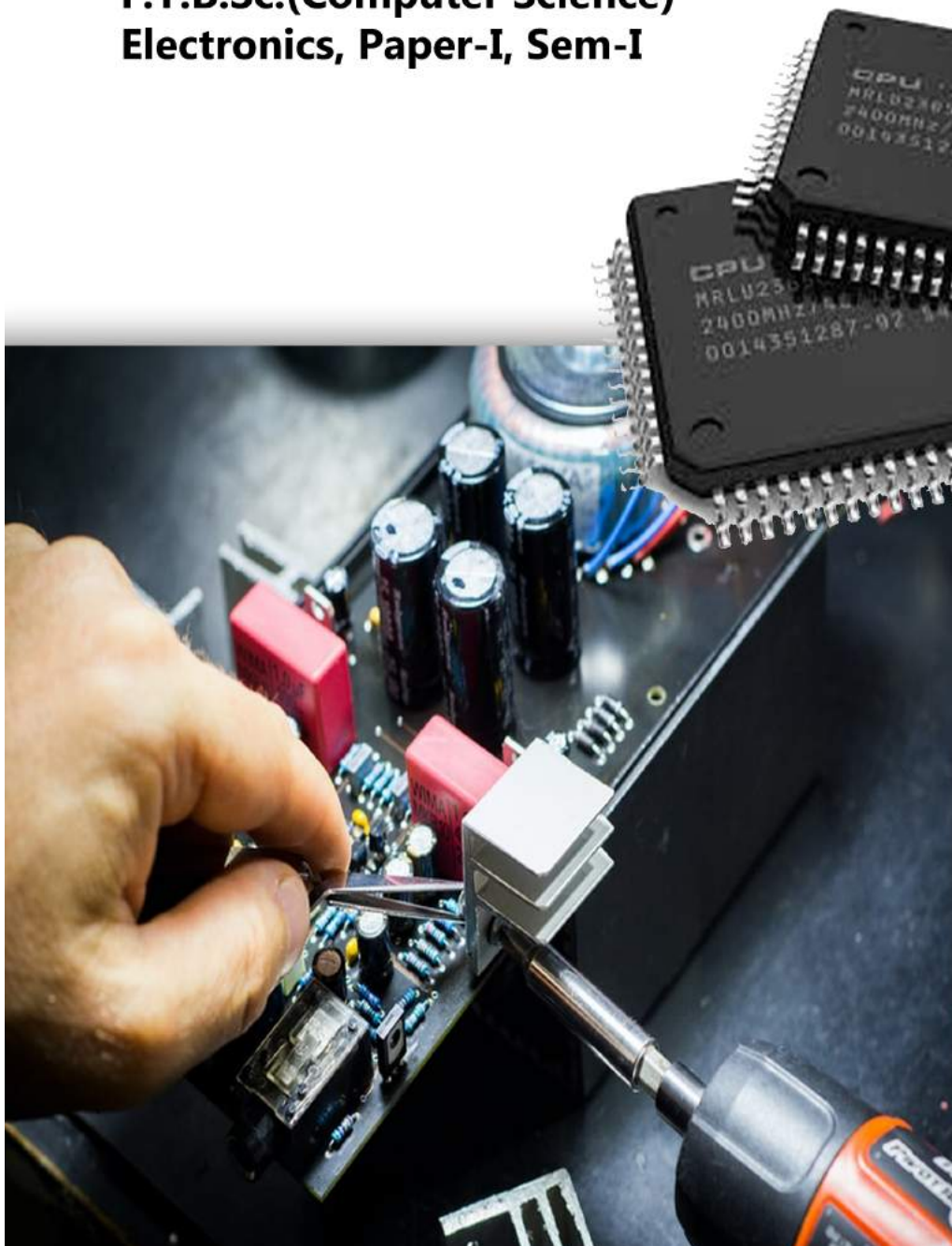


Semiconductor Devices and Basic Electronic Systems

F.Y.B.Sc.(Computer Science)
Electronics, Paper-I, Sem-I



Authors:

Dr. Arif Tamboli
Dr. Arun Patil
Mr. R. V. Bhujbal
Dr. R. S. Gosavi
Dr. Ugalal P. Shinde



Semiconductor Devices and Basic Electronic Systems.

F.Y.B.Sc. Electronic Science
of B.Sc (Computer Science).
**Paper I Semester-I, ELC-111,
CBCS (June-2019-20).**

First Edition

Author

Dr. Arif Tamboli
Associate Professor
Poona College of Arts
Science and Commerce Camp-PUNE

Co-Authors

Professor Dr. Arun Vitthal Patil

Mr. Ramakant V. Bhujbal

Dr. R. S. Gosavi

Dr. Ugalal P. Shinde



INSC International Publishers

Title of the Book: Semiconductor Devices and Basic Electronic Systems.

F.Y.B.Sc. Electronic Science of B.Sc (Computer Science) Paper I Semester-I, ELC-111, CBCS (June-2019-20).

Edition: First-2021

Copyright © Author's Dr. Arif Tamboli, Associate Professor in the subject of Electronic Science and Department of Electronic Science at Poona College of Arts, Science and Commerce Camp-PUNE

Co-Author (1) is Dr. Arun Vitthal Patil, Designation: Professor in Physics-Dept. Arts, Commerce & Science College, Manmad, Dist- Nashik(MS), 16-digit ORCID identifier is 0000-0002-6927-2237.

Co-Author (2) is Mr. Ramakant Vasant Bhujbal Director, Future Chip Technologies, 409, Shaniwar Peth, Pune.

Co-Author (3) is Dr. R. S. Gosavi, working as Associate Professor and Head Department of Electronic Science, at Loknete Ramdas Patil Dhumal, Arts, Science and Commerce College, Rahuri, Dist Ahmednagar.

Co-Author (4) is Dr. Ugalal P. Shinde M.Sc. Ph.D, Professor, Research Guide and Head, Department of Electronic Science. Mahatma Gandhi Vidya Mandir's L.V.H. Arts, Science and Commerce College, Panchavati, Nashik- 422003 (M.S.)”

No part of this book may be reproduced or transmitted in any form by any means, electronic or mechanical, including photocopy, recording, or any information storage and retrieval system, without permission in writing from the copyright owners.

Disclaimer The author's are solely responsible for the contents published in this book. The publishers or editors do not take any responsibility for the same in any manner. Errors, if any, are purely unintentional and readers are requested to communicate such errors to the editors or publishers to avoid discrepancies in future.

E-ISBN: 978-1-68576-019-9

MRP Rs. 350/-

PUBLISHER & PRINTER: INSC International Publishers
Pushpagiri Complex, Beside SBI
Housing Board, K.M. Road
Chikkamagaluru, Karnataka
Tel.: +91-8861518868
E-mail: info@iiponline.org

IMPRINT: I I P

Preface

I have great pleasure to present this book on Semiconductor Devices and Basic Electronic Systems F.Y.B.Sc. Electronic Science of B.Sc (Computer Science) Paper I Semester-I, ELC-111, CBCS (June-2019-20).

It is written as per the 2019-20 patterns of Choice Base Credit System (CBCS) syllabus of Savitribai Phule Pune University, Pune-411007 implemented from June-2019.

The Author and Co-Author have tried their level best to simplify the difficult concept in electronic science with neat diagram and simple mathematical equation.

The basics of electronics which is required to understand the concept of Semiconductor, Conductor, Insulator, PN Junction Diode, The Light-Emitting Diodes (LEDs): Symbol and its use in circuit, IR transmitter and receiver applications, Photo diode circuit, Photo transistors, LDR and its use in street light controller and Opto- Isolators (MCT2E) and its use in isolation are made very simple.

Application of PN Junction Diode in Power Supply such as half wave, full Wave and Bridge rectifier. Regulated Power Supply Unregulated Power supply, Automatic Voltage Regulator, SMPS, UPS are covered.

Advance transistors such as JFET Transistor, MOSFET and application as switch is covered. The oscillator such as RC Oscillator Wein bridge and Crystal Oscillator and Square wave generator that is Multivibrator circuit using IC-555 is covered.

Digital to Analog converter Binary weighted and R-2R ladder type DAC Circuit , Analog to Digital converters such as Flash ADC, successive approximation ADC, parameters of DAC and ADC.

Acknowledgement

Firstly, I thank the Almighty **Allah**, Creator of Universe for making me physically and mentally capable of undertaking this work.

I offer my Sincere thanks to the management of Poona College of Arts, Science and Commerce Camp-Pune-411001, Y and M, Anjuman Khairul Islam Mumbai for providing me the necessary facility to complete the work.

I owe a special debt of gratitude to Dr. Aftab Anwar Shaikh, Principal Poona College of Arts, Science and Commerce, Camp, Pune-411001, Dr. Arunkumar Walunj, Head Department of Electronic Science, Mr Iqbal Shaikh, Head Department of Chemistry and IQAC Coordinator. Dr. Aif Shaikh, Ex-Head Department of Electronic Science, Mr. Z.B. Pathan Ex-Head Department of Electronic Science, Dr. Gulam Rabbani my research Guide for cooperation, motivation and continuous help.

The present work is dedicated to my beloved late parents, whose love and affection apart from their moral support made it possible to complete. My wife, Mrs. Shabana, son Azim and lovely daughter Alfiya deserve special mention for their continuous support and sacrifice.

Finally I would like to thank teaching staff members Mr. Musharraf Hussain, Mrs. Swaleha Mulla, Ms. Saima Sayyed and all other teaching and non teaching staff of Electronic Science Department of Poona College, Camp, Pune-411001, all friends and all those who are directly or indirectly involved in helping me to complete this work.

I thank to Publisher IIP Publishing House (IPH) **www.iiponline.org** for helping me to publish this book.

Dr. Tamboli Arif

About author and Co-Author

Author **Dr. Arif Tamboli** is working as Associate Professor in the subject of Electronic Science and Department of Electronic Science at Poona College of Arts, Science and Commerce Camp-PUNE-411001 since **1st August-1994**.

The College is affiliated to Savitribai Phule Pune University, Pune-411007, formerly known as University of Pune, is a collegiate public state university located in the city of Pune, Maharashtra state, India. Established in 1949, PUNE-411007.

Co-Author (1) is Dr. Arun Vitthal Patil, Designation: Professor in Physics-Dept. Arts, Commerce & Science College, Manmad, Dist- Nashik(MS), 16-digit ORCID identifier is 0000-0002-6927-2237, and full ORCID iD and the link to public record is <https://orcid.org/0000-0002-6927-2237> Contact: 9604828463 Email: aruptl@gmail.com .

Guide for Ph. D. in Physics & Electronic Science – S. P. Pune University, Pune, Total No. of Ph.D. Students guided: Declared– 03, Pursing – 03, Completed Research Projects: 02 (01 Major, 01 Minor), Total No. of Paper Published in National /International Journals: 83, Total No. of Conferences/Workshop/Symposium Attended/ Presented papers- 39, Total No. of Published Book: 03, Resource Person (Invited Talk): 12, Awards: Best paper presentation award at Busan, South Korea, Best Teacher Award 2020 by Mahavir International, Nashik.

Co-Author (2) is Ramakant Vasant Bhujbal Director, Future Chip Technologies, 409, Shaniwar Peth, Pune-411030. Industrial Experience: 1) VLSI-INDIA PVT. LTD. Ahmedabad as Design Engineer from Oct. 2001 to Nov. 2002 2) Chip Campus, Ahmedabad as Design Engineer cum Faculty from June 2001 to Sep. 2001 3) Ace Telecom, Pune Authorized Service Center of Tata Telecom as Electronics Engineer from Aug. 1999 to July 2000. 4) Cubix Automation, Pune as Application Engineer from Oct. 1998 to July 1999. Developed software to program PLC's of Messung Systems, Pune, India and Mitsubishi Electric, Japan for Industrial Automation projects.

Co-Author (3) is Dr. R. S. Gosavi, working as Associate Professor and Head Department of Electronic Science, at Loknete Ramdas Patil Dhumal, Arts, Science and Commerce College, Rahuri, Dist Ahmednagar.

Co-Author (4) is Dr. Ugalal P. Shinde M.Sc. Ph.D, Professor, Research Guide and Head, Department of Electronic Science. Mahatma Gandhi Vidya Mandir's L.V.H. Arts, Science and Commerce College, Panchavati, Nashik- 422003 (M.S.)

5. Contents list (List of topics):

Sr. No Chapters

| | | |
|----------|---|----------------|
| | Introduction to Semiconductors, Conductors and Insulator | |
| 1 | Unit 1 : Semiconductor Diode | 1-84 |
| 2 | Unit 2: Bipolar Junction Transistor (BJT) | 85-157 |
| 3 | Unit 3: Field Effect Transistor (FET) Metal Oxide Semiconductor Field Effect Transistor (MOSFET) | 158-180 |
| 4 | Unit 4: Power Supply | 181-241 |
| 5 | Unit 5:oscillators | 242-292 |
| 6 | Unit 6:Data Converters | 293-325 |
| | Extra Notes | 326-344 |

Index

Unit 1. Semiconductor Diodes.

Semiconductor, P and N type semiconductors, Formation of PN junction diode, it's working, Forward and Reverse bias characteristics, Zener diode: working principle, breakdown mechanism and characteristics, Working principle of Light emitting diode, photo diode, optocoupler, Solar cell working principle and characteristics

Unit 2. Bipolar Junction Transistor (BJT)

Bipolar Junction Transistor (BJT) symbol, types, construction, working principle, Transistor amplifier configurations - CB, CC (only concept), CE configuration: input and output characteristics, Concept of Biasing, Potential Divider bias, Transistor as amplifier (Concept of Gain and Bandwidth expected), Transistor as a switch.

Unit 3. MOSFET (4)

MOSFET types, Working principle, Characteristics, Application of MOSFET as a Switch.

Unit 4. POWER SUPPLY (6)

Block Diagram of Regulated Power Supply, Rectifiers (half wave, full wave, Bridge), rectifier with capacitor-filter, Use of Zener Diode as a Voltage Regulator, IC 78XX and 79XX as regulator, Block Diagram and explanation of SMPS, Block diagram and explanation of UPS

Unit 5. OSCILLATORS (4)

Barkhaussain Criteria, Low frequency Wein bridge oscillator, High frequency crystal oscillator, IC 555 as Astable Multivibrator used as square wave generator / clock

Unit 6. DATA CONVERTERS (5)

Need of Digital to Analog Converters (DAC), parameters, weighted resistive network, R-2R ladder network, need of Analog to Digital converters (ADC), parameters, Flash ADC, successive approximation ADC.

7. Main content of the book:

The Book contains the basics of Conductor, Semiconductor and Insulators. The Band Diagram and Energy required to force an electron from valance band to conduction is explain.

The importance of Intrinsic and Extrinsic material in fabrication of PN Junction Diode is explain very simple way. The formation of depletion layer barrier potential is also explain.

The applications of PN Junction as Half wave, full wave and bridge rectifiers is also explain. Concept of AC Voltage and DC Voltage as well as Voltage regulator using Zener diode the line regulation and load regulation is explained. Voltage regulator IC(78XX or 79XX) series for positive and negative Voltage regulator is explain.

BJT: Symbol, terminals, types, basic operation, configurations and characteristics (Showing different regions). Applications: Transistor as switch, Transistor as amplifier Transistor. Gain and Bandwidth product. FET: Terminals, Symbol, Basic operation and FET as Switch. MOSFET: Terminals, Symbol, Basic operation, characteristics and MOSFET as switch.

The oscillator such as RC Oscillator Wein bridge and Crystal Oscillator and Square wave generator that is Multivibrator circuit using IC-555 is covered.

Light-Emitting Diodes (LEDs): Symbol and its use in circuit, IR transmitter and receiver applications, Photo diode circuit, Photo transistors, LDR and its use in street light controller and Opto- Isolators (MCT2E) and its use in isolation, Solar cell.R-2R ladder network, need of Analog to Digital converters, parameters, Flash ADC, successive approximation ADC.



Dr. Tamboli Arif



Dr. Arun Patil



Mr. R. V. Bhujbal.

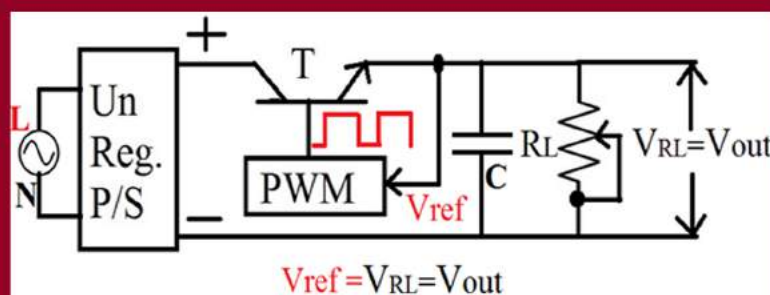


Dr. R. S. Gosavi



Dr. Ugalal P. Shinde.

The Book Contains the basics of Conductor, Semiconductor and Insulators, applications of PN Junction as Half wave, full wave and bridge rectifiers, Voltage regulator using Zener diode, Voltage regulator IC(78XX or 79XX) series, SMPS, UPS, BJT, FET, MOSFET: Terminals, Symbol, Basic operation, characteristics and application as Switch. The oscillators Wein bridge and Crystal Oscillator and Multivibrator circuit using IC-555 is covered. Light-Emitting Diodes Photo diode, Photo transistors, LDR, Opto-Isolators (MCT2E) , Solar cell, Data converters (DAC and ADC).



Selfpage Developers Pvt Ltd.

E-ISBN:978-1-68576-024-3



MRP Rs.150/-