

Mathematics in Ancient Indian Literature and Its Contemporary Relevance: A Study

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Abstract: *This study explores mathematical concepts embedded in ancient Indian literature across Sanskrit, Pali, and Prakrit traditions through a chronological and analytical approach. Drawing upon primary sources such as the Vedas, Śulba Sūtras, Buddhist Pali Canon, Jain Āgamas, and classical Sanskrit mathematical treatises, the paper highlights the development of number systems, geometry, arithmetic operations, algebra, and concepts of infinity. Ancient Indian texts reveal that mathematics was not treated as an isolated discipline but was deeply integrated with ritual practices, philosophical inquiry, and cosmological understanding.*

The study incorporates complete and authentic textual references in Devanagari script and interprets them in the context of modern mathematical ideas. Concepts such as cyclic time measurement, arithmetic progression, irrational numbers, infinity, and systematic classification are analyzed through textual evidence. Furthermore, the paper evaluates the contemporary relevance of these ideas in modern disciplines such as computer science, data structures, optimization theory, and applied mathematics. The research demonstrates that ancient Indian mathematical thought provides both historical insight and practical value for modern scientific understanding.

Keywords: Ancient Indian Mathematics, Vedic Literature, Geometry, Number System, Infinity, Śulba Sūtra, Pali Canon, Jain Mathematics

I. INTRODUCTION

Mathematics in ancient India represents one of the oldest and most continuous intellectual traditions, spanning over five millennia. Unlike modern mathematics, which is often treated as an independent discipline, ancient Indian mathematics developed in close association with religion, philosophy, astronomy, and ritual practices. Mathematical ideas were expressed through hymns, sutras, and philosophical discourse, forming a holistic knowledge system.

The earliest mathematical concepts appear in the Vedic literature, particularly the Rigveda, where structured numerical patterns and cyclic representations of time are observed. The division of time into 360 parts later became fundamental to geometry and trigonometry. These ideas were further developed in the Śulba Sūtras, which provided geometric principles for constructing sacrificial altars, including the Pythagorean relation and approximations of irrational numbers such as $\sqrt{2}$.

Buddhist literature in Pali introduced systematic classification and enumeration, while Jain literature in Prakrit developed advanced concepts of numbers, including countable, innumerable, and infinite quantities. These contributions reflect an early understanding of mathematical abstraction and structured thinking.

The classical period marked the formalization of mathematics through works of Āryabhaṭa, Brahmagupta, and Bhāskara II, who developed arithmetic, algebra, trigonometry, and numerical methods. Thus, ancient Indian mathematics evolved from symbolic representations to systematic scientific formulations, significantly influencing the development of modern mathematics.



II. OBJECTIVES

1. To examine mathematical ideas embedded in ancient Indian literature across Sanskrit, Pali, and Prakrit traditions.
2. To identify and analyze complete and authentic verses, sutras, and textual passages containing mathematical concepts.
3. To interpret these mathematical ideas using modern mathematical terminology and frameworks.
4. To evaluate the contemporary relevance of ancient Indian mathematical thought in fields such as computer science, engineering, and applied mathematics.
5. To establish a chronological understanding of the development of mathematical concepts from Vedic to classical periods.

III. RESEARCH METHODOLOGY

This study adopts a qualitative and analytical research methodology based on the examination of primary textual sources. The research is primarily textual in nature, focusing on original Sanskrit, Pali, and Prakrit texts.

3.1 Textual Analysis

Primary sources such as the Rigveda, Yajurveda, Upanishads, Śulba Sūtras, Buddhist Pali Canon, Jain Āgamas, and classical mathematical treatises are examined.

3.2 Conceptual Interpretation

Each verse is analyzed to identify the mathematical concept it represents.

3.3 Comparative Approach

The study compares ancient mathematical ideas with their modern counterparts.

3.4 Chronological Arrangement

All texts and concepts are arranged chronologically.

3.5 Relevance Analysis

Each concept is evaluated in terms of its applicability in modern fields.

IV. ANALYSIS

The Vedic literature represents the earliest stage of mathematical thinking in ancient India. Mathematical ideas in this period are not presented in formal symbolic notation but are embedded within hymns, ritual descriptions, and cosmological models. These ideas include numerical enumeration, cyclic structures, and early concepts of infinity.

4.1 Mathematics in Vedic Literature

Ancient Indian mathematics begins with the Vedic corpus, where numerical ideas appear in symbolic, cosmological, and ritual contexts. These texts reflect early developments of number systems, sequences, cyclic structures, and abstract concepts such as infinity.

Rigveda 1.164.11

द्वादशप्रथयश्चक्रमेकं त्रिणिभ्यानि कउतच्चिकेत ।
तस्मिन्साकं त्रिशतं शङ्खवोऽर्पिता षष्टिर्नचलाचलासः ॥

Meaning: The cosmic wheel has twelve divisions and 360 components, representing the structure of time.



Mathematical Concept Represents division of a circle into 360 parts and cyclic periodic systems.

Contemporary Relevance: Forms the basis of angular measurement (360°), trigonometry, and calendrical astronomy. Rigveda 10.90.1–2 (Puruṣa Sūkta)

सहस्रशीर्षाःपुरुषःसहस्राक्षःसहस्रपात्।
सभूमिंविश्वतोवृत्वात्यतिष्ठदशाङ्गुलम्॥

Meaning: The Cosmic Being pervades the entire universe and extends beyond it.

Mathematical Concept “सहस्र” denotes large or unbounded quantity indicating infinity. “दशाङ्गुलम्” reflects dimensional extension beyond limits.

Contemporary Relevance: Relates to infinite sets, large-scale systems, and multidimensional modeling in modern mathematics and physics.

Yajurveda (Taittirīya Saṁhitā 4.7.11 — Chamaka)

एकचमे।तिस्रश्चमे।पञ्चचमे।सप्तचमे।नवचमे।
एकादशचमे।त्रयोदशचमे।पञ्चदशचमे।सप्तदशचमे।नवदशचमे॥

Meaning: This passage presents a systematic enumeration of odd numbers in ascending order.

Mathematical Concept: Represents arithmetic progression and structured numerical sequencing.

Contemporary Relevance: Used in discrete mathematics, algorithm design, and pattern recognition in computer science.

Śukla Yajurveda (Vājasaneyi Mādhyamīna Saṁhitā), Chapter 17, Mantra 2

इमामेअग्नेइष्टकाथेनवःसन्तुएकाचदशचदशचशतंचशतंचसहस्रंचसहस्रंचायुतंचायुतंचनियुतंचनियुतंचप्रयुतंचार्बुदंचन्यर्बुदंचसमुद्रश्चमध्यंच
न्तश्चपरार्थश्चैतामेअग्नेइष्टकाथेनवःसन्तुअमुत्रामुष्मिल्लोके॥

Meaning: This mantra presents a progressive enumeration of numbers from one to extremely large magnitudes.

Mathematical Concept: This mantra explicitly demonstrates the ancient Indian decimal place-value system (powers of 10), listing successive magnitudes in steps of $\times 10$:

- ekā (1)
- daśa (10)
- śataṁ ($100 = 10^2$)
- sahasraṁ ($1,000 = 10^3$)
- ayutaṁ ($10,000 = 10^4$)
- niyutaṁ ($100,000 = 10^5$)
- prayutaṁ ($1,000,000 = 10^6$)
- arbudaṁ ($10,000,000 = 10^7$)
- nyarbudaṁ ($100,000,000 = 10^8$)
- samudraḥ ($1,000,000,000 = 10^9$)
- madhyam ($10,000,000,000 = 10^{10}$)
- antaḥ ($100,000,000,000 = 10^{11}$)
- parārdhaḥ (10^{12} or higher)



Contemporary Relevance: - Forms the foundation of modern mathematics and computing (decimal place-value system).

- Essential for large-scale computation, scientific notation, and big data processing.

Isha Upanishad (1)

पूर्णमदःपूर्णमिदं पूर्णात्पूर्णमुदच्यते ।

पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ॥

Meaning: Infinity remains unchanged even after subtraction.

Mathematical Concept: Represents concept of infinity and conservation within infinite sets.

Contemporary Relevance: Forms the basis of set theory and infinite mathematical structures.

Chāndogya Upaniṣad (6.2.1)

सदेवसोम्येदमग्र आसीदेकमेवाद्वितीयम् ।

तदैक्षतबहुस्यांप्रजायेयेतितत्तेजोऽसृजत ॥

Meaning: One fundamental existence becomes many.

Mathematical Concept: Represents transformation from unity (1) to multiplicity (∞).

Contemporary Relevance: Reflects binary systems and unified theories in modern science.

4.2 Mathematics in Śulba Sūtras

The Śulba Sūtras represent the earliest systematic treatment of geometry in ancient India.

Baudhāyana Śulba Sūtra (1.12)

दीर्घचतुरस्रस्याक्षयारज्जुःपार्श्वमानीतिर्यग्मानीच ।

यत्पृथग्भूतेकुरुतस्तदुभयंकरोति ॥

Meaning: The diagonal relates to the sum of squares of the sides.

Mathematical Concept: Represents the Pythagorean theorem.

Contemporary Relevance: Used in engineering, navigation, physics, and computer graphics.

Baudhāyana Śulba Sūtra (1.61 — $\sqrt{2}$ Approximation)

प्रमाणं तृतीयेन वर्धयेत्तत्तुर्थेनात्मचतुस्त्रिंशोनेन सविशेषः ॥

Meaning: Provides an approximation of $\sqrt{2}$.

Mathematical Concept : $\sqrt{2} \approx 1 + 1/3 + 1/(3 \times 4) - 1/(3 \times 4 \times 34)$

Contemporary Relevance: Used in numerical analysis, simulations, and engineering calculations.

Baudhāyana Śulba Sūtra (Area Transformation)

अतिदीर्घचेत्पार्श्वमानीछित्त्वा पुनः पुनः संयोजयेत्ततः यथासंभवं संयोजयेत् ॥

Meaning: Transformation of shapes while preserving area.

Mathematical Concept : Represents area-preserving geometric transformation.



Contemporary Relevance: Used in optimization, computational geometry, and spatial modeling.

Bhagavad Gita (6.17)

युक्ताहारविहारस्य युक्तचेष्टस्य कर्मसु।
युक्तस्वप्नावबोधस्य योगो भवति दुःखहा॥

Meaning: Balance in food, activity, and rest leads to the removal of suffering.

Mathematical Concept: Optimization under constraints

Contemporary Relevance: This can be interpreted in terms of linear programming, where optimal solutions are achieved within given constraints (feasible region).

4.3 Mathematics in Buddhist Literature (Pali Tradition)

Buddhist literature, particularly in the Pali Canon, reflects mathematical thinking through systematic classification, enumeration, and logical structuring of knowledge. Although not presented as formal mathematics, these texts demonstrate an advanced understanding of ordered systems and categorization.

Dhammapada (Verse 1)

मनोपुब्बङ्गमाधम्मामनोसेट्ठामनोमया।
मनसा चेपदुट्ठेन भासति वाकरोति वा।
ततो नन्दुःखमन्वेति चक्कं ववहतो पदं॥

Meaning: All phenomena are preceded by the mind; if one speaks or acts with an impure mind, suffering follows like the wheel follows the foot of the ox.

Mathematical Concept: Sequential logic Cause-effect relationship

Contemporary Relevance: This reflects the structure of algorithms, where output depends on input conditions. It is analogous to deterministic processes in computer programming and logical systems.

Dhammapada (Verse 2)

मनोपुब्बङ्गमाधम्मामनोसेट्ठामनोमया।
मनसा चेपसन्नेन भासति वाकरोति वा।
ततो न सुखमन्वेति छायेव अनपायिनी॥

Meaning: If one speaks or acts with a pure mind, happiness follows like a shadow that never leaves.

Mathematical Concept: Deterministic systems Predictable outcomes

Contemporary Relevance: This idea parallels predictive modeling and machine learning, where consistent input conditions lead to predictable outputs.

Dīgha Nikāya (Saṅgīti Sutta, DN 33)

एककानिधम्मानी, दुकानिधम्मानी, तिकानिधम्मानी, चतुक्कानिधम्मानी,
पञ्चकानिधम्मानी, छक्कानिधम्मानी, सत्तकानिधम्मानी, अट्ठकानिधम्मानी,
नवकानिधम्मानी, दसकानिधम्मानी॥

Meaning: Teachings are systematically arranged into groups of one, two, three, and so on up to ten.



Mathematical Concept: Structured enumeration Hierarchical classification

Contemporary Relevance: This reflects modern data organization techniques such as indexing, hierarchical databases, and structured programming.

4.4 Mathematics in Jain Literature (Prakrit Tradition)

Jain literature provides some of the most advanced discussions of numbers and infinity in ancient Indian thought. The classification of numbers into finite, innumerable, and infinite demonstrates a deep understanding of numerical abstraction.

Anuyogadvāra Sūtra

संख्याअसंख्याअणंताएसालोएविष्णाया॥

Meaning: Numbers are classified into countable, innumerable, and infinite categories.

Mathematical Concept: Types of infinity Numerical classification

Contemporary Relevance: This concept anticipates modern set theory, particularly the distinction between finite sets, countably infinite sets, and uncountable sets.

Uttarādhyayana Sūtra

जेएगंजाणइसेसव्वंजाणइ।

जेसव्वंजाणइसेएगंजाणइ॥

Meaning: One who understands a single element understands the whole; one who understands the whole understands the single element.

Mathematical Concept: System theory Interconnected structures

Contemporary Relevance: This idea is foundational in systems theory, network analysis, and holistic modeling used in modern science and engineering.

Bhagavati Sūtra (Numerical Enumeration)

एगं, दुयं, तियं, चउं, पंच, छ, सत्त, अट्ठ, नव, दस॥

Meaning: A sequential enumeration of numbers from one to ten.

Mathematical Concept: Natural numbers Counting system

Contemporary Relevance: This represents the foundational concept of number systems used in arithmetic, computing, and everyday calculations.

4.5 Classical Sanskrit Mathematics

Brāhmasphuṭasiddhānta (18.2)

योगोऽन्तरंगुणनंभागोवर्गोवर्गमूलमेवच।

घनंघनमूलंचेतिगणितस्याष्टधाक्रियाः॥



Meaning:

The eight fundamental operations of mathematics are: addition, subtraction, multiplication, division, square, square root, cube, and cube root.

Mathematica Concept :

This verse represents one of the earliest formal classifications of arithmetic operations such as addition–subtraction, multiplication–division, square–square root, and cube–cube root. This reflects a closed operational system foundational to algebra.

Contemporary Relevance:

These operations form the core of modern computation systems. In computer science, arithmetic logic units (ALU) perform these exact operations. In algorithm design, numerical methods rely heavily on these operations. In data science and AI, matrix computations and neural networks depend on multiplication, addition, and exponentiation..

Āryabhaṭīya (2.10)

चतुरधिकंशतमष्टगुणंद्वाष्टिस्तथासहस्राणाम्।
अयुतद्वयविष्कम्भस्यासन्नोवृत्तपरिणाहः॥

Meaning:

Add 4 to 100, multiply by 8, then add 62,000. This gives the approximate circumference of a circle whose diameter is 20,000, yielding $\pi \approx 3.1416$.

Mathematical Concept :

This verse provides an algorithmic rule for approximating π . It demonstrates advanced understanding of circle geometry and numerical approximation techniques. It implicitly uses ratios and stepwise computation, making it an early example of algorithmic thinking rather than just a static formula.

Contemporary Relevance:

Approximation of π is fundamental in engineering, physics, and computational science. It is used in simulations, graphics rendering, and scientific modeling. The stepwise nature of the computation resembles modern algorithms and programmatic instructions.

Thus, this verse represents an early form of computational algorithm design.

Bhāskara II (Līlāvati – Rule of Three)

त्रैराशिकेफलमिष्टप्रमाणंज्ञेयमेवच।
तत्रप्रमाणफलयोःसम्बन्धःकथ्यतेबुधैः॥

Meaning :

The rule of three determines an unknown quantity based on its proportional relationship with known quantities.

Mathematical Concept :

This describes proportional reasoning using the relation $a/b = x/c$. It reflects ratio, proportion, and linear relationships. It is fundamental to scaling and solving real-world quantitative problems.

Contemporary Relevance:

The rule of three is widely used in commerce, economics, engineering, and data science. It underlies linear modeling, unit conversions, interpolation methods, and proportional algorithms used in programming.



V. CONCLUSION

The study of mathematics in ancient Indian literature reveals a rich and continuous intellectual tradition that spans several millennia. From the symbolic and philosophical expressions found in the Vedas to the precise geometric constructions of the Śulba Sūtras, and from the logical classifications in Buddhist and Jain texts to the systematic formulations of classical mathematicians, ancient Indian mathematics demonstrates remarkable depth and diversity.

The analysis shows that mathematical concepts such as cyclic systems, arithmetic progression, geometry, irrational numbers, infinity, and algebra were not only present but were also applied in practical and philosophical contexts. These ideas have evolved into fundamental principles of modern mathematics and continue to influence contemporary scientific disciplines.

Furthermore, the integration of mathematics with philosophy and spirituality in ancient Indian thought provides a unique perspective that enriches modern mathematical understanding. The study highlights the importance of revisiting ancient knowledge systems to gain insights into the historical development of mathematics and its interdisciplinary applications.

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