SEMESTER STUDY PLAN
ELEMENTARY LINEAR ALGEBRA
(COMPULSORY 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
Elementary Linear Algebra	MAT62111	https://sci.ilearn.unand.ac.id	3	2	May 11th, 2024

Person In Charge	Study Plan Creator	Head of Research Group	Head of Study Program
	Dr. Yanita	Nova Noliza Bakar, M.Si	Dr. Noverina Alfiany

Intended Learning Outcomes (ILO) and Performance Indicator (PI)	**Intended Learning Outcomes (shadow)**	
	ILO-2	Possesses profound knowledge of the basic concept mathematics PI-1: An ability to explain basic mathematical concepts PI-2: An ability to provide examples that are relevant to basic mathematical concepts PI-3: An ability to determine solutions to simple problems using basic mathematical concepts
	ILO-3	An ability to identify, explain, and generalize simple mathematical PI-1: An ability to identify simple mathematical problems PI-2: An ability to explain simple mathematical problems PI-3: An ability to generalize simple mathematical problems
	ILO-4	An ability to use concept and fundamental technique of mathematics in solving simple mathematical problems PI-1: An ability to choose appropriate basic mathematical concepts and techniques in solving simple mathematical problems PI-2: An ability to illustrate simple mathematical problems based on appropriate basic mathematical concepts and techniques PI-3: An ability to solve simple mathematical problems using appropriate basic mathematical concepts and techniques

	ILO-5	An ability formally and correctly proves a simple mathematical statement using facts and methods that have been studied PI-1: An ability to identify formal structures and analogous forms in mathematics PI-2: An ability to use facts and apply methods to prove simple mathematical statements PI-3: An ability to present simple mathematical statement proof rigorously (sequentially and conscientious) PI-4: An ability to conclude or interpret result of the proving simple mathematical statement
	Course Learning Outcomes	
	1	Ability to solve and analyze a system of linear equation) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)
	2	Ability to calculate and analyze operations on matrix, determinant and inverse matrix. (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)
	3	Ability to calculate norm, dot product and cross product in $2-$space and $3-space$) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)
	4	Ability to show that a set is a vector space, subspace, span, linearly independent, and base. (**CPL-2**: PI-1, PI-2; **CPL-5**: PI-1)
	5	Ability to show a vector space is an inner product space with a given defined function and their properties) (**CPL-2**: PI-1, PI-2, PI-3, **CPL-5**: PI-1)
	6	Ability to calculate eigen value, eigen vector and their application to diagonalization) (**CPL-2**: PI-1, PI-2, PI-3, **CPL-4**: PI-1, PI-2)
	7	Ability to determine a mapping that is a linear transformation, and their properties) (**CPL-2**: PI-1, PI-2, PI-3, **CPL-5**: PI-1)
Brief Description	This course provides experience for students to know more about the basic techniques in linear algebra and apply them in solving linear system problems. In addition, in the course, this student has the opportunity to work with objects other than numbers such as matrices, vectors, and functions. The lecture approach is carried out inductively with $R^2 and\ R^3$, up to general vector space, ending with examples other than R^n which include matrices, polynomial spaces, or function space. In general, the contents of this lecture are a system of linear equations, matrices, real vector spaces, bases, eigen values and eigen vectors, and linear transformation.	

<table>
<tr><td>Course Materials</td><td colspan="2">1. System of linear equation and matrices
2. Determinants
3. Euclidean vector space
4. General vector space
5. Inner product space
6. Eigen value and eigen vector
7. Linear transformation</td></tr>
<tr><td>References</td><td colspan="2">Main:
1. H. Anton & C. Rorres (2014). Elementary Linear Algebra. 11th edition. Wiley, USA
Additional:
2. G. Strang. (2009). Introduction to Linear Algebra. 4th edition. Wellesley - Cambridge Press,
3. R. Bronson & G. B. Costa. (2007). Linear Algebra: an Introduction. 2nd edition. Elsevier, Inc. USA.
4. S. Lipschutz's & M. L. Lipson (2009) Linear Algebra (Schaum Outline Series). McGRaw-Hill Companies, Inc. New York.</td></tr>
<tr><td>Learning Media</td><td>Software:
● LMS Unand (http://fmipa.ilearn.unand.ac.id/)
● Zoom Meeting
● Whatsapp</td><td>Hardware:
● Computer/Laptop
● Smartphone</td></tr>
<tr><td>Team Teaching</td><td colspan="2">1. Dr. Yanita
2. Nova Noliza Bakar, M.Si
3. Prof. I Made Arnawa
4. Monika Rianti Helmi, M.Si.</td></tr>
<tr><td>Assessment</td><td colspan="2">Homework, Quizzes, Mid-Term exam, Final exam</td></tr>
<tr><td>Required courses</td><td colspan="2">-</td></tr>
<tr><td>Academic Norms</td><td colspan="2">https://akademik.unand.ac.id/images/2022-03-30%20Peraturan%20Rektor%20Nomor%207%20Tahun%202022%20Penyelenggaraan%20Pendidikan-khusus%20Bab%20II.pdf</td></tr>
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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)			
1/1,2	CLO-1 Able to solve and analyze a system of linear equations) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in determining whether an equation are linear equation or not • Accuracy in writing a system of linear equations • Accuracy in determining linear equation • Accuracy in performing elementary row operations on a system of linear equations • Accuracy in determining the solution of a system of linear equation	Non test: Test 1st Quiz: 1% Mid-term: 5%	Teaching and discussion: • Explanation of Semester Study Plan • Explanation of learning material • explanation of the task • explanation of the assessment [2 × 3 × 50 minutes]	Teaching and discussion: • Explanation of Semester Study Plan • Explanation of learning material • Explanation of the task • explanation of the assessment [2 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the	• Students read and study learning materials • Students do assignments independently to solve - Linear equation - System of linear equation [2 × 3 × 120 minutes]		• PPT • I learn (LMS Unand) (Specific condition: Zoom meeting, WA group, learning video)	• Tuition Contract • SSP • System of linear equation (definition of linear equation and system of linear equation, how to find its solutions) • Elementary row operations • Gauss-Jordan Elimination [1] Chapter 1, pp. 1 – 38 [2] Chapter 1 [3] Chapter 1	6%

					total number of meetings)				[4] Chapter 2 and 3	
2/1	CLO-1 Able to solve and analyze a system of linear equation) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in writing a system of linear equations in the form $Ax = b$. • Accuracy in performing elementary row operations on a matrix. • Accuracy in determine a solution of system of linear equation using augmented matrix and elementary row operation	Non test : 1st Task: (1,5%) Test 1st Quiz: 1% Mid-term: 2%	Teaching and discussion: • explanation of learning material • explanation of the task • explanation of the assessment [1 × 3 × 50 minutes]	Teaching and discussion: • explanation of learning material • explanation of the task • explanation of the assessment [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	• Students read and study learning materials • Students do assignments independently [1 × 3 × 120 minutes]		• PPT • I learn (Specific condition: Zoom meeting, WA group, learning video)	• Matrix • System of linear equation • Elementary row operations elemen-ter • Gauss-Jordan Elimination [1] Chapter 1, pp. 39 – 60 [2] Chapter 1 [3] Chapter 1 [4] Chapter 2 dan 3	4,5%

3/1	CLO-1 Able to solve and analyze a system of linear equation) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in determine a solution of system of homogeny linear equation using augmented matrix and elementary row operation • Accuracy in recognizing diagonal, triangular and symmetric matrices	Non test : 2nd Task (1,5%) Test 1st Quiz: 1% Mid-term: 3%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	• Students read and study material from the main and additional references • Students work on assignments individually regarding determining solutions to: Systems of linear equations (inhomogeneous and homogeneous) [1 × 3 × 120 minutes]		• PPT • I learn (Specific condition: Zoom meeting, WA group, learning video)	• Matrix • System of linear equation • Elementary row operations elemen-ter • Gauss-Jordan Elimination [1] Chapter 1st pp. 61 – 74 [2] Chapter 1st [3] Chapter 1st [4] Chapter 2nd and 3rd	5,5%
3/2	CLO-2 Ability to calculate and analyze operations on matrix, determinant and inverse matrix. (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in determining permutations of a set of n objects. • Accuracy of determining the inversion of a permutation	Non test : - Test 1st Quiz: 1% Mid-term: 2%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Students read and study material from the main and additional references [1 × 3 × 120 minutes]		• PPT • I learn (Specific condition: Zoom meeting, WA group, learning video)	Determine the determinant by calculating the signed elementary product of the 2 × 2, 3 × 3 and 4 × 4 matrices [1] Chapter 2nd , pp. 105 – 112	3%

		• Accuracy in determining even/odd permutations • Accuracy in determining signed elementary products in 2×2, 3×3 and 4×4 matrices • Accuracy in determining the determinant of 2×2, 3×3 and 4×4 matrices by adding signed elementary products.			(Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)				[2] Chapter 4th [4] Chapter 8th	
4/1	CLO-2 Ability to calculate and analyze operations on matrix, determinant and inverse matrix. (**ILO-2**: PI-1, PI-2, PI-3,	• Accuracy in determining changes in the value of the matrix determinant is related to one of the elementary	Non test : 3rd Task (2%) Test 1st Quiz: 1% Mid-term: 3%	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 from the main and additional references • Students do assignments		• PPT • I learn (Specific condition: Zoom meeting, WA group,	• Determining the determinant using the row reduction method (using elementary	6%

	ILO-3: PI-1, PI-2)	row operations. ● Accuracy in determining the determinant of a matrix using the row reduction method (using elementary row operations) ● Know the properties of determinants ● Understand the relationship between determinants of matrix and the existence of solution of system of linear equation		[1 × 3 × 50 minutes]	[1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	independently on determining the determinant of a matrix using the signed elementary product addition method and the row reduction method [1 × 3 × 120 minutes]		learning video)	row operations) ● Properties of determinant [1] Chapter 2nd , pp. 113 – 117 [2] Chapter 4th [4] Chapter 8th	
5/1	CLO-2 Ability to calculate and analyze operations on matrix, determinant and inverse matrix. (**ILO-2**:	● Accuracy in calculating determinants with cofactor expansion along rows or along columns ● Accuracy in	Non test : 4th Task (1,5%) Test 1st Quiz: 1% Mid-term: 3%	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 from the main and additional references		● PPT ● I learn (Specific condition: Zoom meeting, WA group,	● Menghitung determinan dengan ekspansi kofaktor ● Menghitung invers matriks	5,5%

	PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	determining the minor and cofactor of an entry in the $n \times n$ matrix • Accuracy in determining the cofactor matrix and adjoint matrix of a $n \times n$ matrix • Accuracy in determining the inverse of a matrix using an adjoint matrix • Accuracy in determining the solution of a system of linear equations using Cramer's rule		[$1 \times 2 \times 50$ minutes]	[$1 \times 2 \times 50$ minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	• Students do assignments independently on: determining the determinant of a matrix using the cofactor expansion method along the rows • Determining the inverse matrix using the adjoint methods		learning video)	menggunakan adjoint • Aturan Cramer [1] Chapter 2, pp. 118 – 130 [2] Chapter 4 [4] Chapter 8	
5/2	CLO-3 Ability to calculate norm, dot product, and cross product in 2 −space and 3 − *space*) (**ILO-2**: PI-1,	• Accuracy in describing vectors in R^2 and R^3 • Accuracy in calculating addition/subtraction of	Non test : - Test 1st Quiz: 1% Mid-term: 3%	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 from the main and additional references [$1 \times 3 \times 120$ minutes]		• PPT • I learn (Specific condition: Zoom meeting, WA group,	• Vector in R^2 and R^3 • Vector geometric representation in R^2 and R^3 • Arithmetic	4%

	PI-2, PI-3, **ILO-3**: PI-1, PI-2)	vectors and multiplication of scalars with vectors • Accuracy in calculating the norm of a vector in R^2, R^3 and R^n • Accuracy in calculating the distance between two vectors in Accuracy in calculating the norm of a vector in R^2, R^3 dan R^n • Accuracy in calculating the dot product • Accuracy in calculating the angle between two vectors using the dot product • Accuracy in calculating the norm of a vector in R^2 and R^3		[1 × 3 × 50 minutes]	[1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)			learning video)	properties of vectors • Norm • Distance • Dot product [1] Chapter 3rd, pp. 131 – 154 [4] Chapter 1st	

6/1	CLO-3 Ability to calculate norm, dot product and cross product in 2 −space and 3 − *space*) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in determining whether two vectors are orthogonal or not • Accuracy in determining the orthogonal projection of a vector u along vector a	Non test: - Test 1st Quiz: 1% Mid-term: 3%	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	Students read and study learning materials from the main and additional references [1 × 3 × 120 minutes]		• PPT • I learn (Specific condition: Zoom meeting, WA group, learning video)	Ortogonalitas [1] Chapter 3, pp. 155 – 163 [2] Chapter 3	4%
7/1	CLO-3 Ability to calculate norm, dot product and cross product in 2 −space and 3 − *space*) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	• Accuracy in calculating the cross product of two vectors (only in R^3) • Accuracy in writing a vector in R^3 using symbol i, j, k. • Accuracy in calculating the area of a	Non test : 5th Task (2%) Test 1st Quiz: 1% Mid-term: 3%	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total	• Students read and study learning materials from the main and additional references • Student do assignment about determination: - Norm, distance, dot product and cross product	-	• PPT • I learn (Specific condition: Zoom meeting, WA group, learning video)	Cross Product [1] Chapter 3 , pp. 172 – 182	6%

		parallelogram whose sides are vectors in R^3 using the dot product ● Accuracy of calculating the area of a parallelogram in R^2 and the area of a parallelogram in R^3 using a matrix determinant whose entries are vector components ● Accuracy determines whether three vectors with the same starting point in R^3 are in the same plane or not using dot product and cross product			number of blended learning meetings is 40% of the total number of meetings)	- the area of a parallelogram in R^2 and the area of a parallelogram in R^3 using properties of dot product and cross product [1×3×120 minutes]				
7/2	CLO-4 Ability to show that a set is a vector space, subspace, span, linearly	● Accuracy in proving that a set is a vector space or not over a set of real numbers,	Non test : 6th Task (1,5%) Test 1st Quiz: 1%	Teaching and discussion: ● explanation of learning material	Teaching and discussion: ● explanation of learning material	● Students read and study learning materials from the main and		● PPT ● I learn (Specific condition: Zoom	● Vector Space ● Subspace [1] Chapter 4, pp. 183 – 201	5,5%

	independent, and base. (**ILO-2**: PI-1, PI-2; **ILO-5**: PI-1)	with the given addition and scalar multiplication operations • Accuracy in proving that a subset of vector space is subspace or not	Mid-term: 3%	• explanation of the task [1 × 3 × 50 minutes]	• explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	additional references • Student do assignment about proving that a set/sub-set is a vector space/vector subspace [1 × 3 × 120 minutes]		meeting, WA group, learning video)	[2] Chapter 2 [3] Chapter 2 [4] Chapter 4	
8	**MID-TERM EXAM**									
9/1	CLO-4 Ability to show that a set is a vector space, subspace, span, linearly independent, and base. (**ILO-2**: PI-1, PI-2; **ILO-5**: PI-1)	• Ketepatan Accuracy in determining that a vector is a linear combination of one or more vectors • Accuracy in writing the span of one or more vectors • Accuracy in proving that one or more vectors are linearly independent or	Non test : Test 2nd Quiz : 1% Final exam: 0%	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: • explanation of learning material • explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total	• Students read and study learning materials from the main and additional references • Student do assignment about: - Linear combination - Span - Linearly independent [		• PPT • I learn • (Specific condition: Zoom meeting, WA group, learning video)	• Linear combination • span • linearly independent [1] Chapter 4, pp. 202 – 211 [2] Chapter 2 [3] Chapter 2 [4] Chapter 4	**1%**

		linearly dependent			number of meetings)	$1 \times 3 \times 120$ minutes]				
10/1	CLO-4 Ability to show that a set is a vector space, subspace, span, linearly independent, and base. (**ILO-2**: PI-1, PI-2; **ILO-5**: PI-1)	• Accuracy in proving that a set in vector space is a basis • Accuracy in determination coordinate vector relative to a basis • Accuracy in determining dimension of a vector space or subspace	Non test : 7th Task (1,5%) Test 2nd Quiz: 1% Final exam: 2%	Teaching and discussion: ● explanation of learning material ● explanation of the task [$1 \times 3 \times 50$ minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [$1 \times 3 \times 50$ minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	● Students read and study learning materials from the main and additional references ● Student do assignment about: - The proof that a set of vectors is a basis - Determination vector coordinate relative to a basis [$1 \times 3 \times 120$ minutes]	-	● PPT ● I learn ● (Specific condition: Zoom meeting, WA group, learning video)	● Basis ● Vector coordinate relative to a basis ● Dimension [1] Chapter 4, pp. 211 – 228 [2] Chapter 2 [3] Chapter 2 [4] Chapter 4	**4,5%**
10/2	CLO-4 Ability to show that a set is a vector space, subspace, span, linearly independent, and base. (**ILO-2**: PI-1,	• Accuracy in determining row space, column space and null space, of $m \times n$ matrix • Accuracy in determining bases of row	Non test : 8th Task (1,5%) Test 2nd Quiz: 1% Final exam: 2%	Teaching and discussion: ● explanation of learning material ● explanation of the task [$1 \times 3 \times 50$ minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [$1 \times 3 \times 50$ minutes]	● Students read and study learning materials from the main and additional references ● Student do assignment about:		● PPT ● I learn ● (Specific condition: Zoom meeting, WA group, learning video)	● Row space, column space, and null space ● Bases of row space, column space, and null space ● Rank, nullity	**4,5%**

	PI-2; **ILO-5**: PI-1)	space, column space and null space of $m \times n$ matrix • Accuracy in determining rank and nullity of $m \times n$ matrix • Accuracy in determining relation of rank and nullity of $m \times n$ matrix			(Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	determining row space, column space and null space, include their bases [$1 \times 3 \times 120$ minutes]			[1] Chapter 4, pp. 237 – 254 [2] Chapter 2 [3] Chapter 2 [4] Chapter 4	
11/1	CLO-5 Ability to show a vector space is an inner product space with a given defined function and their properties) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-5**: PI-1)	• Accuracy in proving a function is an inner product space and understanding its general properties • Accuracy in determining the norm of a vector • Accuracy in determining the distance between two vectors based on the given norm definition • Accuracy in checking/proving orthogonality of vectors	Non test: 9th Task (1,5%) Test 2nd Quiz: 1% Final exam: 3%	Teaching and discussion: • explanation of learning material • explanation of the task [$1 \times 3 \times 50$ minutes]	Teaching and discussion: • explanation of learning material • explanation of the task [$1 \times 3 \times 50$ minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	• Students read and study learning materials from the main and additional references • Student do assignment about: The proving that a function from $V \times V$ to R is a inner product [$1 \times 3 \times 120$ minutes]		• PPT • I learn • (Specific condition: Zoom meeting, WA group, learning video)	• The inner product generated by the matrix • Properties of inner product • Cauchy-Schwarz inequality • Properties of norm and distance • angles and orthogonality in inner product spaces • Orthogonal complement	**5,5%**

		• Accuracy in determining the orthogonal complement of a subspace							[1] Chapter 6, pp. 345 – 354 [3] Chapter 5 [4] Chapter 4	
12/1,2	CLO-5 Ability to show a vector space is an inner product space with a given defined function and their properties) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-5**: PI-1)	• Accuracy in determining the basis of the orthogonal complement subspace • Accuracy in identifying orthogonal (and orthonormal) sets • Accuracy in determining orthogonal projections on a subspace • Accuracy in determining the orthogonal basis (orthonormal) using the Gram-Schmidt process	Non test : 10th Task (1,5%) Test 2nd Quiz: 1% Mid-term: 7%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	● Students read and study learning materials from the main and additional references ● Student do assignment about: determining eigenvalue, eigenvector and eigen space, and also a basis of eigen space [1 × 3 × 120 minutes]		● PPT ● I learn ● (Specific condition: Zoom meeting, WA group, learning video)	● Orthonormal basis ● Gram-Schimidt process [1] Chapter 6, pp. 355 – 377 [3] Chapter 5	**9,5%**
13/1	CLO-6 Ability to calculate eigen value, eigen vector and their application to	Accuracy in determining eigenvalue, eigenvector, and eigen space	Non test : - Test 2nd Quiz :1,5% Final exam: 4%	Teaching and discussion: ● explanation of learning material	Teaching and discussion: ● explanation of learning material	● Students read and study learning materials from the main and additional references		● PPT ● I learn ● (Specific condition: Zoom	● Eigenvalue and eigenvector ● Diagonalization	**5,5%**

	diagonalizatio n) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-4**: PI-1, PI-2)			● explanation of the task [1 × 3 × 50 minutes]	● explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	● Student do assignment about: determining eigenvalue, eigenvector and eigen space, and also a basis of eigen space [1 × 3 × 120 minutes]		meeting, WA group, learning video)	[1] Chapter 5, pp. 291 – 311 dan pp. 409 – 417 [2] Chapter 5 [3] Chapter 4 [4] Chapter 9	
14/1	CO-6 Ability to calculate eigen value, eigen vector and their application to diagonalizati on) (**CPL-2**: PI-1, PI-2, PI-3, **CPL-4**: PI-1, PI-2)	Accuracy of diagonalizing a matrix	Non test : Tugas 11 (1,5%) Test Kuis 2:1,5% UAS: 4%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the	Students read and study learning materials from the main and additional references [1 × 3 × 120 minutes]		● PPT ● I learn (Specific condition: Zoom meeting, WA group, learning video)	● Eigenvalue and eigenvector ● Diagonalizat ion [1] Chapter 5, pp. 291 – 311 [2] Chapter 5 [3] Chapter 4 [4] Chapter 9	**7%**

					total number of meetings)					
14/2	CLO-6 Ability to calculate eigen value, eigen vector and their application to diagonalization) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-4**: PI-1, PI-2)	• Accuracy in determining a matrix that can be diagonalized based on the number of eigenvalues, algebraic multiplicity, and geometric multiplicity • Accuracy in diagonalizing matrices orthogonally	Non test : 12th Task (1,5%) Test 2nd Quiz: 1% Final exam: 4%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes] (Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	● Students read and study learning materials from the main and additional references • Student do assignment about: matrix diagonalization [1 × 3 × 120 minutes]		● PPT ● I learn ● (Specific condition: Zoom meeting, WA group, learning video)	Orthogonal Diagonalization [1] Chapter 5, pp. 409 – 417 [2] Chapter 5 [3] Chapter 4 [4] Chapter 9	**6,5%**
15/1	CLO-7 Ability to determine a mapping that is a linear transformation, and their properties) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-5**: PI-1)	● The accuracy in proving a transformation is linear ● Accuracy in determining the standard linear transformation matrix from R^n to R^m ● Accuracy in	Non test : 13th Task (1%) Test 2nd Quiz: 1% Final exam: 4%	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	Teaching and discussion: ● explanation of learning material ● explanation of the task [1 × 3 × 50 minutes]	● Mahasiswa Students read and study learning materials from the main and additional references ● Students do assignment about:		● PPT ● I learn ● (Specific condition: Zoom meeting, WA group, learning video)	● Linear transformation ● Kernel dan range [1] Chapter 8, pp. 447 – 465 [3] Chapter 3	**6%**

		determining compositional transformations • Accuracy in determining the kernel and range of a linear transformation and its properties			(Specific conditions: The total number of blended learning meetings is 40% of the total number of meetings)	- Proof that a transformation is linear - Determining the kernel and range of a linear transformation [$1 \times 3 \times 120$ minutes]			[4] Chapter 5 dan 6	
									Total Weight	100%
16	**FINAL EXAM**									

1 credit = 50 minutes face-to-face meeting, 60 minutes structured study, 60 minutes independent study
Each meeting duration is 2 credits = 2×50 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	Homework	20
4	Quizzes	20
TOTAL		**100**

2. Assessment weight for Intended Learning Outcome
   - CLO-1: 16 %
   - CLO-2: 14,5 %
   - CLO-3: 14 %
   - CLO-4: 15,5 %
   - CLO-5: 15 %
   - CLO-6: 19%
   - CLO-7: 6%

Assessment Plan Table:

No.	CLO	Assessment				Weigth (%)
		Homework (%)	Quizzes (%)	Mid-Term Exam (%)	Final Exam (%)	
1	Ability to solve and analyze a system of linear equation) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	1st Task : 1,5 2nd Task : 1,5	1st Quiz : 3	10		16
2	Ability to calculate and analyze operations on matrix, determinant and inverse matrix. (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	3rd Task : 2 4th Task : 1,5	1st Quiz : 3	8		14,5

3	Ability to calculate norm, dot product and cross product in 2 −space and $3-space$) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-3**: PI-1, PI-2)	5th Task : 2	1st Quiz : 3	9		14
4	Ability to show that a set is a vector space, subspace, span, linearly independent, and base. (**ILO-2**: PI-1, PI-2; **ILO-5**: PI-1)	6th Task : 1,5 7th Task : 1,5 8th Task : 1,5	1st Quiz : 1 2nd Quiz : 3	3	4	15,5
5	Ability to show a vector space is an inner product space with a given defined function and their properties) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-5**: PI-1)	9th Task : 1,5 10th Task : 1,5	2nd Quiz : 2		10	15
6	Ability to calculate eigen value, eigen vector and their application to diagonalization) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-4**: PI-1, PI-2)	11th Task : 1,5 12th Task : 1,5	2nd Quiz : 4		12	19
7	Ability to determine a mapping that is a linear transformation, and their properties) (**ILO-2**: PI-1, PI-2, PI-3, **ILO-5**: PI-1)	13th Task : 1	2nd Quiz : 1		4	6
	Total	**20**	**20**	**30**	**30**	**100**

Matrix of CLO and ILO

CLO	ILO																															
	1			2			3			4			5				6					7			8				9			
	PI			PI			PI			PI			PI				PI					PI			PI				PI			
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	4	1	2	3	4	5	1	2	3	1	2	3	4	1	2	3	4
1				□	□	□	□	□																								
2				□	□	□	□	□																								
3				□	□	□	□	□																								
4									□																							
5				□	□								□																			
6				□	□	□				□	□																					
7				□	□	□							□																			

Task / homework	About	Recommended question sources (reference [1])
1	Students do assignments about determination solution of: - Linear equation - System of linear equation - Matriks eselon baris terduksi	Exercise 1.1, pp.8-9, No. 1, 2, 7c, 12, 14. Exercise 1.2, pp. 22-23, No. 3, 5, 6, 7.
2	Students do assignments about determination solution of system of linear equation (inhomogeny and homogeny)	Exercise 1.2, pp. 23-24, No. 13, 14, 17, 21, 25, 29 Exercise 1.3, pp. 37, No. 11, 13, 14, 23

3	Students do assignments on determining the determinant of a matrix using the signed elementary product addition method and the row reduction method	Exercise 2.1, pp. 111-113, No. 1, 2, 9, 14, 26, 31
4	Students do assignments about determination: - determinant of a matrix using the cofactor expansion method along the rows - matrix inverse with the adjoint method - Solution of system of linear equation using Cramer's rule	Exercise 2.2, pp. 117-118, No. 3, 5, 11, 13, 14, 15-22, 23, 25, 29, 30 Exercise 2.3, pp. 127-128, No. 19, 23, 26, 28, 31.
5	Students do assignments about determination: - Norm, distance, dot product, and cross product - orthogonality - The area of a geometric figure using the properties of the dot product and cross product	Exercise 3.2, pp. 153, No. 3, 4, 5, 9, 11, 12 Exercise 3.3, pp. 162-163, No. 1, 3, 7, 11, 14, 16, 27, 30. Exercise 3.5, pp. 179-181, No. 1, 7, 11, 14, 19, 22, 23, 27.
6	Student do assignment about the proof that a set/sub-set is a vector space/vector subspace	Exercise 4.1, pp. 190-191, No. 3, 4, 5, 6, 7, 9. Exercise 4.2, pp. 1, 2, 3, 4.
7	Students do assignments - Linear combination - span - linearly independent	Exercise 4.3, pp. 210-211, No. 1, 3, 5, 9.
8	● Students do assignments on determining row space, column space, null space and their bases ● Students do assignments - Proof that a set of vector is a basis - Determining vector coordinate related to basis	Exercise 4.4, pp. 219-220, No. 2, 3, 5, 11, 14, 19. Exercise 4.7., pp. 246-247, No. 9, 1013, 14.
9	Students do assignments on determining eigenvalues, eigenvectors, and eigenspaces, as well as the basis of eigenspaces	Exercise 5.1, pp. 300-301, No. 5, 7, 11.
10	Students do assignments about diagonalizing (and orthogonally diagonalizing) a $n \times n$ matrix	Exercise 5.2, pp. 311, No. 5, 8, 9, 19.
11, 12	Students do assignments about - inner product space - orthogonality is based on the definition of a given inner product space - determination of orthogonal and orthonormal bases using the Gram-Schmidt process and factoring matrices using the QR decomposition methods	Exercise 6.1, pp. 353-354, No. 1, 2, 11, 12, 15, 16, 37, 38. Exercise 6.2, pp. 361-362, No. 1, 3, 5, 7, 11, 31. Exercise 6.3, pp. 376-377, No. 1, 2, 3, 4, 45, 46, 49.

13	Student do assignment about: - Proof that a transformation is linear - Determining the kernel and range of a linear transformation	Exercise 8.1, pp. 456-457, No. 1, 2, 3, 6, 7, 12.