ELECTROMAGNETISM AND OPTICS

Phys 132 Fall 2026

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Office Hours:	M 1-2pm, T 1 – 2pm, W 9 – 10am, Th 11am – 12noon, F 2 – 3pm
Class Meetings:	MTWF 11:00-11:50am, Houston 106
Course Website:	Phys 132 Fall 2026 Website
Required Text:	R. D. Knight, *Physics for Scientists and Engineers,* Vol 2, 5th ed, Pearson (2022).
Prerequisites:	PHYS 131/PHYS 131L, and MATH 152 or MATH 136 (either may be taken concurrently).

Overview

The theory of electromagnetism was one of the great accomplishments of 19th century physics and, built on the general framework of Newton's Laws of mechanics, unified and explained a large range of phenomena associated with charged objects, currents and magnets. By the end of the century the theory had evolved to a compact and aesthetically pleasing form, which is still widely used.

Electromagnetism is perhaps the most important way of probing and learning about the physical world. Almost all modern scientific laboratories and the experiments conducted in them would be impossible to imagine without extensive use of electronic equipment. Much of what is learned in these circumstances hinges on understanding the electromagnetic interaction between the equipment and the physical system that is being observed. Electromagnetism has made possible much of the technology that is characteristic of the industrialized world: electric appliances, electronics, electric motors, power generation, computers, wireless communication, etc,....

One of the predictions of the theory of electromagnetism is the existence of electromagnetic waves, which offer a complete description of the classical properties of light. Optics is the study of the properties of light. Some, such as reflection, refraction and image production using lenses are readily apparent. However, optics has consistently yielded surprising phenomena, which often provide fundamental insights into the nature of the physical world.

Phys 132 aims to introduce you to the phenomena of electricity and magnetism and optics and the theories which describe them as well as some of their practical applications.

The course will cover:

1. Electric charge, fields, potentials and currents.
2. Electric circuits.
3. Magnetic fields, interaction with currents.
4. Maxwell's equations, electromagnetic waves.
5. Wave optics.
6. Geometric optics.

Course Structure

The Monday, Wednesday and Friday class meetings will usually be in lecture format. You will be expected to study the relevant sections of the text before class meetings.

Most Tuesday meetings will consist of a discussion/problem session during which you will work in small groups (with the instructor's help) on pre-assigned problems. You will be expected to attempt these **before the discussion/problem session class meeting.** There will be a short quiz covering the material at the end of the discussion/problem session.

Assignments, Quizzes and Exams

The components of the course that count toward the final grade are listed below.

Unless otherwise specified, work turned in will be graded for **completeness and correctness**. For these, to obtain full credit (100%) for any question or problem your solution must be correct with a complete explanation starting with basic physics or mathematics principles and including all steps that lead to final conclusions. Partial credit may be given for incomplete or partly correct solutions. No credit (0%) will be given for problems not attempted, assignments not turned in or quizzes and exams missed without an excused absence.

Certain work turned in will only be graded for **completeness**. In this case, a good-faith effort to complete the task will be given full credit.

1. **Warm Up Exercises:** Warm up exercises, available on the course D2L shell, are based on readings of the text and must be completed by 10:00am on the day on which they are due. Instructions and grading schemes for each exercise are provided on the D2L shell. Graded for *completeness.*

2. **Group Exercises:** There will be structured group exercises during certain classes. Each group's response will be graded and all members of the group will receive the same grade. You must attend the class meetings in order to receive credit for these. Graded for *completeness and correctness.* Attendance is required to receive credit.

3. **Quizzes:** There will be a short quiz at the end of each discussion/problem session. Graded for *completeness and correctness.* Attendance for the entire class meeting is required to receive credit.

4. **Homework assignments:** Homework assignments will be due **by 5:00pm on the designated day**. You can discuss the broad outlines of problem solutions with your colleagues but must write your submitted solutions independently. You are also encouraged to consult me for help with homework problems. You are not allowed to use any services which provide solutions to any assigned problems. Each homework set will be graded out of 10 points. Two problems will be selected at random and graded for correctness and completeness, each out of 2 points. The remaining problems will be checked for completeness and assigned 6 points. Your single lowest homework score will be dropped at the end of the semester. Homework turned in after the deadline will be subject to a penalty of a 5% reduction in maximum grade for each half hour increment (rounded up) that the work is late. Graded for *completeness and correctness*.

5. **Class Exams:** There will be three exams during class on the following days:

   Class Exam 1 September 18, 2026
   Class Exam 2 October 7, 2026
   Class Exam 3 November 6, 2026

   Exams will be closed book and closed notes although you can use a formula sheet. Calculators will be allowed. Graded for *completeness and correctness*.

6. **Final Exam:** There will be a final exam at **10:00am on Wednesday, December 9, 2026**. The final will last one hour and 50 minutes and be comprehensive and closed book although a formula sheet will be allowed. Calculators will be allowed. Graded for *completeness and correctness*.

Aside from the homework assignments, whose late policy is described above, work will not be accepted after the deadline (the end of the particular class meeting time for work done during any particular class). The only exceptions will be for *documented* absences or illness. In this case, the work must be returned within two business days after the end of the documented absence period.

An undergraduate student should expect to spend a minimum of two hours outside the classroom for every hour in the classroom. The outside hours may vary depending on the number of credit hours or type of course. More details are available from the faculty member or department office and in CMU's Curriculum Policies and Procedures Manual.

Grades

Your course grade will be composed as follows:

Component	Number in Semester	Maximum Points for Each	Total
Warm Up Exercises	15	2	30
Group Exercises	8	3	24
Quizzes	11	5	55
Homework Assignments	11 (drop one)	10	100
Class Exams	3	80	240
Final Exam	1	175	175
All components			**624**

Your total score out of 601 points will be converted into a percentage. The minimum percentages for which letter grades will be *guaranteed* are as follows:

90%	A
80%	B
70%	C
55%	D

It is possible that letter grades will be attained at lower numerical scores than those above. This depends on the difficulty of exams and assignments during the semester. The only exception is that an F will be given if your numerical score is less than 55%.

Policies

1. **Helpful Resources:**The Center for Academic Support (CAS) provides FREE tutoring and writing support across all disciplines to CMU and CMU Tech students in a variety of subject areas. Peer tutors are available to support your learning and help you with your questions. CAS offers four different tutoring options to students: in-person tutoring (one-on-one), online tutoring, group tutoring, and writing help. Check out the CAS website or or email tutoring@coloradomesa.edu with any questions.

   In coordination with Educational Access Services, reasonable accommodations will be provided for qualified students with disabilities. Students should contact Educational Access Services at 970-248-1856 or Houston Hall 108 as soon as possible. Please visit Educational Access Services for additional information.

2. **Attendance:** Attendance policies are described in the Maverick Guide. You are expected to attend all the class meetings and attendance will be recorded. In case of an absence due to illness, another emergency, or a conflicting CMU-sanctioned event,

you must be able to produce the *appropriate documentation from someone other than you* that attests to the conflict or absence. If you miss a class for a *documented* valid reason, turn in any assignments due within two business days after the end of the documented absence period. If you miss more than half of the class meetings in the first week of the semester, you will be dropped from the course.

The dates of the class and final exams are set at the beginning of the semester and these have priority over any other events. If you have a conflicting event with these **that was scheduled before the start of the semester,** you must notify the instructor about this prior to 5:00pm on **August 19, 2026**, provide documentation from someone other than you that attests to the event and I will arrange an alternative test time. If you notify the instructor about a conflict after **August 19, 2026**, the possibility of taking the test at an alternative time will depend on the nature of the conflict (e.g. illness, other emergencies, or CMU-sanctioned event). In this case you must explain the nature of the conflict to the instructor, provide documentation from someone other than you that attests to the conflict and the instructor will decide whether the absence warrants an alternative testing time or arrangement. Alternative testing times will be decided by the instructor.

3. **Withdrawals:** There are several ways to drop this course. The deadline for dropping without penalty is **September 1, 2026.** Please consult the CMU academic calendar and catalog for more details about adding and dropping courses.

4. **Electronic Equipment Use:** The only electronic equipment that can be used during exams are calculators. During exams you will not be allowed to use electronic equipment that allows you to communicate with the internet, other people or to store information, e.g. tablets, computers, phones. The only exceptions are for students who have a documented disability and need a particular device as part of their disability accommodation.

5. **Academic Integrity:** You are expected to present your own work in assignments, exams and quizzes. Fabrication of data, plagiarism, and copying from any source, particularly in closed book exams, are serious violation of academic norms. CMU has extensive policies on these matters and penalties for infringement can be severe. For more details, consult the academic integrity policies in the Maverick Guide.

   You are prohibited from using sources, of any type, which provide solutions to homework assignment or exam problems. These include AI sources that generate solutions to homework problems. Students who are discovered to have submitted any assignment or exam problem to any such service that provides solutions or have used any such service to obtain or view solutions to any assignment or exam problem will receive zero credit for that entire assignment and the instructor will submit a Report of Academic Dishonesty with the Office of Academic Affairs. Additional penalties may be levied in such cases.

Student Learning Outcomes

Upon completion of this course, a student should be able to:

1. Translate between verbal and mathematical descriptions of physical situations. Apply mathematical reasoning, using algebra, trigonometry and calculus, to analyze these situations.
2. Articulate the arguments, verbal and mathematical, used to analyze physical situations.
3. Represent physical processes graphically and describe given graphical representations in physical terms.
4. Use calculus to describe and analyze physical situations.
5. Use the mathematics of vectors, vector algebra, products of vectors and vector components to analyze physical situations.
6. Distinguish between and relate electric charge, forces, fields, potentials and currents.
7. Distinguish between and relate magnetic forces and fields.
8. Describe and use basic concepts associated with waves and superpositions of waves.
9. Determine and use electric fields, electric potentials, electric forces, electrostatic energy, magnetic fields and magnetic forces in various physical situations.
10. Use the geometrical picture of light to describe the properties of and propagation of light in various physical situations.
11. Use the wave picture of light to describe the properties of and propagation of light in various physical situations, including interference and diffraction phenomena.

This course is a critical component of CMU's Essential Learning Curriculum and a CMU Degree. In addition to knowledge in the course content area, this class will provide specific learning opportunities in the following areas:

1. Demonstrate investigative and analytical thinking skills to solve problems.
2. Select and use appropriate information in an academic project.
3. Demonstrate quantitative literacy.

This course contributes to the fulfillment of the following program learning outcomes for the BS in Physics degree. A student will have demonstrated the ability to:

1. Show fluency with the major fields of physics (classical mechanics, electromagnetism, statistical physics and quantum theory).
2. Use mathematical representations to analyze physical scenarios.

Guaranteed Transfer

The Colorado Commission on Higher Education has approved PHYS 133 for inclusion in the Guaranteed Transfer (GT) Pathways program in the GT-SC1 category. For transferring students, successful completion with a minimum C- grade guarantees transfer and application of credit in this GT Pathways category. For more information on the GT Pathways programs, go to https://highered.colorado.gov/academics/transfers/gtpathways/curriculum.html.

The course addresses the following GT Pathways Student Learning Outcomes:

Content Criteria

This course should provide students with the opportunity to/Students should be able to:

a) Develop foundational knowledge in specific field(s) of science.
b) Develop an understanding of the nature and process of science.
c) Demonstrate the ability to use scientific methodologies.
d) Examine quantitative approaches to study natural phenomena.

The laboratory (either a combined lecture and laboratory, or a separate laboratory tied to a science lecture course) content of a GT Pathways science course (GT-SC1): Students should be able to:

a) Perform hands-on activities with demonstration and simulation components playing a secondary role.
b) Engage in inquiry-based activities.
c) Demonstrate the ability to use the scientific method.
d) Obtain and interpret data, and communicate the results of inquiry.
e) Demonstrate proper technique and safe practices.

Inquiry and Analysis Competency

Students should be able to:

1. Select or Develop a Design Process
    a) Select or develop elements of the methodology or theoretical framework to solve problems in a given discipline.
2. Analyze or Interpret Evidence
    a) Examine evidence to identify patterns, differences, similarities, limitations, and/or implications related to the focus.
    b) Utilize multiple representations to interpret the data.
3. Draw Conclusions
    a) State a conclusion based on findings.

Quantitative Literacy Competency

Students should be able to:

1. Interpret Information
    a) Explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words).
2. Represent information
    a) Convert information into and between various mathematical forms (e.g., equations, graphs, diagrams, tables, words).

Week	Dates	Topic
1	8/17 – 8/21	Electric charge, Coulomb's law, electric fields (Ch 22.1 – 22.5).
2	8/24 – 8/28	Electric fields, charged particle in a field (23.1 – 23.5).
3	8/31 – 9/4	Electric potential energy, electric potential (Ch 23.6, 24.6, 25.1 – 25.4).
4	9/7 – 9/11	Electric potential, field and potential, conductors, capacitors (Ch 25.5 – 25.7, 26.1 – 26.3).
5	9/14 – 9/15	Capacitors, currents (Ch 26.5 – 26.6, 27.1 –27.3).
5	9/16 –9/18	Exam review, **Class Exam 1**.
6	9/21 – 9/25	Ohm's law, circuits (Ch 27.5, 28.1 – 28.6).
7	9/28 – 10/2	Circuits, magnetic fields (Ch 28.4, 28.6 – 28.9, 29.1 – 29.4).
8	10/5	Magnetic fields (Ch 29.4).
8	10/6 – 10/7	Exam review, **Class Exam 2**.
9	10/12 – 10/16	Magnetic fields and forces (Ch 29.4 –29.7).
10	10/19 – 10/23	Magnetic forces on currents, induction (Ch 29.8 – 29.9, 30.1 – 30.3).
11	10/26 – 10/30	Faraday's law, waves overview, (Ch 30.4 – 30.7, 16.1 – 16.3).
12	11/2 – 11/3	Electromagnetic waves, interference overview (Ch 31.6 – 31.7, 17.1, 17.5 – 17.6).
12	11/4 – 11/6	Exam review, **Class Exam 3**.
13	11/9 – 11/13	Interference overview, interference of light. (Ch 31.6 – 31.7, 33.1 – 33.4).
14	11/16 – 11/20	Diffraction, reflection, refraction, image formation, lenses (Ch 33.4 – 33.8, 34.1 – 34.6).
15	11/30 – 12/4 – 5/1	Lenses, optical instruments (Ch 34.4 – 34.6, 35.1, 35.4).