematical modelling with relatively new ideas and present the results orally and in writing

CPL-6 (KK2) - The students are able to apply the mathematical method for solving a mathematical related-problem with or without the aid of computers and software

Course Learning Outcomes (CLO)

CPMK-1: Students are able to investigate the stability of a system (CPL4 dan CPL6)

CPMK-2: Students are able to understand the importance of initial conditions and understand the meaning of the terms attractor and repellent (CPL4 dan CPL6)

CPMK-3: Students are able to understand the importance of parameter values in a model (CPL4, CPL5 dan CPL6)

CPMK-4: Students are able to qualitatively describe the long-term behavior of a system (CPL5 dan CPL6)

CPMK-5: Students are able to understand the sensitivity of chaotic systems to initial conditions (CPL5 dan CPL6)

Sub-CLO

Sub CPMK-1: Determine the solution curve and phase field of a dynamic system (CPMK-1)

Sub CPMK-2: Transforming the system into a canonical system form Classifying the phase plane of a linear system in the plane (CPMK-2)

Sub CPMK-3: Determining the stability of a linear system for dimensions of more than two (CPMK-1, CPMK-2 dan CPMK-3)

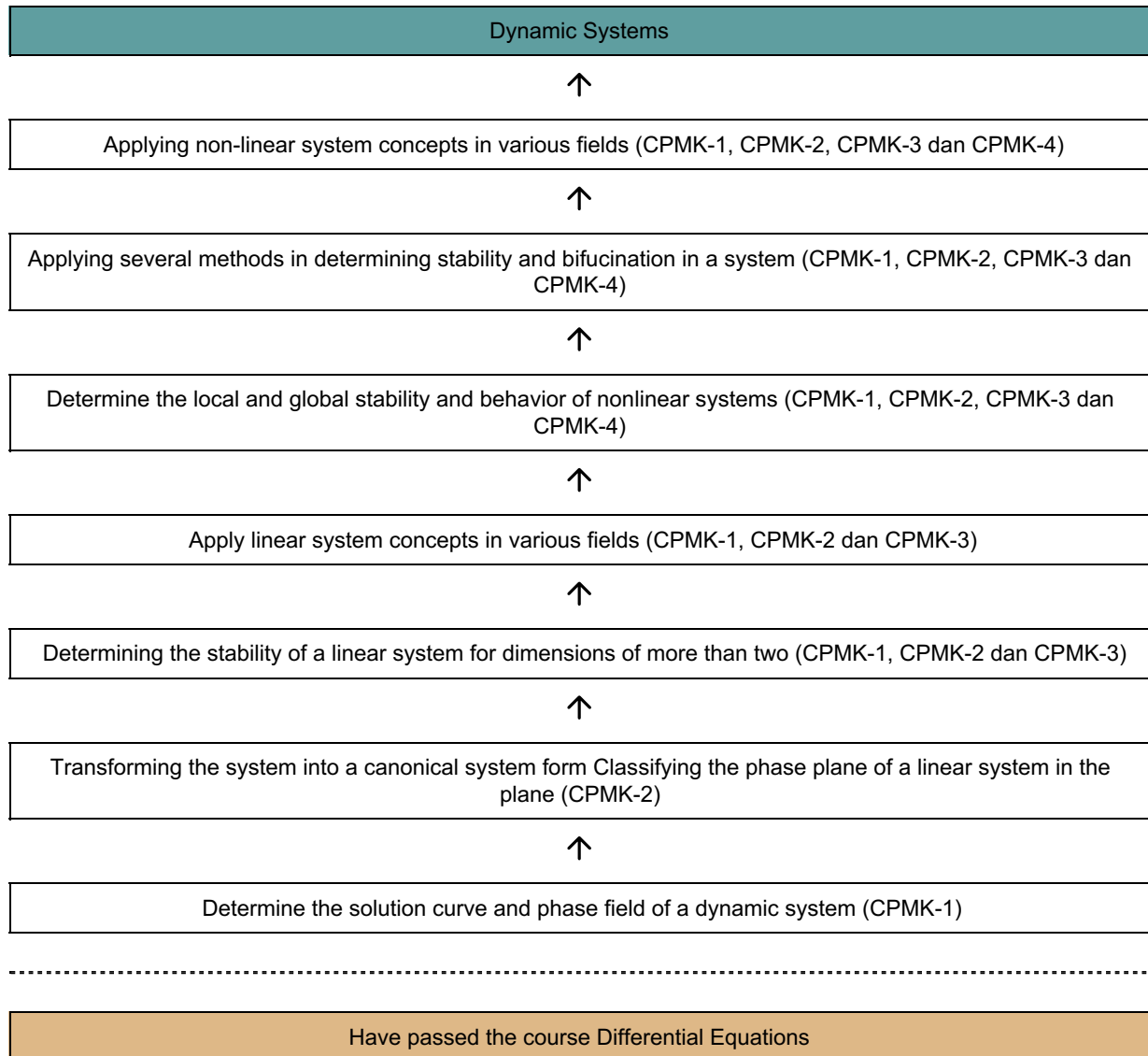
Sub CPMK-4: Apply linear system concepts in various fields (CPMK-1, CPMK-2 dan CPMK-3)

Sub CPMK-5: Determine the local and global stability and behavior of nonlinear systems (CPMK-1, CPMK-2, CPMK-3 dan CPMK-4)

Sub CPMK-6: Applying several methods in determining stability and bifurcation in a system (CPMK-1, CPMK-2, CPMK-3 dan CPMK-4)

Sub CPMK-7: Applying non-linear system concepts in various fields (CPMK-1, CPMK-2, CPMK-3 dan CPMK-4)

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
Dynamic Systems		23H01121603	Elective Courses	3	4	10 Agustus 2025
AUTHORITY		SLP Developer Lecturer	Coordinator		Head of Study Program	
		Prof. Dr. Syamsuddin Toaha, M.Sc., Prof. Dr. Jeffry Kusuma, Prof. Dr. Kasbawati, S.Si., M.Si.	Prof. Dr. Syamsuddin Toaha, M.Sc.		Dr. Firman, S.Si.,M.Si.	
	SLOs that are imposed on the course					
	SLO-4:	Mahasiswa dapat menggunakan pemikiran kritis matematis mereka yang cukup untuk abstraksi dan generalisasi masalah matematika berdasarkan hasil analisis informasi dan data				
	SLO-5:	Mahasiswa dapat membangun pemodelan matematika dengan ideide yang relatif baru dan mempresentasikan hasil dengan jelas secara lisan dan tertulis				
	SLO-6:	Mahasiswa dapat menerapkan metode matematika untuk memecahkan masalah terkait matematika dengan atau tanpa bantuan komputer dan perangkat lunak				
	SLO ⇒ Course Learning Outcomes					
	After completing this course, it is expected:					
	SLO-4	CLO-1: Students are able to investigate the stability of a system				
		CLO-2: Students are able to understand the importance of initial conditions and understand the meaning of the terms attractor and repellent				
		CLO-3: Students are able to understand the importance of parameter values in a model				
	SLO-6	CLO-1: Students are able to investigate the stability of a system				
		CLO-2: Students are able to understand the importance of initial conditions and understand the meaning of the terms attractor and repellent				
		CLO-3: Students are able to understand the importance of parameter values in a model				
		CLO-4: Students are able to qualitatively describe the long-term behavior of a system				
		CLO-5: Students are able to understand the sensitivity of chaotic systems to initial conditions				
	SLO-5	CLO-3: Students are able to understand the importance of parameter values in a model				
CLO-4: Students are able to qualitatively describe the long-term behavior of a system						

Learning Outcomes Course		CLO-5: Students are able to understand the sensitivity of chaotic systems to initial conditions
	CLO ⇒ Sub-CLO	
	CLO-1	Sub-CLO-1:Determine the solution curve and phase field of a dynamic system
		Sub-CLO-3:Determining the stability of a linear system for dimensions of more than two
		Sub-CLO-4:Apply linear system concepts in various fields
		Sub-CLO-5:Determine the local and global stability and behavior of nonlinear systems
		Sub-CLO-6:Applying several methods in determining stability and bifucination in a system
		Sub-CLO-7:Applying non-linear system concepts in various fields
	CLO-2	Sub-CLO-2:Transforming the system into a canonical system form Classifying the phase plane of a linear system in the plane
		Sub-CLO-3:Determining the stability of a linear system for dimensions of more than two
		Sub-CLO-4:Apply linear system concepts in various fields
		Sub-CLO-5:Determine the local and global stability and behavior of nonlinear systems
		Sub-CLO-6:Applying several methods in determining stability and bifucination in a system
		Sub-CLO-7:Applying non-linear system concepts in various fields
	CLO-3	Sub-CLO-3:Determining the stability of a linear system for dimensions of more than two
		Sub-CLO-4:Apply linear system concepts in various fields
		Sub-CLO-5:Determine the local and global stability and behavior of nonlinear systems
		Sub-CLO-6:Applying several methods in determining stability and bifucination in a system
		Sub-CLO-7:Applying non-linear system concepts in various fields
	CLO-4	Sub-CLO-5:Determine the local and global stability and behavior of nonlinear systems
		Sub-CLO-6:Applying several methods in determining stability and bifucination in a system
		Sub-CLO-7:Applying non-linear system concepts in various fields
	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						
				Independent Assignment	Case Studies	Written Exam	Written Exam			
SLO-6	CLO-1	SUB-CLO-1	discipline, perseverance, activeness and discipline, perseverance, activeness	10	15	4.55	0	29.55		
SLO-6	CLO-2	SUB-CLO-2	discipline, perseverance, activeness	0	10	1.82	0	11.82		
SLO-6	CLO-3	SUB-CLO-3	discipline, perseverance, activeness	0	10	1.82	0	11.82		
SLO-6	CLO-3	SUB-CLO-4	discipline, perseverance, activeness	0	10	1.82	0	11.82		
SLO-6	CLO-4	SUB-CLO-5	discipline, perseverance, activeness	0	15	0	6	21		
SLO-6	CLO-4	SUB-CLO-7	discipline, perseverance, activeness	10	0	0	4	14		
				20	60	10	10	100		
Course Description		In a dynamical system, the model, usually a set of differential or difference equations, determines the evolution of the system only by considering its initial state, that is, its long-term behavior. It is known once the initial conditions are known. The aim of this module is to learn how to use models to predict the long-term behavior of a system analytically and qualitatively								
Learning Materials/Subjects		1. Linear Systems 2. Nonlinear Systems 3. Local and Global Stability 4. Bifurcation								
Reference		Main References								
		1. Arrowsmith, D.K., Place, C.M. 1982. Ordinary Differential Equations. Chapman and Hall. London								
		Additional References								
		1. J.D. Murray, Mathematical Biolgy I, Springer, New York.								

Teaching Team		Prof. Dr. Syamsuddin Toaha, M.Sc., Prof. Dr. Jeffry Kusuma, Prof. Dr. Kasbawati, S.Si., M.Si.					
Course requirement		Differential Equations					
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	Determine the solution curve and phase field of a dynamic system (CPMK-1)	Formative: accuracy of understanding Sumative: - Accuracy of the solution - Clarity of phase fields	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 01 Sumative Criteria: Independent Assignment (10) Assessment Technique: Test and Non-Test	Studying: Collaborative learning (Collaborative Learning), other methods 2X3X50		Tuition Contract Autonomous System, fixed point, flow, and solution evolution	10
3-4	Transforming the system into a canonical system form Classifying the phase plane of a linear system in the plane (CPMK-2)	Formative: accuracy of understanding Sumative: - Determination of the transformation formula - Clarity of interpretation	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 01 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 01 Assessment Technique: Test and Non-Test	Studying: Group discussions (Small Group Discussion), Collaborative Learning (Collaborative Learning) 2X3X50		Linear System, point fixed, canonical system, type of stability, trajectory	10

5-6	Determining the stability of a linear system for dimensions of more than two (CPMK-1, CPMK-2, CPMK-3)	Formative: accuracy of understanding Sumative: - Determination of the transformation formula - Clarity of interpretation - Accuracy of determining fixed points - Accuracy of the type of stability - Accuracy of the trajectory curve plot	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 02 Sumative Criteria: Case Studies (10) dinilai dengan rubrik 02 Assessment Technique: Gagal diterjemahkan	Studying: Group discussions (Small Group Discussion), Collaborative Learning (Collaborative Learning) 2X3X50		Dimensional linear systems with more dimensions of two, fixed points, trajectory	10
7	Apply linear system concepts in various fields (CPMK-1, CPMK-2, CPMK-3)	Formative: accuracy of understanding Sumative: - Assumption determination - Accuracy of analysis - Clarity of interpretation - Teamwork	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 04 Sumative Criteria: Case Studies (10) Assessment Technique: Gagal diterjemahkan	Studying: Group discussion (Small Group Discussion) 1X3X50		Multiple systems linear, oscillator mechanics, circuits electricity, economic model	10
8	WRITTEN EXAMINATION						10

9-11	Determine the local and global stability and behavior of nonlinear systems (CPMK-1, CPMK-2, CPMK-3, CPMK-4)	Formative: accuracy of understanding Sumative: - Fixed point determination accuracy - Accuracy of the type of stability - Accuracy of the trajectory curve plot	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 01 Sumative Criteria: Case Studies (15) dinilai dengan rubrik 01 Assessment Technique: Gagal diterjemahkan	Studying: Group discussions (Small Group Discussion), Collaborative Learning (Collaborative Learning), Other methods 3X3X50		Nonlinear Systems, Period fixed, Linearization, stability, Limit Cycle, Poincare's theory - Bendixson	15
12-14	Determine the solution curve and phase field of a dynamic system (CPMK-1)	Formative: accuracy of understanding Sumative: - Fixed point determination accuracy - Accuracy of the type of stability - Accuracy of the trajectory curve plot	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 02 Sumative Criteria: Case Studies (15) dinilai dengan rubrik 02 Assessment Technique: Gagal diterjemahkan	Studying: Group discussions (Small Group Discussion), Collaborative Learning (Collaborative Learning), Other methods 3X3X50		Lienard's equation, Lyapunov function, period bifocacy	15

15	Applying non-linear system concepts in various fields (CPMK-1, CPMK-2, CPMK-3, CPMK-4)	Formative: accuracy of understanding Sumative: - Assumption determination -Precision of analysis - Clarity of interpretation - Teamwork	Formative Criteria: discipline, perseverance, activeness dinilai dengan rubrik 01 Sumative Criteria: Independent Assignment (10) dinilai dengan rubrik 01 Assessment Technique: Gagal diterjemahkan			Some systems Non linear, models species competition, Lotka Volterra models, Holling - Tanner model	10
16	WRITTEN EXAMINATION						10
							100

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2	CLO-3	CLO-4
CPL-4 (KU2)	Independent Assignment (Weight 10%) Case Studies (Weight 15%) Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	
CPL-5 (KK1)			Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 15%) Independent Assignment (Weight 10%)
CPL-6 (KK2)	Independent Assignment (Weight 10%) Case Studies (Weight 15%) Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 10%) Case Studies (Weight 10%) Case Studies (Weight 15%) Independent Assignment (Weight 10%)	Case Studies (Weight 15%) Independent Assignment (Weight 10%)

Evaluation Type and Assessment Weight

Type	Assessment Weight
Independent Assignment	20
Case Studies	60
Written Exam	10
Written Exam	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						
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SLO-6	CLO-4	SUB-CLO-5	discipline, perseverance, activeness	0	15	0	6	21		
SLO-6	CLO-4	SUB-CLO-7	discipline, perseverance, activeness	10	0	0	4	14		
				20	60	10	10	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 tepat, 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
Keperimpinan 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