APPLIED PHYSICS-I

(with Lab Manual)

Mina Talati
Vinod Kumar Yadav

KHANNA BOOK PUBLISHING CO. (P) LTD.
PUBLISHER OF ENGINEERING AND COMPUTER BOOKS
4C/4344, Ansari Road, Darya Ganj, New Delhi-110002
Phone: 011-23244447-48 **Mobile:** +91-99109 09320
E-mail: contact@khannabooks.com
Website: www.khannabooks.com

Dear Readers,

To prevent the piracy, this book is secured with HIGH SECURITY HOLOGRAM on the front title cover. In case you don't find the hologram on the front cover title, please write us to at contact@khannabooks.com or whatsapp us at +91-99109 09320 and avail special gift voucher for yourself.

Specimen of Hologram on front Cover title:

Moreover, there is a SPECIAL DISCOUNT COUPON for you with EVERY HOLOGRAM.

How to avail this SPECIAL DISCOUNT:

Step 1: Scratch the hologram
Step 2: Under the scratch area, your "coupon code" is available
Step 3: Logon to www.khannabooks.com
Step 4: Use your "coupon code" in the shopping cart and get your copy at a special discount
Step 5: Enjoy your reading!

ISBN: 978-93-91505-43-1
Book Code: DIP120EN

Applied Physics-I

by Mina Talati, Vinod Kumar Yadav

[English Edition]

First Edition: 2021

Published by:

Khanna Book Publishing Co. (P) Ltd.
Visit us at: **www.khannabooks.com**
Write us at: **contact@khannabooks.com**
CIN: U22110DL1998PTC095547

To view complete list of books, Please scan the QR Code:

KPH

Printed in India

प्रो. अनिल डी. सहस्रबुद्धे
अध्यक्ष
Prof. Anil D. Sahasrabudhe
Chairman

सत्यमेव जयते

अखिल भारतीय तकनीकी शिक्षा परिषद्
(भारत सरकार का एक सांविधिक निकाय)
(शिक्षा मंत्रालय, भारत सरकार)
नेल्सन मंडेला मार्ग, वसंत कुंज, नई दिल्ली–110070
दूरभाष : 011–26131498
ई–मेल : chairman@aicte-india.org

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
(A STATUTORY BODY OF THE GOVT. OF INDIA)
(Ministry of Education, Govt. of India)
Nelson Mandela Marg, Vasant Kunj, New Delhi-110070
Phone : 011-26131498
E-mail : chairman@aicte-india.org

FOREWORD

Engineering has played a very significant role in the progress and expansion of mankind and society for centuries. Engineering ideas that originated in the Indian subcontinent have had a thoughtful impact on the world.

All India Council for Technical Education (AICTE) had always been at the forefront of assisting Technical students in every possible manner since its inception in 1987. The goal of AICTE has been to promote quality Technical Education and thereby take the industry to a greater heights and ultimately turn our dear motherland India into a Modern Developed Nation. It will not be inept to mention here that Engineers are the backbone of the modern society - better the engineers, better the industry, and better the industry, better the country.

NEP 2020 envisages education in regional languages to all, thereby ensuring that each and every student becomes capable and competent enough and is in a position to contribute towards the national growth and development.

One of the spheres where AICTE had been relentlessly working from last few years was to provide high-quality moderately priced books of International standard prepared in various regional languages to all it's Engineering students. These books are not only prepared keeping in mind it's easy language, real life examples, rich contents and but also the industry needs in this everyday changing world. These books are as per AICTE Model Curriculum of Engineering & Technology – 2018.

Eminent Professors from all over India with great knowledge and experience have written these books for the benefit of academic fraternity. AICTE is confident that these books with their rich contents will help technical students master the subjects with greater ease and quality.

AICTE appreciates the hard work of the original authors, coordinators and the translators for their endeavour in making these Engineering subjects more lucid.

(**Anil D. Sahasrabudhe**)

ACKNOWLEDGEMENT

The author(s) are grateful to AICTE for their meticulous planning and execution to publish the technical book for Diploma students.

We sincerely acknowledge the valuable contributions of the reviewer of the book Prof. Medha Shirish Gijare, for making it students' friendly and giving a better shape in an artistic manner.

This book is an outcome of various suggestions of AICTE members, experts and authors who shared their opinion and thoughts to further develop the engineering education in our country.

It is also with great honour that we state that this book is aligned to the AICTE Model Curriculum and in line with the guidelines of National Education Policy (NEP) -2020. Towards promoting education in regional languages, this book is being translated in scheduled Indian regional languages.

Acknowledgements are due to the contributors and different workers in this field whose published books, review articles, papers, photographs, footnotes, references and other valuable information enriched us at the time of writing the book.

Finally, we like to express our sincere thanks to the publishing house, M/s. Khanna Book Publishing Company Private Limited, New Delhi, whose entire team was always ready to cooperate on all the aspects of publishing to make it a wonderful experience.

Mina Talati

Vinod Kumar Yadav

PREFACE

The book titled 'Applied Physics-I' is an outcome of the experience of our teaching of fundamental physics courses at the diploma engineering level. We have included the topics of fundamentals of physics relevant to diploma engineering courses and as per the requirements of Outcome Based Education (OBE) model curriculum of AICTE for 1st-year diploma engineering and new National Education Policy (NEP) 2020. Sincere efforts have been made to keep the content of this book interesting, student-friendly and lucid while at the same time revealing and explaining fundamental concepts of physics to the engineering students have not been compromised.

Throughout the preparation of the manuscript of this book, we have considered various standard textbooks, research papers, and reports, and accordingly, we have included questions, solved and supplementary problems. The book covers problems of different difficulty levels which certainly can be solved with some thoughtful efforts. In this book, the emphasis has been laid on definitions of physical phenomena and physical quantities, laws of physics, and various physics formulae relevant to the curriculum for quick revision of basic principles. We have also tried to provide various illustrations and examples in each unit for a proper understanding of the concepts of physics that a student can relate to. For further clarification of the concepts, we have used the figures and diagrams available under fair use policies and creative commons licenses.

It is important to note that, we have included the relevant twelve laboratory practical as per curriculum at the end of each unit. In addition, we have put together some essential formulae and conversion of units in the annexure section. In each unit, video and/ simulation links have been given to support and boost the user's desire for self-learning of the topics within the limits of the curriculum.

We sincerely hope that the book will create curiosity and inspire the students to learn, discuss and make use of the basic principles of physics for addressing the problems related to their core disciplines. The reader's beneficial comments and suggestions will play a major role in improving the future editions of the book. It gives us immense pleasure to place this book, written under 'Technical Book Writing Scheme' for 1st-year diploma engineering, in the hands of the teachers and students.

Mina Talati

Vinod Kumar Yadav

OUTCOME BASED EDUCATION

The outcome-based curriculum has been developed for the implementation of an outcome-based education for diploma engineering students. It incorporates the outcome-based assessment also through which educators and evaluators will be able to assess and evaluate the achievement of students in the form of standard, specific and measurable program outcomes. Outcome-based education emphasizes achieving program-specific skills systematically and gradually which diploma engineering students must acquire. Through outcome-based education,learners will be able to commit to achieving a minimum standard without quitting the program at any level. Upon completion of the specific program with an outcome-based education strategy, diploma engineering students will be able to arrive at the following program outcomes:

1. **Basic and Discipline specific knowledge**: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering Tools, Experimentation and Testing**: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.
5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.
6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.
7. **Life-long learning**: Ability to analyse individual needs and engage in updating in the context of technological changes.

COURSE OUTCOMES

After completion of the course the students will be able to:

CO-1: Select the physical quantities for accurate and precise measurements of engineering problems and estimate the errors in measurements.

CO-2: Perform addition, subtraction, multiplication (scalar and vector product) of vector and find resolution of vectors for relevant applications. Analyse and apply the type of motions to resolve the engineering applications.

CO-3: Define scientific terms work, energy and power and their units and derive relationships between them to solve engineering problems. Describe forms of friction and methods to minimize friction between different surfaces. State the principle of conservation of energy and identify various forms of energy and energy transformations.

CO-4: Compare and relate physical properties associated with linear motion and rotational motion and apply conservation of angular momentum principle to known problems

CO-5: Select relevant materials in industry by analysing the physical properties of solids and liquids to solve broad-based engineering problems.

CO-6: Explain the basic principles of heat and measure the temperature using various thermometers. Identify and apply modes of heat transfer by knowing coefficient of expansion and thermal conductivity of material in related engineering applications.

Course Outcome	Expected Mapping with Program Outcomes *(1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)*						
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7
CO-1	3	2	1	1	2	1	1
CO-2	3	2	1	1	3	2	1
CO-3	3	2	1	1	2	1	1
CO-4	3	2	1	1	1	3	2
CO-5	3	3	1	1	2	2	2
CO-6	3	2	1	1	2	2	2

ABBREVIATIONS AND SYMBOLS

List of Abbreviations

General Terms			
Abbreviations	**Full form**	**Abbreviations**	**Full form**
amu	Atomic Mass Unit	PO	Programme Outcome
AU	Astronomical Units	PRT	Platinum Resistance Thermometer
CO	Course Outcome	TME	Total Mechanical Energy
KE	Kinetic Energy	UO	Unit Outcome
LC	Least Count	UTS	Ultimate Tensile Strength
PE	Potential Energy		
Units Used			
Abbreviations	**Full form**	**Abbreviations**	**Full form**
Å	angstrom	kW-h	kilowatt-hour
BTU	British Thermal Unit	m	meter
°C	degree Celsius	mm of Hg	millimeters of Hg
cal	calorie	N	newton
eV	electron volt	P	Poise
°F	Fahrenheit	Pa	Pascal
Hz	hertz	PI	Poiseuille
J	joule	°R	Rankine
K	kelvin	St	Stokes
kg	kilogram	W	Watt

List of Symbols

Symbols	Description	Symbols	Description
Å	angstrom	η	Coefficient of viscosity OR modulus of rigidity
B	Bulk Modulus	λ	wavelength
R_e	Reynolds number	μ_k	Coefficient of kinetic friction
T	time period	μ_s	Coefficient of static friction
Y	Young's modulus	ρ	Density
α	Coefficient of linear expansion	ω	angular velocity
β	Coefficient of surface expansion	f	Frequency
γ	Coefficient of volume expansion	f_k	Kinetic friction
v	velocity	f_s	Static friction

LIST OF FIGURES

Unit 1: Physical World, Units and Measurements — Page No.

Unit 2: Force and Motion

Unit 3: Work, Power and Energy

Unit 4: Rotational Motion

Unit 5: Properties of Matter

Unit 6: Heat and Thermometry

LIST OF TABLES

Unit 1: Physical World, Units and Measurements — Page No.

GUIDELINES FOR TEACHERS

To implement Outcome Based Education (OBE) knowledge level and skill set of the students should be enhanced. Teachers should take a major responsibility for the proper implementation of OBE. Some of the responsibilities (not limited to) for the teachers in OBE system may be as follows:

- Within reasonable constraints, they should channelize their time for the advantage of all students.
- They should assess the potential of students only upon defined criterion and without any bias and discrimination.
- They should try to cultivate and grow the learning abilities of the students to a certain level before they leave the institute.
- They should try to ensure that all the students are gain sufficient quality knowledge as well as competence aligning with their core discipline after they finish their education.
- They should always encourage the students to develop their ultimate performance capabilities.
- They should facilitate and encourage group work and team work to consolidate newer approach.
- They should follow Blooms taxonomy in every part of the assessment.

Bloom's Taxonomy

Level	Teacher should check	Student should be able to	Possible mode of assessment
Creating	Student ability to create	Design or create	Micro project
Evaluating	Student ability to justify	Argue or defend	Assignment
Analysing	Student ability to distinguish	Differentiate or distinguish	Project/Lab Methodology
Applying	Student ability to use information	Operate or demonstrate	Technical Presentation/ Demonstration
Understanding	Student ability to explain the ideas	Explain or classify	Presentation/ Seminar
Remembering	Student ability to recall (or remember)	Define or recall	Quiz

Students should take equal responsibility for implementing the OBE. Some of the responsibilities (not

GUIDELINES FOR STUDENTS

limited to) for the students in OBE system are as follows:

- Students should be well aware of each UO before the start of a unit in each and every course.
- Students should be well aware of each CO before the start of the course.
- Students should be well aware of each PO before the start of the programme.
- Students should think critically and reasonably with proper reflection and action.
- Learning of the students should be connected and integrated with practical and real-life consequences.
- Students should be well aware of their competency at every level of OBE.

CONTENTS