

Electricity and Magnetism II (PHY 322)

Spring 2024

Scott N. Walck

Course Information

Contact Information

- Instructor: Scott N. Walck
- Preferred names: Scott, Dr. Walck, Prof. Walck (I prefer not to be called by my unadorned last name.)
- Pronouns: He, his, him
- Office: Neidig-Garber 223
- Office Phone: 717-867-6153 (messages reach me by email)
- Email: walck@lvc.edu
- Web page: <http://quantum.lvc.edu/walck/>

Email is the best way to contact me. Many questions and issues can be solved over email.

Office Hours

I will be in my office

every

Monday	11:00–12:00
Tuesday	11:00–12:00
Tuesday	1:00– 2:00
Wednesday	11:00–12:00
Friday	11:00–12:00

during the course of the Spring 2024 semester.

If you would prefer a Zoom meeting, or would like to schedule an in-person meeting at a time outside the office hours above, please send me an email to set that up. You can drop by my office any time to see if I am there. If I'm there, we can chat.

My Zoom personal room is

- Meeting ID: 744 519 1002
- <https://lvc-edu.zoom.us/j/7445191002>

Meeting Times and Locations

We meet Monday, Wednesday, and Friday from 12:00-12:50 in N-G 212. The first week of classes (January 15, 17, and 19) will be held online, as Dr. Walck recovers from his hospital stay.

Course Description

Second semester of the theory of the basic phenomena of electromagnetism together with the application of fundamental principles of the solving of problems. The electric and magnetic properties of matter, direct current circuits, alternating current circuits, the Maxwell field equations and the propagation of electromagnetic waves are among the topics treated. Physics 322 consists of 3 credits hours; it has 3 contact hours per week. Physics 321 is a prerequisite for Physics 322.

Course Objectives

It is expected that students will

1. describe physical situations using the mathematical language of scalar and vector fields (Goals 1, 2, 4)
2. describe light as an electromagnetic wave (Goals 1, 2, 4)
3. interpret the behavior of light in terms of the interaction between matter and electromagnetic field (Goal 1)
4. apply Maxwell's electromagnetic theory to specific physical situations (Goals 1, 2)
5. apply Gauss's law in matter to calculate electric field (Goals 1, 2)
6. apply Ampere's law in matter to calculate magnetic field (Goals 1, 2)
7. calculate transmission and reflection coefficients for an electromagnetic wave incident on a plane interface between two materials (Goals 1, 2)
8. explain the relationships between electricity and magnetism (Goals 1, 4)

Program Goals for the Physics Major

These goals are referred to in the course objectives above.

1. Graduates from our program will have a working understanding and knowledge of fundamental areas in physics.
2. Graduates from our program will have a working understanding and knowledge of mathematics along with computational skills necessary for advanced work in physics.
3. Graduates from our program will be skilled in the methods of scientific research and investigation.
4. Graduates from our program will have effective written and verbal communication skills.
5. Students will apply learning in situations where they develop and hone professional activities and show evidence of an applied and integrated skill set.

Textbooks

We will use two textbooks for this course. The first textbook for the course is *Introduction to Electrodynamics* (4th edition), by David J. Griffiths, Cambridge University Press (2017), ISBN 978-1-108-42041-9. This is an excellent (perhaps the best) undergraduate textbook in electromagnetic theory, but it contains nothing about numerical and computational techniques in electromagnetic theory, which are important to learn in the 21st century.

The second textbook for the course is *Learn Physics with Functional Programming*, by Scott N. Walck, No Starch Press (2023), ISBN 978-1-718-50166-9. This book contains numerical and computational techniques in electromagnetic theory, making it an excellent complement to Griffiths. I will refer to this book as LPFP.

Exams

An exam is an opportunity to demonstrate what you know about physics. There are three regular exams and one final exam in this course. The dates of these exams are listed later in the syllabus. Each exam consists of about three problems.

An exam is an individual endeavor in which you write and submit *your* ideas, *your* solutions, *your* guesses, and *your* work.

During an exam,

- you *may* consult any notes that you have made during the course, whether in class or outside of class,
- you *may* consult the textbooks, and
- you *may* use any calculator, as long as it cannot communicate with other machines or people.

During an exam,

- you *may not* communicate with other people,
- you *may not* share a calculator with anyone else,
- you *may not* use the notes of other people, and
- you *may not* search for help on the web or anywhere else.

There will be portions of exams in which we will use a computer. During those portions, you may not use the computer to communicate with other people (exceptions: you can send me an email and use Canvas to submit your work), you may not search for help on the web or anywhere else, and you may not engage in any activity which violates the spirit of an exam being a one-person activity designed to probe what you know and what you can do. We will talk about the details closer to the first exam.

If you have any questions about whether a particular resource is allowed or not allowed during an exam, please ask me.

At the end of the semester, we will have a comprehensive final exam.

You should not think that office hours are only a time for people that need remedial help. Coming to office hours is helpful for people at all levels. Nobody is too advanced or too far behind to benefit from coming to office hours. A typical student in this class probably cannot get a high grade without coming to office hours, at least from time to time. Even if you don't have specific questions, I can suggest problems for you to work on that will deepen your understanding, putting you in a better position for exams.

Homework

The homework is the centerpiece of this course. It is in doing the homework problems that you will begin to understand electromagnetic theory. Give the homework problems the time they deserve. I expect that many of the problems I am asking you to work will take about one hour each. I would not ask you to do these problems if I didn't believe that the process was worth your time. You cannot succeed with this subject if you wait until the day before the homework is due to start. Start the homework a week before the due date by reading the problems and seeing if you can do any of them. Come to me with questions, or if you get stuck.

You may work together on the homework, talking about how to solve the problems, but you must write your homework solutions independently. Do not copy homework solutions from the web or from your classmates. Copying another person's homework solutions is an act of cheating and plagiarism. Submitting your own work for the homework will cause you to learn electromagnetic theory. Everything that you write in your homework solutions you should be able to explain to me if I were to ask. This does not mean that your homework needs to be perfect, only that it must have come from your mind.

If you can't finish some of the problems before the due date, turn in what you have done. It is still worth trying to do the remaining problems, because they all have a purpose in learning electromagnetic theory. If you know in advance that you will have trouble finishing the homework by the deadline, come and talk to me.

Class Participation

A portion of your grade is determined by class participation. Obviously, attendance is a prerequisite for participation in class. If you attend every class, and participate by asking questions, answering questions, and taking your turn in doing problems at the (virtual white) board, you will have a perfect score for this area. If you need to miss a class, see me in advance and I'll give you an alternative assignment.

Grading

Your grade will be determined by a weighted average as indicated in the table below.

Exams	45%
Homework	30%
Class Participation	10%
Final Exam (comprehensive)	15%

Your letter grade for the course is determined by the weighted average. The minimum weighted average (out of 100) required for each letter grade is indicated below.

A	93
A-	90
B+	87
B	83
B-	80
C+	77
C	73
C-	70

D+	67
D	63
D-	60
F	0

Make-up Work and Extra Credit Policy

Homework and exams can only be made up in the event of serious circumstances such as illness. There is no extra credit in this course.

Class Schedule

Date	Topic	Read and do before next class
01/15	Scalar waves in 1D	1.1.1
01/17	Scalar waves in 2D	half of 1.1.2
01/19	Scalar waves in 2D	1.1.2
—		
01/22	Scalar waves in 3D	1.1.3
01/24	EM Wave equation	1.2.1
01/26	Constraints	1.2.2
—		
01/29	Energy and Momentum	1.2.3
01/31	Polarization	half of 1.2.4
02/02	Polarization	1.2.4
—		
02/05	Modes	1.3
02/07	Potentials	1.4
02/09	Review Chapter 1	
—		
02/12	Exam 1	
02/14	Numerical solution of wave equations	
02/16	Scalar wave equation in 1D	
—		
02/19	Scalar wave equation in 1D	
02/21	Maxwell equations in 1D	
02/23	Maxwell equations in 1D	
—		
02/26	Scalar wave equation in 2D	
02/28	Maxwell equations in 2D	
03/01	Scalar wave equation in 3D	
—		
03/04	Spring vacation	

03/06	Spring vacation	
03/08	Spring vacation	
—		
03/11	Maxwell equations in 3D	
03/13	Exam 2	
03/15	Lorentz Force Law	LPFP 28
—		
03/18	Lorentz Force Law, Analytical	LPFP 28
03/20	Analytical solution to particle in a magnetic field	
03/22	Analytic, electric and magnetic fields	
—		
03/25	Numerical solution to Lorentz force law	
03/27	Numerical solution to Lorentz force law	
03/29	Easter vacation	
—		
04/01	Easter vacation	
04/03	Lorentz force law review	
04/05	Exam 3	
—		
04/08	Maxwell equations	LPFP 29
04/10	Radiation from an accelerating charge	LPFP 29
04/12	Naive method	
—		
04/15	FDTD method	
04/17	Animating an EM field	
04/19	Project ideas	
—		
04/22	Project ideas	
04/24	Work time and check-in for projects	
04/26	Dutchmen Day	
—		
04/29	Project presentations	
05/01	Project presentations	
05/03	Review	

Course Objectives Alignment to Program Goals and Assessment of Course Objectives

Program Goal	Course Objective	Assessment
Graduates from our program will have a working understanding and knowledge of fundamental areas in physics.	interpret the behavior of light in terms of the interaction between matter and electromagnetic field	Exam 3
	apply Maxwell's electromagnetic theory to specific physical situations	Exam 3, Final Exam
	apply Gauss's law in matter to calculate electric field	Exam 2
Graduates from our program will have a working understanding and knowledge of mathematics along with computational skills necessary for advanced work in physics.	apply Ampere's law in matter to calculate magnetic field	Exam 2
	describe physical situations using the mathematical language of scalar and vector fields	Exam 1
	calculate transmission and reflection coefficients for an electromagnetic wave incident on a plane interface between two materials	Exam 3
Graduates from our program will have effective written and verbal communication skills.	describe light as an electromagnetic wave	Exam 1, Final Exam
	explain the relationships between electricity and magnetism	Final Exam

College-Wide Course Policies

RESPONDUS or EXAMSOFIT POLICY

In this course, you may be asked to use a custom browser that locks down the testing environment within the Canvas learning management system. While using these programs, your instructor may require you to activate the video camera and microphone of your computer while completing the exam. Students who are not willing to provide the requested video and audio feeds may ask to take the exam using an alternative proctoring method. Students may arrange for the exam to be proctored at a professional testing center such as Sylvan Learning Centers. The student is responsible for finding the testing site and must pay any fees associated with testing. The Alternate Proctoring Request form can be obtained by contacting Kristen Shutter at shutter@lvc.edu or by phone at 717-867-6028.

EXPECTATIONS FOR STUDENTS IN FACE-TO-FACE CLASS SESSIONS

Students participating in face-to-face class sessions must adhere to the guidelines put forth in LVC's Community Covenant (<http://wordpress.lvc.edu/wordpress/lvcforward/2020/07/09/community-covenant/>). To facilitate contact tracing, students will be given assigned seats for the semester.

POLICY ON RECORDING CLASS SESSIONS

Audio and/or video recordings of the class sessions may be made by the College and/or by students who have been authorized by the LVC Center for Accessibility Resources to record classes as an accommodation for a disability. By participating in the class, all students consent to being recorded for these purposes. Any other recordings of class sessions are not permitted. Students participating in on-line courses are asked to respect the privacy of those participating in the class by ensuring that class sessions cannot be overheard by those who are not enrolled in the course.

Academic Honesty Policy

Any student who submits work that is in violation of the academic honesty policy will be subject to the penalties described in the College Catalog and outlined in LVC's Academic Honesty Policy. Lebanon Valley College expects its students to uphold the principles of academic honesty. Violations of these principles will not be tolerated. Students shall neither hinder nor unfairly assist the efforts of other students to complete their work. All individual work that a student produces and submits as a course assignment must be the student's own.

Cheating and plagiarism are violations of the academic honesty policy. Cheating is an act that deceives or defrauds. It includes, but is not limited to, looking at another's exam or quiz, using unauthorized materials during an exam or quiz, providing unauthorized material or assistance to another student, colluding on assignments without the permission or knowledge of the instructor, and furnishing false information to receive special consideration, such as postponement of an exam, essay, quiz, or deadline of an oral presentation.

Plagiarism is the act of submitting as one's own the work (e.g., the words, ideas, images, compositions, or other intellectual property) of another without accurate attribution. Plagiarism can manifest itself in various ways: it can arise from sloppy, inaccurate note-taking; it can emerge as the incomplete or incompetent citation of resources; it can take the form of presenting passages or work prepared by another as one's own, whether from an online, oral, or printed source. It may also take the form of re-using one's own previously submitted work (such as a paper written for a different class) without the current instructor's knowledge and permission.

A student is culpable for violations of the academic honesty policy, as outlined above, when caused by either academic negligence or academic dishonesty. An act of academic negligence is when a student engages in behaviors outlined above through irresponsible ignorance or carelessness. Acts of dishonesty involve the intent to deceive or mislead. Initially, the instructor will make the determination that a violation of the policy may have occurred.

Students who take part in violations as described above are subject to a meeting with the Associate Provost of Undergraduate Education, who has the authority to take further action, up to and including expulsion from the College.

UNICHECK POLICY

In this course, you may be asked to submit some or all of your assignments for review by LVC's online plagiarism service, Unicheck. This service will compare the content of your work to content found on the internet and several proprietary databases. Any work submitted to this service may become part of the service's permanent collection of submitted papers. After your work is submitted, the service will generate an originality report, which will be sent to your instructor. Any student who submits plagiarized work will be subject to the penalties outlined in LVC's Academic Honesty Policy found in the Student Handbook and the College Catalog.

END OF TERM COURSE EVALUATIONS

Most courses at the College utilize a course evaluation system called EvaluationKIT. Near the end of the term, you will have the opportunity to evaluate the course in a number of key areas: learning environment, instructor performance, overall course structure, progress on relevant course objectives, and Constellation learning outcomes (if they apply). The faculty have approved a set of common questions that students will respond using an agreement

scale. Please note that quantitative survey results and comments are used for course and instructor improvements and to indirectly measure the progress on relevant student learning objectives.

POLICIES REGARDING ACCESSIBILITY RESOURCES

Individuals with disabilities are guaranteed certain protections and rights of equal access to programs and activities under Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Therefore, Lebanon Valley College recognizes the responsibility of the college community to provide equal educational access for otherwise qualified students with disabilities.

In-Person and Online Courses: Any student who needs accommodations is invited to provide letters from the Center for Accessibility Resources and discuss accommodations with me.

Any student who feels they may need accommodations based on a documented disability or other condition that may affect academic performance should: contact The Center for Accessibility Resources, located in the Lebegern Learning Commons — Mund Suite 002. Students may schedule an appointment by calling 717-867-6028 or emailing hannafor@lvc.edu to determine if accommodations are warranted and to obtain an official letter of accommodation.

Assistive Technology is available to enhance your academic skills. The Center for Accessibility Resources, located in the Lebegern Learning Commons—Mund Suite 002, offers educational software and personal assistive devices for short-term loans. Available assistive devices include LiveScribe pens, mini iPads, digital recorders, headphones, and adaptive keyboards. Our student coordinator is available to meet with students throughout the semester to suggest devices and/or software aligned to individual student needs.

If a student believes that appropriate accommodations are being denied, the student may file a grievance. Procedures for filing grievances may be found at www.lvc.edu/offices-directories/center-for-accessibility-resources.

STATEMENT ON INCLUSIVE EXCELLENCE

LVC is a community of inclusive excellence. We affirm the rights of all persons to a superior educational experience that is characterized by respect for others. As such, this class and all classes at LVC, are places where our core values of inclusiveness, civility and appreciation of difference are affirmed.

POLICY ON PREFERRED NAMES AND PRONOUNS

Lebanon Valley College is committed to fostering an environment of inclusion and support, which includes honoring all its members' forms of self-identification. This policy provides uses of preferred first names and pronouns for students, faculty, staff, friends, and alumni who wish to provide them. Many members of the LVC community may use names other than their legal names to identify themselves. If the use of this different name is not for

misrepresentation, LVC acknowledges that a preferred name may be used wherever possible. The preferred name will be recorded and used except where the legal name is required.

Although students, faculty, staff, friends, and alumni are free to determine the preferred name and pronoun they wish to be known by, the College deserves the right to deny a preferred name and pronoun if it is used inappropriately.

Gender pronouns are those pronouns that members of the community use to represent themselves. Gender pronouns can include, but are not limited to, he/him/his, she/her/hers, they/them/theirs, etc. Asking for and correctly using a person's pronoun is one of the most basic ways to show respect for a person's gender identity.

Preferred name and pronouns will be entered and accessible internally for members of the campus community. Lebanon Valley College expects all faculty, staff, and students to facilitate the use of preferred names and pronouns listed on the directory and class rosters.

TITLE IX STATEMENT

Lebanon Valley College prohibits discrimination on the basis of race, color, national origin, ancestry, religion/creed, sex, pregnancy, sexual orientation, gender identity or expression, age, disability, genetic information, marital/familial status, or veteran status in all programs and activities, as required by Title IX of the Educational Amendments of 1972, the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and/or College policies. Lebanon Valley College prohibits discriminatory harassment and sexual harassment, including sexual violence and any type of sexual misconduct.

Title IX makes it clear that violence, harassment, and any type of sexual misconduct based on sex and gender are civil rights violations. If you or someone you know has experienced violence, discrimination, or harassment, support is available through Counseling Services, Health Service, the Chaplain's office, the Victim Advocacy Program, and Title IX deputies. Please refer to the Student Handbook or the College Catalog for specific contact information.

HYBRID AND ONLINE INSTRUCTIONAL EQUIVALENCIES

The faculty of Lebanon Valley College approved guidelines on Equivalent Instructional Activities that will be used to substitute for face-to-face contact hour requirements for this online or hybrid course. These activities are clearly documented in this syllabus. For further details, please review the approved Equivalent Instructional Activities.

Policy on Student Success and Intervention

- **THE CENTER FOR ACADEMIC SUCCESS**

Starfish is an online tool used at LVC that gives you the opportunity to connect with faculty and staff to cultivate your success. Through Starfish, you can submit concerns,

access beneficial resources, connect with your Success Network, and receive updates on your academic progress. This tool also allows faculty and staff to recognize when you might need extra help and reach out to collaboratively resolve an issue. If you receive a Starfish Flag showing that someone has a concern, you will receive an email with a specific action plan to follow. Take that action and work with us to maximize your success.

- CARE Team

At Lebanon Valley College, we want you to succeed in and out of the classroom. Administrators and faculty work together on the CARE Team to cultivate Confidence, Accountability, Resilience, and Engagement in every student. If a member of the LVC community is concerned about you for any reason (i.e. academic, social, or emotional issues), they will ask a CARE team member to reach out to you and work with you towards a solution. You should consider it your assignment to follow through and accept assistance from the appropriate source(s). Don't be afraid or hesitant to seek help from these individuals: supporting you is their job! Be proactive and take control of your success.

- The Center for Academic Success and Exploratory Majors

Located in the lower-level of Mund College Center, the Center for Academic Success and Exploratory Majors serves to support, inspire, and cultivate student success. The key to performing well academically lies in frequently utilizing support services across campus; in fact, many of our top students utilize tutors to help prepare for exams, talk through challenging concepts, learn how to take effective notes, and more. For this reason, we staff peer tutors in almost all 100 and 200-level classes, including subject-specific writing conferencing. Students can request tutoring appointments through Starfish and the sessions serve as a place to connect with classmates, ask questions, and work on homework as well as drop-in writing support from 7pm-9pm, Mondays through Thursdays. If you would like to work with a tutor, please request a time using Starfish.

In addition, the Center features academic success coaching, where staff members support students by designing and implementing a plan for academic success. These "coaching" sessions focus on developing effective time management, organizational, test-taking, critical reading, note-taking, and study skills, as well as learning healthy behavioral techniques like stress management and self-motivation. . For more information on any of these services, visit the Center for Academic Success. To request an appointment, please email findyoursuccess@lvc.edu.

The Center also serves as the home on campus to Exploratory (undecided) majors. Professional staff advise students who are still determining their major/career path and support students who are in transition between majors as they determine their next steps.

STATEMENT ON SUPPORTING MENTAL HEALTH

Your mental health, including excessive stress, anxiety, depression or problems with eating and/or sleeping can adversely influence your academic performance. At LVC we care about the whole person. If you feel that any of these issues are negatively impacting your

performance, please contact our Counseling Services to consult with one of our professional counselors. During a brief phone conversation, they can assess your particular needs and help you make a connection to the services you may need. If you would like a phone consultation, just email counselingservices@lvc.edu and leave your contact information. A professional counselor will return your call or email the next business day. We will not check email after hours or over the weekend/vacation times. If you experience an emergency, please call 911 in your local area or text 741741 to request immediate assistance.

Notice of Non-Discrimination

Lebanon Valley College does not discriminate on the basis of race, color, national origin, ancestry, religion/creed, pregnancy, sexual orientation, gender identity or expression, age, disability, genetic information, or veteran status in its programs and activities as required by the Americans with Disabilities Act of 1990, Section 504 of the Rehabilitation Act of 1973, Title VII of the Civil Rights Act of 1964, and other applicable statutes and/or College policies.

The following person has been designated to handle inquiries regarding the Americans with Disabilities Act, the Rehabilitation Act, Title VII, and related statutes and regulations: Ann C. Hayes, Senior Director of Human Resources and Title IX Coordinator, Administration Building/Humanities Center 108, Lebanon Valley College, 101 N. College Avenue, Annville, PA 17003-1400, 717-867-6416, hayes@lvc.edu.

Statement on the Use of Artificial Intelligence (AI)

Students should be aware that the work they submit must be their own. Professors may create assignments or activities that require or encourage the use of AI. If such use is not either required or allowed explicitly, then students must assume that the use of artificial intelligence is **not** acceptable in any given assignment. In this instance, unacknowledged uses of artificial intelligence in student work can be deemed violations of our academic honesty policy (see above). If this is unclear in any way, it is the student's responsibility to ask the professor about appropriate uses of AI for the assignment.

Religious Accommodations

Lebanon Valley College is committed to providing a welcoming and supportive environment for students from all cultural and religious backgrounds. All members of the community should commit to students not suffering adverse consequences for practicing their religions. We recognize the Christian centeredness of our campus, including our Academic Calendar. We seek to support an environment that is welcoming to persons of all faith traditions and backgrounds. Students whose religious practice requires that they observe holidays other than those specified on the Academic Calendar should have a conversation with either a faculty member or the Chaplain and Coordinator of Spiritual Life to initiate the accommodation process. This conversation should happen within the first two weeks (or first

week, if the course is a summer, winter, or graduate course meeting for less than 15 weeks) of each semester of their intent (even when the exact date of the day will not be known until later) so that alternative arrangements for both students and faculty can be made at the earliest opportunity. Any such conversation should seek to determine the needs of the student and the appropriate next steps. If the conversation starts through a faculty member, the faculty member should recommend that the student also have a conversation with the Chaplain so that the Chaplain may learn about the student's needs, attend to any non-academic requests, and refer the student to other impacted faculty. If the conversation starts with the Chaplain, the Chaplain will direct the student to also have a conversation with impacted faculty members.