

university physics with modern physics

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Overview

University Physics with Modern Physics by Hugh D. Young and Roger A. Freedman is a foundational and comprehensive calculus-based textbook designed for introductory physics courses at the university level, typically spanning two or three semesters. The book systematically covers the core principles of physics, beginning with classical mechanics, including kinematics, dynamics, work, energy, momentum, rotation, and gravitation. It then progresses through oscillations, waves, sound, and thermodynamics, laying a robust groundwork for understanding macroscopic physical phenomena.

The text continues its rigorous exploration with a detailed treatment of electromagnetism, covering electric fields, circuits, magnetic fields, and electromagnetic induction, followed by optics, encompassing both geometric and physical optics. A significant portion of the book is dedicated to modern physics, introducing students to the revolutionary concepts of special relativity, quantum mechanics, atomic physics, nuclear physics, and elementary particles. The authors emphasize a clear, logical presentation of concepts, supported by numerous worked examples, conceptual questions, and a vast array of challenging problems designed to foster both conceptual understanding and advanced problem-solving skills. Its enduring popularity stems from its pedagogical clarity, thoroughness, and consistent updates to reflect contemporary physics education.

Key Takeaways

- Mastering the fundamental principles of classical mechanics is crucial before advancing to more complex topics like electromagnetism or modern physics.
- Developing strong problem-solving strategies, including drawing diagrams and identifying knowns and unknowns, is as important as understanding the theoretical concepts.
- Conceptual understanding should be prioritized alongside mathematical derivation to truly grasp the physical meaning behind equations.
- Regularly practicing with a variety of problems, from straightforward applications to multi-concept challenges, is essential for solidifying knowledge.
- The interconnectedness of different physics disciplines means that concepts learned in one area often apply or provide context for others.

- Pay close attention to units and significant figures in all calculations to ensure accuracy and physical relevance.
- Embrace the iterative process of learning physics: read, understand, apply, reflect, and re-evaluate your understanding.
- Modern physics introduces a paradigm shift from classical mechanics, requiring an open mind to new, often counter-intuitive, principles.

Chapter Summaries

Part 1: Mechanics

This section introduces the foundational principles of classical mechanics, starting with kinematics in one, two, and three dimensions, followed by Newton's laws of motion and their applications. It delves into work, energy, and power, conservation of energy, momentum, and collisions. Further topics include rotational motion, angular momentum, static equilibrium, elasticity, and the universal law of gravitation. The aim is to build a strong understanding of how objects move and interact under various forces, using calculus as a primary tool for analysis.

Part 2: Oscillations, Waves, and Acoustics

This part explores periodic motion, beginning with simple harmonic motion and its applications. It then transitions to mechanical waves, covering wave propagation, superposition, and interference. Specific attention is given to sound waves, including intensity, resonance, and the Doppler effect. The section establishes the mathematical framework for describing wave phenomena and their physical manifestations, preparing students for the study of light and quantum mechanics.

Part 3: Thermodynamics

Thermodynamics is introduced by defining temperature, heat, and the first law of thermodynamics, which relates heat, work, and internal energy. The discussion extends to specific heats, phase changes, and heat transfer mechanisms. The second law of thermodynamics, entropy, and the efficiency of heat engines and refrigerators are thoroughly examined. This section provides a macroscopic understanding of energy transformations and the directionality of natural processes.

Part 4: Electromagnetism

This extensive section covers electrostatics, including Coulomb's law, electric fields, Gauss's law, and electric potential. It then moves to capacitance, dielectrics, and direct-current circuits, introducing Kirchhoff's rules. Magnetism is explored through magnetic fields, forces on moving charges, sources of magnetic field, and Ampere's law. Finally, electromagnetic induction, inductance, alternating-current circuits, and Maxwell's equations are discussed, unifying electricity and magnetism.

Part 5: Optics

Optics is divided into geometric optics and physical optics. Geometric optics covers reflection, refraction, mirrors, lenses, and optical instruments, focusing on ray tracing and image formation. Physical optics delves into the wave nature of light, including interference, diffraction, and polarization. This section provides a comprehensive understanding of light's behavior, from macroscopic imaging to its fundamental wave properties.

Part 6: Modern Physics

The final section introduces the revolutionary concepts of modern physics. It begins with special relativity, discussing time dilation, length contraction, and mass-energy equivalence. Quantum mechanics is then explored, covering wave-particle duality, the Schrödinger equation, and atomic structure. Subsequent chapters delve into nuclear physics, radioactivity, nuclear energy, and elementary particles, providing an overview of the fundamental constituents of matter and forces.

Themes

- Conceptual understanding
- Problem-solving skills
- Mathematical application
- Foundational physics
- Scientific inquiry

Frequently Asked Questions

What is university physics with modern physics about?

University Physics with Modern Physics is a comprehensive calculus-based textbook covering all major areas of physics. It systematically introduces classical mechanics, thermodynamics, electromagnetism, optics, and a substantial section on modern physics, including relativity and quantum mechanics. The book aims to provide a rigorous foundation for science and engineering students.

Is university physics with modern physics worth reading?

Yes, it is highly regarded as one of the most thorough and pedagogically sound introductory physics textbooks available. It is an excellent resource for university students in STEM fields, offering clear explanations, extensive examples, and a vast array of problems to develop both conceptual understanding and problem-solving abilities.

How does university physics with modern physics end?

Spoiler: The book concludes with a deep dive into modern physics, covering topics such as special relativity, the principles of quantum mechanics, atomic structure, nuclear physics, and an introduction to elementary particles. It provides a contemporary understanding of the universe's fundamental constituents and forces.

Who should read university physics with modern physics?

This textbook is primarily intended for university students pursuing degrees in physics, engineering, chemistry, and other science-related fields. It is also suitable for advanced high school students or self-learners who have a strong background in calculus and are seeking a rigorous, comprehensive introduction to physics.

How long does it take to read university physics with modern physics?

Given its extensive content and the need for thorough understanding and problem-solving practice, reading and studying University Physics with Modern Physics can take hundreds of hours. A typical university course using this book spans two or three semesters, implying a dedicated study time of several hours per week over a year or more.