

# Theory of $\pi$

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**Abstract**— The research, the theory of  $\pi$  is not connected with economics activities, but it is a pure science & pure mathematics, which does not gain anything much to the society and does not motivate the economic activities like applied research. This research does not have much important to society in general, but can be useful to astronomy, astrophysics, space calculations, nuclear science, pure geometry and exact measurement of curved area, surfaces & volume with curved surface in physics only. The research, the theory of  $\pi$  uses the major tool as algebra, geometry, trigonometry, arithmetic, statistics & calculus with the help of even simple calculator, pc. , Main framed computer & super computer in the form of mathematical formulas and Computer programming. Present value of  $\pi$  - 3.141592653589793238462643383279502884197169399375105820974944592307816406286209 is not correct at all. It is not the area of circle but it is area of regular polygon having infinite sides. Hence we create vertical line at equi-distance method and with the help of computer program UP09R that is based on our method, we calculate value of  $\pi$  that is 3.1416 which we have suggested is the area of circle and is rational & exact most probable number.

**Key words:** Importance of  $\pi$ , value of  $\pi$ , History of  $\pi$ , Vertical line at equi-distance method, Wallis Approximation of  $\pi$

## I. INTRODUCTION

Mankind have find out wheel and fire at an early stage which were the basic research till today. Among the wheel and fire researched, wheel played important and vital role in the life of mankind. In every place of life like agriculture, transportation, power generation, industries, and also in a day to day life wheel is needed. At a very first day of invention of wheel, man is eager to know the relationship between the diameter of the circle/wheel and its circumference. The ratio of circumference of a circle to its diameter is a constant and donated by Greek letter  $\pi$  (pi).

Initially, Greek civilization have studied this relationship between the circumference of the circle and its diameter and they have find out the value of pi equal to  $3\frac{1}{7}$  i.e.  $\frac{22}{7}$  and denoted this constant by their letter  $\pi$  (pi) firstly and hence throughout history of circle, this symbol remains as a ratio of circumference of the circle to its diameter. (It is believed that the letter of the Greek world periphERIC – meaning “periphery” - inspired the pi symbol). The Greeks did not recognize the full extent of pi’s irrationality and so they devoted much labour trying to solve the one big problem which this fact made impossible – constructing a square whose area is equal to that of a given circle or literally trying to “square the circle”.

Before Greek world, the approximate values of pi have been known to several ancient civilization, such as Babylonia, where the accepted value was 3.0 sometimes after this civilization, the mathematicians found that this

value is more than 3.0 and they found out approximately  $3\frac{1}{7}$  i.e.  $\frac{22}{7}$  which was also an approximation. Later on, persons have also suggested the value of pi as  $\frac{415}{133}$  which was also an approximation.

By the mid-20<sup>th</sup> Century, an electronic computer had calculated it to 100,000 digits. It would have taken a man working without error eight hours a day on a desk calculator for 30,000 years to make this calculation. Recently with the help of super computer, mathematician/engineers have calculated this value of Pi in Million digits. Hence, till today mathematicians says that Pi is not a fraction. It cannot be calculated exactly. It is an irrational number and cannot be possible to square the circle. It cannot however be expressed by an exact arithmetic figure, because it is an incommensurable number. That is, a number having an infinite number of decimals.

The research, the theory of  $\pi$  is research in a mathematical science. But, it is also to be called research in physics – the physical science in the field of measurements of physical quantities of physics, basically for curved areas, curved surfaces and volumes of articles having curved surfaces.

Hence it is basically the research in physics also as no science Have existence without mathematics.

Research, the theory of  $\pi$  is not one research it is three in one.

There are three basic research connected with this research of theory of  $\pi$ .

Namely, The circular  $\pi$  i.e.  $\pi_c$ (Finite value) & the trigonometric  $\pi$  i.e.  $\pi_t$ (Infinite value)

Till today one cannot be able to decide whether hen is first or egg.

That mean, till today, one cannot define clearly that  $\pi$  can be calculated by the value of Radian or Radian can be calculated by the value of  $\pi$ !

As Radian value was derived from  $\pi$  and  $\pi$  can be calculated with the help of  $\sin \theta$  value which itself is depending upon value of Radian.

The  $R_c$  &  $R_t$  are so close that one cannot differentiate them very clearly. Unit value of  $\pi_c$  and  $\pi_t$  are also so close and the differentiation is so narrow that one cannot determine accurately and clearly. That is value of  $\pi_c$  and  $\pi_t$  of  $0.1^\circ$  or  $0.01^\circ$  or  $0.001^\circ$  and so on are so close that one cannot differentiate them properly.

## II. THEORY OF $\pi$

### A. Present Concept Regarding Pi ( $\pi$ )

- 1) Pi is not a fraction.
- 2) Pi is an irrational number.
- 3) Pi is an approximate value that cannot be possible to calculate.
- 4) Pi is a transcendental i.e. It cannot be a root of an algebraical equation with rational co-efficient.

- 5) Pi cannot be found rightly by actual measurement, but it can be determined to any degree of accuracy from the first principal by algebraic method.
- 6) Pi value is such that it cannot possible to square the circle. i.e. To construct with straight edge and compass, square and circle of identical area is not possible.
- 7) Value of Pi can be calculated by considering the circle as the limit of regular polygons with an increasing number of sides inscribed in the circle.

#### B. Salient Features of Theory of Pi ( $\pi$ )

- 1) Present concept of Pi itself is wrong.
- 2) Present value of Pi is also a wrong figure even it is not an appropriate approximation at all.
- 3) Present method of calculation for Pi is faulty and not appropriate.
- 4) In view of above, undersigned have proposed a new theory of Pi totally diversified from the original are as under.

#### C. New Concept of Theory of Pi ( $\pi$ )

- 1) Pi is a fraction.
- 2) Pi is a commensurable number i.e. it has finite number and can be expressed by an exact arithmetical figure.
- 3) Pi is a rational number.
- 4) Pi has exact value but it cannot be possible to calculate directly.
- 5) Pi is a non-transcendental i.e. It can be a root of an algebraically equation with rational co-efficient.
- 6) Pi value is such that it is possible to Equivalent Square the circle. I.e. To construct with straight edge and compass, square and circle of identical areas are possible.
- 7) Pi-c is different from Pi-t i.e. Circular Pi is different from the trigonometric Pi. The older concepts were applicable to trigonometric Pi only and not to circular Pi.
- 8) Trigonometric functions and rules are applicable to trigonometric pi only and not to circular Pi. This is the main difference.

### III. VERTICAL LINE AT EQUI-DISTANCE METHOD

Draw a quadrant of the circle with centre 0 & 1 at the end of radius on x axis and 0 & 1 at the end of radius on y axis. Put ten points on x axis at equal distance and draw vertical line perpendicular to x axis say  $y_1, y_2, y_3, \dots, y_{10}$  etc. as described in "Fig. 1". Use principle of Pythagoras and find the value of each 'y' as per the following formula:

$$y = \sqrt{1 - x^2}$$

Preparing simple computer program logic as under:

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xst = xst + incr
y1 = xst * incr
y2 = 1 - y1
y = sqrt(1 - y1)
sumy = sumy + y
    
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Similarly finding the each value of y and summing up them and dividing them by number of operation y will get simple area of quadrant of the circle. Now by increasing number of operation also increasing value of x from 10 to 100, 1000 and so on, one will get more accurate area of the

quadrant. Thus we can get more and more accurate area of the circle and hence the value of  $\pi$ . We will get most accurate near to present value of  $\pi$  at  $10^{10}$  segment of the x axis then after we will definitely get more value than the present value of  $\pi$  i.e. segment of  $10^{11}, 10^{12}, 10^{13}, 10^{14}, 10^{15}$  of x axis. The details are given in the annexure.

The advantages of this method is that we will certainly get most accurate value of  $\pi$  as well as higher value than the present value of  $\pi$ .

The present value of  $\pi$  is the area of infinite regular polygon and not the circle. The area of polygon measured depends upon trigonometric function and their method and hence we will call this area of infinite regular polygon or  $\pi_t$  and the actual  $\pi$  of the circle is to be called by  $\pi_c$ . The difference between  $\pi_t$  &  $\pi_c$  is negligible but it is dominating factor at all.

Draw a quadrant of a circle with x-axis (Horizontal) and y-axis (Vertical).  $x=y=R$  such that  $x=y=R=\text{unit length}$ . Divide x axis into 100 parts. It is found that at 60 parts on x axis, y is found to be 80 units; from 60 to 100 parts, the area BCG is found to be equal of curved area DEF and area of rectangle OAFD is 0.48 unit described in "Fig. 2".

Hence if we can found area of BCG from 80 units to 100 units, we can find out area of DEF and by adding area of OAFD as 0.48 in that area, we can able to find out area of OAFE. Balance area of ABGF can be calculated from 60 unit to 80 unit and thus we can find out total area of quadrant of a circle and hence the area of circle.

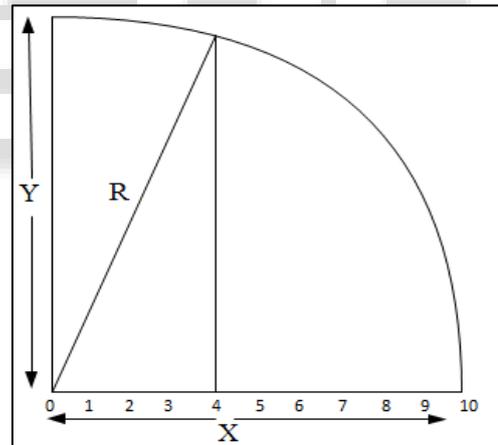


Fig. 1:

Thus only finding 40% area of quadrant, we can able to find out 100% of area of quadrant and thus we can save time & energy both at higher unit of 1012 and so on.

Here we have calculated 100% area of the quadrant up to 1012 unit as operations are relatively small and time taken is also relatively small, but above 1012 units, it is found that operations took placed more time and hence we have calculated area 60 to 80 units and 60 to 100 unit area and then we can get area of 0 to 60 units with above formulation and hence able to find out complete area of quadrant and hence than the area of circle i.e. the value of  $\pi_c$ . This  $\pi_c$  is found to be the more than the present value at ....1010 units and above. We can able to calculate  $\pi_c$  value up to 1015 which took time about 150 days (full day & night operations on laptop & pc). Hence to find out value of 1016 it may take time about 1500 days which is not

possible for me at this stage due to limited resources and technological availability to me. Hence we have calculated the value of  $\pi_c$  of 1015 operations and rest will be left for world.

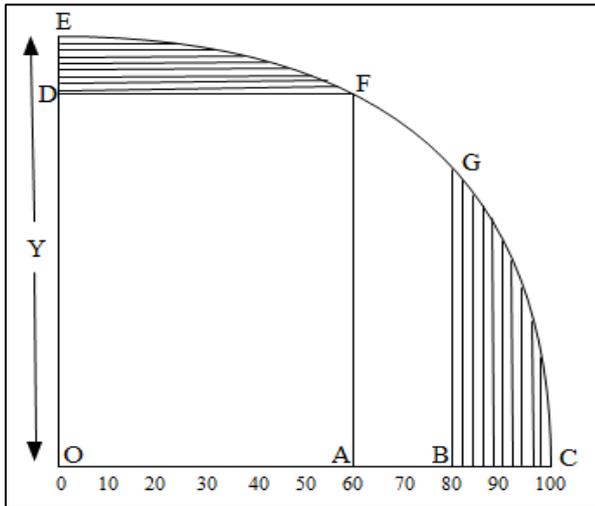


Fig. 2

The program was design in such way that each parameter or subpart of parameter should not increase more than eight to nine digit. So that no inaccuracy should occur. To avoid inaccuracy of computer, we have avoided more than 9 digit calculation and hence a unit of 4 digit was selected that we can get 8 digit by operating multiplication and square operations. Thus we can get 32 digits accuracy by combination of 4 digits in multiplication, square etc. By adjusting them in proper digits places.

The final program is designed in such a way that we get accuracy of 32 digits and hence we can able to find the value of  $\pi_c$  very accurately. Though all the results are irrationals but if we get the final result in the form of 7853999....999.... Up to infinity means the value of  $\pi_c/4$  is 7854, by adding some very small value to them and hence the value of  $\pi_c$  is 3.1416 which is a rational number and exact number.

#### IV. COMPARISON WITH $\pi_T$ FOR UP09R

$$\pi_t = 3.141592653589793238462643383279502884197169399375105820974944592307816406286209$$

##### A. N7

$$N7 \text{ Total Sum} = 7853 \ 9800 \ 82.86 \ 9221 \ 3296 \ 8902 \ 5879$$

\_\_\_\_\_ Lower at 8<sup>th</sup> Digit

$$N7 = 3.1415 \ 9203 \ 3147 \ 6885 \ 3187 \ 5610 \ 3516$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832$$

$$\text{Diff.} = -0.0000006204421047065870330316$$

##### B. N8

$$N8 \text{ Total Sum} = 7853 \ 9812 \ 86.05 \ 3856 \ 3728 \ 3325 \ 1953$$

\_\_\_\_\_ Lower at 8<sup>th</sup> Digit

$$N8 = 3.1415 \ 9251 \ 4421 \ 5425 \ 4913 \ 3300 \ 7812$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832$$

$$\text{Diff.} = -0.000000139168250689329342602$$

##### C. N9

$$N9 \text{ Total Sum} = 7853 \ 9816 \ 36.35 \ 7794 \ 7616 \ 5771 \ 4844$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N9 = 3.1415 \ 9265 \ 4543 \ 1179 \ 0466 \ 3085 \ 9376$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832$$

$$\text{Diff.} = 0.000000009533246662004425544$$

##### D. N10

$$N10 \text{ Total Sum} = 7853 \ 9816 \ 39.38 \ 8188 \ 7778 \ 1526 \ 438$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N10 = 3.1415 \ 9265 \ 5755 \ 2755 \ 1112 \ 6105 \ 752$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 383$$

$$\text{Diff.} = 0.000000002165482272663462369$$

##### E. N11

$$N11 \text{ Total Sum} = 7853 \ 9816 \ 41.49 \ 1228 \ 4910 \ 6788 \ 635$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N11 = 3.1415 \ 9265 \ 6596 \ 4913 \ 9642 \ 7154 \ 54$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 38$$

$$\text{Diff.} = 0.00000000300669815796451116$$

##### F. N12

$$N12 \text{ Total Sum} = 7853 \ 9816 \ 41.64 \ 1531 \ 7058 \ 5632 \ 3242$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N12 = 3.1415 \ 9265 \ 6656 \ 6126 \ 8234 \ 2529 \ 2968$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832$$

$$\text{Diff.} = 0.0000000030668194438798859136$$

##### G. N13

$$N13 \text{ Total Sum} = 7853 \ 9816 \ 41.64 \ 3452 \ 3582 \ 4584 \ 9609 \ 4$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N13 = 3.1415 \ 9265 \ 6657 \ 3809 \ 4329 \ 8339 \ 8437 \ 6$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832 \ 7$$

$$\text{Diff.} = 0.00000000306758770483569646049$$

##### H. N14

$$N14 \text{ Total Sum} = 7853 \ 9816 \ 41.65 \ 3040 \ 3137 \ 2070 \ 3125$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N14 = 3.1415 \ 9265 \ 6661 \ 2161 \ 2548 \ 8281 \ 25$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 38$$

$$\text{Diff.} = 0.00000000307142288702563787$$

##### I. N15

$$N15 \text{ Total Sum} = 7853 \ 9816 \ 41.91 \ 6875 \ 7653 \ 2363 \ 891602$$

\_\_\_\_\_ Higher at 10<sup>th</sup> Digit

$$N15 = 3.1415 \ 9265 \ 6766 \ 7503 \ 0612 \ 9455 \ 5664 \ 08$$

$$\pi_t = 3.1415 \ 9265 \ 3589 \ 7932 \ 3846 \ 2643 \ 3832 \ 79$$

$$\text{Diff.} = 0.000000003176957067666812183129$$

#### V. CONCLUSION

After completion of this research project we successfully get the exact value of  $\pi$  which is different from the current one. It is important in mathematics, measurement of the circle and also in more advance mathematics in connection with

such topics as continued fraction, logarithm of imaginary numbers, and periodic functions

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