

Part – II

TEXTBOOK FOR CLASS XII

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राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद् NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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# Foreword

The National Curriculum Framework (NCF), 2005 recommends that children's life at school must be linked to their life outside the school. This principle marks a departure from the legacy of bookish learning which continues to shape our system and causes a gap between the school, home and community. The syllabi and textbooks developed on the basis of NCF signify an attempt to implement this basic idea. They also attempt to discourage rote learning and the maintenance of sharp boundaries between different subject areas. We hope these measures will take us significantly further in the direction of a child-centred system of education outlined in the National Policy on Education (NPE), 1986.

The success of this effort depends on the steps that school principals and teachers will take to encourage children to reflect on their own learning and to pursue imaginative activities and questions. We must recognise that, given space, time and freedom, children generate new knowledge by engaging with the information passed on to them by adults. Treating the prescribed textbook as the sole basis of examination is one of the key reasons why other resources and sites of learning are ignored. Inculcating creativity and initiative is possible if we perceive and treat children as participants in learning, not as receivers of a fixed body of knowledge.

These aims imply considerable change in school routines and mode of functioning. Flexibility in the daily time-table is as necessary as rigour in implementing the annual calendar so that the required number of teaching days are actually devoted to teaching. The methods used for teaching and evaluation will also determine how effective this textbook proves for making children's life at school a happy experience, rather than a source of stress or boredom. Syllabus designers have tried to address the problem of curricular burden by restructuring and reorienting knowledge at different stages with greater consideration for child psychology and the time available for teaching. The textbook attempts to enhance this endeavour by giving higher priority and space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience.

The National Council of Educational Research and Training (NCERT) appreciates the hard work done by the textbook development committee responsible for this book. We wish to thank the Chairperson of the advisory group in science and mathematics, Professor J.V. Narlikar and the Chief Advisor for this book, Professor A.W. Joshi for guiding the work of this committee. Several teachers contributed to the development of this textbook; we are grateful to their principals for making this possible. We are indebted to the institutions and organisations which have generously permitted us to draw upon their resources, material and personnel. We are especially grateful to the members of the National Monitoring Committee, appointed by the Department of Secondary and Higher Education, Ministry of Human Resource Development under the Chairpersonship of Professor Mrinal Miri and Professor G.P. Deshpande, for their valuable time and contribution. As an organisation committed to systemic reform and continuous improvement in the quality of its products, NCERT welcomes comments and suggestions which will enable us to undertake further revision and refinement.

New Delhi 20 November 2006 Director National Council of Educational Research and Training O berepublicher

## PREFACE

It gives me pleasure to place this book in the hands of the students, teachers and the public at large (whose role cannot be overlooked). It is a natural sequel to the Class XI textbook which was brought out in 2006. This book is also a trimmed version of the textbooks which existed so far. The chapter on thermal and chemical effects of current has been cut out. This topic has also been dropped from the CBSE syllabus. Similarly, the chapter on communications has been substantially curtailed. It has been rewritten in an easily comprehensible form.

Although most other chapters have been based on the earlier versions, several parts and sections in them have been rewritten. The Development Team has been guided by the feedback received from innumerable teachers across the country.

In producing these books, Class XI as well as Class XII, there has been a basic change of emphasis. Both the books present physics to students without assuming that they would pursue this subject beyond the higher secondary level. This new view has been prompted by the various observations and suggestions made in the National Curriculum Framework (NCF), 2005. Similarly, in today's educational scenario where students can opt for various combinations of subjects, we cannot assume that a physics student is also studying mathematics. Therefore, physics has to be presented, so to say, in a stand-alone form.

As in Class XI textbook, some interesting box items have been inserted in many chapters. They are not meant for teaching or examinations. Their purpose is to catch the attention of the reader, to show some applications in daily life or in other areas of science and technology, to suggest a simple experiment, to show connection of concepts in different areas of physics, and in general, to break the monotony and enliven the book.

Features like Summary, Points to Ponder, Exercises and Additional Exercises at the end of each chapter, and Examples have been retained. Several concept-based Exercises have been transferred from end-of-chapter Exercises to Examples with Solutions in the text. It is hoped that this will make the concepts discussed in the chapter more comprehensible. Several new examples and exercises have been added. Students wishing to pursue physics further would find Points to Ponder and Additional Exercises very useful and thoughtful. To provide *resources beyond the textbook* and to encourage *eLearning*, each chapter has been provided with some relevant website addresses under the title *ePhysics*. These sites provide additional materials on specific topics and also provide learners the opportunites for interactive demonstrations/ experiments.

The intricate concepts of physics must be understood, comprehended and appreciated. Students must learn to ask questions like 'why', 'how', 'how do we know it'. They will find almost always that the question 'why' has no answer within the domain of physics and science in general. But that itself is a learning experience, is it not? On the other hand, the question 'how' has been reasonably well answered by physicists in the case of most natural phenomena. In fact, with the understanding of how things happen, it has been possible to make use of many phenomena to create technological applications for the use of humans.

For example, consider statements in a book, like 'A negatively charged electron is attracted by the positively charged plate', or 'In this experiment, light (or electron) behaves like a wave'. You will realise that it is not possible to answer 'why'. This question belongs to the domain of philosophy or metaphysics. But we can answer 'how', we can find the force acting, we can find the wavelength of the photon (or electron), we can determine how things behave under different conditions, and we can develop instruments which will use these phenomena to our advantage.

It has been a pleasure to work for these books at the higher secondary level, along with a team of members. The Textbook Development Team, the Review Team and Editing Teams involved college and university teachers, teachers from Indian Institutes of Technology, scientists from national institutes and laboratories, as well as higher secondary teachers. The feedback and critical look provided by higher secondary teachers in the various teams are highly laudable. Most box items were generated by members of one or the other team, but three of them were generated by friends and well-wishers not part of any team. We are thankful to Dr P.N. Sen of Pune, Professor Roopmanjari Ghosh of Delhi and Dr Rajesh B Khaparde of Mumbai for allowing us to use their box items, respectively in Chapters 3, 4 (Part I) and 9 (Part II). We are very thankful to the members of the Review and Editing Workshops to discuss and refine the first draft of the textbook. We also express our gratitude to Prof. Krishna Kumar, Director, NCERT, for entrusting us with the task of presenting this textbook as a part of the national effort for improving science education. I also thank Prof. G. Ravindra, Joint Director, NCERT, for his help from time-to-time. Prof. Hukum Singh, Head, Department of Education in Science and Mathematics, NCERT, was always willing to help us in our endeavour in every possible way.

We welcome suggestions and comments from our valued users, especially students and teachers. We wish our young readers a happy journey into the exciting realm of physics.

> A. W. Joshi *Chief Advisor* Textbook Development Committee

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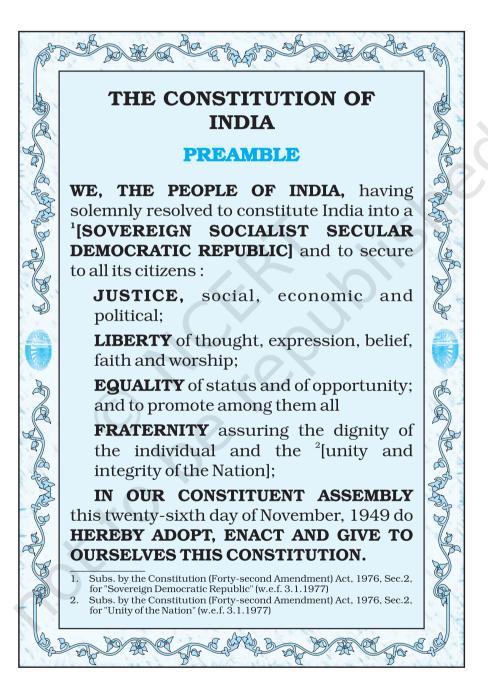
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# Contents of Physics Part I Class XII

CHAPTER ONE Electric Charges and Fields	
CHAPTER TWO Electrostatic Potential and Capacitance	51
CHAPTER THREE Current Electricity	93
CHAPTER FOUR Moving Charges and Magnetism	132
CHAPTER FIVE MAGNETISM AND MATTER	173
CHAPTER SIX Electromagnetic Induction	204
CHAPTER SEVEN Alternating Current	233
CHAPTER EIGHT Electromagnetic Waves	269
ANSWERS	288

# **CONTENTS**

Forew	YORD	υ
PREFAC	CE	vii
СНАР	TER NINE	
RAY O	PTICS AND OPTICAL INSTRUMENTS	
9.1	Introduction	309
9.2	Reflection of Light by Spherical Mirrors	310
9.3	Refraction	316
9.4	Total Internal Reflection	319
9.5	Refraction at Spherical Surfaces and by Lenses	323
9.6	Refraction through a Prism	330
9.7	Some Natural Phenomena due to Sunlight	332
9.8	Optical Instruments	335
СНАР	PTER TEN	
WAVE	Optics	
10.1	Introduction	351
10.2	Huygens Principle	353
10.3	Refraction and Reflection of Plane Waves using Huygens Principle	355
10.4	Coherent and Incoherent Addition of Waves	360
10.5	Interference of Light Waves and Young's Experiment	362
10.6	Diffraction	367
10.7	Polarisation	376
СНАР	PTER ELEVEN	
DUAL I	NATURE OF RADIATION AND MATTER	
11.1	Introduction	386
11.2	Electron Emission	387
11.3	Photoelectric Effect	388
11.4	Experimental Study of Photoelectric Effect	389

11.5	Photoelectric Effect and Wave Theory of Light	393
11.6	Einstein's Photoelectric Equation: Energy Quantum of Radiation	393
11.7	Particle Nature of Light: The Photon	395
11.8	Wave Nature of Matter	398
11.9	Davisson and Germer Experiment	403

### CHAPTER TWELVE

### Атомѕ

12.1	Introduction	414
12.2	Alpha-particle Scattering and Rutherford's Nuclear Model of Atom	415
12.3	Atomic Spectra	420
12.4	Bohr Model of the Hydrogen Atom	422
12.5	The Line Spectra of the Hydrogen Atom	428
12.6	DE Broglie's Explanation of Bohr's Second Postulate of Quantisation	430

### CHAPTER THIRTEEN

#### NUCLEI **13.1** Introduction 438 13.2 Atomic Masses and Composition of Nucleus 438 **13.3** Size of the Nucleus 441 **13.4** Mass-Energy and Nuclear Binding Energy 442 **13.5** Nuclear Force 445 13.6 Radioactivity 446 13.7 Nuclear Energy 451

### CHAPTER FOURTEEN

### SEMICONDUCTOR ELECTRONICS: MATERIALS, DEVICES AND SIMPLE CIRCUITS

14.1	Introduction	467
14.2	Classification of Metals, Conductors and Semiconductors	468
14.3	Intrinsic Semiconductor	472
14.4	Extrinsic Semiconductor	474
14.5	p-n Junction	478
14.6	Semiconductor Diode	479
14.7	Application of Junction Diode as a Rectifier	483

14.8	Special Purpose p-n Junction Diodes	485
14.9	Digital Electronics and Logic Gates	490
APPENDICES		500
		000
ANSW	ERS	502
BIBLI	OGRAPHY	518

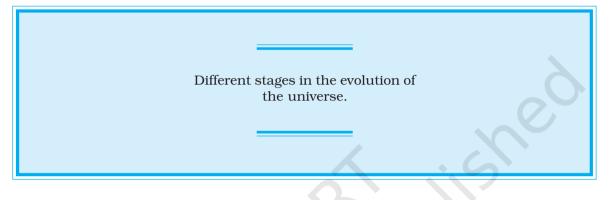
INDEX

520

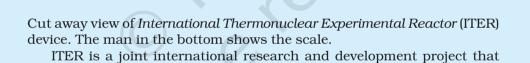
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BACK COVER (Adapted from http://www.iter.org and http://www.dae.gov.in)



aims to demonstrate the scientific and technical feasibility of fusion power. India is one of the seven full partners in the project, the others being

the European Union (represented by EURATOM), Japan, the People's Republic of China, the Republic of Korea, the Russian Federation and the USA. ITER will be constructed in Europe, at Cadarache in the South of France and will provide 500 MW of fusion power.

Fusion is the energy source of the sun and the stars. On earth, fusion research is aimed at demonstrating that this energy source can be used to produce electricity in a safe and environmentally benign way, with abundant fuel resources, to meet the needs of a growing world population.

For details of India's role, see *Nuclear India*, Vol. 39, No. 11-12/ May-June 2006, issue available at Department of Atomic Energy (DAE) website mentioned above.