Course Syllabus

Last updated: 8/19/09

Course Information

(course number, course title, term, any specific section title)

Physics 6400-001 Quantum Mechanics I Fall 2009
Tues, Thurs 3:30-5:15 PM in CBW1.101

Professor Contact Information

(Professor's name, phone number, email, office location, office hours, other information)

Prof. J. M. Izen Office: ECSN 2.510 (972) 883-2598
Office hours: Tues and Thurs 5:15 PM.

Teaching Assistant: Masayuki Kondo 972 883-6448 ECSN 2.210 masa@utdallas.edu
Office hours: TBA

Course Pre-requisites, Co-requisites, and/or Other Restrictions

(including required prior knowledge or skills)

An undergraduate quantum mechanics course at the level of Chapters 1 – 4 of Introduction to Quantum Mechanics by David Griffiths (probability density; linear algebra; fundamental principles of quantum theory, application to one and three dimensional systems under various potentials; free particle; bound particle; harmonic oscillator, angular momentum, addition of angular momentum, hydrogen atom). Phys 6400 is not intended as a first course in Quantum Mechanics (QM). Students without the proper preparation are encouraged to audit or register for Phys 4301, a first undergraduate QM course offered during the spring semester. Students should be familiar with Hamiltonian and Lagrangian formulations of classical mechanics, canonical transformations, and Hamilton–Jacobi theory for the fullest appreciation of the postulates of QM.

Course Description

Graduate QM I revisits the fundamentals, formalisms, and approximate techniques of QM in greater depth than is offered in an undergraduate course. The follow-on course, Grad QM II (Physics 6401) places a greater emphasis on applications. Material for Phys 6400 will be drawn from Chapters 1, 2, 3, and 5 of Sakurai. The class will be asked to review some topics previously covered in undergraduate quantum mechanics independently to allow time to delve into perturbation theory.

Topics: Dirac formalism, kets, bras, operators and position, momentum, and matrix representations, change of basis, Stern-Gerlach experiment, observables and uncertainty principle, translations, wave functions, time evolution, the Schrödinger and Heisenberg pictures, simple harmonic oscillator, wave equation, WKB approximation, rotations, angular momentum, spin, Clebsch-Gordan coefficients, perturbation theory, variational methods.

Student Learning Objectives/Outcomes

Students will master the use of bra-ket notation that is common in physics literature, and will be able to articulate the difference between abstract states and operators and the representations of states and operators as wave functions in position or momentum space and matrix representations. Students shall be able to articulate the differing treatments of time dependence in the Schrödinger and Heisenberg pictures. A mastery of problem solving techniques and approximate methods from this class will prepare students for research problems they will encounter in their laboratories and scientific literature.

Required Textbooks and Materials

Modern Quantum Mechanics, revised edition by J. J. Sakurai.
Introduction to Quantum Mechanics, 2nd Edition by David Griffiths
If you already own the 1st edition of Griffiths, consult with Prof. Izen before replacing it with the 2nd edition.

Suggested Course Materials

Additional References that some students may find useful:
Principles of Quantum Mechanics, 2nd Edition by R. Shankar – a popular grad, QM text
Lectures on Quantum Mechanics by Gordon Baym – an older graduate-level text with a chatty style

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Assignments & Academic Calendar

(Topics, Reading Assignments, Due Dates, Exam Dates)

Mastering quantum theory requires that you flex your mathematical and philosophical muscles. Homework problems will be assigned from Sakurai, Griffiths, and additional sources. Assignments and other important course announcements will be posted via a WWW based discussion Yahoo®!Group typically by Thursday or Friday of each week. Please join the group by sending an email to phys6400–subscribe@yahoogroups.com and then follow the instructions in the return email. To unsubscribe your email, use phys6400–unsubscribe@yahoogroups.com. You may choose to read and send postings by email or via the WWW at http://groups.yahoo.com/group/phys6400/. It is your responsibility to join the group and check for postings. The Yahoo®!Group is also intended to be a discussion/question/answer forum for the class. You are expected to keep posts on topic, following commonly accepted practices of nettiquette.

Homework normally is to be turned in at the start of class on Tuesday. Exceptions will be clearly posted with the assignment. Your work should be neat, problems should be ordered, and pages should be **stapled**.

Students may work on homework with classmates, but each student is required to write up his/her answers independently. Outright copying is not permitted. You are required to write all collaborating group members' names at the start of the problem. Failure to disclose all members of a collaborating homework group will be treated as plagiarism. I recognize that some students will master this material better by working in peer groups, however I reserve the right to restrict homework collaboration at my discretion.

Grading Policy

(including percentages for assignments, grade scale, etc.)

Individual Homework problems are usually given equal weight and are graded on a 10 point scale. Homework will count towards 25% of the course grade. Exams will count for 75% of the course grade. There will be either 2 or 3 exams including the final.

Course & Instructor Policies
(make-up exams, extra credit, late work, special assignments, class attendance, classroom citizenship, etc.)

Notes, homework solutions, exams, and exam solutions that are provided to the class are strictly for personal use. They do not become the property of the student, and they may not be distributed or shared with anyone outside this class without the written permission of the instructor.

Seeking help from an instructor solution manual, a solution posted on the Internet, a homework solution from a student who has previously studied QM (except for the Teaching Assistant), or previous exams of this instructor is expressly forbidden. Violations will be prosecuted per the UTD Academic Dishonesty policy. My recommended penalty to the UTD Judicial Officer for any violation is likely to be a course grade of F. Possession of materials in violation of a copyright will be reported as permissible by law. Homework plays a crucial role in the mastery of Quantum Mechanics. Several past students have admitted, much to their regret that copying QM homework contributed to their dismal test performance.

Any video recordings of class made available via the internet, they are strictly for the use of registered students currently enrolled, or people auditing with my permission. The recordings are the intellectual property of Prof. Izen. They may not be captured or transferred by any means, and may only be used in their streamed format from the UTD net-id/password-authenticated campus server. Any unauthorized capturing, recording, or sharing of a class video recording, whether during this or a future semester will be treated as an Academic Integrity violation and prosecuted under UTD's disciplinary policy. An Academic Integrity prosecution does not preclude an independent civil action.

Field Trip Policies
Off-campus Instruction and Course Activities

> *Off-campus, out-of-state, and foreign instruction and activities are subject to state law and University policies and procedures regarding travel and risk-related activities. Information regarding these rules and regulations may be found at the website address http://www.utdallas.edu/BusinessAffairs/Travel_Risk_Activities.htm. Additional information is available from the office of the school dean. Below is a description of any travel and/or risk-related activity associated with this course.*

No field trips are anticipated.

Student Conduct & Discipline

> The University of Texas System and The University of Texas at Dallas have rules and regulations for the orderly and efficient conduct of their business. It is the responsibility of each student and each student organization to be knowledgeable about the rules and regulations which govern student conduct and activities. General information on student conduct and discipline is contained

in the UTD publication, *A to Z Guide*, which is provided to all registered students each academic year.

The University of Texas at Dallas administers student discipline within the procedures of recognized and established due process. Procedures are defined and described in the *Rules and Regulations, Board of Regents, The University of Texas System, Part 1, Chapter VI, Section 3*, and in Title V, Rules on Student Services and Activities of the university's *Handbook of Operating Procedures*. Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations (SU 1.602, 972/883-6391).

A student at the university neither loses the rights nor escapes the responsibilities of citizenship. He or she is expected to obey federal, state, and local laws as well as the Regents' Rules, university regulations, and administrative rules. Students are subject to discipline for violating the standards of conduct whether such conduct takes place on or off campus, or whether civil or criminal penalties are also imposed for such conduct.

Academic Integrity

The faculty expects from its students a high level of responsibility and academic honesty. Because the value of an academic degree depends upon the absolute integrity of the work done by the student for that degree, it is imperative that a student demonstrate a high standard of individual honor in his or her scholastic work.

Scholastic dishonesty includes, but is not limited to, statements, acts or omissions related to applications for enrollment or the award of a degree, and/or the submission as one's own work or material that is not one's own. As a general rule, scholastic dishonesty involves one of the following acts: cheating, plagiarism, collusion and/or falsifying academic records. Students suspected of academic dishonesty are subject to disciplinary proceedings.

Plagiarism, especially from the web, from portions of papers for other classes, and from any other source is unacceptable and will be dealt with under the university's policy on plagiarism (see general catalog for details).

Please consult Course and Instructor Policies for more specific information pertaining to this course. It is a student's responsibility to seek guidance if a policy or its application to a specific situation is not clear.

Email Use

The University of Texas at Dallas recognizes the value and efficiency of communication between faculty/staff and students through electronic mail. At the same time, email raises some issues concerning security and the identity of each individual in an email exchange. The university encourages all official student email correspondence be sent only to a student's U.T. Dallas email address and that faculty and staff consider email from students official only if it originates from a UTD student account. This allows the university to maintain a high degree of confidence in the identity of all individual corresponding and the security of the transmitted information. UTD furnishes each student with a free email account that is to be used in all communication with university personnel. The Department of Information Resources at U.T. Dallas provides a method for students to have their U.T. Dallas mail forwarded to other accounts.

Withdrawal from Class

The administration of this institution has set deadlines for withdrawal of any college-level courses. These dates and times are published in that semester's course catalog. Administration procedures must be followed. It is the student's responsibility to handle withdrawal requirements from any

class. In other words, I cannot drop or withdraw any student. You must do the proper paperwork to ensure that you will not receive a final grade of "F" in a course if you choose not to attend the class once you are enrolled.

Student Grievance Procedures

Procedures for student grievances are found in Title V, Rules on Student Services and Activities, of the university's *Handbook of Operating Procedures*.

In attempting to resolve any student grievance regarding grades, evaluations, or other fulfillments of academic responsibility, it is the obligation of the student first to make a serious effort to resolve the matter with the instructor, supervisor, administrator, or committee with whom the grievance originates (hereafter called "the respondent"). Individual faculty members retain primary responsibility for assigning grades and evaluations. If the matter cannot be resolved at that level, the grievance must be submitted in writing to the respondent with a copy of the respondent's School Dean. If the matter is not resolved by the written response provided by the respondent, the student may submit a written appeal to the School Dean. If the grievance is not resolved by the School Dean's decision, the student may make a written appeal to the Dean of Graduate or Undergraduate Education, and the deal will appoint and convene an Academic Appeals Panel. The decision of the Academic Appeals Panel is final. The results of the academic appeals process will be distributed to all involved parties.

Copies of these rules and regulations are available to students in the Office of the Dean of Students, where staff members are available to assist students in interpreting the rules and regulations.

Incomplete Grade Policy

As per university policy, incomplete grades will be granted only for work unavoidably missed at the semester's end and only if 70% of the course work has been completed. An incomplete grade must be resolved within eight (8) weeks from the first day of the subsequent long semester. If the required work to complete the course and to remove the incomplete grade is not submitted by the specified deadline, the incomplete grade is changed automatically to a grade of **F**.

Disability Services

The goal of Disability Services is to provide students with disabilities educational opportunities equal to those of their non-disabled peers. Disability Services is located in room 1.610 in the Student Union. Office hours are Monday and Thursday, 8:30 a.m. to 6:30 p.m.; Tuesday and Wednesday, 8:30 a.m. to 7:30 p.m.; and Friday, 8:30 a.m. to 5:30 p.m.

The contact information for the Office of Disability Services is:
The University of Texas at Dallas, SU 22
PO Box 830688
Richardson, Texas 75083-0688
(972) 883-2098 (voice or TTY)

Essentially, the law requires that colleges and universities make those reasonable adjustments necessary to eliminate discrimination on the basis of disability. For example, it may be necessary to remove classroom prohibitions against tape recorders or animals (in the case of dog guides) for students who are blind. Occasionally an assignment requirement may be substituted (for example, a research paper versus an oral presentation for a student who is hearing impaired). Classes enrolled students with mobility impairments may have to be rescheduled in accessible facilities. The college or university may need to provide special services such as registration, note-taking, or mobility assistance.

It is the student's responsibility to notify his or her professors of the need for such an accommodation. Disability Services provides students with letters to present to faculty members to verify that the student has a disability and needs accommodations. Individuals requiring special accommodation should contact the professor after class or during office hours.

Religious Holy Days

The University of Texas at Dallas will excuse a student from class or other required activities for the travel to and observance of a religious holy day for a religion whose places of worship are exempt from property tax under Section 11.20, Tax Code, Texas Code Annotated.

The student is encouraged to notify the instructor or activity sponsor as soon as possible regarding the absence, preferably in advance of the assignment. The student, so excused, will be allowed to take the exam or complete the assignment within a reasonable time after the absence: a period equal to the length of the absence, up to a maximum of one week. A student who notifies the instructor and completes any missed exam or assignment may not be penalized for the absence. A student who fails to complete the exam or assignment within the prescribed period may receive a failing grade for that exam or assignment.

If a student or an instructor disagrees about the nature of the absence [i.e., for the purpose of observing a religious holy day] or if there is similar disagreement about whether the student has been given a reasonable time to complete any missed assignments or examinations, either the student or the instructor may request a ruling from the chief executive officer of the institution, or his or her designee. The chief executive officer or designee must take into account the legislative intent of TEC 51.911(b), and the student and instructor will abide by the decision of the chief executive officer or designee.

These descriptions and timelines are subject to change at the discretion of the Professor.