	Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Data Science Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Matrix Algebra	4920203008	Compulsory Study Program Subjects	T=3	P=0	ECTS=4.77	2	January 22, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Yuliani Puji Astuti, S.Si., M.Si.	Dr. Atik Wintarti, M.Kom	Yuliani Puji Astuti, S.Si., M.Si.

Learning model: Case Studies

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

PLO-6	Has professional responsibility and can make informed judgments in computing practices based on legal and ethical principles
PLO-9	Able to apply data science principles to solve problems
PLO-12	Able to design and develop algorithms for various purposes such as big data analysis, artificial intelligence, databases, data mining, inferential statistics, algorithm design and analysis, and data warehouse.

Program Objectives (PO)

PO - 1	Responsible for completing every task assigned
PO - 2	Able to use software to solve problems regarding matrices
PO - 3	Able to design problem solving in data processing using matrix methods
PO - 4	Able to demonstrate knowledge and insight into matrices related to data science

PLO-PO Matrix

P.O	PLO-6	PLO-9	PLO-12
PO-1			
PO-2			
PO-3			
PO-4			

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																

Short Course Description: This course is a case method course which studies the concept of matrices and their applications related to data processing. The use of related computer applications is also introduced in this course.

References

Main :

1. Hartman, G. 2011 . Fundamentals of Matrix Algebra 3rd Edition. Creative Common
2. Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley

Supporters:

	1. Lay, D.C., Lay, S. R. McDonald, J.J. 2015. Linear Algebra and Its Applications 5th Edition. Pearson 2. https://www.geogebra.org/t/matrices 3. Lopez, C. P. 2014. MATLAB Matrix Algebra. APress 4. Klein, P. N. 2013. Coding the Matrix: Linear Algebra Through Applications to Computer Science. Newtonian Press 5. Vinod, H. D. 2011. Hands on Matrix Algebra Using R . World Scientific
Supporting lecturer	Dr. Agung Lukito, M.S. Yuliani Puji Astuti, S.Si., M.Si. Hasanuddin Al-Habib, M.Si. Fadhilah Qalbi Annisa, S.T., M.Sc. Ulfa Siti Nuraini, S.Stat., M.Stat.

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	Understanding systems of linear equations (KNO-1)	1.1. Explain the system of linear equations (SPL) 2.2. Using matrices to solve SPL 3.3. Using elementary row operations and Gaussian elimination to solve the SPL problem 4.4. Explain the existence and singularity of the SPL solution	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Tutorial on using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Systems of Linear Equations **References:** *Hartman, G. 2011 . Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	3%
2	Understanding systems of linear equations (KNO-1)	1.1. Explain the system of linear equations (SPL) 2.2. Using matrices to solve SPL 3.3. Using elementary row operations and Gaussian elimination to solve the SPL problem 4.4. Explain the existence and singularity of the SPL solution	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Tutorial on using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Matrix arithmetic **Reference:** *Hartman, G. 2011. Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	3%
3	Using SPL to solve real problems (SKI-2)	1.1. Convert real problems into SPL form 2.2. Complete the SPL modeling results 3.3. Interpret SPL solutions in real situation language	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Tutorial on using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** SPL Application **Reference:** *Hartman, G. 2011 . Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	4%

4	Understand the basic concepts of matrices (KNO-1)	1.1. Explain addition and multiplication of scalar matrices 2.2. Explain matrix multiplication 3.3. Visualize matrix operations in 2D 4.4. Explain the SPL vector solution	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Matrix definition Matrix notation Matrix order Types of matrices Addition and multiplication scalar matrices Multiplication matrices Visualization of matrix operations in 2D SPL vector solutions **References:** *Hartman, G. 2011. Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	4%
5	Understanding the inverse and determinant of matrices (KNO-1)	1.1. Explain matrix inverse 2.2. Summarize the properties of the inverse matrix 3.3. Explain the determinant of the matrix 4.4. Summarize the properties of matrix determinants 5.5. Use Cramer‘s rule to solve the SPL	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Inverse matrix and its properties Matrix determinant and its properties Cramer‘s rule **Bibliography:** *Hartman, G. 2011. Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	4%
6	Understand the concept of vectors in 2-space, 3-space, n-space and their operations (KNO-1)	1.1. Explain the concept of vectors in 2-space, 3-space, n-space 2.2. Explain the operations of vector scalar addition and multiplication in 2-space, 3-space, n-space 3.3. Summarize the properties of vector operations in 2-space, 3-space, n-space	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Vectors in 2-space, 3-space, n-space Addition and scalar multiplication operations of vectors in 2-space, 3-space, n-space **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	4%
7	Understanding real vector spaces and their sub-spaces (KNO-1)	1.1. Explain real vector spaces 2.2. Explain sub-space 3.3. Infer the properties of subspace	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Real vector space Sub-space **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	4%
8	Understanding real vector spaces and their sub-spaces (KNO-1)	Midterm exam	**Criteria:** Writing test **Form of Assessment** : Participatory Activities, Tests	UTS 150	UTS 150	**Material:** Real vector space Sub-space **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	20%

9	Understand the concept of basis and dimension (KNO-1)	1.1. Explain linear freedom 2.2. Explain the basis for vector spaces 3.3. Summarize the properties of the basis for vector spaces 4.4. Explain the dimensions of vector space 5.5. Determine the basis and dimensions of the vector space	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Linear freedom Basis of Vector Space Dimensions of Vector Space **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	3%
10	Understand the concept of basis and dimension (KNO-1)	1.1. Explain linear freedom 2.2. Explain the basis for vector spaces 3.3. Summarize the properties of the basis for vector spaces 4.4. Explain the dimensions of vector space 5.5. Determine the basis and dimensions of the vector space	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Linear freedom Basis of Vector Space Dimensions of Vector Space **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	3%
11	Understand the concept of Inner Product Space and the Gram-Schmidt process (KNO-1)	1.1. Explain the concept of Internal Product 2.2. Summarize the properties of the inner product 3.3. Explain orthogonality in Inner Product space 4.4. Explain the Gram-Schmidt orthogonalization process 5.5. Use the Gram-Scmidt process to generate a set of orthogonal vectors	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Products in the Orthogonality of the Gram-Schmidt Process **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	2%
12	Understand the concept of Inner Product Space and the Gram-Schmidt process (KNO-1)	1.1. Explain the concept of Internal Product 2.2. Summarize the properties of the inner product 3.3. Explain orthogonality in Inner Product space 4.4. Explain the Gram-Schmidt orthogonalization process 5.5. Use the Gram-Scmidt process to generate a set of orthogonal vectors	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Products in the Orthogonality of the Gram-Schmidt Process **References:** *Anton, H., Rorres, C. 2014. Elementary Linear Algebra 11th Edition. Wiley*	2%

13	Understanding Linear Transformations (KNO-1)	1.1. Explain the Cartesian plane transformation 2.2. Summarize the properties of linear transformations 3.3. Visualize vectors in 3D	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Cartesian plane transformation Linear transformation Vector visualization **References:** *Hartman, G. 2011. Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	6%
14	Understanding Eigen Values and Eigen Vectors (KNO-1)	1.1. Explain the concept of Eigen Values and Eigen Vectors of a square matrix 2.2. Determine the Eigenvalues and Eigenvectors of a square matrix 3.3. Summarize the properties of Eigen Values and Eigen Vectors 4.4. Explain the concept of diagonalization of a square matrix 5.5. Diagonalize a square matrix	**Criteria:** Non Test **Form of Assessment** : Participatory Activities	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Eigenvalues and Eigenvectors of matrices Properties of Eigenvalues and Eigenvectors of Diagonalization matrices **References:** *Hartman, G. 2011. Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	4%
15	Using computer programs to solve problems related to matrices (SOC-2, SKI-1-2 and COM-2)	1. Using computer programs to solve problems related to matrices	**Criteria:** Non Test **Form of Assessment** : Participatory Activities, Practical Assessment	Lectures and Questions and Answers 150	Lectures and videos using LMS, Asynchronous or Synchronous, Questions and Answers 150	**Material:** Computer program to solve problems **References:** *Hartman, G. 2011 . Fundamentals of Matrix Algebra 3rd Edition. Creative Commons*	4%
16		Final exams	**Form of Assessment** : Participatory Activities	UAS 150	UAS 150		30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	88%
2.	Practical Assessment	2%
3.	Test	10%
		100%

Notes

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.