

# Introduction to Quantum Mechanics II

*171.304 Spring 2006*

**Course Description:** This is the second semester of a rigorous two semester introduction to Quantum Mechanics. We shall see how quantum mechanics can be used to solve problems at the atomic scale that are important for understanding our physical world. The major topics this semester are quantum mechanics of atoms and molecules, perturbation theory, theory of scattering, quantum statistical mechanics, and quantization of the electromagnetic field.

**Professor:** Collin Broholm (<http://www.pha.jhu.edu/~broholm/homepage>). Office hours Monday 2-4 pm in room 345 and by appointment. Questions are also answered by email ([broholm@jhu.edu](mailto:broholm@jhu.edu)) or phone (410) 516 7840.

**Teaching Assistants:** Andrew Blechman. Office hours Tuesday 3-5PM in room 465 and by appointment. Email [blechman@pha.jhu.edu](mailto:blechman@pha.jhu.edu) ; phone (410) 516 0461. Minh Son, Office Hours Friday 3-5PM in room 467, email [mhson@pha.jhu.edu](mailto:mhson@pha.jhu.edu), phone: (410) 516 4910.

**Text Books:** “A Modern Approach to Quantum Mechanics” by John S. Townsend (A JHU graduate!). We will cover Chapters 9-14 during the spring semester. “Introduction to Quantum Mechanics” by David J. Griffiths will be used more extensively this semester as a supplementary text book.

**Lectures:** MTW 9-9:50 pm in room 274. I will introduce new concepts and provide examples that help you understand how quantum mechanics works. Read the assigned text in advance of the lecture and then again afterwards for optimal comprehension. Your active participation during lectures with questions and comments is strongly encouraged.

**Conference:** Th. 1-1:50 pm in room 274. Conferences focus on improving your problem solving skills. Participation is highly recommended and attendance will be taken. Andrew has been a TA in this course for several years so he is well aware of the challenges you face and will be an excellent resource for you.

**Homework:** Solving problems is how you will learn quantum mechanics. Problem sets will be assigned on Mondays, to be due Wednesday of the following week. Assignments and

solutions will be posted at the course web page, which is accessible from <http://physics.jhu.edu/courses/> .

**Academic Ethics:** The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Heated discussions and intense collaborations gave birth to quantum mechanics. So you are strongly encouraged to discuss the material and the problems with your friends. However, ultimately you must solve the homework problems yourself. Please report any violations you witness to the instructor. You may consult the associate dean of students and/or the chairman of the Ethics Board beforehand. See the guide on "Academic Ethics for Undergraduates" and the Ethics Board web site (<http://ethics.jhu.edu>) for more information.

## Spring 2006 Syllabus

| <b>Dates</b>            | <b>Topic</b>   | <b>Reading</b>         |
|-------------------------|--|------------------------|
| Jan. 30-Feb. 1          | Quantum Mechanics in 3D  | T 9.1-9.8              |
| Feb. 6-8                | Central Potentials   | T 9.9-10.1, 10.3-10.6  |
| Feb. 13-15              | Hydrogen Atom  | T 10.2, G 4.2          |
| Feb. 20-22              | Perturbation Theory  | T 11                   |
| Feb. 27-Mar. 1          | Hydrogen Fine Structure  | G 6                    |
| Mar. 6-8                | Identical Particles, Variational Method                          | T 12.1, G 5.1, G 7.1   |
| Mar. 13-15              | He, H <sub>2</sub> , and atoms                                   | T 12.2-12.4, G 7.2-7.3 |
| Mar. 27-29<br>11.1-11.2 | Partial Wave Analysis  | T 13.4-13.6, G         |
| <b>Mar. 30, 1-2 pm</b>  | <b>Midterm Exam (Bloomberg 361)</b>                              |                        |
| Apr. 3-5                | The Born Approximation   | T 13.1-13.3, G 11.3    |
| Apr. 10-12              | Quantum Statistical Mechanics                                    | G 7.4, G 9.3           |
| Apr. 17-19              | Time Dependent Perturbation Theory                               | T 14.5-14.6, G 9.1-9.2 |
| Apr. 24-26              | Quantizing the Electromagnetic Field                             | T 14.1-14.4            |
| May 1-3                 | Emission and Absorption of Radiation                             | T 14.7-14.9            |
| <b>May 16, 9-noon</b>   | <b>Final exam Tuesday covering all assigned reading material</b> |                        |

**Exam Rules:** No books are allowed.

|                 |              |     |
|-----------------|--------------|-----|
| <b>Grading:</b> | Final Exam   | 50% |
|                 | Midterm Exam | 25% |
|                 | Homework     | 25% |

### Acronyms:

T: J. S. Townsend "A modern approach to quantum mechanics"

G: D. J. Griffiths "Introduction to quantum mechanics"