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variables

*An authorised reissue of the long out of print classic textbook, Advanced Calculus by the late Dr Lynn Loomis and Dr Shlomo Sternberg both of Harvard University has been a revered but hard to find textbook for the advanced calculus course for decades. This book is based on an honors course in advanced calculus that the authors gave in the 1960's. The foundational material, presented in the unstarred sections of Chapters 1 through 11, was normally covered, but different applications of this basic material were stressed from year to year, and the book therefore contains more material than was covered in any one year. It can accordingly be used (with omissions) as a text for a year's course in advanced calculus, or as a text for a three-semester introduction to analysis. The prerequisites are a good grounding in the calculus of one variable from a mathematically rigorous point of view, together with some acquaintance with linear algebra. The reader should be familiar with limit and continuity type arguments and have a certain amount of mathematical sophistication. As possible introductory texts, we mention Differential and Integral Calculus by R Courant, Calculus by T Apostol, Calculus by M Spivak, and Pure Mathematics by G Hardy. The reader should also have some experience with partial derivatives. In overall plan the book divides roughly into a first half which develops the calculus (principally the differential calculus) in the setting of normed vector spaces, and a second half which deals with the calculus of differentiable manifolds. Multivariable Mathematics combines linear algebra and multivariable mathematics in a rigorous*

approach. The material is integrated to emphasize the recurring theme of implicit versus explicit that persists in linear algebra and analysis. In the text, the author includes all of the standard computational material found in the usual linear algebra and multivariable calculus courses, and more, interweaving the material as effectively as possible, and also includes complete proofs. \* Contains plenty of examples, clear proofs, and significant motivation for the crucial concepts. \* Numerous exercises of varying levels of difficulty, both computational and more proof-oriented. \* Exercises are arranged in order of increasing difficulty. This book is aimed at mathematics students, typically in the second year of a university course. The first chapter, however, is suitable for first-year students. Differentiable functions are treated initially from the standpoint of approximating a curved surface locally by a flat surface. This enables both geometric intuition, and some elementary matrix algebra, to be put to effective use. In Chapter 2, the required theorems - chain rule, inverse and implicit function theorems, etc- are stated, and proved (for  $n$  variables), concisely and rigorously. Chapter 3 deals with maxima and minima, including problems with equality and inequality constraints. The chapter includes criteria for discriminating between maxima, minima and saddlepoints for constrained problems; this material is relevant for applications, but most textbooks omit it. In Chapter 4, integration over areas, volumes, curves and surfaces is developed, and both the change-of-variable formula, and the Gauss-Green-Stokes set of theorems are obtained. The integrals are defined with approximative sums (expressed concisely by using step-functions); this preserves

some geometrical (and physical) concept of what is happening. Consequent on this, the main ideas of the 'differential form' approach are presented, in a simple form which avoids much of the usual length and complexity. Many examples and exercises are included. Intended for students who have already completed a one-year course in elementary calculus, this two-part treatment advances from functions of one variable to those of several variables.

*Solutions.* 1971 edition. This text was produced for the second part of a two-part sequence on advanced calculus, whose aim is to provide a firm logical foundation for analysis. The first part treats analysis in one variable, and the text at hand treats analysis in several variables. After a review of topics from one-variable analysis and linear algebra, the text treats in succession multivariable differential calculus, including systems of differential equations, and multivariable integral calculus. It builds on this to develop calculus on surfaces in Euclidean space and also on manifolds. It introduces differential forms and establishes a general Stokes formula. It describes various applications of Stokes formula, from harmonic functions to degree theory. The text then studies the differential geometry of surfaces, including geodesics and curvature, and makes contact with degree theory, via the Gauss-Bonnet theorem. The text also takes up Fourier analysis, and bridges this with results on surfaces, via Fourier analysis on spheres and on compact matrix groups. This self-contained textbook gives a thorough exposition of multivariable calculus. The emphasis is on correlating general concepts and results of multivariable calculus with their counterparts in one-variable calculus. Further, the book

*includes genuine analogues of basic results in one-variable calculus, such as the mean value theorem and the fundamental theorem of calculus. This book is distinguished from others on the subject: it examines topics not typically covered, such as monotonicity, bimonotonicity, and convexity, together with their relation to partial differentiation, cubature rules for approximate evaluation of double integrals, and conditional as well as unconditional convergence of double series and improper double integrals. Each chapter contains detailed proofs of relevant results, along with numerous examples and a wide collection of exercises of varying degrees of difficulty, making the book useful to undergraduate and graduate students alike. This book is designed primarily for undergraduates in mathematics, engineering, and the physical sciences. Rather than concentrating on technical skills, it focuses on a deeper understanding of the subject by providing many unusual and challenging examples. The basic topics of vector geometry, differentiation and integration in several variables are explored. It also provides numerous computer illustrations and tutorials using MATLAB® and Maple®, that bridge the gap between analysis and computation. Features:*

- Includes numerous computer illustrations and tutorials using MATLAB® and Maple®*
- Covers the major topics of vector geometry, differentiation, and integration in several variables*
- Instructors' ancillaries available upon adoption*

*Multivariable Calculus with Mathematica is a textbook addressing the calculus of several variables. Instead of just using Mathematica to directly solve problems, the students are encouraged to learn the syntax and to write their own code*

to solve problems. This not only encourages scientific computing skills but at the same time stresses the complete understanding of the mathematics. Questions are provided at the end of the chapters to test the student's theoretical understanding of the mathematics, and there are also computer algebra questions which test the student's ability to apply their knowledge in non-trivial ways. Features

Ensures that students are not just using the package to directly solve problems, but learning the syntax to write their own code to solve problems Suitable as a main textbook for a Calculus III course, and as a supplementary text for topics scientific computing, engineering, and mathematical physics Written in a style that engages the students' interest and encourages the understanding of the mathematical ideas Wiley is proud to publish a new revision of this successful classic text known for its elegant writing style, precision and perfect balance of theory and applications. The Tenth Edition is refined to offer students an even clearer understanding of calculus and insight into mathematics. It includes a wealth of rich problem sets which makes calculus relevant for students. Salas/Hille/Etgen is recognized for its mathematical integrity, accuracy, and clarity. Applied Mathematics: Body & Soul is a mathematics education reform project developed at Chalmers University of Technology and includes a series of volumes and software. The program is motivated by the computer revolution opening new possibilities of computational mathematical modeling in mathematics, science and engineering. It consists of a synthesis of Mathematical Analysis (Soul), Numerical Computation (Body) and Application. Volumes I-III present a modern version of

*Calculus and Linear Algebra, including constructive/numerical techniques and applications intended for undergraduate programs in engineering and science. Further volumes present topics such as Dynamical Systems, Fluid Dynamics, Solid Mechanics and Electro-Magnetics on an advanced undergraduate/graduate level. The authors are leading researchers in Computational Mathematics who have written various successful books. This new, revised edition covers all of the basic topics in calculus of several variables, including vectors, curves, functions of several variables, gradient, tangent plane, maxima and minima, potential functions, curve integrals, Green's theorem, multiple integrals, surface integrals, Stokes' theorem, and the inverse mapping theorem and its consequences. It includes many completely worked-out problems. This superb and self-contained work is an introductory presentation of basic ideas, structures, and results of differential and integral calculus for functions of several variables. The wide range of topics covered include the differential calculus of several variables, including differential calculus of Banach spaces, the relevant results of Lebesgue integration theory, and systems and stability of ordinary differential equations. An appendix highlights important mathematicians and other scientists whose contributions have made a great impact on the development of theories in analysis. This text motivates the study of the analysis of several variables with examples, observations, exercises, and illustrations. It may be used in the classroom setting or for self-study by advanced undergraduate and graduate students and as a valuable reference for researchers in mathematics, physics, and engineering. Two-*

*dimensional calculus is vital to the mastery of the broader field, and this text presents an extensive treatment. Advantages include the thorough integration of linear algebra and development of geometric intuition. 1986 edition. This fifth edition of Lang's book covers all the topics traditionally taught in the first-year calculus sequence. Divided into five parts, each section of A FIRST COURSE IN CALCULUS contains examples and applications relating to the topic covered. In addition, the rear of the book contains detailed solutions to a large number of the exercises, allowing them to be used as worked-out examples -- one of the main improvements over previous editions. This book uses elementary versions of modern methods found in sophisticated mathematics to discuss portions of "advanced calculus" in which the subtlety of the concepts and methods makes rigor difficult to attain at an elementary level. A new revision of this successful classic text known for its elegant writing style, precision and perfect balance of theory and applications. This Ninth Edition is refined to offer students an even clearer understanding of calculus and insight into mathematics. It includes a wealth of rich problem sets which give relevance to calculus for students. Salas, Hille. and Etgen are recognized for their mathematical integrity, accuracy, and clarity. Key features that make this text an outstanding learning tool include:*

*Precision and Clarity: Emphasis on mathematical exposition -- an accurate and understandable treatment of topics.*

*Accessibility: Completely accessible to the beginning calculus student without sacrificing approximate mathematics.*

*Balance of Theory and Applications: Problems drawn from the sciences and engineering are used to motivate calculus*



concepts which are then applied to a variety of disciplines through examples and exercises. *ADVANCED CALCULUS OF SEVERAL VARIABLES* covers important topics of Transformations and topology on Euclidean in  $n$ -space  $R^n$  Functions of several variables, Differentiation in  $R^n$ , Multiple integrals and Integration in  $R^n$ . The topics have been presented in a simple clear and coherent style with a number of examples and exercises. Proofs have been made direct and simple. Unsolved problems just after relevant articles in the form of exercises and typical problems followed by suggestions have been given. This book will help the reader work on the problems of Numerical Analysis, Operations Research, Differential Equations and Engineering applications. Modern conceptual treatment of multivariable calculus, emphasizing the interplay of geometry and analysis via linear algebra and the approximation of nonlinear mappings by linear ones. At the same time, ample attention is paid to the classical applications and computational methods. Hundreds of examples, problems and figures. 1973 edition. This book begins with the basics of the geometry and topology of Euclidean space and continues with the main topics in the theory of functions of several real variables including limits, continuity, differentiation and integration. All topics and in particular, differentiation and integration, are treated in depth and with mathematical rigor. The classical theorems of differentiation and integration are proved in detail and many of them with novel proofs. The authors develop the theory in a logical sequence building one theorem upon the other, enriching the development with numerous explanatory remarks and historical footnotes. A

number of well chosen illustrative examples and counter-examples clarify the theory and teach the reader how to apply it to solve problems in mathematics and other sciences and economics. Each of the chapters concludes with groups of exercises and problems, many of them with detailed solutions while others with hints or final answers. More advanced topics, such as Morse's lemma, Brouwer's fixed point theorem, Picard's theorem and the Weierstrass approximation theorem are discussed in starred sections. This new edition, like the first, presents a thorough introduction to differential and integral calculus, including the integration of differential forms on manifolds. However, an additional chapter on elementary topology makes the book more complete as an advanced calculus text, and sections have been added introducing physical applications in thermodynamics, fluid dynamics, and classical rigid body mechanics. This book provides the higher-level reader with a comprehensive review of all important aspects of Differential Calculus, Integral Calculus and Geometric Calculus of several variables. The revised edition, which includes additional exercises and expanded solutions, and gives a solid description of the basic concepts via simple familiar examples which are then tested in technically demanding situations. Readers will gain a deep understanding of the uses and limitations of multivariate calculus.

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