# PHYC 521, FALL 2012

## GENERAL INFORMATION

Instructor: Dr. Huaiyu "Mike" Duan, duan@unm.edu, P&A 1144, 505-277-1508
Instructor's office hour: Tuesday morning or by appointment, P&A 1144
TA: Xiaodong Qi, qxd@unm.edu.
TA's office hour: 1:00 -- 2:00 PM on Wednesday, the lobby next to the department front office.
Class schedule: 9:30 -- 10:45 AM on Monday and Wednesday, P&A 5.
Problem session (PHYC551.057): 7:00 -- 8:30 PM on Wednesday, P&A 184.
Make sure you can receive emails from your UNM email address *every weekday*.
This course is administered through WebCT (http://vista.unm.edu/webct). Lecture notes, calendar, home assignments, exams and solutions will all be posted in WebCT.

## TEXTBOOK AND LECTURE NOTES

We will use *Principles of Quantum Mechanics* by R. Shankar (2nd edition, published by Springer, ISBN 978-0-306-44790-7) as the main textbook. However, we will not follow the exact sequence of the chapters. *Skeleton* lecture notes and supplementary materials (if any) will be distributed through WebCT.
A couple of reference books that you may find useful:

- ★ *Quantum Mechanics, vol. I&II,* by C. Cohen-Tannoudji, B. Diu, and F. Laloë (another popular textbook used by some instructors).
- ★ *Modern Quantum Mechanics* by J. J. Sakurai & J. Napolitano (a textbook used by some instructors for QM II).
- ★ *A Modern Approach to Quantum Mechanics* by J. S. Townsend (a popular undergraduate textbook).

## HOMEWORK, PROBLEM SESSIONS, EXAMS AND GRADES

There will be one home assignment approximately every week. Home assignments are due at the beginning of the problem sessions unless otherwise notified. Your grade for homework = (sum of all your homework scores)/(maximum total homework score) × 110%. There will be **NO MAKEUP ASSIGNMENT**, and **NO LATE ASSIGNMENT** is accepted. The solution for each assignment is posted in WebCT after the assignments have been collected. *The grades of home assignments are not curved*.
There will be **three equally weighted exams**. The first two exams will be held during problem sessions or lecture hours on **September 19** and **October 24**. The date of the last exam will be decided after exam 2. The exams are strictly **CLOSED-BOOK**, i.e. no cheat sheet or calculator. *The grades of each exam are curved*. (Your grades may be curved up or down relative to the raw score.)
There will be short (~10 minutes), closed-book quizzes focusing on the fundamental concepts and frequently used formulas once every four lectures. Your final grade for quizzes = (sum of all your quiz scores)/(maximum total quiz score) × 110%. There will be **NO MAKEUP QUIZ**.
*You **should** register for the problem session*. Home assignments will be distributed during the problem sessions as well as through WebCT. During a problem session you will work on one or two of the homework problems in groups of 3 or 4. To prepare you for the exams, *the problem sessions will also be closed-book*.
Your final grade = (homework)×40% + (exam 1)×18% + (exam 2)×18% + (exam 3)×18% + (quiz)×6% .
The scales for letter grades are: A+ (≥100), A (95–99), A- (90–94), B+ (85–89), B (80–84), B- (75–79), C+ (70–74), C (65–69), C- (60–64), F (≤59).
You will receive *Credit* for the problem session as long as you register and show up for more than 60% of the time.

## TOPICS AND PREREQUISITES

The main goal of *Quantum Mechanics I* is to help you understand the principles of quantum mechanics. We will use two-state systems and 1D systems as examples to illustrate these principles. We will also learn how to deal with 3D systems using the concept of angular momentum.

This course assumes that you have solid background of undergraduate *Quantum Mechanics* (PHYC491/492) and *(Mathematical) Methods of Theoretical Physics* (PHYC466). You may encounter a steep learning curve if the prerequisites are not met.

This course is NOT intended to prepare you for the quantum prelim. You should attend PHYC491/492 instead if you want to prepare for the prelim.

## TENTATIVE SCHEDULE

Below is a **TENTATIVE** schedule for this semester. Look at the **CALENDAR** in WebCT for the actual schedule.

A lecture number in the shaded/orange background indicates a quiz in the beginning of that lecture.

| WEEK | LEC | DATE | TOPIC | BOOK |
|---|---|---|---|---|
| 1 | 1 | 8/20 | The Hilbert space of finite dimensions | 1.1-3, 1.5-7 |
| | 2 | 8/22 | Physical measurements | 1.4, 1.8-9 |
| 2 | 3 | 8/27 | The Hilbert space of infinite dimensions | 1.10 |
| | 4 | 8/29 | Postulates of quantum mechanics | 4.1-2 |
| 3 | | 9/3 | **LABOR DAY** | |
| | 5 | 9/5 | Two-state systems | 4.3 |
| 4 | 6 | 9/10 | | |
| | 7 | 9/12 | 1D square potential | 5.1-5.6 |
| 5 | 8 | 9/17 | | |
| | | 9/19 | **EXAM I** | |
| 6 | 9 | 9/24 | | |
| | 10 | 9/26 | The classical limit | Chap 6 |
| 7 | 11 | 10/1 | The Heisenberg Uncertainty relations | Chap 9 |
| | 12 | 10/3 | | |
| 8 | 13 | 10/8 | Variational method | 16.1 |
| | 14 | 10/10 | WKB method | 16.2 |
| 9 | 15 | 10/15 | Harmonic oscillator (coordinate basis) | 7.1-3 |
| | 16 | 10/17 | Harmonic oscillator (energy basis) | 7.4-5 |

| WEEK | LEC | DATE | TOPIC | BOOK |
|---|---|---|---|---|
| 10 | 17 | 10/22 | Harmonic oscillator (coherent basis) | |
| | | 10/24 | **EXAM II** | |
| 11 | 18 | 10/29 | Systems with N degrees of freedom | 10.1-2 |
| | 19 | 10/31 | Density matrix, pure and mixed state | |
| 12 | 20 | 11/5 | | |
| | 21 | 11/7 | Eigenvalue problem of $L_z$ | 12.3 |
| 13 | 22 | 11/12 | Eigenvalue problem of $L^2$ and $L_z$ | 12.5 |
| | 23 | 11/14 | | |
| 14 | 24 | 11/19 | Solution of rotationally invariant problems | 12.6 |
| | 25 | 11/21 | Hydrogen atom | Chap 13 |
| 15 | 26 | 11/26 | | |
| | 27 | 11/28 | | |
| 16 | 28 | 12/3 | Spin | Chap 14 |
| | 29 | 12/5 | | |
| 17 | | | **EXAM III** | |

Important Deadlines:

**8/31** Last day to add courses or change sections

**9/7** Last day to drop a course without a grade

**9/14** Last day to change grading options

**11/9** Last day to withdraw without approval of college dean

**12/7** Last day to withdraw from a course with approval of college dean