APPLIED PHYSICS-II

(with Lab Manual)

Hussain Jeevakhan

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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 grateful to AICTE for their meticulous planning and execution to publish the technical book for Diploma students.

I sincerely acknowledge the valuable contributions of the reviewer of the book Prof. Kavita Agrawal, 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 I 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, I like to express my 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.

Hussain Jeevakhan

Preface

The book titled "Applied Physics II" is an outcome of the experience of my teaching physics courses at UG and PG level and training of technical teachers on content specific areas in physics. The importance of applied physics has been proven in all fields of technology and everyone has experienced that Applied physics is important in the development of future technology. As a result, regardless of their primary discipline, every diploma student must master fundamental knowledge and skills to get an understanding of technology's potential and application.

Focus in writing this book has been on developing outcomes in the students related to applied physics, as expected from diploma engineers and to provide learner a successful learning experience. Method for developing unit outcomes and course outcomes adopted in the book is to connect concepts and principle of physics with day to day life experiences and observations, in line with national education policy (NEP) 2020. Corresponding to concept and principles, some activities and microproject are suggested, to create interest and learning challenges in students and which would benefit their clarification. To harness the ICT tool available for teaching learning, QR codes and *url* for the online resources of simulation and videos are given in each unit covering almost all topics, so that it will develop element of self-learning in the students.

In the end of each units the laboratory instructions for the practical's related to that unit has been provided, which will guide students and to perform the practical in the right way with necessary resources required to achieve desired outcome. The laboratory instructions are designed in a way that it is helpful to both the instructors and the students.

Students can apply the knowledge and skills they've gained via this reading this book and by hands-on learning experiences in laboratory and connected activities to tackle real-world problems in their careers.

Hussain Jeevakhan

Outcome Based Education

Outcome based education (OBE) is based on three pillars outcome- based curriculum (OBC), outcome-based learning teaching (OBLT) and outcome-based assessment (OBA). The learning outcomes can be at program levels (POs), course level (COs), unit level (UOs) and session level outcomes (attained in classroom learning, practical's and using other basic and advanced instructional methods). The mapping between POs and COs & COs and UOs is given in the book so that student can connect learning at any different level directly to the program level outcomes. Assessment is an integral part of learning teaching process. Hence to assess learning outcomes, the difficulty level of solved and unsolved problems given in the book matches with the cognitive level of unit learning outcomes. The course level outcomes can be attained through unit outcome and practical outcomes(PrOs). At the end of the programme running with the aid of outcome based education, a student will be able to arrive at the following outcomes

PO-1. **Basic and Discipline specific knowledge**: Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.

PO-2. **Problem analysis**: Identify and analyse well-defined engineering problems using codified standard methods.

PO-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.

PO-4. **Engineering Tools, Experimentation and Testing**: Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

PO-5. **Engineering practices for society, sustainability and environment**: Engineering practices for society, sustainability and environment: Apply appropriate technology in context of society, sustainability, environment and ethical practices.

PO-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.

PO-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: Apply the concept of waves and sound waves for various acoustics and other engineering applications involving wave dynamics

CO-2: Use optical equipment/ instruments based on ray optics

CO-3: Select relevant capacitors in electrical circuits.

CO-4: Apply Laws of current electricity in engineering problems

CO-5: Select relevant material by analysing its magnetic properties

CO-6: Apply the basic concepts of semiconductor physics, laser and nanotechnology in solving engineering problems

Course Outcome	Expected Mapping with Programme 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	1	1	2	1	-	1
CO-2	3	1	1	2	-	-	1
CO-3	3	2	1	2	-	-	1
CO-4	3	2	1	2	1	-	1
CO-5	3	1	1	2	-	-	1
CO-6	3	1	1	1	1	-	-

Abbreviations and Symbols

List of Abbreviations

General Terms			
Abbreviations	**Full form**	**Abbreviations**	**Full form**
AC	Alternating Current	NDT	Non-Destructive testing
AFM	Atomic Force Microscope	OHP	Over Head Projector
CO	Course Outcome	OCT	Optical Coherence Tomography
CD	Compact Disc	PE	Potential Energy
DC	Direct Current	PO	Programme Outcome
DVD	Digital Video Disc	RF	Radio Frequency
DTH	Direct To Home	RI	Refractive Index
FSD	Full Scale Deflection	RP	Resolving Power
He-Ne	Helium-Neon	SHM	Simple Harmonic Motion
KE	Kinetic Energy	SONAR	Sound Navigation and Ranging
KCL	Kirchhoff's Current Law	SET	Single Electron Transistor
KVL	Kirchhoff's Voltage Law	SI	International System of Units
LASER	Light Amplification by Stimulated Emission of Radiation	SEM	Scanning Electron Microscope
LC	Least Count	STM	Scanning Tunneling Microscope
LCD	Liquid Crystal Display	TIR	Total Internal Reflection
LED	Light Emitting Diode	TV	Television
NA	Numerical Aperture	UO	Unit Outcome
Units Used			
Abbreviations	**Full form**	**Abbreviations**	**Full form**
Å	angstrom	eV	electron-volt
C	coloumb	kWh	kilowatt hour
F	farad	mm	millimeter
Hz	hertz	ms	millisecond
W	watt	mW	milliwatt
cm	centimeter	nm	nanometer
dB	decibel	Ω	ohm
esu	electrostatic unit	μF	microfarad

List of Symbols

Symbols	Description	Symbols	Description
Al_2O_3	Aluminum Oxide	h	Planck's Constant
B	Magnetic Field	i_c	Critical Angle
C	Capacitance	k	Wave number
D	Least Distance of Distinct Vision	v	Velocity
E_g	Band Gap Energy	f	Frequency
H	Magnetic Intensity	f_b	Beat Frequency
H_c	Coercive Magnetic field	f_e	Eyepiece focal length
I	Intensity of Magnetization	f_o	Objective focal length
I_R	Retentivity Magnetization	v_d	Drift Velocity
I_s	Saturation Current	ε_r	Relative Permittivity
R	Resistance	κ	Specific Conductance
RT_{60}	Reverberation Time	λ	Wavelength
T	Time period	μ	Refractive Index
T_B	Beat Period	ρ	Specific Resistance
Y	Young's modulus	τ	Torque
C	Velocity of Light	ω	Angular velocity

List of Figures

UNIT 1

Fig. 1.1 Ripple in water due to energy transfer from stone 2
Fig. 1.2 Pulse on string 3
Fig. 1.3 Disturbance in one dimensional medium 3
Fig. 1.4 Longitudinal and transverse waves 4
Fig. 1.5 Displacement v/s Time graph 5
Fig. 1.6 Displacement v/s position graph 5
Fig. 1.7 Propagation of disturbance 6
Fig. 1.8 Particles in same and different phases 7
Fig. 1.9 Formation of beats 8
Fig. 1.10 Particle executing SHM 10
Fig. 1.11 Vibration of cantilever 13
Fig. 1.12 Reverberation and Echo 15
Fig. 1.13 Absorption of sound wave 16
Fig. 1.14 Types of sonic waves 17
Fig. 1.15 Ultrasonic position sensor 18

UNIT 2

Fig. 2.1 Phenomenon of reflection 33
Fig. 2.2 Phenomenon of refraction 33
Fig. 2.3 Image formation by lens 40
Fig. 2.4 Chromatic aberration 41
Fig. 2.5 Spherical aberration 42
Fig. 2.6 Coma 42
Fig. 2.7 Astigmatism 43
Fig. 2.8 Total internal reflection 43
Fig. 2.9 TIR in optical fiber 44
Fig. 2.10 Simple microscope 46
Fig. 2.11 Compound microscope 47
Fig. 2.12 Astronomical telescope 47
Fig. 2.13 Optical projection system 49

UNIT 3

Fig. 3.1 Coulomb force between charges 67
Fig. 3.2 Electric field due to point charge 68
Fig. 3.3 Electric lines of force 69
Fig. 3.4 Electric flux passing through surface 69

Fig. 3.5 Electric flux passing through surface making angle with Electric field 70
Fig. 3.6 Electric potential due to point charge 70
Fig. 3.7 Work done in displacing charge 70
Fig. 3.8 Electric potential difference 71
Fig. 3.9 Depiction of Gauss' law 72
Fig. 3.10 Direction of electric field due to long straight charged wire 72
Fig. 3.11 Electric field due to an infinitely long straight charged wire by Gauss' law 73
Fig. 3.12 Electric field due to uniformly charged plane sheet 74
Fig. 3.13 Electric field due to uniformly charged sphere 75
Fig. 3.14 Capacitor 77
Fig. 3.15 Type of capacitor 78
Fig. 3.16 Charge on capacitor 78
Fig. 3.17 Parallel plate capacitor 79
Fig. 3.18 Capacitors in series 79
Fig. 3.19 Capacitors in parallel 80
Fig. 3.20 Dielectrics in capacitor 80

UNIT 4

Fig. 4.1 Direction of electrical current 91
Fig. 4.2 Depiction of electric current as scalar quantity 92
Fig. 4.3 Electric current in conductor 92
Fig. 4.4 Current and drift velocity 92
Fig. 4.5 Direct current 93
Fig. 4.6 Alternating current 93
Fig. 4.7 Series and parallel combinations of resistances 95
Fig. 4.8 Colour coding of carbon resistor 96
Fig. 4.9 Voltage V/s current graph 97
Fig. 4.10 Kirchhoff's Current Law 98
Fig. 4.11 Kirchhoff's Voltage Law 98
Fig. 4.12 Wheatstone's bridge 99
Fig. 4.13 Meter bridge 99
Fig. 4.14 Electric cell 100
Fig. 4.15 emf and terminal potential difference 100
Fig. 4.16 Heating due to electric current in circuit 101

UNIT 5

Fig. 5.1 Orbital and spin angular momentum associated with electrons 121
Fig. 5.2 Ferromagnetic materials 122
Fig. 5.3 Magnetic field due to bar magnet 123

Fig. 5.4 Magnetic lines of force originating from bar magnet 123
Fig. 5.5 Magnetization curve 124
Fig. 5.6 Magnetic field due to solenoid 124
Fig. 5.7 Force on a moving charge in magnetic field 125
Fig. 5.8 Force on current carrying conductor 126
Fig. 5.9 Force on rectangular coil placed in magnetic field 127
Fig. 5.10 Moving coil galvanometer 128
Fig. 5.11 Force on rectangular coil in moving coil galvanometer 128
Fig. 5.12 Conversion of galvanometer into ammeter 129
Fig. 5.13 Conversion of galvanometer into voltmeter 130

UNIT 6

Fig. 6.1 Energy bands in solids 145
Fig. 6.2 Energy band diagram for conductor, semiconductor and insulator 146
Fig. 6.3 Fourth group of periodic table 147
Fig. 6.4 Covalent bond in Si and Ge 147
Fig. 6.5 p type semiconductor 148
Fig. 6.6 n type semiconductor 149
Fig. 6.7 Depletion region in pn junction 149
Fig. 6.8 pn junction diode and its symbol 150
Fig. 6.9 (a) Diode in forward and reverse bias 150
Fig. 6.9 (b) Forward and reverse bias characteristics 151
Fig. 6.10 Half wave rectifier 152
Fig. 6.11 Full wave rectifier 153
Fig. 6.12 npn and pnp transistor and their symbols 154
Fig. 6.13 Operation of transistor 154
Fig. 6.14 Photocell 155
Fig. 6.15 Solar cell: construction, symbol and VI characteristics 156

UNIT 7

Fig. 7.1 Energy level diagram of hydrogen atom 169
Fig. 7.2 Optical Absorption 170
Fig. 7.3 Spontaneous Emission 170
Fig. 7.4 Stimulated Emission 170
Fig. 7.5 Width of excited energy level 170
Fig. 7.6 Number of atoms in excited state in normal and population inversion conditions 170
Fig. 7.7 Three and four level pumping schemes 171
Fig. 7.8 Optical resonator 172
Fig. 7.9 Construction of ruby laser and energy level diagram of ruby laser 173

Fig. 7.10 Construction of He-Ne laser and energy level diagram of He-Ne laser 174
Fig. 7.11 Diode laser 175
Fig. 7.12 Normal and laser light 175
Fig. 7.13 Construction of optical fiber 177
Fig. 7.14 Light propagation in optical fiber 178
Fig. 7.15 TIR in optical fiber 178
Fig. 7.16 Refractive index profile and light propagation step index fiber 179
Fig. 7.17 Refractive index profile and light propagation Graded index fiber 179
Fig. 7.18 Optical fiber communication system 180
Fig. 7.19 Comparison of nanomaterial with bulk material 182
Fig. 7.20 Variation of surface to volume ratio 183

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 constraint, they should manipulate time to the best advantage of all students.
- They should assess the students only upon certain defined criterion without considering any other potential ineligibility to discriminate them.
- They should try to 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 equipped with the quality knowledge as well as competence 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	Students ability to create	Design or Create	Mini project
Evaluating	Students ability to Justify	Argue or Defend	Assignment
Analysing	Students ability to distinguish	Differentiate or Distinguish	Project/Lab Methodology
Applying	Students ability to use information	Operate or Demonstrate	Technical Presentation/ Demonstration
Understanding	Students ability to explain the ideas	Explain or Classify	Presentation/Seminar
Remembering	Students ability to recall (or remember)	Define or Recall	Quiz

Guidelines for Students

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

Foreword *iii*
Acknowledgment *v*
Preface *vii*
Outcome Based Education *ix*
Course Outcomes *xi*
Abbreviations and Symbols *xii*
List of Figures *xiv*
Guidelines for Teachers *xviii*

1. Wave Motion and its Applications **1-30**

Unit specifics 1
Rationale 1
Pre-Requisites 2
Unit Outcomes 2
1.1 Wave motion 2
1.1.1 Transverse and Longitudinal waves 3
1.1.2 Sound and light waves and their properties 5
1.1.3 Wave Equation 6
1.1.4 Principle of superposition of waves 7
1.1.5 Beat Formation 8
1.2 Simple Harmonic Motion (SHM) 10
1.2.1 SHM 10
1.2.2 Simple harmonic progressive wave 12
1.2.3 Vibration of cantilever 13
1.2.4 Free, forced and resonant vibrations with examples 13
1.3 Acoustics of buildings 15
1.3.1 Echo and Reverberation 15
1.3.2 Reverberation time 15
1.3.3 Coefficient of absorption of sound 15
1.3.4 Methods to control reverberation time 16
1.3.5 Ultrasonic waves 17
1.3.6 Engineering and medical applications of ultrasonic waves 17
Unit summary *19*
Exercises *19*
Practical *22*
Know More *28*
References & Suggested Readings *30*

2. Optics **31-64**

Unit Specifics 31
Rationale 31
Pre-Requisites 31
Unit Outcomes 32
2.1 Basic Optical laws 32

2.1.1 Reflection 33
2.1.2 Refraction 33
2.1.3 Refractive index 33
2.1.4 Image and image formation by mirrors, lens and thin lenses 34
2.1.5 Lens formula 40
2.1.6 Power of Lens 41
2.1.7 Magnification and Defects 41
2.1.8 Total Internal reflection (TIR) 43
2.2.1 Simple and compound microscope 45
2.2.2 Astronomical telescope in normal Adjustment 47
2.2.3 Magnifying power 48
2.2.4 Resolving power 48
2.2.5 Uses of microscope and telescope 48
2.2.6 Optical Projection system 48
Unit Summary *50*
Exercises *50*
Practical *52*
Know More *63*
References & Suggested Readings *64*

3. Electrostatics **65-89**

Unit Specifics 65
Rationale 65
Pre-Requisites 65
Unit Outcomes 66
3.1 Coulomb's Law 66
3.1.1 Unit of charge 67
3.1.2 Electric field 68
3.1.3 Electric lines of force and their properties 68
3.1.4 Electric flux (ϕ) 69
3.1.5 Electric Potential (V) 70
3.1.6 Electric Potential difference 71
3.1.7 Gauss' Law 71
3.1.8 Applications of Gauss' law 72
3.2 Capacitors and its working 77
3.2.1 Types of capacitors 78
3.2.2 Capacitance and its units 78
3.2.3 Parallel plate capacitor 78
3.2.4 Series and parallel Combination of capacitors 79
3.2.5 Dielectric and its effect on Capacitance. 80
3.2.6 Dielectric breakdown 81
Unit Summary *82*
Exercises *82*
Practical *84*
Know More *88*
References & Suggested Readings *89*

4. Current Electricity 90-119

Unit specifics 90
Rationale 90
Pre-Requisites 90
Unit Outcomes 91
4.1 Electric current and its units 91
4.2 Direct and Alternating current. 93
4.3 Resistance (R) and its units 93
4.4 Specific Resistance (ρ) 94
4.5 Conductance (G) 94
4.6 Specific Conductance (κ) 94
4.7 Series and parallel combinations of resistance 95
4.8 Factors affecting the resistance of wire 96
4.9 Carbon resistances and color coding 96
4.10 Ohm's Law and its verification 97
4.11 Kirchhoff's laws 98
4.12 Wheatstone bridge and its applications 99
4.13 Concept of terminal potential difference and Electro motive force 100
4.14 Heating effect of current 101
4.15 Electric power 101
4.16 Electric energy and its units 102
4.17 Advantages of Electric Energy over other forms of energy 102
Unit Summary *104*
Exercises *104*
Practical *106*
Know More *118*
References & Suggested Readings *119*

5. Electromagnetism 120-143

Unit specifics 120
Rationale 120
Pre-Requisites 120
Unit Outcomes 121
5.1 Types of Magnetic materials 121
5.1.1 Dia, para and ferromagnetic materials with their properties 121
5.1.2 Magnetic field and units 122
5.1.3 Magnetic intensity 123
5.1.4 Magnetic lines of force 123
5.1.5 Magnetic flux and units 123
5.1.6 Magnetization 124
5.2 Concept of electromagnetic induction 124
5.2.1 Faraday's laws 125
5.2.2 Lorentz force (force on moving charge in magnetic field) 125
5.2.3 Force on current carrying conductor. 126
5.2.4 Force on rectangular coil placed in magnetic field 126
5.2.5 Moving coil galvanometer: Principle, construction and working, 127

5.3 Conversion of a galvanometer into ammeter and voltmeter 129
Unit Summary *131*
Exercises *131*
Practical *133*
Know More *142*
References & Suggested Readings *143*

6. Semiconductor Physics 144-166

Unit Specifics 144
Rationale 144
Pre-Requisites 144
Unit Outcomes 145
6.1 Energy bands in solids 145
6.2 Types of materials (insulator, semiconductor, conductor) 146
6.3 Intrinsic and extrinsic semiconductors. 147
6.4 p-n junction 149
6.5 Junction diode and V-I Characteristics 150
6.6 Types of junction diode 151
6.7 Diode as rectifier 152
6.8 Transistor 153
6.9 Types of Transistors 153
6.10 Some electronic Applications of Transistor 154
6.11 Photocells 155
6.12 Solar cells 155
Unit Summary *157*
Exercises *157*
Practical *159*
Know More *165*
References & Suggested Readings *166*

7. Modern Physics 167-193

Unit Specifics 167
Rationale 167
Pre-Requisites 168
Unit Outcomes 168
7.1 Lasers 168
7.1.1 Energy Level 169
7.1.2 Ionization and Excitation potential 169
7.1.3 Spontaneous and Stimulated emission 169
7.1.4 Population inversion 170
7.1.5 Pumping method 171
7.1.6 Optical feedback 171
7.1.7 Types of Lasers 172
7.1.8 Laser characteristics 175
7.1.9 Engineering and medical applications of lasers. 176
7.2 Fiber Optics 177

7.2.1 Introduction to optical Fibers. 177
7.2.2 Light propagation, acceptance angle and numerical aperture. 177
7.2.3 Fiber types 179
7.2.4 Applications in telecommunication, medical and sensors 180
7.3 Nanoscience and Nanotechnology: Introduction 181
7.3.1 Nanoparticles and nanomaterials 181
7.3.2 Properties at Nanoscale 182
7.3.3 Nanotechnology 183
7.3.4 Nanotechnology based devices and applications 183
7.3.5 Nanometer size devices 184
Unit summary *185*
Exercises *185*
Practical *187*
Know More *193*
References & Suggested Readings *193*

Table of Physical Constants **194**
Appendices **195**
Annexures **197**
References for Further Learning **198**
CO and PO Attainment Table **199**
Index **200**