REVIEWS AND DESCRIPTIONS OF TABLES AND BOOKS

The numbers in brackets are assigned according to the American Mathematical Society classification scheme. The 1980 Mathematics Subject Classification (1985 Revision) can be found in the December index volumes of Mathematical Reviews.

23[33A65, 42C05].—C. Brezinski, A. Draux, A. P. Magnus, P. Maroni & A. Ronveaux (Editors), *Polynômes Orthogonaux et Applications*, Lecture Notes in Math., Vol. 1171, Springer-Verlag, Berlin, 1985, xxxvii + 584 pp., 24 cm. Price $42.00.

To help celebrate the 150th anniversary of the birth of Edmond Laguerre, a symposium on orthogonal polynomials was held on October 15–18, 1984, at Bar-le-Duc, the city of Laguerre's birth. With nearly a hundred registered participants, over seventy papers were presented on various aspects of orthogonal polynomials, their applications and several related topics. The proceedings for this conference reflect the remarkable renaissance the subject of orthogonal polynomials has enjoyed during the past two decades.

Sixty of the papers read at this meeting are included in the proceedings edited by the organizers of the symposium. Additionally, C. Brezinski contributes a biographical sketch of Laguerre while A. P. Magnus and A. Ronveaux discuss Laguerre's work with orthogonal polynomials and the connection of this work with contemporary research. J. Labelle contributes his "Tableau d'Askey." Many readers of this review are already familiar with this chart. For those who do not have access to a copy, its reproduction here will have to serve as an existence theorem since it appears in an eyeball-popping reduced size. For a more constructive approach to the information it contains, readers will have to write the author for a full size copy or else dig the information out for themselves from Andrews and Askey's contributed paper (described below).

There are four invited papers. J. Dieudonné provides a brief survey of the relevant aspects of the theory of positive definite J-fractions and Jacobi matrices and their connections with orthogonal polynomials and concludes with a short discussion of the Hamburger and Stieltjes moment problems. In between, he sandwiches a description of Laguerre's work with a problem in differential equations which led him to "his" polynomials.

W. Hahn next discusses formally orthogonal polynomials defined by a three-term recurrence formula which also satisfy a second-order linear differential equation. This leads to properties of a class of polynomials which are generalizations of the Classical orthogonal polynomials since the latter are characterized by being solutions of the familiar second-order Sturm-Liouville type differential equation.

Richard Askey has long contended that applying the term "classical" to the "Classical" orthogonal polynomials of Jacobi, Hermite and Laguerre (and sometimes Bessel) results in too much attention (read "characterization theorems") being placed on too small a class of orthogonal polynomials. G. E. Andrews and R. Askey describe the various orthogonal polynomials which they contend should be included in any family called "classical." Their thesis is that the term "classical orthogonal polynomials" should apply to the special and limiting cases of certain ${}_4\varphi_3$ basic hypergeometric polynomials: the Askey-Wilson polynomials (née q-Racah polynomials) and their absolutely continuous analogues. The limiting cases which have ordinary hypergeometric representations are the basis for the classification which Labelle has summarized in his "Tableau d'Askey." Andrews and Askey contend that this is the largest class of orthogonal polynomials that have such nice properties as a Rodrigues type formula of the right form, and they challenge their readers to prove wrong their claim that they now have the "ultimate" extension of the classical orthogonal polynomials. A characterization theorem seems to be called for here.

The final invited address is by W. Gautschi, who discusses some new applications of orthogonal polynomials in Gauss-Christoffel quadrature, spline approximation theory, and summation of series. He also discusses the critical role played by the Askey-Gasper inequality in de Branges' proof of the Bieberbach conjecture. The author's own numerical calculations played an important role in convincing de Branges of the correctness of his approach and led Gautschi to contact Askey (with the resulting spectacular consequences).

The contributed papers are far too numerous to describe individually, but a listing of the topics by which they are grouped will indicate the wide range of subjects discussed: orthogonality concepts, combinatorics and graphs, function spaces, the complex plane, measures, zeros, approximations, special families, numerical analysis, applications, problems. It is perhaps worth mentioning, however, that one paper deals with a special case of the Freud conjecture, but D. S. Lubinsky, H. N. Mhaskar and E. B. Saff have recently announced settling the general case. All of this activity attests to the healthy state of a subject that seemed moribund a scant thirty years ago.

B. C. C.

24[35J60, 65N05, 65N10, 35B25].—Peter A. Markowich, *The Stationary Semiconductor Device Equations*, Computational Microelectronics (S. Selberherr, Editor), Springer-Verlag, Wien and New York, 1986, ix + 193 pp., 25 cm. Price $45.00.

This book is a well-written, eminently readable introduction to the mathematical analysis of the stationary semiconductor device problem.

There are four serious chapters: Chapter 2 describes the source of the problem, various parameter models, geometric assumptions, and boundary conditions currently in use, and the possible scaling of the dependent variables.

Chapter 3 discusses existence, uniqueness, and regularity of the solutions, and has some interesting comments on the continuous dependence of the solution on the problem. The analysis proceeds primarily via maximum principle estimates and compactness arguments. The uniqueness result is confined to conditions very close to thermal equilibrium and is obtained via the implicit function theorem.

Chapter 4 describes the approach to this problem via singular perturbation theory. This is the best chapter in the book, hardly surprising in view of the research interests of the author. There is a very nice theorem showing how the singular perturbation construction approximates the electrostatic potential function associated with a thermal equilibrium solution. Unfortunately, such results have not been obtained for the full system corresponding to nonzero applied voltages. Indeed, the treatment of the current continuity equations is limited essentially to one dimension.

Chapter 5 discusses approximation methods. Unfortunately, the discussion is primarily a derivation of the commonly used methods, not containing convincing convergence proofs. There is a very good discussion, however, of the difficulties occurring when the simplest centered averages are used for the carrier densities in the continuity equations.

This book is a good complement to that of S. Selberherr [1], providing much of the needed detail of the mathematical methods, particularly the discretization methods. I expect that it will be helpful indeed to a considerable number of readers.

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1. S. SELBERHERR, *Analysis and Simulation of Semiconductor Devices*, Springer-Verlag, Vienna and New York, 1984.

25[65-06].— D. F. GRIFFITHS & G. A. WATSON (Editors), *Numerical Analysis*, Pitman Research Notes in Mathematics Series, Vol. 140, Longman Scientific & Technical, copublished in the U.S. by John Wiley, New York, 1986, vi + 262 pp., 24 cm. Price $24.95.

These are the proceedings of the 11th Dundee Biennial Conference on Numerical Analysis held at the University of Dundee June 25–28, 1985. They contain the complete versions of 16 invited lectures, as well as the titles of 80 contributed talks. The range of topics covered is quite broad.

W. G.

26[53-01, 68U05].— J. A. GREGORY (Editor), *The Mathematics of Surfaces*, The Institute of Mathematics and its Applications Conference Series, Vol. 6, Clarendon Press, Oxford, 1986, xi + 282 pp., 24 cm. Price $49.00.

From the Preface: "This book contains the proceedings of the conference 'The Mathematics of Surfaces' organized by the Institute of Mathematics and its Applications and held at the University of Manchester from 17th–19th September, 1984.

The main aim of the conference was to consider mathematical techniques suitable for the description and analysis of surfaces in three dimensions, and to consider the application of such techniques in areas such as 'computer-aided geometric design'.

The papers range from those of an introductory nature to ones of a more advanced or specialist character.

The book begins with expository papers on the basic mathematical tools of computational geometry, classical differential geometry, parametric representations for computer aided design and differential forms. Further papers deal with algorithms for multivariate splines, recursive division techniques, surface-surface intersections, principal surface patches including cyclide surfaces, N-sided patches, Gaussian curvature and shell structures, and flexible surface structures."

W. G.

27[76-06, 76-08].—K. W. MORTON & M. J. BAINES (Editors), *Numerical Methods for Fluid Dynamics II*, The Institute of Mathematics and its Applications Conference Series, New Series, No. 7, Oxford Univ. Press, Oxford, 1986, xv + 679 pp., 24 cm. Price \$95.00.

This volume is based on the proceedings of a conference held in Reading in April 1985. The purpose of the conference was to review recent advances in mathematical and computational techniques for modelling fluid flows. The emphasis is on various forms of discretization (particle, spectral or vortex models, finite difference and finite element approaches, and alternative choices of dependent variables), adaptive modelling, and the solution of systems of linear and nonlinear equations arising in discretized models of fluid flow. There are two sections: the first containing 14 invited papers, arranged in the order in which they were presented at the conference, the second containing 23 contributed papers arranged in the same way.

W. G.

28[65A05].—HERBERT E. SALZER & NORMAN LEVINE, *Supplement to Table of Sines and Cosines to Ten Decimal Places at Thousandths of a Degree*, Applied Science Publications, New York, 1986, 68pp., $23\frac{1}{2}$cm. Price \$3.50.

This supplement to the authors' table of sines and cosines, reviewed in [1], consists of two appendices following an introductory note.

Appendix I presents a detailed proof that the computational error in linear inverse interpolation by any method does not exceed the tabular uncertainty error, as stated on pages xi–xii in the original table.

Appendix II consists of a table of decimal values of $\sin x$ in floating-point form to 10S for $x = 0°(0.001°)5.740°$, which correspond to the values of $\cos x$ for $x = 90°(-0.001°)84.260°$, as noted in the title of the table. As a partial check on the accuracy of this table, the reviewer successfully compared every tenth entry with the corresponding entry in [2].

The introductory note explains why linear interpolation in the supplementary table yields accuracy to ten significant figures, which in particular represents a gain of four significant figures beyond that obtained from the sine values at the beginning of the original table. Also included in this note is a list of all known corrections in the original work. Most of these have been previously reported [1], [3].

The authors have herewith completed tables that together yield decimal values of sine and cosine to 10S accuracy everywhere, using only linear interpolation.

J. W. W.

1. Review **35**, *Math. Comp.*, v. 17, 1963, pp. 304–305.

2. NATIONAL BUREAU OF STANDARDS, *Table of Sines and Cosines to Fifteen Decimal Places at Hundredths of a Degree*, Applied Mathematics Series, No. 5, U. S. Government Printing Office, Washington, D. C., 1949.

3. Table Erratum **604**, *Math. Comp.*, v. 43, 1984, p. 346.

29 [11R23].—REIJO ERNVALL & TAUNO METSÄNKYLÄ, "Tables of the Iwasawa λ-invariant," 107 pages of computer output deposited in the UMT file.

These tables were prepared in connection with the work [1] which appears elsewhere in this issue. They contain the components of the λ^--invariant of $Q(\zeta_p, \sqrt{m})$, where p and m range through the following values (m squarefree):

$$\begin{array}{rcl} p = 3 & \text{and} & -3235 \leqslant m \leqslant 3454, \\ p = 5 & \text{and} & -5000 < m \leqslant 3147, \\ p = 7 & \text{and} & -3002 \leqslant m < 1000, \\ p = 11 & \text{and} & -1000 < m < 500. \end{array}$$

The computations were carried out on the DEC-20 computer at the University of Turku.

AUTHORS' SUMMARY

1. REIJO ERNVALL & TAUNO METSÄNKYLÄ, "A method for computing the Iwasawa λ-invariant," *Math. Comp.*, v. 49, 1987, pp. 281–294.