

PHYS 601
Quantum Mechanics - 1
Fall 2024

<u>Instructor:</u>	Dr. Can Ataca E-mail: ataca@umbc.edu (expect a response in 48 hours, excluding breaks and weekends) Office: PHYS 315 Office hours: Wednesdays 13:50-14:30 PM or by appointment
<u>Prerequisite:</u>	-
<u>Lecture Hours:</u>	Monday, Wednesday, Friday 13:00-13:50
<u>Classroom:</u>	PHYS 107
<u>Textbook:</u>	R. Shankar, Principles of Quantum Mechanics, ISBN: 0-306-44790-8 (Required) J. J. Sakurai, Advanced Quantum Mechanics ISBN: 10:0201067102 (Recommended)

Course Objectives: This course will introduce the advanced concepts, theory and applications of quantum physics, with the emphasis on one-dimensional and multi-dimensional systems, angular momentum, operator methods, harmonic oscillators, hydrogen and helium atoms and spin systems. 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. Have strong mathematical foundation to tackle any quantum mechanical systems.
2. Understand the need for quantum theory and things that cannot be handled with classical mechanics.
3. Understand the basic quantum mechanical postulates and relations.
4. Be able to solve simple particle problems (harmonic oscillator, particle in box/potential, hydrogen atom)
5. Distinguish symmetries and their consequences.
6. Have a better understanding of how different branches of physics such as statistical mechanics, condensed matter and quantum physics are related with each other.
7. Broaden and deepen your physical scientific reasoning and problem-solving skills.

<u>Grading:</u>	Your final grade will be determined by:	
	Final Exam:	20%
	Mid-Term Exams:	2x15%
	Homework:	10 x 5%

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

≥ 90	, your letter grade will be	“A”
$90 > X \geq 85$, then	“A-”
$85 > X \geq 80$, then	“B+”
$80 > X \geq 75$, then	“B”

$75 > X \geq 70$, then	“B-”
$70 > X \geq 65$, then	“C+”
$65 > X \geq 60$, then	“C-”
$60 > X \geq 55$, then	“D”
$55 > X$, 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, during the class hours 17-19 and 29-35. This date may be subject to change. The first midterm exam will include all discussions up to “Simple Problems in One-Direction” (Course 19) and the second midterm exam will include everything upto “Spin” (Course 35) 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 18th, 2024 (1:00 PM-3:00 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 11) homeworks each having up to 3 questions. The top 10 highest graded homeworks will be counted towards your grading. This is meant to allow for things that come up unexpectedly.

Topics to be covered:

Courses	Chapter	Subject
1-6	1	Mathematical Concepts (HW1)
7-11	2-3	Classical Mechanics (HW2)
12-16	4	Postulates of Quantum Mechanics (HW3)
17-19	5	Simple Problems in One-Direction (HW4)
20-22	7	The Harmonic Oscillator (HW5)
23	9	The Heisenberg Uncertainty Relation (HW6)
24-25	10	N-Dimensional Systems (HW7)
26-28	11	Symmetries and their consequences (HW8)
29-35	12-13	Rotational Invariance and Angular Momentum, Hydrogen Atom (HW 9)
36-39	14	Spin (HW10)
40-42	15	Addition of Angular Momentum (HW 11)

Course Material: All of the course materials will be uploaded to the Blackboard page of the course. Your duty is to check the Blackboard regularly.

Important Dates: No classes on 9/2, 11/28, 11/29.
15 minute delay start on 8/30, 9/13, 10/4, 11/1

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.

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/>

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.

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 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 for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: [410-455-2459](tel: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:

[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 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; 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

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

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:

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.

Hate, Bias, Discrimination and Harassment:

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.