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Work Out

Electronics

G. Waterworth

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The examination boards accept no responsibility whatsoever for the accuracy or method in the answers given to questions set by them. The answers are the entire responsibility of the author.

Introduction

How to Use this Book

This book is intended primarily as a text to help electrical engineering students, who are taking a first course in electronics, prepare for an examination. It will also be useful to students on some second-year courses and to students of mechanical engineering, physics and other disciplines for which a first course in electronics is included.

The questions vary in their level of difficulty and the book should be found useful at various stages of both degree and diploma courses.

Each chapter contains:

- (a) A brief summary of the major facts and concepts;
- (b) Worked examples of representative university, polytechnic and IEE/CEI/EC examination questions;
- (c) Unworked problems of a similar standard with answers at the back of the book.

The topics are arranged in the traditional order of semiconductor devices (diodes, BJTs, FETs, op-amps), followed by their applications in a variety of electronic subsystems such as amplifiers, oscillators, non-linear circuits, power amplifiers, regulated power supplies, power electronics systems, combinational and sequential logic circuits. This should enable the reader to use these worked examples alongside any of the standard textbooks in electronics, or as a guide in working through past examination papers and tutorial sheets provided by the appropriate examining body.

The text at the beginning of each chapter is deliberately brief, but a comprehensive range of techniques and equations is developed from basic principles, allowing the reader to use this both as a companion guide during initial studies and as a revision book towards the end of the course.

The author has attempted to give an engineering approach to the subject by including questions that have a sound application and a realistic solution. Examples are included both on discrete devices and on integrated-circuit devices.

The book uses up-to-date techniques and devices and includes questions on the current mirror, bootstrapping, the constant current source, the Miller effect, the cascode circuit, feedback amplifiers, differential amplifiers, instrumentation amplifiers, i.c. regulators, switched mode regulators, chopper control, programmable logic arrays, synchronous counter design, and logic hazard detection.

Extensive use has been made of device models in analysing circuit operation, and in the case of the bipolar junction transistor, both the h -parameter and the model based on the Ebers-Moll equation have been included.

Examination Technique

No student can expect to pass examinations without a sound knowledge of the subject material to be examined, but it is possible to improve one's chances by attention to the following.

The Candidate's Presentation

When a candidate is faced with an examination paper, he or she may avoid common errors (which can seriously prejudice the performance) and present the work most favourably by attention to the following advice.

(a) *Choice*

Take time to read through the whole paper, decide on the questions to be answered, and mark them in order of preference; note any rubric concerning compulsory questions or restricted choice from a sectional paper.

(b) *Timing*

Do not spend too much time on a question (e.g. with 5 questions to answer in 3 hours not more than 30–40 minutes should be spent on each). It is unwise to persist with complicated and laborious work that seems to be leading nowhere: the answer sought by the examiners is unlikely to involve several pages of analysis.

(c) *Interpretation*

Carefully read each question before starting to answer it: answer the question set, not some alternative of your own; do not just 'describe' when the question states, 'compare'; do not omit an essential part of the question.

(d) *Presentation*

Either read each answer carefully after writing it, or allow adequate time towards the end of the examination period, to revise and correct the work.

(e) *Formula*

Do not attempt to memorise extensive lists of formula. A candidate is expected to know (by common usage and familiarity rather than by a conscious effort of memory) a few simple expressions directly based on fundamental laws and principles. Complex formulae will normally be quoted in the question, or the candidate asked to develop them from 'first principles'.

The Examiner's Requirements

In assessing a candidate's ability, the examiner looks particularly for the following:

- (a) Sound knowledge of the appropriate fundamental principles; facility in the analysis of problems based thereon; and a clear and explicit understanding of the methods used and approximations legitimately made.
- (b) Facility in numerical and graphical work in the solution of (in the examination sense) 'practical' engineering problems; logical layout of steps in the working; and an appreciation of practical orders of size and of numerical accuracy.
- (c) Collective marshalling of logic and critical arguments for and against the choice of methods, equipment and lines of action.
- (d) Some knowledge, derived from wider reading and professional motivation, of the general trend of modern developments.
- (e) Ability to present descriptive answers legibly, concisely and grammatically; the use, where appropriate, of clear and neat freehand sketches.