# GOVERNMENT DEGREE COLLEGE

VEERAGHATTAM

**STUDENT STUDY PROJECT**

**ON**

**BIOGRAPHY OF**

**BHASKARA CHARYA**

## DEPARTMENT OF MATHEMATICS

**SUBMITTED TO**

**SRI.CH.NAIDU**

**LECTURER IN MATHEMATICS**

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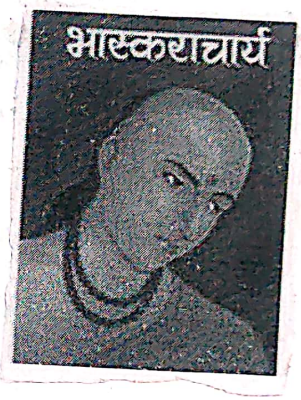
# BHASKARACHARYA

Bhaskara is a famous mathematician of ancient India. He was born in 1114 A.D in the city of Bijapur, Karnataka state, India. Peoples also know him as Bhaskaracharya, which means "Bhaskara the Teacher". His father name was Maheswara. By profession he was an astrologer, who taught him mathematics, which he later passed on to his son Loksamudra




## BIRTH AND EDUCATION :-

Ganesh Daivadnya has bestowed a very apt title on Bhaskaracharya. He has called him "Ganakchakrachudamani" which means, 'a gem among all the calculators of astronomical phenomena.' Bhaskaracharya himself has written about his birth, his place of residence, his Teacher and his education, in Siddhantashiromani as follows, 'A place called 'Vijjadvad' which is surrounded by sahyadri ranges, where there are scholars of Three vedas, where all branches of knowledge are studied, and where all kinds of noble people reside, a brahmin called Maheshwar was staying who was born in shandilya Gotra (in Hindu religion, Gotra is similar to lineage from a particular person, in this case sage shandilya), well versed in shroud (originated from shut of vedas) and smart (originated from smrut) Dharma, respected by all

and who was authority in all the branches of knowledge. I acquired knowledge at his feet.

## Bhaskara's contributions to mathematics :-

Lilavati and Beejaganit together consist of about 500 verses. A few important highlights of Bhaskar's mathematics are as follows:

### Terms for numbers :-

In English, cardinal numbers are only in multiples of 1000. They have terms such as thousand, million, billion, trillion, quadrillion etc. eka (1), dasha (10), shata (100), sahastra (1000), ayuta (10,000), laksha (100,000), prayuta (1,000,000 = million), koti (107), arbuda (108), abja (109 = billion), kharva (1010), nikharva (1011), mahapadma (1012 = trillion), shanku (1013), jaladhi (1014), antya (1015 = quadrillion), madhya (1016) and parardha (1017).

### Kuttak :-

Kuttak means to crush to fine particles or to pulverize. There are many kinds of kuttaks. Let us consider one example.

In the equation, $ax+b=cy$, a and b are known positive integers. we want to also find out the values of x and y in integers. A particular example is, $100x+90=63y$

Bhaskaracharya gives the solution of this example as, $x = 18, 81, 144, 207 \ldots$ and $y = 30, 130, 230, 330$

Indian Astronomers used such kinds of equations to solve astronomical problems. It is not easy to find solutions of these equations but Bhaskara has given a generalized

solution to get multiple answers.


Bhaskarachārya

## A Summary of Bhaskara's Contributions

* A proof of the Pythagorean theorem by calculating the same area in two different ways and then canceling out terms to get $a^2+b^2=c^2$.
* His method for finding the solutions of the problem $x^2-ny^2=1$ (so-called "Pell's equation") is of considerable interest and importance.
* Preliminary concept of mathematical analysis.
* Preliminary concept of infinitesimal calculus, along with notable contributions towards integral calculus.
* Stated Rolle's theorem, a special case of one of the most important theorems in analysis, the mean value theorem. Traces of the general mean value theorem are also found in his works.
* Calculated the derivatives of trigonometric functions and formulae. (See calculus section below)
* In Siddhanta Shiromani, Bhaskara developed spherical trigonometry along with a number of other trigonometric results. (See Trigonometry section below)

## Arithmetic :-

Lilavati is divided into 13 chapters and covers many branches of mathematics, arithmetic, algebra, geometry, and a little trigonometry and mensuration. More specifically the contents include.

* Definitions.
* properties of zero (including division, and rules of operations with zero)
* Further extensive numerical work, including use of negative numbers and words.
* Estimation of π.
* Arithmetical terms, methods of multiplication, and squaring
* Inverse rule of Three, and rules of 3, 5, 7, 9 and 11
* Problems involving interest and interest computation.
* Arithmetical and geometrical progressions.
* plane (geometry)
* Solid geometry
* Permutations and combinations.
* Indeterminate equations (kuttaka), integer solutions (First and second order).

## Algebra :-

His work Bijaganita is effectively a treatise on algebra and contains the following topics.

* positive and negative numbers.
* zero
* The 'unknown' (includes determining unkown quantities)
* Determining unknown quantities.
* surds (includes evaluating surds)
* Kuttaka (for solving indeterminate equans and Diophantine equations)
* Simple equations (indeterminate of second, third and fourth degree)
* Simple equations with more than one unknown.
* Indeterminate quadratic equations (of the type $ax^2+b=y^2$)
* Solutions of indeterminate equations of the second, third

and fourth degree.

* Quadratic equations
* Quadratic equations with more than one unknown.
* operations with products of several unknowns.

## Trigonometry :-

The siddhanta shiromani (written in 1150) demonstrates Bhaskara's knowledge of trigonometry, including the sine table and relationships between different trigonometric functions. He also discovered spherical trigonometry, along with other interesting trigonometrical results.

## Astronomy :-

using an astronomical model developed by Brahmagupta in the 7th century, Bhaskara accurately defined many astronomical quantities, including, for example, the length of the sidereal year, the time that is required for the Earth to orbit the sun, as 365.2588 days [citation needed] which is same as in suryasiddhanta. The modern accepted measurement is 365.2563 days, a difference of just 3.5 minutes.

The twelve chapters of the first part cover topics such as

* Mean longitudes of the planets
* True longitudes of the planets.
* the three problems of diurnal rotation.
* syzygies
* Lunar eclipses.
* solar eclipses
* Latitudes of the planets.

* Sunrise equation
* The moon's crescent.
* Conjunctions of the planets with each other.
* Conjunctions of the planets with the fixed stars.
* The patas of the sun and moon.

The second part contains thirteen chapters on the sphere. It covers topics such as:

* Praise of study of the sphere.
* Nature of the sphere.
* Cosmography and geography.
* Planetary mean motion.
* Eccentric epicyclic model of the planets.
* The armillary sphere.
* Spherical trigonometry.
* Ellipse calculations. [citation needed]
* First visibilities of the planets.
* Calculating the lunar crescent.
* Astronomical instruments.
* The seasons.
* Problems of astronomical calculations.

EARth's circumference and diameter:-

Bhaskara has given a very simple method to determine the circumference of the Earth. According to this method, first find out the distance between two places, which are on the same longitude. Then find the correct latitudes of those two places and difference between the latitudes. Knowing the distance between two latitudes, the distance that corresponds to 360 degrees can be easily found, which the circumference of is the Earth.

# A GLANCE AT THE ASTRONOMICAL ACHIEVEMENTS OF BHASKARACHARYA

* The Earth is not flat, has no support and has a power of attraction.
* The north and south poles of the Earth experience six months of day and six months of night.
* One day of moon is equivalent to 15 earth-days and one night is also equivalent to 15 earth-days.
* Earth's atmosphere extends to 96 kilometers and has seven parts.
* There is a vacuum beyond the Earth's atmosphere.

Bhaskara calculated the equinoctial shadow at any place and the new corrections to be applied to the calculation of the time of sunrise Bhaskara too accepted the precession of the equinoxes, through later astronomers allowed Bhaskara's correct theory to be perverted. Bhaskara's works have served as reference books in every nook and corner of India. He died in 1185 in Ujjain, India.