RETRACING GOALPARA

Editors
Dr. Mainul Hoque Chaudhury
Himani Devi

Assam College Teachers' Association
Goalpara Zone

Retracing Goalpara :
A collection of Research Papers and Articles edited by Dr. Mainul Hoque Chaudhury & Himani Devi and published by Purbayon Publication, Panbazar, Guwahati-1, Assam, India on behalf of Assam College Teachers' Association (ACTA), Goalpara Zone & Assam College Teachers Association, Goalpara

1st Edition : December, 2022 ₹ 350/-

ISBN : 978-93-95103-97-8

Retracing Goalpara

First Edition : December, 2022

Price : 350/-

Cover : Chitralekha

Published by:

Dr. Nazrul Islam, Secretary,
Assam College Teachers' Association (ACTA), Goalpara Zone,
Goalpara, Assam

&

Purbayon Publication
Jaswanta Road
Near Panbazar Aadarsha Prathamik Vidyalaya
Panbazar, Guwahati- 1, Assam, India

Printed at : Purbayon Publication Pvt. Ltd.
Panbazar, Guwahati- 1, Assam, India

Mathematics in Arts and Beauty : An Analytical Study Regarding Interdisciplinary Application of Mathematics with special mention of Goalpara District

Dr. Abdul Wahed
Bikali College Dhupdhara

Abstract :

All the arts including music, dance, painting, architecture, sculpture etc. have strong relationship with mathematics. Mathematical beauty is found in the creative fine arts as well as in natural beauty. This knowledge of interdisciplinary application of mathematics has its real, aesthetic and educational values. It can reduce the math anxieties among the people and foster

mathematical research in the diversified field of applications. In this study attempts were made to explore the different mathematical ideas present in arts and beauty.

Keywords : *Mathematics, arts, beauty.*

1. Introduction :

Mathematics has been remaining indispensible in every sphere of our life. It is being an independent subject for its own disciplinary value and at the same time playing the role of interdisciplinary subject in all the scholastic areas of an academy. Outside the academy mathematics is effectively used in all the fields of work places- agriculture, business, industries, economics, statistics, science and technology in day to day life. For the purpose of decision making simple mathematics is effectively used by the common people in their all walks of life (D. P. Wilson, 2009). Humanities and social science is also used mathematics in a variety of forms. The Graph theory and Network theory has wide application in the humanities and social science. Formation and management of social networks, citation networks and networks for dissemination of knowledge are day by day growing problems in the society which can be handled effectively by network theory in mathematics. In this study attempt was made particularly to see mathematics in arts and beauty.

Mathematics is a beautiful subject with its systematic approach through logical steps to arrive at a right conclusion. "I worship this most beautiful subject of all and I don't care that my love remains unrequited" (Quoted Fujiwara, 2011). This enthusiastic and emotional feeling regarding mathematics was expressed by the French poet Paul Valery (1871-1945) who was a great admirer of mathematics. Paul Valery is not only the person but there are many personalities who experience the beauty of mathematics in their own field of studies. English Romantic poet John Keats (1795-1821) cited "beauty is truth and truth is beauty." It would be noteworthy to extend here in that beauty is truth, truth is mathematics and mathematics is beauty. Because, truth is the mathematical conclusion of deductive reasoning followed by premises and pre conditions. The romantic thinkers are

just like the enlightened philosophers, they believe in the intrinsic ability of mankind to understand nature and its phenomena. In the period of romanticism (19th century), the nature of mathematics changed from problem solving attitude to theoretical one in which logic, rigour and internal consistency are found. Logical thinking brings universal reasoning among the great poets, philosophers, mathematicians and abstract thinkers to assimilate their interdisciplinary knowledge and ideas in the fields of learning. The aim of the paper is to explore the different mathematical ideas and applications present in arts and beauty.

Prof. G. H. Hardy (1940), a respected mathematician, in his book *A Mathematician's Apology* highlighted the beauty of mathematics as a patterns of painters or poets. "It may be very hard to *define* mathematical beauty, but that is just as true of beauty of any kind—we may not know quite what we mean by a beautiful poem, but that does not prevent us from recognizing one when we read it." (P.14). Again, in the same edition he asserted that "Mathematics may, like poetry or music, ,,promote and sustain a lofty habit of mind , and so increase the happiness of mathematicians and even of other people" (P.31). This is the aesthetic and educational value of mathematics that can reduce mathematical anxieties a nong the peoples and make mathematics universally acceptable in all the field of endeavour.

2. Methodology of the Study :

The methodology of the study based on extensive literature survey to find analytically the relevant fact and information regarding use of mathematics in arts and beauty.

3. Discussion and Analysis :

3.1. Golden Ratio:

The Golden Ratio is a mysterious example of mathematical beauty which presents almost in every creature of God. The Golden Ratio is also known by number of names such as Golden Section, Golden Proportion, Devine Section, Devine Proportion etc. depending on the situation and phenomena where it occurs. At this juncture of

discussion it would be appropriate to define and analyze Golden Ratio so that its beautiful applications can be realized in nature as well as in geometry and verity of designs.

Let us consider two real numbers *a, b* with the property $a>b>o$ which satisfies the ratio.

$$\frac{a+b}{a}=\frac{a}{b} \qquad (1)$$

This ratio is called Golden Ratio and it is denoted by ϕ

That is $\frac{a+b}{a}=\frac{a}{b}=\phi$, the Golden Ratio (2)

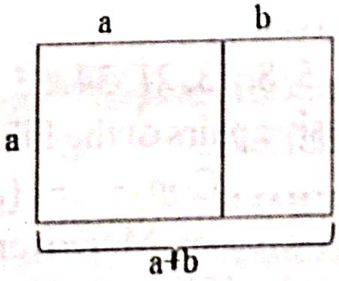
Now, $\frac{a}{b}=\phi$ implies $\frac{a}{b}=\frac{1}{\phi}$. Hence, the equation (2) can be written as follows :

$$1+\frac{1}{\phi}=\phi$$

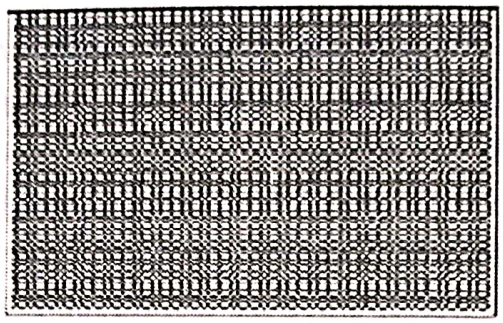
$$\Rightarrow \phi^2-\phi-1=0$$

$$\Rightarrow \phi=\frac{1+\sqrt{5}}{2}=1.6180339887.....$$

Now, let us construct a Golden Rectangle with length unit and breath unit. In this rectangle if a square of side equal to the length is drawn, then the remaining part is again a Golden Rectangle. The part of the square can be again split into small Golden Rectangles. Proceeding in this alternate way it can be further sub divided infinitely to arrive at a point where mathematical consistency of self-similarity remain same. After subsequent sub-divisions with the help of Golden Ratio the rectangle in fig-1 reduces to the beautiful design in fig-2.



(Fig-1)



(Fig-2)
Source: file:///D:/Golden%20Ratio.htm

The architectures, Designers and painters usually use different types of golden ratios such as Golden rectangle, golden angle, golden triangle, golden hexagon, golden pentagon etc. for their works of aesthetic values and landscape. It seems that the numerous Sivalings of SriSurjya Hill of Goalpara district were shaped using this ratio. The Buddist stupas found on that hill are also examples of application of golden ratio.

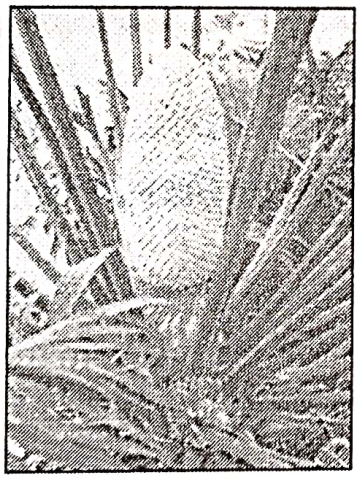
3.2. Fibonacci Sequence and Mathematical Beauty in the Nature :

The patterns in nature occur in different context. These patterns are studied by the Greek philosophers Plato and Pythagoras and they tried to explain the order of nature. Their studies resulted in many mathematical models to understand the pattern of the nature. Golden Ratio is one of the important models, presents in the morphology of the plants and animals in the natural world. In the nature phyllotaxis spirals are generally found in the distribution of branches and leaves around the stem of trees and in the arrangement of flower.s petals. This type of spiral can be generated mathematically from Fibonacci sequence. In this sequence every term (number) is the sum of its two preceding terms. It is given by

0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55.....

The ratio of the successive pairs of the Fibonacci numbers 3/2, 5/3, 8/5, 13/8, 21/13..... Converges (approximate) to the Golden Ratio as the number increases. Moreover, the Fibonacci ratios approximate the Golden Angle, 137.508^0. The Fibonacci numbers

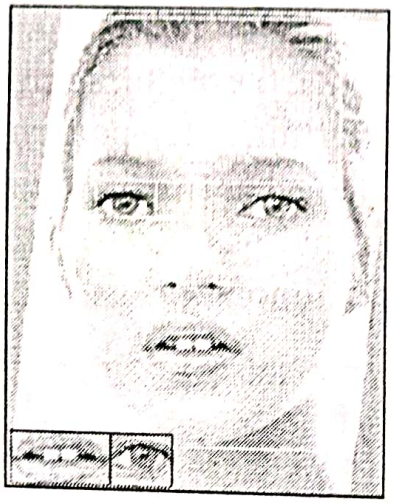
are associated with the spiral of Pine apples, pine cones, sunflowers and cycas circinalis. A pine apple has 8 spirals of opposite directions. In pine cone there are 8 spirals in clockwise directions and 13 spirals are in anti-clockwise directions. This is similar with that of the spirals in sun flowers having numbers 55 and 89. The interesting and remarkable thing is that 8, 13 and 55, 89 are pairs of consecutive numbers in Fibonacci sequence. Moreover, the reveres ratio of the Fibonacci numbers (deleting the middle term) of the sequence i.e., 1/2, 1/3, 2/5, 3/8 .....determined the patterns of the spirals. When one rotation of the spiral touches two leaves alternate up a stem then it is 1/2nd pattern. This pattern is $1/3^{rd}$ for hazel, $2/5^{th}$ for apricot, $3/8^{th}$ for pear and $5/13^{th}$ for almond.



(Fibonacci patterns of cycas circinalis)
Source:, file:///D:/patern in nature-Wikipedia.htm

Men are indifferent from nature. The presence of God Gifted Divine Ratio in their body structure makes men beautiful creature of the world. What is beauty? Symmetry, order, structure and internal consistency make a thing pleasant and beautiful. The facial beauty of a person occurs in the model of Golden Rectangle with symmetry and order as shown in the figure. Behind the beauty of women.s breasts, presence of Golden Section is found in their structure along with their occurrence of symmetry in position, similar in shape, equal in size and measures; and possess equal inclination to the vertical and horizontal directions with respect to the body. Symmetricity,

similarity, equality, and inclination all are mathematical properties to produce the character of beauty in the animate and inanimate objects of the world. In the version of P.A.M. Dirac, a great physicists ¡°God is a Mathematician of very high order and He used very advanced mathematics in constructing the Universe.¡±



Source: http://io9.com/5985588/15

3.3. Mathematics in Arts and Music:

The use of golden ratio are found in the mathematical- based fine arts of Leonardo Da Vinci (1452-1529)1, in the architectural work of Santiago Calatrava (1951)2, in the sculpture of Robert Longhurst (1949)3 and in the digital arts of Scott Draves (1968)4 . In fact, the entire list of the artists using mathematics in their artistic works is too long and beyond the scope of the study. The famous piece of works- the Mona Lisa, the Last Supper, the Old Man, and the Vitruvian Man painted by Leonardo Da Vinci are in accordance with the golden proportion.

In music, the Fibonacci sequence can be seen in piano scales. The C scale of the piano consists of 13 keys of which 8 are white keys and 5 are black keys (arranging in a group of 3 and 2) the numbers 13, 8, 5, 3, 2 are in the reversed order of Fibonacci sequence. Again, sound is a physical phenomenon which can be studied with the help of mathematics. Pythagoras observed that different sound can be produced with the help of different weights and vibrations. It

leads to the discovery that pitch of a vibrating string is proportional to its length and when the string is shorter, pitch is higher.

3.4. Mathematics in Literature and History:

Sally I. Lipsey and Bernard S. Pasternack (2002) in the article "Mathematics in Literature" emphasized in using mathematics in stories, plays or poems in a variety of different ways. On one hand, writers may be inspired by mathematical themes to create a work of art based on the themes and on the other hand, may call on mathematicians to illuminate a theory for their necessity. Literature can elicit expressions of feeling about joys and frustrations of the mankind with the help of mathematics. In this regard the works and perseverance of Clinton Fadiman is highly appreciable. "Fantasia Mathematica" composed by Fadiman is a collection of mathematical stories, essays and anecdotes which provides humorous, mysterious and always entertaining literatures of everyday life. It has great contributions towards the essential pedagogical values in the learning of mathematics.

In "War and Peace", Russian novelist, Tolstoy uses mathematics to support his theory of history (see pp. 568-1145) and forward his views that history needs to be analyzed mathematically and statistically. The reasons may be that it can ably depict the clear picture of economic status of that period. He used ratio, proportion and linear equations to calculate power of an army to its sprit and clarified how the Russians, a disadvantaged group can win battles against the French, an advantaged group with the help of sprit and energy (Sally et.al.)

5. Findings of the Study:

The findings of the study can be summarized as follows

a) Golden ratio is used in beautiful designing, architectural works and in fine arts.

b) The facial beauty of a person is also occurred in the form of Golden ratio.

c) The natural beauty of plants and trees can be explained with the help of Fibonacci sequence.

d) Fibonacci sequence can be seen in musical device- piano scales.

e) Mathematics is also used in various forms in literature and history.

6. Conclusion :

Mathematics has its own beauty and romance. The world of mathematics is not a boring one. It is a beautiful endeavor of life; it gives knowledge and pleasure to mankind. Without fear and hesitation all sections of people can use mathematics in their everyday life. In essence, there is a presentation of a poem composed by the author.

Mathematics

Counting begins
One, two, three, four, Five, six, seven.....
Recycling of digits begins
Through reasoning at the arrival of ten.

Calculation begins
With addition and subtraction.
Mutual Puzzle begins
With multiplication and division.

Measurement comes
With analogue and continuity.
Life completes
With learning and activity.

Zero (0) is the Big Hero
How we will fight?
Point (.), think it as atom
Ingredient of line and letters.

Lines make a letter
Letters make word

Words make a sentence
Sentences make the literatures
Literatures share knowledge of the world.

Footnotes :

1. *"Leonardo DaVinci and the Golden Section-Math Central". Mathcentral.uregina.ca Retrieved, 18 March 2019*

2. Greene, Robert. *"How Santiago Calatrava blurred the lines between architecture and engineering to make buildings move". Arch daily. Retrieved 7 June 2015.*

3. Robert Longhurst Studio: Portfolio, *www.robart longhurst.com . Retrieved, 18 March 2019*

4. *"Portfolio-Scott Draves-Software Artist,* https:// scottdraves.com. *Retrieved, 18 March 2019*

References:

1. Fujiwara, M. (2011), "Literature and mathematics" *Asymptote,* Issue Jan 2011

2. Golden Ratio, Source: Mathworld.wolfram.com/Golden Ratio.html

3. Golden Ratio, file:///D:/Golden%20ratio%20-%20Wikipedia,.htm

4. Hardy,G.H. (1940), "A Mathematician s Apology", Electronic Edition 2005, Version 1.0, Published by University of Alberta Mathematical Science Society. http://www.math. ualberta.ca/mss/

5. Keats, J. (1819), "Ode on a Grecian Urn", a poem by John Keats. https://englishhistory.net/keats/poetry/

6. Konch, A. (2014), "Phibonacci Sequence and morphology of Plants": *Recent Trends in Mathematics and its Application*, an anthology of articles; Edited by Dr. Sahin Ahmed; EBH Publishers (India).

7. Pattern in nature, Source: file:///D:/patern in nature-Wikipedia.htm

8. Romanticism in Science, From Wikipedia File: ///D:/ Romanticism in Science.html

9. Sally I. Lipsey and Bernard S. Pasternack (2002),

Mathematics in Literature, Source : http://www.asymptotejournal.com/article. php%3Fcat%3DNonfiction%26id%3D4

10. The Golden Number, Source: www.goldennumber.net/golden-ratio/

11. "Monthly essays on mathematical topics: Mathematics and Art". American Mathematical Society. Retrieved 7 June 2015.

12. Greene, Robert. "How Santiago Calatrava blurred the lines between architecture and engineering to make buildings move". Arch daily. Retrieved 7 June 2015.

13. "Leonardo DaVinci and the Golden Section-Math Central". Retrieved, 18 March 2019

14. "Portfolio-Scott Draves-Software Artist, https://scottdraves.com. Retrieved, 18 March 2019

15. Robert Longhurst Studio : Portfolio, www.robartlonghurst.com . Retrieved, 18 March 2019

■■■