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A Study on the Contributions of Indian Mathematicians in Modern Period

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Abstract

The purpose of this paper is to provide an overview of the contributions of Indian mathematicians to a claim about a Diophantine equation in modern times. Vedic literature has contributed to Indian mathematics. About 1000 B.C. and the year 1800 A.D. For the first time, Indian mathematicians have drawn up various mathematics treaties, defining zero, the numeral method, the methods of arithmetic and algorithm, the square root, and the cube root. Although, there is a distinct contribution from the sub-continent during readily available, reliable information.

Keywords: Number theory, Diophantine equation, Indian Mathematicians, Shakuntala Devi, and Manjul Bhargava.

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Introduction

The history of mathematics shows the great works, including the mathematical contents of the Vedas, of ancient Indian mathematicians.India seems to have in the history of mathematics, an important contribution to the simplification of inventions.[1] In addition to the Indians, the entire world is proud that ancient India has made great mathematical accomplishments. Thus, without the history of ancient Indian mathematics, the history of mathematics cannot be completed.In the early stages, two major traditions emerged in mathematics (i) Arithmetical and algebraic (ii) geometric (the invention of the functions of sine and cosine). The position ofthe decimal number system was its most significant and most influential contribution. But the Indian mathematical history is much more than that of the second half of the 19th century, especially after the recovery of Indian academic life. Major contributions were made by scholars such as Bhramagupta, Bhaskara II, and Varahamira during classical Indian mathematics (400 AD to 1200 AD). First reported in Indian math's the decimal number scheme used today [2].

Indian scientists contributed a great deal in the field of mathematical Astronomy and thus significantly contribute to the development of arithmetic, algebra, and trigonometry. Perhaps the most noteworthy developments were in the areas of endless expansion trigonometric terminology and disparity equations. Yet the invention of the decimal counting system is probably the most amazing evolution in mathematical history. Indians were the first to analyse methods for the determination of integral Diophantine equations the typical Indian programming skills have dominated the non-European field in Southern India and were effectively used by Professor Ashok He wrote a book "Indian Mathematics, an introduction". The knowledge was primarily based on the concepts and the techniques for mathematical analysis.

History of Indian Mathematician

The first goal is to keep before us instances of first-rate mathematics, highlighting the mathematical ideas involved and the relation involved [3].

Old Period

Vedic Time (approximate 3000 B.C. – 1000 B.C.)

Vedic works include various rules and advances in geometrysuch as:

1. Usage of the geometric forms, containingrectangles,trapezium, triangles, circles, andsquares.
2. Field and Numbers uniformity
3. The difficulty of quadrature of the loop was equivalent and vice versa
4. Problems of Pythagoras theorem.
5. Approximation for π– Three numerical π values are discovered in Shatapata Brahmana

Vedic works include every four arithmetical operators (addition, subtracting, multiplying, and dividing). This shows that different mathematical approaches were not at that time in a conceptual process but were rather used methodically and extensively [4]

Vedic Post Era (1000 B.C. – 500 B.C.)

Altars had to be created for rituals to be performed. The altar had to be very accurate to be effective with this ritual sacrifice. To make these precise measurements, geometric mathematics has been established. Procedures were accessible in the shape of Shulv Sutras (also Sulbasutras). Shula's lead implies. This lead was used during altar formation for geometry calculation.

Jain Mathematics

The development of mathematics is primarily contributed by Jain Acharyas. In Jain's literature, there are extensive math explanations.

Jain Mathematics was primarily concerned with:

1. Numbers theory
2. Operators of arithmetic
3. Operations with fractions
4. Geometry
5. Permutation and Combination
6. Simple equations
7. Cubic and Quadratic equations

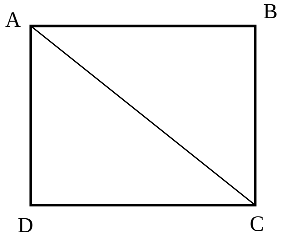
Jains created an infinite theory that included five degrees of infinity: endless in one way, in two directions, in space, endlessall over and endless forever. They had a prehistoric knowledge of indices and severalnotions of base 2 logarithms.

Baudhyayana Sulba Sutras

The fire altar types used in different religious rituals include geometric patterns such as squares, triangles, rectangles, and rhomboids, etc. One shape was required to change to another shape, keeping the area fixed. Methods for transforming a square into a rectangle, trapezium, rhombus, and triangle and vice versa were found in the BAUDHYAYANA SULBA SUTRAS.In this process, it is recognized that the square on the diagonal of a given square contains twice the original area. [2]

If ABCD be a square of side of measure 'l', say then the area of the square ABCD is given byl^2.Then according to the method of the SULBA SUTRAS BAUDHYAYANA.

Fig.1 Baudhyayana Sulbha Sutra [2]



$$AC^2 = 2L^2$$
$$= L^2 + L^2$$
$$= AB^2 + BC^2$$
$$\text{Or } AC^2 = AD^2 + CD^2 \qquad \text{Eq.1}$$

Which is the well-known Pythagoras theorem?

Mathematics was also given due consideration by Buddhist literature. The mathematics is divided into two categories:

1. Garena (Simple mathematics)
2. Sankhyan (Higher mathematics)

Numbers in three categories have been described:

1. Sankhya (Countable)
2. Asankheya (Uncountable)
3. Anant

Bakshali Manuscript

There are eight major topics in the Bakshali script:

1. Threerules (profit and loss and attention)
2. Linear equation solution of up to five unknowns
3. Quadratic equation solutions
4. Composite Series
5. Geometric and Arithmetic Progressions
6. Quadratic Unspecifiedcalculations
7. Simultaneous Equations

Pre-Mid Period (500 B.C. – 400 A.D.)

Mathematics was also adequately established during this time. The following is the subject of Vaychali Ganit in particular:

1. Fractions
2. Numbers based on 10
3. Basic math calculation
4. Interest methods
5. Rule of false position
6. Squares and Cubes of numbers

Mid-Term Classic Period (400 A.D. – 1200 A.D.)

Throughout this era, the practice of writing Siddhantas (astronomical works) which started about 500 BC,continual. The Pitamaha Siddhanta is the oldest of the Siddhanta's (about 500 BC) and the most recognized is the Surya Siddhanta (about 400 AD, unknown author, prejudiced Aryabhata). The invention of the sinus mechanism was the key achievement of these works.

The setting-up of the "galaxy" of Aryabhata-led mathematician astronomers. Those men were first and foremost astronomers, but astronomers developed many fields of mathematics because of the mathematical criteria of astronomy (and probably of further interest). [5]

Classic End (1200 A.D. – 1800 A.D.)

The function of Bhaskara is studied the peak point of mathematics in India, and Indian mathematics has long since ceased. Kamalakara (1616 A.D.-1700 A.D.) and Jagannatha Samrat (1690 A.D.-1750 A.D.) are worth considering for short purposes. Kamalakara gave fascinating trigonometric results and Samrat created both mixing the conventional ideas of Indian astronomy and the principle of Arabic.

The Kerala School of Mathematics

Madhava was the founder of the school. He has found extensions of the power series to sine, cosine, and arctangent functions and has created an infinitesimal calculus for trigonometric functions, polynomials, and rational functions [6].

In particular the famous formula $\pi/4 = 1 - 1/3 + 1/5 - \ldots\ldots\ldots$, Which was found by Gregory and Leibniz centuries later was known to the Kerala School. This series is now known as the Madhava– Gregory series.

Important discovery by Keralese mathematicians contain:

1. Sum of an infinite series
2. Infinite series
3. Newton-Gauss interpolation formula
4. Expansions of trigonometric functions

Current Period (1800 A.D. Onwards)

Books about geometrical mathematics, numerical mathematics, and trigonometry were published by Bapudev Shastri (1813 A.D.). Books were published by Sudhakar Dwivedi (1831 A.D.) titled:

1. Samikaran Meemansa (analysis of equations)
2. Golaya Rekha Ganit (sphere line mathematics)
3. Deergha Vritta (dealing with ellipse)

Yet, the Indian mathematicians continued to do appreciable work in several branches of mathematics. Some of them were K. Anand Rau (1893-1966), S.S. Pillai (1901-1950), S. Chowla (1907-1995), T. Vijayaraghavan (1902-1955), K. Chandrashekharan (1920-1995), and S. Minakshisundaram (1913-1968) (Seth, 1963). The indigenous interest and achievements in mathematics in the past must have fuelled their urge additionally.

Srinivasa Ramanujan

The modern mathematical scholar Srinivasa Ramanujan (1889 A.D.) He went into the Vedic form of writing and then proving mathematical principles. His logically is shown by the fact: some of his fifty theorems have taken many modern mathematicians to prove.

Ramanujan has also shown that it is possible to write any large number as the sum of no more than four prime numbers. It showed how the number could be split into two or more squares or cubes. "It is a very interesting number," Ramanujan responded. It is the minimum number that can be interpreted as the sum of two cubes in two different ways: Author also suggested that 1729 is the nominalfigure that can be inscribed in two ways in the system of the sum two cubes numbers, i.e.,1729 =$9^3 + 10^3 = 1^3 + 12^3$. The number 1729 has since been named Ramanujan's number. [7]

Swami Bharti Krishna Tirtha (1884 A.D. – 1960 A.D.)

The book Vedic Ganit has been published by Swami Bharti Krisnateerthaji. He's Vedic Ganit's creator and father. With lexicographic details, the key to the Ganita Sutra encoded in Atharva Veda was obtained by Bharati Krishnaji. He considered "65 sutras," a word that covers all undergrowth of mathematics,geometry, arithmetic, trigonometry, physics, spherical and plane geometry, conical and calculus, and all kinds of applied mathematicsvarying and precise, complex, hydrostatic, and all kinds of mathematics.[8]

Shakuntala Devi (1929 A.D.-2013 A.D.)

Shakuntala Devi, the most famous Indian female mathematician ever, was more often called the human-machine. Because of her immense ability, she was named by no calculator to solve equations. Sakuntala Devi published a significant number of mathematics books. She also was the President of India's astrologer. In 1980, in 28 seconds, she gave two thirteen-digit figures and variousnationsrequested her to prove her outstanding ability. She was playing with a PC in Dallas to see who was going quicker the cube root of 188138517! In the US University, the 23rd root of the 201 numbers was demanded. In fifty seconds, she responded. It took a complete one-minute UNIVAC 1108 to report that she was fed 13,000 instructions directly afterward.[9]

Manjul Bhargava (1974 A.D.-2013 A.D.)

The coveted Fields Medal, honoured as the 'Nobel Prize for mathematics' in 2014, was won by a mathematician of Indian descent. A Canadian-American mathematics professor at Princeton UniversityManjul Bhargava was awarded a Fields Medal for the development of powerful new numerical geometry methods that he used to count small rank rings and connect the average rank of elliptic curves,"was awarded a Fields Medal for the development of powerful new numerical geometry methods, which he applied to counting small rank rings and binding the average elliptical curve rank.

The work of Mr. Bhargava in number theory had "a profound influence"on the field.He has a taste for simplistic problems of timeless elegance that he has solved by creating sleek and strong modern approaches that give profound insights.

A Mathematical man with exceptional imagination.

The generalization was that if perfect quadrature is sum of two numbers and each one is multiplied by a perfect square; the result is again the sum of an entire perfect quadrature. The procedure is if unique multiplies two binary square shapes, the rule states which square shapes will emerge.The method was that if one multiplies two binary quadratic forms, the rule says which quadratic form would seem. Manjula saw that if he put numbers on each of the mini-four cube's corners and cut the cube in half, it will be possible to combine the eight corner numbers to create a binary quadratic form.

Fig.2 Rubik

Indeed, as there are three methods to break the cube in half-make the front-back, left-wing or top-bottom divisionsthe cube could produce three binary quadratic formats, "One found in Gauss was that it was made up of a binary quadratic form rule, i.e.,$\boldsymbol{ax^2}$+ bxy + cy^2, with a, b and c being fixed complete numbers, and x and y being variables.

"Prof. Bhargava showed that quadratic forms were not the only forms with such composition, but that other forms such as cubic forms also have such composition. He was also able to show that the Gauss composition is only one of at least 14 such laws".[10][11]

Shreeram Shankar Abhyankar (22nd July 1930 – 2nd Nov 2012.)

He was a mathematician from Indian America. Shreeram Abhyankar has given a large number of significant mathematical contributions, in particular commutative algebra, algebraic geometrythe functional theory of numerous complex variables, combinatorics, invariant conceptual. Many books were written by Professor Abhyankar: "Resolution of Singularities of Embedded Algebraic Surfaces,""Ramification Theoretical Methods in Algebraic Geometry, "Local Analytic Geometry,"

Algebraic Space Curves," and "Algebraic Geometry for Scientists and Engineers,""Algebraic Geometry Expansion Techniques,""Young Tableaux Enumerative Combinatorics," and"Canonical De-singularization Weighted Expansions," etc.[12]

He developed the problem which has now become well-known by the entitle "Abhyankar–Moh Epimorphism Theorem". In a modern book, it would be specified in fancy language as:

Suppose that $f \in k[X,Y]$ — a polynomial in two variables such that f is biregular to a line, then is f a generator of the polynomial ring? While precise, this statement needs lots of explanation. Abhyankar reformulated it so that even a middle scholar can understand and think about it:

Assume$p(t) = t^n + p_1 t^{n-1} + \cdots + p_n$ and $q(t) = t^m + q_1 t^{m-1} + \cdots + q_m$are polynomials so that t can be inscribed as a polynomial in p(t) and q(t). Is it factual that n splits m or m splits n?

Hedefined a polynomial $f(X,Y)$ to be a "variable" if there is a polynomial $g(X,Y)$ such that each polynomial in X, Y can be inscribed as a polynomial in X, Y. In regularrepresentation, this describes $k[X,Y] = k[f,g]$. Then the significantqueryeducated by Abhyankar was, how can you express if a assumed$f(X,Y)$ is a variable? The Epimorphism Theorem provides anadequatestate that there are polynomials p, q as defined above so that f(p(t), q(t)) = 0.[13] (This is factualsimplywhile you are running in distinguishing zero, but that way it is true in the common real or compound numbers).

Vinod Johri (1935-2014)

Vinod Johri was an astrophysicist of Indian people. He has been an excellent cosmologist and retired astrophysics professor at the Indian Institute of Technology, Madras since 1995.His key research contributions include 'power law inflation, quintessence genesis in fields of dark energy, and fantasy cosmology.' In Brans-Dicke theory he was the co-creator of the first model of inflation in power law along with C. Mathiazhagan. He won the Research Award of the Council of Science and Technology (CSIR) from the Uttar Pradesh Government.

Jayanta Kumar Ghosh (1937-2017)

Jayanta Kumar Gosh he was an Indian statistician, an Indian Statistical Institute professor of Emeritus and Purdue University Professor of Statistics.His research contributions fall within the fields of: Bayesian inference, High dimesntion data, statistical genetics.

Vashishtha Narayan Singh (1942-2019)

Vashishtha Narayan Singh was an Indian academic. In the 1960s and 1970s, he taught mathematics at different schools. A Reproducing Kernel Hilbert space (RKHS) is a functional analysis (a branch of math) where the point evaluation is a continuous linear functionality.They includes complex analysis, harmonic analysis, and quantum mechanics. These fields have broad applications.

K.S.S. Nambooripad (6th April 1935 – 4th January 2020)

Nambooripad was born in Puttumanoor, near Cochin, in central Kerela, on 6 April 1935. He was a mathematician from India who made a profound contribution to the structural theory of regular semigroups. He initiated his investigate livelihood running in investigation and figure theory. Nambooripad's has contributed significantly to our understanding of the construction of regular semigroups.

The definition of a periodic bordered set is one of his fundamental principles. If e and f are idempotents of a semigroup S like ef=e or ef=f or fe=e or fe=f, then the resultof is additional S idempotent, it is easy to see. Such products are referred to as essential products by Nambooripad. Thus,concerning simple products, the set E(S) of idempotents of S becomes a limited binary algebra. As an axiomatic classification of this part algebra related with the idempotents of a ordered semigroup, he interacts the notion of a normal bordered set. Equally, a bordered set of a normal semigroup S is characterized axiomatically as the set E(S) prepared with the two quasiorders$\omega^r$and ω^1(defined by $e\,\omega^r f$ iff $fe = e$ and $e\,\omega^1 f$ iff $ef = e$) along with conversions linked to these quasiorders that allow us to describe the elementary products. Its axiomatic classification is inherent to E(S) in much the similarmanner that it is possible to define the set of idempotents of an inverse semigroup as a (lower) semilattice.

The idea of a bordered set of Nambooripad can be seen as a vast generalization of the concept of a semilattice. What Nambooripad denotes to as the sandwich set S (e, f) of two idempotents$e, f \in E(S)$. The purpose of the meeting (outcome) of idempotents in an inverse semigroup is aided by (S). If S is a semigroup and $e, f \in E(S)$, then it is possible to define $S(e,f) = \{h \in E(S): he = h = fh, ef = ehf\}$. Eq. 2

Note that if e and f are regular semigroup S idempotents, then$S(e,f) = \emptyset$. Indeed if (ef)' is an inverse of ef in S, then the $h = f(ef)'e$ element is in S (e, f). [14]

Modern Methodologies used

Number theory

The number theory is a field of pure mathematics dedicated to the analysis of integer functions, or arithmetic, or higher arithmetic in older use. Number theoreticians analyse primary numbers as well as properties of integers (for instance rational numbers) of mathematical objects described as simplifications of the integer (such as, algebraic integers). The older word is algebra for number theory. The root of the modern numeral in mathematics, which is a position decimal number system, may be considered as the most controversial in the history of numbers systems. By the early 20th century, the philosophy of numbers had been overtaken.

Algebraic number theory

An algebraic number is any complex number that is a resolution to a rational coefficient polynomial calculation: for instance, any solution of an algebraic number. Algebraic number theory is a branch of number theory that uses abstract algebra methods to study the integral, rational number and their generalization. There are numerical problems surrounding the features of algebraic objects such as the algebraic number fields and their integer rings, finite fields, and function fields.

Probabilistic number theory

The analysis of variables that are approximately but not commonly independent, demonstrates several probabilistic number-theories. For example, it is almost independent if a random integer between 1 million and 1 million is divisible into 2 and if it is divisible by 3. Sometimes it is supposed that probabilistic combinatory components use the fact that anything exists with greater possibility than sometimes must occur; one may justly argue that certain uses of probabilistic number theory rely on the fact that whatever is exceptional must be uncommon.

Infinite series

Any (well-ordered) infinite arrangement of terms (i.e., numbers, functions, or something that can be additional) describes a sequence in modern language, which is the process of one after another additionof a_i. A series may be known as an infinite series to highlight that there is an infinite number of words. A sequence like this is represented (or denoted) by an expression such as

$a_1 + a_2 + a_3 + \ldots,$

Eq. 3

or, using the summation sign,

$\sum_{i=1}^{\infty} a_i.$

Eq. 4

The infinite sequence of additions that a series means cannot be carried out effectively (at least in a finite amount of time). However, if there is a notion of a limit in the set to which the terms and their finite sums belong, it is often probable to allocate a value to a sequence, known as series number. This value is the finite sums limit of the n first terms of the sequence, which are considered the nth biasedseries sums, as n inclines toward infinity (if limit occurs).

That is,

$$\sum_{i=1}^{\infty} a_i = \lim_{n\to\infty} \sum_{i=1}^{n} a_i.$$

Eq. 5

Basic properties

An infinite series is an infinite number defined by an infinite expression of the form, or simply a series as

$a_0 + a_1 + a_2 + \ldots,$

Eq. 6

Where (a_n) is an ordered sequence of terms that can be added, such as numbers, functions, or something else (a group of abelian). This is an illustration that is derived from the words list $a_0, a_1, \ldots$.. By placing them side by side and associating them with the "+" sign. By using summation notation, such as a sequence can also be represented.

$\sum_{n=0}^{\infty} a_n.$

If there is a definition of limit (for example, if it is a metric space) in an Abelian group A of terms, then any series, the convergent series, can be construed as having a value in A, known as the series number. This comprises the usual calculus cases where the group is either the real number field or the complex number field. Given a series $\sum_{n=0}^{\infty} a_n$, its kth partial sum is

$$s_k = \sum_{n-0}^{k} a_n = a_0 + a_1 + \cdots + a_k.$$

Eq. 7

By definition, the series $\sum_{n=0}^{\infty} a_n$ Converges to the edge L (or simply amounts to L) if the series of its biased amounts has a limit L. In this scenario, one typically writes to L as

$L = \sum_{n=0}^{\infty} a_n.$

Eq. 8

A series is supposed to be converging if it is converging to about limit, or divergent if it is not converging. If it exists, the value of that limit is then the series value.

Representation theory of quadratic forms

The Theory of representation is a branch of mathematics that studies abstract algebraic structures by representing their elements as a linear transformation of the vector spaces [1]. Essences of a representation are more concrete in representing an abstract algebraic object, algebraic operations and Matrices, (e.g., multiplication and addition of matrix). The concept of linear operators and matrices is well known, which helps to glean properties and also simplifies computations for extra complex theories of abstract subjects expressed about common linear algebra artifacts. Theory of Representation is a valuable technique since it decreases abstract algebra difficulties to linear algebra problems.

Algebraic Geometry

Algebraic geometry is a subdivision of mathematics that traditionally studies polynomials zeros. Current algebraic geometry is grounded on use in the resolution of intellectual algebraic techniques, especially commutative algebra. In modern mathematics, algebraic geometry is central to several conceptual relationships, including complex analysis, topology, and count theory in a variety of fields. The theme of algebraic geometry begins with the initial study of polynomial equation systems in several variables, and the inherent properties of the totality of equation solutions are far more important than the discovery of a particular solution. This contributes to some of the most profound fields of mathematics, both conceptually and conceptually.

Regular semi groups

In Mathematics, a regular semigroup is a semigroup S, in which each object is systematic or regular, e.g., a component x exists for every single component such that axa = a. More commonly considered semigroup classes is regular semigroups.

The description of a regular semigroup S consists in two related ways:

1. For every a in S, there is an x in S, which is known as a pseudoinverse, with axa = a.
2. All components a has a minimum one inverse b, in the sense that aba = a and bab = b.
3. To see the similarity of these explanations, first suppose that S is defined by (ii). Then b operates as the requisite x in (i).
4. Equally, if S is described by (i)
5. then in that case xax is an inverse for a, since a(xax)a = axa(xa) = axa = a and (xax)a(xax) = x(axa)(xax) = xa(xax) = x(axa)x = xax.

V(a) indicates the inverses set (in the above logic) of a component in an S(arbitrary semigroup).[9] Thus another way of describing state (2) above is to say that V(a) is nonempty in a normal semigroup, for each an in S. Every element an in the V(a) has a product of idempotence: abab = ab, as aba = a.

Examples of regular semigroups

1. Every band (idempotent semigroup) is regular.
2. The bicyclic semigroup is regular.
3. Each group is a semigroup regularly.
4. The homomorphic image is regular of a regular semigroup
5. A Rees matrix semigroup is systematic
6. Any complete conversion semi group is Systematic.

Discussions

Trigonometry methods, arithmetic, algorithms, squares, cube roots, negative numbers, and the most important decimal method are principles discovered and used worldwide by an ancient Indian mathematician. The Indian mathematicians contributed over several thousand years to very significant developments in mathematics. Although the development of Indian mathematics is significant, it is not distributed to the degree that the expertise and understanding are due to many other mathematicians. The analysis of indeterminate equations is a matter on which all of these mathematicians contributed profoundly (also called Diophantine equations).Here One seeks integer solutions (not just rational solutions) of a polynomial equation whose coefficients are integers.In reality, Diophantus had studied solutions of Equations inRational Number (not integers) - rational equation solutions are of important geometric significance the integer solutions of a polynomial equation with integers (not just rational solutions).Diophantine equations are usually contained in a polynomial equation in several unknowns (an entire solution that takes integer values for all unknowns) [15] in mathematics. The number of two or more monomials, each of degree 1 in one of the variables, is equated with a constant by a linear Diophantine equation. An exponential Diophantine equation is an exponent of unknown terms Since the individual equation contains something like a puzzle considered throughout history, it is the achievement of the twentieth century to formulate the general theories of Diophantine equation (above the theory of quadrilateral forms). Divakaran has researched the continuing effects on Indian mathematics of recursion and claims that it is one of Indian mathematics' key features.The remarkable advances in mathematics during the 18th century are the scope of the future works of the great mathematician Sri Srinivasa Ramanujan. Srinivasa Ramanujan was the twentieth century's greatest mathematician. Ramanujan and the contributions of other mathematicians were part of world mathematics.

Conclusion

The principal purpose of this paper is to provide the development of Indian mathematics during ancient, medieval, and modern times with chronological order. In many mathematical fields in the 20th century, Indians contributed significantly. However, in the course of the 17th to 19th centuries Indians were practically not interested in the rapid growth of mathematics the general stagnation in national life. Although secondary school mathematics, particularly in arithmetic and algebra, is mainly Indian, the majority of these mathematics were developed in Indian courses in the late 17th and early 20th centuries. The Indian math scenario has now developed to higher levels. Several mathematicians have contributed enormously, and study continues relentlessly to the field of mathematics.

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