IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Theoretical And Practical Insights Into The Sutras Of Vedic Mathematics

Chanchal Baghel[1] , Akanksha Dubey [1], Mr. Nigama Prasan Sahoo[2]*

[1]Bsc (PCM) 6 Sem., Kalinga University, Raipur 492101(C.G)

[2]*Assistant Professor, Department of Mathematics, Kalinga University, Raipur 492101(C.G)

ABSTRACT

Vedic math's or `sutras mathematics' the general name for the mathematical system contracted in a few Dozen Sanskrit stanzas; however, calculation. it is not merely a system of manner of problems in arithmetical, algebra, and trigonometry too, any problem be it trigonometrical, algebraic or geometrical in type the technique of Vedic mathematics is simple to apply; it is based on 16 sutras-``word- equation`` akin to those of a computer program that reveal the steps of reasoning in solving difficult math's problems as well as time saving techniques for their solution which are not possible. After studying the Vedas for eight years, SWAMI BHARATI KRISHNA TIRTHA JI MAHARAJA (1884-1960) rebuilt Vedic mathematics from the ancient Indian texts. The sixteen word – formula, or principal, known as sutras from the foundation of Vedic mathematics. Vedic mathematics ideas are illustrated using multiple examples allowing individuals to complete a variety of mathematical operation like as addition, subtraction, multiplication and division. While Vedic math's simplifies fundamental mathematics it provisos a more. Effective method for tackling mathematical issues. Its bright future resides in its ability to increase understanding of mathematics through clear explanations. This strategy is now being adopted in high school and colleges around the country, making it more accessible to students.

Keyword: - multiplier, Vedic multiplier, sutras, formula, Veda

INTRODUCTION

India is home to the ancient mathematical discipline known as Vedic mathematics; basic arithmetic techniques are straight-forward effective, and rational. Its regularity is another benefit. Vedic mathematics has gained importance as a result of these benefits. The sixteen sutras serve as the primary foundation for the methods used in Vedas for eight years SWAMI BHARTI KRISHNA TRTHAJI MAHARAJA (1884-1960) rebuilt Vedic mathematics from the ancients Indian fascinating topic that offers some useful methods that may be used in a variedly of technical domains. Including digital signal processing and computing

S.NO.	Vedic sutras(Formulae)	Meaning
1	EKADHIKINA PURVENA	By one more than the previous One.
2	EKANYUNENA PURVENA	By one less than the previous one
3	(ANURUPYE) SHUNYAMANYAT	If one is in ratio, the other is zero
4	CHALANA KALANABHAM	Differences and similarities.
5	SANKALANA - VYAVAKALANABHYAM	By addition and by subtraction.
6	SHESANYANKENA CHARAMENA	The remainders by the last digit.
7	PURANAPURANABYHAM	By the completion non - completion.
8	URDHVA – TIRYABHYAM	Vertically and crosswise.
9	NIKHILAM NAVATASHCARAMAM DASHATAH	All from 9 and last form 10.
10	PARAAVARTYA YOJAYET	Transpose and adjust.
11	SHUNYAM SAAMYASAMUCCAYE	When the sum is same then sum is zero
12	YAAVADUNAM	Whatever the extent of its deficiency.
13	VYASHTISAMANSTIH	Part and whole
14	GUNITASAMUCHYAH	The product of sum is equal to sum of the product
15	SOPAANTYADVAYAMANTYAM	The ultimate and twice the penultimate.
16	GUNAKASAMUCHYAH	Factors of the sum is equal to the sum of factors.

1. EKADHIKENA PURVENA

It indicates one more than the previous one. We apply this sutra to the multiplication of number (let's say that a has the digit [a1, a0] and b has the digit [b1, b0], whose last digit addition (b0+a0) equals 10 and whose previous digits both (a1=b1) are the same. However, in addition to this requirement, the number of digits in the two numbers should also be the same. According to this sutra, the process is as follows.

(a) Last digit a0 x B0 =x1x0 (2 digit number)

(b) Previous digit (a1=b1) = a1x(a1+1) =y2y1y0

(c) Concatenate result of equations mentioned in point no. 2and 1 gives y2y1y0x1x0(i.e. equal to numeric value of (a x b)

EXAMPLE:- 1. Square of 35

[Addition of last digit 5+5=10]

a. Last digit is 5: 5 x 5=25

b. Previous digit 3:3x (3+1) =3x4 =12

c. Concatenate in point result of equation mention in point no b and a we get square of 35 i.e. 1225

EXAMPLE:- 2. 43 X 47

[Addition of last digit 3+7 =10]

a. Last digit is 3 and 7 : 3 X 7 = 21 (2 digit number)

b. Previous digit 4: 4x(4+1) = 4X5 =20

c. Concatenate in point result of equation mention in point no b and a we get square of 43 X 47 i.e. 2021

2. EKADHIKENA PURENA

Since it is regarded as a sub sutra of "nikhilamnavatashcaramamdashatoh" it implies one less than one before or one less than the one before. When two number are multiplied, this sutra applies if the multiplier is nine or an array of nine, and the multiplicand is any integer.

EXAMPLE:- 1. 8×9

STEP 01. 8 - 1 = 7

(Subtract the result from multiplier i.e. 9 or array of 9)

Step 02. 9 - 7 = 2

Answer 8× 9 = 72

EXAMPLE:- 2. 24× 99

Step 01. 24 – 1 = 23

(Subtract the result from multiplier i.e. 9 or array of 9)

Step 02. 99- 23 = 76

Answer 24 × 99 = 2376

3.ANURUPYE SUNYAMANAYAT SUTRA

When solving a particular kind of simultaneous simple equation where the coefficients of one variables are in the same ratio to none another as the independent terms are to one another we apply the sutra. Anurupye Sunyamanyat, which states that if one in is ratio, the other is zero. In this situation, the sutra

states that the "other" variable is zero, from which we obtain two simple equations in the first variable (already taken into consideration) and, of course, given the same value for the variables

Example:- 4x+3y =5

2x+15y =25

The y coefficients are in the ratio 3:15 =1:5, hence putting other variable x=0 in any one of the above equation we get 3y=5 or 15y =25which gives y=5/3

4.CHALANA-KALANABHYAM

The sutra means sequential motion or ''by calculus''

Example: - 2x2+10x+11=0

Now by calculus formula

$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

2ax+b =±√b 2 − 4ac

2(2) x +10= ±√(10) 2 − 4(2)(11)

4x+ 10=±√2

x=$\frac{-10+\sqrt{2}}{4}$

5.GUNAK SAMUCCAYAH

This sutra means that factor of sum is equal to the sum of factor

ax2+bx+c=(x + d) (x = e) where d and e are factors of c and addition of d and e is equation to b

By calculus formula:$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$

2ax=-b$\pm\sqrt{b^2-4ac}$

2ax+b=$\pm\sqrt{b^2-4ac}$

2ax+b=(x+d)+(x+e)

Example:- x 2 +2x+1 = x(x+1)+1(x+1)

(x+1)= (x+1) +(x+1)

6.SANKALANA – VYAKAKALANABYAM

The sankalana –vyaavakalanabyam sutra is identical to Anurupye- Shunyamanyat and is effective for solving simultaneous equation .this sutra is particularly useful when the coefficients are interchanged.

Example – 24x – 20y = 88 -------1

20x – 24 y = 44 ---------2

Step 01 – addition of equation 1 and 2

(24x – 20y) + (20x – 24y) = 88 + 44

44x – 44y = 132

(x-y) 44 = 132

x- Y = 132/44

x- Y = 3 ----------3

Step 02 subtraction the equation 1 and 2

(24x – 20y) – (20x – 24y) = 88- 44

4x + 4y = 44

(x+ y) 4 = 44

x+ y = 44/4

x+ y= 11 ---------- 4

x- y = 3

x+y = 11

x-y=3
+x+y=11

2x = 14
x=7

x+y=11
7+y=11
y=11-7
y=4

7.SHESANYANKENA CHARAMEN

Remainder by last digit is what she's anyankena charamena means a fraction can be expressed as a decimal up to the necessary decimal place using this sutra.

Example- Express 1/7 as a decimal

	Quotient	Remained	× 7	Last digit
$\frac{1}{7}$				
$\frac{10}{7}$	1	3	21	1
$\frac{30}{7}$	4	2	14	4
$\frac{20}{7}$	2	6	42	2
$\frac{60}{7}$	8	4	28	8
$\frac{40}{7}$	5	5	35	5

$\frac{50}{7}$	7	1	07	7

$\frac{1}{7}$= 0.142857

8.PURANAPURANABYHAM

Algebra issuer can be made simpler or solved with puranpuranbyham

Example :-let us assume $(x+2)^3$

$(x+2)^3$=x^3+6x^2+12x+8

Clearly the deficient terms are (x+2) addition (x+2) both sides

(x^2+6x^2 +11x +6)+(x+2)= 0+(x+2) or $(x+2)^3$= (x+2)

Let y =(x+2) than

y^3=y solves for 0,1 and -1

X+2=0 given x=-2

Also x+2+1 given x=-1

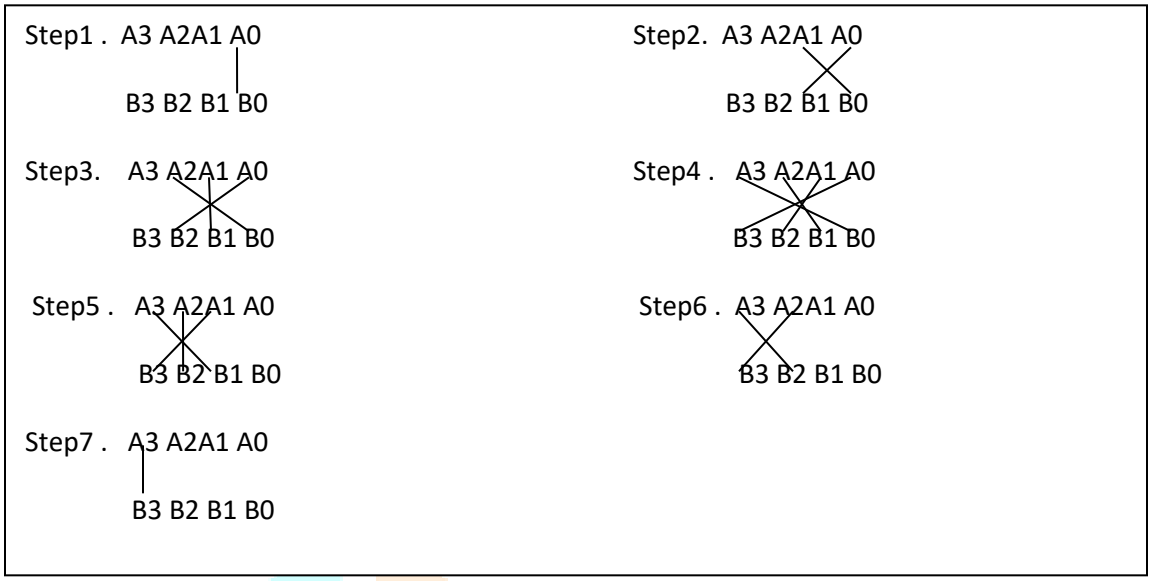
And x+2=-1 given x=-3

Thus we get x=-2, x=-1, x=-3

9. URDHVA – TIRYAKBHYAM

Traditionally, this sutra is used for the multiplication of two number in the decimal number system; the some idea can be applied to the binary number system. The benefit of multiplier is that, in comparison to other conventional multipliers delay and area increase very slowly as the number of bits increases . The term ‘’urdhva –tiryakbhyam’’ resources vertical and crosswise multiplication. This multiplication formula is equally application to all cases of algorithm for N bet number

Multiplication method of urdhva – tiryakbhyam.



EXAMPLE:- 1

435

×723

Step1 . **4 3 5** **RESULT =15**

×7 2 3 PREV.CARRY=0

5 RESULT =5 1 5

1 CARRY

Step2 . 4 3 5 **RESULT =10+9 =19**

×7 2 3 PREV.CARRY = 1

0 5 **RESULT =0** **2 0**

2 CARRY

Step3. 4 3 5 **RESULT =12+35+6=53**

×7 2 3 PREV.CARRY =2

5 0 5 RESULT =5 55

5 CARRY

Step4 . 4 3 5 **RESULT =8+21=29**

×7 2 3 PREV.CARRY =5

4 5 0 5 RESULT=4 34

3 CARRY

Step5. 4 3 5 RESULT =28

×7 2 3 PREV.CARRY =3

3 1 4 5 0 5 RESULT =31 31

435X723=314505

10. PARAVARTYA YOJAYET

Paravartya yojayet translates to transpose and apply. Division and transpose are marginally larger than the power of 10. Using the division method (left to right), write the first digit first, then the other digit or digits using the negative (-) symbol, and then position them.

EXAMPLE:- 1 4973÷121

121 4 9 7 3 43

-2 -1 -8 -4

-2 -1

-2 - 1

00

4 1 1 10 32

QUOTIENT=4110

REMAINDER=32

11. NIKHILAM NAVATASHCHARAMAM DASHATAH

The meaning of NIKHILAM sutra is ‘’ all from and last form10 ‘’. a number must be subenacted form the nearest power of 10such as 10,100,1000, etc according to the nikhilam sutra . The base is the power of 10 form which the difference is computed. These figures are used as references to determine whether a given number is greater or less than the base. If the provided number is 104 , the base is 100, which is the nearest power of 10. As a result, there’s is a positive difference of 4, or nikhilam , between the base and the number . The value of nikhilam may serve as a reference for example nikhilam 87 is – 13 and nikhilam 113 is + 13

Vedic mathematics nikhilam sutra provides methods for speedier number division and multiplication. The translation into English is all from 9 and last from 10 this means subtracting the final number from 10 and the remaining numbers from 9. Multiplication using nikhilam sutras is used when number are closer to power of 10 i. e 10, 100, 1000 etc

The procedure are as follows

a. Numbers are below the base number

b. Number are above the base numbers

c. One number is above the base and the other number is below it .

d. Numbers are not near the base number , but are near a multiple of the base numbers like 20 , 30 , 50, 250 , 600, etc

e. Number near different bases like multiplier is near to different base and multiplicand is near to different base.

EAMPLE :- 1 8 -2 BASE 10

X 9 -2 9-2=7 ,-2X-1=2

72

NKHILAM SUTRA FOR DIVISION

Applying the nikhilam sutra to division occurs when the divisor is nearer and marginally less than the power of 10. Nikhilam sutra is provides a particular technique for dividing number based on Vedic mathematics. This division method from Vedic math can be used when the divisor is less than ten but near to it .

EAMPLE :-1 14/9

	9	1	4
	1		1
		1	5

QUOTIENT=1

REMAINDER=5

12 .SHUNYAM SAMYASAMUCCAYE SUTRA

When the sum is same then sum is zero. The sutra sunyamsamyasamuccaye says that samuccaya is the same. Than samuccaya is zero. There are six cases in this sutra as follows

1. Samuccaye terms occur as a common factor and equate that common factor to zero.

Example – 5 (x + 1) = 3 (x + 1), by sutra 5x – 3 =0

2. Application for same numerator (sum of denominator = 0)

Example - 1/ (3x – 2) = 1 / (2x – 1), by sutra 5x - 3 = 0

3. Samuccaya = the sum of the numerator and the sum of denominator is same then sum equals to zero.
Example – (3x+ 4) / (3x + 5) = (3x + 5) / (3x + 4), by sutra 6x – 9 = 0

4. For any constant factor k

Example – (2x + 3) / (4x + 5) = (x+ 1) / (2x + 3) , by sutra 3x + 4 = 2 (3x + 4) , 3x + 4 = 0

5. For same denominator

Example – 1 / (x-4) + 1 (x-6) = 1 / (x-2) + 1 / (x- 8) , 2x – 10 = 0

6. In the context of a quadratic equation (number = n , denominator = d)

Example – 3x+2/2x+5 = 2x+5 / 3x+2

13.YAAVADUNAM SUTRA

This sutra states that , regardless of how much it lacks, it can be used to calculate the square of integers that are close to (or less than) ten.

Example: – square of 97

a. Nearest power of 10 to 97 is 100

b. 100 a base

c. 100 – 97 = 3 here 3 is deficiency

d. 97 – 3 = 94 is left side of answer

e. Square of deficiency = right side of answer (square of 3=9) In spite of 9 because number of digit in square number is equal to number of zeros in base

f. Answer is 9409

14.VYASHTISAMANSTIH SUTRA (part and whole)

The part – whole ratio can be found using this sutra. As seen below, it provides us with the quantity of a certain component from the entire combination.

Example:-

1 a bag contgains 4 apple , 8 mangoes, 12 bananas

Total quantity = 24

Now part – whole ratio of apple = 4/24

part – whole ratio of mangoes = 8/24

part – whole ratio of banana = 12 / 24

15.GUNITASAMUCHYAH SUTRA

According to this sutra the product of the sum equals the total of the products. This sutra is used to verify that any given equation is accurate.

Example: – (x+ 4) (x+3) = x^2+ 3x + 4x+ 12

Coefficient of in x+4 is 1, Coefficient of in x+3 is 1, Coefficient of in x2 is 1, Coefficient of in 5x is 5 , for correctness = sum of coefficients in product.

(1+ 4) (1+3) = 20

1+3+4+12 = 20 correct

16.SOPAANTYADVAYAMANTAM SUTRA

This sutra means the ultimate and twice the penultimate of given multiplication .

Ultimate + twice the penultimate (4 + 2P)

Example: - 143×12

Step 1. Make a sandwich number with zero

01430

U + 2P = { 1+ (2×0)} { 4+ (2×1) } { 3+ (2×4) } { 0+ (2×3) }

= 16116 = 1716

Example: - 153×12

01530

U + 2P = { 1+ (2×0) } { 5+(2×1) } { 3+(2×5)} { 0+(2×3)}

= 17136 = 1836

Applications

Vedic Maths is not limited to simple arithmetic; it has applications in various branches of mathematics. Here's how it can be applied in different areas:

Arithmetic: Vedic Maths offers techniques for quick addition, subtraction, multiplication, and division. For instance, the sutra "Nikhilam Navatashcaramam Dashatah" simplifies subtraction by focusing on complements.

Algebra: The sutras can be used to solve algebraic equations, simplify expressions, and factorize polynomials. The "Sunyam Samyasamuccaye" sutra, for example, helps in solving simultaneous equations.

Geometry: Vedic Maths provides methods for calculating areas, volumes, and other geometric properties. The techniques can simplify the process of working with geometric figures.

Calculus: Though less common, Vedic Maths techniques can be adapted to solve calculus problems, including differentiation and integration.

Competitive Exams: Due to its speed and efficiency, Vedic Maths is particularly useful for students preparing for competitive exams like IIT-JEE, SAT, and GMAT, where time management is crucial.

Addition: The addition is one of the most basic steps of Vedic math. When using Vedic math in addition follows this steps.

Find out the number closest to the 10s multiple because it is easier to add those numbers.

7, 8, 9 close to 10
21, 22, 23 close to 20
67, 68, 69, are close to 70
97, 98, 99, are close to 100 ……. and so on.

2. Add the numbers which are the multiples of 10s

3. Add/Subtract the deficiency of numbers.

Subtraction:For subtraction using Vedic math, follow these steps:

1. If the subtrahend is less than minuend, we subtract the numbers directly.
2. If any digit in minuend is less than the corresponding digit in subtrahend, we use the concept of complements.

CONCLUSION:

When it comes to digital designs, Vedic sutras are thought to be more efficient in terms of speed and area than other logical circuits. We can infer, after taking into account all of the sutras that were previously addressed, that the Vedic sutra – based multiplier whit urdhva tiryakbhyam sutra and nikhilam navatashcaramamdashatah is regarded as a promising technique in terms of speed, area and possibly even power. The work can be further expanded by designing such a multiplier in an arithmetic logical unit, multiplying an accumulator unit, and comparing the outcome with those of previous iterations.

REFRENCES:

[1] Swami Bharati Krishna Tirthaji Maharaja, “Vedic Mathematics”, MotilalBanarsidass Publishers, 1965.

[2] Yogita Bansal,Charu Madhu, Pardeep Kaur,“High speed vedic multiplier designs a-review”Proceedings of 2014 RAECS UIET Panjab University Chandigarh, 06 – 08 March, 2014,Pages: 1 – 6.

[3] J. K. Mandal, Suresh Chandra Satapathy, Manas Kumar Sanyal, ParthaPratim Sarkar, AnirbanMukhopadhyay“Information Systems Design and Intelligent Applications ..., Volume 2” proceeding of second international conference India 2015.

[4] Shalini Khanna, series editor Sangeeta malikshalinilall,” Knowledge Hunt – 8” 2009.

[5] Vitthal B. Jadhav, Charan Lal "Demystifying Speed Mathematics" First Edition May 2016.

[6] A DebasishSubudhi, KanhuCharanGauda, Abinash Kumar Pala, Jagamohan Das, "International Journal of Advance Research in Computer Science and Software Engineering Volume 4, Issue11, November 2014.0020

[7] AnantVyawahare,ShriramChouthaiwale,Suresh. Borgoankarvedic Mathematics / Nachiket Prakashan,2014.

[8] Charan Lal, Michael Empeigne, Vitthal B. Jadhav "Quicker mathematics for all" first edition September 2016.

[9] K. mounika, A. damodarreddy "A Comparative Analysis of Multiplier Topologies using Different Vedic Sutras" International Conference on Industrial Scientific Research Engineering Conference No.06, February-2016, Pages:21-27