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# Contributions of Indian Mathematicians in Modern Period

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## Abstract

The current study has conducted with the objective to know the contributions of Indian Mathematicians in modern period. Some of the observations and algorithms that Indian mathematicians have found will be studied in some depth. The mechanisms by which Indian mathematicians appear, explain the outcomes and methods are hardly discussed. There are numerical problems surrounding the features of algebraic objects such as the algebraic number fields, function fields, integer rings, and finite fields. The solution of extract periodicity from signal, the SSP (subset sum problem) and NP-Hard computational problem, and the solution of Musical Morphism with delay will be analyse by the Ramanujan's theory, Kamalakara theorem and Narayana's method, Respectively.

**Keywords:** Indian Mathematicians, SSP (subset sum problem), NP-Hard, Musical Morphism, Ramanujan, Kamalakara, Narayana

## 1. Introduction

There have been several books written on the history of the Indian mathematical tradition. [1] In addition, "several books on the history of mathematics, a chapter, sometimes even a section is dedicated to the discussion of Indian mathematics". Some of the observation and algorithm that Indian mathematicians have found will be analysed in some depth. But there has been little exposure to the foundations and methods of Indian mathematics. Hardly mentioned are the methods by Indian mathematicians appear, procedures, and explain the findings. There is not nearly consideration given to the metaphysical foundations of Indian mathematics, validation of mathematical procedures, the Indian understanding of the life of mathematical objects, and outcomes.

The current researcher outlook can rightly be called scientific. Contemporary academics, therefore, have quite a certain curiosity in the history of mathematics and science. It is never possible to exaggerate the value of making zero points. The characteristic of the Hindu race, where it originated is giving to airy nothing, not merely a local dwelling and a name, image, sign, but useful force. It's like coining dynamos with nirvana. For the general on-going knowledge and strength, no single mathematical conception has been more effective.

For a long time, mathematics has been an important intellectual concern for man. It is said that the mathematics of the common man or the mathematics of the millions do not have the trained mathematician's esoteric abstractions and expressions of mathematics or the mathematics problems of the millennium.

It is an isolated small work, introduced by Bharati Krishna Tirthaji, Shankaracharya of Puri (1925), Vedic Mathematics, a wonder of the 20th century with 16 sutras that stock the mystical forces of measurement and calculation. Vedic mathematics should not be referred to as the vast amount of work done in the field of mathematics, as neither these sutras nor the system has any association with mathematical works or Vedas work from the ancient period. It is tragic that the long Indian mathematical legacy of an information bank of about 3000 years is not fully known or not fully discovered and is becoming extinct. It is high time to investigate with diligence and objectivity the heritage and culture of Indian Mathematics and move it on to the current generation.

- **Early Medieval Era**

Indus valley human headway (3000 before the common era) with its two notable metropolitan territories Mohenjo-Daro and Harappa didn't show any record affirmation yet gives the indication of usage of Science in the improvement of city for instance the advancement of building followed a standardized assessment decimal in nature, estimation plan of metropolitan networks and the square making advancement which was done by using genuine mathematical measure for instance estimation degree to 4:2:1, which were used being developed of building and banks of stream for flood control. The Harappan culture fell due to some climate change around 2000 - 6 - B.C. Nonetheless, the arithmetic for galactic work is viewed as considerably more established and expected that there may have been some numerical hypotheses behind this, which was followed in additional coming period's numerical work for figuring distances among planets and sun, in the field of geometry, size of various planets and so on

- **Classical Era (500 – 1200 C.E)**

For Indian mathematics, the era among 500 to 1200 C.E is considered to be a golden period, where mathematics flourished and was at its highest height. In this period, ideas that arose were cultivated a great influence on the growth and improvement of Indian culture and knowledge - 10. Mathematical astronomy or one might claim that the Siddhanta tradition dominated and endured the mathematical tradition in India during this time. Some of the mathematicians who helped to cultivate and establish mathematics were fifth century Ryabhata, sixth century Varahmihira, seventh century Bhaskara I and Brahmagupta, ninth century Sankaranarayana, Govindswami, Mahavira, Sridhara and Prthudakasvami, tenth century Vijayanandi and Ryabhata II, eleventh century Sripati, Two Mathematical Research Centers gained recognition during this period, one at Kusumapura near Patliputra and the other at Ujjain. Mathematicians of this time jointly created a vast ocean of knowledge in the form of sutras, issues and solutions that are still to be explored.

- **Modern era (1200 A.D – Till date)**

Present day period has seen numerous significant and critical disclosures made by Mathematician of Indian mainland. It is no place not exactly the traditional period in contributing an extraordinary arrangement to the Universes Numerical legacy. In beginning century of current period the work in North West India stopped or kicked the can by virtue of Mughal assault yet in South the advancement continued, this time saw the raise of Southern Mathematician works - 15 - A part of the prominent Mathematician of this time were: R.C Gupta of twenty first century, Harish Chandra of twentieth century, Ramanujan of nineteenth century, Jagannatha Samrat of eighteenth century, Kamalakara of seventeenth century, and Jyesthadeva and Nilkantha Somaiyaji of fifteenth century, Narayana Pandit, Mahendra Suri, Paramesvara and Madhava of fifteenth and fourteenth century.

## 2. Modern Mathematician

**Srinivasa Ramanujan** FRS 22/12/1887-26/04/920) [2] was a mathematician from India who lived in India during the British Rule. Author made major contributions to mathematical evaluation, infinite series, number theory, continued fractions, and then considered unsolvable including solutions to mathematical issues had almost no formal training in pure mathematics. Initially, Ramanujan created to isolated mathematical research: according to the Hans Eysenck: “Author tried to interest the leading professional mathematicians in the work but failed for the most part. What author had to show them was too novel, too unfamiliar, and additionally presented in unusual ways; they could not be bothered” [3] In 1913, it started a postal collaboration along with the English mathematician G, finding mathematicians who can well understand the work. H. Hardy at Cambridge University, England. Hardy, considering the work of Ramanujan as exceptional prepared for him to fly to Cambridge. Hardy noted in the notes that Ramanujan had developed revolutionary new theorems, including several that “defeated me completely; I had never seen anything in the least like them before [4], and some recent, but highly advanced results”.

Ramanujan independently compiled approximately 3,900 findings during his brief life (mostly equations and identities). [5] Several were entirely new; his extremely unorthodox findings and original, such as mock theta functions, partition formulae, Ramanujan prime, and Ramanujan theta function, opened entirely new fields of work and stimulated a great deal of further study. [6] Almost all of his arguments have been proved right. [7] The Ramanujan Journal was set up to publish work in all areas of Ramanujan-influenced mathematics,[8] and his notebooks, which contain summarization of the unpublished, published results, have been examined and studied as a source of new mathematical ideas for decades since his death. As late as 2011 and again in 2012, researchers kept on finding that simple remarks on “comparative yields” and “basic properties” for specific discoveries were themselves significant and unpretentious number hypothesis results in his works, which stayed unsuspected until right around a century after his demise. [9] It became the first Indian to be elected as a fellow at Trinity College and some of the youngest fellows of the Royal Society, Cambridge. Hardy said of his “original letters that a single look was sufficient to prove that they could have been written by only a mathematician of the highest calibre, comparing Ramanujan to mathematical geniuses such as Jacobi and Euler”.

**Radha Charan Gupta** is a mathematics historian from India. Radha Charan grad. from Lucknow University, where graduated with a bachelor's degree in 1955 and post grad. in 1957. In 1971, It is received the Ph.D. from Ranchi University in the history of mathematics. [10] He did his thesis at Ranchi University with T.A., an Indian mathematics historian Amma Sarasvati. It is worked Christian College as a lecturer at Lucknow (1957 to 1958) and entered the “Birla Institute of Technology”, Mesra, in 1958. In 1982, it was awarded a full professorship. and retired in 1995 as Professor Emeritus of the study of logic and mathematics. [10] In February 1995 it is became a Corresponding Member of the history of Science Foreign Academy. [11]

Radha Charan tackled [12] exclamation in Indian mathematics in 1969. He inscribed about Govindasvamin and his interpolation of the tables of sin. In addition, it is subsidised an article on

“Paramesvara's work: Paramesvara's rule for the circumradius of a cyclic quadrilateral”. [13] It was selected as fellow of the “National Academy of Sciences”, India, in 1991 and became President of the Mathematics Teachers' Association of India in 1994. He started Ganita Bharati magazine in 1979. [14] It was given to “the Kenneth O. May Prize in 2009 alongside Ivor Grattan-Guinness, a British mathematician. [15] He is, in fact, the first Indian to win this award”. [16]

**Harish-Chandra** FRS [17] (11/10/1923 to 16/10/1983) was a physicist and “Indian American mathematician” who, in representation theory, harmonic analysis, did fundamental work on semi simple Lie groups. [18] Harish-Chandra was born in Kanpur. [19] He was studied at “B.N.S.D. College, Kanpur, and at the University of Allahabad. [20] He moved to the Indian Institute of Science Bangalore, and after completing his master's degree in physics in 1943, for further studies in theoretical physics, and worked with Homi J. Bhabha”. It relocated to Cambridge University in 1945 where he worked under Paul Dirac as a research student. [20] He attended Wolfgang Pauli's lectures while at Cambridge and pointed out an error in Pauli's work. There were created to become best friends. He developed deeply involved in mathematics during this period. In 1947, he received his PhD from Cambridge.

He was a fellow and member of the National Academy of Sciences Royal Society. [17] He was the 1954 recipient of the American Mathematical Society's Cole Prize. The “Indian National Science Academy” awarded with the Srinivasa Ramanujan Medal in 1974. Yale University granted him an honorary degree in 1981. In the mathematics department of the V. S. S. D. College, which includes lectures from students, institutes, professors from various colleges, and students visiting the “Harish-Chandra Research Institute”. The “Harish-Chandra Research Institute”, an institute dedicated to Mathematics and Theoretical Physics was named after him by the Indian Government.

**Shakuntala Devi** was an Indian mathematician, mental calculator, and writer, popularly known as the “Human Computer” (4 November 1929 to 21 April 2013). For students, Devi tried to simplify numerical calculations. [21] In the 1982 edition of The Guinness Book of World Records her talent earned a spot. [22] However, despite Devi attaining her world record at Imperial College, London on 18 June 1980, the record certificate was given posthumously on 30 July 2020. Devi was a precocious child, and at Mysore University she demonstrated her arithmetic abilities without any formal schooling. [23]

In 1977, at Southern Methodist University, it given the $23^{rd}$ root of a 201-digit number in 50 seconds. [21] Her response to 546, 372, 891 was validated by measurements made at the U.S. Bureau of Standards by a machine called UNIVAC 1101, for which a special program had to be written to carry out such an enormous calculation that it took longer to do the same than it did. [24]

She confirmed the multiply of 2 thirteen-digit numbers, 2,465,099,745,779, 7,686,369,774,870, on 18 June 1980. Imperial College London Department of Computing selected these numbers at random. She correctly replied in 28 seconds to 18,947, 668, 177, 995, 426, 462, 773, 730. [25] The 1982 Guinness World Records List registered this event. The outcome is so far superior to something earlier reported that it can only be explained as incredible. “The outcome is so much superior to anything previously recorded that it can only be defined as fantastic”. Shakuntala, note that I have various ambassadors around the world, but these are a roving ambassador, a mathematical ambassador, you are a very special ambassador. “Shakuntala, remember that I have so many ambassadors all over the world, but you are a very special ambassador because you are a roving ambassador, a mathematical ambassador, who can win friendly ambassadors all over the world. [27]

## 3. Modern Methodology:

*3.1* 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 of systems. By the early 20th century, the philosophy of numbers had been overtaken**.**

*i.*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**.**

*ii.*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.

*3.2* 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 addition of $a_i$. 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

$$a_1 + a_2 + a_3 + \ldots, \qquad \text{Eq. 3}$$

or, using the summation sign,

$$\sum_{i=1}^{\infty} a_i. \qquad \text{Eq. 4}$$

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 biased series 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

$$a_0 + a_1 + a_2 + \ldots, \qquad \text{Eq. 6}$$

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 description, the series of $\sum_{n=0}^{\infty} a_n$ unites 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

$$L = \sum_{n=0}^{\infty} a_n. \qquad \text{Eq. 8}$$

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.

*3.3* Representation theory of quadratic forms-The Theory of representation is a department of mathematics that studies abstract algebraic structures by representing the fundamentals as a linear transformation of the vector spaces [28]. 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.

*3.4* 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.

*3.5* Regular semi groups- In Mathematics, a regular semigroup is a semigroup S, which each object is systematic or regular, e.g., a component x is every single component a such that axa = a. More commonly considered semigroup classes is regular semigroups.

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

i. for every a in S, there is an x in S, which is known as a pseudoinverse, with axa = a.
ii. In the sense that aba = a and bab = b, all elements a have a minimum of one inverse b.
iii. First, to understand the similarities of the theories, assume that S is described through (ii). Then, b functions as the necessary x in (i).
iv. Equally, if S is well-defined by (i)
v. Then xax is the inverse of an in this case since (xax)a(xax) = x(axa)(xax) = xa(xax) = x(axa)x = xax and a(xax)a = axa(xa) = axa = a.

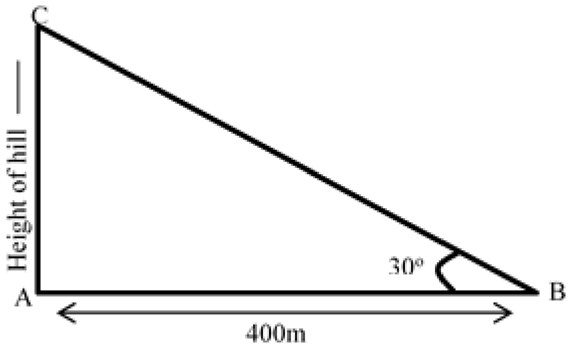
V(a) indicates the inverses set (in the above logic) of a component in an S (arbitrary semigroup). [9] Thus another way of describing state (2) above is to say that V(a) is nonempty in a normal semigroup, for each an in S. Every element an in the V(a) has a product of idempotence: abab = ab, as aba =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

**Regular semigroups Examples**

- Every band (idempotent semigroup) is regular.
- The bicyclic semigroup is regular.
- Each group is a semigroup regularly.
- The homomorphic image is regular of a regular semigroup.
- A Rees matrix semigroup is systematic.
- Any complete conversion semigroup is systematic.

## 4 Research Methodology

In our proposed work we have studied the work of various Indian mathematicians and their theorems. In the study of Radhanath Sikdar's theory we found that he was one of the first few mathematician to calculate the height of mount Everest in the year 1856. Pervious to his work Kangchenjunga was considered to be the tallest mountain in the world but in actuality that was not the case, in 1856 Radhannath calculated the height of mount Everest to 29000 feet, but due to the fear of it being a round figure "Waugh added an arbitrary two feet because he was afraid that the Sikdar's figure would be considered a rounded number rather than an accurate one". Radhanath used trigonometry for his work later his work was known as Great Trigonometric Survey. 100 years later, however, it was re-calculated to be 29,029 ft or 8848 meter in 1955 in an Indian survey. But the feat of only using trigonometry in the mid-1800s to measure roughly the right height of Mount Everest is an accomplishment.




as the trigonometric function

Tanθ = perpendicular/ base

here we have perpendicular is side AC and base side AB and θ is 30 degree.

so Tan30 = AC/AB so AC = Tan30 x AB

hence 0.57735 x 400 = AC = 230.94

hence, we can say using this trigonometric function we can approximate the height of any give object.

Two books, an algebraic treatise called Bijaganita Vatamsa and arithmetical treatise called Ganita Kaumudi, were written by Narayana Pandit. Narayanan is also believed to be the author of an extensive commentary entitled Karmapradipika (or Karma-Paddhati) on Bhaskara II's Lilavati.[3] While there is little original work in the Karmapradipika, “there are 7 dissimilar methods for squaring numbers, a contribution entirely original to the author, as well as contributions to algebra and magic squares”.[3]

The cows of Narayana are an integer sequence described by Narayana is the number of cows present every year, beginning with one cow in the first year, where each cow has one cow every year, starting in its fourth year of life. The series' first few words are as follows: 1, 1, 1, 2, 3, 4, 6, 9, 13, 19, ... In OEIS, the A000930 sequence is the cows of Narayana. The supergold ratio exceeds the consecutive word ratio.

Kaprekar discovered an interesting characteristic known as the Kaprekar constant number 6174 in 1949. [5] According to the study, 6174 is produced by repeatedly subtracting a sequence of non-equivalent four-digit integers from the highest and lowest values. There have beginning with 1278:

8721−1278 = 7443, then

7443−3447 = 4096, then

9640−0469 = 9171, then

9711−1179 = 8532, and

8532−2358 = 6174.

The same number is left to repeat from this stage onwards (8752 − 2578 = 6174). In general, it does so in a maximum of seven iterations when the procedure converges.

"It states that if you add all the natural numbers, that is, 1, 2, 3, 4, and so on, all the way to infinity, it is find that it is equal to -1/12 for those of you who are not familiar with this series, which, after a famous Indian mathematician named Srinivasa Ramanujan, has come to be known as the Ramanujan Summation". Yup, -0.0833333333333333.

To give trigonometric formulae for the cosines and sines of triple, double, quintuple angles, and quadruple Kamalakara used the subtraction and addition theorems for cosine and sine. In terms of "sin"(A) and iterative formulas for "sin"(1/3 A) and "sin" (1/5 A), he gives formulas for "sin" (1/2 A) and "sin" (1/4 A). It is gives formulas for "sin" (1/3 A) and "sin" (1/5 A).

In the Narayana's cow's hypothesis, the point is to construct the chain of expanding individuals it can likewise be utilized to compute the quantity of connections that will be there later yet because of inclined to numerous mistakes consequently this hypothesis was supplanted by GP and AP.

Kaprekar constant demonstrate that if take a four-digit number and rearrange it so make the maximum number possible and then subtract the minimum number possible within seven iteration we will get 6174 as a result. However, this does not apply to the numbers that have all the same digits.

Srinivasa Ramanujan stated that if we add all the natural number like 1+2+3+4+5+6+7+8+9…… to the infinity we will get -1/12. As a result, which is equal to -0.08333333333.

Also known as inverse trigonometric function Kamalakara solved the addition and subtraction of trigonometric values as a result the use of triple, double, quintuple angles and quadruple was easy to calculate. As he gave formulae for "sin" (1/2 A), "sin" (1/4 A) in terms of "sin" (A), iterative formulae for "sin" (1/3 A) and "sin" (1/5 A).

**a) Objective**

1. To find out the solution of extract periodicity from signal by Ramanujan's theory.
2. To analyze the SSP (subset sum problem) and NP-Hard computational problem with the help of Kamalakara theorem.
3. To examine the solution of Musical Morphism with delay by using Narayana's method.

**b) Hypothesis**

This is hypothesized that Ramanujan sum cq(n) for infinite series expansions of arithmetic- function in number theory is significant for the solution of extract periodicity from signal.

There is a significant impact of Kamalakara addition and subtraction theorems on the subset sum problem (SSP), NP-Hard computational problem.

Narayana's cow's method has a significant impact on the Musical Morphism with delay.

**c) Research Design**

ThereHere we are using quasi-experimental research design. Its "Quasi-experimental research is a study that approaches experimental research but is not actual experimental research".

**d) Research method**

In this study theorem or method of mathematics is used of Ramanujan sum cq(n) for infinite sequence expansions of arithmetic-functions in number theory, Kamalakara addition, subtraction theorems and Narayana's cows Method.

## 5 Analysis:

Ramanujan sum is a summation introduced by Srinivasa Ramanujan in 1918 [1]. The sum of $q^{th}$ from Ramanujan is defined by

$$c_q(n) = \sum^{q}_{\substack{k=1\\(k,q)=1}} W_q^{kn} = \sum^{q}_{\substack{k=1\\(k,q)=1}} W_q^{-kn}$$

Eq. 9

Where k, q denotes the gcd of k or q and $W_q = e^{-j2\pi/q}$. So, coprime to q and sum is going over the k. For instance, if q=10, then ke{1,3,7,9} in such a way that

$$c_{10}(n) = e^{j2\pi n/10} + e^{j6\pi n/10} + e^{j14\pi n/10} + e^{j18\pi n/10}$$

Eq. 10

There are many different-different mathematicians and their theorem but for this study it is hypothesized that Ramanujan sum cq(n) for infinite series expansions of arithmetic- function in number theory is significant for the solution of extract periodicity from signal. Ramanujan-aggregate based techniques for distinguishing periodicities work uniquely in contrast to regular Fourier-based strategies and give favourable circumstances when the length of the information is short and a few shrouded periodicities should be recognized, particularly when the time frames are whole number esteemed (albeit the actual signs may have non-whole number, even mind boggling, values). What's more, by creating a time span plane plot utilizing a purported Ramanujan channel bank, as periodicities change with time, and screen the changes.

In large domains such as cryptography, number theory, operation analysis and complexity theory, SSP has its applications. The Backtracking Algorithm that has exponential time complexity is the most popular algorithm for solving SSP. Therefore, better alternative enumeration techniques for the faster generation of SSP solutions need to be planned and developed. Given the set of first n natural numbers that are denoted by Xn and a target sum S, an enumeration technique that finds all subsets of Xn that add up to sum S based on Kamalakara addition and subtraction theorems is required.

We need to explore the mathematics behind this exponential problem for this purpose and analyze Xn's power set distribution and current formulas that indicate specific patterns and relationships between these subsets and three main distributions of Xn power set: Sum Distribution, Length-Sum Distribution, and Portion Distribution. These distributions are pre-possessing processes for solving SSP for different alternative enumeration techniques.

By the above analysis it is proved that there is a significant impact of Kamalakara addition and subtraction theorems on the subset sum problem (SSP), NP-Hard computational problem.

The canonical isomorphism (or musical isomorphism) is an isomorphism between cotangent bundle TM and tangent bundle TM of a pseudo-Riemannian manifold induced by its metric tensor in mathematics, more precisely, in differential geometry. Similar isomorphisms on simplistic manifolds are present. The word musical refers to the use of the ♭ (flat) and the flat symbols ♯(sharp). The exact origin of this notation is not known, but the term musicality in this sense will be due to Marcel Berger.

A cow produces one calf annually. At the beginning of the year, each calf produces one calf starting in its fourth year. Many things can be said about Natayana's cows' mathematics, about different ways of translating them into music, about different ways of translating them into music, about the point at which the cows are beginning to outnumber the cows, about the rise in population rate, the approaching limit of this rate, and so on. The root of the problem, however, is simply the sequence that results in 1,1,1,2,3,4,6,9,13 as the year goes by.... Each number, like the Fibonacci sequence, is calculated by adding an earlier number, but instead of adding the previous two numbers, as is the case with the Fibonacci series, you add the previous number in the sequence plus the number of two positions before that, as is the case with the Fibonacci series:

$$S_n = S_{n-1} + S_{n-3}$$

Eq. 11

Above analysis defined that Narayana’s cow’s method has a significant impact on the Musical Morphism with delay.

## 6 Conclusion

The presented study objects to know the contributions of Indian mathematicians in modern period. Several of the observations and methods that Indian mathematicians have found studied in a variety of depth. The mechanisms by which Indian mathematicians arrived and explain the outcomes and processes are hardly discussed. There are numerical problems surrounding the features of algebraic objects such as the integer function areas and algebraic number fields, rings, and finite fields. The solution of the signal periodicity extract, the SSP (subset sum problem) and NP-Hard computational problem, and the delay solution of Musical Morphism are studied by the theory of Ramanujan, Kamalakara theorem, and the method of Narayana, respectively.

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