



Universitas Negeri Surabaya
Faculty of Mathematics and Natural Sciences
Bachelor of Mathematics Education Study Program

Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight	SEMESTER	Compilation Date
Elementary Linear Algebra	8420203007		T=3 P=0 ECTS=4.77	3	July 17, 2024
AUTHORIZATION	SP Developer		Course Cluster Coordinator	Study Program Coordinator	
	Dr. Endah Budi Rahaju, M.Pd.	

Learning model	Case Studies																																																	
Program Learning Outcomes (PLO)	PLO study program that is charged to the course																																																	
	PLO-5 Demonstrate a scientific, critical and innovative attitude in teaching and learning mathematics and professional tasks																																																	
	PLO-7 Apply basic mathematical principles to solve simple mathematical problems																																																	
	PLO-9 Communicate ideas and research results effectively, verbally and literally																																																	
	PLO-12 Demonstrate mathematical knowledge and insight																																																	
	Program Objectives (PO)																																																	
	PO - 1 Able to understand the basic concepts of linear algebra which include systems of linear equations (SPL), matrices and their operations, vector spaces and subspaces, bases and dimensions, row/column spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors as well as being thorough and argumentative in doing the task.																																																	
	PLO-PO Matrix																																																	
	<table border="1" style="margin: auto;"> <tr> <td>P.O</td> <td>PLO-5</td> <td>PLO-7</td> <td>PLO-9</td> <td>PLO-12</td> </tr> <tr> <td>PO-1</td> <td></td> <td></td> <td></td> <td></td> </tr> </table>	P.O	PLO-5	PLO-7	PLO-9	PLO-12	PO-1																																											
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PO-1																																																		
PO Matrix at the end of each learning stage (Sub-PO)																																																		
<table border="1" style="margin: auto;"> <tr> <td rowspan="2">P.O</td> <td colspan="16">Week</td> </tr> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td> </tr> <tr> <td>PO-1</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>	P.O	Week																1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	PO-1																
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PO-1																																																		

Short Course Description Provides a foundation for understanding linear algebra. Some of the study materials that will be discussed in this course include: systems of linear equations (SPL), matrices and their operations, vector spaces and subspaces, bases and dimensions, row/column spaces, inner product spaces, linear transformations, eigenvalues and eigenvectors. In the SPL material, we will discuss how to solve the SPL, both by Gauss elimination and Gauss-Jordan elimination. A more specific discussion of matrix operations will discuss the determinant and inverse of the nxn matrix. The inner product space that will be discussed is the inner product space of Euclid and others. Apart from that, norms, orthogonality and the Gramm-Scmidt process are also discussed. The eigenvalues that will be discussed are real eigenvalues. Learning is carried out by activating students through questions and answers, training students to argue using presentation media.

References

Main :

- Anton, H.& Rorres, C. 2014. Elementary Linear Algebra (11th Edition) . John Wiley & Sons.
- Andrilli, S.& Hecker, D. 2010. Elementary Linear Algebra (Fourth Edition) . Academic Press.
- H. Ted Davis & Kendall T Thomson. 2000. Linear Algebra and Linear Operators in Engineering .

Supporters:

Supporting lecturer Dr. Agung Lukito, M.S.
 Prof. Dr. Raden Sulaiman, M.Si.
 Prof. Rooselyna Ekawati, Ph.D.
 Yulia Izza El Milla, S.Pd., M.Pd.
 Dayat Hidayat, S.Pd., M.Pd., M.Si.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (offline)	Online (online)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

1	Understand systems of linear equations, solve and apply them in the context of problems	<ol style="list-style-type: none"> 1. Defining equations 2. Defining linear equations 3. Defining Systems of Linear Equations (SPL) 4. Solving systems of linear equations (including SPLH) 5. Solve problems using the SPL concept 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to solve systems of linear equations (including Systems of Homogeneous Linear Equations) 2. Able to solve problems using the SPL concept <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion, questions and answers 6 x 50 minutes		<p>Material: Systems of Linear Equations, Gauss Elimination, Gauss-Jordan Elimination</p> <p>References: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
2	Understand systems of linear equations, solve and apply them in the context of problems	<ol style="list-style-type: none"> 1. Defining equations 2. Defining linear equations 3. Defining Systems of Linear Equations (SPL) 4. Solving systems of linear equations (including SPLH) 5. Solve problems using the SPL concept 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to solve systems of linear equations (including Systems of Homogeneous Linear Equations) 2. Able to solve problems using the SPL concept <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion, questions and answers 6 x 50 minutes		<p>Material: Systems of Linear Equations, Gauss Elimination, Gauss-Jordan Elimination</p> <p>References: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
3	Understand the concept of matrices, operations on matrices (especially determinants and inverses)	<ol style="list-style-type: none"> 1. State the definition of a matrix and matrix order 2. Operating the matrix 3. Using the properties of matrix operations 4. Determine the determinant of the matrix 5. Determining the inverse of a matrix 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to operate matrices using the properties of matrix operations 2. Able to determine the determinant of a matrix 3. Able to determine the inverse of a matrix <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion, question and answer. 9 x 50 minutes		<p>Material: Matrices, Operations on Matrices, Determinants of Matrices, and Inverse Matrices</p> <p>Library: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
4	Understand the concept of matrices, operations on matrices (especially determinants and inverses)	<ol style="list-style-type: none"> 1. State the definition of a matrix and matrix order 2. Operating the matrix 3. Using the properties of matrix operations 4. Determine the determinant of the matrix 5. Determining the inverse of a matrix 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to operate matrices using the properties of matrix operations 2. Able to determine the determinant of a matrix 3. Able to determine the inverse of a matrix <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion, question and answer. 9 x 50 minutes		<p>Material: Matrices, Operations on Matrices, Determinants of Matrices, and Inverse Matrices</p> <p>Library: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
5	Understand the concept of matrices, operations on matrices (especially determinants and inverses)	<ol style="list-style-type: none"> 1. State the definition of a matrix and matrix order 2. Operating the matrix 3. Using the properties of matrix operations 4. Determine the determinant of the matrix 5. Determining the inverse of a matrix 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to operate matrices using the properties of matrix operations 2. Able to determine the determinant of a matrix 3. Able to determine the inverse of a matrix <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion, question and answer. 9 x 50 minutes		<p>Material: Matrices, Operations on Matrices, Determinants of Matrices, and Inverse Matrices</p> <p>Library: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%

6	Understand the concepts of vector spaces and subspaces	<ol style="list-style-type: none"> 1. Give an example of a vector space 2. Identifying sets that are vector spaces and those that are not 3. Give examples of subspaces of vector spaces 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to identify sets that are vector spaces and those that are not 2. Able to identify sets that are subspaces of vector spaces and those that are not <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Expository, question and answer, and presentation 6 x 50 minutes		<p>Material: Vector Space and Vector Subspace Reference: Anton, H. & Rorres, C. 2014. <i>Elementary Linear Algebra (11th Edition)</i>. John Wiley & Sons.</p>	10%
7	Understand the concepts of vector spaces and subspaces	<ol style="list-style-type: none"> 1. Give an example of a vector space 2. Identifying sets that are vector spaces and those that are not 3. Give examples of subspaces of vector spaces 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to identify sets that are vector spaces and those that are not 2. Able to identify sets that are subspaces of vector spaces and those that are not <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Expository, question and answer, and presentation 6 x 50 minutes		<p>Material: Vector Space and Vector Subspace Reference: Anton, H. & Rorres, C. 2014. <i>Elementary Linear Algebra (11th Edition)</i>. John Wiley & Sons.</p>	5%
8	UTS		<p>Form of Assessment : Test</p>	Written Test (Mid-Semester Exam) 3 x 50 minutes			30%
9	Understand the concept of basis and dimensions	<ol style="list-style-type: none"> 1. Determining whether a set spans a vector space or not 2. Determining linearly independent/non-linearly independent sets 3. Determining the basis and dimensions of a vector space 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to determine whether a set spans a vector space or not 2. Able to determine a set that is linearly independent/not linearly independent 3. Able to determine the basis and dimensions of a vector space <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Expository and group work 6 x 50 minutes		<p>Material: Sets of Vector Spaces, Linear Independent and Non-Linear Independent Sets, Bases and Dimensions Library: Anton, H. & Rorres, C. 2014. <i>Elementary Linear Algebra (11th Edition)</i>. John Wiley & Sons.</p>	0%
10	Understand the concept of basis and dimensions	<ol style="list-style-type: none"> 1. Determining whether a set spans a vector space or not 2. Determining linearly independent/non-linearly independent sets 3. Determining the basis and dimensions of a vector space 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to determine whether a set spans a vector space or not 2. Able to determine a set that is linearly independent/not linearly independent 3. Able to determine the basis and dimensions of a vector space <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Expository and group work 6 x 50 minutes		<p>Material: Sets of Vector Spaces, Linear Independent and Non-Linear Independent Sets, Bases and Dimensions Library: Anton, H. & Rorres, C. 2014. <i>Elementary Linear Algebra (11th Edition)</i>. John Wiley & Sons.</p>	0%
11	Understand the row/column space of a matrix	<ol style="list-style-type: none"> 1. Determining the row space of a matrix 2. Determine the basis and row space dimensions of a matrix 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to determine the row space of a matrix 2. Able to determine the basis and row space dimensions of a matrix <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Discussion and presentation 3 x 50 minutes		<p>Material: Row/column space References: Anton, H. & Rorres, C. 2014. <i>Elementary Linear Algebra (11th Edition)</i>. John Wiley & Sons.</p>	0%

12	Understand the concept of inner product space (RHKD) and the Gram-Scmidt process	<ol style="list-style-type: none"> 1. Give an example of RHKD 2. Identifying a set with an operation is RHKD or not 3. Determining the length of a vector 4. Determine the distance and angle between two vectors 5. Determining orthonormal vectors 6. Determining the orthonormal basis with the Gram-Scmidt process 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to identify a set with an operation whether it is RHKD or not 2. Able to determine the orthonormal basis using the Gram-Scmidt process 3. Able to determine orthonormal vectors <p>Form of Assessment : Participatory Activities</p>	Expository and question and answer 3 x 50 minutes		<p>Material: Inner Product Space, Orthonormal Basis, and Gram-Scmidt Process</p> <p>Reference: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	0%
13	Understand the concept of linear transformation	<ol style="list-style-type: none"> 1. Give examples of linear transformations 2. Identify functions that are linear transformations and those that are not 3. Determine the basis and dimensions of the area resulting from the linear transformation 4. Determining nullity 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to identify whether a function is a linear transformation or not 2. Able to determine the basis and dimensions of linear transformation results 3. Determining nullity <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	6 x 50 minute group discussions and assignments		<p>Material: Linear Transformation</p> <p>References: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
14	Understand the concept of linear transformation	<ol style="list-style-type: none"> 1. Give examples of linear transformations 2. Identify functions that are linear transformations and those that are not 3. Determine the basis and dimensions of the area resulting from the linear transformation 4. Determining nullity 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to identify whether a function is a linear transformation or not 2. Able to determine the basis and dimensions of linear transformation results 3. Determining nullity <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	6 x 50 minute group discussions and assignments		<p>Material: Linear Transformation</p> <p>References: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	5%
15	Understand eigenvalues and eigenvectors	<ol style="list-style-type: none"> 1. Determine the eigenvalues and eigenvectors of a matrix 2. Determining the basis and dimensions of the eigenspace 	<p>Criteria:</p> <ol style="list-style-type: none"> 1. Able to determine the values and eigenvectors of a matrix 2. Able to determine the basis and dimensions of eigenspace <p>Form of Assessment : Participatory Activities, Practice/Performance</p>	Lectures and discussions 3 x 50 minutes		<p>Material: Eigen Values and Eigen Vectors</p> <p>References: <i>Anton, H. & Rorres, C. 2014. Elementary Linear Algebra (11th Edition). John Wiley & Sons.</i></p>	0%
16			<p>Form of Assessment : Test</p>	Written Test (Final Semester Exam) 3 x 50 minutes			20%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	25%
2.	Practice / Performance	25%
3.	Test	50%
		100%

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.