| 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 Mechanics-1 |
| 2. | Course Number | 0302363 |
| 3. | Credit Hours (Theory, Practical) | (3 Theory,0) |
| | Contact Hours (Theory, Practical) | (3 hours per week, 0) |
| 4. | Prerequisites/ Corequisites | Modern Physics (0302261) |
| 5. | Program Title | B.Sc. |
| 6. | Program Code | 02 |
| 7. | School/ Center | Science |
| 8. | Department | Department of Physics |
| 9. | Course Level | First year students |
| 10. | Year of Study and Semester (s) | 2026, Fall |
| 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 | 19/11/2025 |
| 16. | Revision Date | |

**17. Course Coordinator:**

Name: Ola Hassouneh Contact hours:

Office number: Phone number:

Email: o.hassouneh@ju.edu.jo

**18. Other Instructors:**

| |
|---|
| Name:<br>Office number:<br>Phone number:<br>Email: |

**19. Course Description:**

| |
|---|
| Introduction to Wave Mechanics; Wave Functions; Schrödinger Equation; Probability Amplitudes; Stationary States; Heisenberg Uncertainty Relation; One-Dimensional System; Potential Well and Potential Barrier Problems. Matrix Mechanics: Linear Vector Spaces, Operators, measurements and Probability Amplitudes, Position and Momentum Space, Wave Functions. Schrödinger Equation in Three Dimensions: Central Potentials, Orbital Angular Momentum and Spin, Hydrogen-Like Atoms. |

| **Program Intended Learning Outcomes:** (To be used in designing the matrix linking the intended learning outcomes of the course with the intended learning outcomes of the program) |
|---|
| SO1: Identify, formulate, and solve broadly-defined technical or scientific problems by applying knowledge of Mathematics and Science and/or technical topics to areas relevant to the discipline. |
| SO2: Formulate or design a system, process, procedure or program to meet desired needs |
| SO3: Develop and conduct experiments or test hypotheses, analyze and interpret data and use scientific judgment to draw conclusions |
| SO4: Communicate effectively with a range of audiences in oral or written forms and exhibit ethical and professional values. |
| SO5: Reflect the impact of technical and/or scientific solutions in economic, environmental, and societal contexts. |
| SO6: Function effectively on teams that establish goals, plan tasks, meet deadlines, and analyze risk and uncertainty. |
| |

| **PILO's** | ***National Qualifications Framework Descriptors*** | | |
|---|---|---|---|
| | **Competency (C)** | **Skills (B)** | **Knowledge (A)** |
| 1. | ☐ | ☐ | ☒ |
| 2. | ☐ | ☐ | ☒ |
| 3. | ☐ | ☐ | ☒ |

| | | | |
|---|---|---|---|
| 4. | ☐ | ☐ | ☒ |
| 5. | ☐ | ☐ | ☒ |

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

Upon successful completion of this course students will be able to

1. Evaluate probability, expectation values, and standard deviation using a given form of a wave function.
2. Use the Schrödinger equation and mathematical techniques to derive related properties and theorems.
3. Solve the time-independent Schrödinger equation for different forms of potentials, such as:

- Infinite and finite potential wells
- Simple harmonic oscillator (SHO)
- Free particle
- Dirac delta potentials

4. Explain and give examples of stationary states, bound states, and scattering states.
5. Solve eigenvalue problems for discrete and continuous spectra and construct uncertainty formulas for different operators.
6. Become familiar with Dirac notation (ket's, bra's) and changing bases.
7. Solve the Schrödinger equation in three dimensions for different potential forms, including the hydrogen atom.

| **Course ILOs** | **The learning levels to be achieved** | | | | | |
|---|---|---|---|---|---|---|
| | **Remembering** | **Understanding** | **Applying** | **Analysing** | **evaluating** | **Creating** |
| 1 | | **X** | **X** | **X** | | |
| 2 | **X** | **X** | **X** | **X** | | |
| 3 | | | **X** | **X** | **X** | **X** |
| 4 | | **X** | | **X** | **X** | **X** |
| 5 | | | **X** | **X** | **X** | **X** |
| 6 | **X** | **X** | **X** | | | |
| 7 | | | **X** | **X** | | **X** |

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

| Course ILOs / Program STOs | ILO (1) | ILO (2) | ILO (3) | ILO (4) | ILO (5) | ILO (6) | ILO ( 7) |
|---|---|---|---|---|---|---|---|
| STO (1) | **X** | **X** | **X** | **X** | **X** | **X** | **X** |
| STO (2) | **X** | | | | **X** | | **X** |
| STO (3) | **X** | | **X** | | **X** | | |
| STO (4) | | | | **X** | | **X** | |
| STO (5) | | | | | | | |
| STO (6) | | | | | | | |

| Ch. # | Sec. # | Topics | # of hrs | Suggested Problems |
|---|---|---|---|---|
| - | - | Introduction | 1 | - |
| **1** | 1-6 | **The Wave Function**<br>The Schrödinger Equation<br>The Statistical Interpretation<br>Probability<br>Normalization<br>Momentum<br>The Uncertainty Principle | 6 | 1, 3, 4, 5<br>7, 8, 9, 16 |
| **2** | 1-6 | **Time-Independent Schrödinger Equation**<br>Stationary States<br>The Infinite Square Well<br>The Harmonic Oscillator<br>The Free Particle<br>The Delta-Function Potential<br>The Finite Square Well | 14 | 3, 4, 7, 8<br>10, 11, 13, 18<br>23, 26, 29, 34 |
| **3** | 1-6 | **Formalism**<br>Hilbert Space<br>Observables<br>Eigenfunctions of a Hermitian Operator<br>Generalized Statistical Interpretation<br>The Uncertainty Principle<br>Dirac Notation | 13 | 3, 4, 5, 7, 6<br>11, 17, 34 |
| **4** | 1-4 | **Quantum Mechanics in Three Dimensions**<br>Schrödinger Equation in Spherical Coordinates | 6 | 1, 3, 10, 13, 14, 16<br>19, 22, 27, 28 |

| | | | | |
|---|---|---|---|---|
| | | The Hydrogen Atom<br>Angular Momentum<br>Spin | | |

**23. Topic Outline and Schedule:**

**24. Evaluation Methods:**

**Opportunities to demonstrate achievement of the ILOs are provided through the following assessment methods and requirements: Written only** Exams, HomeWorks, Discussion in the class.

| Evaluation Activity | Mark | Topic(s) | ILO/s Linked to the Evaluation activity | Period (Week) | Platform |
|---|---|---|---|---|---|
| First Exam | 25% | | 1-3 | | |
| Mid Exam | 25% | | 3-6 | | |
| Final Exam | 50% | | 1-7 | | |

**25. Course Requirements:**

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

computer, internet connection

**26. Course Policies:**

A- Attendance policies:

Class attendance is expected. Past experience has shown that students who do not attend the lectures invariably receive poor grades.

A student whose absence exceeds 15% of lectures will be dismissed.

B- Absences from exams and handing in assignments on time:

Absence from exams without an acceptable excuse means ZERO.

Some homework assignments will be graded. Some problems will be selected and discussed in an extra lecture for every chapter.

C- Health and safety procedures:

No special precautions.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

All these issues will be considered according to the regulations and laws adopted at the University of Jordan.

E- Grading policy + Weighting (i.e. weight assigned to exams as well as other student work)

Grades will be awarded based on the statistical distribution of marks out of 100%

F- Available university services that support achievement in the course:

Class Room, Some Office Toys, Library

G- Statement on Students with disabilities

Students with disabilities who need special accommodations for this class are encouraged to meet with the instructor and/or their academic advisor as soon as possible. In order to receive accommodations for academic work in this course, students must inform the course instructor and/or their academic advisor, preferably in a written format, about their needs no later than the 4th week of classes.

**27. References:**

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

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

**Griffiths, D. Jand Schroeter D.F, Introduction to Quantum Mechanics.**

**(Third edition, Cambridge university press, 2018).**

B- Recommended books, materials, and media:

1- Quantum Physics of Atoms, Molecules, Solids, Nuclei, and Particles, 2nd Edition (1985), by R. Eisberg and R. Resnick.
2- Understanding Quantum Physics: A User's Manual (1990), by Michael A. Morrison.
3- **Quantum Mechanics: Concepts and Applications**, 2nd Edition, Nouredine Zettili, Wiley (2009).

**28. Additional information:**

| | | |
|---|---|---|
| Name of the Instructor or the Course Coordinator: | Signature: | Date: |
| …… | ……..…… | ……..…… |
| Name of the Head of Quality Assurance Committee/ Department | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Head of Department | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Head of Quality Assurance Committee/ School or Center | Signature: | Date: |
| ……. | ……..…… | ……..…… |
| Name of the Dean or the Director | Signature: | Date: |
| ……. | ……..…… | ……..…… |