

SEMESTER STUDY PLAN
DYNAMIC OPTIMIZATION / MAT81241
(ELECTIVE COURSE)



DEPARTMENT OF MATHEMATICS AND DATA SCIENCE
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS ANDALAS
2024



**SEMESTER STUDY PLAN (SSP)
BACHELOR PROGRAM OF MATHEMATICS
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS ANDALAS**

Course Name		Course Code	URL I-Learn	Credits	Semester	Compilation Date
Dynamic Optimization		MAT81241	https://sci.ilearn.unand.ac.id	3	3	5 May 2024
Person In Charge		Study Plan Creator	Head of Research Group	Head of Study Program		
		Prof. Dr. Muhafzan	Dr. Ahmad Iqbal Baqi	Prof. Dr. Ferra Yanuar		
Intended Learning Outcomes						
Intended Learning Outcomes (ILO) and Performance Indicator (PI)	ILO-1	Possesses a good ethics and integrity PI-1: Possess academic ethics PI-2: Demonstrate academic integrity.				
	ILO-3	Comprehensive mastery of one or several theories for development in the fields of analysis, algebra, applied mathematics, statistics and combinatorial mathematics PI-2: An ability to identify complex mathematical problems PI-3: An ability to solve complex mathematical problems				
	ILO-4	Mastering scientific techniques and developing them in solving research problems through multidisciplinary or interdisciplinary approaches PI-1: An ability to apply mathematical techniques in research problem-solving. PI-2: An ability to analyze research problems. PI-4: An ability to use various mathematical software to solve complex mathematical problems.				
	ILO-5	An ability to work and conduct research in the field of mathematics and related fields of science by developing the latest issues independently or collaboratively and communicating them academically. PI-1: Capable of formally and correctly proving mathematical statements. PI-2: An ability to employ relevant techniques for conducting research. PI-3: Capable of communicating research findings in an academic manner				
	Course Learning Outcomes					
	1	Students are familiar with dynamic optimization system problems (both continuous and discrete) on various real phenomena (ILO-1; ILO-3; ILO-4)				
	2	Students master the theoretical aspects related to dynamic optimization (both continuous and discrete) (ILO-3; ILO-4; ILO-5)				

	3	Students are able to solve the dynamic optimization problems using various appropriate methods: (ILO-3: ILO-4; ILO-5)
	4	Students are able to analyze and interpret the optimal solution of dynamic optimization problems. (ILO-3: ILO-4; ILO-5)
	5	Students are able to use Matlab software to solve several dynamic optimization problems (ILO-3: ILO-4; ILO-5)
Brief Description	<p>This course introduces the dynamic optimization problem for both continuous time system and discrete time system. Lecture begins by introducing the concept of variational calculus for both continuous time system and discrete time system. The existence solution of the dynamic optimization problem is analyzed. Then the lecture on discrete linear quadratic regulator problem and the tracking problem is considered as well.</p> <p>This course is equipped with self-study activities through practice problems, discussion/review of material, and other forms of learning. Furthermore, to meet the demands of global developments in the mastery of technology for a master of mathematics, participants of this course are also equipped with the skills to use Matlab software related to the dynamic optimization.</p>	
Course Materials	<ol style="list-style-type: none"> 1. Variational calculus for continuous time system 2. Dynamic optimization for continuous time system 3. Variational calculus for discrete time system 4. Dynamic optimization for discrete time system 5. Discrete linear quadratic regulator problem 6. The tracking problem 	
References	<p>Main:</p> <p>[1]. Friesz, T. L., 2010, Dynamic Optimization and Differential Games, Springer, New York</p> <p>Additional:</p> <p>[2]. Lewis, F. L., Vrabie, D. L., Syrmos, V. L., 2012, Optimal Control, third edition, Wiley, New Jersey</p>	
Learning Media	<p>Software:</p> <ul style="list-style-type: none"> • LMS Unand (http://fmipa.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp 	<p>Hardware:</p> <ul style="list-style-type: none"> • Computer/Laptop • Smartphone
Team Teaching	1. Prof. Dr. Muhafzan	
Assessment	Homework(assignment), Mid-Term exam, Final exam	
Required courses	-	
Academic Norms	https://akademik.unand.ac.id/images/2022-03-	

Weekly Study Plan

Week/Meet (1)	Course Outcomes (2)	Indicator (3)	Assessment (4)	Activities/Forms of Learning [Time estimated]					Subject, references (10)	Weight (11)
				Synchronous*		Asynchronous**		Media (9)		
				Face to face Offline (5)	Face to face Online (6)	Individual (7)	Collaboration (8)			
1-2	CLO-1 Students are familiar with dynamic optimization system problems (both continuous and discrete) on various real phenomena	<ul style="list-style-type: none"> • Discipline in implementing the lecture contract • Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work • Originality of assignment results 	Assignment : 3% Mid term: 7%	Teaching and discussion: - Explanation of Semester Learning Plan - explanation of learning material - explanation of the task - explanation of the assessment [2 × 3 × 50 minutes]	Teaching and discussion: - Explanation of Semester Learning Plan - explanation of learning material - explanation of the task - explanation of the assessment 2 × 3 × 50 minutes]	<ul style="list-style-type: none"> • Students read and study learning materials • Students do assignments independently [2 × 3 × 120 minutes] 		<ul style="list-style-type: none"> • PPT • I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	<ul style="list-style-type: none"> • Assessment Rules, SSP, Course Contract • Variational calculus for continuous time system [1]	10%
3-4	CLO-2 Students master the theoretical aspects related to dynamic optimization (both continuous and discrete) CLO-3 Students are able to solve the dynamic	<ul style="list-style-type: none"> • Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work 	Assignment : 5% Mid term: 15%	<ul style="list-style-type: none"> • Lecture: - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 50 minutes] 	<ul style="list-style-type: none"> • Lecture: - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 50 minutes] 	<ul style="list-style-type: none"> • Students read and study learning materials • Students do assignments independently [2 × 3 × 120 minutes] 		<ul style="list-style-type: none"> • PPT • I learn (LMS Unand) • (Specific condition: Zoom meeting, WA group, learning video)	Dynamic optimization for continuous time system [1]	20%

	optimization problems using various appropriate methods	<ul style="list-style-type: none"> Originality of assignment results 								
5-7	<p>CLO-3 Students are able to solve the dynamic optimization problems using various appropriate methods</p> <p>CLO-5 Students are able to use Matlab software to solve several dynamic optimization problems</p>	<ul style="list-style-type: none"> Accuracy in understanding related material Accuracy in answering assignment questions Neatness of assignment work Originality of assignment results 	Assignment : 5% Mid term: 15%	<ul style="list-style-type: none"> Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material [3 × 3 × 50 minutes] 	<ul style="list-style-type: none"> Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material [3 × 3 × 50 minutes] 	<ul style="list-style-type: none"> Students read and study learning materials Students do assignments independently [3 × 3 × 120 minutes] 		<ul style="list-style-type: none"> PPT I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video) 	<ul style="list-style-type: none"> Dynamic optimization for continuous time system Variational calculus for discrete time system [1, 2]	20%
8-9	MID-TERM EXAM									
10-11	<p>CLO-3 Students are able to solve the dynamic optimization problems using various appropriate methods</p> <p>CLO-5 Students are able to use Matlab software to solve several dynamic optimization problems</p>	<ul style="list-style-type: none"> Accuracy in understanding related material Accuracy in answering assignment questions Neatness of assignment work Originality of assignment results 	Assignment : 3% Final term: 7%	<ul style="list-style-type: none"> Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 50 minutes] 	<ul style="list-style-type: none"> Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 60 minutes] 	<ul style="list-style-type: none"> Students read and study learning materials Students do assignments independently [2 × 3 × 120 minutes] 		<ul style="list-style-type: none"> PPT I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video) 	Dynamic optimization for discrete time system [1, 2]	10%

12-13	<p>CLO-3 Students are able to solve the dynamic optimization problems using various appropriate methods</p> <p>CLO -4 Students are able to analyze and interpret the optimal solution of dynamic optimization problems</p>	<ul style="list-style-type: none"> • Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work • Originality of assignment results 	<p>Assignment : 5% Final term: 15%</p>	<ul style="list-style-type: none"> • Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material <p>[2 × 3 × 50 minutes]</p>	<ul style="list-style-type: none"> • Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material <p>[2 × 3 × 50 minutes]</p>	<ul style="list-style-type: none"> • Students read and study learning materials • Students do assignments independently <p>[2× 3 × 120 minutes]</p>		<ul style="list-style-type: none"> • PPT • I learn (LMS Unand) • (Specific condition: Zoom meeting, WA group, learning video) 	Discrete linear quadratic regulator problem [1, 2]	20%
14-16	<p>CLO-3 Students are able to solve the dynamic optimization problems using various appropriate methods</p> <p>CLO -4 Students are able to analyze and interpret the optimal solution of dynamic optimization problems</p>	<ul style="list-style-type: none"> • Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work • Originality of assignment results 	<p>Assignment : 5% Final term: 15%</p>	<ul style="list-style-type: none"> - Presentation project by students <p>[3 × 3 × 50 minutes]</p>	<ul style="list-style-type: none"> • Lecture: <ul style="list-style-type: none"> - explanation of concepts - discussion, question and answer of lecture material <p>[3 × 3 × 50 minutes]</p>	<ul style="list-style-type: none"> • Students read and study learning materials • Students do assignments independently <p>[3× 3 × 60 minutes]</p>	<p>Students present the project outcomes</p> <p>[3 × 3 × 60 minutes]</p>	<ul style="list-style-type: none"> • PPT • I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video) 	The tracking problem [1, 3]	20%
Total Weight										100%
17-18	FINAL EXAM									

1 credit = 50 minutes face-to-face meeting, 60 minutes structured study, 60 minutes independent study
Each meeting duration is 3 credits = 3×50 minutes

Indicators, Criteria, and Assessment Weights

1. Assessment weight for each Assessment

NO	Assessment	Weight (%)
1	Mid-Term Exam	40
2	Final Exam	40
3	Assignment (Homework)	20
TOTAL		100

2. Assessment weight for Intended Learning Outcome

- CLO-1: 10 %
- CLO-2: 25 %
- CLO-3: 25 %
- CLO-4: 20 %
- CLO-5: 20 %

Assessment Plan Table:

No.	CLO	Assessment			Weight (%)
		Homework (%)	Mid-Term Exam (%)	Final Exam (%)	
1	Students are familiar with dynamic optimization system problems (both continuous and discrete) on various real phenomena (ILO-1: ILO-3: ILO-4)	2	4	4	10
2	Students master the theoretical aspects related to dynamic optimization (both continuous and discrete) (ILO-3: ILO-4; ILO-5)	5	10	10	25
3	Students are able to solve the dynamic optimization problems using various appropriate methods: (ILO-3: ILO-4; ILO-5)	5	10	10	25
4	Students are able to analyze and interpret the optimal solution of dynamic optimization problems. (ILO-3: ILO-4; ILO-5)	4	8	8	20
5	Students are able to use Matlab software to solve several dynamic optimization problems (ILO-3: ILO-4; ILO-5)	4	8	8	20
Total		20	40	40	100