PHYS A135: UNIVERSITY PHYSICS 2: ELECTRICITY/ MAGNETISM WITH LAB

Item	Value
Curriculum Committee Approval Date	11/03/2021
Top Code	190200 - Physics, General
Units	4 Total Units
Hours	108 Total Hours (Lecture Hours 54; Lab Hours 54)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Grading Policy	Standard Letter (S)
Associate Arts Local General Education (GE)	• OC Physical/Biological Sci - AA (OB)
Associate Science Local General Education (GE)	• OCC Physical/Biological Sci-AS (OSB)

Course Description

Formerly: University Physics 2 (non-majors). The second semester of a two-semester sequence with lab (PHYS A130/A135) covering a calculus-based study of all topics in basic physics. Core topics for this second semester include: electromagnetism, optics, and modern physics. PREREQUISITE: PHYS A130; and MATH A182H, MATH A185, or MATH A185H. Transfer Credit: CSU; UC: Credit Limitation: PHYS A120, PHYS A125, PHYS A130, PHYS A135 and PHYS A185, PHYS A280, PHYS A285 combined: maximum credit, 1 series.

Course Level Student Learning Outcome(s)

1. State the basic principles of electromagnetism, optics, and modern physics, define important scientific terms in these areas, and provide explanations of how they apply to real-world situations.
2. Apply calculus, algebra, trigonometry, and conceptual reasoning towards the solution of problems involving electromagnetism, optics, and modern physics.
3. Conduct experiments using standard scientific methods, evaluate the resulting data, and construct evidence-based conclusions in a written report.

Course Objectives

- 1. State the basic principles of electromagnetism and modern physics, define important scientific terms in these areas, and give an explanation of how they apply to real-world situations.
- 2. Use calculus and conceptual reasoning to solve problems involving the laws of electromagnetism and modern phsyics.
- 3. Conduct simple experiments using standard scientific methods, evaluate the resulting data, and construct a scientific conclusion in a formal written report.

Lecture Content

1. Electrostatics, charge conductors and insulators, Coulombs law 2. The electric field, conductors in an electric field, motion of charges in uniform static fields, dipoles, Millikans oil drop experiment 3. Calculus review; Gauss theorem, Stokes theorem, multidimensional calculus, divergence and curl 4. Electric flux, Gauss law 5. Electric potential, potential energy of charge distributions 6. Capacitance and capacitors, energy stored in a capacitor, energy density of the electric field, dielectrics, atomic view of dielectrics 7. Current, current density, resistance, Ohms law, power, microscopic theory of conduction 8. Direct current circuits, electromotive force, Kirchoffs rules, RC circuits, direct current instruments 9. The magnetic field, force on a current-carrying conductor, torque on a current loop, the galvanometer, the motion of charged particles in magnetic fields, combined electric and magnetic fields, the Hall effect 10. Field due to a long, straight wire, magnetic force between parallel wires, Biot-Savart law of a current element, Amperes law 11. Electromagnetic induction, magnetic flux, Faradays law and Lenzs law, generators, the origins of the induced emf 12. Inductance, LR circuits, energy stored in an inductor, LC oscillations, magnetic properties of matter nb 13. Alternating current circuits: circuit elements in an AC circuit, phasors, RLC series circuits, transformers 14. Displacement current, Maxwells equations, electromagnetic waves, Poynting vector, momentum and radiation pressure, Hertzs experiment, the electromagnetic spectrum 15. Ray optics, reflection, refraction, dispersion, images formed by plane and spherical mirrors, the speed of light 16. Optical instruments: lenses, the simple magnifier, the compound microscope, telescopes 17. Wave optics: interference, diffraction, Youngs experiment, Michelson interferometer, coherence 18. Fraunhofer and Fresnel diffraction, single slit diffractions, the Rayleigh criterion, gratings, resolving power of a grating, X-ray diffraction, polarization 19. Special relativity: the Michelson-Morley experiment, the two postulates, relativity of simultaneity, time dilation, length contraction, relativistic Doppler effect, the twin paradox, the Lorentz transformations, addition of velocities, momentum and energy 20. Early quantum theory: blackbody radiation, the photoselectric effect, the Compton effect, line specta, models of atom, wave-particle duality of light, Bohrs correspondence principle 21. Wave mechanics: de Broglie waves, electron diffraction, Schroedingers wave equation, Heisenbergs uncertainty principles, wave particle duality 22. Atoms and solids: quantum numbers for the hydrogen atom, X-rays and Moseleys law, Pauli exclusion principle and the periodic table, magnetic moments, band theory of solid s, semiconductor devices 23. Nuclear physics: models, binding energy and nuclear stability, radioactivity, the radioactive decay law, nuclear reactions 24. Elementary particles: antimatter, exchange forces, classification of particles, symmetry and conservation laws, the eightfold way and quarks, color Gauge theory, the electroweak interaction, the new quarks, quantum chromodynamics, grand unified theories List of Laboratory Experiments 1 Electric fields 2 Ohms law 3 Oscilloscope familiarization 4 Precision of resistors 5 Field near a magnetic dipole 6 AC circuit analysis 7 Apparent depth and index of refraction 8 Prism spectrometer 9 Object-image relationship with thin lenses 10 LASER, diffraction and interference 11 Spectroscopic analysis 12 b Gamma ray absorption

Lab Content

See Course Content.

Method(s) of Instruction

- Lecture (02)
- DE Live Online Lecture (02S)
- DE Online Lecture (02X)
- Lab (04)
- DE Live Online Lab (04S)
- DE Online Lab (04X)

Instructional Techniques

1. Lecture and some demonstrations will be used to present the basic concepts. 2. Various methods and strategies of problem solving are taught by thoroughly discussing typical sample problems in the class. 3. Students are provided with an environment that encourages participation with the instructor, i.e. during the office hours of the instructor as well as during the experimentation in the lab, students have the opportunity to interact with the instructor. 4. Students will perform laboratory experiments to further the understanding of applications of the theory.

Reading Assignments

2 hrs/week as assigned by instructor from texts, on-line or library research, and/or instructor handouts.

Writing Assignments

To promote critical thinking component, problem solving will be emphasized in homework and exams. For each laboratory experiment, a conclusion has to be written which contains a critical evaluation of the laboratory results.

Out-of-class Assignments

4 hrs/week of assignments and test preparation emphasizing problem solving and concept application.

Demonstration of Critical Thinking

1. Weekly homework assignments 2. Short problem quizzes 3. Problem solving exams 4. Comprehensive final exam 5. Laboratory experiment reports

Required Writing, Problem Solving, Skills Demonstration

To promote critical thinking component, problem solving will be emphasized in homework and exams. For each laboratory experiment, a conclusion has to be written which contains a critical evaluation of the laboratory results.

Eligible Disciplines

Physics/Astronomy: Masters degree in physics, astronomy, or astrophysics OR bachelors degree in physics or astronomy AND masters degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Masters degree required.

Textbooks Resources

1. Required Learner, Lawrence . Physics for Scientists , Latest ed. Chicago: Jones and Bartlett Publishers, Inc., , 2010 2. Required Halliday, David, et al. Fundamentals of Physics, Extended, latest ed. Atlanta: John Wiley and Sons, 2007 Rationale: . 3. Required Moebs, William, et. al.. University Physics, ed. OpenStax College, 2017