**COURSE SYLLABUS**

Subject: **Introduction to Quantum Mechanics**

Lecturer: **Dr.NGUYEN Tran Thuat**

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**Academic year: 2014-2015**

**COURSE DESCRIPTION**

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| **Credit points** | 4 hours credit |
| **Level** | Undergraduate |
| **Teaching time**  |  |
| **Location** | University of Science and Technology of Hanoi |
| **Time Commitment** | Lecture | 30 hrs |
| Exercises | 10 hrs |
| Practical | 0 hrs |
| Total | 40 hrs |
| **Prerequisites** | Linear algebra, Riemann intergration and partial differential equations |
| **Recommended** **background knowledge** | Fundamental physics |
| **Subject description** | The course will start with a brief review of the experiments (blackbody radiation, photoelectric effect, Compton effect) that cannot be explained by classical physics, thereby providing the necessity for quantum mechanics. The chapter 1 will present the wave function and its properties, leading to Schrödinger’s equation. The chapter 2 will present various applications of the 1-D Schrödinger equation (Infinite and finite square wells, free particle, harmonic oscillator, δ-function potential, potential barriers). The chapter 3 will expose the mathematical formalism of quantum mechanics (Hilbert space, observables and Hermitian operators, eigenvalues and eigenfunctions, uncertainty principle, and Dirac bra and ket notation). The last chapter will treat Schrödinger’s equation in 3-D. with solutions to the hydrogen atom (radial equation and the angular equation), the angular momentum in QM – orbital and spin. This will include the Pauli spin matrices, and addition of angular momenta (Clebsch-Gordon coefficients).Students are encouraged to read following subjects after the course: Identical particles, Perturbation theory, Variation principle  |
| **Objectives & Out-come** | The goals of this course are: 1. A fundamental knowledge of quantum mechanics.2. The ability to formulate physical problems in the language of mathematics to solve physical problems These objectives will be assessed by my observations of your participation in class discussions, as well as your performance on home work problem sets and written exams. |
| **Assessment/ Evaluation** | Attendance/Attitude | 10% |
|  | Exercise(s) | 10% |
|  | Practicals | 0% |
|  | Mid-term test | 30% |
|  | Final exam | 50% |
| **Prescribed Textbook(s)** | Introduction to Quantum Mechanics, 2nd edition, David J. Griffiths |

**COURSE CONTENTS & SCHEDULE**

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| **Class** | **Contents** | **Hours** | **Ref/Resources** | **Assignment (s)** |
| **Lect.** | **Exr.** | **Prc.** |
| Chapter 0 : Limit of classical physics and introduction to quantum notation |  | 1 |  |  |  |  |
| Chapter 1: The wave function | * Schrodinger equation
* The statistical interpretation
* Probability
* Normalization
* Momentum
* The uncertainty Principle
 | 3 | 1 | 0 |  | 1 |
| Chapter 2: Time-independent Schrodinger equation | * Stationary states
* The infinite square well
* The harmonic oscillator
* Algebraic method
* Analytic method
* The free particle
* The Delta-function potential
* Bound & Scattering states
* The Delta-Function Well
* The Finite Square Well
 | 10 | 4 | 0 |  |
| Chapter 3: The Hilbert formalism | * Observables
* Eigenfunctions of a hermitian operator
* Generalized statistical interpretation
* The Uncertainty principle
* Dirac Notation
 | 5 | 2 | 0 |  | 1 |
| Chapter 4: Quantum mechanics in 3 dimensions | * S.E. in spherical coordinates
* Separation of variables
* The angular equation
* The radial equation
* The Hydrogen Atom
* The radial wave function
* The spectrum of hydrogen
* Angular Momentum
* Eigenvalues
* Eigenfunctions
* Spin
* Spin ½
* Addition of Angular Momenta
 | 10 | 4 | 0 |  |
| Further | * Identical particles
* Perturbation theory
* Variation principle
 | For further reading |

**Notes:**

* Abbreviation: Lect. (lecture), Exr. (Exercise), Prc. (Practise).
* Exercises may include assignment, reports, student’s presentation, homework, class exercises for each class sessions
* Practicals mostly refer to Lab- work or outside practice such as field trip.

**Reference Literature:**

[1] Introduction to Quantum Mechanics, 2nd edition, David J. Griffiths

[2] L.D. Landau & E.M. Lifshitz Quantum Mechanics (Volume 3 of A Course of Theoretical Physics) Pergamon Press 1965