** University of Management and Technology**

**School of Sciences**

**Department of Physics**

**Course Code** **PH-308**

**Course Title: Quantum Mechanics 1**

**Program: BS (PH)**

**Course Outline**

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| --- | --- | --- | --- | --- |
| **Schedule** | Tuesday & Friday | **Pre-requisite** | NIL | |
| **Course Coordinator** | Muhammad Bilal Siddique | **Contact** | [bilal.siddique@umt.edu.pk](mailto:bilal.siddique@umt.edu.pk) | |
| **Course**  **Description** | Origin of Quantum Physics, Mathematical tools of Quantum Mechanics, Postulates of Quantum Mechanics, One Dimensional Problems, Angular Momentum, Three Dimensional Problems, Rotation and addition of Angular Momentum, Identical Particles, and Approximation Methods for stationary states. | | | |
| **Expected**  **Outcomes** | Participants will learn Mathematical based quantum mechanics. They will also be ready for quantum mechanics II course. | | | |
| **Text**  **Book** | Quantum Mechanics Concepts and Applications, Nouredine Zettili, Jacksonville State University, 2nd edition by David J. Griffiths | | | |
| **Assignment & Projects** | i). Problems will be assigned at regular intervals as an assignment.  ii). Projects on different topics may also be assigned to the students.  Marks will be deducted for late submission. | **Quizzes** | | All quizzes will be announced well before time.  No make-ups will be offered for missed quizzes. |
| **Mid Term**  **Examination** | A 60-minutes exam will cover all the material covered during the first  14-16 lectures.  Combined Mid Term exam for all multiple sections. | **Final**  **Examination** | | A 120-minutes exam will cover all the material covered during the semester.  Combined Final exam for all multiple sections. |
| **Attendance**  **Policy** | Students missing more than 20% of the lectures will receive an “SA” grade in the course and will not be allowed to take final exam. | | | |
| **Grading**  **Policy** | Assignment +Projects+ Quizzes: 20%  Mid Term Examination: 30%  Final Examination: 50% | | | |



Quantum Mechanics I

**Lecture Plan**

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| **Week** | **Lecture**  **#** | **TOPICS** | **CH** | **Sections** |
| 1 | 1  2 | Wave Aspects of Particles, de Broglie’s Hypothesis: Matter waves  Particle versus Waves, Classical view of Particles and waves | 01  01 | 1 – 3  4 |
| 2 | 1  2 | Quantum view of Particles and waves, probabilistic Interpretation  Wave Packets, Localization of Wave Packets | 01  01 | 5  1.8 |
| 3 | 1  2 | Wave Packets and the Uncertainity Relations, Motion of Wave Packets  Square-Integrable function: Wave function, Dirac Notation (Bra-Ket algebra), Hermitian Adjoint | 01  02 | 1.8  2 – 4 |
| 4 | 1  2 | Eigen-values and Eigen-vectors of an operator, position representation, Momentum representation  Momentum operator in position representation | 02  02 | 2.6  2.6 |
| 5 | 1  2 | Parity operator  The basic Postulates of Quantum Mechanics | 02  03 | 2.6  1 – 2 |
| 6 | 1  2 | Expectation values, Time evaluation operator  Stationary states: Time-independent Potentials | 03  03 | 5 – 6  3.6 |
| 7 | 1  2 | Conservation of Probability  The potential step | 03  04 | 1 – 2  4 |
| 8 | 1  2 | The potential Barrier and Well  Tunneling | 04  04 | 4.5  4.5 |
| 9 | 1  2 | The infinite square well potential  The symmetric potential well | 04  04 | 4.6  4.6 |
| 10 | 1  2 | Finite square well  Boundary state solution | 04  04 | 4.7  4.7 |
| 11 | 1  2 | Harmonic Oscillator  Energy Eigen-values, Energy Eigen-states | 04  04 | 4.8  4.8 |
| 12 | 1  2 | Orbital angular momentum  General formulism of angular momentum | 05  05 | 1-2  3 |
| 13 | 1  2 | Geometrical and Matrix representation  Spin angular momentum | 05  05 | 4-5  6 |
| 14 | 1  2 | Eigen function of orbital angular momentum  3-D problems in cartesian coordinates | 05  06 | 7  6.2 |
| 15 | 1  2 | 3-D problems in spherical coordinates  Revision | 06 | 6.3 |