

# PHYS 324: Modern Physics

Prof. Adi Foord

Spring, 2024

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Office Hours: W 1-3:00pm  
Office: PHYS 316

Class Hours: M/W/F 10-10:50am  
Class Room: Sherman Hall 006

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## Course Description

This course will provide a general overview of the main subjects in modern physics, with the emphasis on relativistic and quantum physics. It will discuss key experiments, introduce the relevant terminology, and develop the main ideas of theoretical understanding. At the end of the course, you should:

- understand the main ideas and consequences of the special theory of relativity;
- understand why quantum mechanics is needed to explain the phenomena of the micro-world and review the most important historical steps of its development;
- be familiar with the most fundamental principles and applications of quantum mechanics;
- understand some basic principles of nuclear physics, radioactivity, and particle physics;
- have better understanding of how the different branches of physics fit together into a coherent picture;
- improve your analytical ability.

## Required Materials

Modern Physics for Scientists and Engineers  
John R. Taylor, Chris D. Zafiratos, and Michael A. Dubson  
University Science Books, ISBN 978-1-938787-75-1

## Prerequisites

Prerequisites: PHYS 224 (Vibration and Waves)

## Important Dates

1. First day of class: January 29, 2024
2. In-class Midterm 1: March 4, 2024
3. In-class Midterm 2: April 8, 2024
4. Last day of class: May 13, 2024
5. Final: TBA

## Course Structure

### Class Structure

PHYS 324 will be a traditional lecture course. Individual reading will play an important role in understanding material. Before each lecture, you are expected to read the upcoming and corresponding chapter/sections of the text book, which will be shared by Prof. Foord at the end of the previous lecture. Feel free to ask questions during lecture, whether you have difficulty with a concept, notice an error, or want to hear more details about an aspect of the material. Students are responsible for checking their academic e-mails and the Blackboard page daily for getting updates about the course, grades, homeworks and class notes.

### Lecture

In order to be successful in this course, you should attend all classes. Please be attentive and take notes during lectures. Bring calculators to lecture to be able to work on in-class problems. You are welcome to ask questions to clarify any point that is not clear, either during class or during my office hours.

There will be 4 surprise quizzes that will each take-place during a lecture. These are closed book/notes. They will relate closely with topics that are currently being taught in class and/or homework assignments. The top 3 highest graded quizzes will count towards your grade.

### Homework

Homework assignments will be available on the Blackboard page every Monday and are due by the beginning of class the following Monday, unless you are told otherwise. You are encouraged to study in groups and discuss the material and homework questions among yourselves. Peer-learning is encouraged. However, the homework solution should be your own work, not a group product. No credit will be given for direct copies. Please cite any resources used to complete homework assignments (including online resources and in-person conversations) at the bottom of each assignment. No late assignments will be accepted.

## Exams

There will be two in-class tests during the semester, each covering specific sections of the material. The final exam will be cumulative. All of the exams will be closed book. You may bring one page ( $8.5 \times 11$  inches; single-sided) of your own hand-written notes to any exam. **These will be evaluated before the exam begins and no photocopies or print-outs are allowed.** If you miss a test for medical or other unavoidable reason, you must provide proof, and we will arrange for a make-up test. If you know that you will have to miss a test for a foreseeable reason (religious holiday, court date, family event, existing medical problem, etc.), make arrangements before the test, rather than after.

## Grading Policy

The grade will count the assessments using the following proportions:

- 30% of your grade will be determined by 2 in-class midterm exams (15% each).
- 25% of your grade will be determined by the final exam
- 25% of your grade will be determined by homework
- 15% of your grade will be determined by quizzes
- 5% of your grade will be determined by attendance

Your letter grade will depend on the total score. If your total grade is:

- $\geq 87.5$ , your letter grade will be "A"
- $87.5 > X \geq 75$ , your letter grade will be "B"
- $75 > X \geq 62.5$ , your letter grade will be "C"
- $62.5 > X \geq 50$ , your letter grade will be "D"
- $50 > X$ , your letter grade will be "F"

## Material

Topics that will be covered in this course are listed below, with a rough schedule. **The exact topics that we cover will depend on the pace of the course, some material may be excluded or additional material may be included.** I will review in detail the exact sections from the textbook that will be included before exams.

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(1) The first third of our class will cover material between Chapters 1–4 in the textbook. Midterm 1 (March 4) will be test your knowledge from these chapters:

Chapter 1: The Space and Time of Relativity

Chapter 2: Relativistic Mechanics

Chapter 3: Atoms

Chapter 4: Quantization of Light

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(2) The second third of our class will cover material between Chapters 5–7 in the textbook. Midterm 2 (April 8) will test your knowledge from these chapters:

Chapter 5: Quantization of Atomic Energy Levels

Chapter 6: Matter Waves

Chapter 7: The Schrödinger Equation in One Dimension

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(3) The last third of our class will cover material between Chapters 8-11 in the textbook:

Chapter 8: The Three-Dimensional Schrödinger Equation

Chapter 9: Electron Spin

Chapter 10: Multielectron Atoms: the Pauli Principle and Periodic Table

Chapter 11: Atomic Transitions and Radiation

*Additional material a possibility*

**The final (TBD) will be cumulative, testing your knowledge of all material covered throughout the semester.**

## Course Policies

### Lectures

Please refrain from using computers in class, with the exception of electronic tablets for taking notes. Phones are prohibited during lecture. Eating and drinking are allowed in class but please refrain from it affecting the course.

### Attendance Policy

Attendance is expected in all lectures. Valid excuses for absence will be accepted before class. In extenuating circumstances, valid excuses with proof will be accepted after class. For every class missed the participation grade will be dropped 1 point.

Late assignments will be accepted for no penalty if a valid excuse is communicated to the instructor before the deadline. After the deadline, any assignments handed in will be given 0.

### Academic Integrity and Honesty

*The following content has been created by others and is mandated to be on all syllabi.*

In February 2001, the Faculty Senate affirmed the importance of our values and practices by adopting the Statement of Values for Student Academic Integrity that is placed on most course syllabi:

*Academic integrity is an important value at UMBC. By enrolling in this course, each student assumes the responsibilities of an active participant in UMBC's scholarly community in which everyone's academic work and behavior are held to the highest standards of honesty. Cheating, fabrication, plagiarism, and helping others to commit these acts are all forms of academic dishonesty, and they are wrong. Academic misconduct could result in disciplinary action that may include, but is not limited to, suspension or dismissal.*

The purposes of higher education are the learning students and faculty undertake, the knowledge and thinking skills developed, and the enhancement of personal qualities that enable students to be strong contributing members of society. In a competitive world, it is essential that all members of the UMBC community uphold a standard that places integrity of each student's honestly earned achievements above higher grades or easier work dishonestly sought.

All members of the UMBC community are expected to make a commitment to academic honesty in their own actions and with others. Academic misconduct can result in disciplinary action that may include suspension or dismissal. The following are examples of academic misconduct that are not tolerated at UMBC:

- Cheating: Using or attempting to use unauthorized material, information, study aids, or another person's work in any academic exercise.
- Fabrication: Falsification or invention of any information or citation in an academic exercise.
- Facilitating academic misconduct: Helping or attempting to help another student commit an act of academic misconduct.
- Plagiarism: Knowingly, or by carelessness or negligence, representing as one's own, in any academic exercise, the intellectual or creative work of someone else.
- Dishonesty: Lack of truthfulness or sincerity when interacting with the faculty member regarding an academic exercise.

To this end, UMBC undergraduate students also adopted the following Undergraduate Honor Statement as it describes the high standards to which everyone in the community will be held:

*I hereby assume the responsibilities of an engaged member in a scholarly and civic community in which academic work and behavior are held to the highest standards of honesty. It is my active participation that affirms these principles and gives them true meaning as well as value in my education. I realize that by committing acts of dishonesty I hurt myself and place an indelible mark on the reputation of UMBC. Therefore, I will not cheat, fabricate materials, plagiarize, or help another to undertake such acts of academic dishonesty, nor will I protect those who engage in acts of academic dishonesty.*

For more information on the topic of Academic Integrity, visit: <http://oue.umbc.edu/ai/>

## Accommodations for Disabilities

*The following content has been created by others and is mandated to be on all syllabi.*

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at [sds.umbc.edu](https://sds.umbc.edu) for registration information and office procedures.

SDS email: [disAbility@umbc.edu](mailto:disAbility@umbc.edu)

SDS phone: 410-455-2459

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

## Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

*The following content has been created by others and is mandated to be on all syllabi.*

**UMBC Policy** in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at [titleixcoordinator@umbc.edu](mailto:titleixcoordinator@umbc.edu) or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the **Online Reporting/Referral Form**. Please note that, if you report anonymously, the University's ability to respond will be limited.

### **Notice that Faculty and Teaching Assistants are Responsible Employees with Mandatory Reporting Obligations.**

All faculty members and teaching assistants are considered Responsible Employees, per **UMBC's Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination**. Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their **rights, resources, and support**. While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of **Confidential Resources** available to support you:

- **Retriever Integrated Health** (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.
- **Center for Counseling and Well-Being** (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) **Online Appointment Request Form**.
- Pastoral Counseling via **The Gathering Space for Spiritual Well-Being**: 410-455-6795; [i3b@umbc.edu](mailto:i3b@umbc.edu); Monday – Friday 8:00 a.m. – 10:00 p.m.

**Other Resources:**

- [Women's Center](#) (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.
- [Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

## Child Abuse and Neglect

*The following content has been created by others and is mandated to be on all syllabi.*

Please note that Maryland law and [UMBC policy](#) require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

## Pregnant and Parenting Students

*The following content has been created by others and is mandated to be on all syllabi.*

UMBC's [Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination](#) expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's [Office of Equity and Civil Rights](#). Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the [Office of Student Disability Services](#).

## Religious Observances & Accommodations

*The following content has been created by others and is mandated to be on all syllabi.*

UMBC [Policy](#) provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at [ecr@umbc.edu](mailto:ecr@umbc.edu).

## Hate, Bias, Discrimination and Harassment

*The following content has been created by others and is mandated to be on all syllabi.*

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement. Consistent with these principles, UMBC [Policy](#) prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to them should use the [online reporting/referral form](#) to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously. Please note that, if you report anonymously, the University's ability to respond may be limited.