either $|X| \leq \omega$ or $|X| = 2^\omega$. Some of the proof can be found in [5].

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## Book Review

# DIFFERENTIAL EQUATIONS: A DYNAMICAL SYSTEMS APPROACH, PART I

Texts in Applied Mathematics 5

J. H. Hubbard and B. H. West

Springer-Verlag, 1991, 348 pages,
ISBN 0-387-97286-2.

**Reviewed by** Donal O'Regan

The book of Hubbard and West provides roughly about one third of a year's undergraduate course in ordinary differential equations for senior undergraduate mathematics students. The authors give a very nice up to date treatment of first order (one dimensional) ordinary differential equations in normal form, namely $x' = f(t, x)$; their own software package MacMath is used and referred to throughout the text to compliment the material.

The book consists of five chapters. Chapter 1 is devoted to qualitative description of solutions; Hubbard and West begin with a discussion of such standard topics as direction fields and computer graphics. However the major part of the chapter is devoted to the introduction of the terms fences, funnels and antifunnels. The authors motivate and illustrate very convincingly how these concepts can be used to examine the behaviour of solutions. Chapter 2 discusses standard methods for solving differential equations analytically; here Hubbard and West provide some lovely insights into some very well known problems. Numerical solutions of differential equations are examined in chapter 3. Here the standard one step methods are discussed and again a very nice treatment is given. Chapter 4 is devoted to the study of existence and uniqueness of solutions. In addition the error bounds stated in chapter 3 are deduced using the ideas (in particular a Dieudonné type inequality) of this section. The final chapter in this book examines iteration methods. This leads naturally to a discussion of intervals of stability for numerical solutions of ordinary differential equations. Hubbard and West finish with a very brief discussion of iteration in one complex dimension.

Overall this book provides an interesting and enlightening introduction to the theory of ordinary differential equations. However in teaching a course on this subject I feel that the book would be more suitable as a supplementary or reference text. The reason for this is that certain sections would have to be optional reading and therefore the main text would only cover about one third of a course. Hence another book would be required and this is far too costly to the student! The book is surprisingly free of typo's; the few I did find are hardly worth mentioning.

Hubbard and West's book will be of interest to those who at some stage were influenced, motivated, frustrated or even baffled by the theory of differential equations. Differential Equations: A Dynamical Systems Approach will provide some of the answers. Moreover it will motivate one to explore more; it is certainly a credit and does credit to the elegant theory of differential equations. If the reader receives even half the pleasure this reviewer obtained from this book then he or she will have purchased wisely. The book is that good.

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**Book Review**

## FUNCTIONAL ANALYSIS AND LINEAR OPERATOR THEORY

Carl L. DeVito

Addison-Wesley, 1990,
ISBN 0 201 11941 2

**Reviewed by** A. Christofides

This is a book with a strong personal flavour and a clear sense of purpose. The author explains in the preface that it is based on courses he gave over the years, which were designed not only for students of mathematics, but also for advanced engineering and science students. As one reads, one soon realises that there is a central theme. This theme is the spectral theory of linear operators—the whole book is designed to lead rapidly to the description of this theory and to the formulation and proof of its main theorems. The mathematical prerequisites are, a sound knowledge of basic analysis and linear algebra and familiarity with the elements of general topology. With such equipment, progress will be swift, and one will soon be immersed in the main topic. Some of the material that one might perhaps expect in a general introduction to functional analysis is left out, while other topics, such as fixed point theorems, are treated parenthetically, as illustrations, rather than for their own sake. Naturally, a lot of important basic material is necessary in order to understand spectral theory and this is discussed both carefully and concisely.

A long first chapter covers all this introductory material: We are introduced to normed vector spaces, Hilbert spaces and, in particular, to $L^2[a,b]$ and to $l^2$. Here there is no compromise with regard to precision, and the definition of $L^2$ is preceded by a brief section on Lebesgue outer measure and Lebesgue measurable sets.