	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
Reasoning and Proof	8420202153	Study Program Elective Courses	**T=2 P=0 ECTS=3.18**	6	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Abdul Haris Rosyidi, M.Pd Prof. Dr. Tatag Y.E.S, M.Pd	Abdul Haris Rosyidi, M.Pd	Dr. Endah Budi Rahaju, M.Pd.

Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

PLO-7	Apply basic mathematical principles to solve simple mathematical problems

Program Objectives (PO)

PO - 1	This course examines the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, the meaning of proof, methods of proof including direct methods, indirect methods, and types of proof which include formal proof and non-formal proof. formal.

PLO-PO Matrix

P.O	PLO-7
PO-1	

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																

Short Course Description	This course examines the meaning and benefits of proof, the types of reasoning used in the proof process and their characteristics, including deductive reasoning and inductive reasoning (analogy, generalization), types of proof in mathematics (proof, formal, informal, direct proof, contradiction , induction, and proof with examples and non-examples) and how to communicate proof through IT-based active learning

References

Main :

1. Sundstrom, T. 2014. Mathematical Reasoning: Writing and Proof Version 2.0 California: Creative Commons

Supporters:

1. [1] Sundstrom, T. 2014. Mathematical Reasoning: Writing and Proof Version 2.0 California: Creative Commons [2] Brodie, K. (2009). Teaching mathematical reasoning in secondary school classrooms (Vol. 775). Springer Science & Business Media. [3] Nickerson, R. S. 2009. Mathematical reasoning : patterns, problems, conjectures, and proofs. New York: Psychology Press. [4] Reid, D. A., & Knipping, C. (2010). Proof in mathematics education. Research, learning and teaching. [5] Stylianou, D. A., Blanton, M. L., & Knuth, E. J. (2010). Teaching and learning proof across the grades: A K-16 perspective. Routledge

Supporting lecturer	Abdul Haris Rosyidi, S.Pd., M.Pd. Sugi Hartono, M.Pd.

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	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to implement basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Define the meaning of reasoning • Differentiate reasoning and thinking • Explain each reasoning based on its level • Give examples of each level of reasoning • Use reasoning in problem solving activities	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • Reasoning and thinking • Definition of reasoning • Levels of reasoning **References:**	10%
2	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain inductive reasoning with examples • Explain deductive reasoning with examples • Explain proportional reasoning with examples • Explain multiplicative reasoning with examples • Explain analogical reasoning with examples • Explain additive reasoning with examples • Explain algebraic reasoning with examples • Explain statistical reasoning with examples • Use various types of reasoning in problem solving activities • Designing middle and high school mathematics assignments and assessments that involve reasoning	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • Types of reasoning based on generalities • Types of reasoning based on mathematical material • Design of tasks involving reasoning **References:**	15%

3	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain inductive reasoning with examples • Explain deductive reasoning with examples • Explain proportional reasoning with examples • Explain multiplicative reasoning with examples • Explain analogical reasoning with examples • Explain additive reasoning with examples • Explain algebraic reasoning with examples • Explain statistical reasoning with examples • Use various types of reasoning in problem solving activities • Designing middle and high school mathematics assignments and assessments that involve reasoning	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • Types of reasoning based on generalities • Types of reasoning based on mathematical material • Design of tasks involving reasoning **References:**	15%
4	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain inductive reasoning with examples • Explain deductive reasoning with examples • Explain proportional reasoning with examples • Explain multiplicative reasoning with examples • Explain analogical reasoning with examples • Explain additive reasoning with examples • Explain algebraic reasoning with examples • Explain statistical reasoning with examples • Use various types of reasoning in problem solving activities • Designing middle and high school mathematics assignments and assessments that involve reasoning	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • Types of reasoning based on generalities • Types of reasoning based on mathematical material • Design of tasks involving reasoning **References:**	15%

5	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain inductive reasoning with examples • Explain deductive reasoning with examples • Explain proportional reasoning with examples • Explain multiplicative reasoning with examples • Explain analogical reasoning with examples • Explain additive reasoning with examples • Explain algebraic reasoning with examples • Explain statistical reasoning with examples • Use various types of reasoning in problem solving activities • Designing middle and high school mathematics assignments and assessments that involve reasoning	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • Types of reasoning based on generalities • Types of reasoning based on mathematical material • Design of tasks involving reasoning **References:**	15%
6	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to implement basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain the urgency of reasoning in solving mathematical problems • Explain the role of reasoning in posing mathematical problems • Use various types of reasoning in problem posing activities	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** • The relationship between reasoning and problem solving and problem posing. **Literature:**	0%

7	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks involving reasoning and proof (CLO-2)	• Explain what is meant by adaptive reasoning • Implement adaptive reasoning into mathematics learning	**Criteria:** Quantitative and Test **Form of Assessment** : Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets			10%
8	UTS						0%
9	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain what is meant by proof, proof, and prove • Analyze the differences between proof, proof, and prove • Prove a mathematical statement • Design middle school and high school mathematics questions that involve proof	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** Evidence, Proof, and prove **Literature:**	15%

10	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain what is meant by proof, proof, and prove • Analyze the differences between proof, proof, and prove • Prove a mathematical statement • Design middle school and high school mathematics questions that involve proof	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material:** Evidence, Proof, and prove **Literature:**	15%
11	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain the definition of arguments and argumentation • examples of arguments and argumentation in mathematics learning at school • Solve problems involving argumentation	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets			10%
12	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to implement basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Explain the difference between proof using direct methods and indirect methods • Prove a mathematical statement using direct/indirect proof methods	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets		**Material: • Reference method of proof:**	15%

13	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Identify types of proof: inductive proof, deductive proof, formal proof, informal proof. • Explain certain types of proof and examples in mathematics	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets			15%
14	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Identify types of proof: inductive proof, deductive proof, formal proof, informal proof. • Explain certain types of proof and examples in mathematics	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets			15%

15	Able to demonstrate knowledge and insight into the meaning of reasoning, types of reasoning including inductive reasoning, deductive reasoning, reasoning in solving mathematical problems, understanding of proof, methods of proof including direct methods, indirect methods, and types of proof (CLO-1) Able to demonstrate pedagogical knowledge in designing tasks that involve reasoning and proof (CLO-2) Able to implement the basic principles of reasoning and proof concepts in problem solving activities (CLO-3)	• Identify types of proof: inductive proof, deductive proof, formal proof, informal proof. • Explain certain types of proof and examples in mathematics	**Criteria:** Quantitative and Test	Collaborative approach (discussion and expository) Asynchronous or Synchronus Discussion forum Problem solving assignments in Student Worksheets			15%
16	UAS						0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Test	80%
		80%

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.