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THE EQUALIZATION OF CERTAIN RECTANGLES OF SQUARE INTO ITS CIRCLE IN AREA

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ABSTRACT

Circle-square composite construction is very common geometrical entity. The area of the square is very easy to arrive at with the formula a^2. But, it was very difficult till March 1998 to find the area of the circle of an inscribed circle in a square. By the grace of God, in this paper, an impossible concept i.e. finding the area of inscribed circle, is done very easily now from the circle's superscribed square.

KEYWORDS— Circle, circumference, diameter, diagonal, radius, rectangle, side, square.

INTRODUCTION (BAYESIAN TECHNIQUE)

The square is a tetragon having four equal sides. A square can be divided into many rectangles. The area of each rectangle can be calculated. It is very common. In this paper, however, each **constituent rectangle of a square is equated to π.** The constant π is nothing to do with the square. This was the opinion of every mathematician till March 1998.

This author, a Zoology teacher cum student, after the discovery of the real π value, equal to $\frac{14-\sqrt{2}}{4}$ = 3.14644660941… is able to equate the constituent rectangles of a square, into π constant, **exactly**. It is a well known fact, that the area of the circle is equal to $\frac{\pi d^2}{4}$, where 'd' is the diameter. When the diameter is one, the area of that circle becomes equal to $\frac{\pi}{4}$. The side of the circumscribed square is also equal to one, like the diameter, and hence, the area of this square, is equal to one.

In this paper, we find, the square is divided into 9 rectangles and are equated in terms of π. **It is a new approach.** This way the areas of its inscribed circle equal to $\frac{\pi}{4}$ is obtained in terms of the areas of rectangles and π value, thus derived, from those rectangles, give π value as $\frac{14-\sqrt{2}}{4}$, and surprisingly, not the 2000-year old 3.14159265358….

Procedure:

1. **Square**: ABCD, Side = a = diameter = d
2. Diagonals: AC = BD = $\sqrt{2}$ a = $\sqrt{2}$ d
3. Parallel side to side DC = FK = a = d
4. **Circle:** Centre = 0, Radius = OG = OJ = $\frac{a}{2} = \frac{d}{2}$
5. **Triangle:** GOJ, GJ = Hypotenuse = OG x $\sqrt{2}$

$$= \frac{a}{2} \times \sqrt{2} = \frac{\sqrt{2}a}{2} = \frac{\sqrt{2}d}{2}$$

6. FG = DF = JK = KC = $\frac{\text{side} - \text{hypotenuse}}{2}$

$$= \left(a - \frac{\sqrt{2}a}{2}\right)\frac{1}{2} = \left(\frac{2-\sqrt{2}}{4}\right)a$$

7. So, CK = $\left(\frac{2-\sqrt{2}}{4}\right)a$

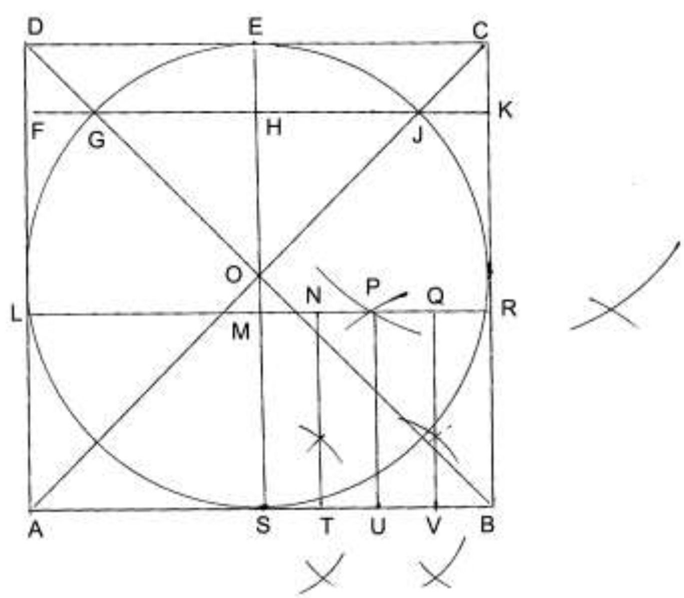
8. KB = Side BC – CK = $a - \left(\frac{2-\sqrt{2}}{4}\right)a = \left(\frac{2+\sqrt{2}}{4}\right)a$

9. So, KB = $\left(\frac{2+\sqrt{2}}{4}\right)a$

10. Bisect KB into KR and RB

$$= \left(\frac{2+\sqrt{2}}{4}\right)a \rightarrow \left(\frac{2+\sqrt{2}}{8}\right)a + \left(\frac{2+\sqrt{2}}{8}\right)a$$

11. Side = AB; Mid point of AB is S



12. AS = SB = $\frac{a}{2}$, Mid point of SB is U

13. SU = UB = $\frac{a}{4}$

14. Bisect SU and UB into ST, TU, UV and VB

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15. Side AB = a, so
16. ST = TU = UV = VB = $\frac{a}{8}$
17. ES = Side = a, where E and S are the mid points of DC side and AB Side.
18. H and M are also the mid points of FK side and LR side
19. ABCD square is divided into **two** types of rectangles. They are
20. 1. Two middle sized rectangles DFHE and EHKC
    2. Four larger rectangles FLMH, HMRK, LASM and MSBR
21. Further, the larger rectangle MSBR is divided into four equal smaller rectangles. They are MSTN, NTUP, PUVQ and QVBR
22. So, the entire square ABCD, finally consists of three types of rectangles

Smaller rectangles	= 4
Middle rectangles	= 2
Larger rectangles	= 3
	= 9

23. Areas of rectangles

Four **smaller** rectangles, each side = ST = $\frac{a}{8}$, SM = $\left(\frac{2+\sqrt{2}}{8}\right)a$

Area = ST x SM = $\frac{a}{8}\times\left(\frac{2+\sqrt{2}}{8}\right)a = \left(\frac{2+\sqrt{2}}{64}\right)a^2$

Three **larger** rectangles

Area = LA x AS = $\left(\frac{2+\sqrt{2}}{8}\right)a\times\frac{a}{2} = \left(\frac{2+\sqrt{2}}{16}\right)a^2$

Two **middle** sized rectangles

Area = DF x FH $= \left(\frac{2-\sqrt{2}}{4}\right)a\times\frac{a}{2} = \left(\frac{2-\sqrt{2}}{8}\right)a^2$

24. The sum of the areas of 9 rectangles must be equal to the area of the square ABCD = a^2.

Four smaller rectangles = $4\left(\frac{2+\sqrt{2}}{64}\right)a^2 = \left(\frac{2+\sqrt{2}}{16}\right)a^2$

Three larger rectangles = $3\left(\frac{2+\sqrt{2}}{16}\right)a^2 = \left(\frac{6+3\sqrt{2}}{16}\right)a^2$

Two middle rectangles = $2\left(\frac{2-\sqrt{2}}{8}\right)a^2 = \left(\frac{2-\sqrt{2}}{4}\right)a^2$

$$= \left(\frac{2+\sqrt{2}}{16}\right)a^2 + \left(\frac{6+3\sqrt{2}}{16}\right)a^2 + \left(\frac{2-\sqrt{2}}{4}\right)a^2 = a^2$$

PART-II RECTANGLE AREAS ARE EQUATED TO π

In the above Part I, the arithmetical values of rectangles are arrived at. Now, the above same areas of rectangles are **equated** to π constant.

25. Each rectangle is equated in terms π

Each smaller rectangle = $\left(\frac{2+\sqrt{2}}{64}\right)a^2 = \left(\frac{4-\pi}{16}\right)a^2$

Each middle rectangle = $\left(\frac{2-\sqrt{2}}{8}\right)a^2 = \left(\frac{\pi-3}{2}\right)a^2$

Each larger rectangle = $\left(\frac{2+\sqrt{2}}{16}\right)a^2 = \left(\frac{4-\pi}{4}\right)a^2$

26. Area of the ABCD square (in terms of π)

$$= 4\left(\frac{4-\pi}{16}\right)a^2 + 2\left(\frac{\pi-3}{2}\right)a^2 + 3\left(\frac{4-\pi}{4}\right)a^2$$

$$= \left(\frac{4-\pi}{4}\right)a^2 + (\pi-3)a^2 + \left(\frac{12-3\pi}{4}\right)a^2 = a^2$$

27. With the guidance of the known new π value of March 1998, the following rectangles constitute the area of the inscribed circle and the remaining as the four corner areas **in between** circle and square.

2. Middle sized rectangles = $2\left(\frac{2-\sqrt{2}}{8}\right)a^2 = 2\left(\frac{\pi-3}{2}\right)a^2$

+ (plus)

3. Larger rectangles $= 3\left(\frac{2+\sqrt{2}}{16}\right)a^2 = 3\left(\frac{4-\pi}{4}\right)a^2$

$$= \left(\frac{2-\sqrt{2}}{4}\right)a^2 = (\pi-3)a^2$$

$$= \left(\frac{6+3\sqrt{2}}{16}\right)a^2 = \left(\frac{12-3\pi}{4}\right)a^2$$

The sum of these areas of rectangles, is equal to, the area of the circle

$$= \frac{\pi d^2}{4} = \frac{\pi a^2}{4}$$

$$= \left(\frac{2-\sqrt{2}}{4}\right)a^2 + \left(\frac{6+3\sqrt{2}}{16}\right)a^2 = (\pi-3)a^2 + \left(\frac{12-3\pi}{4}\right)a^2$$

$$= \left\{\frac{\left(8-4\sqrt{2}\right)+\left(6+3\sqrt{2}\right)}{16}\right\}a^2 = \left\{\frac{4\pi-12+12-3\pi}{4}\right\}a^2$$

$$= \left(\frac{14-\sqrt{2}}{16}\right)a^2 = \frac{\pi a^2}{4}$$

$$\therefore\ \pi = \frac{14-\sqrt{2}}{4}$$

28. Four smaller rectangles of larger rectangle MSBR, and **each** smaller rectangle of this larger rectangle represents each **corner curvilinear area** of the square, which is outside the inscribed circle, on four corners of the ABCD square.

CONCLUSION

The circle-square composite construction is represented as the sum of 9 rectangles, demarcating exactly, the area of the circle and the four corner areas of the square, outside the inscribed circle.

DISCUSSION

Pi value is derived geometrically by the Exhaustion method of **Eudoxus** of Cnidos (408-355 B.C). Using the same method **Archimedes** of Syracuse (240 B.C.) said π value is **less** than 22/7. Later mathematicians finalized π value as 3.14159265358… geometrically, by **refining** the same Exhaustion method of Eudoxus. From 1450 AD onwards, **infinite series** came which was introduced by **Madhava** of Kerala, India. Thus from Madhava, and independently by **John Wallis** (1660) of England and **James Gregory** (1660) of Scotland till today, with the infinite series of **Simon Plouffe** (1996), 3.14159265358… of Exhaustion method has been **established as final value to π constant.**

Paragraph 2. Thus, from the past to the present, this number: 3.14159265358… has ruled the mathematical world **as Pi of the circle**. The same value has been derived by **Sir Isaac Newton, Leonhard Euler, S.Ramanujan** and about a dozen **great** mathematicians. It has been called a **transcendental number** by **C.L.F. Lindemann.** 3.14159265358… has been **dissociated from the circle** altogether from 1660. However, it was argued, squaring a circle an unsolved geometrical problem. **It is confusing** that π number has been dissociated from the circle, on one hand, and **the impossibility of squaring a circle** with 3.14159265358… has been said again, on the other, going back to the square a circle.

3. **Secondly,** in the Exhaustion method, the so called π number 3.14159265358… is derived from the regular **polygon, involving $\sqrt{3}$.** The same number 3.14159265358… is computed from the infinite series **without using square root extraction.**

4. Geometrically, square root extraction **is a must** in getting 3.14159265358… and in the infinite series, the operation of square root extraction is **vehemently opposed**, and hence, this number 3.14159265358… called **a special** and non rational number as a transcendental number.

5. Thus, the number that was derived from regular polygon and from infinite series, though, **is same**, it is **called differently.** An algebraic number 3.14159265358 of regular polygon with $\sqrt{3}$ derivation, has been **elevated to** the status of a transcendental number, when it is derived from infinite series **without** square root extraction. Again here, we find **contradictory statements**.

6. **Third ambiguity** regarding 3.14159265358… is, **it represents polygon**

$$\frac{\text{Perimeter of polygon}}{\text{Diameter of circle}} = \pi$$

The **original definition** of π is

$$\frac{\text{Circumference of circle}}{\text{Diameter of the same circle}} = \pi$$

Here also, we find 3.14159265358… which is derived from the **polygon-circle hybrid combination.** Hence, 3.14159265358… is **not a pure π value**, in other words, it is a **hybrid π value**.

7. Calling 3.14159265358… as a transcendental number by **C.L.F. Lindemann** is **cent per cent correct.** However, this number is **not Pi of the circle.**

8. C.L.F. Lindemann is **wrong**, if he calls π constant a transcendental number. **Why ?**

9. His proof was based on **Euler's equation** $e^{i\pi} + 1 = 0$.

This equation **accepts** π radians 180^0. But, Euler's equation **rejects π constant 3.14.**

$e^{\sqrt{-1}\times 180} + 1 = 0$	Right
$e^{\sqrt{-1}\times 3.14} + 1 = ?$	Right or Wrong ?

How can Lindemann incorporate π radians 180^0 in the Euler's equation and give transcendental status to another one i.e. π constant 3.14 ? **Is it not a wrong conclusion ?** His conclusion may be right when
π radians 180^0 = π constant 3.14

Does mathematics accept the above equation ?
Euler's equation accepts π radians 180^0 only. Does this number 180 deserve a transcendental status then ? Thus, this is another one which has conditioned the thinking of mathematicians since 1882, unfortunately.

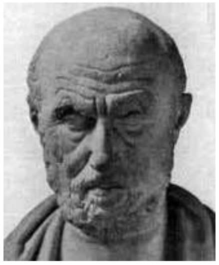
10. **Yet another confusing** observation is, till March 1998, **nobody knew the real π value.** Without knowing the true π value, how can one say that squaring of circle is an unsolved geometrical problem ? The number 3.14159265358… which **actually** represents polygon and expecting this transcendental number of "circle", and converting it into a square (squaring a circle) is another human created problem which does not exist in geometry.

11. Thus, everything done, so far, for 2500 years, has been **attributed to circle,** its value and nature of Pi – and are all questionable statements, except the work of **Hippocrates of Chios** (450 B.C) who squared lunes, squared full circle and also squared semi-circle with the help of lunes. His work alone is cent percent perfect and **excellent**. **It must have disturbed the real thinkers of mathematics, in the past 2500 years.**

12. **The Nature**, must have **dissatisfied** with the prevailing wrong notions on π, and would have **perhaps,** thus chosen a non-mathematician in this author, and revealed to him the real π value $\frac{14-\sqrt{2}}{4}$ an **algebraic number to tell the world,** after keeping this author 26 long years (from 1972 to March 1998) in pensive mood or in gestation period for inculcating in him, to develop **patience** and prepared him for **not to get disturbed** when the **onslaught** on his work and on him personally, would be very extreme and filthy sometimes, due to the intolerance of a few people across the world, as this new value is radical or revolutionary in nature and oppose the whole mathematical world, coming from a layman in mathematics, a Zoology teacher cum student.

13. Everything said about $\frac{14-\sqrt{2}}{4}$ has been questioned and rejected. Every method which derives $\frac{14-\sqrt{2}}{4}$ has been questioned that this method **does not agree** with any known geometrical concepts. Association of circle with $\sqrt{2}$, circle with square, rectangle, triangle, trapezium has been objected.

14. Hence, this author is **not disturbed and distracted** with the indecent comments made on his work and on him personally, by some, but hopes on the Mathematical establishment. It is also said, all the 100+ methods have been passing on **undetectably a mistake** to the next every method.
To sum up, this author is not against the number 3.14159265358… (of polygon). **Attribution** of this number to circle as its circumference **is wrong**. This arrangement is only a stop-gap (= temporary substitute) in character, till the **real** π value is known. Now, the true value is known. **Thank God, Sirs ! Decision is Yours.**



This paper is humbly dedicated to **HIPPOCRATES OF CHIOS** for he alone understood the circle, rightly. He was honoured already as the Founding Father of Mathematics for he authored the first book on Mathematics which became the guidance for Euclid's **Elements**. Hippocrates of Chios should be honoured with **1st Greatest Mathematician** instead of OR in addition to the Founding Father of Mathematics (Now, the real π value 3.14644660941… is known and from this, Archimedes's **prophesy** of value of π equal to **less than** 22/7 = 3.142857142857… proved false).

Author (December 19th 2015)

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