General Physics II

Lab Manual – Undergraduate Physics (Core) Programme

MALINI K A - MINI KRISHNA K
DHANYA JOHNSON - ANEESH GEORGE

VIMALA PUBLICATIONS

General Physics II

(Lab Manual for Undergraduate Physics – Core Programme)

Malini K A - Mini Krishna K – Aneesh George – Dhanya Johnson

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(Lab Manual for Undergraduate Physics – Core Programme)

Editors:

Malini K A, Associate Professor

Mini Krishna K, Assistant Professor

Aneesh George, Assistant Professor &

Dhanya Johnson, Assistant Professor

Department of Physics, Vimala College (Autonomous),

Thrissur, Kerala – 680 009, India

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To our beloved students….

PREFACE

Post Graduate and Research Department of Physics, Vimala College is proud to come up with a lab manual for General Physics II, a practical paper for the Undergraduate Physics students of the core programme. This compilation aims to present the theory and procedures of the undergraduate experiments prescribed in the 2019 syllabus revision in a simplified manner. The manual is structured in a way to incorporate relevant theory, procedure, diagrams and graphical representations of each experiment. A brief idea on how to perform the calculations from the recorded observations is provided as and when required. Necessary tips, viva questions and model questions pertaining to each experiment have been included. The standard operating procedures (SOP) to be adopted while in laboratory, other relevant physical data and pictures of components are also incorporated as appendix to give the students further insight on lab experiments explained in the book.

We wish that the book unveils the joy of experimentation to the physics students at the under graduate level.

Department of Physics

Vimala College

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Department of Physics

Vimala College

Semester 5 & 6 - Core Course V

PHY6B15: PRACTICALS II

36 hours in each semester (Credit - 5)

	Course Outcome	CL	KC
CO1	Apply and illustrate the concepts of properties of matter through experiments	**Ap**	**P**
CO2	Apply and illustrate the concepts of electricity and magnetism through experiments	**Ap**	**P**
CO3	Apply and illustrate the concepts of optics and spectroscopy through experiments	**Ap**	**P**
CO4	Apply and illustrate the principles of heat through experiments	**Ap**	**P**

Syllabus (Any 20 experiments)

1. e/m measurement - Thomson's apparatus
2. Spectrometer - Cauchy's constants
3. Spectrometer - Diffraction Grating - Normal incidence
4. Spectrometer - Diffraction Grating - minimum deviation
5. Spectrometer $i_1 - i_2$ curve
6. Laser-wavelength using transmission grating
7. Spectrometer - Quartz prism - Refractive indices of quartz for the ordinary and extra ordinary rays
8. Newton's rings - wavelength of sodium light
9. Air wedge-angle of the wedge, radius of a thin wire
10. Lee's Disc - thermal conductivity of a bad conductor
11. Potentiometer - Calibration low range and high range voltmeters
12. Potentiometer - Reduction factor of TG
13. Variation of field with distance - Circular coil - moment of magnet and B_h
14. Resolving power of grating
15. Carey Foster's bridge - Temperature coefficient of Resistance
16. Conversion of Galvanometer to voltmeter and calibrating using Potentiometer (Plot using software)
17. Conversion of Galvanometer to ammeter and calibrating using Potentiometer
18. BG Absolute Capacity

19. BG - High resistance by leakage method
20. Dispersive power of grating
21. Planck's constant using LED's (Minimum 4 nos.)
22. Polarimeter - Specific rotation of sugar solution.
23. Numerical aperture of an optical fibre by semiconductor laser
24. Frequency of AC using Sonometer

Books of Study:

1. Electronics lab manual - K A Navas (Vol 1 and 2)
2. B.Sc. Practical Physics - C L Arora
3. Practical Physics - S L Gupta & V Kumar

Reference Books:

1. Advanced Practical Physics for students – B L Worksnop and H T Flint
2. A practical approach to Nuclear Physics, First Edition, K. Muraleedhara Varier - Narosa Publishing House

CONTENTS

Standard Operating Procedures (SOP) of the lab

General instructions regarding Practical Record

1. Attendance is must for all experiments. Students who miss 25% (or, as per the syllabus followed) experiments shall not be permitted to write the exam.
2. Make up labs are not promoted except under unforeseen circumstances.
3. No eating or drinking is allowed during class in laboratory.
4. The grading guidelines shall be strictly followed as per the syllabus followed for each batch.
5. Each student must submit an individual report for every lab paper.
6. Cover page must include title of every experiment, page number and date.
7. Aim, apparatus, theory and principle, relevant diagrams and procedure must be recorded along with the observations, graphs (optional) and result for every experiment.
8. The students must submit attested lab records for the exam.

SOP for the Safety measures to be followed in the lab

1. Be always alert and attentive in the lab. Follow all written and verbal instructions. Never hesitate to ask your doubts.
2. Do not waste electricity, consumables and water.
3. Do not work alone in the lab without prior permission from the teacher in charge / HoD.
4. Report all accidents, injuries or breakage to the teacher in charge/ lab attendant immediately. Also, report any equipment that you suspect is malfunctioning.
5. Avoid wearing overly-bulky or loose-fitting clothing, or dangling jewelry that may become entangled in your experimental apparatus. Pin or tie black long hair.
6. Use goggles:
   a. when heating anything.
   b. when using any type of projectile or laser experiments
   c. when instructed to do so.
7. Do not perform unauthorized experiments. Get the permission of teacher in charge before you try something original.

8. Be careful when working with apparatus that may be hot. If you must pick it up, use tongs, a wet paper towel, or other appropriate holder.
9. If a thermometer breaks, inform the teacher/lab attendant immediately. Do not touch either the broken glass or the mercury with your bare skin.
10. Ask the teacher to check all electrical circuits before you turn on the power.
11. When working with electrical circuits, be sure that the current is turned off before making adjustments in the circuit.
12. Do not connect the terminals of a battery or power supply to each other with a wire. Such a wire will become dangerously hot.
13. Return all equipment, clean and in good condition, to the designated location at the end of the lab to the concerned staff. Leave your lab area cleaner than you found it.
14. Know locations of laboratory eye wash stations, fire extinguishers and emergency exit routes.
15. Avoid skin and eye contact with all chemicals. Minimize all chemical exposures. Never leave containers of chemicals open.
16. Be vigilant of warning signs when unusual hazards, hazardous materials, hazardous equipment, or other special conditions are present.
17. Do not taste or intentionally sniff chemicals. Never consume and/or store food or beverages or apply cosmetics in areas where hazardous chemicals are used or stored.
18. Wash exposed areas of the skin prior to leaving the laboratory.
19. No cell phone or ear phone usage in the active portion of the laboratories, or during experimental operations.

Appendix

PHYSICAL CONSTANTS

Table 1.3 Density of various substances

Substance	Density ($\times 10^3$ Kgm^{-3})	Substance	Density (Kgm^{-3})
Common salt	2.2	Air	1.293
Copper sulphate	2.28	Carbon dioxide	1.977
Granite	2.7	Hydrogen	0.09
Sand	2.6	Helium	0.179
Brick	2.3	Nitrogen	1.251
Sugar	1.6	Oxygen	1.429
Cork	0.24	Water vapour	0.8

Table 1.4 Wavelengths of spectral lines

Mercury spectrum		Colour	Wavelength (nm)
Colour	Wavelength (nm)		
Violet I	404.65	Sodium D_1	589.59
Violet II	407.78	Sodium D_2	589
Blue	435.83	H_α red	656.3
Greenish blue	491.6	H_β blue green	486.1
Green	546.07	H_γ blue	434
Yellow I	576.96	H_δ	410.2
Yellow II	579.06	K red	766.5

Constants to Remember

1. Refractive index of water – 1.33
2. Refractive index of flint glass – 1.60 – 1.62
3. Refractive index of crown glass – 1.52
4. Velocity of light $c = 3 \times 10^8$ m/s
5. Planck's constant $h = 6.626 \times 10^{-34}$ Js
6. Resistivity of Nichrome = 1.1×10^{-6} Ωm
7. $B_h = 3.8 \times 10^{-5}$ T
8. $e/m = 1.758 \times 10^{11}$ C·kg^{-1}
9. Acceleration due to gravity $g = 9.8$ m/s^2
10. Permeability of free space $\mu_0 = 4\pi \times 10^{-7}$ H/m
11. Permittivity of free space $\varepsilon_0 = 8.85 \times 10^{-12}$ F/m

Conversions to Remember

1. 1 Kg = 1000 g
2. 1 g = 1000 mg
3. 1 cm = 0.01 m
4. 1 mm = 0.001 m
5. 1 pF = 10^{-12} F
6. 1 μF = 10^{-6} F
7. 1 nm = 10^{-9} m
8. 1 μm = 10^{-6} m

General Physics II

MODEL QUESTIONS

1. Using Thomson's apparatus, measure the e/m constant.
2. Determine the constant appearing in the Cauchy's dispersion formula for the given prism
3. Standardize the grating using mercury green light. Find the prominent wavelengths of spectral lines of mercury light by normal incidence method
4. Standardize the grating using mercury green light. Find the prominent wavelengths of spectral lines of mercury light by minimum deviation method
5. Determine the angle of emergence for various values of angle of incidence using spectrometer. Draw i1-i2 curve and find the refractive index of the material of the prism
6. Determine wavelength of laser using transmission grating.
7. Determine the refractive indices of the material of the quartz prism for the ordinary and extraordinary rays
8. Determine the wavelength of sodium light by forming Newton's rings using reflected light
9. Find the radius of curvature of the given lens by forming Newton's rings. Verify the result by direct method
10. Determine the diameter of a thin wire by measuring the width of interference bands formed by the air wedge. Also find the angle of wedge. Take readings of 30 bands
11. Lees disc
12. Convert the galvanometer into a voltmeter to read 0.1V per division and calibrate it using a voltmeter
13. Calibrate a low range voltmeter using potentiometer and draw the calibration curve
14. Calibrate a high range voltmeter using potentiometer and draw the calibration curve
15. Determine the reduction factor of the tangent galvanometer using potentiometer
16. Conversion of Galvanometer to ammeter and calibrating using Potentiometer
17. Convert the galvanometer into a voltmeter to read 0.1V per division and calibrate it using a voltmeter
18. Determine the reduction factor of the tangent galvanometer using potentiometer
19. Plot the variation of magnetic flux density with distance along the axis of a circular coil carrying current. Also find out the horizontal component of earth's magnetic field

20. Determine the value of horizontal component of earth's magnetic flux density at a place using circular coil apparatus
21. Determine the length of the given wire by finding the resistance using Carey foster's bridge. Given the resistivity of the wire 1.1x10-6 ohmm
22. Determine the resistivity of the material of the given wire by finding the resistance using Carey foster's bridge
23. Determine the ballistic constant using Hibbert's magnetic standard.
24. Compare the capacitances of two given capacitors using Ballistic galvanometer.
25. Determine the plank constant using different colours of LED's (3 Nos)

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Other books published by the authors

- **General Physics I** (Lab Manual for Undergraduate Physics – Core Programme)
- **Electronics & Python** (Lab Manual for Undergraduate Physics – Core Programme)
- **General Physics & Electronics** (Lab Manual for Undergraduate Physics – Complementary Programme)

General Physics II

Lab Manual – Undergraduate Physics (Core) Programme

MALINI K A - MINI KRISHNA K - DHANYA JOHNSON - ANEESH GEORGE

ABOUT DBT STAR COLLEGE SCHEME

The Star College scheme by the Department of Biotechnology of the Government of India. Facilitates improvement in the skills of teachers through FDPs, improved curriculum, and practical training to the students by providing specialised access to infrastructure and consumables. The support provided under the scheme strengthens physical infrastructure in laboratories, library, teaching aids and promotes networking with neighbouring institutes. Hands on training, product oriented projects and projects of day to day relevance. Enhance the interest in students to pursue science at undergraduate level.

ABOUT VIMALA COLLEGE

Vimala College (Autonomous), a first grade women's college under the CMC Management, was established in 1967 in Thrissur District, Kerala, India. The college offers 19 Undergraduate and 16 Postgraduate programmes, and is a Centre for Research in Physics, English, Commerce, Economics, Social Work and Malayalam. The institution was accredited at the national level with a Five Star status in 2001 by the NAAC, and has undergone two subsequent cycles of re-accreditation in 2008 and 2014 and presently holds the top grade A with a CGPA of 3.50 on a 4 point scale. The University Grants Commission (UGC) conferred autonomy in 2015 and identified her as a College with Potential for Excellence in 2016. The College was accorded with DBT-STAR College status in 2019. In the National Institution Ranking Framework (NIRF) 2020, the Ministry of Human Resource Development, Government of India ranked Vimala College among the top Colleges in India.

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