SEMESTER STUDY PLAN

DISCRETE CONTROL THEORY / MAT82245

(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
Discrete Control Theory	MAT82245	https://sci.ilearn.unand.ac.id	3	2	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 (ILO) and Performance Indicator (PI)	**Intended Learning Outcomes**	
	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	An ability to recognize the discrete linear control system problems in various real phenomena (**ILO-1**: **ILO-3**: **ILO-4**)
	2	Mastering the basic aspects of the discrete system of linear differential equations; such as the use of Z

		transformation, determination of the state transition matrix and solving the system of linear difference equations (**ILO-3**: **ILO-4; ILO-5**)
	3	Mastering the modeling of physical systems in the form of discrete state space models, transfer function models and block diagram models (**ILO-3**: **ILO-4; ILO-5**)
	4	An ability to analyze the discrete state space models; such as controllability, observability, canonical form, realizability and stability of discrete linear system (**ILO-3**: **ILO-4; ILO-5**)
	5	An ability to poles assignment for discrete linear system (**ILO-3**: **ILO-4; ILO-5**)
	6	An ability to use Matlab software to solve problems in discrete linear control systems (**ILO-3**: **ILO-4; ILO-5**)
Brief Description	The lecture begins by introducing the discrete linear control system problems in various real phenomena, followed by deepening aspects of the system of linear difference equations; such as the use of Z transformations, determination of discrete state transition matrices and solving systems of linear difference equations. The core of this lecture is the analysis of control systems in discrete state space, such as controllability, observability, stability, canonical form, realization and pole placement. In addition, the use of Matlab software to detect controllability, observability and other aspects is also introduced. This course is equipped with self-learning activities through question exercises, 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 in this course are also equipped with the expertise to use Matlab software related to the discrete linear control systems	
Course Materials	1. Discrete linear control system problems in some real phenomena 2. Some basic aspects of systems of linear difference equations, including the use of Z transform, determination of discrete state transition matrices and solving systems of linear difference equations. 3. Modeling of physical systems in the form of discrete state space models, transfer function models and block diagram models 4. Controllability, observability, canonical form, realization and stability. 5. Pole placement for discrete linear systems 6. Use of Matlab software to solve problems in discrete linear control systems	
References	**Main:** [1]. G. Gu, Discrete Time Linear Systems, Springer, London, 2012. **Additional:** [2]. A. V. Oppenheim, R. W. Schaffer, J. R. Buck, Discrete Time Signal Processing, Prentice Hall, New Jersey, 1999.	
Learning Media	**Software:**	**Hardware:**

	• LMS Unand (http://fmipa.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp	• 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/2022-03-30%20Peraturan%20Rektor%20Nomor%207%20Tahun%202022%20Penyelenggaraan%20Pendidikan-khusus%20Bab%20II.pdf	

Weekly Study Plan

Week / Meet (1)	Course Outcomes (2)	Indicator (3)	Assessment (4)	Activities/Forms of Learning [Time estimated]				Media (9)	Subject, references (10)	Weight (11)
				Synchronous*		Asynchronous**				
				Face to face Offline (5)	Face to face Online (6)	Individual (7)	Collaboration (8)			
1	CLO-1 An ability to identify the discrete linear control system problems and understand basic concepts, definitions, classification of the discrete linear control system problems	● 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 [*1 × 3 × 50* minutes]	Teaching and discussion: - Explanation of Semester Learning Plan - explanation of learning material - explanation of the task - explanation of the assessment *1 × 3 × 50* minutes]	● Students read and study learning materials ● Students do assignments independently [1× *3 × 120* minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Assessment Rules, SSP, Course Contract ● Basic concept ● Examples of discrete linear control system problems [1, 2]	10%
2-3	CLO-2 An ability to understand the basic aspects of the system of linear difference equations, including the use of Z transformations, determination of state transition matrices and solving the	● Accuracy in understanding related material ● Accuracy in answering assignment questions ● Neatness of assignment work ● Originality of assignment results	Assignment : 1% Mid term: 15%	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	● Students read and study learning materials ● Students do assignments independently [2× *3 × 120* minutes]		● PPT ● I learn (LMS Unand) ● (Specific condition: Zoom meeting, WA group, learning video)	● Basic aspects of systems of linear difference equations; such as the use of Z transform, determination of state transition matrices and solving systems of	16%

	system of linear difference equations.								linear difference equations. [1]	
4-5	CLO-3 An ability to model physical systems in the form of discrete state space models, transfer function models and block diagram models.	• Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work • Originality of assignment results	Assignment : 5% Mid term: 14%	• Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	• Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	• Students read and study learning materials • Students do assignments independently [2× *3 × 120* minutes]		• PPT • I learn (LMS Unand) • (Specific condition: Zoom meeting, WA group, learning video)	Modeling of physical systems in the form of discrete state space models, transfer function models, and block diagram models [1]	19%
6-7	CLO-4 An ability to understand the concept of controllability of discrete linear system, controllability test criteria CLO 6 An ability to use Matlab software to solve controllability problems	• Accuracy in understanding related material • Accuracy in answering assignment questions • Neatness of assignment work • Originality of assignment results	Assignment : 1% Mid term: 4%	• Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	• Lecture: - explanation of concepts - discussion, question and answer of lecture material [*2 × 3 × 50* minutes]	• Students read and study learning materials • Students do assignments independently [2× *3 × 120* minutes]		• PPT • I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Controllability of discrete linear system [1, 2]	5%
8-9	**MID-TERM EXAM**									
10-11	CLO-4 An ability to understand the concept of observability of discrete linear	• Accuracy in understanding related material • Accuracy in answering	Assignment : 5% Final term: 15%	• Lecture: - explanation of concepts - discussion, question and answer	• Lecture: - explanation of concepts - discussion, question and answer	• Students read and study learning materials		• PPT • I learn (LMS Unand) • (Specific condition:	Observability of discrete linear systems, canonical form, realization and related test	20%

	systems, canonical form, realization and related test criteria. CLO 6 An ability to use Matlab software to solve observability, canonical form, and realization problems.	assignment questions ● Neatness of assignment work ● Originality of assignment results		of lecture material [2 × 3 × 50 minutes]	of lecture material [2 × 3 × 50 minutes]	● Students do assignments independently [2× 3 × 120 minutes] -		Zoom meeting, WA group, learning video)	criteria. [1, 2]	
12-13	CLO-4 An ability to understand the stability concept of discrete linear system	● Accuracy in understanding related material ● Accuracy in answering assignment questions ● Neatness of assignment work ● Originality of assignment results	Assignment : 5% Final term: 15%	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 50 minutes]	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [2 × 3 × 50 minutes]	● Students read and study learning materials ● Students do assignments independently [2× 3 × 120 minutes] -		● PPT ● I learn (LMS Unand) ● (Specific condition: Zoom meeting, WA group, learning video)	Stability of discrete linear system. [1, 2]	20%
14-16	CLO-5 An ability to poles assignment for discrete linear system	● Accuracy in understanding related material ● Accuracy in answering assignment questions ● Neatness of assignment work ● Originality of assignment results	Assignment : 5% Final term: 15%	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [3 × 3 × 50 minutes]	● Lecture: - explanation of concepts - discussion, question and answer of lecture material [3 × 3 × 50 minutes]	● Students read and study learning materials ● Students do assignments independently [3× 3 × 120 minutes]		● PPT ● I learn (LMS Unand) Specific condition: Zoom meeting, WA group, learning video)	Pole placement for discrete linear systems [1, 2]	10%
									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: 20 %
   - CLO-3: 20 %
   - CLO- 4: 20 %
   - CLO-5: 20 %
   - CLO-6:10%

Assessment Plan Table:

No.	CLO	Assessment			Weigth (%)
		Homework (%)	Mid-Term Exam (%)	Final Exam (%)	
1	Ability to recognize the discrete linear control system problems in various real phenomena (**ILO-1**: **ILO-3**: **ILO-4**)	2	4	4	10
2	Mastering the basic aspects of the discrete system of linear differential equations; such as the use of Z transformation, determination of the state transition matrix and solving the system of linear difference equations (**ILO-3**: **ILO-4; ILO-5**)	4	8	8	20
3	Mastering the modeling of physical systems in the form of discrete state space models, transfer function	4	8	8	20

	models and block diagram models (**ILO-3**: **ILO-4; ILO-5**)				
4	Ability to analyze the discrete state space models; such as controllability, observability, canonical form, realizability and stability of discrete linear system (**ILO-3**: **ILO-4; ILO-5**)	4	8	8	20
5	Ability to poles assignment for discrete linear system (**ILO-3**: **ILO-4; ILO-5**)	4	8	8	20
6	Ablility to use Matlab software to solve problems in discrete linear control systems (**ILO-3**: **ILO-4; ILO-5**)	2	4	4	10
	Total	**20**	**40**	**40**	**100**