

Lecture Contact Hours: 48-54; Outside-of-Class Hours: 96-108;  
Laboratory Contact Hours: 48-54; Outside-of-Class Hours: 0;  
Total Student Learning Hours: 192-216

**CUYAMACA COLLEGE**  
**COURSE OUTLINE OF RECORD**

**Physics 131 – Fundamentals of Physics**

3 hours lecture, 3 units  
3 hours laboratory, 1 unit  
Total units: 4 units

**Catalog Description**

A mathematical and philosophical introduction to basic physical phenomena including electricity, magnetism, optics and modern physics using calculus, trigonometry and algebra-based problem solving. Laboratory experience is an integral part of this course.

**Prerequisite**

“C” grade or higher or “Pass” in PHYC 130 or equivalent

**Entrance Skills**

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Solve algebraic word problems by using substitution or simultaneous equations.
- 2) Application of trigonometric functions and their identities.
- 3) Solve linear, quadratic and trigonometric equations.
- 4) Application of related rates and derivatives.
- 5) Integrate polynomial, exponential and trigonometric functions.
- 6) Use the relationship between force, mass and acceleration to solve dynamics problems.
- 7) Use conservation of energy and conservation of momentum concepts.
- 8) Understand simple harmonic motion and apply its concepts to analyze oscillating systems including traveling and standing waves.
- 9) Use integration techniques such as integration by parts, trig substitution and "u" substitution.

**Course Content**

- 1) Lecture
  - a. Electrostatics
  - b. Fields
  - c. Potentials
  - d. Electric energy
  - e. DC circuits
  - f. Capacitors
  - g. Resistivity
  - h. Magnetism
  - i. Ampere’s Law
  - j. Electromagnetic induction (Faraday’s and Lenz’s Laws)
  - k. AC circuits
  - l. Electromagnetic waves
  - m. Geometric optics
  - n. Lenses, Mirrors and optical instruments
  - o. Wave optics
  - p. Special Relativity
  - q. Photons

- r. Matter as a wave
  - s. Quantum Mechanics
  - t. The hydrogen atom
  - u. Atomic structure
  - v. Nuclear physics
  - w. Historical development of physics
  - x. Application of physics principles to the real world
- 2) Labs
- a. Electrostatics
  - b. Electric Fields
  - c. Equipotentials
  - d. Bulbs, Batteries and current
  - e. Basic circuits
  - f. RC Time constant
  - g. Magnetism
  - h. Geometric Optics
  - i. Wave on a String
  - j. Young's Double Slit Experiment
  - k. Atomic Spectra

### Course Objectives

Students will be able to:

- 1) Recognize the basic concepts concerning electric fields, electric potential, capacitance, resistance, current, DC circuits, magnetic fields, inductance, AC circuits, Maxwell's Equations, geometric optics, diffraction and interference, special relativity, photon behavior, matter waves, the uncertainty principle, quantum mechanics, nuclear physics, radioactivity, and use mathematical expressions including calculus to represent physical situations involving these subjects.
- 2) Investigate and delineate the relationship between the theoretical principles of physics and their practical applications, and explain how this relationship affects real world problem solving.
- 3) Investigate, interpret and analyze the fundamental principles of physics based on reading assignments and in-class discussions.
- 4) Calculate solutions to physics problems using the fundamental principles of physics and symbolic logic skills.

During the lab students will:

- 5) Design experiments using the methods of scientific inquiry
- 6) Demonstrate laboratory technique by collecting data using both traditional and computer data acquisition methods, using computers to interpret and analyze numerical data and to generate a visual representation of the data.
- 7) Evaluate the experimental results using techniques presented in class.

### Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in the subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Quizzes, exams that measure the student's ability to recognize physical situations and the concepts associated with them, and use mathematical expressions to formulate solutions while under a time pressure.
- 2) Homework that measures the student's ability to use the fundamental principles of physics and symbolic logic skills to calculate solutions to physics problems.
- 3) Lab technique as demonstrated by the student's ability to design an experiment, set up the equipment, make the appropriate measurements, and maintain a safe work environment.
- 4) Lab reports will demonstrate the student's ability to use the English language; record, interpret and analyze data; draw conclusions from the results.

- 5) Physics research paper(s) in which students are required to analyze, interpret and draw conclusions from scientific sources.
- 6) Participation based on in-class responses to questions, contribution to discussions, and attendance.

### Special Materials Required of Student

Scientific calculator

### Minimum Instructional Facilities

- 1) Laboratory with Smart cart, blackboard, appropriate lab/demonstration equipment
- 2) Computers with data acquisition probes

### Method of Instruction

- 1) Integrated lecture, demonstration, discussion
- 2) Small/large group discussion
- 3) In-class activities and independent homework, research projects
- 4) Group work in a laboratory situation
- 5) Instructional slides, video presentations
- 6) Auxiliary use of study groups, peer tutoring and/or instructional office hours
- 7) Computer-facilitated instruction

### Out-of-Class Assignments

- 1) **Reading:** textbook chapters on electrostatics, magnetism, and optics; scholarly articles on medical imaging or radiation therapy; instructor-provided notes.
- 2) **Writing:** formal lab reports; problem-set reflections; short essays explaining the physics of biological or medical devices (e.g., MRI, x-ray).
- 3) **Other:** computer-based circuit simulations; field observations of optical phenomena; data collection using online tools; portfolio of graphs and analyses.

### Texts and References

- 1) Required (representative example):
  - a. Redish, Edward F. and Patrick J. Redish. *Living Physics: An Introductory Physics Course for Life Science Students*. Top Hat, 2023.
  - b. OpenStax. *College Physics 2e*. OpenStax Press, 2024.
  - c. Cutnell, John D. and Kenneth W. Johnson. *College Physics*. 12<sup>th</sup> edition. John Wiley and Sons, 2021.
- 2) Supplemental: None

### Exit Skills

Students having successfully completed this course exit with the following skills, competencies and/or knowledge:

- 1) Analyze electrostatic systems: calculate electric fields; electric potential.
- 2) Predict motion of charged particles: apply Lorentz force law; determine trajectory.
- 3) Analyze AC and DC circuits: compute current; voltage; power.
- 4) Apply optics principles: reflection; refraction; lens and mirror equations.
- 5) Analyze wave interference and diffraction: double slit; diffraction grating; wide slit.
- 6) Apply special relativity: time dilation; length contraction; energy-momentum relations.
- 7) Apply quantum concepts: particle in a box; atomic models.

### Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) Evaluate biological systems and medical technologies: explain how electric force, magnetism, and radioactive decay govern their function.
- 2) Apply conservation of energy to electromagnetic systems: determine velocity and position of charged particles.

- 3) Apply ray optics principles: analyze corrective lenses, microscopes, and telescopes.
- 4) Use the scientific method to design experiments: collect data; graph results; interpret relationships between variables.