

University of Southern California (USC)
Dornsife College of Letters, Arts and Sciences/Department of
Physics & Astronomy

PHYS 173: Applied Physics III: Topics in Modern Physics

Section 50790, Fall 2021

Instructor: Hamid R. Chabok, Ph.D.
Office Address: SHS 361
Email: chabok@usc.edu
Class schedule: Twice a week on Monday/Wednesday 10:00-10:50 am in SLH 102
Office hours: Twice a week on Monday/Wednesday 09:00 -09:30 AM
Other appointments should be scheduled in advance.

Course Description

This course will give an introductory understanding of quantum mechanics, statistical mechanics, and solid-state physics, with emphasis on applications in the areas of applied physics and engineering. It includes the ideas behind quantum computers and quantum information processing.

Required Course Materials

Required for lectures:

- **Textbook:** Introduction to Quantum Mechanics 3rd Edition, by David J. Griffiths and Darrell F. Schroeter.

Learning Objectives

By the end of this course, you will be able to:

- Explain the postulates of quantum theory and apply them to simple quantum systems;
- Describe quantum states and operators in terms of complex vectors and matrices, and represent them in Dirac notation;

- Find the time evolution of finite-dimensional systems (such as qubits) by solving the Schrödinger equation, and calculate the probabilities of measurement outcomes;
- Express quantum computations by quantum logic circuits, explain how several well-known quantum algorithms work and determine their computational complexity;
- Describe the evolution of particles in space by the Schrödinger equation for continuous variables, and solve this equation for several simple systems;
- Incorporate open-system effects such as decoherence and loss into quantum theory using density operators, and use this to describe quantum systems at nonzero temperatures;
- Carry out experimental demonstrations of basic quantum effects;
- Run simulations of small-scale quantum systems in Mathematica.

Assignments and Grading Policy

1. Grades are based on homework, quizzes, two midterms and final exam.
2. There **are 5 quizzes**, each has 3 points.
3. There are 4 homework, each has 2.5 points.
4. There are 2 midterm exams, each has 10 points.

The overall grade will be determined as follows:

Assignment	Percentage
Final Exam	35%
Midterm Exam I	10%
Midterm Exam II	10%
Quiz (x5)	15%
Homework (x4)	10%
Labs	20%
Total:	100%

Grading Scale

Letter Grade	Quality Grade	Percentage	Letter Grade	Quality Grade	Percentage
A	4.0	≥ 93%	C	2.0	≥ 73%
A-	3.7	≥ 90%	C-	1.7	≥ 70%
B+	3.3	≥ 87%	D+	1.3	≥ 67%
B	3.0	≥ 83%	D	1.0	≥ 63%
B-	2.7	≥ 80%	D-	0.7	≥ 60%

Letter Grade	Quality Grade	Percentage	Letter Grade	Quality Grade	Percentage
C+	2.3	≥ 77%	F	0.0	< 60%

COURSE PACING GUIDE/SCHEDULE OF ASSIGNMENTS

- ✓ Participation in class discussions and asking about unclear subjects is extremely important and encouraged.
- ✓ Students are responsible for all information given in class whether they are there or not. Students are expected to attend the class on time and wait until the end of the lecture.
- ✓ The final exam must be taken in order to pass the class.

Course Communication

Interaction with Instructor

The Instructor will make every effort to communicate frequently with students through announcements and postings within the Blackboard site. Questions can be sent to the Instructor via email [chabok@usc.edu].

As a student, you should expect to receive assignment feedback and responses to postings within 48 hours. The Instructor will post an announcement alerting the students if he will be unavailable for more than a day.

Turnaround/Feedback

During the week (M-F) I will check Messages and emails several times a day. If you have a concern and send me an email message, you can expect a response within two days.

Course & University Policies

Students with Disabilities

Any Student requesting academic accommodations based on a disability is required to register with Disability Services and Programs (DSP) each semester. A letter of verification for approved accommodations can be obtained from DSP. Please be sure the letter is delivered to me (or to TA) as early in the semester as possible. DSP is located in STU 301 and is open 8:30 a.m. - 5:00 p.m., Monday through Friday. http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html, (213) 740 - 0776n

(Phone), (213) 740-6948 (TDD only), (213) 740-8216 (FAX), ability@usc.edu

Academic Honesty/Student Conduct

Many incidents of plagiarism result from students' lack of understanding about what constitutes plagiarism. However, you are expected to familiarize yourself with USC's policy on plagiarism. All work you submit must be your own scholarly and creative efforts. At USC, plagiarism is defined as the act of using ideas, words, or work of another person or persons as if they were one's own, without giving proper credit to the original sources.

As a USC student, you must behave with honor and integrity at all times. The University in its quest for truth and knowledge embraces honesty and integrity. These fundamental values must not be compromised. The trust and respect among professors, students and the society need to be vigilantly protected. Cheating and plagiarism can be neither justified nor condoned as this would destroy the ideals and purposes of higher education. Students enter the University to gain the knowledge and tools necessary for participation in society. Academic integrity is one foundation for a society based on trust and honesty. Therefore, the University takes seriously its responsibility for academic honesty. For more information, refer to (www.usc.edu/dept/publications/SCAMPUS/)

FACULTY LIASION

All classes in the Department of Physics & Astronomy have an assigned Faculty Liaison to serve students as a confidential, neutral, informal, and independent resource when they wish to discuss issues concerning their course without directly confronting their instructor. The Faculty Liaison for this class is Dr. Jack Feinberg, feinberg@usc.edu, 213-740-1134, SSC 327

COVID REQUIREMENTS

Students are expected to comply with all aspects of USC's COVID-19 policy. Failure to do so may result in removal from the class and referral to Student Judicial Affairs and Community Standards. <https://coronavirus.usc.edu/>

Tentative Course Outline/Schedule of Assignments

Week	Topic	Readings, Assignments, Deadlines:
Week 1 08/23, 08/25	<ul style="list-style-type: none"> Wave Optics 	<ul style="list-style-type: none"> Expected readings: Course Syllabus Assignment: Syllabus Quiz (Quiz #1) uploaded on Mon. Assignment Due: N/A Prepare for topic: Read Slides for Week 1
Week 2 08/30, 09/01	<ul style="list-style-type: none"> Introduction to Quantum Physics 	<ul style="list-style-type: none"> Expected readings: Week 1 lecture materials Assignment: N/A Assignment Due: Quiz #1 on Fri. (09/03) 10:00 am Prepare for topic: Read Slides for Week 2
Week 3 09/06, 09/08	<ul style="list-style-type: none"> Linear algebra Mon: Labor Day 	<ul style="list-style-type: none"> Expected readings: Week 2 lecture materials Assignment: Homework #1 assigned on Wed. Assignment Due: N/A Prepare for topic: Read Slides for Week 3
Week 4	<ul style="list-style-type: none"> Finite dimensional systems 	<ul style="list-style-type: none"> Expected readings: Week 3 lecture materials Assignment: Quiz #2 on Wed. Assignment Due: Due: Homework #1 on Mon. 10:00 am

Week	Topic	Readings, Assignments, Deadlines:
09/13, 09/15		Prepare for topic: Read Slides for Week 4
Week 5 09/20, 09/22	<ul style="list-style-type: none"> Quantum dynamics and measurement Wed: Midterm Exam I 	<ul style="list-style-type: none"> Expected readings: Past Weeks lecture materials Assignment: N/A Assignment Due: N/A Prepare for topic: N/A
Week 6 09/27, 09/29	<ul style="list-style-type: none"> Joint systems 	<ul style="list-style-type: none"> Expected readings: N/A Assignment: N/A Assignment Due: N/A Prepare for topic: Read Slides for Week 6
Week 7 10/04, 10/06	<ul style="list-style-type: none"> Entanglement and quantum communication 	<ul style="list-style-type: none"> Expected readings: Week 6 lecture materials Assignment: Homework #2 assigned on Mon. Assignment Due: N/A Prepare for topic: Read Slides for Week 7
Week 8 10/11, 10/13	<ul style="list-style-type: none"> Applications-I 	<ul style="list-style-type: none"> Expected readings: Week 7 lecture materials Assignment: Quiz #3 on Wed. Assignment Due: Homework #2 on Mon. 10:00 am Prepare for topic: Read Slides for Week 8
Week 9 10/18, 10/20	<ul style="list-style-type: none"> Applications-I Wed: Midterm Exam II 	<ul style="list-style-type: none"> Expected readings: Past Weeks lecture materials Assignment: N/A Assignment Due: N/A Prepare for topic: N/A
Week 10 10/25, 10/27	<ul style="list-style-type: none"> Free particle in space 	<ul style="list-style-type: none"> Expected readings: N/A Assignment: N/A Assignment Due: N/A Prepare for topic: Read Slides for Week 10
Week 11 11/01, 11/03	<ul style="list-style-type: none"> Bound states 	<ul style="list-style-type: none"> Expected readings: Week 10 lecture materials Assignment: Homework #3 assigned on Mon. Assignment Due: N/A Prepare for topic: Read Slides for Week 11
Week 12	<ul style="list-style-type: none"> Central potentials 	<ul style="list-style-type: none"> Expected readings: Week 11 lecture materials Assignment: Quiz #4 on Wed. Assignment Due: Homework #3 on Mon. 10:00 am

Week	Topic	Readings, Assignments, Deadlines:
11/08, 11/10		<ul style="list-style-type: none"> Prepare for topic: Read Slides for Week 12
Week 13 11/15, 11/17	<ul style="list-style-type: none"> Central potentials 	<ul style="list-style-type: none"> Expected readings: Week 12 lecture materials Assignment: Homework #4 assigned on Mon. Assignment Due: N/A Prepare for topic: Read Slides for Week 13
Week 14 11/22, 11/24	<ul style="list-style-type: none"> Applications-II Wed: Thanksgiving Holiday 	<ul style="list-style-type: none"> Expected readings: Week 13 lecture materials Assignment: Quiz #5 on Mon. Assignment Due: Homework #4 on Mon. 10:00 am Prepare for topic: Read Slides for Week 14
Week 15 11/29, 12/01	<ul style="list-style-type: none"> Comprehensive Review 	<ul style="list-style-type: none"> Expected readings: Past Weeks lecture materials Assignment: N/A Assignment Due: N/A Prepare for topic: N/A
Week 16	<ul style="list-style-type: none"> Final Exam: 	<ul style="list-style-type: none">

Calendar of Assignments & Dates

Due Date	Assignment	#Points
09/03	Syllabus Quiz (Quiz #1) on Wed. 10:00 am	3
09/06	Holiday: Labor Day	
09/13	Homework #1, 10:00 am	2.5
09/15	Quiz #2	3
09/22	Midterm Exam I	10
10/11	Homework #2, 10:00 am	2.5
10/13	Quiz #3	3
10/20	Midterm Exam II	10

11/08	Homework #3, 10:00 am	2.5
11/10	Quiz #4	3
11/22	Homework #4, 10:00 am	2.5
11/22	Quiz #5	3
11/24	Holiday: Thanksgiving Holiday	
12/13 08-10am	Final Exam	35

³Final Examination Policy

Student Scheduling Conflicts

No student is permitted to omit or take early a final examination and no instructor is authorized to permit a student to do so.

Students should plan in advance to avoid scheduling conflicts in their final examinations. If a student is scheduled for two final examinations at the same time, the student should request to take one of the examinations on a different day or time. If a student is scheduled for more than two final examinations in one day, the student may request to take one of the exams on a different day or time. In either situation the student must contact the professors involved no later than two weeks prior to the scheduled examination date and request an accommodation. If an accommodation cannot be arranged, the student should contact USC Testing Services at testing@usc.edu or (213) 740-7166 for assistance.

Faculty are reminded that grades are due 96 hours after the university-scheduled final examination day and time. Therefore, it might not be possible to accommodate late student requests for an alternate, makeup final examination after the published examination period.

Religious Observance Conflicts

When a final examination is scheduled at a time that conflicts with a student's observance of a holy day, faculty members should accommodate a request for an alternate examination date and time. A student must discuss a final examination conflict with the professor no later than two weeks prior to the scheduled examination date to arrange an acceptable alternate examination date and time.

The student and/or professor may reach out to the Office of Religious Life (213-740-6110 or vasoni@usc.edu, Dean of Religious Life) for guidance.

Documented Emergencies

In the case of a documented emergency that occurs after the withdrawal date and/or during the final exam period, students should consult the professor about receiving a grade of Incomplete

(IN) for the semester. Faculty and students alike should refer to the rules regarding the mark of Incomplete at the time of the request.

The Registrar's recommended definition of emergency:

“An unforeseeable situation or event beyond the student’s control that prevents her from taking the final examination or final summative experience.” Based on this definition, a student may not request an IN before the withdrawal deadline. The rationale is that the student has the option to drop the course until the withdrawal date. The grade of IN exists so there is a remedy for illness or emergency, which occurs after the deadline to withdraw.

³*From USC website*