Electronics and Python

Lab Manual – Undergraduate Physics (Core) Programme

MALINI K A - MINI KRISHNA K
VEENA GOPALAN E - JOVIA JOSE

VIMALA PUBLICATIONS

Electronics and Python

(Lab Manual for Undergraduate Physics – Core Programme)

Malini K A – Mini Krishna K – Veena Gopalan E – Jovia Jose

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(Lab Manual for Undergraduate Physics – Core Programme)

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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 Electronics and Python, 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. The python programs prescribed in syllabus is laid out with algorithms, syntax and outputs. 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 XVI
PHY6B16: PRACTICAL III
72 hours in each semester (Credit - 5)

	Course Outcome	CL	KC	Class Sessions allotted
CO1	Apply and illustrate the principles of semi-conductor diode and transistor through experiments	Ap	P	36
CO2	Apply and illustrate the principles of transistor amplifier and oscillator through experiments	Ap	P	36
CO3	Apply and illustrate the principles of digital electronics through experiments	Ap	P	36
CO4	Analyze and apply computational techniques in Python programming	Ap	P	36

Unit: I (Any 15 experiments)

1. Construction of full wave a) Centre tapped and b) Bridge rectifiers
2. Characteristics of Zener diode and construction of Voltage regulator.
3. Transistor input, output & transfer characteristics in Common Base Configuration and calculation of current gain.

4. Transistor input, output & transfer characteristics in Common emitter Configuration and calculation of current gain
5. CE Transistor Amplifier-Frequency response. (Design the circuit for a given collector current I_C)
6. Negative feedback amplifier
7. Half adder using NAND gates
8. Full adder using NAND gates-construction & verification
9. LC Oscillator (Hartley or Colpitt's)
10. Phase shift oscillator
11. Operational Amplifier –inverting, non-inverting, Voltage follower
12. LCR circuits-Resonance using CRO
13. Construction of basic gates using diodes (AND, OR) & transistors (NOT), verification by measuring voltages
14. Voltage multiplier (Doubler, Tripler) (Connections to be realized through soldering. The desoldering has to be carried out at the end of the experiment.)
15. Multivibrator using transistors.
16. Flip-Flop circuits –RS and JK using IC's
17. Verification of De-Morgan's Theorem using basic gates.
18. Photo diode V-I characteristics. Determine quantum efficiency and responsivity of the PD
19. Study the characteristics of LED (3 colours) and LDR.
20. Wave shaping R-C circuits -integrator and differentiator

21. OPAMP- adder, subtractor

    Unit: II Numerical Methods Using Python: Minimum 5 programs to be done.

22. Solution of equations by bisection and Newton-Raphson methods
23. Least square fitting – straight line fitting.
24. Numerical differentiation using difference table.
25. Numerical Integration – Trapezoidal and Simpson's 1/3 rd rule.
26. Taylor series - $\sin\theta$, $\cos\theta$
27. Solution of 1st order differential equation Runge-Kutta method
28. Simulation of freely falling body. Tabulation of position, velocity and acceleration, as function of time.
29. Simulation of projectile – Tabulation of position, velocity and acceleration as a function of time – Plot trajectory in graph paper from tabulated values.

Books of Study:

1. Electronics lab manual- K A Navas (vol 1 & 2)
2. B.Sc Practical Physics- C L Arora
3. Practical Physics- S L Gupta & V Kumar
4. Computational Physics, V.K.Mittal, R.C.Verma & S.C.Gupta-Published by Ane Books
5. Introductory methods of numerical analysis, S.S.Shastry, (Prentice Hall ofIndia,1983)
6. Introduction to Python for Engineers and Scientists by Dr.Sandeep Nagar, Apress publications.

7. Python for Education by Dr. B P Ajithkumar, IUAC, New Delhi; e-book freely downloadable from www.expeyes.in/documents/mapy.pdf

Reference Books:

1. Advanced Practical Physics for students – B L Worksnop and H T Flint

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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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