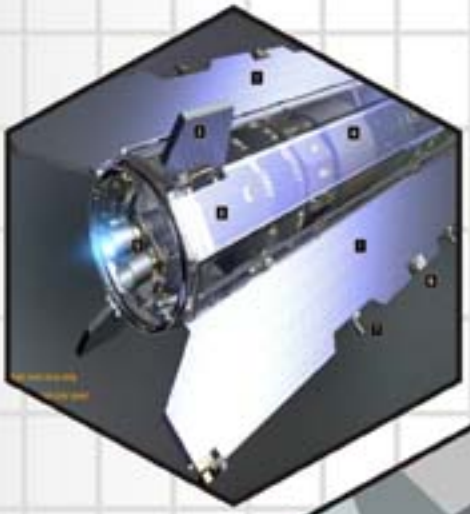
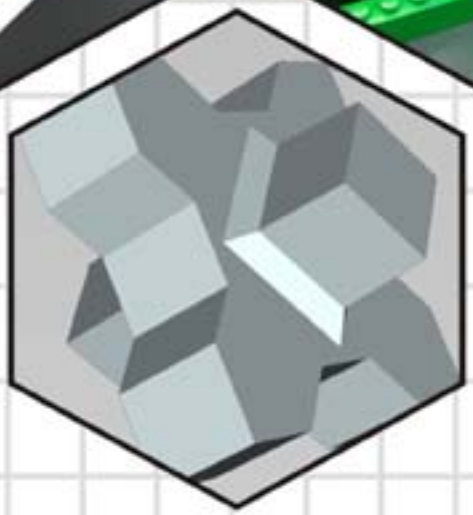
VAYU EDUCATION OF INIDA

Applied Physics-I

Second Edition





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Applied Physics – I

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AN ISO 9001:2008 CERTIFIED COMPANY

Vayu Education of India
2/25, Ansari Road, Darya Ganj, New Delhi-110 002

Applied Physics – I

ISBN: 978-93-82174-28-8

First Edition: 2011
Second Edition: 2013

₹ 150/-

Published by:

VAYU EDUCATION OF INDIA
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Dedicated

to

my respected, caring

and

loving parents

S. Swaran Singh and Satvinder Kaur

Preface

Physics is the liberal art of high technology

This book is based on the common core syllabus of State Board of Technical Education, Haryana. It explains, in a simple and systematic manner, the basic principles and applications of Applied Physics-I for diploma students. The book would serve as an excellent text for first year diploma students.

Physics is a fundamental science, and those who study it will gain an understanding of the basic laws that govern everything from the very samll subatomic to the very large cosmic scale. The study of physics provides us with an unparalleled power of analysis that is useful in the study of the other sciences, enginnering and mathematics, as well as in daily life. This second edition of Applied Physics-I, contains material for the new syllabus. It includes a chapter I about basics of units and diamensions, along with many discussion questions for units and diamensions, along with many discussion questions for units and dimenstions, Chapter II covers Force and Motion in an easy and interesting way, Chapter III covers Work, Power and Energy effectively with examles, similarly whole syllabus is covered very clearly and in an easy way. The questions at the end of each chapter will increase the knowledge of students. The book contains many example questions and answers that are meant to make the student more comfortable with solving problems. Some are more involved than others. There are also questions at the end of each chapter, which the student should attempt to answer to test his or her understanding. (Starting a physics course at this level knows the basics of trigonometry and is comfortable with simple algebraic manipulations).

Applied Physics is not watered-down physics. It is advanced physics. It covers the most interesting and most important topics. Students recongnize the value of what they are learning, and are natuarally motivated to do well. In every chapter they find material they want to share with thier friends, roommates, and parents.

The response to this new approach is going to be fantastic. Many of the sutdents previously hated physics, and swore (after their high school class) never to take it

again. But they will drawn, like maths to a flame, to a subject they find fascinating and important. My job is to make sure their craving is fulfilled, and that won't be burned again. These students come to college to learn, and they will feel happiest when they sense their knowledge and abilities growing.

Students don't take the course because it is easy; it isn't. It covers an enormous amount of material. But every chapter is full of information that is evidently important. That's why students will sign up. They don't want to be entertained. They want a good course, well taught, that fills them with importat information and the ability to use it well. They are proud that they are going to enjoy it.

Physics is the liberal arts of high technonlogy. Understand physics, and never again be intimidated by technological advances. This book is designed to attract studenst, and teach them the physics they need to know to be an effective engineer.

I wish to thank my husband, Er. Vikas Sharma, for his great help and support. I am thankful to me respected, loving and caring parents S.Swarn Singh & Mrs. Satvinder Kaur, my dear sister Sweety for their love and support they give me time to time. I am indebted to fellow my Computer lab Supervisor Mr. Ashok for his cooperation during typing the matter and drawing the related figures on computer. I thank him sincerely. I would like to thank, Mr. Rajiv Jain, publisher of this book.

—Rupinder Kaur

Syllabus

RATIONALE

Applied Physics includes the study of a large number of diverse topics all related to things that go in the world around us. It aims to give an understanding of this world both by observation and prediction of the way in which objects will behave. Concrete uses of physical principles and analysis in various fields of engineering and technology are given prominence in the course content.

Note: Teachers should give examples of engineering/technology applications of various concepts and principles in each topic so that students are able to appreciate learning of these concepts and principles.

DETAILED CONTENTS

1. Units and Dimensions (10 hrs)

- Physical quantities
- Fundamental and derived units
- Systems of units (CGS, MKS and SI units)
- Dimensions and dimensional formulae of physical quantities (area, volume, velocity, acceleration, momentum, force, impulse, work, power, energy, surface tension, coefficient of viscosity, stress, strain, moment of inertia, gravitational constant.)
- Principle of homogeneity
- Dimensional equations and their applications, conversion from one system of units to other for density, force, pressure, work, power, energy, velocity, acceleration
- Limitations of dimensional analysis

2. Force and Motion (12 hrs)

- Scalar and vector quantities – examples, representation of vector, statement of triangle law and parallelogram law
- Force, resolution and composition of forces parallelogram law of forces with

derivation, friction, laws of friction, types of friction, coefficient of friction, angle of friction.

- Newton's Laws of motion – concept of momentum, determination of force equation from Newton's second law of motion; Newton's third law of motion conservation of momentum (statement only), recoil of gun, impulse and impulsive forces, simple numerical problems
- Projectile, horizontal and oblique projections (definitions)
- Derivation of time of flight, maximum height and horizontal range for oblique projections
- Circular motion, definition of angular displacement, angular velocity, angular acceleration, frequency, time period
- Relation between linear and angular velocity, linear acceleration and angular acceleration, relation between frequency and time period
- Centripetal force and centrifugal force (definition)
- Banking of roads (with derivation)

3. Rotational Motion (6 hrs)

- Definitions of torque, moment of inertia, radius of gyration
- Derivation of rotational kinetic energy and angular momentum
- Conservation of angular momentum (qualitative)

4. Gravitation and Satellites (6 hrs)

- Gravity, acceleration due to gravity
- Kepler's law of planetary motion
- Newton's law of gravitation
- Escape velocity (no derivation)
- Satellites, natural satellites, artificial satellites, geostationary satellite

5. Work, Power and Energy (10 hrs)

- Work: definition and its SI unit, examples of zero work, positive work and negative work
- Work done in moving an object on horizontal surface.
- Power: definition and its SI unit
- Energy: definition and its SI units, Type - kinetic energy and potential energy with examples and their derivation
- Principle of conservation of mechanical energy (for freely falling bodies), transformation of energy from one form to another

6. Properties of Matter (8 hrs)

- Elasticity, definition of stress and strain
- Different types of modulus of elasticity
- Pressure – its units, gauge pressure, absolute pressure, atmospheric pressure
- Surface tension – its units, capillarity, rise of liquid in capillary tube (derivation), applications of surface tension, effect of temperature and impurity on surface tension
- Fluid motion, stream line and turbulent flow
- Viscosity, coefficient of viscosity; effect of temperature on viscosity

7. Heat and Temperature (12 hrs)

- Difference between heat and temperature on the basis of K.E. of molecules
- Principles of measurement of temperature and different scales of temperature
- Modes of transfer of heat (conduction, convection and radiation with examples)
- Thermal conductivity, coefficient of thermal conductivity (derivation)
- Properties of heat radiation
- Laws of Black Body Radiation: Stefan's law, Kirchoff's law, Wien's law

LIST OF PRACTICALS

1. Familiarisation with vernier calliper, screw gauge and spherometer and determination of their vernier constants and least counts
2. To find diameter of solid cylinder using a vernier calliper
3. To find diameter of hollow cylinder using vernier calliper
4. To find area of cross-section of wire/needle using screw gauge
5. To find thickness of glass strip using spherometer
6. To find radius of curvature of spherical surface using spherometer.
7. To verify parallelogram law of forces.
8. To determine atmospheric pressure at a place using Fortin's Barometer

INSTRUCTIONAL STRATEGY

Teacher can take help of various instructional materials like models, charts and graphs for imparting instructions. The field application should be made clear before teaching the forces and motion; rotational motion; gravitation and satellites; work, power and energy; properties of matter and heat and temperature etc to develop proper understanding of the physical phenomenon. Effective demonstration will make the subject interesting and develop scientific temper in the students.

SUGGESTED DISTRIBUTION OF MARKS

S.No	Time Allotted(Hrs.)	Marks Allotted(%)
1	10	16
2	12	20
3	06	10
4	06	10
5	10	16
6	08	12
7	12	16
Total	**64**	**100**

Contents

Chapter-1

Unit and Dimensions

PHYSICS

The word 'Physics' comes from the Greek word 'phusis' meaning 'nature', introduced by the ancient scientist 'Aristotle'. Man has always been fascinated by nature. So, he questioned and sought answers for every phenomena nature could offer. The branch of science which is devoted to the study of nature and natural phenomena is called Physics. It is expected that all the events in nature takes place according to some basic laws. Physics reveals these basic laws from day-to-day observations.

The knowledge of physics accumulated till 1900 is called classical physics that deals with macroscopic phenomena. It includes subjects like:

- Mechanics
- Thermodynamics
- Electromagnetism, and
- Optics

The recent knowledge (beyond 1900) is termed 'modern physics', consisting of 2 basic theories.

1. Relativity
2. Quantum mechanics

PHYSICS IN RELATION TO SCIENCE, SOCIETY AND TECHNOLOGY

Among the various disciplines of science, the only discipline which can be regarded as being most fundamental is physics.

It has played a key role in the development of all other disciplines.

For example,

Physics in Relation to Chemistry

The study of structure of atoms, radioactivity, X-ray, diffraction, etc., in physics has enabled chemists to rearrange elements in the periodic table and to have a better understanding of chemical bonding and complex chemical structures.

Physics in Relation to Biological Science

The optical microscopes developed in physics are extensively used in the study of biological samples.

Electron microscope, X-rays and radio isotopes are used widely in medical sciences.

Physics in Relation to Astronomy

The giant astronomical telescopes and radio telescopes have enabled the astronomers to observe planets and other heavenly objects.

Physics Related to Mathematics

Mathematics has served as a powerful tool in the development of modern theoretical physics.

Physics Related to other Sciences

The other sciences like Biophysics, Geology, Heterology and Oceanography and Seismology use some of the laws of physics.

Physics Related to Society and Technology

- The development of telephone, telegraph and telex enables us to transmit messages instantly.
- The development of radio and television satellites has revolutionized the means of communication.
- Advances in electronics (computers, calculators and lasers) have greatly enriched the society.
- Rapid means of transport are important for the society.
- Generation of power from nuclear reactors is based on the phenomenon of controlled nuclear chain reaction.
- Digital electronics is widely used in modern technological developments.

UNITS AND DIMENSIONS

Before all the branches of science were clubbed together under the nomenclature 'Natural philosophy', under which all observations of subjective nature were being carried out and spirit of enquiry was almost non-existent, we were satisfied with simple explanations.

The subjective interpretation including measurement obviously varies from person-to-person, since the interpretation is based on one's senses. Gradually, the generations began to ask 'how' things are happening. Thus, the observations became more objective and physics – one of the many sciences, became a subject of observation and measurement.

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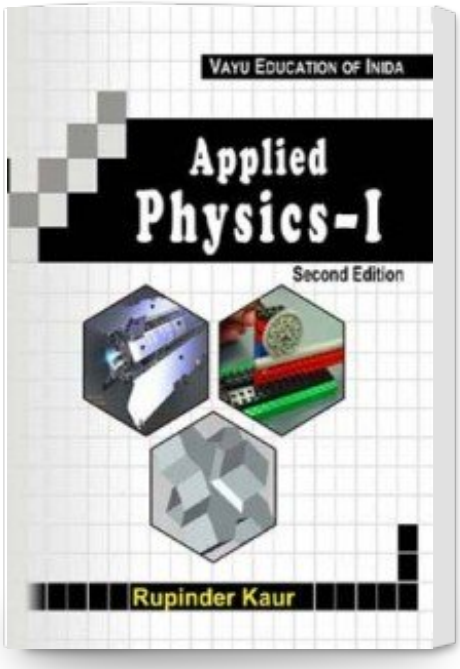

Publisher : Vayu Education ISBN : 9789382174288 Author : Rupinder Kaur