The National Council of Educational Research and Training (NCERT) is the apex body concerning all aspects of refinement of School Education. It has recently developed textual material in Physics for Higher Secondary stage which is based on the National Curriculum Framework (NCF)-2005. NCF recommends that children’s experience in school education must be linked to the life outside school so that learning experience is joyful and fills the gap between the experience at home and in community. It recommends to diffuse the sharp boundaries between different subjects and discourages rote learning. The recent development of syllabi and textual material is an attempt to implement this basic idea. The present Laboratory Manual will be complementary to the textbook of Physics for Class XI. It is in continuation to the NCERT’s efforts to improve upon comprehension of concepts and practical skills among students. The purpose of this manual is not only to convey the approach and philosophy of the practical course to students and teachers but to provide them appropriate guidance for carrying out experiments in the laboratory. The manual is supposed to encourage children to reflect on their own learning and to pursue further activities and questions. Of course, the success of this effort also depends on the initiatives to be taken by the principals and teachers to encourage children to carry out experiments in the laboratory and develop their thinking and nurture creativity. The methods adopted for performing the practicals and their evaluation will determine how effective this practical book will prove to make the children’s life at school a happy experience, rather than a source of stress and boredom. The practical book attempts to provide space to opportunities for contemplation and wondering, discussion in small groups, and activities requiring hands-on experience. It is hoped that the material provided in this manual will help students in carrying out laboratory work effectively and will encourage teachers to introduce some open-ended experiments at the school level.

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The development of the present laboratory manual is in continuation to the NCERT's efforts to support comprehension of concepts of science and also facilitate inculcation of process skills of science. This manual is complementary to the *Physics Textbook for Class XI* published by NCERT in 2006 following the guidelines enumerated in National Curriculum Framework (NCF)-2005. One of the basic criteria for validating a science curriculum recommended in NCF–2005, is that ‘it should engage the learner in acquiring the methods and processes that lead to the generation and validation of scientific knowledge and nurture the natural curiosity and creativity of the child in science’. The broad objective of this laboratory manual is to help the students in performing laboratory based exercises in an appropriate manner so as to develop a spirit of enquiry in them. It is envisaged that students would be given all possible opportunities to raise questions and seek their answers from various sources.

The physics practical work in this manual has been presented under four sections (i) experiments (ii) activities (iii) projects and (iv) demonstrations. A write-up on major skills to be developed through practical work in physics has been given in the beginning which includes discussion on objectives of practical work, experimental errors, logarithm, plotting of graphs and general instructions for recording experiments.

Experiments and activities prescribed in the NCERT syllabus (covering CBSE syllabus also) of Class XI are discussed in detail. Guidelines for conducting each experiment has been presented under the headings (i) apparatus and material required (ii) principle (iii) procedure (iv) observations (v) calculations (vi) result (vii) precautions (viii) sources of error. Some important experimental aspects that may lead to better understanding of result are also highlighted in the discussion. Some questions related to the concepts involved have been raised so as to help the learners in self assessment. Additional experiments/activities related to a given experiment are put forth under suggested additional experiments/activities at the end.

A number of project ideas, including guidelines are suggested so as to cover all types of topics that may interest young learners at higher secondary level. A large number of demonstration experiments have also been suggested for the teachers to help them in classroom transaction. Teachers should encourage participation of the students in setting up and improvising apparatus, in discussions and give them opportunity to analyse the experimental data to arrive at conclusions.
Appendices have been included with a view to try some innovative experiments using improvised apparatus. Data section at the end of the book enlists a number of useful Tables of physical constants.

Each experiment, activity, project and demonstration suggested in this manual have been tried out by the experts and teachers before incorporating them. We sincerely hope that students and teachers will get motivated to perform these experiments supporting various concepts of physics thereby enriching teaching learning process and experiences.

It may be recalled that NCERT brought out laboratory manual in physics for senior secondary classes earlier in 1989. The write-ups on activities, projects, demonstrations and appendices included in physics manual published by NCERT in 1989 have been extensively used in the development of the present manual.

We are grateful to the teachers and subject experts who participated in the workshops organised for the review and refinement of the manuscript of this laboratory manual.

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We warmly welcome comments and suggestions from our valued readers for further improvement of this manual.

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like beaker/glass/calorimeter and hence to calculate its volume

E2 Use of screw gauge to
(a) measure diameter of a given wire,
(b) measure thickness of a given sheet and
(c) determine volume of an irregular lamina

E3 To determine the radius of curvature of a given spherical surface by
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E4 To determine mass of two different objects using a beam balance

E5 Measurement of the weight of a given body (a wooden block) using
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E6 Using a simple pendulum plot L – T and L – T^2 graphs, hence find
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E7 To study the relation between force of limiting friction and normal
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E8  To find the downward force, along an inclined plane, acting on a roller due to gravity and study its relationship with the angle of inclination by plotting graph between force and $\sin \theta$

E9  To determine Young’s modulus of the material of a given wire by using Searle’s apparatus

E10  To find the force constant and effective mass of a helical spring by plotting $T^2\cdot m$ graph using method of oscillation

E11  To study the variation in volume ($V$) with pressure ($P$) for a sample of air at constant temperature by plotting graphs between $P$ and $V$, and between $P$ and $\frac{1}{V}$

E12  To determine the surface tension of water by capillary rise method

E13  To determine the coefficient of viscosity of a given liquid by measuring the terminal velocity of a spherical body

E14  To study the relationship between the temperature of a hot body and time by plotting a cooling curve

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A8  To observe the change of state and plot a cooling curve for molten wax

A9  To observe and explain the effect of heating on a bi-metallic strip
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A11 To study the effect of detergent on surface tension of water by observing capillary rise

A12 To study the factors affecting the rate of loss of heat of a liquid

A13 To study the effect of load on depression of a suitably clamped metre scale loaded (i) at its end and (ii) in the middle

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P8 To study Fortin’s Barometer and use it to measure the atmospheric pressure

P9 To study of the spring constant of a helical spring from its load-extension graph

P10 To study the effect of nature of surface on emission and absorption of radiation

P11 To study the spring constant of a helical spring from its load-extension graph

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