	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
Multiple variable calculus	4420104057	Study Program Elective Courses	T=4	P=0	ECTS=6.36	3	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Case Studies**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	Program Objectives (PO)	
	PO - 1	Able to generalize concepts related to vectors, vector-valued functions, real-valued multi-variable functions, differential calculus on multi-variable functions, integral calculus on multi-variable functions, and calculus on vector fields.
	PO - 2	Able to identify and explain simple problems related to vectors, vector-valued functions, real-valued multi-variable functions, differential calculus on multi-variable functions, integral calculus on multi-variable functions, and calculus on vector fields
	PO - 3	Able to formulate and solve fundamental mathematical problems related to vectors in planes and space, the concept of vector-valued functions, the concept of real-valued multi-variable functions, the concept of differential calculus in multi-variable functions, the concept of integral calculus in multi-variable functions, and the concept of calculus in vector fields
	PO - 4	Able to use solution search methods in solving mathematical problems related to vectors, vector-valued functions, real-valued multi-variable functions, differential calculus on multi-variable functions, integral calculus on multi-variable functions, and calculus on vector fields.
	PO - 5	Able to implement solution search methods related to vectors, vector-valued functions, real-valued multi-variable functions, differential calculus on multi-variable functions, integral calculus on multi-variable functions and calculus on vector fields using the help of Maple or Mathematica software.
	PO - 6	Producing work related to the application of vector concepts, vector-valued functions, real-valued multi-variable functions, differential calculus on multi-variable functions, integral calculus on multi-variable functions, and calculus on vector fields
	PO - 7	Able to complete tasks within the specified time
	PLO-PO Matrix	

P.O
PO-1
PO-2
PO-3
PO-4
PO-5
PO-6
PO-7

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																
PO-7																

Short Course Description	Studying two and three dimensional vectors, real functions with two variables (understanding, limits and continuity, partial derivatives, derivative algebra and chain rule, higher order partial derivatives, Taylor's Theorem, maximum and minimum problems, Lagrange Method), vector valued functions (definition, limits and continuity, partial derivatives, derivative algebra, high level partial derivatives, tensors), double integrals, line integrals through ICT-assisted active learning using lecture, question and answer and discussion methods.
References	**Main :**
	1. Stewart, J., 2012, Multivariable Calculus 7th edition,Brooks/Cole Publishing, California.
	Supporters:
	1. Finney, Weir dan Giardano, 2001. Thomas' Calculus 10th, Addison-Wesley 2. Holder, L.I, DeFranza, J., dan Pasachoff,J.M.1994, Multivariable Calculus, Brooks/Cole Publishing, California. 3. Martono, K.,1992, Kalkulus Lanjut 1, ITB: Bandung.
Supporting lecturer	Dr. Budi Rahadjeng, S.Si., M.Si. Rudianto Artiono, S.Pd., M.Si. Dwi Nur Yunianti, S.Si., M.Sc. Budi Priyo Prawoto, 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	1.Identify vectors in planes and space 2.Explain the concepts of dot product and cross product 3.Explain the equation of line vectors in planes and space 4.Solve problems related to vectors in planes and space	1.Identify vectors in planes and space 2.Explain the concepts of dot product and cross product 3.Explain the equation of line vectors in planes and space 4.Solve problems related to vectors in planes and space	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Vectors in Fields and Space **Library:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
2	1.Defines a vector-valued function 2.Calculates vector functions, arc length, curvature 3.Draw graphs of vector-valued functions with the help of computer software	1.Defines a vector-valued function 2.Calculates vector functions, arc length, curvature 3.Describe vector-valued function graphs with the help of maple or mathematics software	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Vector Valued Functions **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%

3	1. Defines a vector-valued function 2. Calculates vector functions, arc length, curvature 3. Draw graphs of vector-valued functions with the help of computer software	1. Defines a vector-valued function 2. Calculates vector functions, arc length, curvature 3. Describe vector-valued function graphs with the help of maple or mathematics software	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Vector Valued Functions **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
4	1. Identify second degree surfaces 2. Explain the concept of a function with two or three variables and their operations 3. Draw graphs of functions of two variables manually or with the help of computer software	1. Identify second degree surfaces 2. Explain the concept of a function with two or three variables and their operations 3. Draw graphs of functions of two variables manually or with Maple or Mathematica software	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Second Degree Surfaces, Functions with Two and Three Variables **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
5	Formulate the concept of limits and continuity of functions with two variables and their properties	Explain the concept of limits and continuity of functions with two variables and their properties	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Limits and Continuity **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
6	1. Determine the derivative of a function with respect to one of its variables 2. Explain the concept of the function of two differentiated variables 3. Use the chain rule to determine partial derivatives 4. Explain the concept of directed derivatives	1. Determine the derivative of a function with respect to one of its variables 2. Explain the concept of the function of two differentiated variables 3. Use the chain rule to determine partial derivatives 4. Explain the concept of directed derivatives	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Partial derivatives, differentiable functions, chain rule and directed derivatives **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%

7	1. Determine the equation of the tangent plane 2. Determine the equation of the normal line 3. Solving problems related to extreme values of functions with two variables	1. Determine the equation of the tangent plane 2. Determine the equation of the normal line 3. Solving problems related to extreme values of functions with two variables	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Tangent plane, normal line, extreme values and Lagrange multipliers **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
8	UTS	All indicators before UTS	**Criteria:** Attached **Form of Assessment** : Test	UTS 100		**Material:** All material before UTS **Bibliography:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	20%
9	1. Define double integral 2. Explain the properties of double integrals 3. Solving double integrals using several methods	1. Define double integral 2. Explain the properties of double integrals 3. Solving double integrals using several methods	**Criteria:** Attached **Form of Assessment** : Practice / Performance	Lectures, Responses, and Tutorials 200		**Material:** Double integrals, Fubini's theorem, Double integrals in right-angled coordinates, Double integrals in polar coordinates **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
10	1. Define double integral 2. Explain the properties of double integrals 3. Solving double integrals using several methods	1. Define double integral 2. Explain the properties of double integrals 3. Solving double integrals using several methods	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Double integrals, Fubini's theorem, Double integrals in right-angled coordinates, Double integrals in polar coordinates **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	1%
11	Determine the surface area with a double integral	1. Solving double integrals using several methods 2. Determine the surface area with a double integral	**Criteria:** Attached **Form of Assessment** : Participatory Activities	Lectures, Responses, and Tutorials 200		**Material:** Surface Area References **:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	8%

12	1.Define triple integral 2.Explain the properties of triple integrals 3.Solve triple integrals using several methods 4.Define triple integral 5.Explain the properties of triple integrals 6.Solve triple integrals using several methods	1.Define triple integral 2.Explain the properties of triple integrals 3.Solve triple integrals using several methods 4.Define triple integral 5.Explain the properties of triple integrals 6.Solve triple integrals using several methods	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, Responses, and Tutorials 200		**Material:** Triple Integral **Bibliography:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	8%
13	Solving double integrals using the transformation change method	Solving double integrals using the transformation change method	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, Responses, and Tutorials 200		**Material:** Changes in variables in double and triple integrals **Reference:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	8%
14	1.Defines a vector field 2.Define line integral	1.Defines a vector field 2.Define line integral	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, Responses, and Tutorials 200		**Material:** Vector fields, line integrals **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	8%
15	1.Defines a vector field 2.Define line integral	1.Defines a vector field 2.Define line integral	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Lectures, Responses, and Tutorials 200		**Material:** Vector fields, line integrals **References:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	9%
16	UAS	All indicators before UAS	**Criteria:** Attached **Form of Assessment** : Test	UAS 100		**Material:** All material before UAS **Bibliography:** *Stewart, J., 2012, Multivariable Calculus 7th edition, Brooks/Cole Publishing, California.*	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	32.5%
2.	Practice / Performance	17.5%
3.	Test	50%
		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.