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a textbook of vector calculus

this textbook focuses on one of the most valuable skills in multivariable and vector calculus visualization with over one hundred carefully drawn color images students who have long struggled picturing for example level sets or vector fields will find these abstract concepts rendered with clarity and ingenuity this illustrative approach to the material covered in standard multivariable and vector calculus textbooks will serve as a much needed and highly useful companion emphasizing portability this book is an ideal complement to other references in the area it begins by exploring preliminary ideas such as vector algebra sets and coordinate systems before moving into the core areas of multivariable differentiation and integration and vector calculus sections on the chain rule for second derivatives implicit functions pdes and the method of least squares offer additional depth ample illustrations are woven throughout mastery checks engage students in material on the spot while longer exercise sets at the end of each chapter reinforce techniques an illustrative guide to multivariable and vector calculus will appeal to multivariable and vector calculus students and instructors around the world who seek an accessible visual approach to this subject higher level students called upon to apply these concepts across science and engineering will also find this a valuable and concise resource

vector calculus is the fundamental language of mathematical physics it pro vides a way to describe physical quantities in three dimensional space and the way in which these quantities vary many topics in the physical sciences can be analysed mathematically using the techniques of vector calculus these top ics include fluid dynamics solid mechanics and electromagnetism all of which involve a description of vector and scalar quantities in three dimensions this book assumes no previous knowledge of vectors however it is assumed that the reader has a knowledge of basic calculus including differentiation integration and partial differentiation some knowledge of linear algebra is also required particularly the concepts of matrices and determinants the book is designed to be self contained so that it is suitable for a pro gramme of individual study each of the eight chapters introduces a new topic and to facilitate understanding of the material frequent reference is made to physical applications the physical nature of the subject is clarified with over sixty diagrams which provide an important aid to the comprehension of the new concepts following the introduction of each new topic worked examples are provided it is essential that these are studied carefully so that a full un derstanding is developed before moving ahead like much of mathematics each

section of the book is built on the foundations laid in the earlier sections and chapters

the aim of this book is to facilitate the use of stokes theorem in applications the text takes a differential geometric point of view and provides for the student a bridge between pure and applied mathematics by carefully building a formal rigorous development of the topic and following this through to concrete applications in two and three variables key topics include vectors and vector fields line integrals regular k surfaces flux of a vector field orientation of a surface differential forms stokes theorem and divergence theorem this book is intended for upper undergraduate students who have completed a standard introduction to differential and integral calculus for functions of several variables the book can also be useful to engineering and physics students who know how to handle the theorems of green stokes and gauss but would like to explore the topic further

introduction in course of an attempt to apply direct vector methods to certain problems of electricity and hydrodynamics it was felt that at least as a matter of consistency the foundations of vector analysis ought to be placed on a basis independent of any reference to cartesian coordinates and the main theorems of that analysis established directly from first principles embodied in the present paper and an attempt is made here to develop the differential and integral calculus of vectors from a point of view which is believed to be new in order to realise the special features of my presentation of the subject it will be convenient to recall briefly the usual method of treatment in any vector problem we are given certain relations among a number of vectors and we have to deduce some other relations which these same vectors satisfy

basic insights in vector calculus provides an introduction to three famous theorems of vector calculus green s theorem stokes theorem and the divergence theorem also known as gauss s theorem material is presented so that results emerge in a natural way as in classical physics we begin with descriptions of flows the book will be helpful for undergraduates in science technology engineering and mathematics in programs that require vector calculus at the same time it also provides some of the mathematical background essential for more advanced contexts which include for instance the physics and engineering of continuous media and fields axiomatically rigorous vector analysis and the mathematical theory of differential forms there is a supplement on mathematical understanding the approach invites one

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to advert to one s own experience in mathematics and that way identify elements of understanding that emerge in all levels of learning and teaching prerequisites are competence in single variable calculus some familiarity with partial derivatives and the multi variable chain rule would be helpful but for the convenience of the reader we review essentials of single and multi variable calculus needed for the three main theorems of vector calculus carefully developed problems and exercises are included for many of which guidance or hints are provided

this text is intended for a one semester course in the calculus of functions of several variables and vector analysis taught at college level this course is normally known as vector calculus or multi variable calculus or simply calculus iii the course usually is preceded by a beginning course in linear algebra the prerequisite for this course is the knowledge of the fundamen tal of one variable calculus differentiation and integration of the standard functions the text includes most of the basic theories as well as many related examples and problems there are many exercises throughout the text which in my experience are more than enough for a semester course in this subject i include enough examples for each topics in each section to illustrate and help the student to practice his her skills also added problems that ask the student to reflect on and explore in his her own words some of the important ideas of vector calculus i have included material enough to be covered during a simple semester with out a hassle and it should be possible to work through the entire book with reasonable care most of the exercises are relatively routine computations to moderate and productive problems to help the students understand the concept of each topic each section in a chapter is concluded with a set of exercises that review and extend the ideas that was introduced in the chapter or section computer softwares were not included in this book most of the exercises can be solved easily by hand but i advise the students to use mathematica or maple to graph the functions in each problem to visualize the problem and understand it better some of the homework might require the use of mathematica

contents differentiation and integration of vectors multiple vectors gradient divergence and curl green s gauss s and stoke s theorem

this book covers multivariable and vector calculus it can be used as a textbook for a one semester course or self study it includes worked through exercises with answers provided for many of the basic computational ones and hints for the more complex ones this second edition features new exercises new sections on twist and binormal vectors for curves in space linear approximations and the laplace and

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poisson equations

building on previous texts in the modular mathematics series in particular vectors in two or three dimensions and calculus and odes this book introduces the student to the concept of vector calculus it provides an overview of some of the key techniques as well as examining functions of more than one variable including partial differentiation and multiple integration undergraduates who already have a basic understanding of calculus and vectors will find this text provides tools with which to progress onto further studies scientists who need an overview of higher order differential equations will find it a useful introduction and basic reference

an introduction to the differential and integral calculus of functions of several variables for students wanting more than a superficial account of the subject topics covered include inverse function theorem the implicit function theorem and the integration theorems of green stokes and gauss

this book gives a comprehensive and thorough introduction to ideas and major results of the theory of functions of several variables and of modern vector calculus in two and three dimensions clear and easy to follow writing style carefully crafted examples wide spectrum of applications and numerous illustrations diagrams and graphs invite students to use the textbook actively helping them to both enforce their understanding of the material and to brush up on necessary technical and computational skills particular attention has been given to the material that some students find challenging such as the chain rule implicit function theorem parametrizations or the change of variables theorem

in this book the notion of a vector has been approached from two points of view geometric and algebraic the relationship between the two has also been established the main aim of the book is to make available to the reader a tool by which she may make a profitable use of various branches of mathematics and of analytic geometry and mechanics

vector calculus is the essential mathematical tool to develop in students a sound conceptual grasp of vector calculus and to help them begin the transition from first year calculus to more advanced technical mathematics

for one semester sophomore level courses in vector calculus and multivariable calculus this brief book presents an accessible treatment of multivariable calculus with an early emphasis on linear algebra as a tool the organization of the text draws strong analogies with the basic ideas of elementary calculus derivative integral and fundamental theorem traditional in approach it is written with an assumption that the student may have computing facilities for two and three dimensional graphics and for doing symbolic algebra

includes solutions to selected exercises and study hints

the aim of this book is to facilitate the use of stokes theorem in applications the text takes a differential geometric point of view and provides for the student a bridge between pure and applied mathematics by carefully building a formal rigorous development of the topic and following this through to concrete applications in two and three variables key topics include vectors and vector fields line integrals regular k surfaces flux of a vector field orientation of a surface differential forms stokes theorem and divergence theorem this book is intended for upper undergraduate students who have completed a standard introduction to differential and integral calculus for functions of several variables the book can also be useful to engineering and physics students who know how to handle the theorems of green stokes and gauss but would like to explore the topic further

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