COMPLEX ANALYSIS - Problems

Nicolae Cotfas, version 29 May 2020 (for future updates see   https://unibuc.ro/user/nicolae.cotfas/)

R Fundamental definitions and results

R0)
$$(x_1+y_1 i)(x_2+y_2 i) = (x_1 x_2 - y_1 y_2) + (x_1 y_2 + x_2 y_1)i$$
$$\overline{x+yi} = x - yi, \quad |x+yi| = \sqrt{x^2+y^2}, \quad d(z_1, z_2) = |z_1 - z_2|$$

R1)
$$\frac{1}{1-z} = 1 + z + z^2 + z^3 + \dots \quad \text{for } |z| < 1$$

R2)
$$e^z = 1 + \frac{z}{1!} + \frac{z^2}{2!} + \frac{z^3}{3!} + \dots \quad \text{for any } z$$

R3) In the neighbourhood of a pole z_0 of order k
$$f(z) = \frac{a_{-k}}{(z-z_0)^k} + \dots + \frac{a_{-1}}{z-z_0} + a_0 + a_1(z-z_0) + \dots$$
and $\mathbf{Res}_{z_0} f = a_{-1} = \frac{1}{(k-1)!} \lim_{z \to z_0} ((z-z_0)^k f(z))^{(k-1)}$

R4) Complex integral of $f: D \longrightarrow \mathbb{C}$ along $\gamma: [a,b] \longrightarrow D$ is
$$\int_\gamma f(z)\,dz = \int_a^b f(\gamma(t))\gamma'(t)\,dt$$

R4) Theorem of Residues. For an open set $D \subseteq \mathbb{C}$:
$$\left.\begin{array}{l} f: D \longrightarrow \mathbb{C} \text{ holomorphic function} \\ S \text{ set of isolated singular points} \\ \gamma \text{ path homotopic to zero in } D \cup S \end{array}\right\} \Rightarrow \begin{array}{l} \int_\gamma f(z)dz = \\ = 2\pi i \sum_{z \in S} n(z, \gamma) \mathbf{Res}_z f \end{array}$$

R4) Lemma 1. For $\gamma_r : [\alpha, \beta] \longrightarrow \mathbb{C}, \gamma_r(t) = r e^{it}$
$$\lim_{z \to \infty} z\, f(z) = 0 \Rightarrow \lim_{r \to \infty} \int_{\gamma_r} f(z)\,dz = 0$$

R5) Lemma 2 (Jordan). For $\gamma_r: [0,\pi] \longrightarrow \mathbb{C}, \gamma_r(t) = r e^{it}$
$$\lim_{z \to \infty} f(z) = 0 \Rightarrow \lim_{r \to \infty} \int_{\gamma_r} f(z) e^{iz}\,dz = 0$$

A Problems

1 $(1-2i)^3 = ?$, $\frac{1}{3+4i} = ?$, $e^{\frac{1+i}{2}} = ?$, $d(1+i, 2-i) = ?$,
$(z \sin z)' = ?$, $(e^{z^2})' = ?$, $\lim_{z \to \infty} \left(\frac{z}{z+1} + \frac{1}{z}i\right) = ?$.

2 Expand in a power series of z the functions
$$f_1(z) = e^{z^2}, \qquad f_2(z) = z e^{\frac{1}{z}}, \qquad f_3(z) = \frac{z}{1-z^2}$$

Solution.
$f_1(z) = 1 + \frac{z^2}{1!} + \frac{z^4}{2!} + \frac{z^6}{3!} + \dots$, for any z.
$f_2(z) = z\left(1 + \frac{1}{1!}\frac{1}{z} + \frac{1}{2!}\frac{1}{z^2} + \frac{1}{3!}\frac{1}{z^3} + \dots\right) = \dots + \frac{1}{3!}\frac{1}{z^2} + \frac{1}{2!}\frac{1}{z} + 1 + z$ for $|z| > 0$.
$f_3(z) = \frac{1}{z}(1 + z + z^2 + z^3 + \dots) = \frac{1}{z} + \frac{1}{z^2} + \dots + 1 + z + \dots$ for $0 < |z| < 1$.

3 Compute the residues of $f(z) = \frac{1}{z^3(z^2+1)^2}$
Hint. 0 is a pole of order 3 and $\pm i$ are poles of order 2.

B Problems

1 Prove that $f: \mathbb{C} \longrightarrow \mathbb{C}, \quad f(z) = 1 + \bar{z}$ is not $\mathbb{C}$-differentiable.
Hint. Use the Cauchy-Riemann theorem.

2 For $\gamma: [0, \pi] \longrightarrow \mathbb{C}, \gamma(t) = e^{it}$, compute $\int_\gamma (\bar z + i)\,dz$.
Hint. Use the definition of the complex line integral.
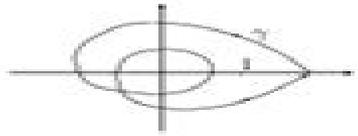
3 Compute the integral $\int_\gamma \frac{1}{z^2(1-z)}\,dz$ where γ is the path from the figure above.
Solution. By using the theorem of residues, we get
$$\int_\gamma \frac{1}{z^2(1-z)}\,dz = 2\pi i(2\,\mathbf{Res}_1 f + \mathbf{Res}_0 f) = 2\pi i.$$

4 Compute the residue of $f(z) = z e^{\frac{1}{z}}$ at the singular point $z_0 = 0$.
Solution. $f(z) = \dots + \frac{1}{3!}\frac{1}{z^2} + \frac{1}{2!}\frac{1}{z} + 1 + z$ for any z $\Rightarrow$ $\mathbf{Res}_0 f = \frac{1}{2}$.

C Problems

1 Compute the residues of $f(z) = z^2 e^{\frac{1}{z-1}}$ at the singular point $z_0 = 1$.
Hint. $f(z) = ((z-1)^2 + 2(z-1) + 1)\left(1 + \frac{1}{1!}\frac{1}{z-1} + \frac{1}{2!}\frac{1}{(z-1)^2} + \frac{1}{3!}\frac{1}{(z-1)^3} + \dots\right)$.

2 Compute the integrals $I_1 = \int_0^{2\pi} \frac{1}{2+\cos t}\,dt$ and $I_2 = \int_0^{2\pi} \frac{1}{2+\cos t}\,dt$
Solution. By using the path $\gamma : [0, 2\pi] \longrightarrow \mathbb{C}, \gamma(t) = e^{it}$, we get
$$I_1 = \int_0^{2\pi} \frac{1}{2+\frac{e^{it}+e^{-it}}{2}}\,dt = \int_0^{2\pi} \frac{2}{4+e^{it}+e^{-it}}(e^{it})'\,dt$$
$$= -i \int_\gamma \frac{1}{z}\frac{2}{4+z+\frac{1}{z}}\,dz = -i \int_\gamma \frac{2}{z^2+4z+1}\,dz = 2\pi \mathbf{Res}_{-2+\sqrt{3}} \frac{2}{z^2+4z+1} = \frac{2\pi}{\sqrt{3}}$$

3 Compute the integrals $\int_0^\infty \frac{x^2}{(x^2+1)(x^2+4)}\,dx$; $\int_0^\infty \frac{x^2}{(x^2+1)(x^2+9)}\,dx$
Solution. The integral is convergent: at infinity $\frac{x^2}{(x^2+1)(x^2+4)} \sim \frac{1}{x^2}$.
By using $\gamma_r : [0, \pi] \longrightarrow \mathbb{C}, \gamma_r(t) = r e^{it}$ and $f(z) = \frac{z^2}{(z^2+1)(z^2+4)}$, we get
$$\int_{\gamma_r} f(z)dz + \int_{-r}^r f(x)dx = 2\pi i\,(\mathbf{Res}_i f + \mathbf{Res}_{2i} f), \quad \text{whence}$$
$$\lim_{r\to\infty} \int_{\gamma_r} f(z)dz + \int_{-\infty}^\infty f(x)dx = 2\pi i\,(\mathbf{Res}_i f + \mathbf{Res}_{2i} f).$$
Since $|z\,f(z)| = \frac{|z^3|}{|(z^2+1)(z^2+4)|} = \frac{|z|^3}{|z^2+1||z^2+4|} \le \frac{|z|^3}{(|z|^2-1)(|z|^2-4)}$,
we have $\lim_{z\to\infty} z\,f(z) = 0$ and in view of lemma 1, $\lim_{r\to\infty} \int_{\gamma_r} f(z)dz = 0$.
Consequently, $\int_0^\infty f(x)dx = \pi i\,(\mathbf{Res}_i f + \mathbf{Res}_{2i} f) = \frac{\pi}{6}$.
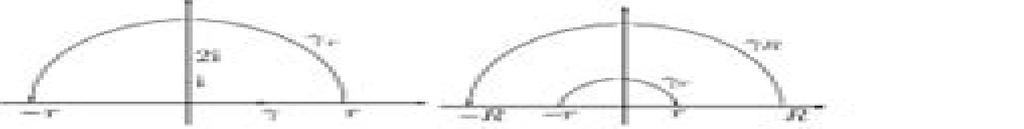
4 Prove that $\int_0^\infty \frac{\sin x}{x} = \frac{\pi}{2}$ (Poisson's integral).
Solution. Let $0 < r < R$ and $\gamma_R, \gamma_r : [0, \pi] \longrightarrow \mathbb{C}, \gamma_R(t) = R e^{it}, \gamma_r(t) = r e^{i(\pi-t)}$.
From the residue theorem (right hand side of fig.) it follows the relation
$$\int_{\gamma_R} \frac{e^{iz}}{z}\,dz + \int_{-R}^{-r} \frac{e^{ix}}{x}\,dx + \int_{\gamma_r} \frac{e^{iz}}{z}\,dz + \int_r^R \frac{e^{ix}}{x}\,dx = 0, \text{ that is}$$
$$\int_{\gamma_R} \frac{e^{iz}}{z}\,dz + \int_{\gamma_r} \frac{e^{iz}}{z}\,dz + \int_r^R \frac{e^{ix}-e^{-ix}}{x}\,dx = 0,$$
$$\int_{\gamma_R} \frac{e^{iz}}{z}\,dz + \int_{\gamma_r} \frac{1}{z}\,dz + \int_r^R \frac{e^{ix}-1}{x}\,dz = 2i\int_r^R \frac{\sin x}{x}\,dx = 0.$$
If g is an antiderivative of $f(z) = \frac{e^{iz}-1}{z}$, by using $\int_{\gamma_r} \frac{1}{z}\,dz = -\pi i$, we get
$$\int_{\gamma_R} \frac{e^{iz}}{z}\,dz - \pi i + (g(r) - g(-r)) + 2i\int_r^R \frac{\sin x}{x}\,dx = 0.$$
But, in view of Jordan's lemma $\lim_{R\to\infty} \int_{\gamma_R} \frac{e^{iz}}{z} = 0$,
and for $R \to \infty$ and $r \to 0$ we get $2i\int_0^\infty \frac{\sin x}{x}\,dx = \pi i$

5 Find the holomorphic function $f: \mathbb{C} \longrightarrow \mathbb{C}$ with $\frac{\partial m f(x+yi)}{} = 2xy - 2x$, $f(i) = 0$.

6 For $z_0 \ne 0$, expand $f: \mathbb{C}^* \longrightarrow \mathbb{C}, f(z) = \frac{1}{z}$ in a power series of $(z-z_0)$.
Solution. We have
$$f(z) = \frac{1}{z_0 + z - z_0} = \frac{1}{z_0}\frac{1}{1+\frac{z-z_0}{z_0}} = \frac{1}{z_0}\left(1 - \frac{1}{z_0}(z-z_0) + \frac{1}{z_0^2}(z-z_0)^2 - \dots\right),$$
$$\text{for } |z-z_0| < |z_0|;$$
$$f(z) = \frac{1}{z_0 + z - z_0} = \frac{1}{z - z_0}\frac{1}{1+\frac{z_0}{z-z_0}} = \frac{1}{z-z_0}\left(1 - \frac{z_0}{(z-z_0)} + \frac{z_0^2}{(z-z_0)^2} - \dots\right),$$
$$\text{for } |z-z_0| > |z_0|.$$

7 Expand in a power series of $(z-i)$ the functions:
$$f_1(z) = \frac{1}{z}, \qquad f_2(z) = \frac{1}{z^2}, \qquad f_3(z) = \frac{1}{z} + \frac{1}{z^2}.$$

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Problems and Solutions for Complex Analysis Rami Shakarchi,1999-10-14 All the exercises plus their solutions for Serge Lang s fourth edition of Complex Analysis ISBN 0 387 98592 1 The problems in the first 8 chapters are suitable for an introductory course at undergraduate level and cover power series Cauchy s theorem Laurent series singularities and meromorphic functions the calculus of residues conformal mappings and harmonic functions The material in the remaining 8 chapters is more advanced with problems on Schwartz reflection analytic continuation Jensen s formula the Phragmen Lindeloef theorem entire functions Weierstrass products and meromorphic functions the Gamma function and Zeta function Also beneficial for anyone interested in learning complex analysis **Algebraic Curves and Riemann Surfaces for Undergraduates** Anil Nerode,Noam Greenberg,2023-01-16 The theory relating algebraic curves and Riemann surfaces exhibits the unity of mathematics topology complex analysis algebra and geometry all interact in a deep way This textbook offers an elementary introduction to this beautiful theory for an undergraduate audience At the heart of the subject is the theory of elliptic functions and elliptic curves A complex torus or donut is both an abelian group and a Riemann surface It is obtained by identifying points on the complex plane At the same time it can be viewed as a complex algebraic curve with addition of points given by a geometric chord and tangent method This book carefully develops all of the tools necessary to make sense of this isomorphism The exposition is kept as elementary as possible and frequently draws on familiar notions in calculus and algebra to motivate new concepts Based on a capstone course given to senior undergraduates this book is intended as a textbook for courses at this level and includes a large number of class tested exercises The prerequisites for using the book are familiarity with abstract algebra calculus and analysis as covered in standard undergraduate courses

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 problems with a flavor towards the computational aspects of infinite series and special products many of which are new to the literature Each chapter contains a section of difficult problems which are motivated by other problems in the book These Open Problems may be considered research projects for students who are studying advanced calculus and which are intended to stimulate creativity and the discovery of new and original methods for proving known results and establishing new ones This stimulating collection of problems is intended for

undergraduate students with a strong background in analysis graduate students in mathematics physics and engineering researchers and anyone who works on topics at the crossroad between pure and applied mathematics Moreover the level of problems is appropriate for students involved in the Putnam competition and other high level mathematical contests

MUS - Mathematimus - Hyperelliptical Geometry Stenio Musich,2024-03-25 M U S Mathematical Uniform Space is a new number of pi representing the reality of the Universe in which we live With this number we created a new geometry Hyperelliptical Geometry which will provide the unification of physics thus uniting the Theory of Relativity and Quantum Theory A new geometry for a new Mathematics and a new Physics ISBN 978 65 00 98107 0   A Complex Analysis Problem Book Daniel Alpay,2016-10-26 This second edition presents a collection of exercises on the theory of analytic functions including completed and detailed solutions It introduces students to various applications and aspects of the theory of analytic functions not always touched on in a first course while also addressing topics of interest to electrical engineering students e g the realization of rational functions and its connections to the theory of linear systems and state space representations of such systems It provides examples of important Hilbert spaces of analytic functions in particular the Hardy space and the Fock space and also includes a section reviewing essential aspects of topology functional analysis and Lebesgue integration Benefits of the 2nd edition Rational functions are now covered in a separate chapter Further the section on conformal mappings has been expanded   **Atomic Pair Distribution Function Analysis** Simon Billinge,Kirsten Jensen,2023-11-08 Since the early 1990s the atomic pair distribution function PDF analysis of powder diffraction data has undergone something of a revolution in its ability to do just that yield important structural information beyond the average crystal structure of a material With the advent of advanced sources computing and algorithms it is now useful for studying the structure of nanocrystals clusters and molecules in solution or otherwise disordered in space nanoporous materials and things intercalated into them and to look for local distortions and defects in crystals It can be used in a time resolved way to study structural changes taking place during synthesis and in operating devices and to map heterogeneous systems Although the experiments are somewhat straightforward there can be a gap in knowledge when trying to use PDF to extract structural information by modelling This book addresses this gap and guides the reader through a series of real life worked examples that gradually increase in complexity so the reader can have the independence and confidence to apply PDF methods to their own research and answer their own scientific questions The book is intended for graduate students and other research scientists who are new to PDF and want to use the methods but are unsure how to take the next steps to get started

Handbook of Conformal Mappings and Applications Prem K. Kythe,2019-03-04 The subject of conformal mappings is a major part of geometric function theory that gained prominence after the publication of the Riemann mapping theorem for every simply connected domain of the extended complex plane there is a univalent and meromorphic function that maps such a domain conformally onto the unit disk The Handbook of Conformal Mappings and Applications is a compendium of at least

all known conformal maps to date with diagrams and description and all possible applications in different scientific disciplines such as fluid flows heat transfer acoustics electromagnetic fields as static fields in electricity and magnetism various mathematical models and methods including solutions of certain integral equations **A First Course in Complex Analysis with Applications** Dennis G. Zill,Patrick Shanahan,Patrick D. Shanahan,2006-07 A First Course In Complex Analysis With Applications Limits Theoretical Coverage To Only What Is Necessary And Conveys It In A Student Friendly Style Its Aim Is To Introduce The Basic Principles And Applications Of Complex Analysis To Undergraduates Who Have No Prior Knowledge Of This Subject Contents Of The Book Include The Complex Number System Complex Functions And Sequences As Well As Real Integrals In Addition To Other Concepts Of Calculus And The Functions Of A Complex Variable This Text Is Written For Junior Level Undergraduate Students Who Are Majoring In Math Physics Computer Science And Electrical Engineering **Digital Technologies and Institutions for Sustainable Development** Aleksei V. Bogoviz,Elena G. Popkova,2022-10-11 This book focuses on digital institutions and the advanced technologies used on their basis as well as their contribution to sustainable development in the unity of seventeen SDGs formulated by the UN which is sequentially disclosed in six parts of the book This book is dedicated to comprehensive coverage of the role of the digital economy in sustainable development and the offering of a set of scientific methodological and practical recommendations to increase the scale and effectiveness of this role The first part explores the training of digital personnel for sustainable development the second part reveals the regional features of Russia and the third part describes the industry specifics of using digital technologies in entrepreneurship in support of sustainable development The fourth part deals with financial organizational and managerial issues of using digital technologies in entrepreneurship in support of sustainable development the fifth part is devoted to security international factors and risks and the sixth part deals with the legal framework and state regulation of digital technologies and sustainable development institutions The novelty of the book lies in its reliance on an institutional approach that allows rethinking and systematically studying the contribution of the digital economy to sustainable development The book is aimed at scholars who will find in it an institutional understanding of the digital economy s support for sustainable development and ways to improve it The secondary target audience of the book is the subject of managing the sustainable development of the digital economy For them the book contains relevant and illustrative examples from practice and applied recommendations **Complex Analysis with Applications** Nakhlé H. Asmar,Loukas Grafakos,2018-10-12 This textbook is intended for a one semester course in complex analysis for upper level undergraduates in mathematics Applications primary motivations for this text are presented hand in hand with theory enabling this text to serve well in courses for students in engineering or applied sciences The overall aim in designing this text is to accommodate students of different mathematical backgrounds and to achieve a balance between presentations of rigorous mathematical proofs and applications The text is adapted to enable maximum flexibility to instructors and to students who may also choose

to progress through the material outside of coursework Detailed examples may be covered in one course giving the instructor the option to choose those that are best suited for discussion Examples showcase a variety of problems with completely worked out solutions assisting students in working through the exercises The numerous exercises vary in difficulty from simple applications of formulas to more advanced project type problems Detailed hints accompany the more challenging problems Multi part exercises may be assigned to individual students to groups as projects or serve as further illustrations for the instructor Widely used graphics clarify both concrete and abstract concepts helping students visualize the proofs of many results Freely accessible solutions to every other odd exercise are posted to the book s Springer website Additional solutions for instructors use may be obtained by contacting the authors directly   *A Collection of Problems on Complex Analysis* Lev Izrailevich Volkovyskiĭ,G. L. Lunts,Isaak Genrikhovich Aramanovich,1991 This comprehensive collection contains over 1 500 problems on the theory of functions of the complex variable and covers nearly every branch of classical function theory It will be of special interest to practicing engineers and researchers in the physical sciences for considerable attention is given to those problems which illustrate the application of the theory of functions of a complex variable to problems dealing with the mechanics of continuous media and electrical engineering The problems themselves range in difficulty from elementary to those encountered only in more advanced treatments The first four chapters involve complex numbers and functions of a complex variable conformal mappings connected with elementary functions supplementary geometrical questions and generalized analytic functions and integrals and power series Chapters V through VIII cover the Launrent series singularities of single valued functions and integral functions various series of functions parametric integrals and infinite products residues and their applications integrals of the Cauchy type and integral functions of Poisson and Schwarz The final three chapters discuss analytic continuation singularities of many valued character and Riemann Surfaces conformal mappings and applications to mechanic and physics Answers and solutions are grouped at the end of the text

Advances in Interdisciplinary Mathematical Research Bourama Toni,2014-07-08 This volume contains the invited contributions to the Spring 2012 seminar series at Virginia State University on Mathematical Sciences and Applications It is a thematic continuation of work presented in Volume 24 of the Springer Proceedings in Mathematics almost stochastic difference equations absolute and conditional stability in delayed equations gamma convergence and applications to block copolymer morphology the dynamics of collision and near collision in celestial mechanics almost and pseudo almost limit cycles rainbows in spheres and connections to ray wave and potential scattering theory null controllability of the heat equation with constraints optimal control for systems subjected to null controllability the Galerkin method for heat transfer in closed channels wavelet transforms for real time noise cancellation signal image processing and machine learning in medicine and biology methodology for research on durability reliability damage tolerance of aerospace materials and structures at NASA Langley Research Center The volume is suitable and valuable for mathematicians scientists and research

students in a variety of interdisciplinary fields namely physical and life sciences engineering and technology including structures and materials sciences computer science for signal image processing and machine learning in medicine

Proceedings of the 12th Workshop on Electronics for LHC and Future Experiments, Valencia, Spain, 25-29 September 2006 ,2007 **Reviews in Complex Analysis, 1980-1986** ,1989 Engineering Problem-Solving 101: Time-Tested and Timeless Techniques : Time-Tested and Timeless Techniques Robert Messler,2012-09-12 MASTER UNIVERSAL ENGINEERING PROBLEM SOLVING TECHNIQUES Advance your engineering skills and become a capable confident problem solver by learning the wide array of tools processes and tactics employed in the field Going far beyond plug and chug solutions this multidisciplinary guide explains the underlying scientific principles provides detailed engineering analysis and lays out versatile problem solving methodologies Written by an engineer who teaches with more than 20 years of experience as a practicing engineer and numerous awards for teaching engineering this straightforward one of a kind resource fills a long vacant niche by identifying and teaching the procedures necessary to address and resolve any problem regardless of its complexity Engineering Problem Solving 101 Time Tested and Timeless Techniques contains more than 50 systematic approaches spanning all disciplines logically organized into mathematical physical mechanical visual and conceptual categories Strategies are reinforced with practical reference tables technical illustrations interesting photographs and real world examples Inside you ll find 50 proven problem solving methods Illustrative examples from all engineering disciplines Photos illustrations and figures that complement the material covered Detailed tables that summarize concepts and provide useful data in a convenient format *Reviews in Complex Analysis, 1980-86* ,1989 *Corporate Social Responsibility to the Green Growth of Business and Economy* Elena G. Popkova,2025-04-28 The book is devoted to the scientific study of the international experience and prospects of the sustainable development of business in the economy of the digital technological mode It outlines the imperatives of the sustainable development of business in the economy of the digital technological mode The role of environmental innovations in the sustainable development of business in the context of the spheres of the economy of the digital technological mode The international experience of the international development of business in the economy of the digital technological mode is considered and discussed The practical and case experience of the sustainable development of business in the economy of the digital technological mode in Central Asia is given The prospects are outlined and recommendations are offered for the sustainable development of business in the economy of the digital technological mode **Student Study Guide to Accompany A First Course in Complex Analysis with Applications** Patrick D. Shanahan,2009-09-29 Twelfth International Conference on VLSI Design VLSI Society of India,IEEE Circuits and Systems Society,1999 The proceedings of the January 1999 conference consist of 103 papers 11 talks and six tutorials The papers are grouped under the headings of TCAD to ECAD low power testing co design and synthesis analog design multi valued logic verification digital signal processor DSP logic synthesis Complex Analysis Dennis G.

Zill,Patrick D. Shanahan,2013-09-20 Designed for the undergraduate student with a calculus background but no prior experience with complex analysis this text discusses the theory of the most relevant mathematical topics in a student friendly manner With a clear and straightforward writing style concepts are introduced through numerous examples illustrations and applications Each section of the text contains an extensive exercise set containing a range of computational conceptual and geometric problems In the text and exercises students are guided and supported through numerous proofs providing them with a higher level of mathematical insight and maturity Each chapter contains a separate section devoted exclusively to the applications of complex analysis to science and engineering providing students with the opportunity to develop a practical and clear understanding of complex analysis The Mathematica syntax from the second edition has been updated to coincide with version 8 of the software

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