PHYS 407 SPRING 2025

SYLLABUS

Course

We will cover vector calculus, electrostatics (with and without matter), magnetostatics (with and without matter), and electrodynamics (including electromagnetic waves). It all boils down to four equations, so relax!

Instructor

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Office hours:	Tu 1:15-2:15, Th 12:15-1:15

I work on gravitational waves, which share a lot of mathematical machinery with electromagnetic waves; and on astrophysical sources of gravitational waves where electromagnetic effects can be important.

I can sometimes manage off-schedule office hours if you contact me for a appointment at least a day ahead of time. They may need to be virtual.

Reading

The required textbook is the classic *Introduction to Electrodynamics* by David Griffiths, which is now in its 5th edition. If you have a previous edition, the differences are not huge but it is a good idea to have a quick look to compare.

Not required, but maybe interesting: Many people have found the little book "Div, Grad, Curl and All That" by Schey to be useful for insight into basic vector calculus.

I will provide homework solutions which you can use as study guides for the exams, plus possibly some other notes. All these will be distributed through Blackboard.

Grades

Your grade consists of three exams (25% each) and the homework (25% total). Indirectly the homework affects your grade much more than that because it prepares you for the exams.

Homework is usually due Friday nights on Blackboard. Please use the solutions to study for the exams. I will accept it up to a week late for half credit.

I do not take attendance, but I have always seen performance correlated with attendance.

Exams are in-class, closed book. A calculator and one page of your notes are OK. Show your work. Makeup exams can be arranged for major issues if you let me know *beforehand*—except the final exam, which is much harder to rearrange since things need to be wrapped up for the end of the semester. I will write some feedback on your exams, but strongly

encourage you to talk about them in office hours later if you missed something significant. The final contains some new material and some recap of previous material.

The conversion from total percentage scores to letter grades is A/B/C = 90%/80%/70%.

You are welcome to discuss and work with your colleagues, but the final writeup needs to be your own. You are welcome to use Wolfram and similar tools to do integrals (note that in your writeup), but be careful of Wikipedia and random stuff on the internet

Schedule

Here is the tentative schedule of lectures and readings, plus homework and exam dates. It may change a little based on class feedback and on my travel schedule. Any changes will be announced in class and this document will be updated on Blackboard.

I recommend skimming the reading before class, then hitting it more carefully after we have discussed it in class. In class I point you toward highlights and mention some things not covered in the book, but the book has details we do not have time for in class. You need both to get a good idea of the subject.

Date	Reading Sections	Topics
Jan. 28	Syllabus, Intro, 1.1, 1.2	Intro, vector algebra, vector calculus
Jan. 30	1.2, 1.3	Vector calculus
Jan. 31		HOMEWORK #1 DUE
Feb. 4	1.3, 1.4	Vector calculus, curvilinear coordinates
Feb. 6	Appendix A, 1.5, 1.6	Vector calculus, δ-functions
Feb. 7		HOMEWORK #2 DUE
Feb. 11	2.1, 2.2	Electric field, Gauss' Law
Feb. 13	2.2, 2.3	Gauss' Law, electrostatic potential
Feb. 14		HOMEWORK #3 DUE
Feb. 18	2.4, 2.5	Work, energy, conductors
Feb. 20	2.5, 3.1	Conductors, Laplace's Equation
Feb. 21		HOMEWORK #4 DUE
Feb. 25	3.2, 3.3	Method of images, separation of variables
Feb. 27	3.4	Multipole expansion
Feb. 28		HOMEWORK #5 DUE
Mar. 4	Chs. 1–3	EXAM REVIEW
Mar. 6	Chs. 1–3	EXAM I
Mar. 11	4.1, 4.2	Polarization, dielectrics
Mar. 13	4.2, 4.3	Dielectrics, electric displacement
Mar. 14		HOMEWORK #6 DUE
Mar. 18	—	NO CLASS
Mar. 20	—	NO CLASS
Mar. 25	4.4, 5.1	Linear dielectrics, Lorentz force
Mar. 27	5.1, 5.2	Lorentz force, Biot-Savart Law
Mar. 28		HOMEWORK #7 DUE

Apr. 1	5.3, 5.4	Diverge and curl of B, magnetic vector potential
Apr. 3	5.4, 6.1	Vector potential, magnetization
Apr. 4		HOMEWORK #8 DUE
Apr. 8	6.2, 6.3	Field of a magnetized object, the H field
Apr. 10	6.3, 6.4	The H field, linear and nonlinear media
Apr. 11		HOMEWORK #9 DUE
Apr. 15	Chs. 4–6	EXAM REVIEW
Apr. 17	Chs. 4–6	EXAM II
Apr. 22	7.1, 7.2	Electromotive force, induction
Apr. 24	7.2, 7.3	Induction, Maxwell's Equations
Apr. 25		HOMEWORK #10 DUE
Apr. 29	9.1, 9.2	Basic waves, electromagnetic waves in vacuum
May 1	9.2, 9.3	Electromagnetic waves in vacuum and matter
May 2		HOMEWORK #11 DUE
May 6	9.4	Absorption and dispersion
May 8	8.1	Conservation laws
May 9		HOMEWORK #12 DUE
May 13	Chs. 7–9	EXAM REVIEW
May 20	10:30am	FINAL EXAM

Learning Outcomes Assessment

There are a number of educational objectives for physics students at UMBC. The 7 specific learning objectives for PHYS 407 are summarized below. By the end of this course, students should be able to:

- Have a working understanding of vector analysis, of the physical meaning of differential operators such as the div and curl, and of related theorems such as the divergence, Gauss's and Stokes' theorems.
- Solve problems in electrostatics that manifest an understanding of the divergence of electrostatic fields, the electric potential, and work and energy in electrostatics.
- Demonstrate an ability to solve problems in electrostatics by solving Laplace's equation, and by using the method of images, or of separation of variables.
- Understand electric fields in matter, through being able to solve problems involving the field of a polarized object, the electric displacement, and dielectrics.
- Demonstrate an understanding of magnetostatics, through the ability to solve problems involving the Lorentz force and the Biot-Savart Law, as well as the divergence and curl of the magnetic field and vector potential of the magnetic field.
- Understand magnetic fields in matter, through solving problems involving magnetization, the field of a magnetized object, the auxiliary field H, magnetic susceptibility and permeability and ferromagnetism.

- Demonstrate an understanding of the electromotive force, the electromagnetic induction, and Maxwell's equations.

These objectives will be assessed by my observations of your participation in class discussions, as well as your performance on homework and written exams.

Academic Integrity

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.

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

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 allknown 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 and 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.