Course Specification
(Bachelor)

Course Title:	Quantum Chemistry
Course Code:	447CHEM3
Program:	Bachelor of Science in Chemistry
Department:	Physical Sciences
College:	College of Science
Institution:	Jazan University (JU)
Version:	TP 153 2024
Last Revision Date:	5/5/2024

Table of Contents

A. General information about the course:

1. Course Identification

1. Credit hours: (3 h)

2. Course type

A.	☐University	☐College	☒ Department	☐Track	☐Others
B.	☒ Required		☐Elective		

3. Level/year at which this course is offered: Level 7 / Year 4

4. Course general Description:

Course Title	*Course Number*	*Contact Hours (CH)*		*Credit unit (CU)*	*Year*	*Level*	*Pre-requisite*
		Lec.	*Prac.*				
Quantum chemistry	*447CHEM3*	*3*	*0*	*3*	*4*	*7*	*Math 202*

This course aims to give students the basic principles of quantum theory and its applications on some chemical systems

Course objectives: They are to identify the following.

- *The nature of the classical mechanics as well as its failure to describe microscopic particles*
- *The historical development of the quantum theory and its postulates*
- *The application of quantum theory for H-atom as an example of simple chemical systems*

Syllabus: A-Theoretical contents

classical mechanics – black body radiation and photoelectric effect – Hydrogen electronic spectra – Compton-effect – De Broglie relation and dual nature of microscopic particles- Schrödinger equation- solution of SE for a particle in one (two and three) dimensional box – solution of SE for rigid rotor – solution of SE for harmonic oscillator – solution of SE for H-atom.

Syllabus: A-Practical contents

none

5. Pre-requirements for this course (if any)**:**

Math 202

6. Co-requisites for this course (if any)**:**

None

7. Course Main Objective(s):

This course aims to give students the basic principles quantum theory and its applications on some chemical systems

2. Teaching mode (mark all that apply)

No	Mode of Instruction	Contact Hours	Percentage
1	Traditional classroom	45	100 %
2	E-learning		
3	Hybrid • Traditional classroom • E-learning		
4	Distance learning		

3. Contact Hours (based on the academic semester)

No	Activity	Contact Hours
1.	**Lectures**	45
2.	**Laboratory/Studio**	
3.	**Field**	
4.	**Tutorial**	
5.	**Others (specify)**	
Total		45

B. Course Learning Outcomes (CLOs), Teaching Strategies and Assessment Methods

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
1.0	**Knowledge and understanding**; (Upon completion of the course, student will be able to)			
1.1	***Demonstrate a broad knowledge and understanding the course topics as, classical mechanics – black body radiation and photoelectric effect – Hydrogen electronic spectra – Compton-effect – De Broglie relation and dual nature of microscopic particles- Schrödinger equation,***	K (1.1)	Lecture group work discussion	Objective Q
1.2	***Describe the difference between classical and quantum mechanics, photoelectric effect, the contribution of scientists (Max Planck, Einstein, De Broglie, Heisenberg, Bohr, Balmer,***	K(1.2)	Lecture group work discussion	Short answer Questions

Code	Course Learning Outcomes	Code of CLOs aligned with program	Teaching Strategies	Assessment Methods
	and Schrödinger) to the quantum theory.			
2.0	**Skills**; (Upon completion of the course, student will be able to)			
2.1	***Demonstrate the knowledge and numeracy skills in quantum mechanical solution of the rigid rotor and harmonic oscillator and the validity of the Schrödinger equation to model the particle in a box problem***	S(2.1)	lecture group work discussion	Solving Problems & chart analysis
2.2	***make effective use of communication, and online technology about quantum chemistry topics in order to improve their basic knowledge in writing (report and paper/ poster) with a good verbal and clear scientific language.***	S((2.4)	project-based learning Technology-enabled learning	Research presentation rubric
3.0	**Values, autonomy, and responsibility**; (Upon completion of the course, student will be able to)			
3.1	***Act with integrity and good ethics in chemistry profession and their obligation to society***	V(3.2)	Research activities	Ethic check rubric

C. Course Content

No	List of Topics	Contact Hours
1.	Historical Development of the quantum theory	9
2.	Schrödinger equation	9
3.	Postulates of the quantum theory	8
4.	Evaluation of the quantum theory	8
5.	Applications of the quantum theory	9
6.	Presentation Session	2
Total		**45**

D. Students Assessment Activities

No	Assessment Activities *	Assessment timing (in week no)	Percentage of Total Assessment Score
1.	HW	2-12	5
2.	Mid-term Exam1	6-8	15
3.	Mid-term Exam2	12-14	15
4.	Presentation Session	14	3
4.	Ethic check	14	2
5.	Final EXAM	16-17	60
Total			100

*Assessment Activities (i.e., Written test, oral test, oral presentation, group project, essay, etc.).

E. Learning Resources and Facilities

1. References and Learning Resources

Essential References	Molecular Quantum Mechanics, Atkins PW, Friedman RS 4th ed. Oxford: Oxford University Press; 2005.
Supportive References	Quantum Chemistry: A Unified Approach, David B. Cook, 2nd Edition, imperial College Press; 2012.
Electronic Materials	Some course contents and materials are posted on Black board sites
Other Learning Materials	• Faculty - Department of Chemistry - Simon Fraser University (sfu.ca) • Chemistry BSc (Hons) - Undergraduate Courses - University of Liverpool • Periodic Table of Elements and Chemistry (chemicool.com) • The Orbitron: a gallery of atomic orbitals and molecular orbitals (shef.ac.uk) • Home | Department of Chemistry (queensu.ca) • 11.2: Quantum Numbers for Electrons - Chemistry LibreTexts • Search - Chemistry LibreTexts • ***www.wikipedia.org/*** • المعرفة (marefa.org) Courses | Chemistry & Biochemistry | Academics | WPI

2. Required Facilities and equipment

Items	Resources
facilities (Classrooms, laboratories, exhibition rooms, simulation rooms, etc.)	1 Lecture room(s) for groups of 50 students

Items	Resources
Technology equipment (projector, smart board, software)	Smart board, Data show, Black board, internet
Other equipment (depending on the nature of the specialty)	none

F. Assessment of Course Quality

Assessment Areas/Issues	Assessor	Assessment Methods
Effectiveness of teaching	Student	Likert-type Survey CES) Indirect
Effectiveness of Students assessment	Instructor & Course coordinator	Class room evaluation (direct & indirect
Quality of learning resources	Program coordinator	Indirect
The extent to which CLOs have been achieved	Assessment committee	Indirect
Other		

Assessors (Students, Faculty, Program Leaders, Peer Reviewer, Others (specify)

Assessment Methods (Direct, Indirect)

G. Specification Approval

COUNCIL /COMMITTEE	Physical Sciences Department Council
REFERENCE NO.	Psci2415
DATE	28/03/1446 Corresponding to 1 / 10 /2024

H. Attachments

1- Practical Work

None

2- Blue Print

Course Name	Quantum Chemistry
Course Code	447 CHEM

PLOs	K1	K2	S1	S2	S3	S4	V1	V2
CLOs	1.1	1.2	2.1			2.2		3.1
Marks	12	21	62	---	---	3	---	2

Learning Domain	PLOs	CLOs	Assessment Type	Assessment Tool	No of Questions	Marks of the Assessment	Weight of the Assessment
Knowledge & understanding	K1	1.1 (12M)	HW	Objective Q	2	2	1
			Mid-term	Objective Q	4	2	4
			Final Exam	Objective Q	14	7	7
	K2	1.2 (21M)	HW	Objective Q	2	2	2
			Mid-term	Objective Q	5	5	6
			Final Exam	Objective Q	7	13	13
Skills	S1	2.1 (62M)	HW	Objective Q ,Solving Problems & chart analysis	3	3	2
			Mid-term	Objective Q ,Solving Problems & chart analysis	6	17	20
			Final Exam	Objective Q ,Solving Problems & chart analysis	8	40	40
	S4	2.2 (3M)	Research presentation	Research rubric	-	-	3
				PPT design	--	-	
				Oral discussion			
Value	V2	3.1 (2M)	Research ethic check	ethic check rubric			2
	TOTAL	100					100