THE PHYSICAL BASIS OF ELECTRONICS

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JOSEPH JOHN THOMSON (1856-1940)

who may rightly be called the “father of electronics”. He demonstrated with the aid of the “electron-beam tube” shown here the real nature of this wonderful “elementary” particle, which in the last few decades has wrought such a revolution in science and industry.

PREFACE

“For many years we have been accustomed to regard the development of electronics as an exponential process. Now, however, a much more impressive phenomenon can be discerned: *it looks as if electronics is no longer content to be a branch of the science of electricity. We are witnesses today of an enormous “electronic revolution”, in which what is traditionally regarded as electricity plays only a subsidiary part . . .*”

A. Ducrocq

(in ELECTRONIQUE INDUSTRIELLE, Oct. 1961)

The education of the electronics engineer (or technician) of tomorrow may be divided into three stages: the *technological*, the *physical*, and the *mathematical*. In the first of these stages, the student should be introduced directly to the practical aspects of electronics (circuitry, measuring techniques) in such a way as to arouse in him real enthusiasm for the subject. This should lead him to ask spontaneously about the why and the wherefore of the many “miracles” he has come into contact with. It is the purpose of the “physical stage” to answer these questions in a systematic way by showing the relationships between the phenomena he has observed, and leading up to others still unknown to him, and in particular to show the qualitative and quantitative effects of various factors on these phenomena. This brings us to the third stage, in which these effects are laid down in precise mathematical form.

This book is intended as a contribution to the second of these three stages. The quotation given above clearly reflects the enormous increase now taking place in the amount of information which must be taken in by the student in the first stage, and the tendency to “philosophizing” which may be observed in many electronics engineers throughout the world *), who feel a need to impose some kind of order on this flood of facts, both for their own sake and for that of the student of electronics.

This search for order lies at the basis of the framework on which this book is written. Starting from the definition of electronics as “the study of all physical phenomena involving electrons (or any other charge car-

*) This same “philosophizing” approach is very evident in, for example, many of the papers by prominent American electronics engineers included in the huge May number of the “PROCEEDINGS OF THE I.R.E.” to commemorate the 50th anniversary of “the biggest engineers’ society in the world”.

riers)” *), we shall divide all electronic phenomena into three main classes:

- 1) *charging* (and *discharging*) phenomena,
- 2) *excitation* (and *radiation*) phenomena, and
- 3) *ionization* and *emission* phenomena.

In each class, we shall show how the phenomena in question can be produced and modified by the following forms of energy: mechanical, thermal, chemical, electrical, radiant, atomic, and nuclear.

It is hoped that this novel arrangement of the subject matter will serve three main purposes:

- a) to provide teachers of electronics and related subjects with a programme basis which will help them to explain and “place” all electronic applications;
- b) not only to give the students some feeling for all the basic phenomena involved in electronic devices which they know and which they will come across in the future, but also to arouse and maintain their interest by showing how these basic phenomena play a part in the most up-to-date electronic devices;
- c) but above all to get both teacher and student to *think*, by showing them the sometimes unsuspected relationships between highly diverse phenomena and applications.

The author is sure that many teachers will be made to think twice on coming across terms in this book whose definition differs somewhat from the “classical” one they are used to from other textbooks; he would however ask them to consider seriously which of the two, the “old” or the “new”, is more logical and in better agreement with modern views on energy and matter. It is perhaps fitting to finish by quoting the wise words of Descartes: “In order to reach the truth, you must once in your life rid yourself of all the opinions you have received, and reconstruct all the systems of your knowledge right from their foundations.”

J. G. R. Van Dijk

*) This definition, adopted by the Comité Electrotechnique Français among other bodies, is a great improvement on other antiquated definitions which are yet still current, such as that contained in the ASA norm C 42 (“electronics is that branch of science and technology which deals with the conduction of electricity through gases and vacuum”). Such limited definitions, which exclude much that is the proper domain of electronics, cannot but breed confusion and illogicality in the minds of both teacher and student.

CONTENTS

	Page
PREFACE	VII
PART I ENERGY AND MATTER	
Chapter 1 THE STRUCTURE OF MATTER	3
1.1. What is matter?	3
1.1.1. Definition	3
1.1.2. States of aggregation	4
1.1.3. The divisibility of matter	4
1.1.4. Molecules	5
1.1.5. Atoms	6
1.1.6. Atomic structure	7
1.1.7. Empty and yet solid	8
1.1.8. Electron	9
1.1.9. Summary	10
1.2. Internal structure of the atom	10
1.2.1. Mass of nucleus and electron	10
1.2.2. The electron as unit of charge	11
1.2.3. Energy and charge	11
1.2.4. Protons and neutrons	12
1.2.5. The periodic table of the elements	13
1.2.6. Radioactivity	14
1.2.7. Electron configuration	16
1.2.8. Chemical reaction	18
1.2.9. Metals	18
1.2.10. Bonds	19
1.2.11. Difference between these two types of bond	19
1.2.12. The crystalline structure of matter	20
List of the most important definitions	24
Short bibliography (to Part I, chapter 1)	27
Chapter 2 THE MAIN FORMS OF ENERGY	29
2.1. What is energy?	29
2.1.1. Importance of the concept of energy	29

2.1.2. Definition	30
2.1.3. Energy and matter	30
2.1.4. Principle of conservation of energy	31
2.2. Various forms of energy	31
2.2.1. Energy equivalents	31
2.2.2. Energy bound to matter and energy free from matter	32
2.2.3. Kinetic and potential energy	32
2.2.4. Divisibility	32
2.2.5. Survey of the various forms of energy	33
2.2.6. Mechanical energy	34
2.2.7. Thermal energy	35
2.2.8. Chemical energy	36
2.2.9. Electrical energy	37
2.2.10. Radiant energy	38
2.3. Energy and force	44
2.3.1. Equilibrium	44
2.3.2. Power (P)	46
2.3.3. Classification of natural forces	48
List of the most important definitions	51
Relationship between the various energy units	55
Survey of the main forms of energy	56
Brief bibliography (to part I, chapter 2)	58
PART II ELECTRONIC PHENOMENA	59
INTRODUCTION	61
1. Charging phenomena	61
2. Excitation phenomena	61
3. Ionization phenomena	62
4. Emission phenomena	62
Chapter 3 CHARGING AND DISCHARGING PHENONEMA	63
3.1. Charging phenomena	63
3.1.1. Principle	63
3.1.2. Survey of charging phenomena	65
3.2. Voltage sources and transducers	81
3.2.1. Classification of voltage sources	82
3.2.2. Electronic transducers	93

3.2.3. Applications in chemical analysis	98
3.3. Discharge phenonema	100
3.3.1. The electric current	100
3.3.2. The various discharge media	101
3.3.3. Various discharge currents	116
3.3.4. Secondary discharge phenomena	122
List of the most important definitions	146
Table 3.1. Charging phenomena	153
Table 3.2. Discharge processes	157
Table 3.3. Effects of discharge processes	161
Units of charge and related quantities	162
Chapter 4 EXCITATION AND RADIATION	163
4.1. Closer study of the structure of the atom	164
4.1.1. Energy levels	164
4.1.2. Quantum numbers	164
4.1.3. Pauli exclusion principle	165
4.1.4. Ground state	165
4.1.5. Excitation energy	165
4.1.6. Electromagnetic radiation	167
4.1.7. Spectral lines	167
4.2. Light from electrons	168
4.2.1. Line spectrum	168
4.2.2. Characteristic spectral lines	169
4.2.3. An excited atom can behave in three different ways	171
4.3. How is an atom excited?	173
4.3.1. Principle	173
4.3.2. Survey of methods of excitation and their effects	174
4.4. The complete electromagnetic spectrum	178
4.4.1. Complete spectrum	178
4.4.2. Radio spectrum	178
Survey of the radio spectrum	179
4.5. Radiation sources	188
4.5.1. Principle	188
4.5.2. Survey	188
4.6. Some of the main applications	192
4.6.1. From atomic clock to “maser”	193

4.6.2. Maser	194
4.6.3. Laser (optical maser)	195
4.6.4. New unit of length	198
4.6.5. Modern light sources	198
4.6.6. Luminophores (phosphors)	206
4.6.7. Material testing by means of luminescence	207
4.6.8. Material testing with X-rays	207
4.6.9. Gamma-radiography	211
List of the most important definitions	212
Table 4.1. Excitation and radiation phenomena	215
Table 4.2. Radiation processes	219
Table 4.3. Various effects of radiation phenomena	223
Excitation and radiation	226
Chapter 5 IONIZATION AND EMISSION PHENOMENA	228
5.1 Ionization potential and work function	228
5.1.1. Definition	228
5.1.2. Ionization potential	230
5.1.3. Ionization potential as a function of the atomic number	230
5.1.4. Role of the boundary layer	230
5.1.5. Conduction-band potential	231
5.1.6. Stimulating emission	233
5.1.7. Contact potential and work function	234
5.1.8. Metal and semiconductor	235
5.1.9. Two semiconductors	237
5.1.10. Rectification effect	238
5.2. Survey of emission phenomena	240
5.2.1. Emission caused by mechanical energy	240
5.2.2. Emission due to heating the cathode material	240
5.2.3. Chemical emission	248
5.2.4. Emission under the influence of strong electric fields (field emission or cold emission)	249
5.2.5. Emission under the influence of light (photoelec- tric emission)	251
5.2.6. Emission produced by bombardment with ele- mentary particles	254
5.2.7. Emission produced by nuclear energy	259
5.3. Elementary-particle sources	259

5.3.1. Electron sources	260
5.3.2. Ion sources	261
5.3.3. Neutron sources	263
List of the most important definitions	264
Table 5.1. Ionization and emission phenomena	267
Table 5.2. Emission processes	270
Table 5.3. Various effects of electron beams	272
PART III ELECTRON TUBES AND SOLID STATE DEVICES	275
Chapter 6 ELEMENTS OF ELECTRON OPTICS	277
6.1. The double nature of electron	277
6.1.1. The electron as charge carrier and little magnet	277
6.1.2. Particle and waves aspects	278
6.1.3. Light beams and electron beams	278
6.1.4. Deflection	279
6.2. Basic electron optics	279
6.2.1. Definition	279
6.2.2. Behaviour of the electron in an electric field . .	279
6.2.3. Non-homogeneous field	281
6.2.4. Behaviour of the electron in a magnetic field . .	281
6.2.5. Light optics and electron optics	282
6.2.6. Electric lenses	285
6.2.7. Magnetic lenses	286
6.3. Some practical applications	287
6.3.1. The control of the electron current in vacuum tubes	287
6.3.2. Velocity-control	291
6.3.3. Travelling wave tubes	292
6.3.4. Tetrode principle (electron acceleration) . . .	293
6.3.5. Electron accelerators	294
6.3.6. Focussing of electron beams by continuous electric and magnetic fields	295
6.3.7. Electron telescope	296
6.3.8. Electron microscope	297
6.3.9. Electron-diffraction camera	301
List of the most important definitions	304
Chapter 7 INTRODUCTION TO THE STUDY OF ELECTRON DEVICES	306

7.1. Introduction	306
7.1.1. Principle and definition	306
7.1.2. Various control methods	307
7.2. Survey of the most important electron devices	307
7.2.1. Intensity devices	307
7.2.2. Electron-beam devices	312
7.2.3. Velocity-modulated devices	315
7.2.4. Kinenergetic devices (accelerators)	317
7.2.5. Electron devices for special purposes	322
7.3. The six main functions of electron devices	323
7.3.1. Rectification	324
7.3.2. Switching (and relay function)	327
7.3.3. Amplification	330
7.3.4. Oscillation	340
7.3.5. Radiation	346
7.3.6. Memory	348
List of the most important definitions	354
INDEX	357
SURVEY OF THE MOST IMPORTANT ELECTRONIC PHENOMENA	363