

Some remarks on the coefficients of cyclotomic polynomials

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Abstract. Some recent advances related to the coefficients of cyclotomic polynomials, including a recurrence formula for their calculation and some numerical simulations are presented.

Keywords: cyclotomic polynomial, coefficients, recurrence formula, Möbius function, Ramanujan sums, partition function

1 Introduction

For an integer $n \geq 1$, an n th root ζ of the unity is called primitive if $\zeta^n = 1$, but $\zeta^d \neq 1$ for all $1 \leq d < n$. Denoting by $\zeta_n = \cos \frac{2\pi}{n} + i \sin \frac{2\pi}{n}$ the first root of order n of the unity, the n -th cyclotomic polynomial Φ_n is defined by

$$\Phi_n(z) = \prod_{\substack{1 \leq k \leq n-1 \\ \gcd(k,n)=1}} (z - \zeta_n^k) = \sum_{j=0}^{\varphi(n)} c_j^{(n)} z^j, \quad (1)$$

where φ is Euler's totient function, also the degree of the polynomial. The term cyclotomic comes from the property of the n th roots of unity to divide the unit circle into n equal arcs, forming a regular polygon inscribed in the unit circle.

The first few cyclotomic polynomials are

$$\Phi_1(z) = z - 1, \Phi_2(z) = z + 1, \Phi_3(z) = z^2 + z + 1, \Phi_4(z) = z^2 + 1,$$

$$\Phi_5(z) = z^4 + z^3 + z^2 + z + 1, \Phi_6(z) = z^2 - z + 1,$$

$$\Phi_7(z) = z^6 + z^5 + z^4 + z^3 + z^2 + z + 1, \Phi_8(z) = z^4 + 1,$$

$$\Phi_9(z) = z^6 + z^3 + 1, \Phi_{10}(z) = z^4 - z^2 + z^2 - z + 1,$$

$$\Phi_{12}(z) = z^4 - z^2 + 1, \Phi_{14}(z) = z^6 - z^5 + z^4 - z^3 + z^2 - z + 1,$$

$$\Phi_{15}(z) = z^8 - z^7 + z^5 - z^4 + z^2 - z + 1, \Phi_{16}(z) = z^8 + 1,$$

$$\Phi_{18}(z) = z^6 - z^3 + 1, \Phi_{20}(z) = z^8 - z^6 + z^4 - z^2 + 1,$$

$$\Phi_{21}(z) = z^{12} - z^{11} + z^9 - z^8 + z^6 - z^4 + z^3 - z^1 + 1,$$

$$\Phi_{22}(z) = z^{10} - z^9 + z^8 - z^7 + z^6 - z^5 + z^4 - z^3 + z^2 - z + 1.$$

On The Coefficients Of Cyclotomic Polynomials

Gregory B. Imhoff



On The Coefficients Of Cyclotomic Polynomials:

On the Coefficients of Cyclotomic Polynomials Gennady Bachman,2014-08-31 This book studies the coefficients of cyclotomic polynomials Let $a_{m,n}$ be the m th coefficient of the n th cyclotomic polynomial $\Phi_n(z)$ and let $a_{m,n}^{\max}$ $a_{m,n}^{\min}$ The principal result is an asymptotic formula for $\log a_{m,n}$ that improves a recent estimate of Montgomery and Vaughan Bachman also gives similar formulae for the logarithms of the one sided extrema $a_{m,n}^{\max}$ $a_{m,n}^{\min}$ In the course of the proof estimates are obtained for certain exponential sums which are of independent inter

Some Properties of the Coefficients of Cyclotomic Polynomials Kau-un Lu,California Institute of Technology. Division of Physics, Mathematics and Astronomy,1968 1982, $\Phi_n(z)$ - $\Phi_n(z)$ $\Phi_n(z)$ $\Phi_n(z)$ *On the Calculations of the Coefficients of Cyclotomic Polynomials* Young Hyun Paik,1969 *On the Coefficients of Cyclotomic Polynomials* Gregory B. Imhoff,2013 New Frontiers in Number Theory and Applications Jordi Guàrdia,Nicușor Minculete,Diana Savin,Montserrat Vela,Abdelkader Zekhnini,2024-05-27 This contributed volume presents recent advances as well as new directions in number theory and its applications Algebraic and analytic number theory are the main focus with chapters showing how these areas are rapidly evolving By gathering authors from over seven countries readers will gain an international perspective on the current state of research as well as potential avenues to explore Specific topics covered include Algebraic Number Theory Elliptic curves and Cryptography Hopf Galois theory Analytic and elementary number theory and applications New Frontiers in Number Theory and Applications will appeal to researchers interested in gaining a global view of current research in number theory **On the Cyclotomic Polynomials with +1 Or -1 Coefficients** Shabnam Akhtari,2004 Coefficients of the Cyclotomic Polynomials Richard Carl Vrem,1968 On the Coefficients of Ternary Cyclotomic Polynomials Thomas Joseph Flanagan,2007 **Computational Number Theory** Attila Pethoe,Michael Pohst,Hugh C. Williams,Horst G.

Zimmer,2011-06-01 No detailed description available for Computational Number Theory **On the Coefficients of Ternary Cyclotomic Polynomials and Their Families** Brenden White,2020 *Analytic Number Theory:The Halberstam Festschrift 2* Bruce C. Berndt,Harold Diamond,Adolf J Hildebrand,1996-05-01 The second of two volumes presenting papers from an international conference on analytic number theory The two volumes contain 50 papers with an emphasis on topics such as sieves related combinatorial aspects multiplicative number theory additive number theory and Riemann zeta function

General Expressions for Certain Coefficients in the Cyclotomic Polynomial $[\psi]\alpha(x)$ Sister Mary Andrea Johnston,1954 **Coefficients of the Cyclotomic Polynomial** Leland Blaine Carter,1974 **Mathematical Analysis and Numerical Methods** Aliaa Burqan,Rania Saadeh,Ahmad Qazza,Osama Yusuf Ababneh,Juan C. Cortés,Kai Diethelm,Dia Zeidan,2024-10-05 This book presents a thoughtful compilation of chapters derived from the proceedings of the 8th International Arab Conference on Mathematics and Computations IACMC 2023 held at Zarqa University in Zarqa Jordan from 10 12 May 2023 Encompassing a broad spectrum of themes crucial to contemporary research and development the

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In an electronic era where connections and knowledge reign supreme, the enchanting power of language has been apparent than ever. Its power to stir emotions, provoke thought, and instigate transformation is really remarkable. This extraordinary book, aptly titled "**On The Coefficients Of Cyclotomic Polynomials**," published by a very acclaimed author, immerses readers in a captivating exploration of the significance of language and its profound impact on our existence. Throughout this critique, we will delve into the book's central themes, evaluate its unique writing style, and assess its overall influence on its readership.

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