PHYS A285: CALCULUS-BASED PHYSICS: MODERN WITH LAB

Item	Value
Curriculum Committee Approval Date	09/18/2024
Top Code	190200 - Physics, General
Units	5 Total Units
Hours	126 Total Hours (Lecture Hours 72; 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
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
Associate Arts Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life Science (OB)
Associate Science Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life (OSB)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5A Physical Science (5A) • Cal-GETC 5C Laboratory Activity (5C)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5A Physical Science (5A) • IGETC 5C Laboratory Activity (5C)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B1 Physical Science (B1) • CSU B3 Laboratory Activity (B3)

Course Description

Formerly: Calculus Based Physics: Modern. Part of a three-semester sequence with lab (PHYS A185/A280/A285) covering a calculus-based study of all topics in fundamental physics. Core topics for this semester include thermodynamics, optics, and modern physics. PREREQUISITE: PHYS A185 or PHYS A185. 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. C-ID: PHYS 215.**C-ID:** PHYS 215.

Course Level Student Learning Outcome(s)

1. State the basic principles of thermodyanmics, optics, and modern physics, define important scientific terms in these areas, and provides explanations of how they apply to real-world situations.
2. Use calculus, algebra, trigonometry, and conceptual reasoning towards the solution of problems involving thermodynamics, 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. Apply the concepts of energy conservation towards the analysis of thermodynamic systems.
- 2. Relate the mechanics of particles on the microscopic scale to the properties of thermodynamic systems.
- 3. Analyze the interaction of light with different media, including applications to optical instrumentation.
- 4. Analyze the wave-particle duality of light and matter, including the generation of interference patterns and standing waves.
- 5. Evaluate the limitations of classical physics at small scales and large velocities.
- 6. Conduct experiments to acquire and analyze real-world data, with appropriate use of measurements, units, significant figures, and error propagation.
- 7. Relate experimental data and results to the basic physical concepts of thermodynamics, optics, and modern physics.

Lecture Content

Laws of Thermodynamics Heat Engines Kinetic Theory Entropy Properties of EM Waves Geometric Optics Lenses, Mirrors, and Optical Instruments Wave Optics / Physical Optics Quantum Mechanics Condensed Matter / Solid State Atomic, Nuclear, and Particle Physics Special Relativity

Lab Content

Laboratory activities cover a range of topics directly related to the lecture portion of the class, with an emphasis on hands-on activities with real-world data collection and analysis, including appropriate use of measurements, units, significant figures, and error propagation. Representative experiments include investigations of: Measurement and Error Propagation Statistics Oscilloscopes Absolute Zero Calorimetry Wave Properties Mirrors and Images Snell s Law Lenses and Images Wave Interference and Diffraction Standing Waves Spectroscopy Gamma Ray Absorption

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

Lectures with demonstrations as well as in-class activities and discussion engage students in core scientific concepts and problem-solving techniques. Assigned readings and homework reinforce conceptual understandings and improve problem-solving skills. Laboratory activities challenge students to critically examine and apply their scientific knowledge and technical skills in a real-world setting. Written lab reports provide further opportunities to improve analytical and communication skills. Students are encouraged to interact with the

instructor and each other through in-class discussions and activities, as well as within lab groups and during instructor office hours.

Reading Assignments

1.5 hours per week as assigned by the instructor from texts, online or library research, and/or instructor handouts

Writing Assignments

1.5 hours per week on written reports summarizing the weekly lab experiments that include appropriate use of scientific and technical vocabulary, as well as significant qualitative and quantitative analysis

Out-of-class Assignments

5 hours per week on assignments and test preparation emphasizing problem-solving and concept application

Demonstration of Critical Thinking

Successful completion of assigned exams and quizzes, homework, in-class discussions and activities, and lab reports

Required Writing, Problem Solving, Skills Demonstration

Students will compose written lab reports summarizing the weekly lab experiments that include appropriate use of scientific and technical vocabulary, as well as significant qualitative and quantitative analysis. Exams, quizzes, and homework will require critical application of problem-solving skills.

Eligible Disciplines

Physics/Astronomy: Master's degree in physics, astronomy, or astrophysics OR bachelor's degree in physics or astronomy AND master's degree in engineering, mathematics, meteorology, or geophysics OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Halliday, D., et al. Fundamentals of Physics, Extended, 12 ed. Wiley, 2021 Rationale: - 2. Required Moebs, W., et al. University Physics Volumes 23, ed. OpenStax, 2016 Rationale: Most recent edition of OER textbook

Manuals Resources

1. OCC Physics Department. PHYS A285 Laboratory Manual, Orange Coast College , 01-01-2024