



National Journal of Hindi & Sanskrit Research

ISSN: 2454-9177

NJHSR 2025; 1(63): 71-73

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www.sanskritarticle.com

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Bhaskara Acharya: The Forgotten Genius Who Pioneered Modern Mathematics and Astronomy

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Bhaskara II, also known as **Bhaskara Acharya**, is one of the greatest minds in the history of mathematics and astronomy. Born in the 12th century, he was far ahead of his time, making groundbreaking contributions to **algebra, calculus, and planetary motion**. His work continues to influence modern mathematics, and his insights helped shape how we understand the universe today.

In this article, we'll explore Bhaskara's genius and his major contributions, showing how his work laid the foundation for some of the most important mathematical and scientific concepts we use today.

Algebra: Laying the Foundation for Modern Equations

Bhaskara's biggest contributions to algebra can be found in his book **Bijaganita**, a Sanskrit term meaning "algebra." At a time when most of the world had yet to formalize algebraic methods, Bhaskara was already solving **quadratic equations, indeterminate equations**, and refining problem-solving techniques.

One of his most important achievements was solving equations that had **multiple solutions**, a concept that later became central to number theory. His work in **indeterminate equations**—those with an infinite number of solutions—anticipated later developments by European mathematicians like **Diophantus**.

Sloka From *Bijaganita* (On Solving Equations):

समानां ज्ञातवृद्ध्या स्यान्निश्चितं सिद्धमिति पञ्च।

गणितवृद्धमृतं शास्त्रं विद्यायां यत्र लक्ष्यं साध्यते॥

MEANING:

By systematically increasing the known quantities, we arrive at a definite solution. This is the essence of algebra—reducing unknowns to a final result through structured calculations.

Example:

Let's solve a basic algebraic equation:

Problem:

Solve for "X" in the equation:

$$2x+5=15$$

Step-by-Step Solution:

1. Start with the equation:

$$2x+5=15$$

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2. Subtract 5 from both sides:

$$2x=15-5$$

3. Now, divide both sides by 2 to isolate xxx:

$$x=10/2$$

Final Solution: $x=5$

How this relates to the sloka:

- The "known quantities" are the numbers 5 and 15, and we systematically manipulate them (add or subtract, divide or multiply) to reduce the unknown X to a final result.
- In the sloka, this process of systematically increasing and reducing values to find the solution mirrors the steps we followed in solving for X.

Bhaskara's ideas travelled beyond India as his works were translated into **Arabic**, influencing **Islamic mathematicians** during the Golden Age of Islam. Eventually, these ideas made their way to **Europe**, playing a crucial role in the development of algebra as we know it today.

Calculus: Concepts 500 Years Ahead of Newton and Leibniz

We usually credit **Isaac Newton and Gottfried Wilhelm Leibniz** for inventing calculus in the 17th century. But Bhaskara had already explored some of its fundamental ideas **500 years earlier** in his book **Siddhanta Shiromani**.

He studied **instantaneous rates of change**, a key concept in differential calculus. When describing the motion of planets, he recognized that their velocity at any given moment could be **calculated as the rate of change of distance over time**—essentially describing **derivatives** before they were formally defined.

Sloka From Siddhanta Shiromani (On Rates Of Change):

नक्षत्रेण स्फटिकेण ग्रहगणं शुद्धिम् आश्रयन्ति।

तदर्थं सृष्टिसिद्धान्तं ग्रहगति रंणं च यत्र॥

Meaning:

The motion of celestial bodies follows mathematical principles and divine harmony. Their changing positions and velocities are governed by precise astronomical laws.

One of those scholars was Bhaskara II, a brilliant mathematician and astronomer from 12th-century

India. Long before Newton and Leibniz formally developed calculus, Bhaskara was already exploring ideas that closely resemble it. When he studied motion and the changing speeds of celestial bodies, he realized something profound: velocity at any given moment could be understood as the rate of change of distance over time.

That insight is strikingly similar to the modern concept of differentiation. Bhaskara's work touched on key ideas like limits, continuity, and instantaneous velocity—concepts that are now fundamental to calculus. Though he didn't formalize the subject the way Newton and Leibniz later did, his understanding of motion and change shows just how ahead of his time he really was.

Planetary Motion: A Visionary in Astronomy

Bhaskara wasn't just a mathematician—he was also a brilliant **astronomer**. His book **Siddhanta Shiromani** contains a detailed study of **planetary motion, timekeeping, and eclipses**, making it one of the most advanced astronomical texts of medieval India.

Understanding Planetary Orbits

One of Bhaskara's greatest achievements was his study of how planets move. He recognized that **planetary orbits are not perfect circles** but follow a more complex path—something that wouldn't be fully understood in Europe until **Johannes Kepler's laws** centuries later.

Sloka From Siddhanta Shiromani (On Planetary Motion):

ग्रहगति परिमाणं सूर्यचन्द्रेण निर्धारितं।

कलानां विधायित्वेन माप्यते यत्र लक्ष्यं॥

Meaning:

The movement of planets is guided by the Sun and Moon, and their positions can be measured using precise astronomical principles

Predicting Eclipses With Mathematical Accuracy.

Bhaskara also made accurate calculations of eclipses, correctly determining the time intervals between solar and lunar eclipses. His understanding of the relationship between the Earth, Moon, and Sun allowed him to make highly precise eclipse predictions, long before the modern era of astronomy.

Sloka From *Siddhanta Shiromani* (On Eclipse Calculation):

सूर्यचन्द्रे पृथिव्यां च प्रतिपन्नं विधत्ते कदा।

तदा स्यादेक्षितं कालं विधानेन निश्चिते विध्या॥

Meaning:

The timing of an eclipse depends on the alignment of the Sun, Moon, and Earth. Using mathematical calculations, this phenomenon can be predicted with great accuracy.

Bhaskara's Lasting Influence

Bhaskara Acharya's genius didn't just benefit India—it influenced **mathematicians and astronomers across the world**. His texts were translated and studied by **Islamic scholars**, whose work later **inspired Renaissance scientists in Europe**.

His ideas also **influenced later Indian mathematicians**, like **Madhava of Sangamagrama**, who expanded on Bhaskara's work with **infinite series and trigonometry**. Scholars like **Al-Khwarizmi**—the father of algebra—were also indirectly shaped by Bhaskara's mathematical legacy.

Through these connections, Bhaskara's ideas made their way into European science, ultimately contributing to the **scientific revolution** that changed the world.

Conclusion: A True Genius Ahead Of His Time

Bhaskara Acharya was not just a mathematician or an astronomer—he was a **visionary**. His work in **algebra, calculus, and planetary motion** laid the foundation for some of the most important discoveries in science.

Centuries before **Newton and Leibniz**, he understood key principles of **calculus**. Before **Kepler**, he analyzed **planetary orbits**. And before modern scientists, he accurately predicted **eclipses** using mathematics.

Even today, his contributions continue to **shape the fields of mathematics and astronomy**. Bhaskara's work reminds us that **great minds transcend time**, and his legacy stands as a testament to the brilliance of ancient Indian science.

His insights, discoveries, and mathematical genius continue to **inspire generations of scientists, mathematicians, and thinkers**, proving that knowledge truly has no boundaries.