	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
Integral Calculus	4420104055	Analysis	T=4	P=0	ECTS=6.36	2	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**	
	PLO-1	Able to demonstrate religious, national and cultural values, as well as academic ethics in carrying out their duties
	PLO-2	Demonstrate the character of being tough, collaborative, adaptive, innovative, inclusive, lifelong learning and entrepreneurial spirit
	PLO-3	Develop logical, critical, systematic and creative thinking in carrying out specific work in their field of expertise and in accordance with work competency standards in the field concerned
	PLO-4	Develop yourself continuously and collaborate.
	PLO-5	Able to work together and have social sensitivity and be able to bring change to society through techno-ecopreneurship;
	PLO-6	Able to show responsibility for work in their field of expertise independently, have a passion for lifelong learning, and have the courage to make decisions.
	PLO-7	Able to formulate and solve fundamental mathematical problems;
	PLO-8	Able to apply basic mathematical principles to solve simple mathematical problems*
	PLO-10	Able to implement simple mathematical procedures in computer programs
	PLO-12	Able to generate ideas used to complete mathematical tasks and communicate them in writing and orally, in accordance with scientific principles
	PLO-13	Able to solve mathematical problems using technology
	PLO-14	Able to demonstrate mathematical knowledge and insight;
	PLO-15	Able to identify and explain the quality of simple mathematical problems*
	Program Objectives (PO)	
	PO - 1	Able to demonstrate mathematical knowledge and insight related to definite and indefinite integrals, as well as their applications
	PO - 2	Solve basic mathematical problems of definite integrals and indefinite integrals
	PO - 3	Apply the basic principles of definite and indefinite integrals to solve simple mathematical problems critically or creatively
	PO - 4	Solving integral problems using computer programs (maple/geogebra)
	PO - 5	Generate ideas in solving integral problems and their implementation and communicate them.
	PO - 6	Able to complete tasks in groups with empathy
	PO - 7	Have a responsible attitude, in completing each task, be open to input/criticism, and be able to make decisions.
	PLO-PO Matrix	

P.O	PLO-1	PLO-2	PLO-3	PLO-4	PLO-5	PLO-6	PLO-7	PLO-8	PLO-10	PLO-12	PLO-13	PLO-14	PLO-15
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	Critically examine the concept of indefinite integrals (antiderivatives), real functions with one variable (definition of antiderivatives, integration techniques), definite integrals of real functions with one variable (understanding, properties, Fundamental Theorem of Calculus, and improper integrals), use of certain integrals of real functions with one variable (parametric equations, polar coordinates, plane area, arc length, volume of rotating objects, volume of objects whose cross-section is known, rotating surface area, and center of mass) through student-centered learning using the discussion, question method - answers, presentations and assignments in groups and individually.
References	**Main :**
	1. Thomas Jr., G. B., Hass, J., Heil C., & Weir, M.D., et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson 2. Purcell, E.J., Varberg, D., and Rigdon, S.E. 2010. Calculus 9th Edition. Ontario: Pearson, Prentice Hall
	Supporters:
Supporting lecturer	Prof. Dr. Manuharawati, M.Si. Dr. Abadi, M.Sc. Dr. Budi Rahadjeng, S.Si., M.Si. Rudianto Artiono, S.Pd., M.Si. Budi Priyo Prawoto, S.Pd., M.Si. Sugi Hartono, M.Pd. 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 the concept of indefinite integrals (anti-derivatives)	1. Define the concept of indefinite integral in your own language. 2. Determine the result of an indefinite integral from a real function of one variable 3. Using indefinite integral formulas to determine the results of indefinite integrals for real functions of one variable 4. Solving problems involving critical thinking skills related to indefinite integrals	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Tests	Discussion and questions and answers discussing the 4 x 50 practice questions	Do quizzes and practice questions on SiDia 1 x 50	**Material:** Review of Derivatives and Integrals, Anti-derivatives **Bibliography:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%
2	Understand the concept of Integral of course	1. Determine the estimated area of the area bounded by the curve using the finite sum method (lower sum, midpoint rule, and upper sum). 2. Define certain integral concepts in your own language.	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Questions and Answers and Discussion of material in learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM in SiDia Asynchronous discussions in SiDia 1 x 50	**Material:** Estimation of area and Sigma and finite numbers **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%
3	Understand the concept of integrals of course	1. Determine the estimated area bounded by certain curves using Riemann sums 2. Determining estimated solutions to real problems using the finite number method 3. Define definite integral	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Questions and Answers and Discussion about the material in the learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Riemann Sum **Bibliography:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%

4	Understand the concept of integrals of course	1. Solving problems involving critical thinking skills is related to definite integrals 2. Use the theorems in the Basic Theorem of Calculus to determine the results of definite integrals	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Questions and Answers and Discussion of material in learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Basic Theorem of Calculus, Total Area **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%
5	Understand integration techniques	1. Determine the results of indefinite integrals and definite integrals from real functions of one variable by substitution. 2. Determine the results of indefinite integrals and definite integrals from real functions of one variable with integrals per part. 3. • Determine the results of indefinite integrals and definite integrals from real functions of one variable using the reduction formula	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Questions and Answers and Discussion of material in learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Substitution Method, Integral per part and formula reduction method. **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson* **Material:** Substitution Method, Integrals per part and reduction formulas **References:** **Material:** Substitution Method, Integral per part and formula reduction method. **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%

6	Understand integration techniques	1. Determine the results of indefinite integrals and definite integrals from real functions of one variable using algebraic substitution, integration by parts, and reduction formulas 2. Express opinions and questions 3. Solve problems involving critical thinking skills on the topic of integration techniques	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	Questions and Answers and Discussion of material in learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Substitution Method, Integral per part and formula reduction method. **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	15%
7	Understand integration techniques	1. Determine the results of indefinite integrals and definite integrals from trigonometric functions of one variable 2. Determine the results of indefinite integrals and definite integrals from real functions of one variable using trigonometric substitution 3. Determine the indefinite and definite integrals of rational functions using the partial fraction method	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Questions and Answers and Discussion of material in learning videos and 4 X 50 LKM	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Trigonometric substitution methods and partial fractions **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%
8	UTS	All indicators before UTS	**Criteria:** Attached **Form of Assessment** : Test	UTS 100		**Material:** UTS **Library:**	20%

9	Understand the concept of improper integrals	1. Restate the definition of an improper integral where one or both limits are infinite. 2. Determine the result of an improper integral where one or both limits are infinite. 3. Restate the definition of an improper integral whose integrand is infinite 4. Determine the result of an improper integral whose integrand is infinite 5. Solving problems that involve critical thinking skills related to improper integrals	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Practice/Performance, Tests	Questions and Answers and Discussion about the material in the learning videos and LKM at Vinesa 4 X 50	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Improper integrals **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%
10	Using integrals to determine the area under the curve and the volume of rotating objects as well as the volume of objects of known cross-section	1. Determines the area above the coordinate axes. 2. Determines the area under the coordinate axes. 3. Determine the area between two curves. 4. Solving problems that involve critical thinking skills is related to the area under the curve 5. Determining the volume of a rotating object using the Cross-Section method	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Answer and discuss the material in the learning videos and LKM on Vinesa 4 X 50	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Area and volume of rotating objects using the cross-sectional section method. **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	5%

11	Using integrals to determine the area under the curve and the volume of rotating objects as well as the volume of objects of known cross-section	1. Determining the volume of a rotating object using the Cross-Section method 2. Determining the volume of a rotating object using the disk method	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Answer and discuss the material in the learning videos and LKM on Vinesa 4 X 50	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Volume of rotating objects using cross-sectional section method and disk method. **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	10%
12	Using integrals to determine the area under the curve and the volume of rotating objects as well as the volume of objects of known cross-section	1. Determining the volume of a rotating object using the ring method (Washer method) 2. Determining the volume of a rotating object using the shell method (shell method)	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Answer and discuss the material in the learning videos and LKM on Vinesa 4 X 50	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Volume of rotating objects using the ring method and shell method **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	10%
13	Use integrals to determine arc length and surface area of rotating objects	1. Determining the arc length of a curve of a parametric function 2. Determines the arc length of the curve 3. Determines the surface area of a rotating object that occurs when an arc is rotated about one of the coordinate axes	**Criteria:** Attached **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Practices / Performance	Answer and discuss the material in the learning videos and LKM on Vinesa 4 X 50	Independent study of learning videos provided at Vinesa working on LKM at Vinesa Asynchronous discussion at Vinesa 1 x 50	**Material:** Arc length and outer surface of rotating objects **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	20%
14	Using integrals to solve work and fluid force problems	1. Solving work (business) problems using integrals 2. Solving fluid force problems using integrals	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Questions and Answers and Discussion about the material in the learning videos and LKM at Vinesa 4 X 50	Independent work through learning videos in the LMS Working on LKM in the LMS Asynchronous discussions in the LMS before lectures 1 x 50	**Material:** Fluid work and forces **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	10%

15	Using integrals to determine momentum, center of mass	1. Determine the center of mass and momentum of the area bounded by the curve 2. Determine the center of mass of the arc between 2 points on the arc. 3. Determine the center of mass of a rotating object	**Criteria:** Attached **Form of Assessment** : Participatory Activities, Practice/Performance	Questions and Answers and Discussion about the material in the learning videos and LKM in LMS 4 X 50	Independent work through learning videos in the LMS Working on LKM in the LMS Asynchronous discussions in the LMS before lectures 1 x 50	**Material:** Momentum and center of mass **References:** *Thomas Jr., GB, Hass, J., Heil C., & Weir, MD, et.al. 2018. Thomas, Calculus 14th Edition (Revised). Boston: Pearson*	10%
16	UAS	All indicators before UAS	**Criteria:** Attached **Form of Assessment** : Test	UAS 100		**Material:** UAS **Literature:**	20%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	50.01%
2.	Project Results Assessment / Product Assessment	23.34%
3.	Practice / Performance	30.84%
4.	Test	50.84%
		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.