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Contributions of Some Famous Indian Mathematicians

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***Abstract*: This paper aims to present the contributions of Indian mathematicians to the subject in ancient and modern times. The history of Mathematics is as old as the humanity itself. With the progress of time, the growth of mathematical knowledge occurs at a tremendous rate. For example, Aryabhata (476-550) calculated the value of π up to four decimal places whereas Ramanujan (1887-1920) was able to find the value of π upto three millionth place after the decimal point. Starting with some of the successful attempts of Baudhayana, Pingala and Aryabhata, contributions of Brahmagupta, Bhaskaracharya, Ramanujan and Shakuntala Devi are explained in this paper.**

***Keywords*: Contributions, Mathematics, Indian, Zero.**

1. Introduction

It is rightly said that 'Mathematics is the most beautiful and the most powerful creation of the human spirit'. Over 3000 years ago, Mathematics emerged in Indian subcontinent. In addition to the concept of zero, ancient Indian Mathematicians gave extraordinary contributions to the study of trigonometry, algebra, arithmetic etc. Decimal number system that is still used in the world was first seen in India. Indian mathematicians were advancing in calculus many hundred years before the other mathematicians of the world. Some evidences of the beginning of Mathematics in India can be seen from the contributions of following ancient Indian Mathematicians:

- *Baudhayana:* Baudhayana was born around 800 BC. He successfully approximated the value of square root of 2.
- *Pingala:* Pingala was born around 500 BC. He worked on binary numeral system and arithmetical triangle.
- *Aryabhata:* Aryabhata was born in 476 AD. He calculated the value of π correct to four decimal places. He also calculated the value of circumference of earth to 99.8% accuracy.

2. Contributions of Brahmagupta

Brahmagupta was born in 597 AD. He was the first mathematician to explain the mathematical rules to compute with zero. He stated that

$$n + 0 = n$$
$$n - 0 = n$$
$$n \times 0 = 0$$

where n is any number.

This means that when zero is added to a number, there is no change in the number. Similarly, when zero is subtracted from a number, there is no change in the number. When a number is multiplied by zero, result is zero. Brahmagupta gave the mathematical formulas to find the sum of squares of first n natural numbers and sum of cubes of first n natural numbers.

$$1^2 + 2^2 + 3^2 + \ldots\ldots + n^2 = \frac{n(n+1)(2n+1)}{6}$$

$$1^3 + 2^3 + 3^3 + \ldots\ldots + n^3 = \left[\frac{n(n+1)}{2}\right]^2$$

Brahmagupta stated that 0/0 = 0 which differs from our modern understanding.

3. Contributions of Bhaskar Acharya

Bhaskaracharya was born in 1114 AD. He explained successfully the operation of division by zero. He noticed that when we try to divide a thing into a number of pieces each having size equal to 1/n of the size of the original thing, n new pieces are obtained.

$$1 \div (1/n) = n$$

For example, when a thing is divided into half sized pieces, two such pieces are obtained.

$$1 \div (1/2) = 2$$

When a thing is divided into pieces having size equal to one third of the original size, three pieces are obtained.

$$1 \div (1/3) = 3$$

As we are decreasing the size, the number of pieces obtained is increasing. So, dividing a thing into pieces of zero size would yield infinitely many pieces.

$$1 \div 0 = \infty$$

Bhaskaracharya was the first mathematician to introduce the concept of infinity. He postulated that when a finite number is divided by zero, the result is infinity. In addition to the concept of infinity, the first general method to find the solution of Pell's

equation $x^2 - ny^2 = 1$ was given by Bhaskaracharya.

4. Contributions of ramanujan

Srinivasa Ramanujan was born on December 22, 1887. He mada substantial contributions to mathematical analysis, number theory and infinite series. Some of his important contributions are

Goldbach's conjecture: The conjecture states that every even integer greater than two is the sum of two primes. The conjecture has been tested up to 4×10^{18}. Ramanujan showed that every large integer can be written as sum of at most four prime numbers.

Partition Function: Srinivasa Ramanujan proved the following identities for the partition function p(n).

$$p(5n+4) \equiv 0 \pmod 5$$
$$p(7n+5) \equiv 0 \pmod 7$$
$$p(11n+6) \equiv 0 \pmod{11}$$

First congruence shows that if a number is 4 more than a multiple of 5, then number of its partitions must be divisible by 5. Second congruence shows that if a number is 5 more than a multiple of 7, then number of its partitions must be divisible by 7. Third congruence shows that if a number is six more than a multiple of 11, then number of its partitions must be divisible by 11. These congruences motivated other mathematicians also and partition function is now an area of research for young researchers in mathematics.

Value of π: Ramanujan gave an infinite series to calculate the value of pi.

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801} \sum_{k=0}^{\infty} \frac{(4k)!\ (1103+26390k)}{(k!)^4\ 396^{4k}}$$

Ramanujan was able to find the value of pi up to three millionth place after the decimal point.

5. Contributions of Shakuntala Devi

Shakuntala Devi is the proud of India. She was born on November 4, 1929. She is known to be human computer. On June 18, 1980, she was invited by the Computer Department of Imperial College, London and was asked to multiply two 13 digit numbers picked up at random in her memory. These numbers were 7686369774870 and 2465099745779. She answered the question in 28 seconds. Her answer was 189476681779954267737 30.

In Dallas, she was asked to give the cube of 188138517. She gave the answer even faster than a computer. Her name is mentioned on page number 26 of the 1995 Guinness Book of Records.

6. Conclusion

This paper helps to understand the origin of some mathematical concepts which we are using today. From ancient times, Indian mathematicians played a remarkable role in the advancement of Mathematics. Important contributions of some famous Indian mathematicians are explained in this paper.

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