ELECTRONICS II

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Foreword

This book is written for one of the many technician courses now being run at technical colleges in accordance with the requirements of the **Technician Education Council (TEC)**. This Council was established in March 1973 as a result of the recommendation of the Government's Haslegrave Committee on Technical Courses and Examinations, which reported in 1969. TEC's functions were to rationalise existing technician courses, including the City and Guilds of London Institute (C.G.L.I.) Technician courses and the Ordinary and Higher National Certificate courses (O.N.C. and H.N.C.), and provide a system of technical education that satisfied the requirements of 'industry' and 'students' but that could be operated economically and efficiently.

Four qualifications are awarded by TEC, namely the Certificate, Higher Certificate, Diploma and Higher Diploma. The **Certificate** award is comparable with the O.N.C. or with the third year of the C.G.L.I. Technician course, whereas the **Higher Certificate** is comparable with the H.N.C. or the C.G.L.I. Part III Certificate. The **Diploma** is comparable with the O.N.D. in Engineering or Technology, the **Higher Technician Diploma** with the H.N.D. Students study on a part-time or block-release basis for the Certificate and Higher Certificate, whereas the Diploma courses are intended for full-time study. Evening study is possible but not recommended by TEC. The Certificate course consists of fifteen **Units** and is intended to be studied over a period of three years by students, mainly straight from school, who have three or more C.S.E. Grade III passes or equivalent in appropriate subjects such as mathematics, English and science. The Higher Certificate course consists of a further ten Units, for two years of part-time study, the total time allocation being 900 hours of study for the Certificate and 600 hours for the Higher Certificate. The Diploma requires about 2000 hours of study over two years, the Higher Diploma a further 1500 hours of study for a further two years.

Each student is entered on to a **Programme** of study on entry to the course; this programme leads to the award of a Technician Certificate, the title of which reflects the area of engineering or science chosen by the student, such as the Telecommunications Certificate or the Mechanical Engineering Certificate. TEC have created three main **Sectors** of responsibility

Sector A responsible for General, Electrical and Mechanical Engineering

Sector B responsible for Building, Mining and Construction Engineering

Sector C responsible for the Sciences, Agriculture, Catering, Graphics and Textiles.

Each Sector is divided into Programme committees, which are responsible for the specialist subjects or programmes, such as A1 for General Engineering, A2 for Electronics and Telecommunications Engineering, A3 for Electrical Engineering, etc. Colleges have considerable control over the content of their intended programmes, since they can choose the Units for their programmes to suit the requirements of local industry, college resources or student needs. These Units can be written entirely by the college, thereafter called a college-devised Unit, or can be supplied as a Standard Unit by one of the Programme committees of TEC. **Assessment** of every Unit is carried out by the college and a pass in one Unit depends on the attainment gained by the student in his coursework, laboratory work and an end-of-Unit test. TEC moderate college assessment plans and their validation; external assessment by TEC will be introduced at a later stage.

The three-year Certificate course consists of fifteen Units at three Levels: I, II and III, with five Units normally studied per year. A typical programme might be as follows.

Year I	Mathematics I	Standard Unit	} six Level I Units
	Science I	Standard Unit	
	Workshop Processes I	Standard Unit	
	Drawing I	Standard Unit	
	General and Communication	College Unit	
Year II	Engineering Systems I	College Unit	} six Level II Units
	Mathematics II	Standard Unit	
	Science II	Standard Unit	
	Technology II	Standard Unit	

Year III	General and Communications II	College Unit	} six Level II Units
	Industrial Studies II	College Unit	
	Engineering Systems II	College Unit	
	Mathematics III	Standard Unit	} three Level III Units
	Science III	Standard Unit	
	Technology III	College Unit	

Entry to each Level I or Level II Unit will carry a prerequisite qualification such as C.S.E. Grade III for Level I or O-level for Level II; certain Craft qualifications will allow students to enter Level II direct, one or two Level I Units being studied as 'trailing' Units in the first year. The study of five Units in one college year results in the allocation of about two hours per week per Unit, and since more subjects are often to be studied than for the comparable City and Guilds course, the treatment of many subjects is more general, with greater emphasis on an **understanding** of subject topics rather than their application. Every syllabus to every Unit is far more detailed than the comparable O.N.C. or C.G.L.I. syllabus, presentation in **Learning Objective** form being requested by TEC. For this reason a syllabus, such as that followed by this book, might at first sight seem very long, but analysis of the syllabus will show that 'in-depth' treatment is not necessary—objectives such as '**states Ohm's law** . . .' or '**lists** the different types of telephone receiver . . .' clearly do **not** require an understanding of the derivation of the Ohm's law equation or the operation of several telephone receivers.

This book satisfies the learning objectives for one of the many TEC Standard Units, as adopted by many technical colleges for inclusion into their Technician programmes. The treatment of each topic is carried to the depth suggested by TEC and in a similar way the **length** of the Unit (sixty hours of study for a full Unit), **prerequisite qualifications**, **credits for alternative qualifications** and **aims of the Unit** have been taken into account by the author.

Preface

This book follows the syllabus of the Standard TEC Unit **Electronics II**, which is a **second-level** Essential Unit in the Telecommunications Technicians Programme and the Electronic Technicians programme. The specification of this Unit is

Unit value: one Number U76/010

design length: sixty hours

prerequisite Units: TEC U75/004 Physical Science I or equivalent

credits for Units: None

aims of the Unit: To introduce students to the electronics principles used in light-current electrical engineering with particular reference to communications and industrial electronics.

It is with this specification in mind, therefore, that this book has been written, in particular with reference to the prerequisite **Physical Science** Unit from Level I. In this basic science Unit the following concepts are introduced to the student

- (1) forces on materials
- (2) the nature and types of energy
- (3) temperature and specific heat capacity
- (4) waves and their behaviour
- (5) electrical circuits including Ohm's law and associated problems
- (6) the effects of an electric current including magnetic fields
- (7) uniform motion and acceleration
- (8) scalars and vectors
- (9) electrolysis
- (10) resistivity, e.m.f., internal resistance and secondary cells.

It is assumed therefore that these topics are already understood, although several references are made to them in the chapter introductions. *Electronics II* is one of the four second-level technical Units for the telecommunications and the electronics technician programmes as suggested by the TEC A2 programme committee, the programme structure being as follows.

Level I: Mathematics I; Physical Science I; Materials and Workshop Practices I; Electrical Drawing I;

Telecommunications Systems I (*or*) Electronics Systems and Practice I

Level II: Mathematics II; Electrical Principles II; Electronics II; Transmission, Radio, Telephone Switching *or* Electronics Systems II

Level III: Electrical Principle III; Electronics III; Digital Techniques *or* Transmission Systems III; Telephone Switching *or* Radio Systems III *or* Electronic Applications III (College-devised)

In addition to these Units, two Units are included at Levels I and II for General and Communications Studies, and in some cases Mathematics is offered as an alternative Level III Unit.

It should be remembered therefore that **Electrical Principles II** will be studied concurrently with this book, the content of this unit being

- (1) electrical units and d.c. circuits
- (2) capacitors; capacitance
- (3) the magnetic field and electromagnetic induction
- (4) alternating voltages and currents
- (5) single-phase a.c. circuits; reactance
- (6) measuring instruments and measurements, multimeters, use of the CRO.

It is intended that **practical** exercises should be carried out by each student who studies Electronics II; this will greatly assist the student in understanding the concepts introduced in this book and carry the student into the Level III Unit Electronics III, a further essential Unit for the technician programmes listed above.

Finally, this book uses BS 3363 and BS 3939 for its electronic circuit symbols, and since these standards are continually being updated, certain of the symbols might need to be modified should the British Standards Institution introduce a revised set of symbols after the publication date.

My thanks go to the staff of TEC for their cooperation in the early stages of the writing of this book.

G. D. BISHOP

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