Syllabus for Calculus-Based Physics: Electricity, Magnetism, and Thermodynamics (PHYS180-02)

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Abstract

The concepts of calculus-based electromagnetism will be presented within the context of interactive problem-solving. The course will begin with the concepts of electric charge, electrostatics, electric potential and applications to DC circuits. The course will proceed with the addition of magnetism, induction, and AC circuits, and conclude with geometric and wave optics. As time permits, some selected topics from quantum mechanics and special relativity will be introduced. The course work will include interactive computational exercises, analytic textbook problems, group-designed projects, and lab-based activities.

***Pre-requisites**: PHYS-150 or PHYS-135A and MATH-141B or MATH-142 (may be concurrent).*
***Course credits, Liberal Arts Categorization**: 4 Credits, COM1*
***Regular course hours**: Monday, Wednesday and Friday from 15:00 - 16:30 in SLC 228*
***Instructor contact information**: jhanson2@whittier.edu, tel. 562.907.5130*
***Office hours**: Tuesdays 12:00-17:00.*
***Attendance/Absence**: Students needing to reschedule midterms and exams should notify the professor a reasonable time beforehand. Further attendance issues are left to the discretion of the instructor.*
***Late work policy**: Late work is generally not accepted, but is left to the discretion of the instructor.*
***Text**: University Physics Volume Two - `https://openstax.org/details/books/university-physics-volume-2`*
***Grading**: There will be three tests, each examining conceptual understanding in step-by-step problems. Each midterm is worth 15% of the final grade. The weekly online homework is worth 20% of the grade. Interactive in-class activities will be worth 10% of the final grade. Lab groups will present results of a group project worth 10% of the grade. The final exam will be held on May 10th, 13:00-15:00, and will be worth 15% of the grade.*
***Grade Settings**: $< 60\%$ = F, $\geq 60\%, < 70\%$ = 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-)*
***Homework Sets**: Typically 5-10 problems per week, assigned and collected on Mondays. See `http://goeta.link/USB06CA-E19C6C-1S0` for online homework setup.*
***Bonus Essay**: Students may submit an essay on the history of scientific developments covered in the course, due at the end of the semester. The essay must be 10 pages, address scientific arguments and results, and must include references. The grade of this paper will replace the lowest midterm grade, if it would raise the final grade.*
***ADA Statement on Disability Services**: The Americans with Disabilities Act (ADA) is a federal anti-discrimination statute that provides comprehensive civil rights protection for persons with disabilities. Among other things, this legislation requires that all students with disabilities be guaranteed a learning environment that provides for reasonable accommodation of their disabilities. If you believe you have a disability requiring an accommodation, please contact Disability Services: disabilityservices@whittier.edu, tel. 562.907.4825.*
***Academic Honesty Policy**: `http://www.whittier.edu/academics/academichonesty`*
***Course Objectives**:*

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

***Course Outline**:*

1. Unit 0: Review of pre-requisite course, 150
    (a) Estimation, approximation, kinematics and Newton's Laws
    (b) Work, energy and power
    (c) Momentum, linear and angular
2. Unit 1: Electrostatics - **Chapters 5-6**
    (a) The Coulomb force
    (b) Electric and gravitational fields
    (c) Gauss' Law and symmetries
3. Unit 2: Electric potential and capacitance - **Chapters 7-8**
    (a) Electric potential (voltage) and potential energy
    (b) Capacitance: stored charge and energy
    (c) Dielectric materials and batteries
4. First midterm exam, end of Unit 2
5. Unit 3: Current, resistance, and DC circuits - **Chapters 9-10**
    (a) Current and resistivity, resistance
    (b) Ohm's law
    (c) Electromotive force
    (d) Resistors in series and parallel, Kirchhoff's rules
    (e) RC Circuits
6. Unit 4: Magnetism 1 - **Chapters 11-12**
    (a) Magnetism and magnetic field lines
    (b) Charged particles in magnetic fields
    (c) Current-carrying conductors in magnetic fields
    (d) The Hall effect
    (e) Applications
    (f) The Biot-Savart Law
    (g) Ampère's Law
7. Second midterm exam, end of Unit 4
8. Unit 5: Field Induction - **Chapters 13-14**
    (a) Faraday's Law and Lenz's Law
    (b) Motional EMF and induced fields
    (c) Electric generators
    (d) Mutual inductance, self-inductance
    (e) RL circuits, RLC circuits, transformers
9. Unit 6: Electromagnetic waves - **Chapter 16**
    (a) Maxwell's equations
    (b) Electromagnetic waves and energy
    (c) The electromagnetic spectrum
10. Third midterm exam, end of Unit 6
11. Unit 7 - **Cumulative Review, group presentations, and final exam**