



PRINCIPLES OF MODERN PHYSICS (PHYS 420)

Term: Spring 2024

Professor: Phoebe Hamilton (she/her)

Office Location: PSC 3208E

Office Phone: 301-405-5970

Email: pmham@umd.edu

Office Hours: Mondays 3:30-4:30 (and by appointment – seriously, I'm always around)

TA: Deepak Sathyan (he/him)

Office location: PSC 3129

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Credits: 3

Course Dates: Jan 25, 2023 - May 9, 2023

Course Times: Tuesdays and Thursdays, 3:30-4:45 pm

Classroom: PHY (Toll Building) 1402

Course Description

An introduction to the major revolutions in physics at the beginning of the 20th century, including:

- special relativity
- quantization of light, blackbody radiation, photoelectric effect...
- deBroglie-Bohm picture of quantum theory
- Schrödinger wave equation
- quantum mechanics in 1-d
- Reflection and transmission problems, nuclear decay
- hydrogenic atoms
- periodic potentials, introduction to band theory of semiconductors.

This course is specifically targeted for non-physics majors in the physical sciences and engineering.

Learning Outcomes

After successfully completing this course you will be able to:

- Articulate and apply the principle of relativity and the contrast between the Galilean relativity encoded in Newton's mechanics and the relativity encoded in the laws of electrodynamics.
- Analyze the consequences of Einstein's special relativity in terms of Lorentz transformations and frame-invariant quantities, and the applications to precision timekeeping.
- Articulate and apply models of atomic structure to the elementary chemistry of the chemical elements and periodic table
- Apply the central ideas of nonrelativistic quantum mechanics to real phenomena underlying modern technology.

Required Resources

- Course Website: elms.umd.edu
- Book: Modern Physics, R. A. Serway, C. J. Moses and C. A. Moyer, 3rd edition, Thomson, Brooks and Cole, 2005. ISBN-13: 978-0-534-49339-4. (or ebook equivalent).
 - Bookstore quote: \$232 new, \$174 used. (Abebooks/Bigwords/etc may have cheaper!)
- Application/Software: none required

Policies and Resources for Undergraduate Courses

It is our shared responsibility to know and abide by the University of Maryland's policies that relate to all courses, which include topics like:

- Academic integrity
- Student and instructor conduct
- Accessibility and accommodations
- Attendance and excused absences
- Grades and appeals
- Copyright and intellectual property

Please visit www.ugst.umd.edu/courserelatedpolicies.html for the Office of Undergraduate Studies' full list of campus-wide policies and follow up with me if you have questions.

Major Assignments

Homework Assignments

- Problem sets will be assigned weekly on Tuesdays covering that week's topics and the previous set will be collected at the same time. Though formally assigned in-class, they will be posted on ELMS the Friday before if you choose to work ahead and/or look them over before lecture.
 - The lowest score (at least) of 11 assigned sets will be dropped. I reserve the right to drop a second.
- Late homework will not be accepted without prior agreement from me. This is necessary to keep the flow of graded homework coming back to the class.

Exams

- There will be two midterm exams throughout the semester. They will be open-book and you will be permitted a single-sided page of notes which should be handed in with your work (you'll get it back!)
- The meeting day before the exam will be dedicated to tying up loose ends and will be an opportunity for you to ask questions and look at homework or examples together for review

Final Exam

- The final exam will be comprehensive and will be approximately 60/40 split between old and new material. You will be permitted a full page front and back of notes.

Midterm "bump" policy

- Material on the final exam which overlaps with the previous exams may be used to adjust up/give extra credit to the corresponding midterm score in the case where a large improvement ($\geq 25\%$) is demonstrated. The amount of extra credit will be half the difference in percentage scores between the two.
 - For example, if you earn 60% (D-) on midterm 1 but a 100% (A+) on the corresponding part of the final, midterm 1 will be treated as an 80% (B-) for the purposes of computing your grade.
- This will only affect at most 1 midterm – the intention is to allow you to make up for a bad day so long as you show mastery of the material in the end. It is not intended to be a way to blow off the midterm exams entirely.

Grading Structure

The final grade will be a combination of exams and homework according to the table below. The cutoffs may be adjusted downward to meet a 'curve' with a median value of a B- and low tail (neglecting anomalous outliers) of a C-. They will not be adjusted upward – an 80% average will always be *at least* a B-.

Assignment	Percentage %
Homework	20%
Midterm 1	25%
Midterm 2	25%
Final Exam	30%
Total	100%

Final Grade Cutoffs									
+	97%	+	87%	+	77%	+	67%	+	
A	93%	B	83%	C	73%	D	63%	F	<60.0%
-	90%	-	80%	-	70%	-	60%	-	

Course Outline

Week beginning	Topics
22-Jan	Syllabus, Principle of relativity, Galilean transformation
29-Jan	Postulates of Relativity, consequences of relativity, Lorentz transform
5-Feb	Invariants, Relativistic energy and momentum, Mass-Energy
12-Feb	Blackbody radiation, planks law, photoelectric effect
19-Feb	Compton scattering, structure of matter (Faraday, Millikan, Thompson)
26-Feb	MIDTERM 1 – relativity and quantization of light
4-Mar	Bohr, correspondence, De Broglie, Heisenberg
11-Mar	Wave functions, Born, Schrödinger, Expectation Values
18-Mar	<i>SPRING BREAK</i>
25-Mar	1d box, boundary conditions, Quantum simple harmonic oscillator
1-Apr	More SHO, Tunneling
8-Apr	MIDTERM 2 – elementary 1d quantum mechanics
15-Apr	Angular momentum quantization, Hydrogen atom
22-Apr	Spin quantum number, Hydrogen Perturbations, Exchange symmetry
29-Apr	Periodic Table, covalent bonding, fermi gas
6-May	Basics of solids: metals, insulators, and semiconductors
	Final exam: Friday, May 17, 10:30 AM

Note: This is a tentative schedule, and subject to change as necessary

Recording

In-class audio or video recording as well as still photography is not allowed without first asking or giving me some kind of notice. You will almost certainly get the okay if you ask, I only wish to be made aware ahead of time so I may agree and consent. This can even be in the moment for one-off instances even (if, say, you need to take a picture of the board, you may speak up and ask). Again, it is not my intention to tie your hands, only to get you to communicate *first*.

Communication Guidelines

Communication with Instructor:

Email: If you need to reach out and communicate with me, please email me at pmham@umd.edu. Please DO NOT email me with questions that are easily found in the syllabus or on ELMS (i.e. When is this assignment due? How much is it worth? etc.) but please DO reach out about personal, academic, and intellectual concerns/questions. While I will do my best to respond to emails within 24 hours, I am not perfect! If I don't see/respond to an email on time I will make sure it is not to your detriment.

ELMS: Please make sure that your email & announcement notifications (including changes in assignments and/or due dates) are enabled in ELMS so you do not miss any messages, as this will be my primary way to reach the class as a whole. You are responsible for checking your email and Canvas/ELMS inbox with regular frequency.

Academic Integrity

The University's Code of Academic Integrity is designed to ensure that the principles of academic honesty and integrity are upheld. In accordance with this code, the University of Maryland does not tolerate academic dishonesty. Please ensure that you fully understand this code and its implications because all acts of academic dishonesty will be dealt with in accordance with the provisions of this code. All students are expected to adhere to this Code. It is your responsibility to read it and know what it says, so you can start your professional life on the right path. **As future professionals, your commitment to high ethical standards and honesty begins with your time at the University of Maryland.**

It is important to note that solutions taken or copied from AI models or sites like CourseHero can be deemed unauthorized material and a violation of academic integrity. I would prefer you work with your classmates than with an LLM.

You may choose to go over the homework in small groups if that is how you work best. However, what you hand in should be your own work and reflect your own process, not a standard answer generated by committee. Please visit the [Office of Undergraduate Studies' full list of campus-wide policies](#) and reach out if you have questions.

Finally, on each exam or assignment you must write out and sign the following pledge: ***"I pledge on my honor that I have not given or received any unauthorized assistance on this exam/assignment."*** If you ever feel pressured to comply with someone else's academic integrity violation, please reach out to me straight away. Also, ***if you are ever unclear*** about acceptable levels of collaboration, ***please ask!***

Resources & Accommodations

Accessibility and Disability Services

The University of Maryland is committed to creating and maintaining a welcoming and inclusive educational, working, and living environment for people of all abilities. The University of Maryland is also committed to the principle that no qualified individual with a disability shall, on the basis of disability, be excluded from participation in or be denied the benefits of the services, programs, or activities of the University, or be subjected to discrimination. The [Accessibility & Disability Service \(ADS\)](#) provides reasonable accommodations to qualified individuals to provide equal access to services, programs and activities. ADS cannot assist retroactively, so it is generally best to request accommodations several weeks before the semester begins or as soon as a disability becomes known. Any student who needs accommodations should contact me as soon as possible so that I have sufficient time to make arrangements.

For assistance in obtaining an accommodation, contact Accessibility and Disability Service at 301-314-7682, or email them at adsfrontdesk@umd.edu. Information about [sharing your accommodations with instructors, note taking assistance](#) and more is available from the [Counseling Center](#).

Student Resources and Services

Taking personal responsibility for your own learning means acknowledging when your performance does not match your goals and doing something about it. I hope you will come talk to me so that I can help you find the right approach to success in this course, and I encourage you to visit [UMD's Student Academic Support Services website](#) to learn more about the wide range of campus resources available to you.

In particular, everyone can use some help sharpening their communication skills by visiting [UMD's Writing Center](#) and schedule an appointment with the campus Writing Center.

You should also know there are a wide range of resources to support you with whatever you might need ([UMD's Student Resources and Services website](#) may help). If you feel it would be helpful to have someone to talk to, visit [UMD's Counseling Center](#) or [one of the many other mental health resources on campus](#).

Notice of Mandatory Reporting

Notice of mandatory reporting of sexual assault, sexual harassment, interpersonal violence, and stalking: As a faculty member, I am designated as a "Responsible University Employee," and I must report all disclosures of sexual assault, sexual harassment, interpersonal violence, and stalking to UMD's Title IX Coordinator per University Policy on Sexual Harassment and Other Sexual Misconduct.

If you wish to speak with someone confidentially, please contact one of UMD's confidential resources, such as [CARE to Stop Violence](#) (located on the Ground Floor of the Health Center) at 301-741-3442 or the [Counseling Center](#) (located at the Shoemaker Building) at 301-314-7651.

You may also seek assistance or supportive measures from UMD's Title IX Coordinator, Angela Nastase, by calling 301-405-1142, or emailing titleIXcoordinator@umd.edu.

To view further information on the above, please visit the [Office of Civil Rights and Sexual Misconduct's](#) website at ocrsm.umd.edu.

Basic Needs Security

If you have difficulty affording groceries or accessing sufficient food to eat every day, or lack a safe and stable place to live, please visit [UMD's Division of Student Affairs website](#) for information about resources the campus offers you and let me know if I can help in any way.

Veteran Resources

UMD provides some additional supports to our student veterans. You can access those resources at the office of [Veteran Student life](#) and the [Counseling Center](#). Veterans and active duty military personnel with special circumstances (e.g., upcoming deployments, drill requirements, disabilities) are welcome and encouraged to communicate these, in advance if possible, to the instructor.

Course Evaluation

Please submit a course evaluation through Student Feedback on Course Experiences in order to help faculty and administrators improve teaching and learning at Maryland. All information submitted to Course Experiences is confidential. Campus will notify you when Student Feedback on Course Experiences is open for you to complete your evaluations at the end of the semester. Please go directly to the [Student Feedback on Course Experiences](#) to complete your evaluations. By completing all of your evaluations each semester, you will have the privilege of accessing through Testudo the evaluation reports for the thousands of courses for which 70% or more students submitted their evaluations.

Copyright Notice

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