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"ADVANCED ENGINEERING MATHEMATICS"

By *Ladis D. Kovach*

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What is the engineer's role in society? How does mathematics assist the engineer? What mathematical skills does an engineer need? Who is best equipped to teach him these skills? Should he receive a shallow treatment of a great variety of different mathematical topics or a thorough treatment of a few?

These are but a few of the many questions that must constantly occupy the minds of faculty members in any institutions that train future engineers; and anybody intending to write a

mathematics textbook for students of modern engineering science must address himself to them. The resulting book will, inevitably, reflect the author's perceptions of what constitutes a suitable mathematical training for the engineer who will tackle tomorrow's problems.

In the preface of the book under review, the author declares "that *design* is the primary function of an engineer"; and that "a prerequisite for design is *analysis*". He goes on to announce his purpose in writing the book: "our objective is to demonstrate in a number of ways how an engineer might strip a problem of worldly features that are unimportant complexities, approximate the problem by means of a mathematical representation, and analyze *this*." In this respect, the author's intentions are no different to those of writers of similar books in which mathematical modelling is used to come to grips with physical problems.

A number of mathematical techniques that are used in engineering analysis are discussed in the text. The chapter headings may convey some idea of the material covered in the book:

1. First-Order Ordinary Differential Equations;
2. Higher-Order Differential Equations;
3. The Laplace Transformation;
4. Linear Algebra;
5. Vector Calculus;
6. Partial Differential Equations;
7. Fourier Series and Fourier Integrals;
8. Boundary-Value Problems in Rectangular Coordinates;
9. Boundary-Value Problems in Other Coordinate Systems;
10. Complex Variables.

The material is arranged so that a topic is not introduced until it is needed. Thus, applications of the Laplace transformation to the solution of linear systems of differential equations motivate an examination of systems of algebraic equations; hence the reason why Chapter 4 follows from Chapter 3. Again, conformal mapping is treated in the last chapter because a need for it was anticipated in the earlier chapters. In this way, the author carries out his plan to write the text so that the topics flow from one to the next.

Over 2000 exercises are given. Some of these are meant to elucidate points in the text, others are designed to provide drill for the student, while a third group is meant to challenge the student's understanding of the techniques used. Answers and hints to selected exercises are presented. Several of the exercises are incorrectly stated.

The book is well-written, very readable and has been very carefully proofread. I detected only five typographical errors - on p. 443, ℓ.11; p. 597, ℓ.13; p. 621, ℓ.17; p. 622, ℓ.1 and p. 635, ℓ.1 - and these are obvious and not likely to trouble the reader.

A feature of the book is the number of very brief biographical sketches that the author gives, either in the body of the text or in footnotes. Indeed, I know of very few books where one is likely to learn the names and origins of so many mathematicians whose work has made an impact in engineering. However, I could not help noticing that the author could not decide on Sir William Rowan Hamilton's nationality: he is referred to as an English mathematician on p. 227 and as an Irish mathematician on p. 275. On the other hand, George G. Stokes is referred to as an Anglo-Irish mathematical physicist. Still, it is nice to see homage paid to our predecessors'.

A few "howlers" have crept into the book. For instance, it is mentioned on p. 597 that " ... some sets cannot be classified as open or closed. The set (of complex numbers z satisfying) $1 \leq \text{Re} z \leq 2$ is such a set (Exercise 1)." The answer to Exercise 1 reveals why: "The set is not closed since it has no boundary in the y-direction"! Again, on p. 621 it is asserted that Cauchy's integral formula (giving the value of an analytic function at a point interior to a simple closed curve in terms of its values on the curve) " ... is called a *formula* because it shows that the value of an analytic function at an isolated singularity can be calculated by means of a contour integral!

Considering the importance of Fourier analysis in applications, it is a little surprising to find on p. 422 the statement "that the convergence problem for a Fourier series is still unsolved." One would have thought that, by now, Lennart Carleson's 1967 result about the almost everywhere convergence of the Fourier series of a square-integrable function would have filtered through to most mathematicians who teach engineering students.

How does the book compare with others on the market? I tested it against two books with exactly the same title, one by Erwin Kreyszig, published by John Wiley & Sons Inc., 1979, 4th ed., and the other by C. Ray Wylie and Louis C. Barrett, published by McGraw-Hill International Book Company, 1982, 5th ed. The first editions of both of these appeared in 1962, and are very highly regarded. In my opinion, the book under review is unlikely to challenge either of them in the market place.

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