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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Numerical Analysis	4420103016		T=3	P=0	ECTS=4.77	6	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	Prof. Dr. Raden Sulaiman, M.Si.

Learning model	**Project Based Learning**
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**
	Program Objectives (PO)
	PLO-PO Matrix

	P.O

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

Short Course Description	The Numerical Analysis course aims to study synthesis-based analysis of the application of the numerical paradigm in systems of linear equations (SPL), the ill-conditioned nature of SPL, and several iterative methods in increasing the accuracy of numerical solutions of SPL. Understanding the numerical paradigm is also applied to determine numerical solutions for GDP with single steps and multi-steps. The discussion also discusses pictorial methods for determining numerical solutions of partial differential equations (PDP) by focusing on three types: elliptic, parabolic, and hyperbolic. Matlab-based analytical proof and simulative illustrations are discussed for a solution model for a problem designed based on techno-echo-entrepreneur-maths. Learning is carried out by applying a combination of problem-based learning, discussion and conventional direct learning approaches. Learning activities are also intended to improve skills through group presentations on specified topics. The assessment is determined with proportional weights and is carried out during the learning process with active interactive participation, presentations, assignments and mid-semester exams, as well as final semester exams.
References	**Main :**

1. Atkinson, K., 1985. Elementary Numerical Analysis. John Wiley and Sons.
2. Boyce, W.E. and DiPrima, R.C., 1977. Elementary Differential Equations and Boundary Value Problems . John Wiley & Sons.
3. Fisher, M.E. 1985. Introductory Numerical Methods for Scientists and Engineers, Revised Edition, Department of Mathematics. The Univesity of Western Australia.
4. Gerald, C.F. and Weatley, P.O., 2004. Applied Numerical Analysis. Addison Wesley.
5. Mathews, J.H. and Fink, K.D., 1999. Numerical Methods: Using Matlab, 3rd Edition . Prentice Hall.

Supporters:	
Supporting lecturer	Dr. Yusuf Fuad, M.App.Sc.

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	Students are able to understand the basic principles of solving linear equations numerically, ill-conditioned, and iterative methods, as well as their applications.	1. Understand the basic principles of solving linear equations numerically. 2. Explains the well-conditioned or ill-conditioned condition of SPL. 3. Demonstrate the application of iterative methods: Jacobi method, Gauss-Seidel method, SOR method, and their applications. 4. Understand the principle of factorization to determine the numerical solution of SPL.	**Criteria:** 10% for each assignment and 5% for each group presentation.	Problem-based learning and case studies combined in group discussions. 3 X 50			0%
2	Students are able to understand the basic principles of solving linear equations numerically, ill-conditioned, and iterative methods, as well as their applications.	1. Understand the basic principles of solving linear equations numerically. 2. Explains the well-conditioned or ill-conditioned condition of SPL. 3. Demonstrate the application of iterative methods: Jacobi method, Gauss-Seidel method, SOR method, and their applications. 4. Understand the principle of factorization to determine the numerical solution of SPL.	**Criteria:** 10% for each assignment and 5% for each group presentation.	Problem-based learning and case studies combined in group discussions. 3 X 50			0%

3	Students are able to understand the basic principles of solving linear equations numerically, ill-conditioned, and iterative methods, as well as their applications.	1. Understand the basic principles of solving linear equations numerically. 2. Explains the well-conditioned or ill-conditioned condition of SPL. 3. Demonstrate the application of iterative methods: Jacobi method, Gauss-Seidel method, SOR method, and their applications. 4. Understand the principle of factorization to determine the numerical solution of SPL.	**Criteria:** 10% for each assignment and 5% for each group presentation.	Problem-based learning and case studies combined in group discussions. 3 X 50			0%
4	Students are able to understand the basic principles of Ordinary Differential Equations (PDB), their properties and proofs, solution methods, and their applications based on techno-echo-entrepreneur-maths.	1. Understand the basic principles of numerical solutions of GDP. 2. Understand the properties of GDP solutions and their analytical proof. 3. Apply Euler, Taylor, Heun, Runge-Kutta, and multi-step methods to determine the solution of a GDP. 4. Explain the basic principles of solving the GDP system. 5. Solving the initial value problem of boundary conditions using shooting and FDM methods. 6. Solving a problem based on techno-echo-entrepreneur-maths.	**Criteria:** 10% for each assignment and 5% for each group presentation.	Problem-based learning and case studies combined in group discussions. 3 X 50			0%

5	Students are able to understand the basic principles of Ordinary Differential Equations (PDB), their properties and proofs, solution methods, and their applications based on techno-echo-entrepreneur-maths.	1. Understand the basic principles of numerical solutions of GDP. 2. Understand the properties of GDP solutions and their analytical proof. 3. Apply Euler, Taylor, Heun, Runge-Kutta, and multi-step methods to determine the solution of a GDP. 4. Explain the basic principles of solving the GDP system. 5. Solving the initial value problem of boundary conditions using shooting and FDM methods. 6. Solving a problem based on techno-echo-entrepreneur-maths.	**Criteria:** 10% for each assignment and 5% for each group presentation.	Problem-based learning and case studies combined in group discussions. 3 X 50			0%
6	Students are able to understand the basic principles of solving PDP and the conditions for the existence of the solution.	1. Identify the type of PDP and the terms of completion. 2. Explains the basic principles of completing PDP with grid and pictorial patterns.	**Criteria:** 10% of group assignment results.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
7	Students are able to understand the basic principles of solving PDP and the conditions for the existence of the solution.	1. Identify the type of PDP and the terms of completion. 2. Explains the basic principles of completing PDP with grid and pictorial patterns.	**Criteria:** 10% of group assignment results.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
8	Midterm exam.	Midterm exam.	**Criteria:** 30% of midterm exam results	Midterm exam. 3 X 50			0%

9	Students have the ability to determine solutions for elliptic, parabolic, hyperbolic PDP solutions, as well as applications based on techno-echo-entrepreneurship-maths.	1. Understand the basic principles of completing elliptical type PDP, the requirements and their application. 2. Understand the basic principles of solving parabolic type PDPs, the requirements and their application. 3. Understand the basic principles of solving hyperbolic type PDPs, requirements and their application.	**Criteria:** 5% per group presentation.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
10	Students have the ability to determine solutions for elliptic, parabolic, hyperbolic PDP solutions, as well as applications based on techno-echo-entrepreneurship-maths.	1. Understand the basic principles of completing elliptical type PDP, the requirements and their application. 2. Understand the basic principles of solving parabolic type PDPs, the requirements and their application. 3. Understand the basic principles of solving hyperbolic type PDPs, requirements and their application.	**Criteria:** 5% per group presentation.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%

11	Students have the ability to determine solutions for elliptic, parabolic, hyperbolic PDP solutions, as well as applications based on techno-echo-entrepreneurship-maths.	1. Understand the basic principles of completing elliptical type PDP, the requirements and their application. 2. Understand the basic principles of solving parabolic type PDPs, the requirements and their application. 3. Understand the basic principles of solving hyperbolic type PDPs, requirements and their application.	**Criteria:** 5% per group presentation.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
12	Students have the ability and skills to solve a problem involving PDP, and demonstrate the solution using the Matlab program.	1. Explains the solution process, solution, and simulation of the solution using Matlab for an elliptic PDP problem. 2. Explains the solution process, solution, and simulation of the solution using Matlab for a parabolic PDP problem. 3. Explains the solution process, solution, and simulation of the solution using Matlab for a hyperbolic PDP problem.	**Criteria:** 10% individual tasks and 5% project results.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%

13	Students have the ability and skills to solve a problem involving PDP, and demonstrate the solution using the Matlab program.	1. Explains the solution process, solution, and simulation of the solution using Matlab for an elliptic PDP problem. 2. Explains the solution process, solution, and simulation of the solution using Matlab for a parabolic PDP problem. 3. Explains the solution process, solution, and simulation of the solution using Matlab for a hyperbolic PDP problem.	**Criteria:** 10% individual tasks and 5% project results.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
14	Students have the ability and skills to solve a problem involving PDP, and demonstrate the solution using the Matlab program.	1. Explains the solution process, solution, and simulation of the solution using Matlab for an elliptic PDP problem. 2. Explains the solution process, solution, and simulation of the solution using Matlab for a parabolic PDP problem. 3. Explains the solution process, solution, and simulation of the solution using Matlab for a hyperbolic PDP problem.	**Criteria:** 10% individual tasks and 5% project results.	Problem-based learning and case studies are combined in group discussions and presentations. 3 X 50			0%
15	Students have a mathematical attitude and responsibility in determining numerical solutions to systems of linear equations, GDP, and PDP in mathematics and non-mathematics fields based on techno-echo-entrepreneur-maths.	Solve mathematical or non-mathematical problems involving PDB and/or PDP, and be able to demonstrate the solution with Matlab.	**Criteria:** 5% per group presentation.	Problem-based learning and case studies combined in presentations and group discussions. 3 X 50			0%
16	Final exams.	Final exams.	**Criteria:** Minimum 30% of UAS results.	Final exams. 3 X 50			0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
		0%

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.