University of New Haven
COLLEGE OF ARTS AND SCIENCES
Department of Mathematics and Physics

§ I: PHYS 2205 Electromagnetism & Optics Syllabus

Catalog Description

Prerequisites: PHYS 1150 and MATH 1118. Corequisite: PHYS 2206 - you must enroll in a section of PHYS 2206 before you can enroll in PHYS 2205. Basic concepts of electricity and magnetism; Coulomb's law, electric field and potential, Gauss' law, Ohm's law, Kirchhoff's rules, capacitance, magnetic field, Ampere's law, Faraday's law of induction, Maxwell's equations, electromagnetic waves. Fundamentals of optics; light, laws of reflection and refraction, interference and diffraction phenomena, polarization, gratings, lenses and optical instruments. Laboratory fee. 4 credits.

Required Textbook

University Physics with Modern Physics, by H. D. Young and R. A. Freedman, Addison-Wesley, 14e, Chapters 21-36, ISBN 9780321973610 (2015).

Course Objectives

This course is a second semester, calculus based physics course for physical science and engineering majors. It introduces basic concepts, theory, and applications of electromagnetism (electrostatics, circuits, magnetism, waves) and optics (light, geometric optics, physical optics). This course:

1. Introduces basic physics concepts in electricity, magnetism, and optics.
2. Provides students with the fundamental understanding of the principles and laws of classical physics;
3. Teaches problem solving techniques;
4. Helps to develop analytical thinking;
5. Introduces the applications of differential and integral calculus in physics;
6. Teaches how to apply the physical principles and knowledge to other disciplines; and,
7. Demonstrates how observation, experiment, and theory work together to continue to expand the frontiers of knowledge of the physical Universe.

The emphasis is on improved critical thinking skills, and on developing an ability to approach and solve physics problems.

Student Learning Outcomes

Students passing this course should be able to:

1. Explain the basic concepts and laws in electromagnetism, CC4.1.1;
2. Use the equations of mechanics and electromagnetic field equations to determine the dynamics of physical bodies, CC4.1.2;
3. Explain the basic concepts and laws in optics, CC4.1.1;
4. Convert a physical situation articulated in English to a mathematical formulation, CC4.1.2;
5. Apply basic mathematical tools, including vectors and calculus, to solve physics problems, CC4.1.2;
6. Exercise the use of physical intuition, including the ability to guess an approximate or conceptual answer to a physics problem;
7. Recognize whether or not the result of a calculation makes physical sense;
8. Apply the physical knowledge to other disciplines, including physical sciences and engineering; and,
9. Illustrate how physical observation, experiment, and theory worked together to develop inventions that advanced our civilization, CC4.1.3.

Students will also achieve the following Core Learning Objectives:

10. the student will be able to articulate structural and/or functional aspects of elements of a portion of the natural world;
11. use discipline-specific methodologies and technologies to draw conclusions about natural phenomena; and
12. illustrate the effects of scientific knowledge and progress on societal issues.

Required Curriculum Content

Key topics covered include:

1. Electric charge, conductors and insulators, induced charges, Coulomb's law, electric field and electric forces, electric field lines, electric dipoles, applications of integrals in computing the electric field of a charged object.
2. Electric flux, Gauss's law and its applications, charges on conductors.
3. Electric potential energy, electric potential, equipotential surfaces, potential gradient.
4. Capacitors and capacitance, capacitors in series and parallel, energy in capacitors, dielectrics and induced charge.
5. Current, resistivity, resistance, electromotive force and electric circuits, Ohm's law, energy and power in circuits, metallic conduction.
6. Resistors in series and parallel, Kirchhoff's rules, electrical measuring instruments, RC circuit.
7. Magnetism, magnetic field, magnetic field lines and magnetic flux, motion of charged particles in magnetic field, magnetic force on a current, torque on a current loop, direct-current motor.
8. Magnetic field of a moving charge, magnetic field of a current element, magnetic field of straight and circular currents, force between parallel conductors, Ampere's law and its applications, magnetic materials.
9. Electromagnetic induction, Faraday's law, Lenz's law, motional electromotive force, induced electric fields, displacement current, Maxwell equations.
10. Mutual inductance, self-inductance and inductors, energy in inductors, RL circuit, LC circuit.
11. Alternating current, reactance, LRC series circuit, power and resonance in LRC circuit, transformers.
12. Electromagnetic waves, plane waves, speed of light, sinusoidal waves, energy and momentum in electromagnetic waves.
13. Light, reflection and refraction, total internal reflection, dispersion, polarization, scattering of light.
14. Flat mirrors, spherical mirrors, refraction at a spherical surface, thin lenses, optical instruments.
15. Interference, double-slit interference, interference in thin films.
16. Diffraction, single-slit diffraction, multiple-slit diffraction, diffraction grating, circular diffraction.

All sections of PHYS 2205 Electromagnetism & Optics will cover, as a minimum, the material from *University Physics with Modern Physics*, by H. D. Young and R. A. Freedman, Addison-Wesley, 14e, Chapters 21-36, ISBN 9780321973610 (2015), as listed:

Section	Textbook Topic
	ELECTROMAGNETISM
	Chapter 21 - Electric Charge and Electric Field
21.1	Electric Charge
21.2	Conductors, Insulators, and Induced Charges
21.3	Coulomb's Law
21.4	Electric Field and Electric Forces
21.5	Electric-Field Calculations
21.6	Electric Field Lines
21.7	Electric Dipoles
	Chapter 22 - Gauss's Law
22.1	Charge and Electric Flux
22.2	Calculating Electric Flux

Section	Textbook Topic
22.3	Gauss's Law
22.4	Applications of Gauss's Law
22.5	Charges on Conductors
	Chapter 23 - Electric Potential
23.1	Electric Potential Energy
23.2	Electric Potential
23.3	Calculating Electric Potential
23.4	Equipotential Surfaces
23.5	Potential Gradient
	Chapter 24 - Capacitance and Dielectrics
24.1	Capacitors and Capacitance
24.2	Capacitors in Series and Parallel
24.3	Energy Storage in Capacitors and Electric-Field Energy
24.4	Dielectrics
	Chapter 25 - Current, Resistance, and Electromotive Force
25.1	Current
25.2	Resistivity
25.3	Resistance
25.4	Electromotive Force and Circuits
25.5	Energy and Power in Electric Circuits
	Chapter 26 - Direct-Current Circuits
26.1	Resistors in Series and Parallel
26.2	Kirchhoff's Rules
26.3	Electrical Measuring Instruments
26.4	R-C Circuits
	Chapter 27 - Magnetic Field and Magnetic Forces
27.1	Magnetism
27.2	Magnetic Field
27.3	Magnetic Field Lines and Magnetic Flux
27.4	Motion of Charged Particles in a Magnetic Field
27.5	Applications of Motion of Charged Particles
27.6	Magnetic Force on a Current-Carrying Conductor
27.7	Force and Torque on a Current Loop
27.8	The Direct-Current Motor
	Chapter 28 - Sources of Magnetic Field
28.1	Magnetic Field of a Moving Charge
28.2	Magnetic Field of a Current Element
28.3	Magnetic Field of a Straight Current-Carrying Conductor
28.4	Force Between Parallel Conductors
28.5	Magnetic Field of a Circular Current Loop
28.6	Ampere's Law
28.7	Applications of Ampere's Law
28.8	Magnetic Materials
	Chapter 29 - Electromagnetic Induction
29.1	Induction Experiments
29.2	Faraday's Law
29.3	Lenz's Law

Section	Textbook Topic
29.4	Motional Electromotive Force
29.7	Displacement Current and Maxwell's Equations
	Chapter 30 - Inductance
30.1	Mutual Inductance
30.2	Self-Inductance and Inductors
30.3	Magnetic Field Energy
30.4	The R-L Circuit
30.5	The L-C Circuit
	Chapter 31 - Alternating Current
31.1	Phasors and Alternating Currents
31.2	Resistance and Reactance
31.3	The L-R-C Series Circuit
31.4	Power in Alternating-Current Circuits
31.5	Resonance in Alternating-Current Circuits
31.6	Transformers
	Chapter 32 - Electromagnetic Waves
32.1	Maxwell's Equations and Electromagnetic Waves
32.2	Plane Electromagnetic Waves and the Speed of Light
	OPTICS
	Chapter 33 - The Nature and Propagation of Light
33.1	The Nature of Light
33.2	Reflection and Refraction
33.3	Total Internal Reflection
33.4	Dispersion
33.5	Polarization
	Chapter 34 - Geometric Optics
34.1	Reflection and Refraction at a Plane Surface
34.2	Reflection at a Spherical Surface
34.4	Thin Lenses (in Lab)
34.8	Microscopes and Telescopes
	Chapter 35 - Interference
35.1	Interference and Coherent Sources
35.2	Two-Source Interference of Light
35.5	The Michelson Interferometer (in Lab)
	Chapter 36 - Diffraction
36.2	Diffraction from a Single Slit
36.4	Multiple Slits (in Lab)
36.5	The Diffraction Grating (in Lab)

Common Department Requirements for PHYS 2205

While students in each section of PHYS 2205 are assessed by the course instructor, there are general guidelines that apply to all sections of PHYS 2205. These include:

- All students registered for PHYS 2205 must be registered for a section of the laboratory course PHYS 2206.

- 25% of the course grade is based on the laboratory PHYS 2206. The Department requires that at least 60% of the course grade be based on in-class exams, i.e., homework and out-of-class projects must constitute no more than 15% of the final grade.
- A passing grade in the laboratory PHYS 2206 is required to pass PHYS 2205.
- Withdrawal from PHYS 2205 results in withdrawal from PHYS 2206, and vice versa. Students repeating PHYS 2205 must also repeat PHYS 2206, and vice versa.
- The final examination constitutes 25% of the course grade. All sections of PHYS 2205 which run at the same time give the same final exam. A final exam assesses Student Learning Outcomes 1–5.
- Electronic devices are not allowed on any exams, except calculators provided by the Department.

Department, College and University Expectations and Policies

It is important that students familiarize themselves with a range of policies and guidelines that have been established by the Department of Mathematics and Physics, the College of Arts and Sciences, and the University of New Haven. These are an integral part of the syllabus for this course.

Adding/Dropping a Class

The final day to drop this course without it appearing on your transcript is discussed on the **Academic Schedules and Registration** web page. After the first week of class, self-service registration will not be enabled for students to directly add or drop classes. Students should contact the Registrar's office directly or the Academic Success Center for assistance with adding and dropping courses during this time.

Attendance Regulations

University attendance policy guidelines require that:

> Students are expected to attend regularly and promptly all their classes, appointments, and exercises. While the university recognizes that some absences may occasionally be necessary, these should be held to a minimum. A maximum of two weeks of absences will be permitted for illness and emergencies. The instructor has the right to dismiss from class any student who has been absent more than the maximum allowed. A dismissed student will receive a withdrawal (W) from the course if they are still eligible for a withdrawal per the university Withdrawal from a Course policy, or a failure (F), if not. A student who is not officially registered in the course is not permitted to attend classes or take part in any other course activities. Students absent from any class meeting are responsible for making up missed assignments and examinations at the discretion of the instructor.

Students are to adhere to the policy attendance policy guidelines outlined in the University Catalog under the heading, *Attendance Regulations*, found online in the **Undergradaduate Catalog** or alternatively found in the **Student Handbook** on **pp.48-49**.

Religious Observance Policy for Students

The University of New Haven respects the right of its students to observe religious holidays that may necessitate their absence from class or from other required university-sponsored activities. Students who wish to observe such holidays should not be penalized for their absence, although in academic courses they are responsible for making up missed work. The College provides that,

> Instructors should try to avoid scheduling exams or quizzes on religious holidays, but where such conflicts occur should provide reasonable accommodations for missed assignment deadlines or exams. If a class, an assignment due date, or exam interferes with the observance of such a religious holiday, it is the student's responsibility to notify their instructor, preferably at the beginning of the term, but otherwise at least two weeks before the holiday.

More information about religious observance policies can be found in the Student Handbook on **pp.48-49** under the heading, *Attendance Policies: Religious Observance Policy for Students*.

Withdrawal from a Course

Students wishing to withdraw must submit a request for an official course withdrawal in writing using the online **Course Withdrawal Form**, or alternatively complete and hand in the pdf based **Course Withdrawal Form**. The final date to request a withdrawal is listed in the **Academic Calendar**. This request must be submitted to the Registrar's Office and signed by the International Office if you are an international student. The grade of W will be recorded, but the course will not affect the GPA. [1]

Incomplete Grade Policy

A grade of Incomplete (INC) is given only in special circumstances and indicates that the student has been given permission by the instructor to complete required course work (with the same instructor) after the end

[1] Please note that it is the responsibility of the student to assure that the required paperwork and documentation is completed by the deadline.

of the term. In the absence of the instructor a student should contact the Department Chair. Students need to examine carefully the **changed guidelines** pertaining to INC grades, specifically:

> To remove the INC grade, the student must complete all required course work in timely fashion as stipulated by the instructor but no later than the end of the following term. Fall and intersession course incomplete grades must be completed no later than the last day of the spring term. Spring and summer course incomplete grades must be completed no later than the last day of the fall term.
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> If the course work is not submitted within the allotted time, the INC grade will be changed to an F shortly after the deadline by the Office of the University Registrar. Students will be notified via campus email at least two weeks prior to the change of grade process.

The University policy on incomplete grades is discussed in the **Academic Catalog** under the heading, *Incomplete (INC) Grade Policy*.

Academic Integrity Policy and Procedures

The University of New Haven expects its students to maintain the highest standards of academic conduct. Academic dishonesty is not tolerated at the University. To know what it is expected, students are responsible for reading and understanding the statement regarding academic honesty in the Student Handbook. Specifically, students are required to adhere to the Academic Integrity Policies specified in the **Student Handbook**, i.e., on **pp.66-73**.

Please ask your instructor about their expectations regarding permissible or encouraged forms of student collaboration if there is any confusion about this topic. The Department of Mathematics and Physics fully adheres to the Academic Integrity Policy:

> Academic integrity is a core university value that ensures respect for the academic reputation of the University, its students, faculty and staff, and the degrees it confers. The University expects that students will conduct themselves in an honest and ethical manner and respect the intellectual work of others. Please be familiar with the University's policy on Academic Integrity. Please ask about expectations regarding permissible or encouraged forms of student collaboration if they are unclear.

Coursework Expectations

This course will require significant in-class and out-of-class commitment from each student. The University estimates that a student should expect to spend two hours outside of class for each hour they are in a class. For example, a three credit course would average six [6] hours of additional work outside of class.[2] Coursework expectations are detailed in the **Academic Catalog** under the heading, *Course Work Expectations*.

Please note, that PHYS 2205 is a 4-credit course, and as such requires a total of 12 hours per week invested in study and homework for the average student.

Commitment to Positive Learning Environment

The University adheres to the philosophy that all community members should enjoy an environment free of any form of harassment, sexual misconduct, discrimination, or intimate partner violence. If you have been the victim of sexual misconduct we encourage you to report this. If you report this to a faculty/staff member, they must notify our college's Title IX coordinator about the basic facts of the incident (you may choose to request confidentiality from the University). If you encounter sexual harassment, sexual misconduct, sexual assault, or discrimination based on race, color, religion, age, national origin, ancestry, sex, sexual orientation, gender identity, or disability please contact the Title IX Coordinator, Caroline Koziatek at (203)-932-7479 or **CKoziatek@newhaven.edu**. Further online information about is available at **Title IX**.

Reporting Bias Incidents

At the University of New Haven, there is an expectation that all community members are committed to creating and supporting a climate which promotes civility, mutual respect, and open-mindedness. There also exists an understanding that with the freedom of expression comes the responsibility to support community

[2] Please note that study guidelines are important, i.e., there is substantial evidence that shows that the pass rates for students in math courses decrease dramatically as the time spent on outside study falls below 2 hours of homework per credit per week.

members' right to live and work in an environment free from harassment and fear. It is expected that all members of the University community will engage in anti-bias behavior and refrain from actions that intimidate, humiliate, or demean persons or groups or that undermine their security or self-esteem.

If you have witnessed or are the target of a bias-motivated incident, please contact the Office of the Dean of Students at 203-932-7432 or Campus Police at 203-932-7014. Further information about this and other reporting options may be found at **Report It**.

University Support Services

The University recognizes students often can use some help outside of class and offers academic assistance through several offices. In addition to discussing any academic issues you may have with your instructor, advisor, or with the the courses or department coordinator or chair, the University provides these additional resources for students:

The Center for Academic Success and Advising (CASA)

The **Academic Success Center** is located in Maxcy 208 for help with your academic studies, or call 203-932-7234 to set up an appointment.

University Writing Center

The mission of the Writing Center (an expansion of the **Writer to Writer** peer-tutoring program) is to provide high-quality tutoring to undergraduate and graduate students as they write for a wide range of purposes and audiences. Tutors are undergraduate and graduate students and they work with students at any stage in the writing process; Bring in your assignment, your ideas, and any writing done so far. To make an appointment, register for an account at **https://newhaven.mywconline.com**.

The Math Zone

Please contact the **Math Zone** if you wish to challenge your Math Placement by taking a Math Challenge Exam or by taking a Math Post Placement Exam. These are discussed more extensively at **http://math.newhaven.edu/mathphysics/placement_html**. The Math Zone also provides a range of tutoring and classroom support service for students taking development math classes.

The Center for Learning Resources (CLR)

The **Center for Learning Resources** located in Peterson Library, provides academic content support to the students of the University of New Haven using metacognitive strategies that help students become aware of and learn to apply optimal learning processes in the pursuit of creating independent learners CLR tutors focus sessions on discussions of concepts and processes and typically use external examples to help students grasp and apply the material.

Accessibility Resources Center

Students with disabilities are encouraged to share, in confidence, information about needed specific course accommodations. The **Accessibility Resources Center** (ARC) provides comprehensive services and support that serve to promote educational equity and ensure that students are able to participate in the opportunities available at the University of New Haven. Accommodations cannot be made without written documentation from the ARC. The ARC is located on the ground floor in the rear of Sheffield Hall. Sheffield Hall is located in the Residential Quad area, and can be contacted at 203-932-7332. The ADA/Section 504 Compliance Officer is Rebecca Johnson, **RJohnson@newhaven.edu**, and can be reached by phone at 203-932-7238. Information on the ARC can be found at

Counseling and Psychological Services

The Counseling Center offers a variety of services aimed at helping students resolve personal difficulties and acquire the balance, skills, and knowledge that will enable them to take full advantage of their experience at the University of New Haven. Information about the, **Counseling and Psychological Services**, is available online.