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Book Reviews

DIGITAL DESIGN LAB MANUAL, by Jerry D. Daniels, Wiley, N.Y., 1996, vi+207 pp, ISBN 0-471-14686-2 (Softcover, £9.99).

As the title suggests, this is a manual for a laboratory course on digital electronic design, and it certainly gives the impression of a well-devised and useful course of instruction. The set of laboratory exercises, each involving design and construction of an item of digital hardware, is rather more than enough to fill a semester of laboratory work, unless for some exceptionally adept students who may manage to cover all of it. The full set of exercises is a basis for a mostly-laboratory course, and a subset is recommended to supplement a lecture course.

The manual is meant to be used in conjunction with a textbook by the same author called *Digital Design from Zero to One*, but it begins with adequate introductory material and can stand alone, though at a few points the student is recommended to refer to the textbook. In some areas the manual goes beyond the treatment in the textbook. There is also reference to items of Macintosh software called "MacBreadboard", "Logic Works" and "Beige Bag" that are useful in connection with some of the exercises. Details are given of laboratory equipment available to the students, such as a logic analyser and the means of programming PROMs (Programmable read-only memories), and such things as power supply units.

The manual is based on two decades of teaching experience, and at various points there are comments that confirm the author's 'hands-on' experience, as when he remarks that the digital contents of a particular circuit will probably remain when its power has been switched off for some time, even though the specifications of the components do not guarantee this. An informal, chatty style is used, and there are even recommendations above the best and cheapest sources of the components and equipment needed. The components are specified precisely, and a kit of them is listed in full. The kit is sufficient for any of the laboratory exercises in the manual. Intensely practical matters such as how to use wire strippers and soldering irons are not forgotten.

There is even information on how students will be assessed in the author's establishment, and a 'carrot' in the form of an invitation to the best of them to become involved in his research on evolutionary algorithms for minimisation of truth tables.

The laboratory exercises begin with such relatively simple and standard things as a one-bit adder and two-bit subtractor, but they soon come to have a more serious flavour, with references to content-addressable memory, dynamic RAM refresh, digital-to-analog and analog-to-digital conversion, among other topics. The requirement for conversion takes the student outside the purely digital environment, and requires the use of operational amplifiers. An understanding of programming, at the machine-code level but including the use of subroutines, is needed in several of the exercises.

A number of the exercises have direct practical applications, such as a controller for a lift (elevator), or for traffic lights at an intersection with both vehicle sensors and pedestrian push-buttons, or for control of lock gates and the passage of ships through a lock in both directions (discussed here with specific reference to the Soo Lock between Lake Huron and Lake Superior).

The manual has a reassuring practical flavour and is clearly the result of much experience. It should be considered by anyone setting up a course on digital electronics, either for adoption as the basis of the course, or at least as a source of ideas. Also, although it poses the design problems as challenges to the student, rather than offering ready-made solutions, it gives enough helpful hints that it could have value as a 'cook book' for practical design.

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PROPERTIES OF OPTICAL AND LASER-RELATED MATERIALS: A Handbook, by D. N. Nikogosyan, J. Wiley and Sons, Chichester et al., 1997, xix+594 pp, index (£125).

This book is a comprehensive, concise and up-to-date collection of information dealing with optical material used in optics, spectroscopy, laser spectroscopy and physics, and quantum electronics. A vast number of references (1075) at the end of the book, a list of abbreviations and fundamental physical constants used, wavelengths of commonly used light sources and other information are of considerable value in enhancing the value of this compilation.

The nine chapters of the book are concerned with the following themes: Laser materials and their hosts; nonlinear optical crystals; alkaline and alkaline earth halides; oxides sulphides, selenides and tellurides; semiconductors and other crystal materials; glasses and polymers; liquids; gases. The material is up-to-date and comprehensive. Indeed, it is a unique contribution to the science and technology that would be of use to academics and industrial personnel, both as a research tool and teaching aid. In industry, the handbook would be of great value to technical personnel in their daily duties and research and development activities.

J. Rose (editor)

THE HANDBOOK OF MACHINE SOLDERING SMT AND TH, third edition, by R. W. Woodgate, Wiley-Interscience, New York et al, 1996, xv+321 pp, index, ISBN 0 471 13904 1 (£50.00).

This book deals with the best techniques of machine soldering of electrical connections which are of fundamental importance in electronics manufacturing. The information presented is comprehensive and self-contained; it covers all of the new technologies, particularly the use of surface mount technology (SMT). The work would be of interest to personnel in the electronics industry, from managers to operators; it may also be of value to undergraduates on specialised university courses.

J. Rose (editor)

DAVENPORT-SCHINZEL SEQUENCES AND THEIR GEOMETRIC APPLICATIONS by Micha Sharir and Pankaj K. Agarwal, Cambridge University Press, Cambridge, UK, 1995, 372 pp (Hbk £35).

The new mathematical machinery introduced by the authors may open the door to new modelling techniques for robot environments. This is because the Davenport-Schinzel sequences are one of the major tools in the analysis of combinatorial and algorithmic problems in geometry.

Davenport-Schinzel sequences contain no pair of equal adjacent elements, and no alternating sub sequence of specified length.

These sequences arise in the analysis of the combinatorial complexity of the lower envelope of univariate functions, and are therefore a basic and important construct in many geometric applications, both combinatorial and algorithmic. The book is organised into two parts; one introduces the Davenport-Schinzel sequences, and the other presents example applications.

A brief description of the theory of the Davenport-Schinzel sequences is given in the first chapter, and is followed by a deeper analysis of these sequences in the subsequent chapters.

After the mathematical survey, some basic applications are presented: Chapter 4 deals with basic geometric applications, and Chapter 5 shows the utilisation of the Davenport-Schinzel sequences for solving elementary combinatorial problems. Chapter 6 considers the computational problems of the realisation of the Davenport-Schinzel sequences, and Chapter 7 extends the results to multivariate functions: this chapter is devoted to the analysis of lower envelopes of multivariate functions and of related structures.

Chapter 8, running to one third of the book, is the largest chapter, and contains various applications of the Davenport-Schinzel sequences. Elementary geometric applications, like Voronoi diagrams; triangulation of convex polygons; determination and geometric permutation of transversals both in 2D and 3D; decomposition of arrangements of surfaces and spheres; analysis of elementary cells; analysis of visibility problems for polyhedral terrains; calculation of width in 3D; determination of the nearest neighbour; analysis of polygon placement, and so on, are presented.

One section of this chapter, however, is particuarly interesting for those who are working on robot motion planning, as in this section the Davenport-Schinzel sequences are applied to develop a new trajectory planning method,[1,2] which uses the configuration space approach to describe the environment, and to determine those trajectories, which provide collision free motion for the manipulator arm, that is the free configuration space.

The advantages of new planning methods based on the Davenport-Schinzel sequences are made possible by realising a sensor based motion planner using an incremental approach. These methods do not assume *a priori* knowledge of the robot environment, that is they require only local sensor information to construct the motion plan in an unstructured environment.

Motion planning using Voronoi diagrams was developed first by P. F. Rowat in 1979.[3] This method was applied to different shapes of objects by Ó'Dúnlaing et al.,[4,5] and later developed further by Cox and Yap in 1991.[6] Although they developed an 'on-line' strategy for rod robots based on Voronoi diagrams, this method is still classical planning, which assumes full knowledge of the world's geometry prior to planning.

Sensor based planning incorporates sensor information, reflecting the current state of the environment. The first sensor based planner using Voronoi diagrams was developed by Rao in 1991,[7] which generated further research on this field.[8]

Evidently, this book cannot analyse nor describe the detailed trajectory planning algorithms, but it is essential for all those, who want to understand this geometric modelling technique, and its mathematical background, the Davenport-Schinzel sequences.

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