UNIVERSITY OF MARYLAND

Course Information

Course Title: Modern Physics
Course Number: PHYS371
Term: Spring 2024
Credits: 3
Course Dates: Jan. 24, 2024 - May 17, 2024
Course Times: Tues. & Thurs. 9:30 - 10:45 am

Professor: Dr. Chandra Turpen
Pronouns: she / her / hers
Email: turpen@umd.edu
Office Hours: By appointment.

Classroom: PHY 1204 (Toll Building)

Our Instructional Team

Professor: Dr. Chandra Turpen, she/her/hers (turpen@umd.edu)
Graduate Teaching Assistant: Yulong Dong, he/him/his (ybdong@umd.edu)
Undergraduate Teaching Assistants:
Thomas Griffith, he/him/his, (tegriff@terpmail.umd.edu)
Susanna Moore (Sanna), she/her/hers (smoore28@terpmail.umd.edu)

Every week our team will hold collaborative group problem-solving sessions in **Toll Physics Room 1324**, where students can come together to work on homework together and find support from educators. We highly encourage all students to attend one or two of these sessions as their schedules allow.

- **TBA – based on in-class scheduling poll responses.**

We highly encourage students to come talk to us in these collaborative group problem-solving (GPS) sessions.

Course Description

The overarching goal of this course is to develop your interest and knowledge around modern physics topics. This course provides an introduction to thermodynamics (one unit), quantum mechanics (two units), and special relativity (one unit). This course will also have a unit woven in guiding you through some reflections on: (a) what are you most interested in exploring in physics and astronomy, and (b) what careers you might be interested in. As an intermediate-level course for physics and astronomy majors, this course will support you in learning to use various resources available to you as you navigate upper-level physics and astronomy topics and build your capacity for translating conceptual ideas in physics to the language of mathematics.

Prerequisites are: PHYS273 and PHYS274 and (concurrently) PHYS373.

Course Learning Outcomes

After successfully completing this course you will be able to:

1. Demonstrate a functional understanding of modern physics concepts, specifically in thermodynamics, quantum mechanics, and special relativity.
2. Translate conceptual ideas in physics into the language of mathematics and use multiple mathematical representations to solve physics problems.
3. Demonstrate a functional understanding of using, building and refining physics models.
4. Work with your peers, as scientists and colleagues, to understand and appreciate the experiences and knowledge that others bring into their scientific work.
5. Draw on and apply critical thinking tools to solve complex physics problems.

6. Expand your understanding of your own career interests and goals as they relate to physics.

We will work toward the goals expressed above throughout the course, using research-based active learning strategies. There will be a small amount of time used for lectures, but we will spend a large amount of time working together to solve problems in-class and developing a sense of community.

Required Course Materials

- Course Website: elms.umd.edu (under Phys371). Required course assignments will always be posted through the ELMS-Canvas system. Students should be automatically enrolled in the course. Students should expect to receive announcements, assignments, etc., through the ELMS system. Important documents (including this syllabus) will be posted on the course page.
- A wifi-enabled smartphone or laptop computer to use to vote on in-class polling questions. These polling tools will be used in some in-class activities and discussions, so please always bring such a device to class with you.
- Book: *There is no required textbook.*
    - This course will draw from the open access OpenStax textbook "University Physics".
        - Our thermodynamics unit will cover topics contained in Volume 2 (Chapters 1-4), which is available for free at: https://openstax.org/details/books/university-physics-volume-2
        - Our quantum physics units will cover topics found in Volume 3 (Chapters 6-7) and our special relativity unit will cover topics found in Volume 3 (Chapter 5), which is available for free at: https://openstax.org/details/books/university-physics-volume-3
    - Additional supplementary notes and required readings will be posted to ELMS, for example we use the first chapter of McIntyre's *Quantum Mechanics: A Paradigms Approach* to launch the second quantum unit. Equivalent content is covered in many other textbooks. You are free to use any equivalent sources; however, it is the students' responsibility to determine what content in their chosen reference corresponds to the assigned readings or content.
- We may on occasion use Zoom (for one-on-one meetings with Prof. Turpen, Yulong Dong, Sanna Moore, or Thomas Griffith) or for pivots to virtual instruction that may become necessary. Students will need to log into their campus Zoom account (https://umd.zoom.us/). Please set a profile picture (either be an actual picture of yourself or a representation of yourself such as a bitmoji; disrespectful profile pictures will not be tolerated).

Course Structure & Weekly Rhythms

We will meet in-person for class on Tuesday and Thursday mornings. Should the conditions necessitate that the University shift classes to online instruction, we will continue to meet synchronously via Zoom at these scheduled times. You will be asked to talk and collaborate with your peers in solving physics problems in-class and submit your answers to physics problems by responding to in-class polls via a personal web-connected device.

To prepare for lectures and homeworks, there will be weekly assigned readings and pre-thinking questions (PTQs). It is essential to do the readings before coming to class, because in class, we will be mostly solving problems and building off of the reading. Your answers to the pre-thinking questions will inform the instructor's design of the in-class lesson.

There will be Problem Sets or Career Interest Development Assignments every week that will be turned in via ELMS. You are welcome (and encouraged) to work on these assignments with classmates, but each student will be expected to submit their own work.

Beyond our 2.5 hours together in class, you should devote at least an additional seven hours per week to this course. I recommend that you block out specific times on your calendar when you intend to put focused attention to work for this course. See the Table below to get a sense for the weekly rhythms in the course.

Typical Weekly Rhythm in Phys371

	Monday	Tuesday	Wednesday	Thursday	Friday	Monday
Attend Class and Participate		Come to class		Come to class		
Assigned Readings		Read for Th Class			Read for Tu Class	
Pre-thinking Questions (PTQs)	Tu PTQs Due 4pm		Th PTQs Due 4pm			Tu PTQs Due 4pm
HW Problem Set		Practice solving problems using concepts from our lecture sessions, Due Mon 10pm				
Collaborate w/ Peers	GPS Session*			GPS Session*		GPS Session*

*Note GPS sessions scheduling is TBD (based on student responses to an in-class poll about their availability)

Course Communication Guidelines

Names/Pronouns and Self-Identifications

The University of Maryland recognizes the importance of a diverse student body, and we are committed to fostering inclusive and equitable classroom environments. I invite you, if you wish, to tell us how you want to be referred to both in terms of your name and your pronouns (he/him, she/her, they/them, etc.). The pronouns someone indicates are not necessarily indicative of their gender identity. Visit trans.umd.edu to learn more. I will do my best to address and refer to all students accordingly, and I ask you to do the same for all of your fellow Terps.

Communication with Instructor

Email: If you need to reach out and communicate with me, email me at turpen@umd.edu. If you need to reach out and communicate with the graduate TA, Yulong Dong, email him at ybdong@umd.edu. In your emails, **please include Phys371 in the subject heading**. Both Yulong and I will do our best to respond to emails within 48 hours. You will be more likely to receive email responses from Dr. Turpen on Mondays, Wednesdays and Fridays from 8:00 AM-10:00 AM EST. Please review the syllabus for questions regarding scheduling, grading, and other policies before sending questions. Please do contact us with personal or academic concerns/questions that are affecting your participation in this course.

ELMS: Our instructional team will send out important announcements via ELMS messaging. You must 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. You are responsible for checking your email and ELMS inbox with regularity.

Life Events

Due to the ongoing pandemic impacts, we expect a higher likelihood of unforeseen events in all of our lives, including issues related to health, employment, and stability for you and your families. Please know that you can come talk to me about these issues as they arise, even if you don't feel they are directly impacting your ability to take this course. Useful resources for these life events can be found on **UMD's Division of Student Affairs website**.

Communication with Peers

With a diversity of perspectives and experience, we may find ourselves in disagreement and/or debate with one another. As such, it is important that we agree to conduct ourselves in a professional manner and that we work

together to foster and preserve a classroom environment in which we can respectfully discuss and deliberate controversial questions.

I encourage you to confidently exercise your right to free speech—bearing in mind, of course, that you will be expected to craft and defend arguments that support your position. Keep in mind, this course is NOT the space for hate speech, harassment, and derogatory language and this will be monitored. I will make every reasonable attempt to create an atmosphere in which each student feels comfortable voicing their argument without fear of being personally attacked, mocked, demeaned, or devalued.

Any behavior (including harassment, sexual harassment, and racially and/or culturally derogatory language) that threatens this atmosphere will not be tolerated. Please alert me immediately if you feel threatened, dismissed, or silenced at any point during our semester together and/or if your engagement in discussion has been in some way hindered by the learning environment.

Major Assignments

Weekly "Pre-Thinking" Questions

- Before every class meeting, you are expected to review some short assigned readings and respond to two short questions. One of these questions will consistently be "What 2 idea(s) are the muddiest to you from these readings?" and one prompt will be tailored to the specific conceptual ideas in the readings.
- The purpose of these pre-class questions is to: (a) support you in actively engaging with and gathering your thoughts about the course material before coming to class, (b) prepare you to come to class ready to talk and reason with your peers about these physics concepts, and (c) help me as an instructor prioritize concepts and problems to review in class.
- These pre-class questions will be made available in ELMS and will be due the night before class (so Mondays and Wednesdays), if you want your questions to be considered for the design of the next class submit by 5 PM, but submissions will be accepted until 10 PM. **These will be graded on completion. If you happen to miss some of these assignments, we will drop up to 3 of these assignments.**

Weekly Physics Problem Sets

- Almost every week there will be 5-8 physics problems assigned. One of the most important things that you can do to train yourself to simplify the physical world is to think through physics problems. After working through conceptual and mathematical problems in-class, you will practice your skills and check your understanding in weekly problem sets assigned.
- The purpose of these problem sets is to give you opportunities to practice applying and using the physics concepts and skills to understand particular physical phenomena. In this spirit, it is encouraged that you turn in work for each problem, even if you are unable to complete it or recognize that your answer is incorrect. Work in progress shows your thinking and will leave open the opportunity to submit revisions (see below).
- These problem sets will be assigned, submitted and graded through ELMS. Problem sets will regularly be due by 10:00 PM ET on Monday evenings. Some questions on the Problem Sets will be graded for correctness, and some questions will be graded for completion. You will *NOT* know ahead of time which problems will be graded for correctness. Note: A problem set will typically not be assigned on exam weeks in order to protect time for you to synthesize and review the material from that unit.

Career Interest Assignments

- Throughout this course we will be taking some time to do reflective work on our own interests and how that connects to our imagined future careers. I have set aside three classes this semester to focus on developing

your career interests including bringing in guest speakers, some of whom graduated from UMD with degrees in physics and are now working in industry positions. Each of these weeks I will ask you to do some work reflecting on your own interests and researching different career options.

- The purpose of these assignments is to expand your understanding of your own career interests and goals as they relate to physics.

Course Participation

- I expect all students to be active participants in every class meeting. During synchronous class meetings we will work in small groups through a series of conceptual questions. You will work together first in small groups and then we will come together as a class to check-in with your responses via a polling system. Your responses will be graded for both voting (80%) and for correctness (20%). If you register a vote for 60% or more of the questions asked in a given day, you will receive full marks for the 80%. The remaining 20% of points will be awarded based on how many questions you answer correctly in class. To acknowledge that everyone has rough patches in life, I will drop the lowest 3 grades in this category.

Exams

- This course will have 2 "unit-level" midterm exams and one comprehensive final exam. Each mid-term exam will focus on three to four weeks of material (one focused on thermodynamics and one focused on early quantum physics). The final will be cumulative, meaning it covers everything we have done in the class up to that point. Exam questions will be comparable in difficulty to those you will do in homework and a bit more challenging than the short questions we discuss together in lecture.

- The purpose of exams is to give you the opportunity to synthesize and review the material. It is often in this third or fourth pass over material that we begin to see coherence across topics. Resources and problem set solutions will be made available through ELMS to support your studying. You will be given an equation sheet that the instructor has developed in advance of all exams and you can use this equation sheet to study with.

Revision of Work

- I recognize that not everyone is starting from the same place upon entering this course. In recognition of this fact, there are two pathways to success in this class. One pathway is the typical one, where students are expected to perform strongly on their first attempt. This course offers a second pathway, where students can revise their work and resubmit it to earn back points they have missed. The purpose of this second pathway is to cultivate a growth mindset and help students to focus on learning and understanding, rather than just performing.
- If you attempted a homework problem or exam problem and lost substantial points on that problem, your TA and UTAs will indicate that the problem qualifies for revision by putting a "redo" symbol on that problem. You may submit a revision for a problem (that has this redo symbol) where you write about where you made mistakes, notice inconsistencies in your prior solution, and describe the reasoning or logic behind the correct answer. In writing your revisions, the emphasis is on showing in writing how you are reflecting on past mistakes, diagnosing past mistakes, illustrating your growth understanding, and naming strategies that you could use in the future for catching such mistakes in the future.
    - For each homework assignment, you may submit a revision for **one problem** of your choice from those that you received a "redo" symbol on and you lost substantial points. If this revision is thoughtful and reflective, you can earn back up to half of the points missed on all attempted problems. All homework problem revisions for a given unit must be submitted by 10pm ET the night before the midterm exam for that unit.
    - For each midterm exam, you may submit revisions for **all problems** where you lost substantial points. If these revisions are thoughtful and reflective, you can earn back up to half of the points missed on all attempted problems. All exam revisions must be submitted within approximately one week from when graded exams are handed back.

Grading Structure

The course grade is determined by contributions from several sources: participating in class, pre-thinking questions, problem sets and assignments, two midterms, and a final exam. Each of these components contributes to the final grade in the following percentages:

Assignment	Percentage %
Weekly Pre-thinking Questions (PTQs)	**5%**
Weekly Problem Sets	**25%**
Career Interest Development (CID) Assignments	**5%**
Course Participation	**10%**
Midterm Exams	**30%**
Final Exam	**25%**
Total	**100%**

Late Assignments and Missed Exams Policy

- I will extend the deadline of 1 problem set for each student during the semester – no questions asked. To request this extension email Prof. Turpen before the homework is due. Late work is to be submitted here so that the entire instructional team has access to it: https://forms.gle/X4UHsPsYDdB4Fa5E8
- Beyond this one extension granted to all students, late work will not be accepted for course credit so please plan to have it submitted well before the scheduled deadline. This is to allow us to publish solutions to problem sets in timely ways for students. If there are extenuating circumstances or significant unforeseen events, please contact Prof. Turpen about your options.
- If you must miss an exam for any reason contact Prof. Turpen as soon as possible. If you provide sufficient notice and are in good standing, it may be possible to arrange a make-up exam. If you miss an exam without permission you will receive a zero. If there are extenuating circumstances or significant unforeseen events, please contact Prof. Turpen about your options for completing the course.
- If you cannot meet course deadlines, contact Prof. Turpen to make alternative arrangements as soon as possible.

Absences: This class is run in a cohort-style, building upon group work and therefore your participation each day is required and evaluated as part of your course grade (see course participation). If you miss class, you will lose points from that day. To acknowledge that everyone has rough patches in life, we will drop the lowest 3 grades in the course participation category. Please note that if you miss a class session, it is your responsibility to communicate with the instructional team and review the course content that you missed.

Excused Absences: Some absences will be “excused” (and not count against you). Good justifications for excused absences include religious accommodations, personal sickness / illness (including mental health challenges), a sickness or illness of someone you are a caregiver for, and significant tragedies that may arise. You will never be penalized for requesting an excused absence, even if the request is not granted. To request an excused absence for any reason please fill out this Google form: https://forms.gle/R2eyeBdMPgkHmo7Z7

Grades

All assessment scores will be posted on the course ELMS page. If you would like to review any of your grades (including the exams), or have questions about how something was scored, please email me and the TA to schedule a time for you to meet and discuss with one of us. Our team is happy to discuss any of your grades with you. If we

have made a mistake we will correct it in a timely way. Any formal grade disputes must be submitted in writing and within one week of receiving the grade. Final letter grades are assigned based on the percentage of total assessment points earned. To be fair to everyone we have to establish clear standards and apply them consistently.

This course is graded on a straight scale (not on a bell curve!). This means that EVERY student can earn an "A" for the course. After computing your course score, the final course grades will be awarded on a standard scale:

60.00-62.99 is a D-	70.00-72.99 is a C-	80.00-82.99 is a B-	90.00-92.99 is an A-
63.00-66.99 is a D	73.00-76.99 is a C	83.00-86.99 is a B	93.00-100 is an A
67.00-69.99 is a D+	77.00-79.99 is a C+	87.00-89.99 is a B+	

Note: The assigned grades will never be tougher than the above.

Draft Course Schedule*

Week	Topic(s)	Deliverable
Week 1 01/25-02/03	**Temperature and Heat First Law of Thermodynamics**	**HW1, Due 2/05**
Week 2 02/05 - 02/09	**Kinetic Molecular Theory Thermal Equilibrium & Equipartition**	**HW2, Due 2/12**
Week 3 02/12-02/16	**Probability & Entropy Entropy & the Second Law of Thermodynamics**	**HW3, Due 2/19**
Week 4 02/19-02/23	**Career Interest Development (CID) Day Exam #1: Thermodynamics**	**CID Assignment Midterm #1 (02/22)**
Week 5 02/26-02/30	**Intro to Light & Photoelectric Effect Photoelectric Effect, continued & Compton Effect**	**HW4, Due 3/4**
Week 6 03/04-03/09	**Atomic Spectra, Atomic Models & Rutherford Scattering Bohr Model & de Broglie Waves & Hydrogen Atom**	**HW5, Due 3/11**
Week 7 03/11-03/15	**Wave-particle Duality + Stern Gerlach Stern Gerlach + Probability**	**HW6, Due 3/17 *Note: Earlier Due Date!!***
Week 8: 3/18-3/22	**N/A - Spring Break**	**N/A**
Week 8 03/25-03/29	**EPR & Bell's Theorem & Entanglement Wave Functions & Probability Density**	**HW7, Due 3/29 *Note: Earlier Due Date!!***
Week 10 04/01-04/05	**Exam #2: Early Quantum Models Career Interest Development (CID) Day**	**Midterm #2 (04/04) CID Assignment**
Week 11 04/08-04/12	**Schrodinger Equation Square Well**	**HW8, Due 4/15**
Week 12 04/15-04/19	**Finite Square Well Tunneling & Radioactive Decay**	**HW9, Due 4/22**
Week 13 04/22-04/26	**Inertial Reference Frames, Galilean Relativity, Einstein's Postulates Interferometers & Michelson-Morley experiment**	**HW10, Due 4/29**
Week 14 04/29-05/03	**Time Dilation & Length Contraction Lorentz Transformations & Spacetime Diagrams**	**HW11, Due 5/06**
Week 15 05/06-05/10	**Lasers and Cloud Chambers (TBD) Career Interest Development Day**	**CID Assignment**
May 13, 2024	**Comprehensive Final (Monday, 05/13/24) from 8:00-10:00 AM ET**	

*Note: This is a tentative schedule that is subject to change at the instructor's discretion – monitor the course ELMS page for current deadlines.

UMD 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 and 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.

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.

It is important to note that course assistance websites, such as CourseHero, are not permitted sources, unless the instructor explicitly gives permission for you to use one of these sites. Material taken or copied from these sites can be deemed unauthorized material and a violation of academic integrity. These sites offer information that might not be accurate and that shortcut the learning process, particularly the critical thinking steps necessary for college-level assignments.

Additionally, it is understandable that students may use a variety of online or virtual forums for course-wide discussion (e.g., GroupME or WeChat). Collaboration in this way regarding concepts and assignments discussed in this course is permissible. However, collaboration on midterm exams and final exams is strictly prohibited unless otherwise stated. Examples of prohibited collaboration include: asking classmates for answers on quizzes or exams, asking for access codes to clicker polls, etc.

Finally, on each exam 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."

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**.

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.

Student Resources and Services
Taking personal responsibility for your 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. 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**.

Technology Policy
Please refrain from using cellphones, laptops, and other electronic devices during class sessions unless we have designated such use as part of a class exercise or activity.

Netiquette Policy
Netiquette is the social code for online spheres of courses. Students share a responsibility for the course's learning environment. Creating a cohesive online learning community requires learners to support and assist each other. To craft an open and interactive online learning environment, communication has to be conducted in a professional and courteous manner at all times, guided by common sense, collegiality and basic rules of etiquette.

Attendance and Participation
Given the interactive style of this class, attendance will be crucial to note-taking and thus your performance in this class. Attendance is particularly important also because class discussion will be a critical component for your learning. Each student is expected to make substantive contributions to the learning experience, and attendance is expected for every session. Students with a legitimate reason to miss a class session should communicate in advance with the instructional team by using the excused absence form (except in the case of an emergency). Students who miss a class session are responsible for learning what they miss from that session. Additionally, students must complete all readings and assignments in a timely manner in order to fully participate in class.

Course Evaluation
Please submit a course evaluation through CourseEvalUM to help faculty and administrators improve teaching and learning at Maryland. All information submitted to CourseEvalUM is confidential. Campus will notify you when evaluations for Spring semester courses are open. Go to the **Course Eval UM website** to complete your evaluations. This is a key metric that my department uses to evaluate the quality of faculty's teaching and whether to continue

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