Lecture Contact Hours: 48-54; Homework Hours: 96-108; Total Student Learning Hours: 144-162
Laboratory Contact Hours: 48-54; Homework Hours: 0; Total Student Learning Hours: 48-54

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

PHYSICS 131 – FUNDAMENTALS OF PHYSICS

3 hours lecture, 3 hours laboratory, 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) Required reading in the textbook or other recommended sources
2) Completion of pre-class and post-class exercises in both lecture and lab
3) Completion of research or other assignments and written laboratory work

Texts and References
1) Required (representative example): Cutnell, John D. and Kenneth W. Johnson. *College Physics*. 11th edition. John Wiley and Sons, 2018.
2) Supplemental: None

Exit Skills
Students having successfully completed this course exit with the following skills, competencies and/or knowledge:
1) Analyze simple static charge distribution and calculate the resulting electric field and electric potential.
2) Analyze simple current distributions and calculate the resulting magnetic field.
3) Predict the trajectory of charged particles in uniform electric and magnetic fields.
4) Analyze AC and DC circuits in terms of current, potential difference and power dissipation for each element.
5) Analyze basic physical situations involving reflection and refraction, and use this analysis to predict the path of a light ray.
6) Analyze situations involving interference and diffraction of light waves, and apply these to situations including double slits, diffraction gratings, and wide slits.
7) Apply concepts from special relativity to analyze physical situations, including time dilation, length contraction, and the Lorentz transformation. Solve basic problems involving relativistic momentum and energy.
8) Apply basic concepts of quantum mechanics to analyze basic physical setups, including a particle in a box and simple atomic models.

Student Learning Outcomes
Upon successful completion of this course, students will be able to:
1) Solve problems using a conceptual understanding of electric and magnetic fields.
2) Apply knowledge of potential and inductance to analyze systems AC and DC circuits.
3) Interpret and apply fundamental physics concepts such as electromagnetic waves, optics and interference.
4) Understand the basics of modern physics concepts including special relativity, quantum mechanics and nuclear physics.

During the lab students will:

5) Analyze experimental data, including appropriate use of units and significant figures.
6) Relate the results of experimental data to the physical concepts discussed in the lecture portion of the class.