Course E-Syllabus

1	**Course title**	Physical Chemistry III
2	**Course number**	0303342
3	**Credit hours**	3
	Contact hours (theory, practical)	45 (42, 0)
4	**Prerequisites/corequisites**	Chem 341
5	**Program title**	Bachelor of Science in Chemistry
6	**Program code**	0303
7	**Awarding institution**	The University of Joran
8	**School**	
9	**Department**	Chemistry
10	**Level of course**	3rd year level
11	**Year of study and semester (s)**	2020 summer
12	**Final Qualification**	
13	**Other department (s) involved in teaching the course**	N/A
14	**Language of Instruction**	English
15	**Teaching methodology**	☐Blended ☒Online
16	**Electronic platform(s)**	☐Moodle ☒Microsoft Teams ☐Skype ☐Zoom ☐Others……
17	**Date of production/revision**	07/18/2020

18 Course Coordinator:

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Office number:
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19 Other instructors:

Name:
Office number:
Phone number:
Email:

Name:
Office number:
Phone number:
Email:

20 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, Raman, and electronic spectra of molecules; chemical bonding; molecular orbital theory and LCAO (linear combination of atomic orbitals) theory, and basics of statistical mechanics.

21 Course aims and outcomes:

A- Aims:

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- Intended Learning Outcomes (ILOs):
Upon successful completion of this course, students will be able to:

Upon successful completion of this course students will be able to …

B1. Develop a solid understanding of the fundamental principles of quantum chemistry.

B2. Explain the fundamental concepts of and language of quantum chemistry.

B3. 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.

B4. Promote problem-solving skills by applying different mathematical methods and techniques to the solution of relevant, but relatively complex, problems.

B5. Appreciate the continuous interplay between experiment and theory in quantum chemistry.

22. Topic Outline and Schedule:

Week	Lecture	Topic	Teaching Methods */platform	Evaluation Methods**	References

1	1.1	***Quantum Theory*** Classical Mechanics Failed to Describe Experiments on Atomic and Molecular Phenomena.	MS-teams	HW and exams	See references
	1.2	Classical Mechanics Failed to Describe Experiments on Atomic and Molecular Phenomena.			
	1.3	The Heisenberg Uncertainty Principle			
	1.4	The SchrÖdinger Equation.			
	1.5	Operators.			
2	2.1	Particle in a One-Dimensional box.			
	2.2	Particle in a One-Dimensional box			
	2.3	Particle in a Three-dimensional box.			
	2.4	Relation between Commutability and Precision of a Measurement.			
	2.5	Classical Harmonic Oscillator. Quantum Mechanical Harmonic Oscillator.			
3	3.1	The Rigid Rotor. Angular Momentum.			
	3.2	The Rigid Rotor. Angular Momentum.			
	3.3	Tunneling. And revision			
	3.4	The SchrÖdinger Equation for Hydrogen Atom. The Spectrum of Hydrogen Atom.			
	3.5	Eigenfunctions and Probability Densities for Hydrogenlike atoms.			
4	4.1	Orbital Angular Momentum of the Hydrogenlike Atom.			
	4.2	Electron Spin.			
	4.3	Variational Method and Helium Atom.			
	4.4	Variational Method and Helium Atom.			
	4.5	Pauli Exclusion Principle. The periodic Table and Aufbau Principle			

5	5.1	Ionization Energy and Electron Affinity. And Angular Momentum of many-electron atoms			
	4.2	Atomic Term Symbols			
	5.3	Atomic Spectra and Selection Rules.			
	5.4	Atomic Spectra and Selection Rules.			
	5.5	The Born-Oppenheimer Approximation			
6	6.1	The Hydrogen Molecule Ion. Calculation of the Hydrogen Molecule Ion			
	6.2	Molecular Orbital Description of the Hydrogen Molecule			
	6.3	Electron Configuration of Homonuclear Diatopmic Molecules.			
	6.4	Hückel Molecular Orbital Theory.			
	6.5	Hückel Molecular Orbital Theory. .			
7	7.1	Basic Ideas of Spectroscopy.			
	7.2	Vibrational-Rotational Spectra of Diatomic Molecules			
	7.3	Vibrational-Rotational Spectra of Diatomic Molecules			
	7.4	The Boltzmann Distribution law. . The Partition Function.			
	7.5	. Thermodynamic Quantities from the Partition Functions.			
8	8.1	Revision, exams and Eid vacation			
	8.2	Revision, exams and Eid vacation			
	8.3	Revision, exams and Eid vacation			
	8.4	Revision, exams and Eid vacation			
	8.5				

- Teaching methods include: Synchronous lecturing/meeting; Asynchronous lecturing/meeting
- Evaluation methods include: Homework, Quiz, Exam, pre-lab quiz…etc

23 Evaluation Methods:

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

Evaluation Activity	Mark	Topic(s)	Period (Week)	Platform
HW#1	10	Topics covered in weeks 1 and 2	First 2 weeks	Will be sent by email
Midterm exam	30	Topics covered in weeks 1-4	First 4 weeks	LMsystem
HW#2	10	Topics covered in weeks 5 and 6	6 week	By email
Final exam	50	All covered topics	8 week	LMsystem

24 Course Requirements (e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):

Computer and internet connection

25 Course Policies:

A- Attendance polices:

According to the University of Jordan Regulations

B- Absences from exams and submitting assignments on time:

According to the University of Jordan Regulations

C- Health and safety procedures:

According to the University of Jordan Regulations

D- Honesty policy regarding cheating, plagiarism, misbehavior:

According to the University of Jordan Regulations

E- Grading policy:

Hw#1 10%

Hw#1 10%
Midterm exam 30 %
Final exam 50%

F- Available university services that support achievement in the course:
E-learning, the university of Jordan website

26 References:

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

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

B- Recommended books, materials and media:

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.

27 Additional information:

Name of Course Coordinator: ----------Signature: ---------- Date: ----------

Head of Curriculum Committee/Department: ---------- Signature: ----------

Head of Department: ---------- Signature: ----------

Head of Curriculum Committee/Faculty: ---------- Signature: ----------

Dean: ---------- Signature: ----------