Course Profile - Department of Physics

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| **Course Number :** PHYS 333 | **Course Title :** Quantum Mechanics I |
| **Required / Elective :** Required | **Pre / Co-requisites :** - |
| **Catalog Description:** Wave packets and uncertainty; postulates of quantum mechanics; eigenfunctions and eigenvalues; simple problems in one dimension; general structure of wave mechanics, harmonic oscillator, hydrogen atom. | **Textbook / Required Material :**<br>1. David J. Griffiths, *Introduction to Quantum Mechanics, 2nd ed.* Prentice-Hall, 2005.<br>2. Gasiorowicz, S. *Quantum Physics, 3rd edition*, Wiley, 2003. |
| **Course Structure / Schedule : (3+0+2) 4 / 8 ECTS** | |
| **Extended Description :** Why quantum mechanics? (Blackbody radiation, photoelectric effect, Compton effect.) The wave function and its Born interpretation, expectation values and momentum operator. Plane waves and wave packets. Heisenberg's uncertainty relation. Time independent Schrödinger equation , eigenvalues and eigenfunctions. Simple eigenvalue problems: One dimensional potentials. Expansion postulate and its physical interpretation, degeneracy, parity. Operator methods in quantum mechanics, Harmonic oscillator. Time dependence of operators. Postulates of quantum mechanics. Schrödinger equation in three dimensions, the central potential, and the hydrogen atom. Matrix representation of operators. | |
| **Design content** : None | **Computer usage**: Students use computational and graphics software in the analysis of wave packets and wave functions and in numerical solution of the Schrödinger equation. |

**Course Learning Outcomes** [relevant program outcomes in brackets]**:**

On successful completion of this course students will be able to

1. demonstrate knowledge of fundamental concepts in quantum mechanics [1];
2. recognize the nature of quantum mechanical wave function and its Born interpretation [1];
3. normalize wave functions [1,2];
4. apply the Schrödinger equation to simple quantum mechanical systems in one dimension [6];
5. develop an understanding of eigenstates and eigenvalues of operators [1];
6. calculate expectation values of observables using the associated operators [1,2,6];
7. use the Dirac notation for inner products [1,2];

8. articulate how quantum mechanics can be used to describe the hydrogen atom [6, 7].

**Recommended reading**

1. Shankar, R. *Principles of Quantum Mechanics, 2nd edition*, New York: Plenum, 1994.
2. Feynman, R.P., Leighton, R.B., Sands, M. *The Feynman Lectures on Physics, Volume III*, Addison Wesley, 1966.

**Teaching methods**

Lectures and exercise sessions of approximately 5 hours per week; pre-readings and homework problems.

**Assessment methods:**

Two mid-term examinations, a final examination, weekly homework assignments, and quizzes.

**Student workload:**

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| Pre-reading | 7 hrs |
| Lectures, discussions | 45 hrs |
| Exercise sessions | 30 hrs |
| Homework | 40 hrs |
| Independent work | 73 hrs |
| Laboratory work | 0 hrs |
| Examinations | 5 hrs |
| **TOTAL ……** | **200 hrs … to match 25 x 8 ECTS** |

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| **Prepared by :** İsmail Karakurt , 01.02.2010 | **Revision Date :** |