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Higher Arithmetic Applications in Engineering

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ABSTRACT

The Research of integers is the main focus of the mathematical field known as number theory. Comparatively to calculus, geometry, etc., engineering uses number theory less frequently. Its inability to be used directly in any application was the difficulty. But the number theory offers intriguing answers to practical issues when paired with the computing capacity of current computers. It is useful in many different areas, including computing, numerical analysis, and cryptography. Here, we concentrate on number theory's applications to problems in engineering.

KEY WORDS: Number theory and Applications in Engineering Number theory, known as the queen of mathematics is the branch of mathematics that concerns about the positive integers 1, 2, 3, 4, 5 which are often called natural numbers and their appealing properties. From antiquity, these natural numbers classified as odd numbers, even numbers, square numbers, prime numbers, Fibonacci numbers, triangular numbers, etc. Due to the dense of unsolved problems, number theory plays a significant role in mathematics. The recent classification of number theory depending upon the tools used to address the related problems is shown in the Figure 1

1. INTRODUCTION :

The area of mathematics known as number theory, or "the queen of mathematics," is concerned with the nonnegative 1, 2, 3, and 4, sometimes known as "natural numbers," and their alluring qualities. These natural numbers have been categorized as odd, even, square, prime, Fibonacci, triangular, and other terms since ancient times. Number theory is important in mathematics because there are so many unanswered issues in it. Figure 1 displays the most current division of number theory according to the methods employed to solve related issues.

Number Theory can be classified as

1. Elementary Number Theory
2. Algebraic Number Theory
3. Analytic Number Theory
4. Geometric Number Theory
5. Probabilistic Number Theory

Greeks deserve all the credit for conducting scientific studies on integers. Later, this theory underwent a significant revolution as a result of the publication of Euclid's famous book, "Elements," in which the subject of mathematics is precisely illustrated. To the best of the authors' knowledge, there aren't many different types of publications addressing the uses of mathematical logic in engineering. Therefore, the goal of the current work is to conduct a critical analysis of the current procedures relating to the applications of number theory in engineering.

2. DEVELOPMENTS OF NUMBER THEORY

Number theory, a field of pure mathematics, saw less practical application in the early years. But when paired with existing processing technology, it offers answers to a number of pressing issues. The authors covered some of the theory's applications to engineering-related topics in this section.

One of the most important fields in the current digital era, when computer security is a major worry, is cryptography. Without adequate security, an information used by a sender to a recipient online runs the danger of being observed by an unauthorised person. Utilizing the cryptographic idea is the solution to this issue. The sender's message was shown to be "encrypted" or "encoded" with the aid of a huge number, typically a prime number, known as a "key," and the recipient needs the same key in order to "decipher" or "demodulates" the message. In this case, the production of such big prime numbers is an application of number theory. With the use of number theory, Maurer [1] created a productive procedure to produce such numbers. Modular arithmetic, a cornerstone of number theory, includes the congruence modulo relation. An important part of cryptography is played by the equivalency modulo relations in conjunction with linear transformations [2]. Semiprimes are natural numbers that can be represented as the combination of three separate prime numbers, such as and. Semi-primes are incredibly useful for cryptography, particularly for public key cryptography.

Elliptic curves are a key idea in number theory. In the past, research on number theoretic issues related to elliptic curves was done mostly for creative purposes. These questions have recently become crucial in several applicable fields, including coding theory, creating pseudorandom numbers, and most importantly, cryptography [4]. The subject of cryptology even has a special topic called "elliptic curve cryptography." An additional defence for the current cryptic system is provided by coding theory, which is based on number theory. The production of pseudorandom numbers is particularly effective at providing "keys." The ultra elliptic Diophantine equation, which is a crucial component of the study of number theory and is used for numerous applications based on computer coding, was described by Srikanth [5].

There are a lot of fascinating number sequences that are crucial for addressing problems. Fibonacci series is one of them (0, 1, 1, 2, 3, 5, 8). In engineering, it can be used in many different ways. The "Fibonacci search strategy," as outlined by Ferguson [6], is a method of searching a sorted array in computer science engineering. It employs a divide and conquer strategy. Using Fibonacci numbers, this approach helps to reduce the number of potential placements for the necessary element. The array is divided into two segments with sizes that are consecutive Fibonacci numbers using the Fibonacci search algorithm. It has the advantage that only addition and subtraction are required to calculate the indices of the accessible array members, eliminating the need for extra time-consuming operations. The Fibonacci series are used in the simulation to defined time overreliance of instants and dimension distributions during consolidation.

The golden ratio is a crucial idea connected to the Fibonacci series (phi). If the ratio of any two quantities is the same as the ratio of their sum to the larger of the two quantities, then the ratio is said to be in the golden ratio. For two numbers x and y, represented algebraically, $x > y > 0$, $(x + y)/x = x/y =$. Numerous natural and man-made items are seen to follow the golden ratio in their shapes [7]. The spirals found in plant blooms and the Parthenon, a well-known structure, are two well-known examples. The Fibonacci series is frequently seen in nature and has been used extensively in engineering and construction. The behaviour of structural components utilised in engineering is explained by the phi code. In the fatigue test of beams, it is regarded as a defining parameter. The existence of the phi formula in the relationship among both tensile stress was highlighted by Collins and Brebbia [8]. For the case when $x = xy$ and $y = 0$, the relationship between the normal stress x and indeed the greatest shear stress m is given by m = x [5 / 2], where m = (1 + 2)/. It is an effective structural analysis tool.

The "Pythagoras theorem" is one of the most well-known mathematical hypotheses. Given is the relationship between the sides as it relates to right-angled triangles. It comes as no surprise that it has uses in any subject that involves triangles. Next, a few well-known examples are shown. The "Delta wing" is the wing configuration found on contemporary jet aircraft. This configuration's efficacious design is aided by the theorem. Rocket tips, which appear to be an inverted triangle in section, have similar uses. Another illustration is the sectional examination of the conical shape of cones, which acts as a fairing between the stages of a multi-stage rocket. The theorem is used to calculate engine and propeller blade angles. This theorem is used by meteorologists and aerospace professionals to determine a region and sound source. The Pythagoras theorem and non-arithmetic sequence make for an intriguing combination in number theory. The legs of the right triangles that make up the digits 3, 5, 9, 11, 15, 19, 21, 25, 29, and 35 are all odd numbers, while the lengths of the sides are all integers. The length of the hypotenuse is a prime number [9].

As Manfred [10] has discussed, number theory can be used to enhance the acoustics of performance halls. The acoustic quality is significantly improved by the cost of building musical scales that maximise sound dispersal in the venues. The work of Manfred illustrates methods for enhanced sound dissipation via reflection phase-gratings based on three different number theory notions. The confined partition function was described by Boris and Leonid [11] as a method for obtaining all quadratic formula separate constants of the degrees arising from the finite group's action on the subspaces over the specialized field. The task of determining "algebraically independent invariants" of the degrees that appear as a result of an action of "the bounded grouping on the embeddings over the domain of complex numbers" is accomplished through the use of restricted partition functions. Victor Barsan [12] developed a two-parameter generalisation of the comprehensive elliptic summation of the second sort, which is presented in relation to the Appell function. In the comprehensive elliptic integrals, this factor is somewhat reduced to a much more pleasant bilinear form, and a few practical applications in solid-state physics are briefly described.

Jacobi's triple product has new polynomial equivalents provided by Krishnaswami Alladi and Alexander Berkovich [13]. Weights of the codewords, a straightforward foundation to either the mathematical and technical aspects of coding theory, was covered by Robert and Howard [14]. From a usage-oriented approach, Roger [15] described the actual properties of regular point lattices increasing. He briefly discussed the traits of plant biology's Farey sequences. Armen et al. [16] studied "Newton-Girard power-sum" formulas equivalents for entire and meromorphic functions with applications to the Riemann zeta function. The discussion concludes with a Ramanujan sum application in engineering. Over the past few decades, signal processing has become aware of the shape of this sum. The Ramanujan sum can be used to extract periodic components from discrete time signals, as demonstrated by Vaidyanathan [17]. Once more, Vaidyanathan [18] introduced the Ramanujan subspace and investigated its characteristics in order to demonstrate how finite duration signals can be broken down into the finite sum of orthogonal subspaces. Thus, numerous areas of number theory's vast applicability are mentioned. Given the current situation, number theory plays a larger part in solving cyber security issues. Because of the advancements in high-speed computers, there are many potential applications in the future, and there is room for number theory applications to increase.

3. CONCLUSION

The number theory's many engineering applications were all covered in depth. It was initially recognised that number theory had made a considerable contribution to computer science engineering in the domain of cryptography in recent years. It was noticed that notable series and sequences are significant in practically every area of engineering. It is clear that while certain implementations of number theory did not directly include them, in others, their fundamental nature served as a catalyst for how to approach a solution. Also recognized was the applications' adaptability. Numerous applications of theoretical physics to both pure mathematics and applied/engineering mathematics will be made possible by further study and development of the subject.

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