PHYS 110H: PHYSICS IN EVERYDAY LIFE - HONORS

Citrus College Course Outline of Record

Heading	Value
Effective Term:	Fall 2024
Credits:	4
Total Contact Hours:	108
Lecture Hours :	54
Lab Hours:	54
Hours Arranged:	0
Outside of Class Hours:	108
Total Student Learning Hours:	216
Prerequisite:	Intermediate algebra or higher or direct placement based on multiple measures. Student must be eligible for the Citrus College Honors Program or obtain a recommendation from an Honors instructor.
Strongly Recommended:	ENGL 101.
District General Education:	B2. Natural Sciences - Physical Sciences, B3. Natural Sciences - Laboratory
Transferable to CSU:	Yes
Transferable to UC:	No
Grading Method:	Standard Letter

Catalog Course Description

A physics course designed to equip non-majors with the knowledge to make wiser decisions for the self, family, organization, community, and planet. Energy, heat, gravity and space, conservation laws, electromagnetism, waves, and nuclear physics, are all explored in the context of their applicability to the core science and technology issues of our modern world. Students are expected to participate at an honors level. This includes leading discussions, giving and receiving detailed feedback to improve speaking and writing, formulating research questions, and developing their number sense through both estimation and precise calculations. 54 lecture hours, 54 lab hours.

Course Objectives

- Motion & Forces
- Distinguish between the concepts of position, distance, displacement, speed, velocity and acceleration.
- Use kinematics to describe and/or predict an object's motion verbally, pictorially, graphically and mathematically.
- Identify forces acting on an object and calculate the net force on the object.
- Thermodynamics & Fluids
- Distinguish between renewable and non-renewable sources of energy
- Distinguish between the concepts of heat (thermal energy transfer) and temperature.
- Distinguish between the various temperature measurement systems.
- Contrast the three heat transfer mechanisms (conduction, convection, and radiation).
- Describe physical changes of matter resulting from heat transfer (e.g. temperature change or phase change).
- Use the first & second law of thermodynamics to explain various physical phenomena (such as gas behavior and heat engines).
- Use the concept of entropy in describing the behavior of physical systems.
- Distinguish between the concepts of pressure and force.
- Distinguish between and apply Pascal's Principle, Bernoulli's Principle and Archimedes' Principle to describe fluid phenomena.
- Waves & Optics
- Describe basic wave properties (amplitude, polarization, frequency, wavelength and wavespeed) and how they apply to the specific cases of waves on strings, sound waves, and light waves.
- Calculate the allowed wavelengths and frequencies of standing waves on strings and standing sound waves in tubes/pipes and how this applies to musical instruments.
- Contrast various sources of light including the sun, light bulbs, chemical reactions, lasers, and excited atoms.
- Describe various wave phenomena such as interference, diffraction, birefringence, etc and their applications.
- Understand the properties of different electromagnetic wavelengths and their uses (communication, imaging, etc.).
- Understand how the index of refraction affects light waves in a medium; understand and apply the laws of reflection and refraction.
- Use the ray model of light (i.e., ray tracing) and the thin-lens equation to analyze image formation by lenses and mirrors to understand how, when, and why images are seen to understand how a various optical instruments (such as cameras, eyes, magnifiers, telescopes, etc.) form images.
- Electromagnetism
- Use the charge model to explain basic electric phenomena.
- Use Coulomb's law to calculate the electric force between charges.
- Use electric potential energy and electric potential in conservation of energy problems.
- Describe how charge moves through a conductor.
- Describe how a battery creates a current in a circuit and the energy transfers as charge moves through simple circuits.
- Understand and analyze basic circuits containing resistors in series and parallel, especially as models for household circuits.
- Understand how electrical power gets to and is used in the home.
- Understand the circumstances under which electricity can be hazardous and the safety systems in homes that reduce these hazards.
- Understand and reason about basic magnetic phenomena using a dipole model of magnetism, analogous to the charge model of electricity.
- Understand the magnetic fields due to currents in wires, loops, and solenoids; understand various applications of magnetic fields.
- Modern Physics
- Describe atomic structure using both the Bohr model of the atom and the quantum mechanical/shell model of the atom.
- Understand what and how we know about the structure of atoms and how this is related to periodic trends on the periodic table.

- Distinguish between continuous, absorption and emission spectra and understand how each is produced/observed; develop an understanding of the photon model of light.
- Understand the experimental evidence for the wave nature of matter and how the wave nature of matter leads to the quantization of energy.
- Understand how the principle of relativity leads to the relativity of simultaneity and length and thus to time dilation and length contraction.
- Understand relativistic energy and momentum and recognize the significance of Einstein's equation E = mc^2.
- Recognize how the uncertainty principle limits our knowledge of the states of particles.
- Nuclear Physics/Cosmology
- Understand the structure and composition of the nucleus.
- Analyze the connection between force and motion by applying Newton's laws of motion to predict and/or explain the behavior of physical systems.
- Understand the forces that hold the nucleus together and under what circumstances it might break apart.
- Distinguish between the different types of radioactive decays.
- Use the concept of half life to determine the age of a radioactive sample.
- Develop a basic understanding of some applications of nuclear & particle physics in areas such as the arts and archaeology.
- Develop an understanding of the current theories that organize and classify elementary particles.
- Develop an understanding of the current theories about how the universe was formed.
- Nature of Science
- Identify ethical and social issues related to current and emerging applications of science and technology.
- Apply principles of experimental design and scientific methodology, including formulation of testable questions and hypotheses, the evaluation of the accuracy and reproducibility of data, and the presentation of the steps and results of a scientific investigation in both verbal and written formats with appropriate use of scientific vocabulary.
- Select and use a variety of scientific tools for recording length, mass, and volume measurements using the metric system in the course of scientific investigations.
- Distinguish between reliable and unreliable sources of scientific information.
- Distinguish between scientific and non-scientific modes of inquiry.
- Develop a curiosity toward and an understanding of the physical world.
- Energy, Momentum & Conservation Laws
- Predict and/or explain the physical characteristics and/or behavior of physical systems & everyday phenomena using the law of conservation of energy.
- Distinguish between the concepts of momentum and impulse.
- Use the Impulse-Momentum Theorem/conservation of momentum to describe and/or predict the behavior of physical systems & everyday phenomena.
- Identify forms of energy as mechanical potential energy (elastic and gravitational), chemical potential energy, kinetic energy, thermal energy and radiation.

Major Course Content

1. The Nature of Science
   a. Scientific Method
   b. Metric system and scientific notation
2. Describing Motion
   a. Displacement
   b. Velocity
   c. Acceleration
   d. Simple Types of Motion
      i. Linear Motion
      ii. Projectile Motion
3. Forces and Newton's Laws of Motion
   a. Identifying Forces
   b. Newton's Laws of Motion
      i. Applied to Linear Motion
      ii. Applied to Uniform Circular Motion
   c. Gravity & Orbits
4. Conservation Laws
   a. Impulse
   b. Conservation of Momentum
   c. Types of Energy
   d. Conservation of Energy
   e. Efficiency & Power
   f. Energy Resources

AND at least any FOUR of the following major topics:

1. Fluids & Thermodynamics
   a. Temperature Scales
   b. Heat Transfer Mechanisms: Conduction, Convection, and Radiation
   c. Temperature Changes and Specific Heat
   d. Phase Changes and Latent Heat
   e. Thermal Properties of Matter
   f. Laws of Thermodynamics & Heat Engines
   g. Fluids
2. Electromagnetism
   a. Electric Charges & Coulomb's Law
   b. Electric fields
   c. Currents & Ohm's Law
   d. Magnets & Magnetic Fields
   e. Induction
   f. Applications: Electromagnets, Motors, Generators & Transformers
   g. Other Applications (ex: magnetic levitation, rail guns, etc)
3. Waves
   a. Wave Properties
   b. Wave Phenomena
      i. Resonance
      ii. Diffraction
      iii. Interference and Standing Waves
   c. Sound Waves and Music

        i. Musical Instruments
    d. Earthquakes
4. Light
    a. Electromagnetic Spectrum
    b. Wave Phenomena: Polarization
    c. Wave Phenomena: Interference & Holograms
    d. Optics (Lenses, mirrors and imaging)
        i. The Human Eye
        ii. Optical Instruments (Telescopes & Microscopes)
    e. Medical Imaging
5. Quantum Physics
    a. Atoms
        i. Bohr Model
        ii. Quantum Mechanical Model & Particle Waves
        iii. Lasers
    b. Quantum Physics Applications
        i. Transistors: (Semiconductor transistors, diode transistors, transistors)
        ii. Superconductors
        iii. Electron Microscope
        iv. Quantum Computing
6. Relativity
    a. Events & Simultaneity
    b. Einstein's Postulates
    c. Time Dilation and Length Contraction
    d. Mass-Energy Equivalence
    e. General Relativity
7. Nuclear Physics
    a. Radioactivity and applications
    b. Nuclear Energy (fission/fusion) and applications
        i. Nuclear Reactors
        ii. Nuclear Waste
    c. Elementary Particles
    d. Cosmology

Lab Content

Students will complete lab activites based on at least 10 of these topics:

1. Nature of Scientific Inquiry/Scientific Method
2. Describing Motion
3. Projectile Motion
4. Newton's Laws of Motion
5. Conservation of Energy
6. Impulse & Momentum
7. Heat & Temperature
8. Electrostatics & Magnetism
9. Basic Circuits
10. Introduction to Waves
11. Sound Waves
12. Standing Waves
13. Ray Optics: Image Formation with Mirrors & Lenses
14. Ray Optics Applications: Human Eye

Examples of Required Writing Assignments

Answer short answer questions such as:
A tortoise and a hare cover the same distance in a race. The hare goes very fast for brief intervals, but stops frequently, whereas the tortoise plods along steadily and finishes the race ahead of the hare. (a) Which of the two racers has the greater average speed over the duration of the race? Explain. (b) Which of the two racers is likely to reach the greatest instantaneous speed during the race? Explain.

Examples of Outside Assignments

For each hour of lecture, students are expected to spend at least 2 hours outside of class doing required work such as viewing pre-lecture videos/ reading required materials, completing short quizzes on the material, solving simple mathematical problems that predict/explain the behavior of physical systems and answer conceptual questions about physical phenomena.
Sample Assignment: Collect a variety of small objects such as coins, pencils, keys, and bottle caps. Ice cubes, if they are available, also make excellent test objects. Try sliding these objects across a smooth surface such as a tabletop or floor, being as consistent as possible in the initial velocity that you give to them. a. Do the objects slide the same distance after they leave your hand? What differences are apparent, and how are they related to the nature of the surface and size of the objects? Which objects come closest to demonstrating Newton's first law of motion? b. What factors seem to be important in reducing the frictional force between the objects and the surface upon which they are sliding? If you see some general principle at work, test this idea by finding other objects that would support your hypothesis.

Instruction Type(s)

Lab, Lecture

IGETC Area 5: Physical and Biological Sciences

5A. Physical Science, 5C. Science Laboratory