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Intelligent Routines

Solving Mathematical Analysis with Matlab, Mathcad, Mathematica and Maple

Springer

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”Homines dum docent discunt.”

Seneca, Epistole 7

”Nihil est in intellectu, quod non prius fuerit in sensu.”

John Locke

”Les beaux (grands) esprits se rencontrent.”

Voltaire

”Men should be what they seem,
Or those that be not, would they might seem none.”

Shakespeare, Othello III. 3

”Science needs a man’s whole life. And even if you had two lives, they would not be enough. It is great passion and strong effort that science demands to men ...”

I. P. Pavlov

"Speech is external thought, and thought internal speech."

A. Rivarol

"Nemo dat quod non habet."

Latin expression

"Scientia nihil aliud est quam veritatis imago."

Bacon, Novum Organon

Preface

Real Analysis is a discipline of intensive study in many institutions of higher education, because it contains useful concepts and fundamental results in the study of mathematics and physics, of the technical disciplines and geometry.

This book is the first one of the kind that solves mathematical analysis problems with all four related main software Matlab, Mathcad, Mathematica and Maple.

Besides the fundamental theoretical notions, the book contains many exercises, solved both mathematically and by computer, using: Matlab 7.9, Mathcad 14, Mathematica 8 or Maple 15 programming languages.

Due to the diversity of the concepts that the book contains, it is addressed not only to the students of the Engineering or Mathematics faculties but also to the students at the master's and PhD levels, which study Real Analysis, Differential Equations and Computer Science.

The book is divided into nine chapters, which illustrate the application of the mathematical concepts using the computer. The introductory section of each chapter presents concisely, the fundamental concepts and the elements required to solve the problems contained in that chapter. Each chapter finishes with some problems left to be solved by the readers of the book and can verified for the correctness of their calculations using a specific software such as Matlab, Mathcad, Mathematica or Maple.

The first chapter presents some basic concepts about the theory of sequences and series of numbers.

The second chapter is dedicated to the power series, which are particular cases of series of functions and that have an important role for some practical applications; for example, using the power series we can find the approximate values of some functions so we can appreciate the precision of a computing method.

In the third chapter are treated some elements of the differentiation theory of functions.

The fourth chapter presents some elements of Vector Analysis with applications to physics and differential geometry.

The fifth chapter presents some notions of implicit functions and extremes of functions of one or more variables.

Chapter six is dedicated to integral calculus, which is useful to solve various geometric problems and to mathematical formulation of some concepts from physics.

Seventh chapter deals with the study of the differential equations and systems of differential equations that model the physical processes.

The chapter eight deals with the line and double integrals. The line integral is a generalization of the simple integral and allows the understanding of some concepts from physics and engineering; the double integral has a meaning analogous to that of the simple integral: like the simple definite integral is the area bordered by a curve, the double integral can be interpreted as the volume bounded by a surface.

The last chapter is dedicated to the triple and surface integral calculus. Although it is not possible a geometric interpretation of the triple integral, mechanically speaking, this integral can be interpreted as a mass, being considered as the distribution of the density in the respective space. The surface integral is a generalization of the double integral in some plane domains, as the line integral generalizes the simple definite integral.

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