

Syllabus: Physics 1271 Electromagnetism, Quantum Mechanics and Thermodynamics

Course Information

- **Credit hours:** 5
- **Mode of delivery:** In person.

Course Prerequisites

Prereqs: One of the following:

- Physics 1270; Prereq or concur: Math 1152, 1155, 1161, 1172, 1181H, or 4181H
OR
- Physics 1250, 1250H, or 1260; Prereq or concur: Math 1152, 1155, 1161, 1172, 1181H, or 4181H; and enrollment in Astronomy & Astrophysics major, Engineering Physics major or pre-major, or Physics major.

Course Description

Calculus-based introduction to classical and modern physics. In depth study of electromagnetism, the principles of quantum mechanics, and thermodynamics. For students majoring in Astronomy & Astrophysics, Engineering Physics, or Physics.

Learning Outcomes

1. Successful students are able to explain basic facts, principles, theories and methods of modern natural sciences; and describe and analyze the process of scientific inquiry.
2. Successful students are able to identify how key events in the development of science contribute to the ongoing and changing nature of scientific knowledge and methods.
3. Successful students are able to employ the processes of science through exploration, discovery, and collaboration to interact directly with the natural world when feasible, using appropriate tools, models, and analysis of data.
4. Successful students are able to analyze the inter-dependence and potential impacts of scientific and technological developments.
5. Successful students are able to evaluate social and ethical implications of natural scientific discoveries.
6. Successful students are able to critically evaluate and responsibly use information from the natural sciences.
7. Student develop skills in problem solving and analysis that establish a foundation for further study in the area of physics.



8. Students will develop hard skills including developing a foundation in electromagnetism, quantum mechanics, and thermodynamics. The electromagnetism will include an understanding of Maxwell's Equations and how to apply these concepts to make predictions of physical systems. The introduction to quantum mechanics will include the foundational principles, the basic implications, and applications to atomic phenomena such as the structure of the hydrogen atom. Thermodynamics will include a mixture of classical physics and quantum physics to develop models for thermodynamic processes, such as the ideal gas law. Using statistical methods students will understand how certain processes are irreversible in nature.
9. Students will develop soft skills, such a good study habits, ability to work well in a group, and good problem-solving skills.



How This Course Works

Mode of delivery: This is an in-person course.

Pace of activities: This course is divided into approximately **weekly modules**. These modules are presented on CARMEN (carmen.osu.edu) and typically include pre-lecture review, problems solved in small groups during recitation, homework, and laboratory exercises.

Credit hours and work expectations: This is a 5 credit-hour course that includes lecture, laboratory, and recitation components. According to [Ohio State bylaws on instruction](http://go.osu.edu/credit%20hours) ([go.osu.edu/credit hours](http://go.osu.edu/credit%20hours)), students should expect 6 hours of in-class work per week (this includes 3 hours of lecture, 2 hours of lab, and 1 hour of recitation) in addition to 9 hours outside of class (reading and assignment preparation, for example) to receive a grade of [C] average.

Attendance and participation requirements:

- **Class Attendance: required**
Lecture participation will involve discussion of topics and answering TopHat questions presented during lecture.
- **Laboratory: required**
Laboratory participation involves attending the laboratory meeting where you will be conducting experiments and analyzing data from those experiments.
- **Recitation: required**
Recitation will involve working in small groups to solve complex problems.
- **Office hours: optional**
Office hours are optional and are attended as needed by students.



Course Materials, Fees and Technologies

Required Materials and/or Technologies

- **Text:** Six Ideas that Shaped Physics, 4th Edition by Thomas Moore, Units E, Q, T.
- **Laboratory Workbook:** Will be provided.

Required Equipment

- **Webcam:** Required for Zoom office hours. Built-in or external webcam, fully installed and tested
- **Microphone:** Required for Zoom office hours. Built-in laptop or tablet mic or external microphone

CarmenCanvas Access

You will need to use [BuckeyePass](https://buckeyepass.osu.edu) (buckeyepass.osu.edu) multi-factor authentication to access your courses in Carmen. To ensure that you are able to connect to Carmen at all times, it is recommended that you do each of the following:

- Register multiple devices in case something happens to your primary device. Visit the [BuckeyePass - Adding a Device](https://go.osu.edu/add-device) (go.osu.edu/add-device) help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- [Install the Duo Mobile application](https://go.osu.edu/install-duo) (go.osu.edu/install-duo) on all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at [614-688-4357 \(HELP\)](tel:614-688-4357) and IT support staff will work out a solution with you.

Technology Skills Needed for This Course

- Basic computer and web-browsing skills
- [Navigating CarmenCanvas](https://go.osu.edu/canvasstudent) (go.osu.edu/canvasstudent)
- [CarmenZoom virtual meetings](https://go.osu.edu/zoom-meetings) (go.osu.edu/zoom-meetings)

Other Skills Needed for This Course

- Basic knowledge of calculus (such as would be obtained in Math 1151, 1141, or 1181H) as well as Newtonian mechanics and conservation laws (covered in Physics 1250, 1260, 1270).

Technology Support

For help with your password, university email, CarmenCanvas, or any other technology issues, questions or requests, contact the IT Service Desk, which offers 24-hour support, seven days a week.

- **Self Service and Chat:** go.osu.edu/it
- **Phone:** [614-688-4357 \(HELP\)](tel:614-688-4357)
- **Email:** servicedesk@osu.edu



Grading and Faculty Response

How Your Grade is Calculated

Assignment Category	Points
Lecture Preparation (Quiz)	10%
Lecture Attendance/Participation	10%
Laboratory Experiments and Exercises	20%
Group Work in Recitation	10%
Homework	10%
Quizzes	10%
Unit Exams (three total)	30% (10% each)

For each component, other than the Unit Exams, the lowest grade of the component will be dropped. For example, there will be thirteen homework assignments. The lowest score will be dropped and the other twelve will count for 20% of your total grade.

See [Course Schedule](#) for due dates.

Descriptions of Major Course Assignments

Lecture participation (10%): Lecture is where we will review concepts and put them to work in practice problems. Participation is assessed based on participation in TopHat questions in class or small group assignments. The purpose of the TopHat questions is for students to engage with the material so the participation grade is entirely based on you responding to the TopHat questions, not whether or not you respond correctly.

Lab work (20%): See physics happening in front of your eyes, and build skill in experimental methods. Activities for credit will be checked by TA prior to departing lab.

Group work (10%): Build your problem-solving muscles by working on harder problems in groups, in an environment where you can phone a friend for help (i.e., talk with your expert TA!).

Lecture Preparation (10%): Prior to the Lectures each week, there will be a reading assignment from the book with a simple CARMEN "quiz" to provide responses, either a simple multiple choice or a short written response. These will be due on Mondays at 1pm and can be accessed through the CARMEN Assignments or Modules tabs. The material covered by the reading assignment is the reading for that current week. The exception is the first reading assignment, which will cover the material from this syllabus in addition to the Week 2 reading. You can take the reading assignment quiz twice, and we'll keep the higher score.

Homework (10%): Weekly homework can be accessed through the CARMEN_Assignments or Modules tabs. These will normally be due Friday nights at 11:59pm.

Quizzes (10%): There will be six quizzes. These will be given during recitation via CARMEN.

Unit exams (30%): There will be three unit exams after the completion of each book unit (E = electromagnetism, Q = Quantum Mechanics, and T = Thermodynamics). Each exam is worth 10% of the grade for a total of 30%. These exams will be completed during recitation.

Academic integrity and collaboration: Your submitted assignments should be your own original work. We do encourage students to help each other understand the material. However, the bulk of each assignment should be - unambiguously - each student's own work. Science is a collaborative field and so working together is important, but one must be careful to distinguish one's own contributions from those of others.

Regrades

If you think there's been a mistake in the grading of any individual assignment, please fill out and submit the regrade form via Carmen within two weeks of getting your graded assignment back. The process is described in the "Useful links for course information" Module on Carmen.

What to do if you miss an assignment or get sick

Drop policy: One week's worth of each element (except for the unit exams) will be dropped, no questions asked. This can be either a missed assignment (e.g., if you get sick), or your lowest grade (if you complete all assignments in the category). We will not count the first week's lecture participation toward the final lecture participation grade in acknowledgment of the flux in enrollment, in addition to a week's worth of other lectures.

Late work: Late Hand-in homework will be accepted after the assignment deadline for 50% credit if it's in within 24 hours of the deadline.

Late/incomplete work beyond the drop policy: If you have an issue that causes you to miss assignments beyond this, please contact your instructor ASAP, as soon as the issue arises.

What to do if you feel like you are falling behind

Reach out! Contact an instructor or TA, and we can help you develop strategies to help. We also strongly recommend that you form study groups--interacting with others helps solidify concepts. Everyone in the group brings a different perspective and skillset to the table.

Grading Scale

93–100: A
90–92.9: A-
87–89.9: B+
83–86.9: B
80–82.9: B-
77–79.9: C+
73–76.9: C
70–72.9: C-
67–69.9: D+
60–66.9: D
Below 60: E

Instructor Feedback and Response Time

- **Preferred contact method:** If you have a question, please contact me first through my Ohio State email address. I will reply to emails within **24 hours on days when class is in session at the university**.
- **Class announcements:** I will send all important class-wide messages through the Announcements tool in CarmenCanvas. Please check [your notification preferences](https://go.osu.edu/canvas-notifications) (go.osu.edu/canvas-notifications) to ensure you receive these messages.
- **Grading and feedback:** For large weekly assignments, you can generally expect feedback within **seven days**.

Other Course Policies

Discussion and Communication Guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Writing style:** While there is no need to participate in class discussions as if you were writing a research paper, you should remember to write using good grammar, spelling, and punctuation. A more conversational tone is fine for non-academic topics.
- **Tone and civility:** Let's maintain a supportive learning community where everyone feels safe and where people can disagree amicably. Remember that sarcasm doesn't always come across to others.

Academic Integrity Policy

See [Descriptions of Major Course Assignments](#) for specific guidelines about collaboration and academic integrity in the context of this online class.

Ohio State's Academic Integrity Policy

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's [Code of Student Conduct](#) (studentconduct.osu.edu), and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university. If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- [Committee on Academic Misconduct](http://go.osu.edu/coam) (go.osu.edu/coam)
- [Ten Suggestions for Preserving Academic Integrity](http://go.osu.edu/ten-suggestions) (go.osu.edu/ten-suggestions)
- [Eight Cardinal Rules of Academic Integrity](http://go.osu.edu/cardinal-rules) (go.osu.edu/cardinal-rules)

Copyright for Instructional Materials

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options on [Ohio State's Title IX website](http://titleix.osu.edu) (titleix.osu.edu) or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information, visit the [OIE website](http://equity.osu.edu) (equity.osu.edu) or email equity@osu.edu.

Commitment to a Diverse and Inclusive Learning Environment

The Ohio State University affirms the importance and value of diversity in the student body. Our programs and curricula reflect our multicultural society and global economy and seek to provide opportunities for students to learn more about persons who are different from them. We are committed to maintaining a community that recognizes and values the inherent worth and dignity of every person; fosters sensitivity, understanding, and mutual respect among each member of our community; and encourages each individual to strive to reach his or her own potential. Discrimination against any individual based upon protected status, which is defined as age, color, disability, gender identity or expression, national origin, race, religion, sex, sexual orientation, or veteran status, is prohibited.

Your Mental Health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. No matter where you are engaged in distance learning, The Ohio State University's Student Life Counseling and Consultation Service (CCS) is here to support you. If you find yourself feeling isolated, anxious or overwhelmed, [on-demand mental health resources](http://go.osu.edu/ccsondemand) (go.osu.edu/ccsondemand) are available. You can reach an on-call

counselor when CCS is closed at [614- 292-5766](tel:614-292-5766). **24-hour emergency help** is available through the [National Suicide Prevention Lifeline website](http://suicidepreventionlifeline.org) (suicidepreventionlifeline.org) or by calling [1-800-273-8255\(TALK\)](tel:1-800-273-8255). [The Ohio State Wellness app](http://go.osu.edu/wellnessapp) (go.osu.edu/wellnessapp) is also a great resource.

Accessibility Accommodations for Students with Disabilities

Requesting Accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with [Student Life Disability Services \(SLDS\)](#). After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion.

Disability Services Contact Information

- Phone: [614-292-3307](tel:614-292-3307)
- Website: slds.osu.edu
- Email: slds@osu.edu
- In person: [Baker Hall 098, 113 W. 12th Avenue](#)

Accessibility of Course Technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- [CarmenCanvas accessibility](http://go.osu.edu/canvas-accessibility) (go.osu.edu/canvas-accessibility)
- Streaming audio and video
- [CarmenZoom accessibility](http://go.osu.edu/zoom-accessibility) (go.osu.edu/zoom-accessibility)
- Collaborative course tools

Course Schedule

The following is a preliminary schedule. If adjustments are needed during the semester, as revised schedule will be posted to the Carmen page and a notice will be made using the Announcements tool in CarmenCanvas. Refer to the CarmenCanvas course for up-to-date due dates.

This course uses the textbook series *Six Ideas that Shaped Physics*, 4th Edition by Thomas Moore. This book series consists of the following book units:

C = Conservation Laws (*Conservation Laws Constrain Interactions*) – covered in 1270

N = Newton’s Laws (*The Laws of Physics are Universal*) – covered in 1270

R = Relativity (*The Laws of Physics are Frame-Dependent*) – covered in 1270

E = Electromagnetism (Electric and Magnetic Fields are Unified) – covered in 1271

Q = Quantum Mechanics (*Particles Behave like Waves*) – covered in 1271

T – Thermodynamics (*Some Processes Are Irreversible*) – covered in 1271

Below lists the chapters that will be covered each week. The letter indicates the book unit above and the number indicates the chapter. For example, “E1” is the first chapter from Unit E. As indicated above, we will use the books for Units E, Q, and T this semester (1271).

Week 1 Lab topic: Electric Fields

E1: Electric Field

E2: Charge Distributions

Week 2 (No class Monday), Lab topic: Electric Potential

E3: Potential

E4: Static Equilibrium

Lecture Preparation Quiz #1 due Wednesday

Quiz #1 (during recitation)

Homework assignment #1 due Friday

Week 3 Lab topic: Moving Charge

E5: Current

E6: Dynamic Equilibrium

E7: Analyzing Circuits

Lecture Preparation Quiz #2 due Monday

Homework assignment #2 due Friday

Week 4 Lab topic: Magnetic Fields – Python Simulations

E8: Magnetic Fields

E9: Currents Respond to Magnetic Fields

Lecture Preparation Quiz #3 due Monday

Quiz #2 (during recitation)

Homework assignment #3 due Friday



Week 5 Lab topic: Magnetic Fields

E10: Currents Create Magnetic Fields

E11: The Electromagnetic Field

Lecture Preparation Quiz #4 due Monday**Homework assignment #4 due Friday****Week 6 Lab topic: Magnetic Energy**

E12: Gauss' Law

E13: Ampere's Law

E15: Maxwell's Equations

Lecture Preparation Quiz #5 due Monday**Quiz #3 (during recitation)****Homework assignment #5 due Friday****Week 7 Lab topic: Magnetic Induction**

E16: Faraday's Law

E17: Induction

E18: Electromagnetic Waves

Lecture Preparation Quiz #6 due Monday**Homework assignment #6 due Friday****Week 8 Lab topic: Standing Waves**

Q1: Wave Model

Q2: Standing Waves and Resonance

Q3: Interference and Diffraction

Lecture Preparation Quiz #7 due Monday**Unit E Exam (Thursday in recitation)****Homework assignment #7 due Friday****Week 9 Lab topic: Interfering Waves**

Q4: The Particle Nature of Light

Q5: The Wave Nature of Particles

Q6: Spin

Lecture Preparation Quiz #8 due Monday**Quiz #4 (during recitation)****Homework assignment #8 due Friday****SPRING BREAK Week****Week 10 Lab topic: Duality of Light**

Q7: The Rules of Quantum Mechanics

Q8: Quantum Weirdness

Q9: The Wavefunction

Lecture Preparation Quiz #9 due Monday

Homework assignment #9 due Friday

Week 11 Lab topic: Duality of Matter

Q10: Simple Quantum Models

Q11: Spectra

Q12: The Schrödinger Equation

Lecture Preparation Quiz #10 due Monday

Quiz #5 (during recitation)

Homework assignment #10 due Friday

Week 12 Lab topic: Temperature and Entropy

T1: Temperature

T2: Microstates and Macrostates

T3: Entropy and Temperature

Lecture Preparation Quiz #11 due Monday

Unit Q Exam (Thursday in recitation)

Homework assignment #11 due Friday

Week 13 Lab Topic: Temperature and Energy

T4: The Boltzmann Factor

T5: The Ideal Gas

Lecture Preparation Quiz #12 due Monday

Homework assignment #12 due Friday

Week 14 Lab Topic: Gas Processes

T7: Gas Processes

T8: Calculating Entropy Changes

Lecture Preparation Quiz #13 due Monday

Quiz #6 (during recitation)

Homework assignment #13 due Friday

Week 15 No Lab

Unit T Review and Contingency

Unit T Exam during Exam Week

