**University of Petra**

**Faculty of Science and Arts**
**Department of Chemistry**

**كلية الآداب والعلوم**
**قسم الكيمياء**

# Course Syllabus

**Year: 2019/2020** **Semester: Second**

| Course No. | Course Title | Prerequisite | Co-requisite | Credit Hours Lectures / ECTS: European Credit Transfer System |
|---|---|---|---|---|
| 101421 | Physical Chemistry (3) | 101322 & 10322 | None | 3/5 |

| Instructor Name | e-mail | Office No. | Office ext. | Office Hours |
|---|---|---|---|---|
| Prof. Rami Abdel-Rahem | rabdelrahem@uop.edu.jo | 6000 | 6000 | Sun, Mon,Tue, Wed, Thu: 12-11 |

| **Coordinator's Name:** (if applicable) | |
|---|---|

| **Short Course Description** | This coures will cover the following contents: Electromagnetic radiation and the old quantum theory, Bohr's atomic theory, The foundation of quantum mechanics, Schrödinger's wave mechanics, Quantum mechanical postulates, Quantum mechanics of some simple systems, Quantum mechanics of hydrogen-like atoms, Physical significance of the orbital quantum numbers, Angular momentum and magnetic moment, The rigid linear rotor, Spin quantum numbers, Many-electron atoms, Approximation methods in quantum mechanics, Molecular orbital theory, Hückel Theory for more complex molecules, Emission and absorption spectra, lambert Beer law, Zimman effect and an introduction to NMR. |
|---|---|

## Course Objectives

1. To inspire in students a sense of interest for physical chemistry, an appreciation of its application in different contexts and to involve them in an intellectually stimulating and satisfying experience of learning and studying.
2. To develop in students the ability to apply their chemical knowledge and skills to the solution of theoretical and practical problems in chemistry.
3. To provide students with a knowledge and skills base from which they can proceed to further studies in specialized areas of physical chemistry or multi-disciplinary areas involving physical chemistry.
4. To create in students a positive reception of the importance of physical chemistry in an industrial, economic, environmental and social context.

## Course Intended Learning Outcomes (ILOs) and their Alignment with Program ILOs, Teaching and Learning Methods, and Assessment Methods:

**Upon successful completion of this course, students are expected to achieve the following learning outcomes:**

| Course ILOs | Program ILOs | Teaching and Learning Method | Assessment Method |
|---|---|---|---|
| **Knowledge (K)** | | | |
| 1. **Demonstrate knowledge and understanding for all contents mentioned in the course syllabus.** | **K (1)** | Lectures & Data show | First, Second and Final Exams and quizzes |
| 2. **Write atoms and molecules electronic configuration as well as complete wave function and show the distribution of angular momentum and magnetic moment at different l and ml values.** | **K (1)** | Lectures & Data show | First, Second and Final Exams and quizzes |
| **Intellectual Skills (I)** | | | |
| 3. **Illustrate the structure and some properties of atom and its orbitals according to old atomic and quantum theories.** | **I (1)** | Lectures & Data show | First, Second and Final Exams and quizzes |
| 4. **Perform calculations related to energy of transitions between different orbitals according to old atomic structure theories, Uncertainty Heisenberg principle, de Broglie theory, new quantum theory (particle in a box), energy of splitting in a magnetic field, and energy of molecules according to Huckel theory.** | **I (2)** | Lectures & Data show | First, Second and Final Exams and quizzes |
| 5. **Derive total energy and radius according to Bohr's theory, time dependent and independent Schrodinger equation, some equations related to quantum postulates, Schrodinger equations of free particle, particle in a box, Angular momentum and magnetic moment, The rigid linear rotor ϕ equation of hydrogen like atom.** | **I (2)** | Lectures & Data show | First, Second and Final Exams and quizzes |
| **Practical skills (P)** | | | |
| **Practical skills is achived through goals mentioned in ILOs (1-5)** | | | |
| **Transferable Skills (T)** | | | |
| **Practical skills is achived through goals mentioned in ILOs (1-5)** | | | |

## Course Schedule:

| Week | Topic Details | Course ILO number | Reference |
|---|---|---|---|
| **1** | Electromagnetic radiation and the old quantum theory, | K(1), I(1) & I(2) | 1 |
| **2** | Bohr's atomic theory | K(1), I(1) & I(2) | 1 |
| **3** | The foundation of quantum mechanics, | K(1), I(1) & I(2) | 1 |
| **4** | Schrödinger's wave mechanics, | K(1), I(1) & I(2) | 1 |
| **5** | Quantum mechanical postulates, | K(1), I(1) & I(2) | 1 |
| **6** | **First Exam:** | K(1), I(1) & I(2) | |
| **7** | Quantum mechanics of some simple systems, Quantum mechanics of hydrogen-like atoms, | K(1), I(1) & I(2) | 1 |
| **8** | Physical significance of the orbital quantum numbers, | K(1), I(1) & I(2) | 1 |
| **9** | Angular momentum and magnetic moment, | K(1), I(1) & I(2) | 1 |
| **10** | The rigid linear rotor, Spin quantum numbers, Many-electron atoms, | K(1), I(1) & I(2) | 1 |
| **11** | Approximation methods in quantum mechanics, | K(1), I(1) & I(2) | 1 |
| **12** | **Second Exam:** | K(1), I(1) & I(2) | |
| **13** | Molecular orbital theory, | K(1), I(1) & I(2) | 1 |
| **14** | Hückel Theory for more complex molecules, | K(1), I(1) & I(2) | 1 |
| **15** | Emission and absorption spectra, lambert Beer law, | K(1), I(1) & I(2) | 1 |
| **16** | Zimman effect and an introduction to NMR. | K(1), I(1) & I(2) | 1 |

## Assessment Methods and Grading System:

| Assessment method | Grade | Comments |
|---|---|---|
| First Exam | 25 | |
| Second Exam | 25 | |
| quizzes | 10 | Any time |
| Final Exam | 40 | |
| Total | 100 | |

## Learning References:

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| **1- Textbook (s):** |
| *Physical Chemistry* by: K.J. Laidler, J. H. Meiser, and B. C. Sanctuary, 4th Ed., Houghton Mifflin (2003). |
| **2- References:** |
| Ira. N. Levine, *Quantum Chemistry*, 5th Ed., Prentice Hall (2000). |
| **3- Other Resources:**<br><< a lecture rooms with data show facility>> |

## Course Policies[1]

- Attendance Policy: University regulations apply to attendance.
- Academic Honesty: Academic dishonesty is an unacceptable mode of conduct, and will not be tolerated in any form at University of Petra. All persons involved in academic dishonesty and plagiarism in any form will be disciplined in accordance with University rules and regulations.

| Approved by | Name | Date | Signature |
|---|---|---|---|
| **Head of Department** | Dr. Abdelmnim Altwaiq | 23/02/2020 | |
| **Faculty Dean/** | Prof . Rami Abdel-Rahem | 25/02/2020 | |



[1] Additional information may be added in this section according to the nature of the course.