SEMESTER STUDY PLAN

MATRIX ALGEBRA

(ELECTIVE COURSE)

DEPARTMENT OF MATHEMATICS AND DATA SCIENCE

FACULTY OF MATHEMATICS AND NATURAL SCIENCE

UNIVERSITAS ANDALAS

2024

SEMESTER STUDY PLAN (SSP)
MASTER OF MATHEMATICS PROGRAM
FACULTY OF MATHEMATICS AND NATURAL SCIENCE
UNIVERSITAS ANDALAS

Course Name	Code	Course URL *i-Learn*	Credits	Semester	Compilation Date
Matrix Algebra	MAT82213	https://sci.ilearn.unand.ac.id	3	2	May 13th, 2024

Person in Charge	Create by	Head of Research Group	Head of Master Program
	Dr. Yanita	Prof. Dr. Admi Nazra	Prof. Dr. Ferra Yanuar

Intended Learning Outcomes (ILO) and Course Learning Outcomes (ILO)	**Intended Learning Outcomes**	
	ILO-2	Mastering mathematical concepts and applications (real analysis, advanced linear algebra, and statistics) in solving complex mathematical problems PI-1 An ability to explain mathematical concepts (Real Analysis, Advanced Linear Algebra, and Statistics). PI-2 An ability to identify complex mathematical problems. PI-3 An ability to solve complex mathematical problems.
	ILO-3	Comprehensive mastery of one or several theories for development in the fields of analysis, algebra, applied mathematics, statistics and combinatorial mathematics. PI-1 An ability to identify theories used in related mathematical problems. PI-2 An ability to apply theories for advancement in related fields (advanced theory). PI-3 An ability to use advanced theory to solve related mathematical problems.
	Course Learning Outcomes	
	1.	An ability to understand the properties and solve problems in specific matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)
	2.	An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)

	3. An ability to understand the properties and solve problems in Kronecker product. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)
	4. An ability to understand the properties and solve problems of the operators on matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)
	5. An ability to understand the properties and solve problems of the matrix transformation (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)
Brief description	This course discusses several concepts about matrix; specific matrix, partition matrix and operations on matrix. The learning method in this course is face-to-face (a combination of Teacher-Centered Learning and Student-Centered Learning)
Study Materials	1. Review some type of matrix 2. Properties of specific matrix (orthogonal, unitary, normal, idempotent Hermitian and skew-Hermitian matrix) 3. Partition matrix 4. Schur Complement 5. Determinan of the partition matrix 6. Inverse of the partition matrix 7. Kronecker product 8. Operators on matrix (vec, vech, vecd, and vecp operator) 9. Matrix transformation (commutation and duplication matrix)
References	**Main:**
	1. D. A. Harville, Matrix Algebra from a Statistician's Perspective, New York: Springer, 2008 2. J. R. Schott, Matrix Analysis for Statistics, 3rd ed., New Jersey: John Wiley and Sons, 2017.
	Additional
	1. R.A. Horn & C.R. Johnson. 2013. Matrix Analysis, 2nd eds., Cambridge University Press, New York. 2. Adi-Ben Israel & Thomas N.E. Greville , 2003, *Generalized Inverses : Theory and Application*, 2nd ed, Canadian Mathematical Society, Springer-Verlag, USA 3. Alexander Graham, 1981. *Kronecker Product and Matrix Calculus with application*, John Wiley and Sons, USA
	Software : / **Hardware :**

Instructional Media	• LMS Unand (http://fmipa.ilearn.unand.ac.id/) • Zoom meeting • Whatsapp	• Computer/Laptop • Smartphone
Team Teaching	Dr. Yanita	
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 [Estimated time]					Subject (10)	Weight (11)
				Synchronous*		Asynchronous**				
				Face-to-face Offline (5)	Face-to-face Online (6)	Individual (7)	Collaboration (8)	Media (9)		
1/1	CLO-1 An ability to understand the properties and solve problems in specific matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy to understand some theory of matrix ● Accuracy in proving the properties of orthogonal, unitary, normal, idempotent Hermitian and skew-Hermitian matrix	Non test : - Test Midterm: 6%	Teaching and discussion: - Explanation of Semester Learning Plan - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - Explanation of Semester Learning Plan - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Tuition Contract ● SLP **Study Materials** ● Review some definitions and properties in matrix theory ● Orthogonal matrix ● Unitary matrix ● Normal matrix ● Idempotent matrix ● Hermitian matrix ● skew-Hermitian matrix	6%
2/2	CLO-1	● Accuracy to understand	Non test : 1st Task : 8%	Teaching and discussion:	Teaching and discussion:	● Students read and study		● PPT	● Determinant	14%

	An ability to understand the properties and solve problems in specific matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	definition of determinant ● Accuracy in proving the properties of determinant	Test : Midterm: 6%	- explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	- explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Properties of determinant	
3/3	CLO-2 An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy in determining partition on a matrix ● Accuracy in using operation on partition matrices ● Transpose of the partition matrix	Non-test : - Test : Mid-term: 6%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50%	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Partition Matrix ● operations on partition matrices ● Transpose of the partition matrix	**6%**

					of the total number of meetings)					
4/4	CLO-2 An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy in determining inverse of the partition matrix ● Accuracy in properties of the partition matrix	Non test : 2nd Task : 8 % Test : Mid-term: 6%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Inverse of the partition matrix ● Complement Schur ● Properties of the partition matrix	**14%**
5/5	CLO-3 An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Accuracy in determining determinant of the partitioned	Non-Test : - Midterm: 4%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Determinant of the partition matrix	**4%**

					(Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)					
6/6	CLO-3 An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Accuracy in determining inverse of the partition matrix	Non-Test : - Midterm : 4%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Inverse of partition matrix	**4%**
7/7	CLO-3 An ability to understand the properties and solve problems in Kronecker product. (**ILO**-2, PI-1, PI-2, PI-3;	● Accuracy in determining Kronecker product of two matrix ● Accuracy in proving basic properties of	●Non-Test : 3rd Task : 8% ●Midterm: 4%	Teaching and discussion: - explanation of learning material - explanation of the task	Teaching and discussion: - explanation of learning material - explanation of the task	● Students read and study learning materials ●Students do assignments independently		● PPT ● I learn (LMS Unand) (Specific condition: Zoom	●Kronecker product ●Basisc properties of Kronecker product	**12%**

	ILO-3, PI-1, PI-2, PI-3)	Kronecker product		- explanation of the assessment [1 x 3 x 50 minutes]	- explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	[1 x 3 x 120 minutes]		meeting, WA group, learning video)		
8	**MID-TERM EXAM**									
9	CLO-3 An ability to understand the properties and solve problems in Kronecker product. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Accuracy in pro ving advanced properties of Kronecker product	● Non-Test Task 6: 4% ● Final exam: 6%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	Advanced properties of Kronecker product	**10%**

					number of meetings)					
10	CLO-4 An ability to understand the properties and solve problems of the operators on matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy in determining operators on matrix (vec, vech, vecd, vecp) ● Accuracy in proving properties of operators on matrix	● Non-Test : - ● Test : Final exam: 4%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group learning video)	● Vec perator ● Vech operator ● Vecd operator ● Vecp operator	**4%**
11	CLO-4 An ability to understand the properties and solve problems of the operators on matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy in determining relation on vec and vech ● Accuracy in determining relation on vec and vecd ● Accuracy in determining relationon vec and vecp	● Non-Test : - ● Test : Final exam: 4%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 menit]	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes]	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Relation on vec and vech ● Relation on vec and vecd ● Relation on vec and vecp	**4%**

					(Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)					
12	CLO-4 An ability to understand the properties and solve problems of the operators on matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	● Accuracy in determining relation on vec vech, and Kronecker product ● Accuracy in determining relation vec, vecd and Kronecker product ● Accuracy in determining relationon vec, vecp and Kronecker product	Non test : 4th Task : 8% Final exam: 4%%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Relation on vec, vech and Kronecker product ● Relation on vec, vecd and Kronecker product ● Relation on vec, vecp and Kronecker product	**12%**
13	CLO-5 An ability to understand the properties and solve problems of the matrix transformatio	Accuracy in determining transformation matrix on vec and vech	● Non-Test : - ● Test : Final exam: 4%	Teaching and discussion: - explanation of learning material - explanation of the task	Teaching and discussion: - explanation of learning material - explanation of the task	● Students read and study learning materials ● Students do assignments independently		● PPT ● I learn (LMS Unand) (Specific condition: Zoom	● Commutation matrix ● Properties of commutation matrix	**4%**

	n (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)			- explanation of the assessment [1 x 3 x 50 minutes	- explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	[1 x 3 x 120 minutes]		meeting, WA group, learning video)		
14	CLO-5 An ability to understand the properties and solve problems of the matrix transformatio n (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Accuracy in determining transformation matrix on vec and vecd	● Non-Test : - ● Test : Final exam: 4%	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes	Teaching and discussion: - explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	● Students read and study learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● PPT ● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Transforma tion matrix ● Properties of transformat ion matrix	**4%**
15	CLO-5	Accuracy in determining	● Non-Test :	Teaching and discussion:	Teaching and discussion:	● Students read and study		● PPT	● Transforma tion matrix	**12%**

	An ability to understand the properties and solve problems of the matrix transformation (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	commutation matrix on vec and vecp	5th Task : 8% ● Test : Final exam: 4%	- explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes	- explanation of learning material - explanation of the task - explanation of the assessment [1 x 3 x 50 minutes] (Specific conditions: The total number of blended learning meetings is 50% of the total number of meetings)	learning materials ● Students do assignments independently [1 x 3 x 120 minutes]		● I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	● Properties of transformations matrix	
									Total	**100%**
16	**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	30
2	Final Exam	30
3	Task (Homework)	40
TOTAL		**100**

2. Assessment weight for Intended Learning Outcome
   - CLO-1: 20%
   - CLO-2: 20%
   - CLO-3: 20%
   - CLO-4: 20%
   - CLO-5: 20%

TAn ability Assesment Plan:

No.	Course Learning Outcomes	Weight (%)			
		Task (%)	**Midterm (%)**	**Final Exam (%)**	**Total**
1	An ability to understand the properties and solve problems in specific matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Task 1 : 8	12		20
2	An ability to understand the properties and solve problems in partition matrix. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Task 2 : 8	12		20
3	An ability to understand the properties and solve problems in Kronecker product. (**ILO**-2, PI-1, PI-2, PI-3; **ILO**-3, PI-1, PI-2, PI-3)	Task 3: 8	6	6	20
4	An ability to understand the properties and solve problems of the operators on matrix. (ILO-2, ILO-3)	Task 4: 8		12	20
5	An ability to understand the properties and solve problems of the matrix transformation (ILO-2, ILO-3)	Task 5 : 8		12	20
Total		**40**	**30**	**30**	**100**

Matrix of CLO and ILO

CLO	ILO																	
	1		2			3			4				5			6		
	PI-1	PI-2	PI-1	PI-2	PI-3	PI-1	PI-2	PI-3	PI-1	PI-2	PI-3	PI-4	PI-1	PI-2	PI-3	PI-1	PI-2	PI-3
1			✓	✓	✓	✓	✓	✓										
2			✓	✓	✓	✓	✓	✓										
3			✓	✓	✓	✓	✓	✓										
4			✓	✓	✓	✓	✓	✓										
5			✓	✓	✓	✓	✓	✓										