Baudhayana:- The Sage of Ancient Indian Mathematics

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ABSTRACT :-

Baudhayana was a important and prominent Figure in ancient Indian Mathematical history. He was renowned for his Contributions to mathematics, geometry and religious law. He is believed to have lived around 8th Century BCE. Though the exact dates of his life remain uncertain.

Baudhayana is primarily known for his authorship of the Baudhayana Sulba sutras . A Collection of vedic texts that deal the Baudhayana with the construction of altars and other sacrificial Structures. These Contain some of the earliest known references to mathematical Concepts. His works remains larely unrecognized outside of academic Circles, overshadowed by the more familiar names of Pythagoras and Euclid.

Keywords :- Important, Prominent, Geometry, Religion, Altars, Structures.

Introuduction :-

The exact dates of Baudhayana's birth and death are uncertain, but his work is believed to have been composed between the 8th and 6th centuries BCE. He was a Vedic scholar and a Brahmin priest, deeply rooted in the traditions of ancient India. Baudhayana's most significant contribution to mathematics is the Sulba Sutras, a collection of sutras that deal with various aspects of geometry, including the construction of altars for Vedic rituals.

One of the most remarkable discoveries attributed to Baudhayana is the Pythagorean theorem, a fundamental principle in geometry that states that in a right-angled triangle, the square of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides. While Pythagoras is often credited with this theorem, Baudhayana's Sulba Sutras contain a clear statement of this principle, predating Pythagoras by centuries.

Baudhayana's formulation of the theorem is expressed in a concise and elegant manner: "The diagonal of a rectangle produces by itself both the areas which the two sides of the rectangle produce separately." This statement is equivalent to the modern algebraic expression $a^2 + b^2 = c^2$, where a and b are the lengths of the two shorter sides of a right-angled triangle, and c is the length of the hypotenuse.

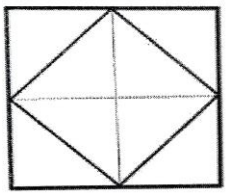
Baudhayana said to be the original Mathematician behind the Pythagoras theorem. Pythagoras theorem was indeed known much before Pythagoras, and it was Indians who discovered it at least 1000 years before Pythagoras was born! The credit for authoring the earliest Sulba Suttergom to him. It is widely believed that he was also a priest and an architect of very high standards. It is possible that Baudhayana's interest in Mathematical calculations stemmed more from his work in religious matters than a keenness for mathematics as a subject itself. Undoubtedly he wrote the Sulbasutra to provide rules for religious rites, and it would appear almost certain that Baudhayana himself would be a Vedic Priest.

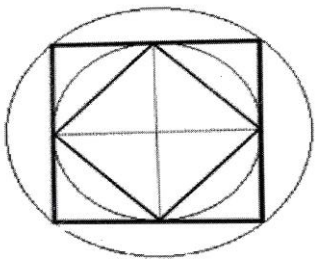
The Sulba sutras is like a guide to the Vedas which wormulate rules for constructing altars. In other words, they provide techniques to solve mathematical problems effortlessly. If a ritual was to be successful, then the altar had to conform to very precise measurements. Therefore mathematical calcularions needed to be precise with no room for error.

People made sacrifices to their gods for the fullmen of their wishes. As these rituals were meant to please the Gods, it was imperative that everything had to be done with precision. It would not be incorrect to say that Baudhayana's work on Mathematics was to ensure there would be no miscalculations in the religious rituals.

Works of Baudhayana :-

Baudhayana is credited with significant contributions towards the advancements in mathematics. The most prominent among them are as follows.





Now, just as the areas of the squares, he realised that the inner circle should be exactly half of the bigger circle in area. He knew that the area of the circle is proportional to the square of its radius and the above construction proves the same. By the same logic, just as the perimeters of the two squares, the perimeter of the outer circle should also be √2 times the perimeter of the inner circle. This proves the known fact that the perimeter of the circle is proportional to its radius. This led to an mportant observation by Baudhayana. That the areas and perimeters of many regular polygons, including the squares above, could be related to each other just as the case of circles.

2. Value of π :-

Baudhayana is considered among one of the first to discover the value of 'π'. There is a mention of this in his Sulbha sutras. According to his premise, the approximate value of π is 3. Several values often occur in Baudhayana's Sulbasutra, since, when giving different constructions, Baudhayana used different approximations for constructing circular shapes.

Some of these values are very close to what is considered to be the value of π today, which would not have impacted the construction of the altars. Aryabhatta, another great Indian mathematician, worked out the accurate value of r to 3.1416. in 499AD.

3. The method of finding the square root of 2.

Baudhayana gives the length of the diagonal of a square in terms of its sides, which is equivalent to a formula for the square root of 2. The measure is to be increased by a third and by a fourth decreased by the 34th. That is it's diagonal approximately. That is 1.414216, which is correct to five decimals.

Baudhayana gives the length of the diagonal of a square in terms of its sides, which is equivalent to a formula for the square root of 2:

"samasya dvikaraṇi pramanam trtiyena vardhayettec caturthenatmacatustrimsonena saviśeşah"

Tat caturtena (vardhayet) - that itself increased by a fourth, Atma – itself;

Caturtrimsah savisesah - is in excess by 34th part

Baudhayana is also credited with studies on the following:-

"It can be concluded without a doubt that there is a Iot of emphasis on rectangles and squares in Baudhayana's works. This could be due to specific Yajna Bhumika's, the altar on which rituals were conducted, for fire-related offerings."

Some of his treatises include theorems on the following.

1. In any rhombus, the diagonals (lines linking opposite corners) bisect each other at right angles (90 degrees)

2. The diagonals of a rectangle are equal and biset each other.

3. The midpoints of a rectangle joined forms a rhom bus whose area is half the rectangle.

4. The area of a square formed by joining the middle points of a square is half of the original one.

Baudhayana Theorems :-

Baudhayana listed Pythagoras theorem in his book called Baudnayana Sulbasutra.

दीर्घचतुरश्रस्याक्ष्णया रज्जुः पार्श्वमानी तिर्यग् मानी च यत् पृथम् भूते कुरुतस्तदुभयं करोति ॥

Baudhayana used a rope as an example in the above shloka/verse, which can be translated as:

The areas produced separately by the length and the breadth of a recrangie together equal the areas produced by the diagonal.

The diagonal and sides referred to are those of a rectangle, and the areas are those of the squares having these line segments as their sides. Since the diagonal of a rectangle is the hypotenuse of the right triangle formed by two adjacent sides, the statement is seen to be equivalent to the Pythagoras theorem. There have been various arguments and interpretations of this.

In general understanding and visualising Pythagoras theorem found in geometry Comparing his findings with Pythagoras' theorem :

In mathematics, the Pythagorean (Pythagoras) theorem is a relation among the three sides of a right triangle (right-angled triangle). It states In any right-angled triangle, the area of the square whose side is the hypotenuse (the side opposite the right angle) is equal to the sum of the areas of the squares whose side are the two legs (the two sides that meet at a right angle) c is the longest side of the triangle(this is called the hypotenuse) with a and b being the other two sides.

The question may well be asked why the theorem is attributed to Pythagoras and not Baudhayana. Baudhayana used area calculations and not geometry to prove his calculations. He came up with geometric proof using isosceles triangles.

Legacy and influence: -

Bodhayana's contributions of mathematics and geometry have had a lasting impact on the development of Indian mathematics. His work, along with other sulba sutras , laid the foundation for the subsequent development of Indian mathematics including the works of great mathematician like Aryabhatta and Brahmagupta. The sulba sutras also Influence the development of the mathematics in the other pert of the world, particularly in the Islamic world, where they were translated and studied by Arab mathematicians.

Bodhayana's legacy extends beyond his mathematical Contributions. He also revered as a sage and philosopher, and his teaching continue to inspire ond lenlighten people' even today His work on sulba sutras not only show Cases the advanced mathematical knowledge of ancient India but also highlights the deep connection between mathematics and spirituality in Indian Culture.

Conclusion:-

Bodhayana , the sage of ancient India, Stand as a testament to the intellectual brilliance of ancestors His groundbreaking work on the Sulba Sutras has left an indelible mark on the history of mathematics. By discovering Pythagoras, and by making making significant contributions to geometry, algebra, and trigonometry, Bothayoma has Secured his place among the greatest mathematicians of all time. His legacy Continues to impire and Challenge us remainding us of of the profound insight that can be gained through the pursuit of knowledge and understanding .

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