

Mathematics and Its Applications

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**Jerzy Urbanowicz  
and Kenneth S. Williams**

# **Congruences for L-Functions**



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# Congruences For L Functions Mathematics And Its Applications

**Hari M Srivastava, Junesang Choi**



## **Congruences For L Functions Mathematics And Its Applications:**

**Congruences for L-Functions** J. Urbanowicz, Kenneth S. Williams, 2013-03-09 In Hardy and Williams 1986 the authors exploited a very simple idea to obtain a linear congruence involving class numbers of imaginary quadratic fields modulo a certain power of 2 Their congruence provided a unified setting for many congruences proved previously by other authors using various means The Hardy Williams idea was as follows Let  $d$  be the discriminant of a quadratic field Suppose that  $d$  is odd and let  $d = \prod p_i^{2\alpha_i}$  be its unique decomposition into prime discriminants Then for any positive integer  $k$  coprime with  $d$  the congruence holds trivially as each Legendre Jacobi Kronecker symbol has the value 1 or  $-1$  Expanding this product gives  $\prod e_i \equiv 1 \pmod{4}$  where  $e_i$  runs through the positive and negative divisors of  $d$  and  $v_i$  denotes the number of distinct prime factors of  $e_i$  Summing this congruence for  $0 \leq v_i < k$

**L-Functions and Automorphic Forms** Jan Hendrik Bruinier, Winfried Kohnen, 2018-02-22 This book presents a collection of carefully refereed research articles and lecture notes stemming from the Conference Automorphic Forms and L Functions held at the University of Heidelberg in 2016 The theory of automorphic forms and their associated L functions is one of the central research areas in modern number theory linking number theory arithmetic geometry representation theory and complex analysis in many profound ways The 19 papers cover a wide range of topics within the scope of the conference including automorphic L functions and their special values  $p$ -adic modular forms Eisenstein series Borcherds products automorphic periods and many more

**Introduction to Cyclotomic Fields** Lawrence C. Washington, 2012-12-06 Introduction to Cyclotomic Fields is a carefully written exposition of a central area of number theory that can be used as a second course in algebraic number theory Starting at an elementary level the volume covers  $p$ -adic L functions class numbers cyclotomic units Fermat's Last Theorem and Iwasawa's theory of  $\mathbb{Z}_p$ -extensions leading the reader to an understanding of modern research literature Many exercises are included The second edition includes a new chapter on the work of Thaine Kolyvagin and Rubin including a proof of the Main Conjecture There is also a chapter giving other recent developments including primality testing via Jacobi sums and Sinnott's proof of the vanishing of Iwasawa's  $f$ -invariant

**Number Theory And Its Applications** Fuhuo Li, Nianliang Wang, Shigeru Kanemitsu, 2012-11-28 This book emphasizes the role of symmetry and presents as many viewpoints as possible of an important phenomenon the functional equation of the associated zeta function It starts from the basics before warping into the space of new interest from the ground state to the excited state For example the celebrated Gauss quadratic reciprocity law is proved in four independent ways which are in some way or other dependent on the functional equation The proofs rest on finite fields representation theory of nilpotent groups reciprocity law for the Dedekind sums and the translation formula for the theta series respectively Likewise for example the Euler function is treated in several different places One of the important principles of learning is to work with the material many times This book presents many worked out examples and exercises to enhance the reader's comprehension on the topics covered in an in depth manner This is done in a different setting each time such that the reader

will always be challenged For the keen reader even browsing the text alone without solving the exercises will yield some knowledge and enjoyment Automorphic Forms, Representations and  $L$ -Functions Armand Borel,W.

Casselman,American Mathematical Society,1979-06-30 Part 2 contains sections on Automorphic representations and  $L$  functions Arithmetical algebraic geometry and  $L$  functions  **$q$ -Series with Applications to Combinatorics, Number Theory, and Physics** Bruce C. Berndt,Ken Ono,2001 The subject of  $q$  series can be said to begin with Euler and his pentagonal number theorem In fact  $q$  series are sometimes called Eulerian series Contributions were made by Gauss Jacobi and Cauchy but the first attempt at a systematic development especially from the point of view of studying series with the products in the summands was made by E Heine in 1847 In the latter part of the nineteenth and in the early part of the twentieth centuries two English mathematicians L J Rogers and F H Jackson made fundamental contributions In 1940 G H Hardy described what we now call Ramanujan's famous  $1/\psi(1)$  summation theorem as a remarkable formula with many parameters This is now one of the fundamental theorems of the subject Despite humble beginnings the subject of  $q$  series has flourished in the past three decades particularly with its applications to combinatorics number theory and physics During the year 2000 the University of Illinois embraced The Millennial Year in Number Theory One of the events that year was the conference  $q$  Series with Applications to Combinatorics Number Theory and Physics This event gathered mathematicians from the world over to lecture and discuss their research This volume presents nineteen of the papers presented at the conference The excellent lectures that are included chart pathways into the future and survey the numerous applications of  $q$  series to combinatorics number theory and physics **Zeta and  $q$ -Zeta Functions and Associated Series and Integrals** Hari M Srivastava,Junesang Choi,2011-10-11 Zeta and  $q$  Zeta Functions and Associated Series and Integrals is a thoroughly revised enlarged and updated version of Series Associated with the Zeta and Related Functions Many of the chapters and sections of the book have been significantly modified or rewritten and a new chapter on the theory and applications of the basic or  $q$  extensions of various special functions is included This book will be invaluable because it covers not only detailed and systematic presentations of the theory and applications of the various methods and techniques used in dealing with many different classes of series and integrals associated with the Zeta and related functions but stimulating historical accounts of a large number of problems and well classified tables of series and integrals Detailed and systematic presentations of the theory and applications of the various methods and techniques used in dealing with many different classes of series and integrals associated with the Zeta and related functions **Automorphic Forms and  $L$ -functions II** David Ginzburg,2009 Includes articles that represent global aspects of automorphic forms This book covers topics such as the trace formula functoriality representations of reductive groups over local fields the relative trace formula and periods of automorphic forms Rankin Selberg convolutions and  $L$  functions and  $p$  adic  $L$  functions American Book Publishing Record ,2000-07 **The Web of Modularity: Arithmetic of the Coefficients of Modular Forms and  $q$ -series** Ken Ono,2004

Chapter 1     **Advances in the Theory of Automorphic Forms and Their  $L$ -functions** Dihua Jiang, Freydoon Shahidi, David Soudry, 2016-04-29 This volume contains the proceedings of the workshop on Advances in the Theory of Automorphic Forms and Their  $L$  functions held in honor of James Cogdell's 60th birthday held from October 16-25 2013 at the Erwin Schrödinger Institute ESI at the University of Vienna The workshop and the papers contributed to this volume circle around such topics as the theory of automorphic forms and their  $L$  functions geometry and number theory covering some of the recent approaches and advances to these subjects Specifically the papers cover aspects of representation theory of  $p$ -adic groups classification of automorphic representations through their Fourier coefficients and their liftings  $L$  functions for classical groups special values of  $L$  functions Howe duality subconvexity for  $L$  functions Kloosterman integrals arithmetic geometry and cohomology of arithmetic groups and other important problems on  $L$  functions nodal sets and geometry

**Families of Automorphic Forms and the Trace Formula** Werner Müller, Sug Woo Shin, Nicolas Templier, 2016-09-20 Featuring the work of twenty three internationally recognized experts this volume explores the trace formula spectra of locally symmetric spaces  $p$ -adic families and other recent techniques from harmonic analysis and representation theory Each peer reviewed submission in this volume based on the Simons Foundation symposium on families of automorphic forms and the trace formula held in Puerto Rico in January-February 2014 is the product of intensive research collaboration by the participants over the course of the seven day workshop The goal of each session in the symposium was to bring together researchers with diverse specialties in order to identify key difficulties as well as fruitful approaches being explored in the field The respective themes were counting cohomological forms  $p$ -adic trace formulas Hecke fields slopes of modular forms and orbital integrals     Advanced Studies in Contemporary Mathematics ,2008     **Number Theory: Sailing On The Sea**

**Of Number Theory - Proceedings Of The 4th China-japan Seminar** Jianya Liu, Shigeru Kanemitsu, 2007-07-05 This volume is not an ordinary proceedings volume assembling papers submitted but a collection of prestigious survey papers on various subjects studied enthusiastically by experts all over the world The reader will uncover profound new research problems as well as numerous signposts for future direction     *Geometric Modular Forms and Elliptic Curves* Haruzo Hida, 2012 This book provides a comprehensive account of the theory of moduli spaces of elliptic curves over integer rings and its application to modular forms The construction of Galois representations which play a fundamental role in Wiles' proof of the Shimura-Taniyama conjecture is given In addition the book presents an outline of the proof of diverse modularity results of two dimensional Galois representations including that of Wiles as well as some of the author's new results in that direction In this new second edition a detailed description of Barsotti-Tate groups including formal Lie groups is added to Chapter 1 As an application a down to earth description of formal deformation theory of elliptic curves is incorporated at the end of Chapter 2 in order to make the proof of regularity of the moduli of elliptic curve more conceptual and in Chapter 4 though limited to ordinary cases newly incorporated are Ribet's theorem of full image of modular  $p$ -adic Galois

representation and its generalization to big adic Galois representations under mild assumptions a new result of the author Though some of the striking developments described above is out of the scope of this introductory book the author gives a taste of present day research in the area of Number Theory at the very end of the book giving a good account of modularity theory of abelian varieties and curves

*Stable Klingen Vectors and Paramodular Newforms* Jennifer Johnson-Leung,Brooks Roberts,Ralf Schmidt,2023-12-27 This book describes a novel approach to the study of Siegel modular forms of degree two with paramodular level It introduces the family of stable Klingen congruence subgroups of  $\mathrm{GSp}\ 4$  and uses this family to obtain new relations between the Hecke eigenvalues and Fourier coefficients of paramodular newforms revealing a fundamental dichotomy for paramodular representations Among other important results it includes a complete description of the vectors fixed by these congruence subgroups in all irreducible representations of  $\mathrm{GSp}\ 4$  over a nonarchimedean local field Siegel paramodular forms have connections with the theory of automorphic representations and the Langlands program Galois representations the arithmetic of abelian surfaces and algorithmic number theory Providing a useful standard source on the subject the book will be of interest to graduate students and researchers working in the above fields

**Frontiers In Orthogonal Polynomials And Q-series** M Zuhair Nashed,Xin Li,2018-01-12 This volume aims to highlight trends and important directions of research in orthogonal polynomials q series and related topics in number theory combinatorics approximation theory mathematical physics and computational and applied harmonic analysis This collection is based on the invited lectures by well known contributors from the International Conference on Orthogonal Polynomials and q Series that was held at the University of Central Florida in Orlando on May 10 12 2015 The conference was dedicated to Professor Mourad Ismail on his 70th birthday The editors strived for a volume that would inspire young researchers and provide a wealth of information in an engaging format Theoretical combinatorial and computational algorithmic aspects are considered and each chapter contains many references on its topic when appropriate

*Elliptic Integrals, Elliptic Functions and Modular Forms in Quantum Field Theory* Johannes Blümlein,Carsten Schneider,Peter Paule,2019-01-30 This book includes review articles in the field of elliptic integrals elliptic functions and modular forms intending to foster the discussion between theoretical physicists working on higher loop calculations and mathematicians working in the field of modular forms and functions and analytic solutions of higher order differential and difference equations

**The Arithmetic and Geometry of Algebraic Cycles** B. Brent Gordon,James D. Lewis,Stefan Müller-Stach,Shuji Saito,Noriko Yui,2012-12-06 The NATO Advanced Study Institute on The Arithmetic and Geometry of Algebraic Cycles was held at the Banff Centre for Conferences in Banff Alberta Canada from June 7 until June 19 1998 This meeting was organized jointly with Centre de Recherches Mathématiques CRM Montreal as one of the CRM Summer schools which take place annually at the Banff Center The conference also served as the kick off activity of the CRM 1998 99 theme year on Number Theory and Arithmetic Geometry There were 109 participants who came from 17 countries Belgium Canada China France Germany Greece India Italy Japan

Mexico Netherlands mania Russia Spain Switzerland the United Kingdom and the United States During a period of two weeks 41 invited lectures and 20 contributed lectures were presented Four lectures by invited speakers were delivered every day followed by two sessions of contributed talks Many informal discussions and working sessions involving small groups were organized by individual participants In addition participants reprints and preprints were displayed throughout in a lounge next to the auditorium which further enhanced opportunities for communication and interaction

Restricted Congruences in Computing Khodakhast Bibak, 2020-09-28 Congruences are ubiquitous in computer science engineering mathematics and related areas Developing techniques for finding the number of solutions of congruences is an important problem But there are many scenarios in which we are interested in only a subset of the solutions in other words there are some restrictions What do we know about these restricted congruences their solutions and applications This book introduces the tools that are needed when working on restricted congruences and then systematically studies a variety of restricted congruences Restricted Congruences in Computing defines several types of restricted congruence obtains explicit formulae for the number of their solutions using a wide range of tools and techniques and discusses their applications in cryptography information security information theory coding theory string theory quantum field theory parallel computing artificial intelligence computational biology discrete mathematics number theory and more This is the first book devoted to restricted congruences and their applications It will be of interest to graduate students and researchers across computer science electrical engineering and mathematics

## Unveiling the Power of Verbal Artistry: An Emotional Sojourn through **Congruences For L Functions Mathematics And Its Applications**

In some sort of inundated with screens and the cacophony of immediate conversation, the profound power and emotional resonance of verbal beauty usually diminish in to obscurity, eclipsed by the continuous barrage of sound and distractions. Yet, situated within the lyrical pages of **Congruences For L Functions Mathematics And Its Applications**, a interesting function of fictional splendor that pulses with fresh emotions, lies an wonderful trip waiting to be embarked upon. Published by way of a virtuoso wordsmith, this interesting opus guides viewers on a mental odyssey, softly exposing the latent possible and profound affect stuck within the complex internet of language. Within the heart-wrenching expanse with this evocative examination, we can embark upon an introspective exploration of the book is main subjects, dissect its charming publishing design, and immerse ourselves in the indelible impression it leaves upon the depths of readers souls.

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