Form: Course Syllabus		
	Form Number	EXC-01-02-02A
	Issue Number and Date	2/3/24/2022/2963 05/12/2022
	Number and Date of Revision or Modification	
	Deans Council Approval Decision Number	2/3/24/2023
	The Date of the Deans Council Approval Decision	23/01/2023
	Number of Pages	06

1.	**Course Title**	Quantum Chemistry
2.	**Course Number**	0333741
3.	**Credit Hours (Theory, Practical)**	3 Hours
	Contact Hours (Theory, Practical)	(3,0)
4.	**Prerequisites/ Corequisites**	-
5.	**Program Title**	Master of Science in Chemistry
6.	**Program Code**	0303
7.	**School/ Center**	The University of Jordan
8.	**Department**	Science
9.	**Course Level**	Chemistry
10.	**Year of Study and Semester (s)**	All semesters
11.	**Other Department(s) Involved in Teaching the Course**	-
12.	**Main Learning Language**	English
13.	**Learning Types**	☒ Face to face learning ☐Blended ☐Fully online
14.	**Online Platforms(s)**	☐Moodle ☐Microsoft Teams
15.	**Issuing Date**	October 15, 2024
16.	**Revision Date**	October 15, 2024

17. Course Coordinator:

Name: Wissam Helal	Contact hours: S, T, T: 10:30 – 12:30
Office number: Chemistry extension building	Phone number: 22175
Email: wissam.helal@ju.edu.jo	

18. Other Instructors:

Name: Office number: Phone number: Email: Contact hours:

19. Course Description:

Quantum chemistry, intended for postgraduates majoring in chemistry, explored advanced concepts and ideas of quantum mechanics, quantum chemistry, atomic structure and spectroscopy, molecular structure and spectroscopy, and basic electronic structure theory. The course covers theorems and postulates of quantum mechanics; systems with exact solutions of Schrodinger equation, including the hydrogen atom; approximation methods (variational and perturbation theories); electronic structure of atoms and atomic term symbols, electronic structure of diatomic molecules; and an introduction to Hartree-Fock theory.

20. Program Student Outcomes (SO's): (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program)

SO1. Demonstrate comprehensive knowledge and understanding of chemistry topics, achieving expertise in foundational research principles.

SO2. Develop independent research skills to solve complex problems, focusing on analytical and critical thinking.

SO3. Improve communication of scientific knowledge through structured reports, presentations, and discussions.

SO4. Engage in activities that enhance practical scientific skills and improve professional expertise.

SO5. Maintain ethical standards in research.

21. Course Intended Learning Outcomes (CLO's): (Upon completion of the course, the student will be able to achieve the following intended learning outcomes)

1. Acquire fundamental conceptual way of thinking related to atomic and molecular structure.

2. Apply problem solving skills to solve chemical problems using quantum chemistry methods.

3. Gain working experience with different computational chemistry tools.

Course CLOs	The learning levels to be achieved					
	Remembering	**Understanding**	**Applying**	**Analysing**	**evaluating**	**Creating**
1		**X**		**X**		
2			**X**	**X**		
3			**X**	**X**		

22. The matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program:

Program SO's / Course CLO's	SO (1)	SO (2)	SO (3)	SO (4)	SO (5)
CLO (1)	X	X			
CLO (2)	X	X			
CLO (3)	X	X			

23. Topic Outline and Schedule:

Week	Lecture	Topic	CLO/s Linked to the Topic	Learning Types Face to Face (FF) Blended (BL) Fully Online (FO)	Platform Used	Synchronous (S) Asynchronous (A)	Evaluation Methods	Learning Resources
1	1.1	**Chapter 1: The Schrodinger Equation**	1	FF			Written Exams	Quant. Chem., Levine, Ch 1
	1.2		1	FF				
2	2.1	**Chapter 2: The Particle in a Box**	1	FF			Written Exams	Quant. Chem., Levine, Ch 2
	2.2		1	FF				
3	3.1	**Chapter 3: Operators**	1	FF			Written Exams	Quant. Chem., Levine, Ch 3
	3.2		1,2	FF				
4	4.1	**Chapter 4: The Harmonic Oscillator**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 4
	4.2		1,2	FF				
5	5.1	**Chapter 5: Angular Momentum**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 5
	5.2		1,2	FF				
6	6.1	**Chapter 6: The Hydrogen Atom**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 6
	6.2		1,2	FF				
7	7.1	**Chapter 7: Theorems of Quantum Mechanics**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 7
	7.2		1,2	FF				
8	8.1	**Chapter 8: The Variation Method**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 8
	8.2		1,2	FF				

9	9.1	**Chapter 9: Perturbation Theory**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 9
	9.2		1,2	FF				
10	10.1	**Chapter 10: Electron Spin**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 10
	10.2		1,2	FF				
11	11.1	**Chapter 11: Many-Electron Atoms**	1,2	FF			Written Exams	Quant. Chem., Levine, Ch 11
	11.2		1,2	FF				
12	12.1	**Chapter 12: Computational Chemistry**	2,3	FF			Projects	Practic. Comput Chem., Helal.
	12.2		2,3	FF			Projects	Practic. Comput Chem., Helal.
13	13.1		2,3	FF			Projects	Practic. Comput Chem., Helal.
	13.2		2,3	FF			Projects	Practic. Comput Chem., Helal.
14	14.1		2,3	FF			Projects	Practic. Comput Chem., Helal.
	14.2		2,3	FF			Projects	Practic. Comput Chem., Helal.
15	15.1		2,3	FF			Projects	Practic. Comput Chem., Helal.
	15.2		2,3	FF			Projects	Practic. Comput Chem., Helal.

16							Final Exam	

24. Evaluation Methods:

Opportunities to demonstrate the achievement of the CLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	CLO/s Linked to the Evaluation activity	Period (Week)	Platform
Midterm Exam	30	Chapters 1-7	CLO-1	9th Week	Written exam
Project 1	10	Computational Chemistry techniques	CLO-3	11rd Week	
Project 2	10	Computational Chemistry techniques	CLO-3	13th Week	
Project 3	10	Computational Chemistry techniques	CLO-3	15th Week	
Final Exam	40	Chapters 1-11 + Computational Chemistry techniques	CLO-1 + CLO-2 + CLO-3	16th Week	Written exam

25. Course Requirements:

Students should have a personal computer or at least access to a PC. Appropriate software and program codes will be provided

26. Course Policies:

1. Attendance policies:
   Students should attend at least 85% of the total number of the lectures.

2. Absences from exams and submitting assignments on time:
   Students who miss an exam must submit and acceptable excuse and then a makeup exam will be appointed.

3. Health and safety procedures:
   Followed according to university regulations.

4. Honesty policy regarding cheating, plagiarism, misbehavior:
   Followed according to university regulations.

5. Grading policy:
   1. Mid exam 30%
   2. Projects 30%
   3. Final exam: 40%
   The letter grade scale is adopted.

F- Available university services that support achievement in the course:
Central library, personal computer labs at different locations in the university, e-learning site, faculty member's website.

27. References:

A- Required book(s), assigned reading and audio-visuals:

1. I. N. Levine, ***Quantum Chemistry***, 7th ed., Pearson Education, Inc., 2014.

2. Wissam Helal, Practical Computational Chemistry, A Training Manual of Selected Short Experiments Using Gaussian & ORCA, The University of Jordan, 2023.

B- Recommended books, materials, and media:

1. P. W. Atkins, R. S. Friedman, ***Molecular Quantum Mechanics***, 5th ed., OUP, 2011.
2. J. Lowe, K. Peterson, ***Quantum Chemistry***, 3rd ed., Elsevier AP, 2006.
3. D. A. McQuarrie, ***Quantum Chemistry***, 2nd ed., University Science Books, 2007.
4. F. Pilar, ***Elementary Quantum Chemistry***, 2nd ed., McGraw-Hill, 1990.

5. J. Simons, A. Nichols, ***Quantum Mechanics in Chemistry***, OUP, 1997.

28. Additional information:

Name of the Instructor or the Course Coordinator: Dr. Wissam Helal	Signature: Wissam Helal	Date: October 15, 2024
The Head of Graduate Studies Committee/ Department Chemistry **Dr. Murad AlDamen, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
The Head of Department of Chemistry **Dr. Murad AlDamen, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
Vice Dean for Graduate Studies and Scientific Research / School of Science **Dr. Kamal Sweidan, Prof.**	**Signature:** **……...……**	**Date:** **……..……**
The Dean of School of Science **Dr. Mahmoud I. Jaghoub, Prof.**	**Signature:** **……...……**	**Date:** **……..……**