Course Specifications

Course Title:	Quantum Chemistry
Course Code:	436CHEM -2
Program:	Bachelor of Science in Chemistry
Department:	Chemistry
College:	Science
Institution:	King Khalid University

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A. Course Identification

1. Credit hours: 2	
2. Course type	
a. University ☐ College ☐ Department ☑ Others ☐	
b. Required ☑ Elective ☐	
3. Level/year at which this course is offered: level 8 / year 4	
4. Pre-requisites for this course: 101Chem-4, 101Math-3	
5. Co-requisites for this course (if any): None	

6. Mode of Instruction (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	**Traditional classroom**	2	100%
2	**Blended**	0	0%
3	**E-learning**	0	0%
4	**Correspondence**	0	0%
5	**Other**	------	------

7. Actual Learning Hours (based on academic semester)

No	Activity	Learning Hours
Contact Hours		
1	**Lecture**	30
2	**Laboratory/Studio**	-
3	**Tutorial**	-
4	**Others** (specify)	-
	Total	30
Other Learning Hours*		
1	**Study**	10
2	**Assignments**	10
3	**Library**	-
4	**Projects/Research Essays/Theses**	10
5	**Others** (specify)	-
	Total	30

* The length of time that a learner takes to complete learning activities that lead to achievement of course learning outcomes, such as study time, homework assignments, projects, preparing presentations, library times

B. Course Objectives and Learning Outcomes

1. Course Description

- This course introduces the basic principles of quantum chemistry and its applications to the description of atoms and molecules and their interactions with other molecular systems and electromagnetic radiation.

2. Course Main Objective

1. Recognize the failures of classical physics.
2. Illustrate and operate on the energy quantization and the wave–particle duality.

3. Describe the Schrödinger equation and the significance of the wavefunction.
4. Interpret the wavefunctions by calculating probability, expectation values, and the eigenvalues of Hermitian operators corresponding to physical observables.
5. Operate on the uncertainty principle, the operator, and the commutators.
6. Compare, analyze, and apply the postulates of quantum mechanics on simple chemical systems that model the translational, vibrational, and rotational motions.

3. Course Learning Outcomes

CLOs		Aligned PLOs
1	**Knowledge:**	
1.1	Recognize the failures of classical physics	K1
1.2	Describe the Schrödinger equation and the significance of the wavefunction	K1,K2
1.3	Compare the postulates of quantum mechanics on simple chemical systems that model the translational, vibrational, and rotational motions	K1
2	Skills :	
2.1	Illustrate and operate on the energy quantization and the wave–particle duality	S1
2.2	Interpret the wavefunctions by calculating probability, expectation values, and the eigenvalues of Hermitian operators corresponding to physical observables	S2 S3
2.3	Operate on the uncertainty principle, the operator, and the commutators	S3
3	Competence:	
3.1	Analyze the postulates of quantum mechanics on simple chemical systems that model the translational, vibrational, and rotational motions	C1,C2
3.2	Illustrate the meaning and significance of the solutions obtained by solving the Schrödinger equation in 1 dimensions for typical model systems.	C2

C. Course Content

No	List of Topics	Contact Hours
1	Course Introduction	1
2	Introduction to Quantum Theory	9
3	The origins of quantum mechanics	6
4	Dynamics of microscopic systems	3
5	The principles of quantum theory	3
6	The Quantum Theory of Motion	3
7	Translational	2
9	Vibrational	3
Total		30

D. Teaching and Assessment

1. Alignment of Course Learning Outcomes with Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
1.0	**Knowledge**		
1.1	Recognize the failures of classical	Lectures and dialogue	Quizzes and exams

Code	Course Learning Outcomes	Teaching Strategies	Assessment Methods
	physics	and discussion	
1.2	Describe the Schrödinger equation and the significance of the wavefunction	Lectures and dialogue and discussion	Quizzes and exams
1.3	Compare the postulates of quantum mechanics on simple chemical systems that model the translational, vibrational, and rotational motions	Lectures and dialogue and discussion	Quizzes and exams
2.0	**Skills**		
2.1	Illustrate and operate on the energy quantization and the wave–particle duality	Lectures, dialogue and discussion, tutorials, and software demonstration	Homework and exams
2.2	Interpret the wavefunctions by calculating probability, expectation values, and the eigenvalues of Hermitian operators corresponding to physical observables	Interpersonal Skills & Responsibility	Homework and exams
2.3	Operate on the uncertainty principle, the operator, and the commutators	Lectures, dialogue and discussion, tutorials, and software demonstration	Homework and exams
3.0	**Competence**		
3.1	Analyze the postulates of quantum mechanics on simple chemical systems that model the translational, vibrational, and rotational motions	Lectures, dialogue and discussion, tutorials, and software demonstration	Homework and exams
3.2	Illustrate the meaning and significance of the solutions obtained by solving the Schrödinger equation in 1 dimensions for typical model systems.	Lectures, dialogue and discussion, tutorials, and software demonstration	Homework and exams

2. Assessment Tasks for Students

#	Assessment task*	Week Due	Percentage of Total Assessment Score
1	Homework Assignments	Every two weeks	5%
2	Quizzes	Every two weeks	5%
3	First mid-term exam	7	20%
4	Second mid-term exam	14	20%
5	Final Exam	15	50%
	Total		100%

***Assessment task** (i.e., written test, oral test, oral presentation, group project, essay, etc.)

E. Student Academic Counseling and Support

Arrangements for availability of faculty and teaching staff for individual student consultations and academic advice :

1. Office Hours: 2 hours
2. Demonstration Session: 1 hour

F. Learning Resources and Facilities

1.Learning Resources

Required Textbooks	Atkins' Physical Chemistry. Peter Atkins and Julio de Paula. 2014, 10th ed. Oxford University Press
Essential References Materials	• Quantum Chemistry and Spectroscopy. Thomas Engel. 2012. 3rd ed. Prentice Hall • Molecular Quantum Mechanics. Peter W Atkins and Ronald S Friedman. 2010. 5th ed. Oxford University Press
Electronic Materials	• E-Learning Deanship (http://elc.kku.edu.sa/) • Atkins & de Paula: Physical Chemistry 10e (http://global.oup.com/uk/orc/chemistry/pchem10e/) • Applicable software for molecular modeling such as Spartan
Other Learning Materials	None

2. Facilities Required

Item	Resources
Accommodation (Classrooms, laboratories, demonstration rooms/labs, etc.)	• One classroom with at least 40 seats and equipped with projector and Internet access.
Technology Resources (AV, data show, Smart Board, software, etc.)	• Data show • Software: Spartan • Computer and internet access.
Other Resources (Specify, e.g. if specific laboratory equipment is required, list requirements or attach a list)	None

G. Course Quality Evaluation

Evaluation Areas/Issues	Evaluators	Evaluation Methods
Course delivery (teaching methods and assessment methods)	Students	Questionnaire
	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
	Program leader	Meeting
Course contents (update)	Departmental plan and curriculum committee; external reviewers.	Reports and workshops
Quality of learning resources	external reviewers.	Reports

Evaluation areas (e.g., Effectiveness of teaching and assessment, Extent of achievement of course learning outcomes, Quality of learning resources, etc.)
Evaluators (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)
Assessment Methods (Direct, Indirect)

H. Specification Approval Data

Council / Committee	Department counsel
Reference No.	1/22/142
Date	15-9-1442