مركز الاعتماد وضمان الجودة
ACCREDITATION & QUALITY ASSURANCE CENTER

Course Syllabus

1	**Course title**	Physical Chemistry III	
2	**Course number**	0303342	
3	**Credit hours**	3	
	Contact hours (theory, practical)	3 hours theory/week	
4	**Prerequisites/corequisites**	0303341	
5	**Program title**	B.Sc.	
6	**Program code**	0303	
7	**Awarding institution**	The University of Jordan	
8	**School**	Science	
9	**Department**	Chemistry	
10	**Course Level**	4th Level	
11	**Year of study and semester (s)**	Summer 2024	
12	**Other department (s) involved in teaching the course**	N/A	
13	**Main teaching language**		
14	**Delivery method**	✓Face to face learning Blended ☐Fully online	
15	**Online platforms(s)**	☐Moodle ☐Microsoft ✓Teams ☐Skype ☐Zoom ☐Others……	
16	**Issuing/Revision Date**	Each semester	

17 Course Coordinator:

Name: Professor Firas F. Awwadi	Contact hours: Sun, Tue, Thu 8:30-9:30
Office number:	Phone number:
Email:f.awwadi@ju.edu.jo	

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18 Other instructors:

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

19 Course Description:

As stated in the approved study plan. Physical chemistry III is the third semester of the three-semester physical chemistry sequence offered by the department of chemistry intended for undergraduates majoring in chemistry. In this semester we explore basic concepts and ideas of quantum mechanics, quantum chemistry, and atomic and molecular structure and spectroscopy. The course covers basic principles of quantum chemistry; particle in a box system, simple harmonic motion; the rigid rotor; atomic and molecular structure; basic principles of vibrational, rotational, and electronic spectra of molecules; chemical bonding; molecular orbital theory and LCAO (linear combination of atomic orbitals) theory, and basics of statistical thermodynamics.

20 Course aims and learning outcomes (CLOs):

A- Course Learning Outcomes: 0303342 physical chemistry 3

Upon successful completion of this course, students will be able to:

1. Develop a solid understanding of the fundamental principles of quantum chemistry.

2. Explain the fundamental concepts of and language of quantum chemistry.

3. Acquire a quantitative understanding of quantum chemistry, by both expressing concepts into mathematical relations, and by understanding physical concepts behind mathematical formulas. Furthermore, students will be able to derive important mathematical relations.

4. Promote problem-solving skills by applying different mathematical methods and techniques to the solution of relevant, but relatively complex, problems.

5. Appreciate the continuous interplay between experiment and theory in quantum chemistry.

B- Students Learning Outcomes (SLOs):

SLO	
1	How classical mechanics failed to explain phenomena at molecular levels
2	Understanding basics of Quantum Mechanics
3	Writing classical Hamiltonians and how to convert it to Quantum mechanical Hamiltonians
4	How to solve Shrodinger Equation.
5	How rationalize physical observables using wavefunctions and Eigen values.
6	Explaining different kinds of spectra using Eigen values
7	Understanding atomic and molecular structures

0333336 Identification of Organic Compounds

		Student Outcomes (SO)						
		SO-1	SO-2	SO-3	SO-4	SO-5	SO-6	SO-7
Course Learning Outcomes (CLO)	CLO-1	✓	✓					
	CLO-2		✓	✓				
	CLO-3		✓	✓	✓	✓		
	CLO-4				✓	✓		
	CLO-5						✓	✓

21. Topic Outline and Schedule:

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Week	Lecture	Topic	Student Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	1.1	Classical Mechanics Failed to Describe Experiments on Atomic and Molecular Phenomena	1					textbook and references
	1.2	Black body radiation and photo electric effect and Quantization of Energy	1 and 2					text book and references
	1.3	The Heisenberg Uncertainty Principle	1 and 2					text book and references
2	2.1	Operators	1 and 2					text book and references
	2.2	Operators	1 and 2					text book and references
	2.3	Well-behaved functions and Eigen Functions	1 and 2					text book and references
Week	**Lecture**	**Topic**	**Student Learning Outcome**	**Learning Methods (Face to Face/Blended/ Fully Online)**	**Platform**	**Synchronous / Asynchronous Lecturing**	**Evaluation Methods**	**Resources**
3	3.1	The SchrÖdinger Equation.	1 and 2					text book and references

	3.2	Particle in a One-Dimensional box.	3-6					text book and references
	3.3	Particle in a One-Dimensional box.	3-6					text book and references
4	4.1	Particle in a One-Dimensional box.	3-6					text book and references
	4.2	Particle in a One-Dimensional box.	3-6					text book and references
	4.3	Particle in a One-Dimensional box	3-6					text book and references
5	5.1	Particle in a One-Dimensional box	3-6					text book and references
	5.2	Particle in a Three-dimensional box	3-6					text book and references
	5.3	Particle in a Three-dimensional box	3-6					text book and references
6	6.1	Relation between Commutability and Precision of a Measurement.	3-6					text book and references
	6.2	Classical Harmonic Oscillator. Quantum Mechanical Harmonic Oscillator.	3-6					text book and references

	6.3	Classical Harmonic Oscillator. Quantum Mechanical Harmonic Oscillator.	3-6					text book and references
7	7.1	Classical Harmonic Oscillator. Quantum Mechanical Harmonic Oscillator.	3-6					text book and references
	7.2	The Rigid Rotor. Angular Momentum.	3-6					text book and references
	7.3	The Rigid Rotor. Angular Momentum.	3-6					text book and references
8	8.1	The Rigid Rotor. Angular Momentum.	3-6					text book and references
	8.2	Tunneling.	3-6					text book and references text book and references
	8.3	Postulates of Quantum Mechanics	3-6					text book and references
9	9.1	Time-dependent Shrodinger equation	3-6					text book and references
	9.2	The SchrÖdinger Equation for Hydrogen Atom.	3-6					text book and references

		The Spectrum of Hydrogen Atom.						
	9.3	The SchrÖdinger Equation for Hydrogen Atom. The Spectrum of Hydrogen Atom.	3-6					text book and references
10	10.1	Eigenfunctions and Probability Densities for Hydrogenlike atoms.	3-6					text book and references
	10.2	Eigenfunctions and Probability Densities for Hydrogen-like atoms.	3-6					text book and references
	10.3	Orbital Angular Momentum of the Hydrogen-like Atom.	3-6					text book and references
Week	**Lecture**	**Topic**	**Student Learning Outcome**	**Learning Methods (Face to Face/Blended/ Fully Online)**	**Platform**	**Synchronous / Asynchronous Lecturing**	**Evaluation Methods**	**Resources**
11	11.1	Electron Spin.	3-6					text book and references
	11.2	Vibrational Method and Helium Atom.	3-6					text book and references

	11.3	Vibrational Method and Helium Atom.	3-6					text book and references
12	12.1	vacation						
	12.2	Ionization Energy and Electron Affinity. And Angular Momentum of many-electron atoms	3-6					text book and references
	12.3	The Born-Oppenheimer Approximation	3-6					text book and references
13	13.1	vacation	3-6					
	13.2	The Hydrogen Molecule Ion. Calculation of the Hydrogen Molecule Ion	3-6					text book and references
	13.3	Molecular Orbital Description of the Hydrogen Molecule	3-6					text book and references
14	14.1	Electron Configuration of Homonuclear Diatopmic Molecules.	3-6					text book and references
	14.2	Hückel Molecular Orbital Theory.	3-6					text book and references

	14.3	Hückel Molecular Orbital Theory. .	4-6					text book and references
15	15.1	Basic Ideas of Spectroscopy.	3-6					text book and references
	15.2	Vibrational-Rotational Spectra of Diatomic Molecules	3-6					text book and references
	15.3	revision						

22 Evaluation Methods:

22 Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
Quize	20	1.1-5.1		3	
Midtermexam	30	5.2-10.3		8	
Final exam	50	All		8	

23 Course Requirements

(e.g., students should have a pen, computer, calculator and notebook

24 Course Policies:

A- Attendance policies:

Students should attend at least 85% of the total number of the lectures.

B- 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.

C- Health and safety procedures: Followed according to university regulations.

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

E- Grading policy:

Mid exam 30%
2. Semester work 20%
3. Final exam: 50%
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.

25 References:

Text Book;

R. Silbey, R. Alberty and M. Bawendi, ***Physical Chemistry***, 4th edition. John and Wiley and Sons, Inc., 2005.

References;

1- L. Pauling and E. B. Wilson, ***Introduction to QUANTUM MECHANICS with application to chemistry.*** New York, Dover Publications INC, 1985.
2- John P. Lowe and Kirk A. Peterson, ***Quantum Chemistry,*** 3rd edition. Elsevier Inc, 2006.

3- Donald A. McQuarrie, ***Quantum Chemistry***. California, University Science Books, 1983.
4- Ira N. Levine, ***Physical Chemistry***, 5th edition. New York, McGraw-Hill, 2002.
5- Laidler and Meiser, ***PHYSICAL CHEMISTRY***, 4rd Ed., Houghton Mifflin.

26 Additional information:

Name of Course Coordinator:Prof. Firas F. AwwadiSignature: ---------- Date23-9-2024
Head of Curriculum Committee/Department: ---------- Signature: ----------
Head of Department: ---------- Signature: ----------
Head of Curriculum Committee/Faculty: ---------- Signature: ----------
Dean: ---------- Signature: ----------