SEMESTER LESSON PLAN (RPS)
QUANTUM CHEMISTRY AND SPECTROSCOPY (KIM 343 3(2-2))

By:
Drs. Ahmad Sjahriza,M.Si
Dr. Muhamad Khotib, S.Si, M.Si

DEPARTMENT OF CHEMISTRY
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
BOGOR AGRICULTURAL UNIVERSITY
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SYLLABUS

Course/Code	:	Quantum Chemistry and Spectroscopy / KIM 1346
Semester/credit	:	Odd/Even/3(2-2)
Course Description	:	This quantum chemistry and spectroscopy course is a compulsory course in the Department of Chemistry and is related to the mathematical chemistry course (previous year). This course is given to equip students with insight into the knowledge of quantum chemistry concepts, the application of quantum theory techniques and applications, atomic and molecular structure, molecular symmetry, and molecular spectroscopy, including vibration, rotation, and electronic transition. The scope of the discussion and learning process is to use active learning through small *group discussion,* cooperative learning, animation, simulation, and assignments. The language of instruction used in this lecture is Indonesian.
Prerequisite Courses	:	KIM 1253 Mathematical Chemistry
Learning Outcomes (LO) Courses	:	1. Able to understand, calculate, and explain quantum chemistry concepts and application to atoms and molecules 2. Able to understand, calculate, identify, and compare atomic and molecular structures 3. Able to understand and apply symmetry to atomic and molecular orbitals 4. Able to understand, calculate, identify, and compare vibrational, rotational, and electronic transition spectra
Study Material on *the Royal Society of Chemistry (RSC) Chemistry Curriculum Map 2)*		
Division/Field of Science	:	Physical Chemistry/Quantum Chemistry and Spectroscopy
Lecturer	:	1. Drs. Ahmad Sjahriza, M.Si 2. Dr. Mohamad Khotib, S.Si., M.Si

One Semester Learning Plan (RPSS) for Lectures:

WEEK TO-	EXPECTED FINAL CAPABILITY	STUDY MATERIALS	LEARNING METHODS	TIME	EXPERIENCE STUDENT LEARNING	VALUATION			BOOK
						CRITERION	INDICATORS	WEIGHT	
1	2	3	4	5	6	7	8	9	10
1	Able to explain the Principles of Quantum Theory of the interrelation of chemistry	Failure of classical physics, wave-particle density properties, Schrodinger equation, notion of wave functions, operators	Synchronous-LectureFace-to-FaceOutNetwork/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	1x2x50'	a. Gain insight and explanation of Quantum Theory Principles through visual learning b. Interact with students and: (i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Hard Skills:** Completeness and truth about: a. Failure of classical physics b. Properties of particle wave duality c. Schrödinger equation d. Understanding the wave function e. Operator definition **Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	Students answered correctly (>90%) questions: a. failure of classical physics theory and quantum theory principles. b. calculations related to the failure of classical physical theory and quantum theory principles.		
2,3 and 4	Able to explain the Technical and Application of Quantum Theory	Translational motion, vibrational motion and rotational motion	Synchronous-LectureFace-to-FaceOutNetwork/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	3x2x50'	a. Gain insight and explanation of Technical and Application of Quantum Theory through visual learning b. Interact with students and:		Students answered correctly (>90%) questions: a. Engineering and application of quantum chemistry. b. engineering		

					(i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.		calculations and applications of quantum chemistry		
5 and 6	Able to explain Atomic Structure and Spectra: The Case of the Hydrogenic Atom	Hydrogen atomic structure, atomic orbitals and energy, multi-electron atomic structure, complex atomic spectra	Synchronous-LectureFace-to-FaceOutNetwork/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	2x2x50'	a. Gain insight and explanation of the Structure and Spectra of Atomic-Case Hydrogenic Atoms through visual learning b. Interact with students and: (i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Hard Skills:** Completeness and truth about: a. Atomic structure of hydrogen b. Atomic orbitals and energy c. Multi-bereleketron atomic structure d. Complex atomic spectra **Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	Students answered correctly (>90%) questions: a. structure and spectra of atoms in hydrogenic atoms. b. calculations relating to the structure and spectra of atoms in hydrogenic atoms		
7	Able to explain Molecular structure	Valence bond theory, molecular orbital theory and energy, molecular orbitals in polyatomic systems	Synchronous-LectureFace-to-FaceOutNetwork/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	2x2x50'	a. Gain insight and explanation of Molecular Structure through visual learning b. Interact with students and: (i) lecturer (ii) Other students (iii) Teaching materials	**Hard Skills:** Completeness and truth about: a. Valence bond theory b. Molecular orbital theory c. Molecular orbitals in polyatomic systems	Students answered correctly (>90%) questions: a. molecular structure. b. calculations related to molek structure		

					c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and statements during interactive discussions			
MIDTERM EXAM (UTS)								**40%**	

8 and 9	Able to explain and use Molecular Symmetry	Elements of molecular symmetry, Character table	*ASynchronous-Online* Lectures include: a. Video Molecular symmetry b. Operation of symmetry software c. Class Interactive Discussion d. Review of Discussion Results	2x2x50'	a. Gain insight and explanation of learning Molecular Symmetry visually b. Conduct interactions between students and: (i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Hard Skills:** Completeness and truth about: a. Element Symmetry b. Element symmetry in molecules c. Table of molecular symmetry characters **Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and statements during interactive discussions The task independently establishes the symmetry of 5 types of molecules	Students answered correctly (>90%) questions: a.molecular symmetry b.classification The group	10%	
10 and 11	Able to explain Rotational and Vibrational Spectra of molecules	Basic principles of spectroscopy, Pure rotational spectra, Vibration of diatomic molecules, Vibration of polyatomic molecules.	Synchronous-LectureFace-to-FaceOutNetwork/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	2x2x50'	a. Gain insight and explanation of Chemistry as a Central Science through visual learning b. Conduct interactions between students and: (i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Hard Skills:** Completeness and truth about: a. Pure rotational spectra b. Vibration of diatomic molecules c. Vibration of polyatomic molecules **Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and	Students answered correctly (>90%) questions: a. Rotational and vibrational spectra. b. calculations related to rotation and vibration spectra		

						statements during interactive discussions			
12,13 and 14	Able to explain Electronic and magnetic transition characteristics of molecules	Electronic transition characteristics, electronic excitation rate, laser principle and application, magnetic effect on core and electron, nuclear magnetic resonance, electron paramagnetic resonance	Synchronous-Lecture Face-to-Face Out Network/Offline includes: a. Lectures b. Class Interactive Discussion c. Review of Discussion Results	3x2x50'	a. Gain insight and explanation of Chemistry as a Central Science through visual learning b. Conduct interactions between students and: (i) lecturer (ii) Other students (iii) Teaching materials c. Obtain conformity or comprehension of a problem's understanding, opinion, agreement, and mutual decision.	**Hard Skills:** Completeness and truth about: a. Characteristics of electronic transitions b. Electronic excitation level c. Laser principle and application d. Magnetic Effects on Nuclei and Electrons e. core magnetic resonance f. electron paramagnetic resonance **Soft Skills:** a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and thoroughness in making questions and statements during interactive discussions	Students answered correctly (>90%) questions: a. Electronic transition characteristics. b. calculations relating to electronic and magnetic transition characteristics		
FINAL SEMESTER EXAM (UAS)								**40%**	

Assessment Design:

	Learning outcomes	Assignment	Quiz	Test	
				UTS	UAS
1	Able to understand, calculate, identify and compare atomic and molecular structures	√		√	√
2	Able to understand, calculate, identify and compare atomic and molecular structures	√		√	√
3	Able to understand and apply symmetry to atomic and molecular orbitals	√	√	√	√
4	Able to understand, calculate, identify and compare vibrational, rotational and electronic transition spectra	√	√	√	√

Rating Weight:

Judging Criteria	Value Range	Value Weight (%)	Information
Quiz	70-100	10	
Tasks of establishing Molecular Symmetry	70-100	10	Individual value
Tuition Assessment: UTS UAS	 0-100 0-100	 40 40	 Individual value Individ value
Value of QUANTUM CHEMISTRY AND SPECTROSCOPY (KIM343 (3(2-2))		**100**	

Paper and Presentation Task Assessment Criteria with instruments: group assessment form and presentation

Value Range	Material Presentation Assessment Criteria
90-100	If students can present material with good systematics, timeliness of delivery, good use of language, ability to answer questions well / precisely, good and clear material delivery attitude.
80--<90	If students can present material with good systematics, timeliness of delivery, good language use, ability to answer questions well / appropriately
70--<80	If students can present material with good systematics, timeliness of delivery, good use of language,

Recommended Required and Supporting Reading Books:

1 Atkin, P.W.2010, Physical Chemistry.9th ed, Oxford University Press
2 Atkin, P.W.1996, Physical Chemistry.6th ed, Oxford University Press (CD)
3 Atkin, P.W.1983, Molecular Quantum Physics.2nd ed, Oxford University Press
4 Davidson,G,1991, Group Theory for Chemist, 1st ed, Mac Millan
5 Pillars, F.L,1990, Elementary Quantum Chemistry, 2nd ed, McGrawHill