

THE REAL AND
COMPLEX NUMBER SYSTEMS

1.1 INTRODUCTION

Mathematical analysis studies concepts related in some way to real numbers, so we begin our study of analysis with a discussion of the real-number system.

Several methods are used to introduce real numbers. One method starts with the positive integers 1, 2, 3, ... as undefined concepts and uses them to build a larger system, the positive *rational numbers* (quotients of positive integers), their negatives, and zero. The rational numbers, in turn, are then used to construct the *irrational numbers*, real numbers like $\sqrt{2}$ and π which are not rational. The rational and irrational numbers together constitute the real-number system.

Although these matters are an important part of the foundations of mathematics, they will not be described in detail here. As a matter of fact, in most phases of analysis it is only the *properties* of real numbers that concern us, rather than the methods used to construct them. Therefore, we shall take the real numbers themselves as undefined objects satisfying certain axioms from which further properties will be derived. Since the reader is probably familiar with most of the properties of real numbers discussed in the next few pages, the presentation will be rather brief. Its purpose is to review the important features and persuade the reader that, if it were necessary to do so, all the properties could be traced back to the axioms. More detailed treatments can be found in the references at the end of this chapter.

For convenience we use some elementary set notation and terminology. Let S denote a set (a collection of objects). The notation $x \in S$ means that the object x is in the set S , and we write $x \notin S$ to indicate that x is not in S .

A set S is said to be a *subset* of T , and we write $S \subseteq T$, if every object in S is also in T . A set is called *nonempty* if it contains at least one object.

We assume there exists a nonempty set $\mathbf{R}$ of objects, called real numbers, which satisfy the ten axioms listed below. The axioms fall in a natural way into three groups which we refer to as the *field axioms*, the *order axioms*, and the *completeness axiom* (also called the *least-upper-bound axiom* or the *axiom of continuity*).

1.2 THE FIELD AXIOMS

Along with the set $\mathbf{R}$ of real numbers we assume the existence of two operations, called *addition* and *multiplication*, such that for every pair of real numbers x and y

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Some Iterative Solutions in Optimal Control John B. Plant, 1968 *Limits, Series, and Fractional Part Integrals* Ovidiu Furdui, 2013-05-30 This book features challenging problems of classical analysis that invite the reader to explore a host of strategies and tools used for solving problems of modern topics in real analysis This volume offers an unusual collection of problems many of them original specializing in three topics of mathematical analysis limits series and fractional part integrals The work is divided into three parts each containing a chapter dealing with a particular problem type as well as a very short section of hints to select problems The first chapter collects problems on limits of special sequences and Riemann integrals the second chapter focuses on the calculation of fractional part integrals with a special section called Quickies which contains problems that have had unexpected succinct solutions The final chapter offers the reader an assortment of

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Time Domain Models of Physical Systems and Existence of Solutions John Lyle Wirth,1962 **Student Solutions Manual for Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences** Ernest Haeussler,Richard Paul,Richard Wood,2009-12-24

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Indiana University Mathematics Journal ,1971 Advanced Calculus Leonard F. Richardson,2008-04-25 Advanced Calculus reflects the unifying role of linear algebra to smooth readers transition to advanced mathematics It fosters the development of complete theorem proving skills through abundant exercises for which answers are provided at the back of the book The traditional theorems of elementary differential and integral calculus are rigorously established presenting the foundations of calculus in a way that reorients thinking toward modern analysis

SIAM Journal on Applied Mathematics Society for Industrial and Applied Mathematics,1966 Contains research articles on mathematical methods and their applications in the physical engineering biological and medical sciences Real Analysis

Polaso,1991 The Numerical Treatment of Integral Equations Christopher T. H. Baker,1977 This book is concerned with the numerical analysis of integral equations We are not principally concerned with the abstract theory of integral equations nor with applications of mathematics where integral equations arise but the first chapter is devoted to a review of the theory of integral equations The survey of certain aspects of numerical analysis in chapter 2 is intended to emphasize various topics which are of relevance in the study of numerical methods for integral equations

Turkish Journal of Mathematics ,2006 **Seminar on Differential Equations and Dynamical Systems** G. S. Jones,1968 **Mathematics Magazine** ,1994

Reviews in Number Theory, as Printed in Mathematical Reviews, 1940 Through 1972, Volumes 1-44 Inclusive William Judson LeVeque,1974 Journal of the Society for Industrial and Applied Mathematics Society for Industrial and Applied

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