A REVIEW ON RAMANUJAN'S AND BHASKARACHARYA'S MATHEMATICAL WORK

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ABSTRACT

In the current paper we discussed an ancient Indian mathematician Ramanujan and Bhaskar Acharya and their contribution in mathematics as they work a lot in science of mathematics they discovered many concepts of mathematics that was unknown to the world, both of them did work in algebra ,trigonometry ,astronomy, finding value of Π ,finding square root and many others we discussed the work of Ramanujan which include Ramanujan – hardy number, series of Π ,Goldbach conjecture ,Ramanujan's equations theory ,congruences of Ramanujan's same way if we see about Bhaskaracharyas work then it goes to the negative number zero and infinity ,rule of zero area of sphere, calculus ,trigonometry.

KEYWORDS *-- astronomy, trigonometry, calculus, infinity, conjecture Goldbach conjecture*

INTRODUCTION

in ancient India mathematics is supposed to be a separate category of knowledge. since it was seen that in metaphysics and spiritual life it plays an important role so it has great importance. in the development of Mathematics Ancient Indian Mathematicians have contributed a lot and these are as old as the civilization of the people of India. And it was observed that the improvement of civilization based on the growth of the science of Mathematics in this paper we studied some ancient Indian mathematician they were the great Ramanujan and Bhaskar Acharya

About Ramanujan

We all very well know the theory of number system this well-known theory is proposed by great Indian mathematician Ramanujan literally he is considered to be the phenomenon of mathematics in twentieth century like other mathematician great Ramanujan got all time popular rank. On 22nd December 1887 he was born in the family of Iyengar in the area of Erode, Madras. from the mother Ramanujan studied all education like, puranas, songs of religion, tradition but after in his school day her virtue his power of mathematics to the goddess of creation and wisdom if anything is there which gives essence of spirituality is only important thing for him. Later he was eminent with mathematics in the reality. He was such genius like that he was born for mathematics actually he thinks that in all his thoughts and his imagination completes in the form of mathematics actually he has quality of interpretation of dreams and astrology.

Because of his geniuses he was able to solve the problems like $\sqrt{x+2\sqrt{x+3\sqrt{x+\cdots}}}$. whose solution

didn't get anyone but Ramanujan found it very easily. In his notebook we studied radical problems.

Introduction of Bhaskarachary –

Bhaskara II is known as Bhaskar Acharya he is consider to be one of the important figures in mathematics in 12^{th} century, he has his foundation in mathematics he born in 1150 AD in Bijapur his work is spread overall. He separated his work in four parts like Lilavati, Bijaganita, Goladhyaya and Grahaganita. He wrote lilavati after his daughter Lilavati which was first volume of sidhant siromani. Which include total 13 chapters containing most important topic like trigonometry, measurement and others he also develop Bijaganita. Which contain total twelve chapters which describe Algebra which contain square root of positive and negative numbers, quadratic equation, determination of surds in the 3^{rd} port of Ganitadhya he gave concept related to astronomy, especially solar system, gravity law he also studied motions of planets he also play an important role in finding the length of year.

Contribution of Ramanujan's in Mathematics –

(A) Hardy was one of the friend of Ramanujan he had daily come to see where Ramanujan was hospitalized he came by the taxi whose number was 1729 by Ramanujan developed this number as the sun of cubes of two number which can be assigning in two separate ways.

$10^3 + 9^3 = 1729$

$12^3 + 1^3 = 1729$

(B) Series of π (infinite series) –

Ramanujan invented some series of π which is considered as the infinite series of π which was nearest 1910 the series are as follows.

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9\,S\,189} \sum_{n=0}^{\infty} \frac{(2^2 n!)\ (1103+26900)}{(n!)4\ (300+96)4}$$

He also find next digit up to Eight decimal point in this procedure the algorithm was invented by this number and developed π series which is infinite.

(C) Goldbach's Conjecture –

It is one of the discoveries of Ramanujan began one statement which was two is greater than every even integer which is addition of two prime number which was 3 + 3 = 6

(D) Ramanujan Equation theory –

He developed new theory for solving the equations which was cubic he gave his own steps to solve it by developing formula of equation which was biquadratic.

(E) Ramanujan's Number:

Highly Composite if any number have large factors, then we can say that number is highly composite: If we take having factors of k by K(x) then only we can say that x €N which was highly composite number.

Ex. If x = 96 is highly composite because

Because k (96) = 16 & 6 smaller numbers which are natural have less number o factors if.

Id $K = 2^{x2}\ 3^{x3}$ …… s^{kp}

Which was nothing but the Arithmetic fundamental theorem.

(f) Congruences of Ramanujan's –

Ramanujan's developed some important congruence they are as followers.

$x (5y + 4) = 0 \pmod 5$

$x (7y + 5) = 0 \pmod 7$

$x (11y + 6) = 0 \pmod{11}$

$\forall\ y \in N$

(G) Asymptotic formula of Ramanujan – Hardy

In the field of separation of number he did major work he discover some formula along with Hardy for the calculation of separation of numbers.

First he invented function for k(x)

Which leads to give Asymptotic formula.

$$K(9x) \cong \frac{1}{(2)^2 S\sqrt{3}}\, \varsigma^{\pi} \frac{\sqrt{2S}}{3}$$

Contribution of Bhaskaracharya in Mathematics –

(1) Negative Numbers –

He was well famous for the work in negative numbers. Which he considered as losses and also work you arithmetic and measurement. He easily solves the equations and problem of arithmetic mathematics along with negative numbers in the field of Bijganit he started to put a dot (.) above the numbers. Which are notations of negative numbers.

(2) Zero and Infinity –

He was the first person who started the concept of infinity which was obtain by dividing the number by zero.

(3) Rule of Zero -

He has strong hand in the math operations like multiplication, addition subtraction but later he recognized some draw backs of Brahmagupta's idea dividing through zero.

Ex. $P + 0 = P$

$P - 0 = P$

$P \times 0 = 0$

He found that for any numbers there are two solutions.

(4) Area of sphere –

For the volume of sphere he found the formula

$\therefore$ Area of sphere = 4 x area of circle

Volume of sphere = sphere area x $\frac{1}{6}$ of its diameter.

(5) Trigonometry –

In trigonometry he has more interest he gave many important results

$\sin (a + b) = \sin a \cos b + \cos a \sin b$

$\sin (a - b) = \sin a \cos b + \cos a \sin b$

(6) Lilavati-

In lilavati he gave two types of multiplication it is given that $(p, 0) / 0 = P$

It is one of the results currently it is assemble with advance concept of non-zero infinitesimal.

(7) Calculus –

In many of his work we got some agreements astronomical concept especially Siddhant Shiromani in this book he proposed such a big concept which was not seen in recent work. He also works on infinitesimal calculus and analysis of mathematics with differential calculus and interred got special interest.

(8) Quadratic Equation –

For solving the quadratic equation, he applies the method of

chakravala for the indeterminate equation his Pell's equation got much more importance by giving the equation.

$$Np^2 + 1 = q^2$$

Bhaskar Acharya's contribution in another mathematical field.

(1) he also works for Pythagoras theorem he finds the area by two variable ways & by cancelling them for obtaining $p^2 + q^2 = r^2$

(2) His inventions in Diophantine equation of order second like $6ly^2 + 1 = x^2$ this was presented.

(3) He studied Pell's theorem; he develops general mean value theorem from the concept & Rolls theorem.

(4) His work in Algebra was really remarkable especially in Bijganita in that he creates 12 chapters this was the first time which gives that a positive number have two square roots.

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