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FIFTH EDITION

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Science for Engineering

Fifth Edition

John Bird BSc(Hons), CEng, CSci, CMath, FIET, FIMA, FCollT

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Science for Engineering

A practical introduction to the engineering science required for engineering study and practice.

Science for Engineering is an introductory textbook that assumes no prior background in engineering. This new edition covers the fundamental scientific knowledge that all trainee engineers must acquire in order to pass their exams, and has been brought fully in line with the compulsory science and mathematics units in the new engineering course specifications.

John Bird focuses upon engineering examples, enabling students to develop a sound understanding of engineering systems in terms of the basic laws and principles. This book includes over 580 worked examples, 1300 further problems, 425 multiple-choice questions (with answers) and contains sections covering the mathematics that students will require within their engineering studies, mechanical applications, electrical applications and engineering systems.

- Colour layout helps navigation and highlights key learning points, formulae and exercises.
- Understanding can be tested with the 580 worked examples, 1300 further problems and 425 multiple-choice questions contained within the book.
- Focuses on real-world situations and examples in order to maximise relevance to the reader.

This book is supported by a companion website of materials that can be found at www.routledge.com/cw/bird, which includes fully worked solutions of all the further problems for students to access for the first time, and the full solutions and marking schemes for the revision tests found within the book for lecturers/instructors. In addition, all 433 illustrations will be available for downloading by staff.

John Bird is the former Head of Applied Electronics in the Faculty of Technology at Highbury College, Portsmouth, UK. More recently, he has combined freelance lecturing at the University of Portsmouth, with examiner responsibilities for Advanced Mathematics with City & Guilds, and examining for the International Baccalaureate Organisation. He is the author of over 125 textbooks on engineering and mathematical subjects with worldwide sales of one million copies. He is currently a Senior Training Provider at the Defence School of Marine Engineering in the Defence College of Technical Training at HMS Sultan, Gosport, Hampshire, UK.

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To Sue

Preface

Science for Engineering, Fifth Edition, aims to develop in the reader an understanding of fundamental scientific and applied mathematical principles which will enable the solution of elementary engineering problems. The aims are to describe engineering systems in terms of basic scientific laws and principles, to investigate the behaviour of simple linear systems in engineering, to calculate the response of engineering systems to changes in variables, and to determine the response of such engineering systems to changes in parameters. In particular, the aim is to develop an understanding of applied mathematics, statics, dynamics, electrical principles, energy and engineering systems.

In this fifth edition of *Science for Engineering*, minor modifications, some further worked problems, a glossary of terms, and famous engineers' biographies have all been added to the text.

More has been added to the website for this new edition – such as full solutions being made available to both students and staff, and much more besides – see page xiii.

The text covers the following courses of study:

(i) **Mathematics for Engineering Technicians** (BTEC First Certificate/Diplom, level 2, Unit 3)

(ii) **Applied Electrical and Mechanical Science for Engineering** (BTEC National Certificate/Diploma, level 2, Unit 4)

(iii) **Mathematics for Engineering Technicians** (BTEC National Certificate/Diploma, level 3, Unit 4)

(iv) **Any introductory/access/foundation course** involving Engineering Science and basic Mathematics

This fifth edition of *Science for Engineering* is arranged in four sections.

Section I, Applied mathematics, chapters 1 to 13, provides the basic mathematical tools needed to effectively understand the science applications in sections 2, 3 and 4. Basic arithmetic, fractions, decimals, percentages, indices, units, prefixes and engineering notation, calculations and evaluation of formulae, algebra, simple equations, transposition of formulae, simultaneous equations, straight line graphs, trigonometry, areas of common shapes, the circle, and volumes of common solids are covered in this first section.

Section II, Mechanical applications, chapters, 14 to 32, covers SI units, density, atomic structure of matter, speed and velocity, acceleration, forces acting at a point, work, energy and power, simply supported beams, linear and angular motion, friction, simple machines, the effects of forces on materials, linear momentum and impulse, torque, pressure in fluids, heat energy and transfer, thermal expansion, ideal gas laws and the measurement of temperature.

Section III, Electrical applications, chapters 33 to 42, covers an introduction to electric circuits, resistance variation, batteries and alternative sources of energy, series and parallel networks, Kirchhoff's laws, magnetism and electromagnetism, electromagnetic induction, alternating voltages and currents, capacitors and inductors and electrical measuring instruments and measurements.

Section IV, Engineering systems, chapter 43, covers an overview of the principles of electronic and mechanical engineering systems, forming a basis for further studies.

Each topic in the text is presented in a way that assumes in the reader little previous knowledge of that topic. Theory is introduced in each chapter by a reasonably brief outline of essential information, definitions, formulae, laws and procedures. The theory is kept to a minimum, for problem solving is extensively used to establish and exemplify the theory. It is intended that readers will gain real understanding through seeing problems solved and then through solving similar problems themselves.

Science for Engineering, Fifth Edition contains over **580 worked problems**, together with **425 multiple-choice questions,** and some **1300 further questions**, arranged in **206 Exercises**, all with answers at the back of the book; the Exercises appear at regular intervals – every

Science for Engineering. 978-1-138-82688-5, © John Bird. Published by Taylor & Francis. All rights reserved.

2 or 3 pages – throughout the text. Also included are **400 short answer questions**, the answers for which can be determined from the preceding material in that particular chapter. **433 line diagrams** further enhance the understanding of the theory. All of the problems – multiple-choice, short answer and further questions – mirror where possible practical situations in science and engineering.

Free Internet downloads of solutions to the further problems and a **PowerPoint presentation of all the illustrations** contained in the text are available – see below.

At regular intervals throughout the text are fifteen **Revision Tests** to check understanding. For example, Revision Test 1 covers material contained in chapters 1 and 2, Revision Test 2 covers the material contained in chapters 3 and 4, and so on. These Revision Tests do not have answers given since it is envisaged that lecturers/instructors could set the tests for students to attempt as part of their course structure. Lecturers may obtain solutions of the Revision Tests in an **Instructor's Manual** available from the publishers via the internet – see below.

A list of the **main formulae** are included at the end of the book for easy reference.

Learning by example is at the heart of ***Science for Engineering, Fifth Edition.***

JOHN BIRD
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HMS Sultan, formerly University of Portsmouth
and Highbury College, Portsmouth

Free Web downloads

The following support material is available from http://www.routledge.com/cw/bird

For Students:

1. **Full worked solutions to all 1300 further questions contained in the 206 Practice Exercises**
2. **A list of Essential Formulae**
3. **A full glossary of terms**
4. **425 multiple-choice questions**
5. **Information on 38 Famous Engineers mentioned in the text**

For Lecturers/Instructors:

1-5. As per students 1-5 above

6. **Full solutions and marking scheme for each of the 15 Revision Tests; also, each test may be downloaded for distribution to students.**
7. **All 433 illustrations used in the text may be downloaded for use in PowerPoint presentations**

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Section I

Applied mathematics

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