PHYS-1220: COLLEGE PHYSICS II

Cuyahoga Community College

Viewing: PHYS-1220 : College Physics II

Board of Trustees:
MARCH 2024

Academic Term:
Fall 2024

Subject Code
PHYS - Physics

Course Number:
1220

Title:
College Physics II

Catalog Description:
Introductory algebra-based physics course designed for non-physics majors covering areas of physics which include electricity, magnetism, waves, sound, light, special relativity, atomic and nuclear physics.

Credit Hour(s):
4

Lecture Hour(s):
3

Lab Hour(s):
3

Other Hour(s):
0

Requisites

Prerequisite and Corequisite
PHYS-1210 College Physics I.

Outcomes

Course Outcome(s):
Develop effective critical thinking and problem-solving skills by applying the fundamental principles of physics to address and solve problems.

Essential Learning Outcome Mapping:
Critical/Creative Thinking: Analyze, evaluate, and synthesize information in order to consider problems/ideas and transform them in innovative or imaginative ways.

Objective(s):
1. Describe the mechanical wave phenomena in terms of frequency, wavelength, wave speed, and simple harmonic motion.
2. Use the mathematical description of traveling waves to describe and predict the motion of mechanical waves.
3. Use the superposition principle to explain and predict the pattern for the interference of two waves.
4. Describe standing wave patterns and their relationship to frequency, speed, and confinement dimensions.
5. Determine the resonant frequency of standing sound waves.
6. Determine the beat frequency of the superposition of two waves.
7. Use the Doppler effect to solve problems involving moving observers and/or moving sources.
8. Define the electric charge, electric field, electrostatic force, electric potential, and electric potential energy.
9. Describe electric conductors, insulators, semiconductors, superconductors, and charging by contact and charging by induction.

10. Describe the electric field, electric force, and electric potential produced by simple charge distributions (point charges, electric dipole, uniformly charged surfaces, and parallel plate capacitors).
11. Understand the relationship between electric field vectors, electric field lines, and equipotential lines and be able to draw the electric field lines and equipotential lines for simple charge distributions.
12. Draw electric field lines of simple electric charges (such as point-like charges, electric dipoles, and uniformly charged objects).
13. Apply Coulomb's law to determine electrostatic forces and electric fields of point-like charges.
14. Relate the electrostatic energy stored in a capacitor to the energy density of the electric field.
15. Describe the motion of a charged particle in an external electric field.
16. Define the electric current, resistance, and resistivity.
17. Determine the equivalent capacitance of a system of capacitors connected in series and parallel.
18. Determine the equivalent resistance of a system of resistors in series and parallel circuits.
19. Determine the power delivered by emf sources and the power dissipated by resistors in single and multi-loop circuits.
20. Apply Ohm's law to determine the current flow and voltage drops across resistors in series and parallel circuits.
21. Apply Kirchhoff's rule to analyze complex multiloop circuits.
22. Solve systems of equations to determine the current through multiloop circuits consisting of batteries and resistors.
23. Relate the time-dependency of the voltage and charge on a capacitor during charging and discharging in an RC (Resistor/ Capacitor) circuit.
24. Relate the time constant to the resistance and capacitance in an RC circuit.
25. Describe the magnetic field using magnetic field lines for simple sources such as bar magnets, current loops, straight current wires, solenoids, and surface currents).
26. Describe the magnetization of ferromagnetic materials in terms of magnetic dipole alignment in domains.
27. Determine the energy stored in a solenoid to the energy density of the magnetic field.
28. Determine the magnetic force on a moving charge particle in an external magnetic field.
29. Determine the torque on a current-carrying coil with magnetic dipole moment μ, in an external magnetic field.
30. Determine the magnetic force on a current wire and loop in an external magnetic field.
31. Calculate the magnetic fields produced by current in a straight wire and current loops.
32. Calculate the magnetic force between two parallel current-carrying wires.
33. Describe the motion of charged particles in regions with both electric and magnetic fields.
34. Apply Faraday's law of induction and Lenz's law to solve problems involving electromagnet induction.
35. Describe the oscillatory time-dependence of the voltage and current in an LC circuit and determine the resonant frequency.
36. Describe the oscillation of the electric and magnetic field energy in an ideal LC (Inductor/Capacitor) circuit.
37. Characterize a series RLC circuit containing a time-varying emf source.
38. Determine the impedance and resonant frequency for driven series RLC circuits
39. Explain phasor diagrams for RC, RL, and RLC (Resistor/Inductor/Capacitor) circuits.
40. Relate the average power dissipated in an AC circuit in terms of rms values of voltage and current.
41. Characterize the electromagnetic spectrum in terms of frequency and wavelength.
42. Define the speed of light in terms of constants related to electric and magnetic fields.
43. Determine the intensity of polarized light transmitted through polarizing filters using Malus's Law.
44. Apply the law of reflection and the law of refraction to relate the angles on the incoming, reflected, and transmitted rays of light when incident at the optically different interface.
45. Solve for the critical angle using Snell's Law.
46. Explain the dispersion of light by the frequency dependence of the index of refraction.
47. Use ray optics of light to describe and characterize image formations using various lenses and mirrors.
48. Determine and characterize image formations using the lens maker's equations and mirror equations.
49. Determine the magnification of images formed using lenses and mirrors.
50. Apply the conditions for constructive and destructive interference to characterize the interference patterns from coherent wave sources.
51. Determine the relativistic momentum and energy of particles moving near the speed of light.
52. Determine the energy of a photon.
53. Calculate the maximum kinetic energy of photoelectrons emitted from metals with known work functions exhibiting the photoelectric effect.
54. Relate the outcome of the Rutherford scattering experiment to the atomic model description.
55. Determine the energy of photons emitted in hydrogen transitions (Balmer and Lyman series).
56. Determine the de Broglie wavelength of particles with a specific momentum or kinetic energy.
57. Relate the wave-like nature of an electron in its stationary state to the size of a confining potential.
58. Calculate the relative perception of time dilation or length contraction of an object for observers in different inertial reference frames using Lorentz transformations.
59. Describe the initial and final isotopes involved in alpha, beta, and gamma decay.

60. Describe radioactive decay and activity in terms of half-life.
61. Distinguish between fission and fusion reactions.
62. Calculate the binding energy per nucleon from the mass difference of the atom.

Course Outcome(s):

Perform laboratory experiments involving the course topics with the appropriate data collection and analysis to support the conclusion of laboratory experiments expressed in written form.

Essential Learning Outcome Mapping:

Written Communication: Demonstrate effective written communication for an intended audience that follows genre/disciplinary conventions that reflect clarity, organization, and editing skills.
Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Apply the scientific method involving physics principles to design and set up laboratory experiments using the appropriate experimental apparatus to investigate, collect, and analyze data to draw evidence-based conclusions.
2. Modify experimental procedures in response to synchronous instructor feedback on the proper use of laboratory equipment, measuring techniques, and safety.
3. Convert between different systems of units.
4. Represent data clearly and concisely through tables, charts, and graphs with appropriate units and significant figures.
5. Identify relationships through graphical data analysis using model fits as solutions to a real-world problem.
6. Identify what information is needed to solve a problem.
7. Assess data and apply the appropriate physics concept and mathematical relationship to determine a solution.
8. Evaluate the validity of experimental results through the reproducibility of data.
9. Determine percent error/difference of experimental results and identify sources of experimental error and limitations.
10. Gather information on scientific topics relevant to the physics topics being investigated from credible sources to assess the accuracy of experimental results.
11. Present results of laboratory experiments in written reports with evidence-based conclusions.

Course Outcome(s):

Apply physics concepts to understand modern-day applications, explain or predict natural phenomena, and assess the validity of data analysis as an appropriate solution to a real-world scenario.

Essential Learning Outcome Mapping:

Quantitative Reasoning: Analyze problems, including real-world scenarios, through the application of mathematical and numerical concepts and skills, including the interpretation of data, tables, charts, or graphs.

Objective(s):

1. Apply circuit analysis to explain real-world applications such as action potentials, pacemakers, defibrillators, pulse lasers, and intermitted windshield wiper blades.
2. Calculate the radius of the trajectory of an ion in a mass spectrometer and analyze the dependence of the ion's mass.
3. Describe real-world applications such as cyclotrons, CRT, auroras, and mass spectrometers in regard to the magnetic force on moving charges.
4. Apply Faraday's Law of Induction to explain electromagnetic induction applications, such as the basics of electric motors, transformers, electric generators, magnetic braking, and wireless charging.
5. Apply thin film interference conditions to explain color patterns in real-world applications.
6. Describe using AC circuits (RL, RLC, LC) in real-world examples, such as transformers, GFI outlets, and frequency filters.
7. Demonstrate that light exhibits wave-like properties using interference and diffraction analysis.
8. Explain everyday optical phenomena (mirages, rainbows, and iridescence) using ray and wave optics.
9. Determine the prescription of near- and far-sighted persons using eyeglasses and contact lenses.
10. Apply the concept of geometric optics to determine the magnification of microscopes, telescopes, and other optical applications.
11. Interpret the results of emission spectra and the photoelectric effect as foundational experiments of the quantum nature of light.
12. Describe the Bohr model of the atom through emission spectra analysis and Rutherford's experiment.
13. Relate the wave-like nature of an electron in its stationary state to the size of the confining potential box of length L.
14. Determine the resolving power of an electron microscope.

15. Use Einstein's postulates of special relativity to illustrate time dilation and length contractions.
16. Describe the basic underlying principle of nuclear physics to medical diagnostics and cancer radiation treatment.

Methods of Evaluation:

1. Quizzes
2. Final examinations
3. Formal laboratory reports
4. Informal laboratory reports
5. Problem assignments
6. Group work
7. Student presentations
8. Other or some combination of the above.

Course Content Outline:

1. Waves
    a. The nature and mathematical description of waves
    b. Sound waves and intensity
    c. Doppler effect
    d. Applications of sound in medicine
    e. The principle of linear superposition
    f. Interference and diffraction
2. Electric forces, fields, and energy
    a. Charges and source of electric fields and forces
    b. Conductors and insulators
    c. Coulombs law
    d. Gauss's law
    e. Electric fields and field lines
    f. Copiers and computer printers
    g. Electric energy and potential
    h. Capacitors and dielectrics
    i. Biomedical applications of electric potential differences
3. Electric circuits
    a. Electromotive force and current
    b. Resistors and Ohm's law
    c. Serial and parallel circuits
    d. RC circuits
    e. Measurement of current and voltage
    f. Safety and physiological effects of current
4. Magnetic forces and fields
    a. Source of magnetic fields and forces
    b. Force of magnetic field on s moving charge
    c. The motion of a charged particle in a magnetic field
    d. Ampere's law
    e. Magnetic materials
5. Electromagnetic induction
    a. Induced electromotive force and current
    b. Faraday's law of electromagnetic induction
    c. Lenz's law
    d. Application of electromagnetic induction to the reproduction of sound
    e. The electric generator
    f. Transformers
6. Alternating currents
    a. Resistors, capacitors, and inductors in AC circuits
    b. Resonance in electric circuits
    c. Semiconductor devices
7. Electromagnetic waves

   a. Nature of electromagnetic waves
   b. Energy carried by electromagnetic waves
   c. The Doppler effect and electromagnetic waves
   d. Polarization
8. Reflection and refraction of light and Interferences of waves
   a. Wave fronts and rays
   b. Reflection of light with mirrors
   c. Refraction of light with lenses
   d. Compound microscopes
   e. Telescopes
   f. Interferences and Young's double-slit experiment
   g. X-ray diffraction
9. Special relativity
   a. Events and inertial reference frames
   b. The postulates of special relativity
   c. Relativity of time and length
   d. The equivalence of mass and energy
   e. Relativistic addition of velocities
10. Particles and waves
   a. Black body radiation and birth of quantum mechanics
   b. The wave particle duality
   c. The photoelectric effect
   d. The Heisenberg uncertainty principle
11. Atomic and nuclear physics
   a. Rutherford scattering and the nuclear storm
   b. Bohr's Model of the hydrogen atom
   c. Quantum mechanical picture of the hydrogen atom
   d. Pauli exclusion principle and the periodic table
   e. X-rays and lasers
   f. Medical application of the laser
   g. Holography
   h. The strong nuclear force and the stability of the nucleus
   i. Radioactivity
12. Laboratory work
   a. Safety in the laboratory
   b. Physical measurement
   c. Experimental error
   d. Laboratory reports

Resources

Knight, Randall D; Jones, Brian; and Field, Stuart. *College Physics: A Strategic Approach*. 4th. Pearson, 2021.

Giancoli, Douglas C. *Physics, Principles and Applications*. 7th ed. Pearson, 2021.

Giambattista, Alan. *College Physics*. 5th ed. McGraw Hill, 2020.

Walker, James S. *Physics*. 5th. Pearson, 2021.

Resources Other

1. "Easy Java Simulations". www.compadre.org/osp (http://www.compadre.org/osp/)
2. "Phet Simulations". Phet.Colorado.edu
3. Audio-visual materials: videos, dvds, audio recordings, computer programs and simulations

4. Laboratory experiments developed by current and past instructors
5. Online homework and study programs

Instructional Services

OAN Number:

OAN Approved: Ohio Transfer 36 TMNS and Transfer Assurance Guide OSC015 and OSC021 (2 of 2 courses for OSC021, both must be taken)

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