

## A study on Vedic Mathematics: An Ancient Method

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### Abstract:

*Vedic Mathematics concerned with the Veda which deliver superfast solution of any problem related with mathematics. The present paper cover the concept of mathematics with the ancient method of Vedas and its relevant consideration. It consider all the sixteen sutras and their related sub sutras or Corollaries which tend in revealing the mathematics problem in easier and fast manner. The paper also detailed about the multiplication and division methods which is one of the most critical arithmetic operations approved with any digital logic algorithm i.e. digital signal processing. The discussion of the methodology with stepwise procedure of connected sutras with the both multiplication and division method give a lot informative and contain numerous application in the mathematical issues. Through this paper one can get the immense knowledge of Vedic mathematics and its reviewed data and the use of Vedic sutras dependent on algorithm conclusively provide the simple architecture and high-efficiency power.*

**Keywords:** Vedic Mathematics, Sutras, Vedas, Algorithm, Digital signal processing, Simple Architecture

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**Introduction**

Vedic Mathematics is one of the ancient mathematics process that deals with the system of mathematics which help in the evaluation and solving of mathematical problems. The term is derived from the Veda which delivers the exact and fast solutions from any of the problem simultaneously with the cross checking mechanism. The Veda is basically derived from the Sanskrit word which define as the meaning to know anything without any limit and consider all the Veda-sakhas i.e. known to humanity. The Veda is depository of combination of all knowledge and informative details. Hence Sri Bharati Krishna Tirthaji again introduced the Vedic Mathematics concepts to the education world. For the extensive study the Atharva Veda by giving the sixteen simple mathematical formulae which is known as Up-sutras or corollaries. It is firmly defined the system of sutras that is define as the simple and powerful and powerful branch of the mathematics (Singh and Gupta, 2017).

Vedic Mathematics is known for the mathematical operations which help in development of brain and also helpful in relating with our past. A serious dedication towards the Vedas math utilize the spiritual bend example, a devotional hymn in tribute of Lord Krishna when deciphered provides the value of pi ( $\pi$ ) till 32 decimal place in the trigonometry problems. These are useful in making the mathematics is flexible and easy as it is having the qualitative approach so as to make use of the required parts of brain. This Vedic mathematics dealing with the student preparation with that of the competitive approach for sake of examination. This need a lot more practice and dedication as this type of studies are not provided by any school and colleges so it is going to be consider with reference of logics, systematical and fast approach (Singhal, 2007).

Vedic Mathematics is dependent upon the 16 sutras that deal with numerous branches of mathematics like algebra, arithmetic, geometry etc. These 16 sutras is defined as follows:

1. Shunyamanyat – If one in ratio, then other is zero
2. Chalana-Kalanabyham – Depends on Difference and Similarities
3. Ekadhikena Purvena – By one more than the previous one

4. Ekanyunema Purvena – By one less than the previous one
5. Gunakasmuchyah- Factor of sum is equal to sum of factors
6. Gunitasamuchyah – Product of sum is equal to sum of product
7. Nikhilam Navastashcaramam – All from 9 and last from 10
8. Paraavartya Yojayet – Transfer and Adjust
9. Puranapuranyam – Completion and Non-completion
10. Sankalana-Vyavakalanabhyam – By Addition and Subtraction
11. Shesanyankena Charamena – Remainder by the last digit
12. Shunyam Saamyasamuccaye – When the sum is same that sum is consider zero
13. Sopaantyadvayamantyam – Ultimate and twice the penultimate
14. Urdhva-tiryagbham – Vertically and crosswise
15. Vyashtisamanstih – Part and Whole
16. Yaavadunam – whatever the extent of its deficiency.

These sutras are helpful in dealing with the different concepts of mathematics including plain and spherical geometry, calculus (both in differential and integral), conics, trigonometry etc. The Vedic formulae are dependent on the natural principles on which the mind of human works. This considered as an interesting field and shows some effective algorithms which also utilize by different branches of engineering and other computing and digital processing.

**Table 1. The Sixteen Sutras and their related Corollaries**

S.no.	Sutras	Sub-Sutras or Corollaries
1	Ekadhikena Purvena	Anurupyena

2	Urdhva-triyagbhyam	Adyamadyenantyam antyena
3	Nikhilam Navataścaramam Daśatah	Sisyate Śesamjnah
4	Sankalana-vyavakalanabhyam	Vestanam
5	Paravartya Yojayet	Kevalaih Saptakam Gunyat
6	Sunyam Samyasamuccaye	Vestanam
7	Yavadunam	Samuccayagunitah
8	Calana Kalanabhyam	Antyayoreva
9	Vyastisamastih	Lopanasthapanabhyam
10	Sunyamanyat	Yavadunam Tavadunam
11	Sopantyadvayamantyam	Gunitasamuccayah Samuccayagunitah
12	Puranapuranaabhyam	Antyayordasake pi
13	Sesanyankena Caramena	Vilokanam
14	Gunitasamuccayah	
15	Gunakasamuccayah	
16	Ekanyunena Purvena	

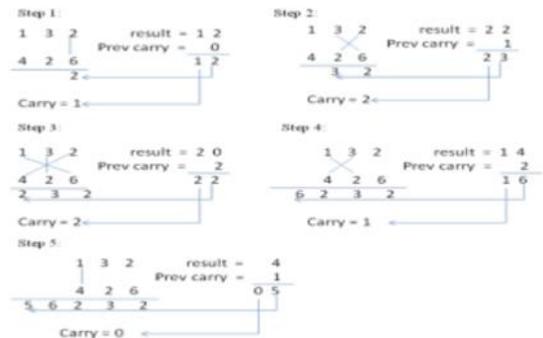
**Sutras used in the multiplication and division technique -**

### Multiplication Technique

- **Urdhva Tiryakbhayam**

It is one of the multiplication technique which define on the basis of vertically and crosswise method. It is one of the universal application which are useful for

all the cases that use decimal numbers with the binary number multiplication. The multiplication is conducted to the end number of the line and if previous carry exist is also added. The previous carry is added with the more than one multiplication of any step. The result is defined on the basis of unit place digit and tens place digit which is later carry out for next step. As per as the partial product and sum calculated in parallel and clock frequency of processor does not alter the multiplier.



**Figure 1. Multiplication by Urdhva Tiryak**

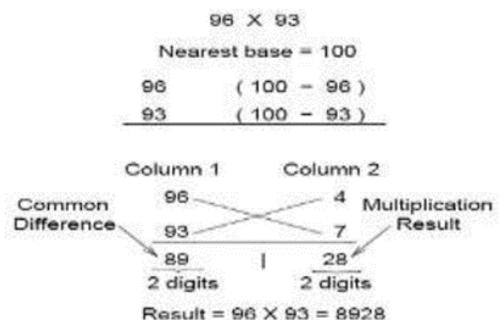
- **Nikhilam Sutra**

## निखिलं नवतश्चरमं दशतः

**Nikhilam Navatascaramam Dasatah**

**“All from nine and last for ten”**

This define on the basis of beneficial of multiplication of the number which are close to the base of 10 which means to the powers of 10{17}. This is considered as the more time efficient and space as well. By taking the example of 96\*93. From the base, two numbers are subtracted i.e. one from the deviation from the base and placed in column 1 and the result summarizes into two parts.



**Figure 2. Multiplication by Nikhilam Sutra**

**Karatsuba Ofman**

This algorithm is used with the involvement of very large numbers. The rule which is used for this method is divide and conquer rule. This is one of the fastest technique for the multiplication of larger numbers. In this if we have to multiply the two 'n' digit number then it is to be used to reduce three n/2 multiplication digit and later a step of addition. The process considered 'x' and 'y' as n digit strings and 'm' as integer.

$$\begin{aligned}
 x &= x_1 B^m + x_0 \\
 y &= y_1 B^m + y_0 \\
 \text{Where } m < n, \\
 \text{Where } x_0, y_0 < B^m. \text{ Substituting } x \text{ and } y \\
 xy &= (x_1 B^m + x_0)(y_1 B^m + y_0) \\
 xy &= z_2 B^{2m} + z_1 B^m + z_0 \\
 \text{Where} \\
 z_2 &= x_1 y_1 \\
 z_1 &= x_1 y_0 + x_0 y_1 \\
 z_0 &= x_0 y_0 \\
 z_1 &= (x_1 + x_0)(y_1 + y_0) - z_2 - z_0
 \end{aligned}$$

**Figure 3. Multiplication by Karatsuba Ofman**

**Division Techniques**

**Nikhilam Sutra**

This can be applied as more efficiently if the divisor is smaller and closer to the power of 10.

This can be defined by applying numerous steps:

**Step 1.** The rearrangement of dividends digits in two parts i.e. questioned and Remainder i.e. the digit in the remainder are equal to the digit of divisor

Dividend: 3483

Divisor: 99

Dividend	Quotient	Remainder
	34	83

**Step 2.** In this divisor is completed on the basis that subtract all the digits by 9 and last digit from 10. The new divisor is termed as deficit.

Compliment of Divisor 99	Quotient	Remainder
01	34	83

**Step 3.** In this the first digit is positioned down as it

Compliment of Divisor 99	Quotient	Remainder
01	34	83
	3	

**Step 4.** Now Deficit the multiple with the first digit and later shifted one place to write and dividend is written below and add the first column.

Compliment of Divisor 99	Quotient	Remainder
01	34	83
multiply and place	0	3
	34	

**Step 5.** With the continuation of first step, add with column so that the number id filled in the last column and add in the same manner.

Compliment of Divisor 99	Sub-Quotient	Sub-Remainder
01	1	17
		01
	1	18

Previous Sub-Quotient Result	Quotient	Remainder
	34	18
	1	
	35	18

**Step 6.** In some cases, there is the possibility that remainder is greater than divisor, then it is important to divide the remainder with divisor which conclusively gave the sub-quotient and sub-remainder. Later add the sub-quotient with quotient and sun remainder with remainder.

Compliment of Divisor 99	Quotient	Remainder
01	34	83
multiply and place	0	3
	0	4
	34	117

Later it is observed that the in the entire process no subtraction step has been included. The entire method is completed with addition and multiplication step. This made the result less complicated and faster. It is conclusively defined on the basis of simplicity of sutra with the largest multiplication required is 9 by 9.

## Review Literature

**Ismail and Sivasubramniam (2010)** described the research which goal for improving one's activities by doing multiplication includes time tables five or more than five i.e. six, seven etc. The study depends upon the four Malaysian Primary school of around 5 years students who are sorted from 30 students on the basis of test on questions of multiplication. They also use the Vedic Method for solving the multiplication problems by making the use of the tables from zero to five. This paper also focus the failures of Vedic method that the student using in mechanical manner and consider as one of the tool as calculator, and it is found to be unacceptable by the student while explaining the algorithm which is difficult for Malaysian School.

**Bhardwaj, Kashyap and Shukla (2012)** discussed about the Vedic mathematics which is known as the ancient system of the mathematics as well as an individual technique of the calculation dependent on the simple principles and rules with which any mathematical issue can be solved. The Vedic sutras are 16 in number which are basically the word formulae analyzing the natural ways for solving the range of mathematical problems. The mathematical Vedic methods are resulting of the ancient systems of computations as compare with the conventional mathematical methods which are easy to execute and quicker. The paper shows the future implications which is useful for most of the universities to create research centers and also include the working of the Vedic mathematics.

**Kumar and Charishma (2012)** discussed about the high speed Vedic Multiplier with the use of the technique of Ancient Indian Vedic Mathematics which help in the improvement and modification in the performance. The design is completely depend upon the Vedic method of the multiplication. This paper focused on the hierarchical multiplier design which help in the complexity which decrease the inputs of large number of the bits and increase in the modularity. Conclusively it shows the high speed multiplier algorithm which reveals the improved efficiency on the basis of speed.

**Dighorikar and Haridas (2014)** detailed about the concept of convolution which is a formal mathematical operation i.e. addition, multiplication and integration. This method is used in numerous field like statistics and probability and the also discussed about the three signals named as input,

output and impulse response. The paper basically proposed to decrease convolution processing time with the use of the hardware computing and application of discrete linear convolution of two finite length sequences.

**Singh and Gupta (2017)** stated about the critical arithmetic operation i.e. multiplication and division which supported in any of the digital logic algorithm like cryptography for encryption and decryption algorithm, digital signal processing, ALU design and other logic computation. The paper focus on the potential of Vedic Mathematics that can be unchecked in an effective manner to implement and design the algorithms for the multiplication and division. They basically implement the applications of Vedic mathematics in VLSI design and hence concluded that the Vedic sutras which are dependent on algorithm in digital logic design had conclusively represent the improved speed, high power efficiency and simple architecture.

**Palata et al. (2017)** stated about the high speed processor on the basis of multipliers which is considered as the one of the key hardware in the digital processing system. This paper represent and suggest the 8\*8 bit binary arithmetic multiplier with the effective use of Vedic Mathematics. The system based on the Vertical and Crosswise structure of ancient Vedic Mathematics. The paper introduce the single method for multiplication based on the Vedic Mathematics. They specify the scheme hierarchical multiplier and specifies the advantage given by Vedic Methods i.e. it get condensed for the inputs of large number of bits. It is conclusively declare in the study that the multiplier is considered to be far better than that of the conventional multiplier.

## Conclusion

The Vedic method is found to be positive and effective for the students in dealing with the mathematical problems or basic algorithms. Various multipliers and divisor are dependent on the Sutras and its related sub sutras with the use of Vedic mathematical techniques and applications. The paper conclusively detailed about the use of this techniques in resolving the problem of mathematical issues with much faster and easier manner and contain the tricks and tactics to deal with numerous concepts of mathematics i.e. trigonometry, calculus, geometry, algebra etc. This method basically decrease the effort and most significantly time by their simple

algorithms techniques. It somehow face problem as well when the Vedic methods used by the individual as a mechanical calculator. The future perspective of applications and meaningful way so as to increase the performance in doing the multiplication and division problems for the students.



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