

## COLLEGE OF DUPAGE

### Physics 2112-005: Physics for Science and Engineering II

**Fall 2024**

*Instructor:* Dr. David R. Fazzini

*Office:* BIC-3E04B

*Office Hours:* Monday: 10:20 AM – 11:50 AM & 1:00 PM – 1:50 PM

Tuesday: 4:00 PM – 4:50 PM

Wednesday: 10:20 AM – 11:50 AM & 1:00 PM – 1:50 PM

Thursday: 1:00 PM – 1:50 PM

Friday: 9:00 AM – 11:00 AM

(Additional times available by appointment.)

**NOTE:** During some of my office hours, I will be found in the Physics Lab Prep area (BIC-3E06) or one of the adjoining labs (BIC-3F03, -3F05, or -3F07).

*Phone:* 630-942-3349

*E-mail:* [fazzinid@cod.edu](mailto:fazzinid@cod.edu)

*Mailbox:* STEM Division

*FAX:* 630-942-2759

#### *Course Description:*

Calculus-based study of electrostatics, electric fields, Gauss' Law, capacitance, current, resistance, magnetic forces and fields, electromagnetic induction, AC circuits, Maxwell's equations, electromagnetic waves, geometric optics and physical optics.

*Semester Credit Hours:* 5 (Weekly: 4 lecture hours and 3 lab hours)

*IAI Course Code:* PHY-912 (for majors)

*Prerequisite:* Physics 2111 or equivalent with a grade of “C” or better. (Proof required.)

*Official Text:* Openstax University Physics Volumes 2 & 3 available free online at:

<https://openstax.org/details/books/university-physics-volume-2>

<https://openstax.org/details/books/university-physics-volume-3>

If you prefer, you may use any *calculus-based* introductory physics text of your choice. (Suggested authors: P. A. Tipler & G. Mosca; R. D. Knight; Halliday, Resnick & Walker; G. Gladding, M. Selen & T. Seltzer; just to name a few.)

*Lab Manual:* Labs for Electricity, Magnetism, Optics & Modern Physics (revised) 2<sup>nd</sup> ed. by Sokoloff.

*Material:* Openstax (Volume 2): Chapter 5-16; (Volume 3): Chapters 1-4

*Lecture Meetings:* Location: BIC-3H06 @ Noon – 12:50 PM, Mon.-Thur.

*Lab Meetings:* Location: BIC-3F07 @ 1:00 PM – 3:50 PM Tues. (section 005)

**Course Objectives:**

Upon successful completion of this course the student should be able to do the following:

1. Calculate the forces on static electrical charges using Coulomb's Law
2. Explain the concept of a field
3. Calculate the electrical field from a system of charged particles using superposition and integral methods
4. Calculate the strength of the electrical field using Gauss' law
5. Calculate the electrical potential of particles using superposition and integral methods
6. Explain the relationship among work, electrical potential, electrical potential energy, the electric field, and the electrostatic force
7. Calculate the current through, and voltage across, various elements in single and multi-loop circuits using Kirchhoff's laws
8. Calculate the capacitance of an electrical capacitor and the energy stored
9. Calculate the magnetic field caused by a moving charge
10. Calculate the force on a moving charge due to a magnetic field
11. Calculate the magnetic forces and torques on both looped and straight current carrying wires
12. Calculate the currents caused by both mutual inductance and self-inductance
13. Differentiate among different types of magnetic materials including diamagnetic, paramagnetic, and ferromagnetic materials
14. Calculate the time varying current and voltage across various parts of an electrical circuit including resistors, capacitors, and inductors
15. Explain the concepts involved in each of Maxwell's equations
16. Draw basic ray diagrams showing focal point, image position, and object position for lenses, mirrors and the human eye
17. Relate the wave and ray methods of modeling light travel
18. Use Snell's law to calculate refraction in lenses and surface boundaries
19. Explain the concept of interference of light
20. Calculate minima and maxima of intensities of electromagnetic waves undergoing thin film interference
21. Explain the concept of the diffraction of light
22. Calculate minima and maxima of intensities of electromagnetic waves undergoing diffraction in both single slit and multiple-slit situations
23. Explain the concept of polarization (linear and circular) and calculate the effect of polarizing lenses on intensities of electromagnetic waves

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**Course Logistics:**

GENERAL COURSE INFORMATION can be found through the class webpage:

<https://cod.edu/faculty/websites/fazzinid/physics-2112.aspx>

and the **Blackboard** website:

<https://bb.cod.edu/webapps/login/>

Check the class webpage and log in to **Blackboard** regularly for general announcements and assignment updates. These sites will provide important announcements and course updates such as reading/online homework assignments and laboratory information. The class webpage will be updated on a regular basis and **Blackboard** will be used for announcements, blanket emails and grade dissemination.

READING assignments will be from the OpenStax University Physics (available FREE online). If you prefer, you may refer to any calculus-based introductory physics textbook for the assigned reading material. It is assumed that you have read the assigned material prior to class on the due date.

HOMEWORK assignments will be provided online using the *Expert TA* homework system. You will need to subscribe to *Expert TA* at a nominal cost. You will also need the following access link:

<https://login.theexpertta.com/registration/classregistration.aspx?regcode=USG15IL-3285ED-39E>

All of the homework for the entire term has been generated. Assignments open one week before they are due. Check the class webpage regularly for assignment updates.

Be aware that it is very important that you make an honest attempt to work through the questions, exercises, calculations and problems since working the homework is a primary technique for learning the material. It is also very important that you be able to understand the solutions conceptually rather than just memorizing formulas since the quiz and exam problems generally require you to demonstrate application of the concepts being assessed. Be sure that you can answer any assigned question or solve any assigned problem since those of similar “style” may appear on the exam. It is your responsibility to seek assistance from you instructor and/or other resources if you are having difficulties.

EXAMS will consist of two “1-hour” exams and a comprehensive final exam. The exams will be performed online. All the exams are of a multiple-choice format although free response questions may be incorporated. Problems are standardized from homework sets, sample problems from the text, and examples worked in class or the laboratory. The 2-hour final exam will be multiple-choice standardized test. All exams are closed book and closed note. However, you will be provided with a sheet of “possibly useful information” that contains formulae, conversions, universal constants, etc. for all exams.

Exam I:	1:00-2:30 PM, Sep. 24 <sup>th</sup> , Vol. 2: Chapters 5-8
Exam II:	1:00-2:30 PM, Nov. 12 <sup>th</sup> , Vol. 2: Chapters 9-14
Final Exam:	12:00-1:50 PM, Mon., Dec. 9 <sup>th</sup> , Vol. 2: Ch. 5-16 & Vol. 3: Ch. 1-4

Important! You must take the exams on the dates scheduled. There are NO make-ups for any reason except call to jury duty, medical quarantine, or call to active military service. If you miss either Exam I or Exam II, then the percentage score of your Final Exam will replace one (and only one) of the missed exams. Also, if the percentage score of the final exam is higher than either of the two earlier exams, the percentage score of the Final Exam will replace the lower score of one of the earlier exams. If you know that cannot take the final exam from 12:00 Noon – 1:50 PM on Wednesday, Dec. 11<sup>th</sup>, then drop this class on Day 1 and get a 100% tuition refund.

QUIZZES consisting a few short questions based upon material covered in the previous unit/chapter will be administered on occasion with warning or without warning. These short exercises/problems are used to monitor conceptual understanding. Quiz questions are typically in a multiple-choice format and answered by conceptual reasoning or with a few short lines of algebra/explanation. All quizzes are closed book and closed note. No equation sheets will be provided for the quizzes.

IN-CLASS POLLING will be administered during the lectures. The system will allow you to further interact with the instructor during the lecture. You will be able to respond to questions and give feedback as the course progresses. For instance, short in-class exercises used to monitor conceptual understanding will be administered from time to time. The questions typically consist of surveys, conceptual questions or short calculations and are designed to surface possible misconceptions and uncover some of the common pitfalls that confuse many students. These questions can generally be answered by keeping up with the reading assignments and class discussions. Responses are recorded and scored. The scoring is used to measure class participation and can be used to determine grades in borderline situations.

LABORATORY sessions meet once per week and are required for this course. The laboratory section is designed to provide you with hands-on experiences related to the topics that are discussed during the lectures. Most of the laboratory handouts come from the laboratory manual that you need to purchase. Handouts are provided for the other sessions. During the lab, you will make predictions, answer questions, and record observations. Laboratory homework assignments are to be completed during the session and submitted by the end of that laboratory session unless otherwise directed. Only officially stamped work will be accepted for credit. Each lab is graded in three parts: 1) completion of the pre-lab **prior** to entering the lab 10%, 2) completion of the requirement measurements and “in-lab” questions, 40% and 2) completion of the laboratory homework, 50% for the total score for that lab.

As laboratory activities are a required part of the course, your final grade will drop one full letter for every two unsubmitted activities that are missed regardless of exam/homework/quiz scores. As there are no “make-ups,” you are strongly advised to perform AND submit all lab activities.

PARTICIPATION in the course can have a reflection in the overall final grade. Items such as attendance, attitude, sincerity, changes in performance, etc. will be considered in borderline situations.

GRADING is tentatively based on the following breakdown:

Homework:	20%	A:	> 90%
Laboratory*:	15%	B:	> 80%
Quizzes/Clickers	10%	C:	> 70%
2 Hourly Exams:	15% each	D:	> 60%
Final Exam:	25% each	F:	< 60%

Depending on other factors involved with the course, it is possible for the grade cut-offs to be lowered by up to 5%, but do not count on it.

\* See laboratory attendance requirement under LABORATORY section.

**ATTENDANCE/TARDINESS:**

In general, course attendance is recorded by means of polling, submitted quizzes, and punctually submitted laboratory work. Students who have missed 4 or more classes or labs AND are not passing with a grade of “C” or better by Friday, October 11, 2024 will be considered in “non-pursuit” and may be administratively dropped from the course by the instructor. (No refunds!)

**ACCOMODATIONS:** The College of DuPage is committed to the equitable access of educational opportunities for students with disabilities in accordance with The Americans with Disabilities Act, As Amended and Section 504 of the Rehabilitation Act of 1973. Any student who feels they may need an accommodation on the basis of an illness, injury, medical condition, or disability should contact the Center for Access and Accommodations to determine eligibility for accommodations and to obtain an official Letter of Accommodation. The Center for Access and Accommodations can be reached via email at

[access@cod.edu](mailto:access@cod.edu).

Students may also initiate a request for services by going to

[www.cod.edu/access](http://www.cod.edu/access)

and clicking on the green box labeled “complete form to request accommodations.” If you are already registered with the Center for Access and Accommodations, please email me your Letter of Accommodation as soon as possible. Please DO NOT send any private health documentation or doctor’s notes to me.

**LATE MATERIAL & MAKE-UPS:**

All labs, quizzes and exams must be completed on the scheduled date at the time they are scheduled. There are no make-ups for any reason (except jury service, medical

quarantine, or call to active military duty). If “absent” for either “1-hour” exam, then the percentage score of the final exam will be applied to one (and only one) missing exam. All online homework must be submitted by the cut-off time and laboratory homework must be submitted at the assigned time to receive maximum credit. Any lab not submitted prior to the end of that day’s session receives a 10% penalty. After that, the penalty is an additional 10% for every 24 hours past the original due date and time.

#### CALCULATORS, LAPTOPS & CELL PHONES:

Only TI-30 non-graphing calculators may be used during exams. These calculators are available for check-out from the Math Assistance Center and/or the COD Library although students should not depend on them being available during the exam. Students are responsible for bringing the correct calculator to the exam and knowing how to use it. During exams, the cover must be removed and there is no sharing of calculators.

No CELL PHONE CALCULATORS may be used during exams. Students may use laptops or tablets to take notes during lecture only under the following conditions: 1) the screen must be displayed upon request and 2) you show me that day’s notes at the conclusion of the class. If these conditions cannot be met, then you may not use the device in class. The proprietors of any cell phone that disrupts the class disruption will guarantee themselves a zero on the next quiz.

#### RETURN POLICY:

In general, every effort will be made to return work/provide feedback in a timely fashion usually within one week after submission. Scores will be updated in Blackboard on a regular basis.

#### WITHDRAWAL POLICY:

The last day to withdraw from this course is Sunday, November 10<sup>th</sup>, 2024. After that date, students may file a *Petition for Late Withdrawal* through the Registration Office. A *Petition for Late Withdrawal* will be granted for extenuating circumstances only, including student illness, death in the immediate family, family emergencies, call to active duty, or other appropriate extenuating circumstances. The student will be required to provide appropriate documentation for all requests for late withdrawal. Prior to withdrawing from this class, students are strongly encouraged to speak to their instructor. Students who have missed 5 or more classes or labs AND are not passing with a grade of “C” or better by Friday, October 11<sup>th</sup>, 2024 will be considered in “non-pursuit” and risk being administratively dropped from the course. (No refunds!)

#### INCOMPLETE POLICY:

Under extraordinary circumstances (such as an extended medical emergency or family tragedy) a student currently earning “C” or better may not be able to complete all of the course requirements. In such instances, the student may petition the instructor for an “incomplete” grade. Only if the instructor deems the request as warranted will a contract agreement be made between the student and instructor as to how the course will be completed. After the contract is signed by both the students and the instructor, the student

will receive a grade of “I”. Note: The course must be completed with the same instructor and within one calendar year of the end of the term for which the student was enrolled.

If the student does not complete the requirements for the course as prescribed in the agreement, the “I” grade will automatically revert to a grade of “F.” It is advised that the students be fully aware of the consequences of receiving an incomplete grade and understand the terms described in the COD Catalog, p. 111: *Grade of Incomplete*.

#### CONDUCT & DISRUPTIONS:

It is expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog, p. 162-163: *Student Rights and Responsibilities*. In particular, *Student Code of Conduct (Board Policy 20-35)*. Individuals that exhibit disruptive behaviors that interfere with the lectures and/or laboratory sessions will be removed from the class so that those individuals who wish to learn physics can do so. Those individuals removed must then conference with either the Dean or an Associate Dean in the STEM Division. Those individuals may then rejoin the class pending the outcome of the conference.

Anyone caught cheating or plagiarizing will receive an automatic failure for the course. You will not be allowed to drop the class if you are found in violation of this section. It is expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog, pp. 163-164: *Students Code of Academic Conduct (Board Policy 20-41)* and that you are aware of the definitions of the terms described therein.

Also, the college will not tolerate discrimination or harassment. It is also expected that you are aware of and follow the guidelines for conduct as described in the COD Catalog, page 167: *Prohibition of Discrimination, Harassment and Sexual Harassment (Board Policies 15-10 and 15-11)*.

#### COMMUNICATION:

You should use email as a method to communication with me. You are strongly encouraged to ask questions about the syllabus during class time and office hours. For more in-depth discussions (such as guidance on assignments) face-to-face office hours are available. Also, it is possible to set up a one-on-one meeting in Blackboard Collaborate or Zoom if necessary. Such guidance conversations should take place in person or over the phone rather than through email. This allows us to communicate more effectively and fosters a more collegial learning atmosphere.

RELIGIOUS OBSERVANCE: The College will reasonably accommodate the religious observances of individual students with respect to class attendance, and the scheduling of examinations and class requirements. The student should notify the instructor well in advance of any anticipated absence or a pending conflict between a scheduled class and the religious observance.

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## PHYSICS 2112 COURSE EXPECTATIONS

### What Dr. Fazzini Expects from You:

- You will have read the syllabus.
- You will be punctual to class.
- You do not make or receive telephone calls or text messages during lecture or lab sessions.
- You demonstrate respect for what your fellow students and I have to say.
- You will come to class prepared (pencils, calculator, lab handouts, etc.)
- You will come to class ready to ask and answer questions of substance on the day's topic(s).
- You will concentrate exclusively on this course during the class hours of this course.
- You will notify me prior to class if you have to leave early.
- You will “check your entitlement at the door” and take responsibility for your own learning.

### What You Can Expect from Dr. Fazzini:

- I will be punctual to class.
- I will give each of you a fair share of my attention.
- I will work to make the class interesting and relevant.
- I will make myself available as a helpful resource outside of class.
- I will work to help you learn the material and perform at your best.
- I will be the sole arbiter of partial credit.
- I will grade the QUALITY of your work rather than the amount of time and effort you spent on it. (In other words, you will be assessed on your demonstrated performance rather than on anecdotal testimony.)



## TENTATIVE WEEKLY SCHEDULE for Physics 2112 Fall 2024

Week	Dates	Vol./Chapter	Topic(s)
1	Aug. 19-22	2 / 5.1-5.2	Electric Charge & Electric Forces
		2 / 5.3	Coulomb's Law
2	Aug. 26-29	2 / 5.4-5.7	Electric Fields
3*	Sep. 3-5	2 / 6.1-6.4	Electric Flux & Gauss' Law
4	Sep. 9-12	2 / 7.1-7.2	Electric Potential Energy
		2 / 7.3-7.4	Electric Potential
5	Sep. 16-19	2 / 7.5-7.6	Conductors & Electrostatic Equilibrium
		2 / 8.1-8.5	Capacitance, Capacitors & Dielectrics
6	Sep. 23-26	Exam 1	Vol. 2 Chapters 5-8
		2 / 9.1-9.3	Electric Current & Resistance
7	Sep. 30-Oct. 3	2 / 9.4-9.6	Electric Power & Ohm's Law
		2 / 10.1-10.5	DC Circuits & Kirchoff's Laws
8	Oct. 7-10	2 / 11.1-11.7	Magnetism: Forces & Fields
		2 / 12.1-12.4	Biot-Savart Law
9	Oct. 14-17	2 / 12.5-12.7	Ampere's Laws & Magnetism in Matter
		2 / 13.1-13.4	Electromagnetic Induction & Faraday's Law
10	Oct. 21-24	2 / 13.1-13.4	Motional EMF
		2 / 13.5-13.7	Induced Electric Fields
11	Oct. 28-31	2 / 14.1-14.4	Inductance & Inductors
		2 / 14.5-14.6	LC & LRC Circuits
12*	Nov. 4-7	2 / 15.1-15.3	AC Circuits
		2 / 15.4-15.6	Power in AC Circuits
13	Nov. 11-14	2 / 16.1-16.5	Electromagnetic Waves
		Exam 2	Vol. 2, Chapters 9-14
14	Nov. 18-21	3 / 1.1-1.4	Light & Polarization
15*	Nov. 25-26	3 / 2.1-2.2	Geometrical Optics
		3 / 2.3-2.4	Mirrors and Lenses
16	Dec. 2-5	3 / 3.1-3.5	Interference
		3 / 4.1-4.6	Diffraction
17*	Dec. 9	Final Exam	All covered material: Vol. 2, Chapters 5-16 & Vol. 3 Chapters 1-4

\* Denotes shortened week due to holidays, college "In-service" days, or final exams:

There are NO COD CLASSES on the following dates:

Monday, September 2<sup>nd</sup> due to the Labor Day holiday

Tuesday, November 5<sup>th</sup>, due to Election Day (Go vote!)

Wednesday-Friday, November 27<sup>th</sup>-29<sup>th</sup> due to the Thanksgiving holiday

## TENTATIVE PHYSICS 2112 LABORATORY SCHEDULE for Fall 2024

Week	Dates	Investigation (Lab Manual)	Topic(s)
1	Tues., Aug. 20	Lab 1	Electric Charges, Forces & Fields
2	Tues., Aug. 27	Handout Lab	Millikan Oil Drop: A Mechanical Analogy
3	Tues., Sep. 3	Lab 2	Electric Fields, Flux & Gauss' Law
4	Tues., Sep. 10	Lab 3	Electric Fields & Equipotential Lines
5	Tues., Sep. 17	Lab 4	Batteries, Bulbs & Current
6	Tues., Sep. 24	Exam 1 & Lab 5	Exam: Vol. 2, Chapter 5-8 Lab: Current in Simple DC Circuits
7	Tues., Oct. 1	Lab 5 (con'd)	Current in Simple DC Circuits
8	Tues., Oct. 8	Lab 6	Voltage in Simple DC Circuits
9	Tues., Oct. 15	Lab 7	Kirchoff's Circuit Rules
10	Tues., Oct. 22	Handout Lab	Magnetism & Electromagnetic Induction
11	Tues., Oct. 29	Exam 2 & 13 (modified)	$e/m$ Ratio of the Electron
12	Tues., Nov. 5	Lab 11	Introduction to AC Circuits
13	Tues., Nov. 12	NO LAB	Election Day (Go vote!)
14	Tues., Nov. 19	14	Introduction to Wireless Communications
15	Tues., Nov. 24	Handout Lab	Geometrical Optics
16	Tues., Dec. 4	Handout Lab	Interference & Diffraction

NOTE: Not every topic in the each assigned chapter may be discussed in class. However, you are responsible for every topic in each assigned chapter unless otherwise stated. If you are having trouble with a topic that is not discussed in class, it is your responsibility to seek out the instructor and/or other resources to ensure understanding of that topic.

## Detailed Topical Outline:

1. Electric charge
2. Coulomb's law
3. Units of charge
4. Quantization of charge
5. Conservation of charge
6. Linear superposition and Coulomb's law
7. Definition and units for the electric field
8. Electrostatics
9. Measuring and calculating electric fields
10. Fields in special configurations
11. Electric dipoles in electric fields
12. Gauss' Law High symmetry and Gauss' law
13. Applications of Gauss' law
14. Electric potential energy
15. Definition and units of potential difference
16. Calculating potential difference
17. Relation between potential difference and the electric field
18. Capacitance
19. Capacitors
20. Calculation of capacitance
21. Capacitive circuits
22. Energy stored in a capacitor
23. Current and resistance
24. Electric current
25. Resistivity and resistance of a wire
26. Ohm's law for resistive media
27. Energy and charge conservation in resistive circuits
28. Batteries and circuits
29. Simple resistive circuits
30. Kirchhoff's laws
31. Magnetic fields
32. Magnetic force on a moving charge
33. Helical motion of charges in uniform magnetic fields
34. Measurement of momentum and voltage for moving charges
35. Mass spectrometer particle accelerators
36. Magnetic fields due to currents
37. Current carrying wire in magnetic fields
38. Current loops in magnetic fields (magnetic dipoles)
39. Electric motors
40. Production of magnetic fields by moving charges
41. Current elements and the Biot-Savart law
42. Special cases for the production of magnetic fields
43. Magnetic lines of force

44. Symmetry and the production of magnetic fields using Ampere's law
45. Induction and inductance
46. Induced voltages and Faraday's law
47. Lenz' law and induced voltages
48. Mutual induction and transformers
49. Self-induction
50. Simple and complex inductive circuits
51. Alternating Current (AC) circuits and Maxwell's equations
52. Inductive-resistive-capacitive (LRC) circuits
53. Damped and forced oscillations in circuits
54. Impedance
55. Phasor diagrams
56. Average voltages, currents, and power
57. Maxwell's equations
58. Magnetism in matter
59. Geometric optics
60. Waves vs. rays
61. Law of reflection
62. Plane and spherical mirrors
63. Image formation
64. Snell's law of refraction
65. Total internal reflection
66. Prisms, lenses, and lens maker's formula
67. Physical optics
68. Reflection and refraction
69. Interference and diffraction
70. Interference from two or more light sources
71. Single slit diffraction
72. Thin film interference
73. Diffraction gratings
74. Dispersion and resolving power
75. Polarization

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**Disclaimer:** To the best of the instructor's knowledge, the information in this syllabus was correct and complete at the start of the semester. However, the instructor reserves the right, acting within the policies and procedures of the College of DuPage, to make changes in the course content, instructional techniques or grading policy during the term. (Any changes would always be in favor of the class as a whole.) It is assumed that you have read this course syllabus. Your continued enrollment in this course means that you accept the terms and conditions outlined in this syllabus.