



# PHYSICS

## Standard XII

Photoelectron spectroscopy beamline



Synchrotron  
Indus-2  
2.5 GeV, 200 mA



The Coordination Committee formed by GR No. Abhyas - 2116/(Pra.Kra.43/16) SD - 4  
Dated 25.4.2016 has given approval to prescribe this textbook in its meeting held on  
30.01.2020 and it has been decided to implement it from academic year 2020-21

# PHYSICS

## Standard XII



Z7S7S4

Download DIKSHA App on your smartphone. If you scan the Q.R.Code on this page of your textbook, you will be able to access full text and the audio-visual study material relevant to each lesson, provided as teaching and learning aids.



2020

**Maharashtra State Bureau of Textbook Production and  
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## The Constitution of India

### Preamble

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

## NATIONAL ANTHEM

Jana-gana-mana-adhināyaka jaya hē  
Bhārata-bhāgya-vidhātā,

Panjāba-Sindhu-Gujarāta-Marāthā  
Drāvida-Utkala-Banga

Vindhya-Himāchala-Yamunā-Gangā  
uchchala-jaladhi-taranga

Tava subha nāmē jāgē, tava subha āsisa māgē,  
gāhē tava jaya-gāthā,

Jana-gana-mangala-dāyaka jaya hē  
Bhārata-bhāgya-vidhātā,

Jaya hē, Jaya hē, Jaya hē,  
Jaya jaya jaya, jaya hē.

## PLEDGE

India is my country. All Indians  
are my brothers and sisters.

I love my country, and I am proud  
of its rich and varied heritage. I shall  
always strive to be worthy of it.

I shall give my parents, teachers  
and all elders respect, and treat  
everyone with courtesy.

To my country and my people,  
I pledge my devotion. In their  
well-being and prosperity alone lies  
my happiness.

## Preface

### Dear Students,

With great pleasure we place this detailed text book on basic physics in the hands of the young generation. This is not only a textbook of physics for XII<sup>th</sup> standard, but contains material that will be useful for the reader for self study.

This textbook aims to give the student a broad perspective to look into the physics aspect in various phenomena they experience. The National Curriculum Framework (NCR) was formulated in the year 2005, followed by the State Curriculum Framework (SCF) in 2010. Based on the given two frameworks, reconstruction of the curriculum and preparation of a revised syllabus has been undertaken which will be introduced from the academic year 2020-21. The textbook incorporating the revised syllabus has been prepared and designed by the Maharashtra State Bureau of Textbook Production and Curriculum Research, (Balbharati), Pune.

The objective of bringing out this book is to prepare students to observe and analyse various physical phenomena in the world around them and prepare a solid foundation for those who aspire for admission to professional courses through competitive examinations. Most of the chapters in this book assume background knowledge of the subject covered by the text book for XI<sup>th</sup> Standard, and care has been taken of mentioning this in the appropriate sections of the book. The book is not in the form of handy notes but embodies a good historical background and in depth discussion as well. A number of solved examples in every chapter and exercises at the end of each one of them are included with a view that students will acquire proficiency and also will get enlightened after solving the exercises. Physics is a highly conceptual subject. Problem solving will enable students understand the underlying concepts. For students who want more, boxes entitled 'Do you know?' have been included at a number of places.

If you read the book carefully and solve the exercises in each chapter, you will be well prepared to face the challenges of this competitive world and pave the way for a successful career ahead.

The efforts taken to prepare the textbook will prove to be worthwhile if you read the textbook and understand the subject. We hope it will be a wonderful learning experience for you and an illuminating text material for teachers too.



(Vivek Gosavi)  
Director

Pune

Date : 21 February, 2020

Bhartiya Saur : 2 Phalguna, 1941

Maharashtra State Bureau of Textbook  
Production and Curriculum Research, Pune

## - For Teachers -

### Dear Teachers,

We are happy to introduce the revised textbook of Physics for XII<sup>th</sup> standard. This book is a sincere attempt to follow the maxims of teaching as well as develop a 'constructivist' approach to enhance the quality of learning. The demand for more activity based, experiential and innovative learning opportunities is the need of the hour. The present curriculum has been restructured so as to bridge the credibility gap that exists between what is taught and what students learn from direct experience in the outside world. Guidelines provided below will help to enrich the teaching-learning process and achieve the desired learning outcomes.

- ✓ To begin with, get familiar with the textbook yourself, and encourage the students to read each chapter carefully.
- ✓ The present book has been prepared for constructivist and activity-based teaching, including problem solving exercises.
- ✓ Use teaching aids as required for proper understanding of the subject.
- ✓ Do not finish the chapter in short. However, in the view of insufficient lectures, standard derivations may be left to the students for self study. Problem solving must be given due importance.
- ✓ Follow the order of the chapters strictly as listed in the contents because the units are

introduced in a graded manner to facilitate knowledge building.

- ✓ 'Error in measurements' is an important topic in physics. Please ask the students to use this in estimating errors in their measurements. This must become an integral part of laboratory practices.
- ✓ Major concepts of physics have a scientific base. Encourage group work, learning through each other's help, etc. Facilitate peer learning as much as possible by reorganizing the class structure frequently.
- ✓ Do not use the boxes titled 'Do you know?' or 'Use your brain power' for evaluation. However, teachers must ensure that students read this extra information and think about the questions posed.
- ✓ For evaluation, equal weightage should be assigned to all the topics. Use different combinations of questions. Stereotype questions should be avoided.
- ✓ Use Q.R. Code given in the textbook. Keep checking the Q.R. Code for updated information. Certain important links, websites have been given for references. Also a list of reference books is given. Teachers as well as the students can use these references for extra reading and in-depth understanding of the subject.

Best wishes for a wonderful teaching experience!

### References:

1. Fundamentals of Physics - Halliday, Resnick, Walker; John Wiley (Sixth ed.).
2. Sears and Zeemansky's University Physics - Young and Freedman, Pearson Education (12<sup>th</sup> ed.)
3. Physics for Scientists and Engineers - Lawrence S. Lerner; Jones and Bartlett Publishers, UK.

**Front Cover :** Picture shows part of Indus 2, Synchrotron radiation source (electron accelerator) at RRCAT, Department of Atomic Energy, Govt. of India, Indore. Indus offers several research opportunities. The photoelectron spectroscopy beamline is also seen.

Picture credit : Director, RRCAT, Indore. The permission to reproduce these pictures by Director, RRCAT, DAE, Govt. of India is gratefully acknowledged.

**Back Cover :** Transmission Electron Microscope is based on De Broglie's hypothesis. TEM picture shows a carbon nanotube filled with water showing the meniscus formed due to surface tension. Other picture shows crystallites of LaB<sub>6</sub> and the electron diffraction pattern (spot pattern) of the crystallite. Picture credit : Dr. Dilip Joag, Savitribai Phule Pune University. Pune

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**Competency Statements :  
Standard XII**

Area/ Unit/ Lesson	Competency Statements After studying the content in Textbook students would be able to....
<b>Unit I</b> Rotational Motion and Mechanical Properties of fluids	<ul style="list-style-type: none"> <li>• Distinguish between centrifugal and centripetal forces.</li> <li>• Visualize the concepts of moment of inertia of an object.</li> <li>• Relate moment of inertia of a body with its angular momentum.</li> <li>• Differentiate between translational and rotational motions of rolling objects.</li> <li>• Relate the pressure of a fluid to the depth below its surface.</li> <li>• Explain the measurement of atmospheric pressure by using a barometer.</li> <li>• Use Pascal's law to explain the working of a hydraulic lift and hydraulic brakes.</li> <li>• Relate the surface energy of a fluid with its surface tension.</li> <li>• Distinguish between fluids which show capillary rise and fall.</li> <li>• Identify processes in daily life where surface tension plays a major role.</li> <li>• Explain the role of viscosity in everyday life.</li> <li>• Differentiate between streamline flow and turbulent flow.</li> </ul>
<b>Unit II</b> Kinetic theory and Thermodynamics	<ul style="list-style-type: none"> <li>• Relate various gas laws to form ideal gas equation.</li> <li>• Distinguish between ideal gas and a real gas.</li> <li>• Visualise mean free path as a function of various parameters..</li> <li>• Obtain degrees of freedom of a diatomic molecule.</li> <li>• Apply law of equipartition of energy to monatomic and diatomic molecules.</li> <li>• Compare emission of thermal radiation from a body with black body radiation.</li> <li>• Apply Stefan's law of radiation to hot bodies .</li> <li>• Identify thermodynamic process in every day life.</li> <li>• Relate mechanical work and thermodynamic work.</li> <li>• Differentiate between different types of thermodynamic processes.</li> <li>• Explain the working of heat engine, refrigerator and air conditioner.</li> </ul>
<b>Unit III</b> Oscillations and waves	<ul style="list-style-type: none"> <li>• Identify periodic motion and simple harmonic motion.</li> <li>• Obtain the laws of motion for simple pendulum.</li> <li>• Visualize damped oscillations.</li> <li>• Apply wave theory to understand the phenomena of reflection, refraction, interference and diffraction.</li> <li>• Visualize polarized and unpolarized light.</li> <li>• Apply concepts of diffraction to calculate the resolving power.</li> <li>• Distinguish between the stationary waves in pipes with open and closed ends.</li> <li>• Verify laws of vibrating string using a sonometer.</li> <li>• Explain the physics involved in musical instruments.</li> </ul>
<b>Unit IV</b> Electrostatics and electric current	<ul style="list-style-type: none"> <li>• Use Gaus's law to obtain the electric field for a charge distribution.</li> <li>• Relate potential energy to work done to establish a charge distribution.</li> <li>• Determine the electrostatic potential for a given charge distribution.</li> <li>• Distingusih between conductors and insulators.</li> <li>• Visualize polarization of dielectrics.</li> <li>• Categorize dielectrics based on molecular properties.</li> <li>• Know the effect of dielectric material used between the plates of a capacitor on its capacitance.</li> <li>• Apply Kirchoff's laws to determine the current in different branches of a circuit.</li> <li>• Find the value of an unknown resistance by using a meter bridge.</li> <li>• Find the emf and internal resistance of a cell using potentiometer.</li> <li>• Convert galvanometer into voltmeter and ammeter by using a suitable resistor.</li> </ul>

<b>Unit V</b> Magnetism	<ul style="list-style-type: none"> <li>• Realize that Lorentz force law is the basis for defining unit of magnetic field.</li> <li>• Visualize cyclotron motion of a charged particle in a magnetic field.</li> <li>• Analyze and calculate magnetic force on a straight and arbitrarily shaped current carrying wires and a closed wire circuit.</li> <li>• Apply the Biot-Savart law to calculate the magnetic field produced by various distributions of currents.</li> <li>• Use Ampere's law to get magnetic fields produced by a current distribution.</li> <li>• Compare gravitational, magnetic and electrostatic potentials.</li> <li>• Distinguish between paramagnetic, diamagnetic and ferromagnetic materials.</li> <li>• Relate the concept of flux to experiments of Faraday and Henry.</li> <li>• Relate Lenz's law to the conservation of energy.</li> <li>• Visualize the concept of eddy currents.</li> <li>• Determine the mutual inductance of a given pair of coils.</li> <li>• Apply laws of induction to explain the working of a generator.</li> <li>• Establish a relation between the power dissipated by an AC current in a resistor and the value of the rms current.</li> <li>• Visualize the concept of phases to represent AC current.</li> <li>• Explain the passage of AC current through circuits having resistors, capacitors and inductors.</li> <li>• Explain the concept of resonance in LCR circuits.</li> </ul>
<b>Unit VI</b> Modern Physics	<ul style="list-style-type: none"> <li>• Establish validity of particle nature of light from experimental results.</li> <li>• Determine the necessary wavelength range of radiation to obtain photocurrent from given metals.</li> <li>• Visualize the dual nature of matter and dual nature of light.</li> <li>• Apply the wave nature of electrons to illustrate how better resolution can be obtained with an electron microscope.</li> <li>• Check the correctness of different atomic models by comparing results of various experiments.</li> <li>• Identify the constituents of atomic nuclei.</li> <li>• Differentiate between electromagnetic and atomic forces.</li> <li>• Obtain the age of a radioactive sample from its activity.</li> <li>• Judge the importance of nuclear power.</li> <li>• Explain use of p-n junction diode as a rectifier.</li> <li>• Find applications of special purpose diodes for every day use.</li> <li>• Explain working of solar cell, LED and photodiode.</li> <li>• Relate the p-n junction diode and special purpose diodes.</li> <li>• Realize transistor as an important building block of electronic circuits, analyze situations in which transistor can be used.</li> </ul>

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