PHYS 324
Modern Physics
Fall 2025

Instructor: Dr. Can Ataca
E-mail: ataca@umbc.edu (expect a response in 48 hours, excluding breaks and weekends)
Office: PHYS 315
Office hours: Wednesdays 10:50-12:00 or by appt

Prerequisite: PHYS 224 (Vibration and Waves)
Lecture Hours: Monday, Wednesday, Friday 10:00-10:50 AM
Classroom: ILSB 302
Textbook: J. R. Taylor, C. D. Zafiratos, M. A. Dubson, *Modern Physics for Scientists and Engineers,* ISBN: 978-1-938787-75-1
(Recommended) J. S. Townsend, *Quantum Physics-A Fundamental Approach to Modern Physics*, ISBN: 978-1-891389-62-7
(Recommended) D. J. Griffiths, *Introduction to Quantum Mechanics*, ISBN: 978-1107179868

Course Objectives: This course will introduce the basic concepts, theory and applications of modern physics, with the emphasis on relativistic and quantum physics. We will talk about special relativity, basic quantum mechanics, solid state and nuclear physics. We will discuss the key experiments and develop a fundamental understanding of the principles and laws of the different branches of physics. Some math will be involved, but the emphasis in the homeworks will be not on solving the standard quantitative problems but rather on learning the important physical concepts and the development of scientific reasoning skills.

At the end of this course, you should:

1. Understand the ideas and consequences of the theory of special relativity.
2. Understand the importance of quantum mechanics to explain nanoscale phenomena with important historical steps of its development.
3. Understand how electrons behave in different environments at nanoscale.
4. Have a better understanding of how different branches of physics such as statistical mechanics, condensed matter and nuclear physics are related with each other.
5. Broaden and deepen your physical scientific reasoning and problem-solving skills.

Grading: Your final grade will be determined by:

Final Exam:	25%
Mid-Term Exam:	2 x 20%
Homework+ Quizzes:	10 x 2%
Term Project:	15%

%75 of attendance is mandatory for a passing grade. Your letter grade will depend on the total score. If your total grade is:

≥ 85 , your letter grade will be		"A"
$85 > X \geq 70$,	then	"B"
$70 > X \geq 60$,	then	"C"
$60 > X \geq 50$,	then	"D"
$50 > X$,	then	"F"

Please focus on learning the material rather than the grades.

Midterms and Final Exam: Two mid-term exam will take place during scheduled class time. The first midterm will include all discussions up to "Quantization of Light" (Course 14) and the second midterm will cover subjects between "Quantization of Light" (Course 14) to "The Three-Dimensional Schrodinger Equation" (Course 25) indicated in the "Topics to be covered" section.

The date of the final exam is determined by the university, and it will be on December 15th, 2025 (10:30 AM-12:30 PM). The exam will include all the course material covered up to the day of the exam, if not informed otherwise.

All of the exams will be closed book. At least one question of the exam will be similar to the ones assigned in homeworks. You may bring one page of **YOUR OWN** hand-written notes to any exam (no photocopies or print-outs are allowed).

Homework: Your preliminary homework for every class is to read the corresponding chapter/sections of the book. Please check the "Topic to be covered" section for the tentative timelines of each course. Homework assignments will be available on the Blackboard page every Friday and are due at the beginning of the class the following Friday, unless you are told otherwise (except holidays). You are encouraged to study in groups and discuss the material and homework questions among yourselves. However, the homework solution should be your own work, not a group product. Homework that are more than two days late will not be accepted for a grade. Late work will be discounted 10% per day late. I plan to assign weekly (~a total of 13) homeworks each having up to 3 questions.

Quizzes: There will be 3 quizzes. Quizzes will be closed book/notes. They might take place any time during the class and related closely with the homework assignments. They will not be longer than 25 minutes. They will be related to the topics covered in that chapter of the book.

The top 10 highest graded homeworks and/or quizzes will be counted towards your grading. This is meant to allow for things that come up unexpectedly.

Term Projects: Every student will choose a subject to work on. The students will work in pairs of two. Please send me an email with your choice of top 3 topics given below before September 9th, 2022. I will assign the final team members for each topic. Your group will write a detailed report on your chosen subject (8-page manuscript in two columns at most) and present your subject within a class-hour. You will also prepare a 2 question-homework set for your subject. The deadline for the term project is the last week of November and the first week of December, respectively. Your final grade will be based on %45 – report, %45 -in class presentation, %10 on the homework questions.

Term project topics: Molecules, Solids-Theory, Solids-Applications, Statistical Mechanics, The Structure of Atomic Nuclei, Radioactivity and Nuclear Reactions, Elementary Particles.

Course Material: All of the course materials including recorded lectures and slides, homeworks and quizzes will be uploaded to the Blackboard page of the course. Your duty is to check the Blackboard regularly.

Topics to be covered:

Courses	Chapter	Subject
1-5	1	The Relativity of Space and Time
6-9	2	Relativistic Mechanics
10-13	3	Quantum Mechanics-Atoms
14-15	4	Quantization of Light
16-17	5	Quantization of Atomic Energy Levels
18-20	6	Matter Waves
21-24	7	The Schrodinger Equation in One Dimension
25-28	8	The Three-Dimensional Schrodinger Equation
29-30	9	Electron Spin Theory

31-33	10	Multi-electron Atoms; the Pauli Principle and Periodic Table
34-35	11	Atomic Transitions and Radiation
36	12	Molecules
37	13	Solid State-Theory
38	14	Solid State Applications
39	15	Statistical Mechanics
40	16	The Structure of Atomic Muclei
41	17	Radioactivity and Nuclear Reactions
42	18	Elementary Particles

Student Responsibilities:

- Students are responsible for checking their academic e-mails and the Blackboard page of the course daily for getting updates about the course, grades, homeworks and class notes.

- If you need to take a make-up exam, please provide a university-approved excuse (such as a nurse/doctor signed document).

- In order to be successful in this course, you should attend all classes by having read the background material. Please be attentive and take notes during lectures. You are welcome to ask questions to clarify any point that is not clear, either during class or during my office hours. Please complete all homework on time and prepare for the exams.

Technology: Access, Requirements, Resources, Support:

To help ensure that UMBC students are equipped for academic success, the Division of Information Technology (DoIT) provides a wealth of resources and support, including tips for getting online and minimum specifications to consider when purchasing a computer (doit.umbc.edu/students). UMBC does require all students to be technologically self-sufficient, which entails having a reliable personal computer (preferably a laptop with webcam) and Internet access. Since UMBC requires all students to have a computer and Internet access, financial aid may be used to meet this requirement. To learn more, students should contact their financial aid counselor at financialaid.umbc.edu/contact.

Statement of Values for Student Academic Integrity at UMBC

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/

Accessibility and Disability Accommodations, Guidance and Resources:
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 would create 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** for registration information and office procedures.
SDS email: disAbility@umbc.edu, SDS phone: (410) 455-2459
If you will be using SDS approved accommodations in this class, please contact me (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:
UMBC's **Policy on Sexual Misconduct, Sexual Harassment and Gender Discrimination** and Federal Title IX law prohibit discrimination and harassment on the basis of sex 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 retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources:
Mikhel A. Kushner, Title IX Coordinator (she/her/hers) 410-455-1250 (direct line), kushner@umbc.edu
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 or thinking about making a report, please see the **Online Reporting Form**. Please note that, while University options to respond may be

limited, there is an anonymous reporting option via the online form and every effort will be made to address concerns reported anonymously.

Notice that Faculty are Responsible Employees with Mandatory Reporting Obligations:

All faculty members are considered *Responsible Employees*, per **UMBC's Policy on Sexual Misconduct, Sexual Harassment, and Gender Discrimination.** Faculty are therefore required to report possible violations of the **Policy** to the Title IX Coordinator, even if a student discloses something they experienced before attending UMBC.

While faculty members want you to be able to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report Sexual Misconduct to the Title IX Coordinator so that the University can inform students of their **rights, resources and support**.

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:

- The **Counseling Center**: 410-455-2472 / After-Hours 410-455-3230
- **University Health Services**: 410-455-2542
- Pastoral Counseling via **Interfaith Center**: 410-455-3657; interfaith@umbc.edu

Other Resources:

- **Women's Center** (for students of all genders): 410-455-2714; womenscenter@umbc.edu.
- **Shady Grove Student Resources**, **Maryland Resources**, **National Resources**.

Child Abuse and Neglect:

Please note that Maryland law and **UMBC policy** require that I report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police.