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Factorization Techniques In Vedic Maths

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***Abstract*:** Vedic mathematics is a system of mathematics that originated in ancient India and has been rediscovered in the modern era. It is based on a set of sutras and sub-sutras (corollaries) that are used to solve mathematical problems. One of the areas where Vedic Mathematics has been found to be particularly effective is in the factorization of algebraic cubic polynomials. In this research paper, we will explore the Vedic maths method of factorization of algebraic cubic polynomials and compare w
Key words: Cubic Polynomials, Gunita Samuccaya: Samuccaya Gunita, Lopansthapanabhyam

Introduction:
Conventional mathematics is a system of mathematical operations and procedures that have been developed over centuries of research and experimentation. It is taught in schools and universities across the world and is the foundation for much of the mathematical and scientific knowledge that exists today. Vedic mathematics, on the other hand, is a system of mathematics that is based on ancient Indian texts called the Vedas. The system was developed by Sri Bharati Krishna Tirthaji Maharaja in the early 20th century and has gained popularity in recent years due to its claimed simplicity and speed. One of the main differences between conventional mathematics and Vedic mathematics is their approach to problem-solving. Conventional mathematics relies on a set of well-defined rules and procedures that are used to solve mathematical problems. These rules and procedures are based on a logical, step-by-step approach that requires the solver to break down the problem into smaller, more manageable parts. This approach is known as algorithmic thinking, and it is the foundation of most mathematical problem-solving.
Factorization of cubic polynomials is an essential aspect of algebra, and it involves finding the factors of a polynomial expression of degree three. Factorization helps in simplifying the expression and finding its roots. There are various methods for factoring cubic polynomials, including the conventional method and the Vedic maths method. In this research paper, we will discuss the Vedic maths method and compare it with the conventional method of factorization of cubic polynomials.
The Vedic maths method of factorization of cubic polynomials is a system of mental calculations that can be used to simplify the process of factoring a cubic polynomial. The method is based on a set of sutras (aphorisms) and sub-sutras (corollaries) that are used to solve mathematical problems. The Vedic maths method involves a combination of mental calculations and algebraic manipulations to arrive at the factors of the polynomial.

2.1 The Vedic Maths Method of Factorization of Algebraic Cubic Polynomials:

A polynomial can be written as the product of its factors having a degree less than or equal to the original polynomial. The process of factoring is called factorization of Polynomials.
By considering a cubic polynomial, there is no short method in conventional mathematics. The conventional method of factorization of cubic polynomials involves identifying the factors of the polynomial expression by using algebraic manipulations.

Either we factorize by Factor theorem method or using Mid – term factorization.
Whereas by vedic Math sutras factorization is very simple and easy.
We use sub-sutra "Gunita Samuccaya: Samuccaya Gunita"[1],[2], which means, "the product of the sum of the coefficients in the factors is equal to the sum of the coefficients in the product.
There will be three roots for cubic polynomial. Let the general cubic polynomial is
[x^3+ax^2+bx+c] and its roots are α, β, γ,Then "Gunita Samuccaya: Samuccaya Gunita, sutra says:

$a = \alpha + \beta + \gamma$; sum of roots=coefficient of x^2
$b = \alpha\beta + \beta\gamma + \gamma\alpha$; sum of the product of two roots = coefficient of x
$c = \alpha\beta\gamma$; product of roots =constant

The Vedic maths method of factorization of a cubic polynomial involves the following steps:

Step 1: Find the factors of the constant term c
The first step in the Vedic maths method of factorization of a cubic polynomial is to find the factors of the constant term c. This can be done using mental calculations and simple algebraic manipulations.
For example, in $x^3+10x^2 + 27x+18$ The last term (constant) is 18 and factors of 18 are 1, 2, 3, 6, 9, 18.
Step 2:
Check sum of each combination of roots to be equal to coefficient of the quadratic term, such that product of factors is c.
For example, in $x^3+10x^2 + 27x+18$,
We will choose three factors among 1,2,3,6,9,18; such that their sum is 10 and product is 18.ie
$\alpha + \beta + \gamma$ = 1+3+6=10
$\alpha\beta\gamma$= 1*3*6=18
There -fore factors of polynomial $x^3+10x^2 + 27x+18$ are (x+1) (x+3) (x+6)
Step3:
The next step is for verification that sum of product of two roots is the coefficient of x.
$\alpha\beta + \beta\gamma + \gamma\alpha = 1^*3 + 3^*6 + 6^*1$ =27

Another Example

$X^3 + 13x^2 + 31x-45$
The Constant term is -45 and its factors are ....$\pm1, \pm3, \pm5, \pm9, \pm15 and \pm 45$.
Choosing three factors α, β, γ $such\ that$ $\alpha + \beta + \gamma$=-1+5+9=1 3

$and; \alpha\beta\gamma$ = (-1) *(5) * (9) [1= -45

It can be verified that $\alpha\beta + \beta\gamma + \gamma\alpha = (-1)^*5 + 5^*9 + 9^*(-1) = 31$ (coefficient of x)
So, the factors of polynomial $x^2 + 13x^2 + 31x-45$) is (x-1) (x+5) (x+9)

Factorization of a second - degree polynomial having more than two Variables.

It is a Herculean task to factorize such type of polynomials by conventional method, Vedic math sutra Lopansthapanabhyam, reduces the polynomial into smaller one and can be factorize easily.

Lopansthapanabhyam [1],[2] means "by elimination and retention,". This sutra is highly useful in solving the co-ordinate geometry problems of a straight line, hyperbola, asymptotes etc.

Lopansthapanabhyam rule for second degree polynomial having three Variables i.e. x ,y ,z is putting x=0, y = 0, z=0 one by one in the given polynomial, and reduce the whole polynomial into three factors and then into two.

Then by sheer observation we can conclude the cyclic nature of the factors. Which help us to write the factors of the polynomial

Example:

For factorizing $6x^2 - 8y^2 - 6z^2 + 2xy + 16yz + 5xz$.;
Putting x=0, we get
$-8y^2 - 6z^2 + 16yz = -2(4y^2+3z^2 - 8yz)$
$= -2(2y-z)(2y-3z)$

Putting y=0,
$6x^2 - 6z^2 + 5xz$
$= (2x+3z)(3x-2z)$

Putting z=0, we get

$6x^2 - 8y^2 + 2xy$
$= 2[3x^2 - 4y^2 + xy]$
$= 2(3x+4y)(x-y)$

Rewriting all the six factors and observing the cyclic order of repeated terms, we get the factorization of the given polynomial ; i.e.
(2x-2y+3z) (3x+4y-2z)

Conclusion

From the above discussion, we can make inference that the Vedic maths method of factorization of cubic polynomials is a mental calculation technique that helps in solving problems quickly. The method involves mental calculations and requires minimal algebraic manipulations, which makes it faster than the conventional method. Also it is flexible and can be adapted to suit different problem-solving scenarios. It is not limited to only cubic polynomials and can be used to solve a wide range of mathematical problems. From the above discussion ,it can be concluded that Vedic maths is very versatile .It can be used to solve a wide range of mathematical problems, from simple addition and subtraction to more complex algebraic equations and trigonometric functions. This versatility is achieved through the use of a series of mental tricks and visualizations that can be applied to a wide range of mathematical problems.

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