1. Record Nr. UNINA9910647396803321

Autore	Popescu Sever Angel
Titolo	Advanced Mathematics for Engineers and Physicists / / by Sever Angel Popescu, Marilena Jianu
Pubbl/distr/stampa	Cham : , : Springer International Publishing : , : Imprint : Springer, , 2022
ISBN	3-031-21502-8
Edizione	[1st ed. 2022.]
Descrizione fisica	1 online resource (833 pages)
Disciplina	620.00151
Soggetti	Mathematical analysis Probabilities Mathematical optimization Calculus of variations Differential equations Analysis Probability Theory Calculus of Variations and Optimization Differential Equations Matemàtica per a enginyers Física matemàtica Llibres electrònics
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Intro -- Preface -- Contents -- Basic Notations -- Sets -- Hyperbolic Functions -- Euler Integrals -- 1 First-Order Differential Equations -- 1.1 Introduction to Ordinary Differential Equations -- 1.2 Separable Equations -- 1.3 Homogeneous Equations -- 1.4 First-Order Linear Differential Equations -- 1.5 Bernoulli Equations -- 1.6 Riccati Equations -- 1.7 Exact Differential Equations -- 1.8 Lagrange Equations and Clairaut Equations -- 1.9 Existence and Uniqueness of Solution of the Cauchy Problem -- 1.10 Exercises -- 2 Higher-Order Differential Equations -- 2.1 Introduction -- 2.2 Homogeneous Linear Differential Equations of Order n -- 2.3 Non-Homogeneous Linear

Differential Equations of Order n -- 2.4 Homogeneous Linear Equations with Constant Coefficients -- 2.5 Nonhomogeneous Linear Equations with Constant Coefficients -- 2.6 Euler Equations -- 2.7 Exercises -- 3 Systems of Differential Equations -- 3.1 Introduction -- 3.2 First-Order Systems and Differential Equations of Order n -- 3.3 Linear Systems of Differential Equations -- 3.4 Linear Systems with Constant Coefficients -- 3.4.1 The Homogeneous Case (the Algebraic Method) -- 3.4.2 The Non-Homogeneous Case (the Method of Undetermined Coefficients) -- 3.4.2.1 The Diagonalizable Case -- 3.4.2.2 The Non-Diagonalizable Case -- 3.4.3 Matrix Exponential and Linear Systems with Constant Coefficients -- 3.4.3.1 Fundamental Matrix -- 3.4.3.2 Matrix Exponential -- 3.4.3.3 The Exponential of a Diagonalizable Matrix -- 3.4.3.4 The Exponential of a Nondiagonalizable Matrix -- 3.4.4 Elimination Method for Linear Systems with Constant Coefficients -- 3.5 Autonomous Systems of Differential Equations -- 3.6 First-Order Partial Differential Equations -- 3.6.1 Linear Homogeneous First-Order PDE -- 3.6.2 Quasilinear First-Order Partial Differential Equations -- 3.7 Exercises -- 4 Fourier Series.
4.1 Introduction: Periodic, Piecewise Smooth Functions -- 4.1.1 Periodic Functions -- 4.1.2 Piecewise Continuous and Piecewise Smooth Functions -- 4.2 Fourier Series Expansions -- 4.2.1 Series of Functions -- 4.2.2 A Basic Trigonometric System -- 4.2.3 Fourier Coefficients -- 4.3 Orthogonal Systems of Functions -- 4.3.1 Inner Product -- 4.3.2 Best Approximation in the Mean: Bessel's Inequality -- 4.4 The Convergence of Fourier Series -- 4.5 Differentiation and Integration of the Fourier Series -- 4.6 The Convergence in the Mean: Complete Systems -- 4.7 Examples of Fourier Expansions -- 4.8 The Complex form of the Fourier Series -- 4.9 Exercises -- 5 Fourier Transform -- 5.1 Improper Integrals -- 5.2 The Fourier Integral Formula -- 5.3 The Fourier Transform -- 5.4 Solving Linear Differential Equations -- 5.5 Moments Theorems -- 5.6 Sampling Theorem -- 5.7 Discrete Fourier Transform -- 5.8 Exercises -- 6 Laplace Transform -- 6.1 Introduction -- 6.2 Properties of the Laplace Transform -- 6.3 Inverse Laplace Transform -- 6.4 Solving Linear Differential Equations -- 6.5 The Dirac Delta Function -- 6.6 Exercises -- 7 Second-Order Partial Differential Equations -- 7.1 Classification: Canonical Form -- 7.2 The Wave Equation -- 7.2.1 Infinite Vibrating String: D'Alembert Formula -- 7.2.2 Finite Vibrating String: Fourier Method -- 7.2.3 Laplace Transform Method for the Vibrating String -- 7.2.4 Vibrations of a Rectangular Membrane: Two-Dimensional Wave Equation -- 7.3 Vibrations of a Simply Supported Beam: Fourier Method -- 7.4 The Heat Equation -- 7.4.1 Modeling the Heat Flow from a Body in Space -- 7.4.2 Heat Flow in a Finite Rod: Fourier Method -- 7.4.3 Heat Flow in an Infinite Rod -- 7.4.4 Heat Flow in a Rectangular Plate -- 7.5 The Laplace's Equation -- 7.5.1 Dirichlet Problem for a Rectangle -- 7.5.2 Dirichlet Problem for a Disk -- 7.6 Exercises.
8 Introduction to the Calculus of Variations -- 8.1 Classical Variational Problems -- 8.2 General Frame of Calculus of Variations -- 8.3 The Case F[y]=abF(x,y,y) dx -- 8.4 The Case F[y]=ab F(x, y, y,…,y(n)) dx -- 8.5 The Case F[y1,…,yn]=abF(x,y1,…,yn,y1,…,yn) dx -- 8.6 The Case F [z]=@D F (x,y,z,zx, zy)dxdy -- 8.7 Isoperimetric Problems and Geodesic Problems -- 8.7.1 Isoperimetric Problems -- 8.7.2 Geodesic Problems -- 8.8 Exercises -- 9 Elements of Probability Theory -- 9.1 Sample Space: Event Space -- 9.2 Probability Space -- 9.3 Conditional Probability: Bayes Formula -- 9.4 Discrete Random Variables -- 9.4.1 Random Variables -- 9.4.2 Expected Value -- Moments -- 9.4.3 Variance -- 9.4.4 Discrete Uniform Distribution -- 9.4.5 Bernoulli Distribution -- 9.4.6 Binomial Distribution -- 9.4.7

Poisson Distribution -- 9.4.8 Geometric Distribution -- 9.5 Continuous Random Variables -- 9.5.1 The Probability Density Function -- The Distribution Function -- 9.5.2 Expected Value, Moments and Variance for Continuous Random Variables -- 9.5.3 Characteristic Function -- 9.5.4 The Uniform Distribution -- 9.5.5 The Exponential Distribution -- 9.5.6 The Normal Distribution -- 9.5.7 Gamma Distribution -- 9.5.8 Chi-Squared Distribution -- 9.5.9 Student t-Distribution -- 9.6 Limit Theorems -- 9.7 Exercises -- 10 Answers and Solutions to Exercises -- 10.1 Chapter 1 -- 10.2 Chapter 2 -- 10.3 Chapter 3 -- 10.4 Chapter 4 -- 10.5 Chapter 5 -- 10.6 Chapter 6 -- 10.7 Chapter 7 -- 10.8 Chapter 8 -- 10.9 Chapter 9 -- 11 Supplementary Materials -- 11.1 Normed, Metric and Hilbert Spaces -- 11.1.1 Normed Vector Spaces -- 11.1.2 Sequences and Series of Functions -- 11.1.3 Metric Spaces. Some Density Theorems -- 11.1.4 The Fields Q, R and C -- 11.1.5 Hilbert Spaces -- 11.1.6 Continuous Functions and Step Functions -- 11.1.7 Orthonormal Systems in a Hilbert Space.
11.2 Complex Function Theory -- 11.2.1 Differentiability of Complex Functions -- 11.2.2 Integration of Complex Functions -- 11.2.3 Power Series Representation -- 11.2.4 Residue Theorem and Applications -- Bibliography -- Index.

Sommario/riassunto

This book is designed to be an introductory course to some basic chapters of Advanced Mathematics for Engineering and Physics students, researchers in different branches of Applied Mathematics and anyone wanting to improve their mathematical knowledge by a clear, live, self-contained and motivated text. Here, one can find different topics, such as differential (first order or higher order) equations, systems of differential equations, Fourier series, Fourier and Laplace transforms, partial differential equations, some basic facts and applications of the calculus of variations and, last but not least, an original and more intuitive introduction to probability theory. All these topics are carefully introduced, with complete proofs, motivations, examples, applications, problems and exercises, which are completely solved at the end of the book. We added a generous supplementary material (11.1) with a self-contained and complete introduction to normed, metric and Hilbert spaces. Since we used some topics from complex function theory, we also introduced in Chapter 11 a section (11.2) with the basic facts in this important field. What a reader needs for a complete understanding of this book? For a deep understanding of this book, it is required to take a course in undergraduate calculus and linear algebra. We mostly tried to use the engineering intuition instead of insisting on mathematical tricks. The main feature of the material presented here is its clarity, motivation and the genuine desire of the authors to make extremely transparent the "mysterious" mathematical tools that are used to describe and organize the great variety of impressions that come to the searching mind, from the infinite complexity of Nature. The book is recommended not only to engineering and physics students or researchers but also to junior students in mathematics because it shows the connection between pure mathematics and physical phenomena, which always supply motivations for mathematical discoveries.