	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
Partial Differential Equations	4420103110	Analysis	**T=3**	**P=0**	**ECTS=4.77**	4	April 26, 2023

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

Learning model	**Case Studies**

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

Program Objectives (PO)

PO - 1	Demonstrate knowledge and insight regarding partial differential equations
PO - 2	Mastering methods for solving partial differential equations and identifying their use in solving problems in partial differential equations
PO - 3	Apply prerequisite materials in differential calculus, integral calculus and ordinary differential equations to solve partial differential equation problems
PO - 4	Solving partial differential equation problems with the help of technology
PO - 5	Work independently or in groups

PLO-PO Matrix

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

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																

Short Course Description	This course examines the fundamental concepts of PDP theory including: first order linear PDP, second order linear PDP, wave equation, and heat equation. Able to determine the solution of PDP analytically, and apply PDP in everyday life, as well as interpret it. Learning is carried out by combining lecture methods, questions and answers and giving assignments assisted by technology.

References

Main :

1. Haberman, R. 2015. Applied Partial Differential Equations with Fourier Series and Boundary Value Problems . Pearson
2. Strauss, W. A. 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley
3. Soehardjo. 2004. Persamaan Diferensial Parsial . Uranus.
4. Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.
5. Weinberger, H. 1965. A First Course in Partial Differential Equations . Dover Publication

	Supporters:	
Supporting lecturer	Dr. Abadi, M.Sc. Rudianto Artiono, S.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 the meaning of Partial Differential Equations (PDP) and their classification	1.Get to know the application of PDP in various fields 2.State the meaning of PDP 3.Determines the type of PDP	**Criteria:** attached **Form of Assessment** : Participatory Activities, Tests	Lecture Discussion Questions and answers 3 X 50		**Material:** Understanding PDP and its application, PDP classification. **References:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%
2	Skilled in solving first order linear PDP	1.Determine the first order linear PDP solution with constant coefficients 2.Form a PDP if one of the solutions is known	**Criteria:** attached **Form of Assessment** : Participatory Activities	Discussion and questions and answers 3 x 50	Asynchronous discussion on Vinesa 1 x 50	**Material:** Forming a PDP, Understanding PDP solutions and determining PDP solutions of order 1 constant coefficients. **References:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%
3	Skilled in solving first order quasi linear PDP	Determining the solution to the inhomogeneous quasi linear first order PDP using the Lagrange method and the Cauchy problem	**Criteria:** attached **Form of Assessment** : Participatory Activities	Discussion and questions and answers. 3 X 50	Asynchronous discussion on Vinesa 1 x 50	**Material:** Solving quasi-linear PDP using the Lagrange Method and Cauchy Problem. **References:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%
4	Skilled in solving second order linear PDP	1.Determine the second order linear PDP solution with constant coefficients. 2.Determine particular solutions using symbolic equations	**Criteria:** 1.attached 2.2 **Form of Assessment** : Participatory Activities	Discussion and questions and answers 3 X 50	Asynchronous discussion on Vinesa 1 x 50	**Material:** Solving second order PPD constant coefficients and symbolic methods **References:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%

5	Skilled in solving second order linear PDP	Determine the second order PDP normal form and its classification.	**Criteria:** attached **Form of Assessment** : Participatory Activities, Practice/Performance	Discussion and questions and answers 3 X 50	Asynchronous discussion on Vinesa 1 x 50	**Material:** Determine the second order PDP normal form and its classification. **Reader:** *Soehardjo. 2004. Partial Differential Equations. Uranus.*	2%
6	Understand the classification of almost-linear PDP with two variables. Skilled in solving almost-linear PDP with two variables	Determine the hyperbolic PDP solution	**Criteria:** attached **Form of Assessment** : Participatory Activities	expository, discussion and question and answer. 3 X 50	asynchronous discussion on Vinesa 1 x 50	**Material:** Hyperbolic PDp **Reference:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%
7	Understand the classification of almost-linear PDP with two variables. Skilled in solving almost-linear PDP with two variables	Determine the solution to the parabolic PDP	**Criteria:** attached **Form of Assessment** : Participatory Activities	Discussion and questions and answers 3 X 50	asynchronous discussion on Vinesa 1 x 50	**Material:** Solving Parabolic PD **References:** *Dennemeyer, R. 1968. Introduction to Partial Differential Equations and Boundary Value Problems. McGraw-Hill.*	2%
8	1. Complete the first order PDP 2. Complete the second order PDP	All indicators before UTS	**Criteria:** attached **Form of Assessment** : Test	Written exam 100		**Material:** UTS **Library:**	20%
9	1. Understand the wave equation along with its solution characteristics and applications 2. Understand the heat equation along with its solution characteristics and applications 3. Understand Laplace's equation along with its solution characteristics and applications	1. Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2. Fourier Series 3. Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4. Solving Laplace's equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Discussion and questions and answers and assignments (case giving) 3 X 50	Asynchronous discussion at Vinesa about Pre-existing materials 1 x 50	**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace's equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	5%

10	1.Understand the wave equation along with its solution characteristics and applications 2.Understand the heat equation along with its solution characteristics and applications 3.Understand Laplace‘s equation along with its solution characteristics and applications	1.Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2.Fourier Series 3.Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4.Solving Laplace‘s equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Discussion and questions and answers and assignments (case giving) 3 X 50	Asynchronous discussion at Vinesa about pre-existing materials 1 x 50	**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace‘s equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	5%
11	1.Understand the wave equation along with its solution characteristics and applications 2.Understand the heat equation along with its solution characteristics and applications 3.Understand Laplace‘s equation along with its solution characteristics and applications	1.Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2.Fourier Series 3.Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4.Solving Laplace‘s equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Discussion and questions and answers and assignments (case giving) 3 X 50	Asynchronous discussions at Vinesa (case analysis in groups) 1 x 50	**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace‘s equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	5%

12	1. Understand the wave equation along with its solution characteristics and applications 2. Understand the heat equation along with its solution characteristics and applications 3. Understand Laplace's equation along with its solution characteristics and applications	1. Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2. Fourier Series 3. Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4. Solving Laplace's equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Discussion and questions and answers and assignments (case giving) 3 X 50	Asynchronous discussion at Vinesa (group case analysis) 1 x 50	**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace's equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	5%
13	1. Understand the wave equation along with its solution characteristics and applications 2. Understand the heat equation along with its solution characteristics and applications 3. Understand Laplace's equation along with its solution characteristics and applications	1. Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2. Fourier Series 3. Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4. Solving Laplace's equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Discussion and questions and answers and assignments (case giving) 3 X 50	Asynchronous discussions at Vinesa (case analysis in groups) 1 x 50	**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace's equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	5%

14	1.Understand the wave equation along with its solution characteristics and applications 2.Understand the heat equation along with its solution characteristics and applications 3.Understand Laplace's equation along with its solution characteristics and applications	1.Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2.Fourier Series 3.Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4.Solving Laplace's equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Presentation 3 X 50		**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace's equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	8%
15	1.Understand the wave equation along with its solution characteristics and applications 2.Understand the heat equation along with its solution characteristics and applications 3.Understand Laplace's equation along with its solution characteristics and applications	1.Solving the wave equation with Dirichlet, Neumann and Robin boundary conditions 2.Fourier Series 3.Solving the heat equation with Dirichlet, Neumann and Robin boundary conditions 4.Solving Laplace's equation with Dirichlet, Neumann and Robin boundary conditions	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	presentation 3 X 50		**Material:** Fourier Series, Problems of Boundary Conditions and Initial Values in the Wave Equation, heat equation and Laplace's equation **References:** *Strauss, WA 2008. Partial Differential Equations, an Introduction (2nd Edition). Wiley*	3%
16	UAS	All indicators before UAS	**Criteria:** Attached **Form of Assessment** : Test	Written Test 100		**Material:** UAS **Literature:**	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	30%
2.	Project Results Assessment / Product Assessment	18%
3.	Practice / Performance	1%
4.	Test	51%
		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.