	Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Education Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Engineering Mathematics	8320302207		T=2	P=0	ECTS=3.18	1	April 28, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Heru Arizal, S.Pd., M.M., M.Pd	Heru Arizal, S.Pd., M.M., M.Pd, Tri HartutukNingsih, S.T., M.T	Ir. Wahyu Dwi Kurniawan, S.Pd., M.Pd.

Learning model	**Case Studies**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	PLO-5	Have social competence and personality competence in mechanical engineering education
	PLO-10	Have an understanding of mathematics and basic mechanical engineering
	Program Objectives (PO)	
	PO - 1	Able to understand and explain number system material
	PO - 2	able to understand and calculate vectors
	PO - 3	Able to define, draw and calculate functions
	PO - 4	Able to solve function limits
	PO - 5	Understand the definition and properties of derivatives and be able to find derivatives of various functions
	PO - 6	Able to understand the application of the derivative of a function
	PLO-PO Matrix	

P.O	PLO-5	PLO-10
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	Study of the basics of mathematics through understanding the concepts of theorems and their application to various problems including real number systems, complexes, vectors, functions, function limits and continuity, graphs of functions, polar coordinates, derivatives of functions along with their application to straight line equations, minimum maximum values and rate changes related fields so that students can apply them in the field of mechanical engineering	
References	**Main :**	

1. [1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981
2. [2]. Kreyzig Erwin, Advance Engineering Mathematic, Edisi ke-7, John Wiley, 1993
3. [3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United Stated of America
4. [4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445

Supporters:	

Supporting lecturer	Dany Iman Santoso, S.T., M.T. Heru Arizal, S.Pd., M.M., 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 explain and understand the real number system, inequalities and absolute values as well as the Cartesian coordinate system.	1. Explain the types of numbers starting from the simplest numbers to the most complex numbers 2. Explains radical power numbers and their mathematical operations. 3. Explain and be able to solve equations and inequalities	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. Incomplete marks, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Brainstorming discussions and problem-based learning 2 X 50	Brainstorming discussions and problem-based learning 2 X 50	**Material:** Number Systems (Real numbers, absolute values, inequalities, complex numbers) **References:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981*	5%
2	Understand the definition of vectors and relations and vector algebra operations and be able to calculate the angle formed by 2 vectors calculate the area of a parallelogram and be able to calculate the volume of a parallelepipedum	1. Explains the definition of vectors and relations and vector algebra operations 2. Calculating the angle formed by 2 vectors calculates the area of a parallelogram and calculates the volume of a parallelepipedum	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** definitions of vectors and relations and vector algebra operations. **Reference:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981* **Material:** definitions of vectors and relations and vector algebra operations. **Reference:** *[2]. Kreyzig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993*	5%

3	Understand the definition of vectors and relations and vector algebra operations and be able to calculate the angle formed by 2 vectors calculate the area of a parallelogram and be able to calculate the volume of a parallelepipedum	1. Explains the definition of vectors and relations and vector algebra operations 2. Calculating the angle formed by 2 vectors calculates the area of a parallelogram and calculates the volume of a parallelepipedum	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** vector algebra operations, angles formed by 2 vectors, area of a parallelogram and parallel volume of the epipedum . **Reference:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America*	5%
4	Understand the definition of vectors and relations and vector algebra operations and be able to calculate the angle formed by 2 vectors calculate the area of a parallelogram and be able to calculate the volume of a parallelepipedum	1. Explains the definition of vectors and relations and vector algebra operations 2. Calculating the angle formed by 2 vectors calculates the area of a parallelogram and calculates the volume of a parallelepipedum	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** vector algebra operations, angles formed by 2 vectors, area of a parallelogram and parallel volume of the epipedum . **Reference:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America*	5%
5	Able to define functions, understand various functions, be able to draw function graphs, determine the origin area (domain) and result area (function), understand graph shifts, calculate function operations and function composition and be able to draw function graphs in polar coordinates	1. Explain the definition of function 2. Explain the various functions 3. Draw function graphs, determine domain areas and function areas 4. Draw function graphs with translation/shift laws 5. Explains the occurrence of new functions based on the operation of functions and function composition 6. Explain the depiction of function graphs in polar coordinates	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** function definition, various functions, function graphs, domain areas and function areas, function graphs with translation/shift laws, function graphs in polar coordinates **Reference:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981*	5%

6	Able to define functions, understand various functions, be able to draw function graphs, determine the origin area (domain) and result area (function), understand graph shifts, calculate function operations and function composition and be able to draw function graphs in polar coordinates	1. Explain the definition of function 2. Explain the various functions 3. Draw function graphs, determine domain areas and function areas 4. Draw function graphs with translation/shift laws 5. Explains the occurrence of new functions based on the operation of functions and function composition 6. Explain the depiction of function graphs in polar coordinates	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** function definition, various functions, function graphs, domain areas and function areas, function graphs with translation/shift laws, function graphs in polar coordinates **Reference:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981*	5%
7	Able to define functions, understand various functions, be able to draw function graphs, determine the origin area (domain) and result area (function), understand graph shifts, calculate function operations and function composition and be able to draw function graphs in polar coordinates	1. Explain the definition of function 2. Explain the various functions 3. Draw function graphs, determine domain areas and function areas 4. Draw function graphs with translation/shift laws 5. Explains the occurrence of new functions based on the operation of functions and function composition 6. Explain the depiction of function graphs in polar coordinates	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** function definition, various functions, function graphs, domain areas and function areas, function graphs with translation/shift laws, function graphs in polar coordinates **Reference:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981*	5%
8	Midterm exam	Midterm exam	**Criteria:** according to the assessment rubric **Form of Assessment** : Participatory Activities	Midterm Exam 2 X 50	Midterm Exam 2 X 50		15%

9	Able to solve function limits	1. Explain the definition of limit 2. Explain limit theorems 3. Explain the limits of trigonometric functions 4. Explain the limits of rational numbers 5. Explain the limit of indefinite numbers 6. Explain the limits of exponential numbers	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** limits and functions **References:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981* **Material:** limits and functions **References:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%
10	Able to solve function limits	1. Explain the definition of limit 2. Explain limit theorems 3. Explain the limits of trigonometric functions 4. Explain the limits of rational numbers 5. Explain the limit of indefinite numbers 6. Explain the limits of exponential numbers	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** limits and functions **References:** *[1]. Spiegel, Murray R, Advanced Calculus, Schaum's Series, Mc. Graw Hill, Singapore, 1981* **Material:** limits and functions **References:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%
11	Able to understand the continuity of function at one point	Proving the condition that the function is continuous at one point	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** continuous function at one point **Reference:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America* **Material:** continuous function at one point **Reference:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%

12	Understand the definition and properties of derivatives and be able to find derivatives of various functions	1. Explain the definition of a derivative and the properties of a derivative 2. Explain derivatives with chain rules, higher order derivatives, implicit function derivatives and parameter function derivatives	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** derivatives and derivative properties **Reference:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America* **Material:** derivatives and derivative properties **Reference:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%
13	Understand the definition and properties of derivatives and be able to find derivatives of various functions	1. Explain the definition of a derivative and the properties of a derivative 2. Explain derivatives with chain rules, higher order derivatives, implicit function derivatives and parameter function derivatives	**Criteria:** 1. Full marks are obtained if you do all the questions correctly 2. The score is not full, if there is an answer to a question that is not correct, the score is adjusted according to the score per point of the question **Form of Assessment** : Participatory Activities	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** derivatives and derivative properties **Reference:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America* **Material:** derivatives and derivative properties **Reference:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%

14	Able to understand the application of the derivative of a function	Explain the application of the derivative of a function to the velocity of solid particles, liquid velocity, extreme values (maximum-minimum) and the associated rate of change	**Criteria:** Full marks are obtained if you do all the questions correctly **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** derivative of a function on solid particle velocity, liquid velocity, extreme values **References:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America* **Material:** derivative of a function on solid particle velocity, liquid velocity, extreme values **References:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%
15	Able to understand the application of the derivative of a function	Explain the application of the derivative of a function to the velocity of solid particles, liquid velocity, extreme values (maximum-minimum) and the associated rate of change	**Criteria:** Full marks are obtained if you do all the questions correctly **Form of Assessment** : Participatory Activities, Tests	Problem-based learning and discussion 2 X 50	Problem-based learning and discussion 2 X 50	**Material:** derivative of a function on solid particle velocity, liquid velocity, extreme values **References:** *[3]. Paul A. Calter, MSME & Michael A. Calter, PH.D, Technical Mathematics with Calculus, 2011, John Willey & Sons Inc. Wesleyan University, United States of America* **Material:** derivative of a function on solid particle velocity, liquid velocity, extreme values **References:** *[4]. Huw Fox & W. Bolton, Mathematics for Engineers and Technologists, 2002, Elsevier Science & Technology Books, ISBN: 0750655445*	5%

16	FINAL SEMESTER EXAMINATION (UAS)	FINAL SEMESTER EXAMINATION (UAS)	**Criteria:** FINAL SEMESTER EXAMINATION (UAS) **Form of Assessment** : Participatory Activities	FINAL SEMESTER EXAMINATION (UAS) 2 X 50	FINAL SEMESTER EXAMINATION (UAS) 2 X 50		15%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	70%
2.	Test	30%
		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.