

# Syllabus for Algebra-Based Physics-2: Electricity, Magnetism, and Modern Physics (PHYS135B)

Dr. Jordan Hanson - Whittier College Dept. of Physics and Astronomy

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## Abstract

The concepts of algebra-based electricity, magnetism, and modern physics will be presented within the context of interactive problem-solving. The course will begin with the concepts of electric charge, electrostatics, and electric potential. Following electrostatics, applications to DC circuits will be covered. Next, the topics of magnetism and electromagnetism will be covered, concluding with light and optics. Time-permitting, selected topics in modern physics will be added. The course work will include interactive computational exercises, analytic textbook problems, group-designed projects, and lab-based activities.

**Pre-requisites:** PHYS135A

**Course credits, Liberal Arts Categorization:** 4 Credits, None

**Regular course hours and location:** Monday through Friday, 8:00-9:15. Synchronous time corresponds to meeting together via Zoom or in person, asynchronous time corresponds to engaging with pre-recorded content and thinking through content that prepares you for the homework and warm-up exercises.

**Instructor contact information:**

1. Email: [jhanson2@whittier.edu](mailto:jhanson2@whittier.edu)
2. Cell: 562.351.0047
3. Zoom ID / pass: 796 092 0745 / 667725
4. YouTube Channel: [www.youtube.com/918particle](http://www.youtube.com/918particle)
5. Book online appointments: <https://fgucmvjkyllumqgfsco.10to8.com>

**Office hours:** Please use the booking service to schedule Zoom meetings: [10to8.com](https://fgucmvjkyllumqgfsco.10to8.com) as above.

**Attendance/Absence:** Students are required to log in for the morning Zoom sessions, however the asynchronous content may be digested on the students' individual schedules.

**Late work policy:** Late work is generally not accepted, but is left to the discretion of the instructor.

**Text:** OpenStax College Physics. Go to <https://openstax.org/details/books/college-physics> for access (free).

**Homework and Reading:** OpenStax Tutor: [https://tutor.openstax.org/enroll/230057/PHYS135B\\_2-Spring-2021](https://tutor.openstax.org/enroll/230057/PHYS135B_2-Spring-2021). Homework sets will usually require 10 exercises per week, and is integrated with the open-access text from which reading assignments will be given. This system costs 10 dollars, but the laboratory software and textbook are free.

**Laboratory Software:** Pivot Interactives. [pivotinteractives.com](http://pivotinteractives.com). Tutorial: [https://youtu.be/ARh\\_nPriGzk](https://youtu.be/ARh_nPriGzk). Class key: ck-7d3aedc1. Join class: <https://app.pivotinteractives.com/join-class?classKey=ck-7d3aedc1>.

**Grading:** There will be one take-home midterm, one (optional) final exam, and daily warm-up exercises. There will also be homework problem sets, submitted via Moodle. Finally, there will be a self-designed project and presentation given at the end of the term. Grading percentages are shown in Tab. 1. Note that the final exam will be optional. The final project is a good opportunity for the use of Digital Storytelling. For more information, see <https://diglibarts.whittier.edu> and contact Sonia Chaidez: [schaidez@whittier.edu](mailto:schaidez@whittier.edu).

Item	Percentage	Item	Percentage
Daily exercises	10 %	Daily exercises	15 %
Homework sets and labs	30 %	Homework sets and labs	35 %
Midterm	20 %	Midterm	25 %
Final	20 %	Final	- -
Final Project + Presentation	20%	Final Project + Presentation	25%

Table 1: (Left) These are the grade settings with the final exam included. (Right) These are the grade settings without the final exam. The final exam is optional. **Grade Settings:**  $\geq 60\%$ ,  $< 70\%$  = D,  $\geq 70\%$ ,  $< 80\%$  = C,  $\geq 80\%$ ,  $< 90\%$  = B,  $\geq 90\%$ ,  $< 100\%$  = A. Pluses and minuses: 0-3% minus, 3%-6% straight, 6%-10% plus (e.g. 79% = C+, 91% = A-).

**Student Disability Services:** Please inform the instructor if you have special instructions from Student Disability Services. Please contact Student Disability Services if you require extended time testing or note-taking: [disability-services@whittier.edu](mailto:disability-services@whittier.edu), tel. 562.907.4825.

**Academic Honesty Policy:** <http://www.whittier.edu/academics/academichonesty>

**Policy due to COVID-19:** Our course combines in-person discussions and activities with online Zoom meetings and asynchronous pre-recorded content.

1. Class will meet via Zoom usually four days per week. There will be asynchronous activities distributed through Moodle that do not require us to meet over Zoom.
2. Group project results will be presented via Zoom during the last week of class.
3. **Students may opt-out of taking the final exam.** In order to accommodate students' preparation for the Fall semester, the final exam is optional. If one does not take it, the assignment weights for the final grade will be those given in Tab. 1 (right).
4. The final project can be created in one of two options. **Option A:** A 10 minute traditional presentation with several minutes for questions. **Option B:** Digital liberal arts style, in the form of video or digital book form that educates the class on a topic. Regardless of the option, students will all present their work to the class at the end of the module.

#### **Course Objectives:**

- To practice written and oral expression of scientifically technical ideas.
- To solve word problems pertaining to physics and mathematics.
- To construct mathematical models of electrical systems like DC circuits.
- To apply logical thinking to conceptually-posed physics problems.
- To practice scientific experimentation, data analysis, and reporting of results.

#### **Course Outline:**

1. **Unit 0:** Review of pre-requisite courses, and electrostatics.
  - (a) Unit analysis, kinematics, and Newton's Laws
  - (b) Work and energy, momentum
  - (c) Electrostatics, I - **Chapters - 18.1 - 18.5**
    - i. The Coulomb Force, and Newton's Second Law for electric charges
    - ii. The concept of an electric field
  - (d) Electrostatics, II, electric potential - **Chapters 18.6 - 18.8, 19.1 - 19.3**
    - i. Charge and electric fields in biology
    - ii. Potential energy and charge: voltage
    - iii. Potential energy and fields, point charges
2. **Unit 1:** Capacitors, current and DC circuits
  - (a) Capacitors and capacitance - **Chapters 19.4 - 19.7**
    - i. Equipotential lines
    - ii. Capacitance and capacitors
    - iii. Capacitors in series and in parallel, energy considerations
  - (b) Current and DC circuits - **Chapters 20.1 - 20.4, 20.7**
    - i. DC current and resistance, Ohm's law
    - ii. Energy and power in DC current
    - iii. Biological example: human nerve conduction
3. **Unit 2:** DC Circuits with resistors in series and parallel, RC circuits
  - (a) DC circuit basics - **Chapters 21.1 - 21.4**
    - i. Resistors in series and parallel, electromotive force (EMF)
    - ii. Kirchhoff's rules
    - iii. Voltmeters and ammeters
4. **Unit 3:** Magnetism I

(a) Magnetostatics I - **Chapters 22.1 - 22.5**

- i. Magnets, ferromagnetic and electromagnetic
- ii. Magnetic fields and field lines, force on moving charge
- iii. Magnetic applications I

(b) Magnetostatics II - **Chapters 22.6 - 22.11**

- i. The Hall effect
- ii. Force on current carrying conductor, torque on current loop
- iii. Ampère's Law: magnetic fields created by current

5. **Unit 4: Magnetism II**

(a) Magnetic induction - **Chapters 23.1 - 23.5, 23.7**

- i. Induced EMF, magnetic flux
- ii. Faraday's Law
- iii. Motional EMF and generators, transformers

6. **Unit 5: Cumulative Review, group presentations, and final exam**

(a) No warm-up exercises

(b) Group presentations, both option A and B

- i. Given as a pair or team
- ii. 10-15 minute duration with questions
- iii. Whiteboard is available
- iv. Final exam is optional (see Tab. 1).

**The five pieces of technology driving the course:**

1. OpenStax Textbook, College Physics: <https://openstax.org/details/books/college-physics>. Sign up at [openstax.org](https://openstax.org) for a free account, and you will be able to save custom highlights. The book can also be downloaded as a PDF or accessed via the smartphone app on Android OS and iOS.
2. OpenStax Tutor, for homework and reading assignments: Course link, [https://tutor.openstax.org/enroll/230057/PHYS135B\\_2-Spring-2021](https://tutor.openstax.org/enroll/230057/PHYS135B_2-Spring-2021). There is a complete getting started guide on Moodle.
3. Pivot Interactives laboratory software: [pivotinteractives.com](https://pivotinteractives.com). Tutorial: [https://youtu.be/ARh\\_nPriGzk](https://youtu.be/ARh_nPriGzk). Class key: ck-7d3aedc1. Join class: <https://app.pivotinteractives.com/join-class?classKey=ck-7d3aedc1>.
4. Online booking service for office hours, 10to8.com: [10to8.com](https://fgucmvjkylvmgqfsc0.10to8.com). Book an online appointment here: <https://fgucmvjkylvmgqfsc0.10to8.com>. Appointments are automatically synced with instructor schedule and last 30 minutes via Zoom (same ID and password as class time).
5. Moodle: We will use modules native to Moodle for sharing lecture notes, quizzes and submitting project files.