	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 Methods	4420103078	Compulsory Study Program Subjects	T=3	P=0	ECTS=4.77	4	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	Program Objectives (PO)	
	PO - 1	Students understand the basic principles of numerical paradigms, feasible error estimation and analytical proof schemes, as well as numerical solutions in techno-ecopreneur-maths-based problems.
	PO - 2	Students understand the approximation of the roots of nonlinear equations, the estimation of errors from the roots of nonlinear equations along with analytical proof schemes and are skilled at applying them in solving problems based on techno-ecopreneur-maths.
	PO - 3	Students understand the principles of curve matching, polynomial interpolation and their analytical proof schemes and are skilled at applying them in solving techno-ecopreneur-maths-based problems
	PO - 4	Students understand smoothing, approximation, cubic splines and their analytical proof schemes and are skilled at applying them in solving problems based on techno-ecopreneur-maths
	PO - 5	Students understand numerical differentiation and integration along with analytical proof schemes and are skilled at applying them in solving problems based on techno-ecopreneur-maths
	PO - 6	Students have a mathematical attitude and responsibility in determining and applying the best numerical solutions in solving techno-ecopreneur-maths-based problems in mathematics and non-mathematics fields.
	PLO-PO Matrix	

P.O
PO-1
PO-2
PO-3
PO-4
PO-5
PO-6

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																
PO-5																
PO-6																

Short Course Description	The Numerical Methods course aims to provide the basic principles of numerical solutions without abandoning the analytical proof scheme. Understanding numerical solutions includes the concept of error including sources and ways to prevent them, approximation of the roots of nonlinear equations including solution methods and analytical proof schemes, interpolation including approximation and smoothing of data, as well as numerical differentiation and integration with analytical proof schemes. Learning is carried out by applying a combination of problem-based learning approaches and collaborative learning based on problems determined based on eco-techno-entrepreneur-maths. 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. Chapra, S. C. 2018. Applied Numerical Methods with MATLAB for Engineers and Scientists (4th Edition). New York: McGraw-Hill Education 2. Fuad, Y. 2010. Metode Numerik. Unipress IKIP Surabaya. 3. Fink, K.K. and Mathews H.J. 2004. Numerical Methods using MATLAB (4th Edition) . New Jersey: Pearson Education Inter. 4. Atkinson, K. 2003. Elementary Numerical Analysis (3rd Edition). John Wiley and Sons **Supporters:** 1. Atkinson, K. 2003. Elementary Numerical Analysis (3rd Edition). John Wiley and Sons
Supporting lecturer	Dr. Yusuf Fuad, M.App.Sc. Dr. Dian Savitri, S.Si., M.Si. Dimas Avian Maulana, S.Si., M.Si. Riska Wahyu Romadhonia, S.Si., M.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	Understand basic numerical principles: numerical solutions, errors and their applications	1. Explain the definition and differences between analytical solutions and numerical solutions. 2. Shows the use of numbers in everyday life and the role of computers in numbers 3. Explain significant figures 4. Shows precision, accuracy 5. State the sources of error 6. Determine relative error and absolute error	**Criteria:** attached **Form of Assessment** : Participatory Activities	Collaborative learning approach (lectures, discussions and questions and answers) 3 X 50			0%
2	Understand the principles of approximating the roots of nonlinear equations, error estimation, and their applications	1. Determining the roots of nonlinear equations using the closed method 2. Solving application problems with closed methods	**Criteria:** attached **Form of Assessment** : Participatory Activities	Collaborative learning approach (lectures, discussions and questions and answers) 3 X 50			0%

3	Understand the principles of approximating the roots of nonlinear equations, error estimation, and their applications	1. Determining the roots of nonlinear equations using the open method 2. Understanding the Δ^2 aitken process 3. Solve application problems with open methods	**Criteria:** attached **Form of Assessment** : Participatory Activities	Collaborative learning approach (lectures, discussions and questions and answers) 3 X 50			0%
4	Understand the principles of approximating the roots of nonlinear equations, error estimation, and their applications	1. Develop a simple algorithm to determine the roots of nonlinear equations using open and closed methods 2. Using mathematical software to create simple programs	**Criteria:** attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Problem-based learning approach (problem-based learning) 3 X 50			20%
5	Understand the principles of curve matching and interpolation	1. Understand the principle of curve fitting 2. Understand forward difference, backward difference, center difference, difference operators and shift operators algorithms 3. Determine the value approach with interpolation	**Criteria:** attached	Discuss and ask questions about the principles of finite differences and interpolation of 3 X 50 polynomials			0%
6	Understand the principles of curve matching and interpolation	Determine the value approach with interpolation	**Criteria:** attached **Form of Assessment** : Test	Collaborative learning approach (lectures, discussions and questions and answers) 3 X 50			20%
7	Understand the principles of curve matching and interpolation	1. Determining the value approach with Lagrange Interpolation 2. Determining the value approach with Inverse Interpolation 3. Solving simple problems with several interpolation approaches	**Criteria:** attached	Collaborative learning approaches (lectures, discussions and questions and answers) and problem-based learning 3 X 50			0%
8	USS 1		**Criteria:** 20% of the final mark is obtained from the USS 1 mark **Form of Assessment** : Test	3 X 50			20%

9	Understand the principles of smoothing and cubic splines and their applications	1.Understand the principles of smoothing 2.Explain the definition of quadratic and cubic splines 3.Determining the value approach with a spline	**Criteria:** attached	Collaborative learning approach (discussion and question and answer) 3 X 50			0%
10	Understand the basic principles of numerical differentiation and skillfully apply them	1.Understand the basic principles of numerical differentiation 2.Determines numerical derivatives for discrete and continuous uniform data	**Criteria:** attached	Collaborative learning approach (discussion, question and answer and presentation of group assignments) 3 X 50			0%
11	Understand the basic principles of numerical differentiation and skillfully apply them	1.Determining higher order derivatives 2.Determines numeric derivatives for non-uniform data	**Criteria:** attached	Collaborative learning approach (discussion, question and answer and presentation of group assignments) 3 X 50			0%
12	Understand the basic principles of numerical differentiation and skillfully apply them	1.Compile simple programs with the help of mathematical software 2.Solving numerical differential application problems	**Criteria:** attached **Form of Assessment** : Project Results Assessment / Product Assessment, Test	Problem-based learning approach (problem based learning) 3 X 50			10%
13	Understand the basic principles of numerical integration, and be skilled in applying them	Determine the numerical integral approach with open and closed Newton-Cotes formulas	**Criteria:** attached	Collaborative learning approach (discussion and question and answer) 3 X 50			0%
14	Understand the basic principles of numerical integration, and be skilled in applying them	Determine the numerical integral approach with open and closed Newton-Cotes formulas	**Criteria:** attached	Collaborative learning approach (discussion and question and answer) 3 X 50			0%
15	Understand the basic principles of numerical integration, and be skilled in applying them	1.Compile simple programs with the help of materika software 2.Solving numerical integral application problems	**Criteria:** attached	Problem-based learning approach (problem based learning) 3 X 50			0%
16			**Forms of Assessment** : Project Results Assessment / Product Assessment, Portfolio Assessment, Tests				30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	6.67%
2.	Project Results Assessment / Product Assessment	21.67%
3.	Portfolio Assessment	10%
4.	Test	61.67%
		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** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities 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.