SYLLABUS (Subject to Modification)
PHYS. 5510.001
Quantum Mechanics II

Dr. Sandra Quintanilla
Spring 2024
Lecture: MWF 9:00 – 9:50 a.m.
Physics 311

Office: Physics 309
email: squintanilla@unt.edu
Phone: 565-4739
Office hours: MW 10:00 a.m. – 11:00 a.m.
or by appointment

On terms exam days Phys. 311 available 8:00 a.m. – 9:50 a.m. Term exams are 8:20 a.m. to 9:50 a.m.

Prerequisite(s): PHYS. 5500 Quantum Mechanics I

Recommended Prerequisites:
MATH. 2700: Linear Algebra and Vector Geometry
MATH. 3410: Differential Equations I
MATH. 3420: Differential Equations II
PHYS. 3310: Mathematical Methods in the Physical Sciences
PHYS. 4310: Quantum Mechanics

Required Text:

- *Principles of Quantum Mechanics*, R. Shankar, 2^{nd} Edition, (Springer, ISBN: 978-1-4757-0578-2. ISBN: 978-1-4757-0576-8 (eBook). DOI : 10.1007/978-1-4757-0576-8)

Useful Resources:

- *Introduction to Quantum Mechanics*, David J. Griffiths and Darrell F. Schroeter, 3^{rd} Edition.
- *Quantum Mechanics*, Eugen Merzbacher, 3^{rd} Edition, (John Wiley & Sons, Inc. 1961, 1970, 1988, 1998) ISBN: 0-471-88702-1.
- *Quantum Mechanics*, Leonard I. Schiff, (International Student Edition, McGraw-Hill International Book Company, 1968) ISBN 9-07-085643-5.
- *Quantum Mechanics*, Albert Messiah, Two volumes bound as one, Dover Publications, Inc., ISBN-13: 978-0-486-78455-7; ISBN-10: 0-486-78455-X
- *Quantum Mechanics*, Claude Cohen-Tannoudji, Bernard Diu, Frank Laloë, Volume I and II, A Wiley & Sons, New York, London, Sydney, Toronto, Hermann Publishers in arts and science Paris.
- *Physics of Atoms and Molecules*, B. H. Bransden and C. J. Joachain, 2^{nd} Edition, 2003 Prentice Hall, An imprint of Pearson Education, Harlow, England, London, New York, ISBN 0582 35692 X
- *Mathematical Methods for Physicists, A Comprehensive Guide*, 7th Edition, George B. Arfken, Hans J. Weber, and Frank E. Harris, Academic Press, An imprint of Elsevier elsevierdirect.com, ISBN-13: 978-0123846549, ISBN-10: 0123846544.
- *NIST Digital Library of Mathematical Functions,* http://dlmf.nist.gov/
- http://www.demonstrations.wolfram.com/search.html?query=Quantum Mechanics

Course Content: 3 hours. Scattering theory; spin, angular momentum; WKB and variational method; time-independent and time-dependent perturbation theory; identical

particles; applications; relativistic waves equations.

Course Content for Phys. 5500: Fundamentals of quantum theory. Foundations of wave mechanics, wavepackets and the uncertainty principles. Schrödinger equation, one-dimensional problems, operators and eigenfunctions, three-dimensional problems, angular momentum and spin.

Course Objectives for both Phys. 5500 and Phys. 5510:

- To have a solid foundation in Quantum Mechanics.

Exams: There are three term exams and one final exam. Exams can be based on the text reading, any other assigned readings, class lectures, homework, *Canvas* postings, and any additional material given. The exams are closed book exams and calculators may not be used unless approved by ODA. On days on Term Exams, the classroom Phys. 311 is available from 8:00 a.m. Term exams are scheduled from 8:20 a.m. to 9:50 a.m.

Homework: In general weekly homework to submitted as a pdf file on *Canvas* by the deadline. For homework assignments, please see *Canvas*. I plan to drop the lowest homework score. No-late homework is accepted unless permission granted by myself. If you are sick, please email me an official medical note.

Reading and Preparation:

- Read appropriate sections of the book before class.
- Read from additional material if suggested.
- Please look at Mathematica files and/or pdf files that are referenced or given on *Canvas*.
- Read class notes and book after class.

Quizzes: Quizzes are to be posted *Canvas*. Please submit your quiz as a pdf file on *Canvas*. I plan to drop the lowest quiz score.

Grading:

Three unit exam average	60%	A: 90-100
Homework	15%	B: 80-89
Quizzes	5%	C: 70-79
Comprehensive final	20%	D: 60-69
	100%	F: < 60

Extra credits assignments maybe given at the discretion of the instructor.

Canvas: Please check *Canvas* daily Monday-Friday for possible announcements, Mathematica files, references, quizzes, homework assignments, etc.

Attendance: *Required* attendance for class unless a student has a legitimate reason not to attend a particular class or classes. Participation in class is important. Attending class should be helpful with your learning and with your motivation. If you plan to miss a class or if you miss a class, please email me.

Office Hours: Please come to my office Phys. 309 during office hours, or by appointment, during the first three weeks of class. If you get less than 60% on any exam, please see me. If you are having trouble with this course, please come to see me during office hours or please make an appointment to see me.

Technology:
From the unt_syllabus_template, https://clear.unt.edu/teaching-resources/unt-syllabus-template: "To fully participate in this class, students will need internet access to reference content on the Canvas Learning Management System." Have access to Mathematica. The University has a site license for Mathematica.

Electronics: Cell phones, iPads, tablets, etc, are to be turned off during class other than for a class related activity or approved by ODA.

Student Evaluation System: "Student feedback is important part of participation in this course. The student evaluation of instruction is a requirement for all organized classes at UNT." The plan is for the SPOT survey to be available to you end of the semester. It gives "you with an opportunity to evaluate how this course is taught."
https://vpaa.unt.edu/file/33330
http://vpaa.unt.edu/spot
https://vpaa.unt.edu/spot/calendars/spring24calendars

Registration: Office of the Registrar: https://registrar.unt.edu/
https://registrar.unt.edu/registration/spring-registration-guide

Academic Calendar 2023-2024:
https://registrar.unt.edu/registration/spring-academic-calendar.html

Policies, Procedures and Resources:
https://teachingcommons.unt.edu/teaching-handbook/definitions-and-policies/
https://teachingcommons.unt.edu/teaching-handbook/definitions-and-policies/unt-teaching-policies

Emergency Notifications & Procedures:
https://teachingcommons.unt.edu/teaching-handbook/definitions-and-policies/

unt-teaching-policies/emergency-notifications-procedures
"Emergency Notification & Procedures. UNT uses a system called Eagle Alert to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Blackboard for contingency plans for covering course materials." [Blackboard → Canvas ?]
https://emergency.unt.edu/
https://emergency.unt.edu/emergency-guidelines-0
https://emergency.unt.edu/sites/default/files/physics_building.pdf
If there is a tornado or hurricane, please proceed to the physics basement.

Student Academic Integrity:
https://policy.unt.edu/policy/06-003
https://teachingcommons.unt.edu/teaching-handbook/definitions-and-policies
/unt-teaching-policies/academic-integrity
https://policy.unt.edu/sites/default/files/06.003
%20Student%20Academic%20Integrity.pdf
https://policy.unt.edu/sites/default/files/06.049
%20Course%20Syllabi%20Requirements%20-%20Supplement.pdf

Division of Student Affairs: https://studentaffairs.unt.edu/office-disability-access

Disabilities Accommodation:
From the unt_syllabus_template,
https://clear.unt.edu/teaching-resources/unt-syllabus-template:
"The University of North Texas makes reasonable academic accommodation for students with disabilities. Students seeking reasonable accommodation must first register with the Office of Disability Access (ODA) to verify their eligibility. If a disability is verified, the ODA will provide you with a reasonable accommodation letter to be delivered to faculty to begin a private discussion regarding your specific needs in a course. You may request reasonable accommodations at any time; however, ODA notices of reasonable accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of reasonable accommodation for every semester and must meet with each faculty member prior to implementation in each class. Students are strongly encouraged to deliver letters of reasonable accommodation during faculty office hours or by appointment. Faculty members have the authority to ask students to discuss such letters during their designated office hours to protect the privacy of the student. For additional information, refer to the Office of Disability Access website (http://www.unt.edu/oda). You may also contact ODA by phone at (940) 565-4323."
https://digitalstrategy.unt.edu/clear/

Disability Accommodation for Students and Academic Units:
https://policy.unt.edu/policy/16-001
https://policy.unt.edu/sites/default/files/16.001%20Disability%20Accommodations
%20for%20Students%20and%20Academic%20Units.pdf
https://policy.unt.edu/policy/06-049
https://policy.unt.edu/sites/default/files/06.049_Standard%20Syllabus
%20Policy%20Statements_supplement.pdf

"A. Academic Integrity Standards and Consequences. According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University.

B. ADA Accommodation Statement. UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding ones specific course needs. Students may request accommodations at any time, however, ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website at disability.unt.edu."

https://policy.unt.edu/sites/default/files/06.049%20Course%20Syllabi%20Requirements.pdf

https://policy.unt.edu/sites/default/files/06.049%20Course%20Syllabi%20Requirements%20-%20Supplement.pdf

In attachment of an email by the Physics Dept. Main Office: "The University of North Texas is on record as being committed to both the spirit and letter of federal equal opportunity legislation; reference Public Law 92-112 The Rehabilitation Act of 1973 as amended. With the passage of new federal legislation entitled Americans with Disabilities Act (ADA), pursuant to section 504 of the Rehabilitation Act, there is renewed focus on providing this population with the same opportunities enjoyed by all citizens.

https://cos.unt.edu/

https://physics.unt.edu/

1-1	W	Jan. 17	Chp. 10	Systems with N Degrees of Freedom
1-2	F	Jan. 19	Chp. 10	Systems with N Degrees of Freedom
2-3	M	Jan. 22	Chp. 10	Systems with N Degrees of Freedom
2-4	W	Jan. 24	Chp. 12	Rotational Invariance and Angular Momentum
2-5	F	Jan. 26	Chp. 12	Rotational Invariance and Angular Momentum
3-6	M	Jan. 29	Chp. 12	Rotational Invariance and Angular Momentum
3-7	W	Jan. 31	Chp. 12	Rotational Invariance and Angular Momentum
3-8	F	Feb. 2	Chp. 12	Rotational Invariance and Angular Momentum
4-9	M	Feb. 5	Chp. 14	Spin
4-10	W	Feb. 7	Chp. 14	Spin
4-11	F	Feb. 9	Chp. 14	Spin
5-12	M	Feb. 12	Chp. 14	Spin
5-13	W	Feb. 14	Chp. 14	Spin
5-14	F	Feb. 16	Exam 1	Chps. 10, 12, 13, & 14
6-15	M	Feb. 19	Chp. 15	Addition of Angular Momenta
6-17	W	Feb. 21	Chp. 15	Addition of Angular Momenta
6-19	F	Feb. 23	Chp. 15	Addition of Angular Momenta
7-20	M	Feb. 26	Chp. 16	Variational and WKB Methods
7-21	W	Feb. 28	Chp. 16	Variational and WKB Methods
7-22	F	Mar. 1	Chp. 16	Variational and WKB Methods
8-21	M	Mar. 4	Chp. 16	Variational and WKB Methods
8-22	W	Mar. 6	Chp. 16	Variational and WKB Methods
8-23	F	Mar. 8	Chp. 16	Variational and WKB Methods

Spring Break, March 11^{th} -17^{th}

9-24	M	Mar. 18	Chp. 17	Time-Independent Perturbation Theory
9-25	W	Mar. 20	Chp. 17	Time-Independent Perturbation Theory
9-26	F	Mar. 22	Chp. 17	Time-Independent Perturbation Theory
10-27	M	Mar. 25	Chp. 17	Time-Independent Perturbation Theory
10-28	W	Mar. 27	Chp. 17	Time-Independent Perturbation Theory
10-29	F	Mar. 29	Exam 2	Chps. 15,16 & 17
11-30	M	Apr. 1	Chp. 18	Time-Dependent Perturbation Theory
11-31	W	Apr. 3	Chp. 18	Time-Dependent Perturbation Theory
11-32	F	Apr. 5	Chp. 18	Time-Independent Perturbation Theory
12-33	M	Apr. 8	Chp. 19	Scattering Theory
12-34	W	Apr. 10	Chp. 19	Scattering Theory
12-35	F	Apr. 12	Chp. 19	Scattering Theory
13-36	M	Apr. 15	Chp. 19	Scattering Theory
13-37	W	Apr. 17	Chp. 19	Scattering Theory
13-38	F	Apr. 19	Chp. 19	Scattering Theory
14-39	M	Apr. 22	Chp. 20	The Dirac Equation
14-40	W	Apr. 24	Chp. 20	The Dirac Equation
14-41	F	Apr. 26	Exam 3	Chps. 17, 18 & 19
15-42	M	Apr. 29	Chp. 20	The Dirac Equation
15-43	W	May 1	Review	

Final Exam: Wednesday, May 8, 2023, 8:00 - 10:00 a.m.