	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
QUANTUM CHEMISTRY	4720102215	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	2	June 20, 2022

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Dr. I Gusti Made Sanjaya, M.Si.	Prof. Dr. Suyono, M.Pd.	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	Able to adapt to various developments in quantum chemistry, continue to develop and learn throughout life to continue education, both formal and non-formal
PO - 2	Able to apply logical, critical, systematic and innovative thinking in the context of developing or applying science and technology by paying attention to and applying humanities values in accordance with quantum chemistry in solving problems.
PO - 3	Able to design an activity to solve a problem by applying quantum chemistry capabilities
PO - 4	Mastering the basic principles and knowledge of how to operate instruments for analysis and characterization of chemical compounds based on quantum chemistry, as well as utilizing ICT for more specific chemical molecular modeling

PLO-PO Matrix

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

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																

Short Course Description: Study of the basic principles of quantum chemistry and their application to atomic structure, chemical bonds, molecular structure, molecular symmetry, spectroscopy and molecular interactions through study, practical work and simple engineering

References

Main :

1. Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek
2. Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press.
3. Levine, Ira N. 2014, Quantum chemistry, 7th edition, New York: Pearson Education, Inc.

Supporters:

	1. LibreTexts Chemistry (https://chem.libretexts.org/)
Supporting lecturer	Dr. I Gusti Made Sanjaya, M.Si. Samik, S.Si., M.Si. Arikasuci Fitonna Ridassepri, 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	Mastering the quantum chemistry lecture achievement targets	Mention the achievements of the quantum chemistry lecture	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Discuss RPS regarding lecture achievement targets, teaching materials for each meeting, and lecture evaluation. 2 X 50		**Material:** Introduction and lecture contract for Quantum Chemistry **References:** *Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press.*	3%
2	Understand the basic principles of quantum chemistry	Distinguish between time-dependent and time-independent Schrodinger equations	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Presentation and case solving through 2 X 50 smart material ideas		**Material:** Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek **Bibliography:**	4%
3	Applying quantum chemistry to translational motion	Determine the wave function, density, and energy of particles in boxes of dimensions 1, 2, and 3i	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Material:** Levine, Ira N. 2014, Quantum chemistry, 7th edition, New York: Pearson Education, Inc. **References:**	4%
4	Applying quantum chemistry to vibrational motion	Determine the wave function and particle density as well as the energy levels of vibrational motion	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Material:** Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek **Bibliography:**	3%
5	Applying quantum chemistry to rotational motion	Determine the wave function and particle density as well as the energy levels of rotational motion	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Material:** Application of Quantum Chemistry to rotational motion. **References:** *Levine, Ira N. 2014, Quantum chemistry, 7th edition, New York: Pearson Education, Inc.*	3%
6	Determine the structure and spectrum of the hydrogen atom	Determine the structure, orbital shape, energy and spectrum of the hydrogen atom	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Matter:** structure, shape and energy of hydrogen atomic orbitals **References:** *Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press.*	4%

7	Determine the structure and spectra of complex atoms with many electrons	Analyzing orbital and term symbol approaches	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case study, presentation and discussion 2 X 50		**Material:** term symbol **References:** *Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press.*	4%
8		Answer correctly all indicators according to sub-CPMK related to meetings 1-7	**Criteria:** Answering midterm exam questions **Form of Assessment** : Test	Written exam			20%
9	Clarifying valence bond theory or VBT	Clarifying VBT for diatomic molecules and polyatomic molecules	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek **Bibliography:**	4%
10	Clarifying the MOT for diatomic molecules	Determine the electronic configuration of diatomic molecules	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek **Bibliography:**	4%
11	Clarifying the MOT for polyatomic molecules	Determine the electronic structure of polyatomic molecules	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Springborg. M. and Zhou, M. 2021. Quantum Chemistry. Berlin: The Deutsche Nationalbibliothek **Bibliography:**	4%
12	Explain the basic principles of molecular symmetry	Determine the elements and operations of molecular symmetry	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Levine, Ira N. 2014, Quantum chemistry, 7th edition, New York: Pearson Education, Inc. **References:**	3%
13	Ensure the symmetry group of a molecule	Identify symmetry and symmetry groups of a molecule	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Levine, Ira N. 2014, Quantum chemistry, 7th edition, New York: Pearson Education, Inc. **References:**	3%
14	Clarify the basic principles of molecular spectroscopy	Distinguish between translational, vibrational and rotational spectra	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press. **References:**	4%
15	Understand molecular interactions related to electrical properties and interfaces of matter	Analyze the molecular interactions that produce the electrical and interfacial properties of a material	**Criteria:** Participation Assessment (20%) and assignments (30%) **Form of Assessment** : Participatory Activities	Case studies, presentations and discussions		**Material:** Atkins, P., Paula, J. d., and Keeler, J. 2018. Physical Chemistry, 11th edition. UK: Oxford University Press. **References:**	3%

16		1. Answer correctly all indicators according to sub-CPMK 8-13 2. Answer correctly all indicators according to sub-CPMK related to meeting 9-15	**Criteria:** Answering end-of-semester test questions **Form of Assessment** : Test	Written Exam			30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	50%
2.	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.