SEMESTER LEARNING PLAN

MATHEMATICAL COMPUTING COURSES
(23H01130703)

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-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

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

CPL-7 (KK3) - The students are able to demonstrate mathematical skills which include interpretation, connecting problems, solving problems, and communicating individually or teamwork

Course Learning Outcomes (CLO)

CPMK-1: Students can understand several mathematical methods and concepts and apply these methods in several other related fields such as industry, economics and agriculture. (CPL3)

CPMK-2: Students can analyze and implement several numerical methods into other fields of study. (CPL3)

CPMK-4: Students can create several mathematical models, explain procedures, and solve problems numerically using appropriate techniques and interpret the results obtained in other related fields. (CPL6)

CPMK-5: Students are able to communicate ideas, develop their abilities based on local wisdom and easily adapt to communities with different backgrounds. (CPL7)

CPMK-3: Students are able to model mathematical problems from information and data through critical analysis. (CPL4)

Sub-CLO

Sub CPMK-1: Students are able to understand well the objectives, uses of the course material, as well as

its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method. (CPMK-1, CPMK-4 dan CPMK-5)

Sub CPMK-2: Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods (CPMK-1, CPMK-2 dan CPMK-4)

Sub CPMK-3: Students are able to solve systems of first order ordinary differential equations numerically (CPMK-1)

Sub CPMK-4: Students are able to solve initial value problems for higher order ordinary differential equations numerically. (CPMK-4)

Sub CPMK-5: Students are able to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations (CPMK-1 dan CPMK-5)

Sub CPMK-6: Students are able to explain vector and matrix norms (CPMK-4)

Sub CPMK-7: Students are able to explain spectral radii, matrix series and their convergence. Analyzing errors from systems of linear equations and proving several related theorems. (CPMK-4)

Sub CPMK-8: Students are able to analyze errors from systems of linear equations and prove several related theorems. (CPMK-1 dan CPMK-2)

Sub CPMK-9: Students are able to solve large systems of linear equations iteratively using the Jacobi, Gauss-Seidel and SOR methods. (CPMK-2 dan CPMK-4)

Sub CPMK-10: Students are able to apply several numerical methods to solve systems of nonlinear equations and create computer programs. (CPMK-4 dan CPMK-5)

Learning Analytics

Mathematical Computation

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Students are able to apply several numerical methods to solve systems of nonlinear equations and create computer programs. (CPMK-4 dan CPMK-5)

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Students are able to solve large systems of linear equations iteratively using the Jacobi, Gauss-Seidel and SOR methods. (CPMK-4 dan CPMK-2)

↑

Students are able to analyze errors from systems of linear equations and prove several related theorems. (CPMK-1 dan CPMK-2)

↑

Students are able to explain spectral radii, matrix series and their convergence. Analyzing errors from systems of linear equations and proving several related theorems. (CPMK-4)

↑

Students are able to explain vector and matrix norms (CPMK-4)

↑

Students are able to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations (CPMK-1 dan CPMK-5)

↑

Students are able to solve initial value problems for higher order ordinary differential equations numerically. (CPMK-4)

↑

Students are able to solve systems of first order ordinary differential equations numerically (CPMK-1)

↑

Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods (CPMK-1, CPMK-4 dan CPMK-2)

↑

Students are able to understand well the objectives, uses of the course material, as well as its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method. (CPMK-1, CPMK-4 dan CPMK-5)

Have passed the course Advanced Mathematics, Numerical Methods and Differential Equations

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

Course	Code	Cource Group	Credits	SEMESTER	Compilation Date
Mathematical Computation	23H01130703	Applied Mathematics	3	5	8 Februari 2025

AUTHORITY	SLP Developer Lecturer	Coordinator	Head of Study Program
	Prof. Agustinus Ribal, S.Si.,M.Sc., Ph. D, Dr. Khaeruddin, M.Sc.	Prof. Agustinus Ribal, S.Si.,M.Sc., Ph. D	Dr. Firman, S.Si.,M.Si.

SLOs that are imposed on the course	
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-6:	Mahasiswa dapat menerapkan metode matematika untuk memecahkan masalah terkait matematika dengan atau tanpa bantuan komputer dan perangkat lunak
SLO-7:	Mahasiswa dapat menunjukkan keterampilan matematika termasuk menghubungkan masalah, menyelesaikan masalah, interpretasi, dan berkomunikasi secara individu atau dengan kerja tim
SLO ⇒ Course Learning Outcomes	
After completing this course, it is expected:	
SLO-3	**CLO-1:** Students can understand several mathematical methods and concepts and apply these methods in several other related fields such as industry, economics and agriculture.
	CLO-2: Students can analyze and implement several numerical methods into other fields of study.
SLO-6	**CLO-4:** Students can create several mathematical models, explain procedures, and solve problems numerically using appropriate techniques and interpret the results obtained in other related fields.
SLO-7	**CLO-5:** Students are able to communicate ideas, develop their abilities based on local wisdom and easily adapt to communities with different backgrounds.
SLO-4	**CLO-3:** Students are able to model mathematical problems from information and data through critical analysis.
CLO ⇒ Sub-CLO	
	Sub-CLO-1: Students are able to understand well the objectives, uses of the course material, as well as its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method.

Learning Outcomes Course	**CLO-1**	**Sub-CLO-2:**Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods
		Sub-CLO-3: Students are able to solve systems of first order ordinary differential equations numerically
		Sub-CLO-5: Students are able to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations
		Sub-CLO-8: Students are able to analyze errors from systems of linear equations and prove several related theorems.
	CLO-4	**Sub-CLO-1:**Students are able to understand well the objectives, uses of the course material, as well as its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method.
		Sub-CLO-2: Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods
		Sub-CLO-4: Students are able to solve initial value problems for higher order ordinary differential equations numerically.
		Sub-CLO-6: Students are able to explain vector and matrix norms
		Sub-CLO-7: Students are able to explain spectral radii, matrix series and their convergence. Analyzing errors from systems of linear equations and proving several related theorems.
		Sub-CLO-9: Students are able to solve large systems of linear equations iteratively using the Jacobi, Gauss-Seidel and SOR methods.
		Sub-CLO-10: Students are able to apply several numerical methods to solve systems of nonlinear equations and create computer programs.
	CLO-5	**Sub-CLO-1:**Students are able to understand well the objectives, uses of the course material, as well as its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method.
		Sub-CLO-5: Students are able to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations
		Sub-CLO-10: Students are able to apply several numerical methods to solve systems of nonlinear equations and create computer programs.
	CLO-2	**Sub-CLO-2:**Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods
		Sub-CLO-8: Students are able to analyze errors from systems of linear equations and prove several related theorems.
		Sub-CLO-9: Students are able to solve large systems of linear equations iteratively using the Jacobi, Gauss-Seidel and SOR methods.
	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-6	CLO-4	SUB-CLO-4		15	10	0	25		
SLO-6	CLO-4	SUB-CLO-6		15	10	0	25		

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-3	CLO-2	SUB-CLO-9		20	0	13.33	33.33		
SLO-7	CLO-5	SUB-CLO-10		10	0	6.67	16.67		
				60	20	20	100		

Course Description	The Computational Mathematics course is one of the elective courses in the Mathematics study program which will give students the ability to solve real problems numerically using computers and analyzing errors and convergence of several numerical methods. This course covers numerical methods for initial value problems such as Euler's method, Runge Kutta method, multi-step method and predictor corrector method. Next, we will apply numerical methods to solve systems of first-order ordinary differential equations. The initial value problem for higher order ordinary differential equations will be solved numerically which includes finite difference methods and finite difference methods. In the second part of this course, we will discuss spectral radii, matrix series and their convergence as well as analyze errors from systems of linear equations. Then the iteration method will be used to solve large-scale systems of linear equations. In the final part of this course, we will discuss numerical solutions of systems of non-linear equations.
Learning Materials/Subjects	1. Numerical methods for initial-value problems 2. Systems of ordinary differential equations 3. Two-point boundary value problems 4. Vector and matrix norms, spectral radius, series of matrices and convergence 5. Iterative methods for large-scale linear systems of equations 6. Non-linear systems of equations
Reference	**Main References**
	Burden R.L. and Faires J.D., Numerical Analysis (9th edition) Brooks/Cole, Australia, UK, USA, 2011
	Additional References
	Smith G.D., Numerical Solution of Partial Differential Equations - Finite Difference Methods, Clarendon Press, Oxford, 1978.
Teaching Team	Prof. Agustinus Ribal, S.Si.,M.Sc., Ph. D, Dr. Khaeruddin, M.Sc.
Course requirement	Advanced Mathematics, Numerical Methods, 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	Students are able to understand well the objectives, uses of the course material, as well as its relationship to other courses.Apply the Euler method in solving first order ordinary differential equations and be able to create computer programs for the Euler method. (CPMK-1, CPMK-4, CPMK-5)	**Formative:** Gagal diterjemahkan **Sumative:** Accuracy in explaining semester learning plans with good.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Non Test	**Studying:** Group discussion (Small Group Discussion) 1x3x50		Teaching contract (purpose, scope, materials, learning uses and relation to other courses and requirements for graduation)	0
2-3	Students are able to apply numerical methods in solving ordinary differential equations and create computer programs for these numerical methods (CPMK-1, CPMK-4, CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to apply numerical methods to solve equations ordinary differential.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Non Test	**Studying:** Group discussion (Small Group Discussion) 2x3x50		Runge Kutta method, Multi-step method (Multi-step methods) and Predictor Corrector methods	0
4	Students are able to solve systems of first order ordinary differential equations numerically (CPMK-1)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to solve systems of first order ordinary differential equations numerically.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Non Test	**Studying:** Group discussion (Small Group Discussion) 1x3x50		Ordinary system of differential equations of order first	0

5	Students are able to solve initial value problems for higher order ordinary differential equations numerically. (CPMK-4)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to solve initial value problems for higher order ordinary differential equations numeric.	**Formative Criteria:** **Sumative Criteria:** Case Studies (15) dinilai dengan rubrik 01 **Assessment Technique:** Test	**Studying:** Group discussion (Small Group Discussion) 1x3x50		Initial value problems for order ordinary differential equations high.	15
6	Students are able to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations (CPMK-1, CPMK-5)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to apply finite difference methods and Shooting methods in solving Ordinary Differential Equations.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Gagal diterjemahkan	**Studying:** Group discussion (Small Group Discussion) 1x3x50		Boundary value problem for two points: finite difference and shooting methods methods, Norms of vectors and matrices	0
7	Students are able to explain vector and matrix norms (CPMK-4)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to explain Vector norms and matrix	**Formative Criteria:** **Sumative Criteria:** Case Studies (15) dinilai dengan rubrik 01 **Assessment Technique:** Gagal diterjemahkan	**Studying:** Group discussion (Small Group Discussion) 1x3x50		Vector and matrix norms	15
8	Written Exam						20

9-10	Students are able to explain spectral radii, matrix series and their convergence. Analyzing errors from systems of linear equations and proving several related theorems. (CPMK-4)	**Formative:** Gagal diterjemahkan **Sumative:** Ability analyzing errors from systems of linear equations and proving several related theorems.	**Formative Criteria:** **Sumative Criteria:** **Assessment Technique:** Gagal diterjemahkan	**Studying:** Group discussion (Small Group Discussion) 2x3x50		Error analysis of system of linear equations	0
11-12	Students are able to solve large systems of linear equations iteratively using the Jacobi, Gauss-Seidel and SOR methods. (CPMK-4, CPMK-2)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to solve large systems of linear equations iteratively using the method Jacobi, Gauss-Seidel and SOR.	**Formative Criteria:** **Sumative Criteria:** Case Studies (20) dinilai dengan rubrik 01 **Assessment Technique:** Test	**Studying:** Group discussion (Small Group Discussion) 2x3x50		Iteration method for large systems of linear equations - Jacobi Method, - Gauss-Seidel - SOR methods	20
13-15	Students are able to apply several numerical methods to solve systems of nonlinear equations and create computer programs. (CPMK-4, CPMK-5)	**Formative:** Gagal diterjemahkan **Sumative:** Ability to apply several numerical methods in solving systems of infinite equations linear and create computer programs.	**Formative Criteria:** **Sumative Criteria:** Case Studies (10) dinilai dengan rubrik 01 **Assessment Technique:** Gagal diterjemahkan	**Studying:** Group discussion (Small Group Discussion) 2x3x50		Application of Numerical Methods to Systems of Nonlinear Equations - Fixed point iteration, - Newton's Method - Quasi Newtonian Method	10
16	Written Exam						20
							100

Matrix of SLO, CLO, and Assessment Method

SLO / CLO	CLO-1	CLO-2	CLO-4	CLO-5
CPL-3 (KU1)		Case Studies (Weight 20%)		
CPL-4 (KU2)				
CPL-6 (KK2)			Case Studies (Weight 15%) Case Studies (Weight 15%) Case Studies (Weight 20%) Case Studies (Weight 10%)	
CPL-7 (KK3)				Case Studies (Weight 10%)

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-6	CLO-4	SUB-CLO-4		15	10	0	25		
SLO-6	CLO-4	SUB-CLO-6		15	10	0	25		
SLO-3	CLO-2	SUB-CLO-9		20	0	13.33	33.33		
SLO-7	CLO-5	SUB-CLO-10		10	0	6.67	16.67		
				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/ 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