	Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Undergraduate Chemistry Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Chemical Mathematics	4720102208	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	1	June 20, 2022

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Dr. Pirim Setiarso, M.Si	Prof. Dr. Nuniek Herdyastuti, M.Si.	Dr. Amaria, M.Si.

Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

Program Objectives (PO)

PO - 1	Students have the ability to utilize and be able to apply and prove mathematical equations in chemistry from mathematical concepts to underlie Chemistry courses which include Functions and Differential Calculus, Integral Calculus, Differential Equations, Multivariable Calculus, Operators, Matrices and Determinants, Group Theory, and specifically functions, Transformations and its Applications in Chemistry. To achieve learning outcomes in mathematics and chemistry subjects, this is done by means of lectures, discussions, presentations and assignments, technology and art according to their expertise and can be adapted to various situations faced in solving a problem.

PLO-PO Matrix

P.O
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	Study of mathematics to underlie Chemistry courses which include Functions and Differential Calculus, Integral Calculus, Multivariable Calculus, Operators, Matrices and Determinants, Group Theory, Series and special functions, Transformations and their Application in Chemistry through simple studies and engineering.

References

Main :

1. David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey
2. Robert G Mortimer, 2005, Mathematics for Physical Chemistry, 3th ed, Elsevier Inc, USA.
3. Irwin Krizig, 1989, Advanced Mathematic for Physicist and Engineering, 4th ed, John Wiley & Sons Inc, New York.

Supporters:

Supporting lecturer	Prof. Dr. Pirim Setiarso, M.Si. Dr. I Gusti Made Sanjaya, M.Si. Samik, S.Si., 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 mathematical orientation of chemistry	Explain the achievement targets for chemistry mathematics	**Criteria:** participation assessment **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Material:** Introduction to Mathematical Chemistry **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%
2	Understand functions and limits and their applications in chemistry	Analyze the types of functions and ideas about limits in chemistry	**Criteria:** assignment assessment and participation **Form of Assessment** : Participatory Activities	Case studies, presentations, and practice solving 3 X 50 questions		**Material:** Functions and Limits **Bibliography:** *Robert G Mortimer, 2005, Mathematics for Physical Chemistry, 3th ed, Elsevier Inc, USA.*	0%
3	Understand the concept of derivatives and their application in chemistry	Evaluating the derivative of a function and the maximum-minimum values of turning points and inflection points in chemistry	**Criteria:** assignment assessment and participation	Case study, presentation and practice questions 2 X 50		**Material:** Derivative concept **Bibliography:** *Irwin Krizig, 1989, Advanced Mathematics for Physicists and Engineering, 4th ed, John Wiley & Sons Inc, New York.*	5%
4	Understand calculus and differential equations and their applications in chemistry	Analyze calculus and differential equations related to chemistry	**Criteria:** assignment assessment and participation	Case studies, presentations, and practice solving 2 X 50 questions		**Material:** Differential calculus **Reference:** *Robert G Mortimer, 2005, Mathematics for Physical Chemistry, 3th ed, Elsevier Inc, USA.*	5%
5	Understand integral concepts and their application in chemistry	Proving anti-derivatives and integration processes in chemistry	**Criteria:** task assessment and participation **Form of Assessment** : Participatory Activities	Case study, presentation and practice solving 2 X 50 questions		**Material:** Integral concept **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%
6	Understand various integration methods and their applications in chemistry	Evaluate the results of normal-unnatural integration with various methods applied in chemistry	**Criteria:** assignment assessment and participation	Case studies, presentations and practice solving 2 X 50 questions		**Material:** Integration Method **Bibliography:** *Irwin Krizig, 1989, Advanced Mathematics for Physicists and Engineering, 4th ed, John Wiley & Sons Inc, New York.*	5%

7	Understand the derivative of multivariable functions and the use of exact differential equations	Analyzing partial derivatives and the application of exact differential equations in chemistry	**Criteria:** assignment assessment and participation **Form of Assessment** : Participatory Activities	Case study, presentation and practice questions 2 X 50		**Material:** Improper integrals **Bibliography:** *Irwin Krizig, 1989, Advanced Mathematics for Physicists and Engineering, 4th ed, John Wiley & Sons Inc, New York.*	5%
8			**Criteria:** UTS assessment **Form of Assessment** : Test	Written test 2 X 50			10%
9	Understand line integrals and fold integrals and their applications in chemistry	Evaluate the integration results of line integrals and fold integrals and their application in chemistry	**Criteria:** assignment assessment and participation	Case study, presentation and practice questions 2 X 50		**Material:** Multi variable and exact **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%
10	Understand the function and work of operators in chemistry	Analyzing operator work in chemistry	**Criteria:** assignment assessment and participation	Case study, discussion presentation, and 2 X 50 practice questions		**Material:** Bibliography Operator **:** *Robert G Mortimer, 2005, Mathematics for Physical Chemistry, 3th ed, Elsevier Inc, USA.*	5%
11	Understand the types, properties and operations of matrices and their applications in chemistry	Analyze the types, properties and results of matrix operations found in chemistry	**Criteria:** assignment assessment and participation	Case study, presentation and practice questions 2 X 50		**Material:** Matrix **References:** *Irwin Krizig, 1989, Advanced Mathematics for Physicists and Engineering, 4th ed, John Wiley & Sons Inc, New York.*	5%
12	Understand determinants and their application in chemistry	Analyzing matrix determinants and their application in chemistry	**Criteria:** assignment assessment and participation	Case study, presentation, discussion and practice questions 2 X 50		**Material:** Determinants **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%

13	Understand vectors and tensors and their applications in chemistry	Analyze the properties and operations of vectors and tensors found in chemistry	**Criteria:** assignment assessment and participation	Case studies, presentations, discussions and practice questions 2 X 50		**Material:** Vectors and tensors **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%
14	Understand sequences, series and special functions and their applications in chemistry	Analyze sequences, series and special functions and their applications in chemistry	**Criteria:** assignment assessment and participation	Case study, presentation, discussion and practice questions 2 X 50		**Material:** Rows and series **Bibliography:** *Irwin Krizig, 1989, Advanced Mathematics for Physicists and Engineers, 4th ed, John Wiley & Sons Inc, New York.*	5%
15	Understand transformations and their applications in chemistry	Analyze transformations and their applications in chemistry	**Criteria:** assignment assessment and participation	Case studies, presentations, discussions and practice questions. 2 X 50		**Material:** Special function, Fourier and Laplace Transformation **Bibliography:** *David Z. Goodson, 2011, Mathematical Methods for Physical and Analytical Chemistry, John Wiley & Sons, New Jersey*	5%
16			**Criteria:** UAS assessment	Written exam 2 X 50			20%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	15%
2.	Test	10%
		25%

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.