

PHYS 3701A Course Outline

Term: Fall 2022

Prerequisites: PHYS 2604, MATH 2000 [1.0] (may be taken concurrently), or MATH 2004 or MATH 2008, and MATH 3705 (may be taken concurrently), or permission of the Department.

NOTE: The initial lectures will be delivered online via zoom and will be switched to in person in the building/room indicated below as soon as is possible. The zoom link for the initial lectures will be provided on Brightspace.

General Information

Class: Tuesday and Thursday 10:05 – 11:25 in Loeb B146

Instructor: Professor Graham (kevin_graham@carleton.ca)

Office-Hours: Herzberg room 3322 Tuesday 11:30 – 12:30 or by appointment

Note that, until lectures are in-person, office-hours will be virtual and by appointment.

Teaching- Assistant: Cyrus Orkish (cyrusrobertsonorkish@cmail.carleton.ca)

Learning Objectives

Students will be able to frame a problem and solve it in a quantitative way, using as tools their knowledge of physics, mathematics, and other areas.

Students will be able to use tools from related fields such as mathematics.

Students will be introduced to the main concepts of non-relativistic quantum mechanics.

Students will develop an understanding of the underlying foundations and build both conceptual and quantitative ability to understand the physics of quantum mechanics.

Course Organization

The course will roughly cover the first 4 Chapters of Griffiths plus, time permitting, select material from Chapter 5. A tentative schedule of topics to be covered in each lecture is provided below. It is essential that students read the textbook sections and ideally before the corresponding material is covered in the lectures.

At the end of each lecture, a short survey will be provided to assess the general level of understanding of the lecture material. The surveys will not contribute to the overall grade determination. These will be conducted via Poll Everywhere and the link is provided in Brightspace.

As indicated below, the evaluation will consist of Assignments, a Midterm, and a Final exam.

In addition to the scheduled lectures, there will be a weekly tutorial session run by Cyrus (course TA). The day/time of the tutorial session will be determined by poll. If possible, the tutorials will be run in person...but if this proves difficult to schedule, they will, instead, be run remotely via zoom.

Required and Supplementary Texts

Required: Introduction to Quantum Mechanics, D Griffiths and D Schroeter

Supplementary:

Introductory Quantum Mechanics, R Liboff
Quantum Physics, S Gasiorowicz
Quantum Physics, L Schiff
Modern Quantum Mechanics, JJ Sakurai and J Napolitano

Course Evaluation

The final grades will be determined from the better of

A) 40% assignments
20% midterm
40% final exam

or

B) 40% assignments
60% final exam

There will be approximately 10 assignments scheduled weekly with the tentative schedule provided below. The assignments will be posted as .pdf files on Brightspace.

Assignment solutions must be posted as .pdf files to Brightspace, but can be scanned versions of hand-written solutions.

Assignments must be **handed in by the indicated due date or they will not be graded and receive a mark of zero**. The lowest assignment grade will not be included in the overall assignment grade calculation.

The midterm exam will occur **October 20th in class**. The **midterm exam is not optional and must be attempted to successfully pass the course**.

The final exam will occur during the final exam period as scheduled by the university.

Approximate Course Schedule

Chapter Sections	Tuesday	Thursday
September		
Course Introduction		8 - Course details - Pre-QM recap
Appendix A 1.1-1.3 and 3.6.2	13 - Math Recap - Dirac Notation	14 - Schrodinger eqn - Interp./probability
1.3-1.4 2.5.1 2.1-2.2	20 - Operators, observables, expectation values	22 - Scattering/bound cases - Infinite square well
	27 - Infinite square well	29 – catchup/examples
October		
2.3 3.2-3.5	4 - Uncertainty principle - Operator commutation - Hermitian operators	6 - Harmonic oscillator
2.4, 2.6	11- Harmonic Oscillator	13 - Free particle
	18 - Catchup/review	20 Midterm Exam
Fall Break	25 - <i>no classes</i>	27 - <i>no classes</i>
November		
2.6 4.1	1 - Barrier/square well	3 – 3D S.E.
4.4	8 - Angular Momentum	10 – ‘Spin’
4.4	15 – A.M. and magnetic field	17 – Addition of A.M.
4.2	22 – Hydrogen atom	24 – Hydrogen atom
December		
4.2 5.1	29 - Hydrogen atom	1 – Multiparticle systems
5.1	6 – Multiparticle systems	8 - Catchup/review

Approximate Assignment Schedule

Assignment	Available	Due Date
#1	September 13	September 20
#2	September 20	September 27
#3	September 27	October 4
#4	October 4	October 11
#5	October 11	October 18
Fall Break		
#6	November 1	November 8
#7	November 8	November 15
#8	November 15	November 22
#9	November 22	November 29
#10	November 29	December 6

Land Acknowledgement

Here at Carleton University, it is important that we acknowledge that the land on which we gather is the traditional and unceded territory of the Algonquin nation.

Special Information Regarding COVID-19

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are [a number of actions you can take](#) to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's [symptom reporting protocols](#).

Masks: Carleton has paused the [COVID-19 Mask Policy](#), but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: While proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in [cuScreen](#) as soon as possible. Please

note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the [University's COVID-19 website](#) and review the [Frequently Asked Questions \(FAQs\)](#). If you have additional questions after reviewing, please contact covidinfo@carleton.ca.

Note About COVID-19 & Mental Health

The global pandemic has led to extra stress and uncertainty for everyone, and while we may all be experiencing some of the same challenges, this does not mean that we are all in the same situation. If you are struggling, please do not hesitate to reach out. I am happy to listen, and/or direct you to resources that might help. If you are finding the material in this course difficult or are encountering other challenges, the most important step you can take is to arrange to meet with me. Also remember that Carleton offers an array of mental health and well-being resources, which can be found [here](#).

University Policies

In accordance with the Carleton University Undergraduate Calendar Regulations, the letter grades assigned in this course will have the following percentage equivalents:

A+ = 90-100	B+ = 77-79	C+ = 67-69	D+ = 57-59
A = 85-89	B = 73-76	C = 63-66	D = 53-56
A- = 80-84	B- = 70-72	C- = 60-62	D- = 50-52
F = <50			

WDN = Withdrawn from the course

ABS = Student absent from final exam

DEF = Deferred

FND = (Failed, no Deferred) = student could not pass even with 100% on final exam

Academic Accommodations, Regulations, Plagiarism, Etc.

Carleton University is committed to providing access to the educational experience in order to promote academic accessibility for all individuals.

Academic accommodation refers to educational practices, systems and support mechanisms designed to accommodate diversity and difference. The purpose of accommodation is to enable students to perform the essential requirements of their academic programs. At no time does academic accommodation undermine or compromise the learning objectives that are established by the academic authorities of the University. More information can be found at:

<https://students.carleton.ca/course-outline/>

University rules regarding registration, withdrawal, appealing marks, and most anything else you might need to know can be found on the university's website, here:

<https://calendar.carleton.ca/undergrad/regulations/academicregulationsoftheuniversity/>

Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. For more details, visit the [Paul Menton Centre website](#).

Addressing Human Rights Concerns

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the [Department of Equity and Inclusive Communities](#) at equity@carleton.ca.

Religious Obligations

Please contact me with requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: <https://carleton.ca/sexual-violence-support/>

Accommodations for Missed Work

Carleton recognizes that students may be experiencing greater stress and other life factors that are not in their control. As a result, Carleton has put into place a protocol for students to apply for accommodations using a self-declaration form in the event of missed work. The form can be found at: <https://carleton.ca/registrar/wp-content/uploads/self-declaration.pdf> [Note that these forms should be used for short-term concerns related to missed work; if you are experiencing chronic, ongoing challenges which necessitate a broader solution, I recommend reaching out to the Paul Menton Centre and/or the Care Support team.](#)

For Pregnancy

Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the [Student Guide to Academic Accommodation \(PDF, 2.1 MB\)](#).

Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact me with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the [Senate Policy on Accommodation for Student Activities \(PDF, 25KB\)](#).

Academic Integrity

Academic Integrity is upholding the values of honesty, trust, respect, fairness, responsibility, and courage that are fundamental to the educational experience. Carleton University provides supports such as academic integrity workshops to ensure, as far as possible, that all students understand the norms and standards of academic integrity that we expect you to uphold. Your teaching team has a responsibility to ensure that their application of the Academic Integrity Policy upholds the university's collective commitments to fairness, equity, and integrity. (Adapted from [Carleton University's Academic Integrity Policy](#), 2021).

Examples of actions that do not adhere to Carleton's Academic Integrity Policy include:

- Plagiarism
- Accessing unauthorized sites for assignments or tests
- Unauthorized collaboration on assignment and exams

Please review the checklist [linked here](#) to ensure you understand your responsibilities as a student with respect to academic integrity and this course.

Sanctions for Not Abiding by Carleton's Academic Integrity Policy

A student who has not upheld their responsibilities under Carleton's Academic Integrity Policy may be subject to one of several sanctions. A list of standard sanctions in science can be found [here](#).

Additional details about this process can be found on [the Faculty of Science Academic Integrity website](#). Students are expected to familiarize themselves with and follow the Carleton University [Student Academic Integrity Policy](#). The Policy is strictly enforced and is binding on all students.

Student Rights & Responsibilities

Students are expected to act responsibly and engage respectfully with other students and members of the Carleton and the broader community. See the [7 Rights and Responsibilities Policy](#) for details regarding the expectations of non-academic behaviour of students. Those who participate with another student in the commission of an infraction of this Policy will also be held liable for their actions.

Student Concerns

If a concern arises regarding this course, **your first point of contact is me**: Email or drop in during student hours and I will do my best to address your concern. If I am unable to address your concern, the next points of contact are (in this order):



Note: You can also bring your concerns to [Ombuds services](#).

Assistance for Students

Academic and Career Development Services: <http://carleton.ca/sacds/>

Writing Services: <http://www.carleton.ca/csas/writing-services/>

Peer Assisted Study Sessions (PASS): <https://carleton.ca/csas/group-support/pass/>

Math Tutorial Centre: <https://carleton.ca/math/math-tutorial-centre/>

Science Student Success Centre: <https://sssc.carleton.ca/>