

ANCIENT INDIAN MATHEMATICIANS AND THEIR SIGNIFICANT CONTRIBUTIONS

1. Baudhayana (c. 800 BCE)

His work is recognized as the *Baudhayana Sulbasutra*, which includes early geometric principles. It presented the Pythagorean theorem centuries before Pythagoras is said to have suggested it.

- The diagonal of a rectangle creates the same total area as the sum of the areas produced by its length and breadth separately.
- It is utilized in approximations of $\sqrt{2}$ and in geometric constructions of altars.
- It established rules for creating circles and squares with the same area.

2. Apastamba (c. 600 BCE)

His work is known as the *Apastamba Sulbastura*. His contributions include a more accurate approximation of $\sqrt{2}$ (1.414216, correct up to five decimal places). It introduced rules for cube roots and advanced geometry. It also suggests techniques for squaring the circle and transformations from circles to squares.

3. Pingala (c. 200 BCE)

His work includes *Chandahsastra*, a treatise on prosody and metre. He contributed the earliest description of binary numbers (laghu = 0, guru = 1) and introduced Pascal's Triangle, known as Meru Prastara. His efforts laid the groundwork for combinatorics and the Fibonacci sequence.

4. Aryabhata (476 – 550 CE)

His works include the *Aryabhatiya* (499 CE). He contributed to the introduction of the concept of zero as a placeholder, an idea later expanded upon by Bharmagupta. The text covers algebra, arithmetic, trigonometry, and quadratic equations. It estimates π as **approximately 3.1416, close to the current value**. Additionally, it introduced the sine function (jya) and versine (kojya), and described Earth's rotation and the reasons for eclipses.

5. Varahamihira (507 – 587 CE)

His work includes *Brihat Samhita* and *Pancha Siddhantika*. He was among the first to treat zero as a number, establishing rules for its use in addition, subtraction, and multiplication. He introduced negative numbers and the rules for working with them. He solved quadratic equations with both positive and negative roots. His work also covers the formula for the area of a cyclic quadrilateral (Brahmagupta's Formula) and made advances in solving indeterminate equations, which Bhaskara II later expanded.

6. Bhaskara I (c. 600 – 680 BCE)

His works include a Commentary on the *Aryabhatiya*. His contributions include providing an approximation for the sine function.

$$\sin(x) \approx 5\pi^2 - 4x(\pi - x)16x(\pi - x)$$

It explained the positional number system, including the concept of zero.

7. Mahavira (9th century CE)

His works include *Ganita Sara Sangraha*. He contributed to the development of systematized Jaina mathematics, which covers permutations, combinations, fractions, and square and cube roots. Additionally, he established rules for solving quadratic and cubic equations.

8. Bhaskara II (1114 – 1185 CE)

He is also known as Bhaskaracharya. His works include *Siddhanta Shromani*, which consists of four parts—*Lilavati*, *Bijaganita*, *Grahaganita*, and *Goladyaya*. His contributions include—

- *Lilavati* Arithmetic (covering series, progressions, and mensuration)
- *Bijaganita* – Algebra (solving quadratic and indeterminate equations)
- *Grahaganita* – Astronomy
- *Goladyaya* – Spherical Trigonometry
- Concept of differentiation (rate of change) – a foundational idea leading to calculus.

- It introduced the concept of the chakravala method (cyclic method) for solving Pell's equation.

9. Madhava of Sangamagrama (c. 1340 – 1425 CE)

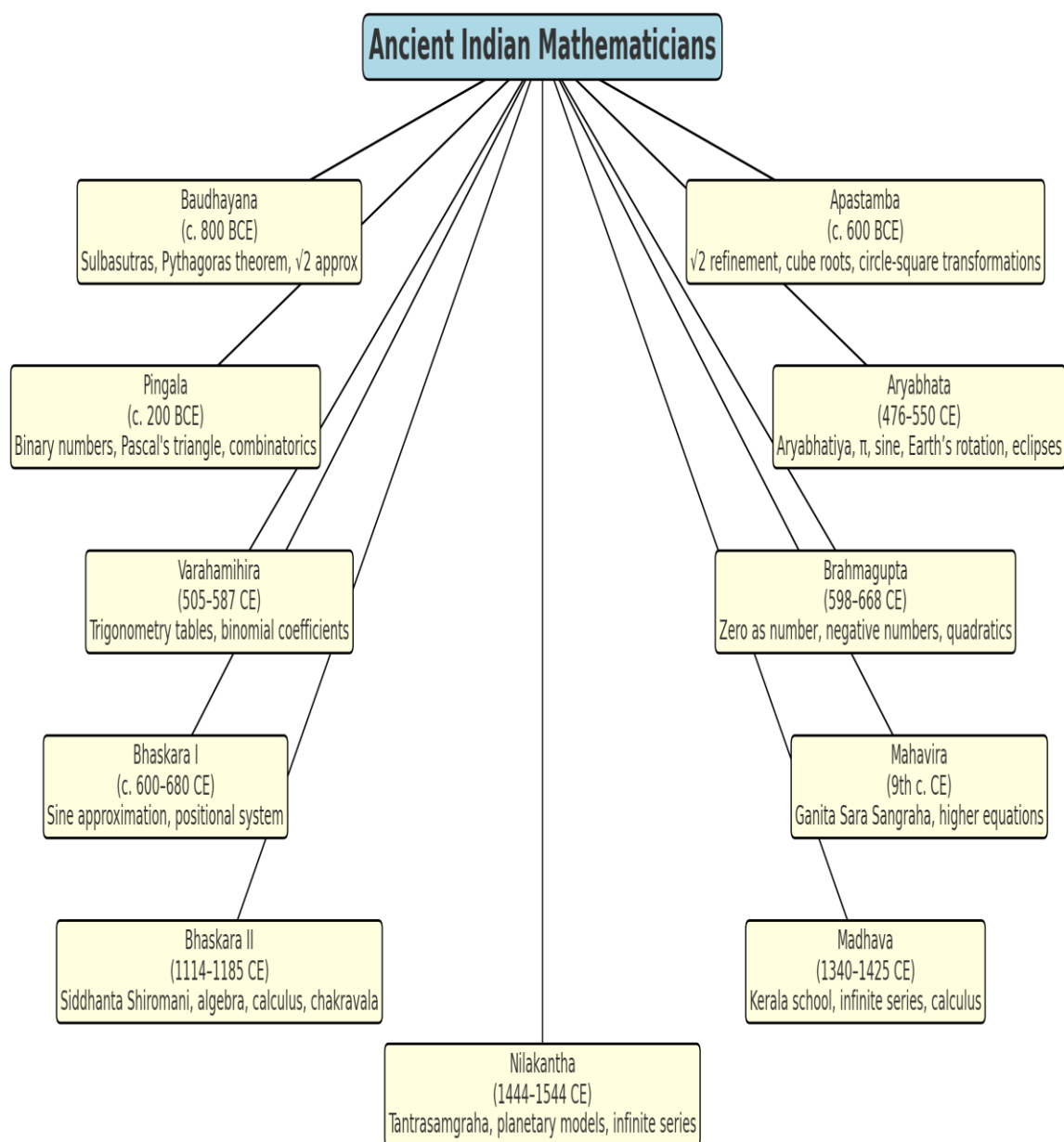
He founded the Kerala School of Mathematics. His work included early infinite series for π , **sine, cosine, and arctan**, predating Newton and Leibniz by centuries. He also explored early concepts of calculus, like integration and differentiation. His contributions influenced later Kerala school mathematicians such as Parameshvara, Nilkantha Somayaji, and Jyesthadeva.

10. Nilakantha Somayaji (1444 – 1544 CE)

His works include the *Tantrasamgraha*. His contributions feature an enhanced infinite series for π . He improved planetary models by integrating trigonometry and later worked together on heliocentric models.

Significance of Ancient Indian Mathematicians

- The introduction of the zero and place-value system was a revolutionary development in global mathematics. This system, which enabled the representation of numbers using a small set of symbols, represented a significant leap in mathematical notation. It paved the way for complex mathematical operations and was a key factor in the development of algebra and calculus.
- The works of ancient Indian mathematicians encompass a wide range of foundational topics, including algebra, geometry, trigonometry, and calculus, shedding light on the depth of their contributions to mathematics.
- The works of ancient Indian mathematicians not only influenced their contemporaries but also had a profound impact on Islamic mathematicians, such as Al-Khwarizmi and Al-Biruni, and through them, on European mathematics, a testament to the rich heritage of Indian mathematics.
- It offered tools that were crucial for fields such as astronomy, architecture, trade, and science. For instance, the concept of zero and the place-value system were instrumental in astronomical calculations. The geometric principles developed by Baudhayana were used in architectural designs. The early exploration of trigonometry and calculus had practical applications in trade and science.



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