

# CENTRAL SANSKRIT UNIVERSITY, NEW DELHI

## SIX-MONTHS DIPLOMA PROGRAMME ON VEDIC MATHEMATICS

Total Credits = 16

### Paper I- Syllabus of Vedic Arithmetic

Total 04 Credits

#### Objectives of Teaching Vedic Arithmetic

- To understand the origin and significance of Vedic Mathematics.
- To familiarize students with the 16 Sutras and 13 Up-sutras.
- To develop a strong foundation in the Indian numeral system
- To highlight the advantages of Vedic Mathematics.
- To strengthen conceptual understanding of basic operations.
- To enhance mental calculation speed using sutras and up-sutras.
- To apply tables in mental calculations and problem-solving.
- To strengthen numerical verification skills.
- To verify divisibility using simple mental methods.
- To find prime factorization and total divisors.
- To perform arithmetic operations in binary system.

These objectives will not only equip students with efficient computational techniques but also foster a deeper understanding of mathematical concepts, enhance mental agility and sharpen their problem-solving skills through the powerful methods of Vedic Mathematics.

Unit	Name of Topics	Expected Learning Outcomes
I	<ul style="list-style-type: none"><li>➤ Brief introduction to Vedic Ganit Sutras.</li><li>➤ Indian place value System.</li><li>➤ Addition and subtraction by Shunyant.</li><li>➤ Subtraction using the Parama-Mitra Method.</li><li>➤ Mixed operations of addition and subtraction,</li><li>➤ Multiplications by Nikhilam Sutra (up to 10,000 bases),</li><li>➤ Antyayordasake'pi Sutra (up to Three-digit Numbers),</li><li>➤ Ekanyunena Purvena Sutra (For Multipliers 9, 99, 999 and 9999),</li><li>➤ Sutra-Urdhva-Tiryagbhyam (up to <math>4 \times 4</math> digits numbers),</li><li>➤ Introduction and applications of beejank in addition, subtraction and multiplication.</li></ul>	<ul style="list-style-type: none"><li>• Able to know brief introduction</li><li>• Able to know brief history</li><li>• Able to know add and subtract</li><li>• Able to know subtract only by Sutra Nikhilam.</li><li>• Able to know addition and subtract of mixed operations.</li><li>• Able to multiply and its applications by Sutra-Nikhilam.</li><li>• Able to multiply and its applications by Antyayoreva.</li><li>• Able to multiply and its applications by Sutra-Ekanyunena</li><li>• Able to multiply and its applications by Sutra-Urdhva.</li></ul>

	<ul style="list-style-type: none"> <li>➤ Multiplication tables from 2 to 1000</li> </ul>	<ul style="list-style-type: none"> <li>• Able to verify the results in addition, subtraction and multiply</li> <li>• Able to drive tables without cram.</li> </ul>
II	<ul style="list-style-type: none"> <li>➤ Square of numbers using Yavadunam</li> <li>➤ Duplex and Sutra-Ekadhikena</li> <li>➤ Cube of numbers</li> <li>➤ Square root of perfect squared numbers.</li> <li>➤ Square root of imperfect Squared numbers</li> <li>➤ Cube root of at most 9-digit numbers</li> <li>➤ Verification of all the operations by Beejank.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to do square using base.</li> <li>• Able to do square of any number.</li> <li>• Able to do cube using base.</li> <li>• Able to find square root.</li> <li>• Able to find square root.</li> <li>• Able to find cube root</li> <li>• Able to verify the results by the concept of beejank.</li> </ul>
III	<ul style="list-style-type: none"> <li>➤ Division by Dhvajank.</li> <li>➤ Division by Nikhilam sutras.</li> <li>➤ GCD up to three numbers by sutras.</li> <li>➤ LCM of two-digit numbers.</li> <li>➤ Divisibility test by Osculator</li> <li>➤ Prime factorization and total number of divisors.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to divide by Dhvajank.</li> <li>• Able to divide by Nikhilam.</li> <li>• Able to find GCD by orally.</li> <li>• Able to find LCM by orally</li> <li>• Able to check the divisibility by all numbers ending 1, 3, 7 and 9.</li> <li>• Able to factorize orally and find the total number of divisors.</li> </ul>
IV	<ul style="list-style-type: none"> <li>➤ Addition and subtraction of Fraction.</li> <li>➤ Multiplication and division of Fractions.</li> <li>➤ Solutions of mixed fractions,</li> <li>➤ Addition, subtraction of irrational numbers (Bhaskara Method).</li> <li>➤ Multiplication and Division of irrational numbers (Bhaskara Method).</li> <li>➤ Square and Square root of irrational numbers (Bhaskara Method).</li> <li>➤ Conversion to binary number and vice versa</li> <li>➤ Addition, subtraction and multiplication of binary numbers (up to 5 binary digits).</li> <li>➤ Percentage by sutra-Vilokanam.</li> <li>➤ Simple and compound interest by Vilokanam.</li> <li>➤ Ratio and proportion by Vilokanam.</li> <li>➤ Profit and loss by Vilokanam.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to add &amp; subtract fraction</li> <li>• Able to multiply &amp; divide fraction</li> <li>• Able to solve mixed fractions</li> <li>• Able to add, subtract the irrational numbers by Bhaskara Method.</li> <li>• Able to multiply and divide the irrational by Bhaskara Method.</li> <li>• Able to do square and square root by Bhaskara Method.</li> <li>• Able to convert and square root by Bhaskara Method.</li> <li>• Able to add, subtract, multiply and divide of binary operations.</li> <li>• Able to find percentage orally.</li> <li>• Able to find Simple Interest and Compound interest orally.</li> <li>• Able to find ratio and proportion.</li> <li>• Able to profit and loss.</li> </ul>

D. Dargth

**Objectives of Teaching Vedic Algebra**

- To explore the historical evolution of algebra in India and its contributions.
- To perform better in basic operations of algebraic expressions.
- To carry out multiplication of linear, quadratic and cubic polynomials.
- To verify polynomial operations using Beejank (Digital Root Method).
- To enhance mental calculation speed using sutras and up-sutras.
- To find solutions for systems involving both linear and quadratic equations.
- To apply sutras in polynomial division.
- To factorize algebraic expressions using sutras.
- To find the solution of algebraic expressions using sutras.
- To apply the approach developed by Indian Mathematicians.

These objectives provide a structured and logical approach to performing algebraic operations while leveraging the fast and efficient problem-solving techniques of Vedic Mathematics Sutras. By integrating these sutras, students can solve equations, factorize polynomials, and perform arithmetic operations with greater accuracy and speed compared to conventional methods. This approach not only enhances computational fluency but also fosters a deeper understanding of algebraic principles through intuitive and elegant techniques.

Unit	Name of Topics	Expected Learning Outcomes
I	<ul style="list-style-type: none"> <li>➤ Introduction to origin and developments of Bhartiya Beejaganita (Algebra).</li> <li>➤ Addition and subtraction of linear, quadratic and cubic polynomials.</li> <li>➤ Multiplication of linear, quadratic and cubic polynomials in one variable.</li> <li>➤ Verification of the operations by <i>Beejank</i>.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know the origin of the development of Beejaganit.</li> <li>• Able to add and subtract up to cubic expressions by sutras</li> <li>• Able to multiply up to cubic expressions.</li> <li>• Able to know verifications.</li> </ul>

D. Dargh

II	<ul style="list-style-type: none"> <li>➤ Division of polynomials with dividend at most fifth-degree polynomial in one variable and the divisor at most three-degree polynomial in one variable.</li> <li>➤ Division of Polynomial using Sutra-Urdhva-tiryagbhyam</li> <li>➤ Verification of operations by the <i>beejank</i>.</li> <li>➤ HCF of two at most cubic polynomials in one variable with leading coefficient 1.</li> <li>➤ LCM of two at most cubic polynomials in one variable with leading coefficient 1</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know division of large expressions by sutras.</li> <li>• Able to know division of large expressions by reverse operations.</li> <li>• Able to verify the <i>beejank</i>.</li> <li>• Able to find the HCF up to cubic expressions orally.</li> <li>• Able to find the LCM up to cubic expressions orally.</li> </ul>
III	<ul style="list-style-type: none"> <li>➤ Solution of 6-types of linear simple equations in one variable as in the following forms: <ul style="list-style-type: none"> <li>i) <math>(ax + m) = (bx + n)</math>,</li> <li>ii) <math>(ax + m)(bx + n) = (cx + p)(dx + q)</math>,</li> <li>iii) <math>\frac{m}{ax + b} + \frac{n}{cx + d} = 0</math>,</li> <li>iv) <math>a_1x + b_1y = c_1</math>, <math>a_2x + b_2y = c_2</math> and its different forms.</li> </ul> </li> <li>➤ Solution of equations using sutras Sunyam-Samyasamuccaye.</li> <li>➤ Solution of equations by Anurupye Sunyamanyat,</li> <li>➤ Solution of equations by Sutra-Urdhva</li> </ul>	<ul style="list-style-type: none"> <li>• Able to solve the complex algebraic equations by sutra of Vedic Mathematics.</li> <li>• Able to solve the linear and quadratic equations by sutras.</li> <li>• Able to solve the linear and quadratic equations by sutras.</li> <li>• Able to solve the linear and quadratic equations by sutras.</li> </ul>
IV	<ul style="list-style-type: none"> <li>➤ Factors of the quadratic equation <math>ax^2 + bx + c = 0</math> by Sutra-Urdhvatiryak.</li> <li>➤ Roots of the quadratic equation <math>ax^2 + bx + c = 0</math> by Sutra-Urdhva-tiryagbhyam.</li> <li>➤ Solution of quadratic and cubic equations, Brahmgupt formula for roots of the quadratic equation <math>ax^2 + bx = c</math>.</li> <li>➤ Shridharacharya method of finding roots of the quadratic equation.</li> <li>➤ Solutions of the following simultaneous linear and quadratic equations.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to factorize quadratic equations by Sutra-Urdhva</li> <li>• Able to find the roots of quadratic by Sutra-Urdhva-tiryagbhyam.</li> <li>• Able to find of cubic equations by Sutra-Urdhva-tiryagbhyam.</li> <li>• Able to find the solution of quadratic by Shridharacharya.</li> <li>• Able to solve linear and quadratic solutions by Vilokanam.</li> </ul>

D. Das

**Objectives of Teaching Vedic Geometry**

- To overview of the four Shulva Sutras and their properties.
- To determine median, centroid, perpendicular bisector, orthocenter, circumcentre and incentre
- To state Baudhayan Theorem and its applications in trigonometric functions.
- To introduce the Baudhayan triplets and its applications.
- To enhance mental calculation speed using sutras and up-sutras.
- To introduce the circle and its applications.
- To derive the trigonometric identities by Baudhayan triplets.
- To solve the Height and Distance Problems using Baudhayan Triplets.
- To introduce the spherical triangles.
- To introduce the astronomy.
- To calculate the distance and orientation between two locations.

This paper examines ancient mathematical principles, including the Shulva Sutras and their properties, as well as key geometric and trigonometric concepts. It explores the Baudhayan Theorem and its applications, along with the significance of Baudhayan triplets in deriving identities and solving practical problems. Additionally, the study introduces fundamental topics such as circles, spherical triangles, and astronomy, while also addressing methods for determining distance and orientation between locations.

Unit	Name of Topics	Expected Learning Outcomes
I	<ul style="list-style-type: none"> <li>➤ Brief introduction to the four Shulva sutras.</li> <li>➤ Properties of triangles.</li> <li>➤ Perimeter and area of different triangles.</li> <li>➤ Determination of median, centroid, perpendicular bisector, orthocenter, circum-center and in-center of a triangle.</li> <li>➤ Baudhayan Theorem; Statement, Proofs, and applications</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know Shulva Sutra</li> <li>• Able to know about triangles.</li> <li>• Able to know perimeter and area.</li> <li>• Able to know the value of medians, centroid, perpendicular, bisector, orthocenter circumcenter</li> <li>• Able to origin of Baudhayan numbers and its applications</li> </ul>
II	<ul style="list-style-type: none"> <li>➤ Properties of circle.</li> <li>➤ Area of a circle.</li> <li>➤ Value of Pi ratio-Aryabhata I, Bhaskara II, Neelkanth and Bharati k Tirtha ji.</li> <li>➤ Properties of Cyclic quadrilateral,</li> <li>➤ Surface area of Prism, Pyramid, Cone and Sphere.</li> <li>➤ Volume of prism, pyramid, cone and Sphere.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know about circle.</li> <li>• Able to know circle &amp; properties.</li> <li>• Able to know the pie ratio by Aryabhata I and others.</li> <li>• Able to know of cyclic figures.</li> <li>• Able to find surface areas of 3-D figures.</li> <li>• Able to volume of prism, pyramid,</li> </ul>

*D. Darg...*

		cone and sphere.
III	<ul style="list-style-type: none"> <li>➤ Baudhayan triplets of standard angles.</li> <li>➤ Basic operations Baudhayan triplets.</li> <li>➤ Concept and properties of six trigonometric functions based on Baudhayan triplets.</li> <li>➤ Derivation of Trigonometric formulae.</li> <li>➤ Solution of Heights and distance problems.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know Baudhayan triplets.</li> <li>• Able to know operations</li> <li>• Able to know the properties of six trigonometric properties.</li> <li>• Able to drive the formulae</li> <li>• Able to solve height-distance.</li> </ul>
IV	<ul style="list-style-type: none"> <li>➤ Spherical triangles and their properties.</li> <li>➤ Great circles and their properties.</li> <li>➤ Small circles and their properties.</li> <li>➤ Arc length of Great circle and small circle.</li> <li>➤ Derivation of cosine formula</li> <li>➤ Derivation of sine formula.</li> <li>➤ Equator, latitude, longitude and meridians.</li> <li>➤ Distance between two locations.</li> <li>➤ Celestial sphere.</li> </ul>	<ul style="list-style-type: none"> <li>• Able to know about triangles.</li> <li>• Able to know great circles.</li> <li>• Able to know small circles</li> <li>• Able to find the length of arcs.</li> <li>• Able to derive cosine formula.</li> <li>• Able to derive sine formula.</li> <li>• Able to know about equators.</li> <li>• Able to find distance.</li> <li>• Able to know celestial sphere.</li> </ul>

D. Das

**Objectives of teaching Contribution of Indian Mathematicians**

- To introduce sutras and up-sutras in arithmetic, algebra and geometry.
- To introduce contributions of Aryabhata-I.
- To introduce the contribution by Brahmgupt.
- To introduce the work Bhaskara II in calculus, algebra and geometry.
- To introduce the work of Kaprekar and His discoveries in number patterns.
- To introduce the work of Srinivasa Ramanujan and his contributions to number theory, infinite series and mathematical analysis.
- To introduce to arithmetic and algebra in Leelavati.
- To introduce to Shulva-Sutras and its significance.
- To introduce Bhartiya Kaal Ganana.

This study aims to introduce the fundamental Sutras and Up-Sutras, along with the significant contributions of Indian mathematicians in the fields of arithmetic, algebra and geometry. It explores their pioneering work highlighting the innovative methods and principles they developed. Additionally, the study provides an insight into Leelavati, a renowned mathematical text focusing on arithmetic and algebra, the Shulva-Sutras, which offer valuable geometric applications and Bhartiya Kaal Ganana, the traditional Indian timekeeping system.

Unit	Name of Topics	Learning Outcomes
I	<ul style="list-style-type: none"> <li>➤ Introduction, meaning and significance of Sutras and Up-sutras in arithmetic</li> <li>➤ Contributions in Arithmetic by Swami Bharati Krishna Tirtha Ji.</li> <li>➤ Life and contributions by Aryabhata-I.</li> </ul>	<ul style="list-style-type: none"> <li>• Interdisciplinary applications of arithmetic by sutras and up-sutras</li> <li>• Able to know contribution in arithmetic by Swami ji.</li> <li>• Introduction of zero and place value System, decimal System, value of <math>\pi</math>, trigonometry, indeterminate equations, arithmetic and geometry.</li> </ul>
II	<ul style="list-style-type: none"> <li>➤ Introduction, meaning and significance of Sutras and Up-sutras for Algebra</li> <li>➤ Contributions by Swami Bharati Krishna Tirtha Ji algebra.</li> <li>➤ Life and contributions by Brahmgupt.</li> <li>➤ Life and contributions by Bhaskara II.</li> </ul>	<ul style="list-style-type: none"> <li>• Interdisciplinary applications of algebra by sutras and up-sutras</li> <li>• Able to know contribution in algebra by Swami ji.</li> <li>• Negative numbers and operations, simultaneous linear and quadratic equations, intermediate equations, arithmetic, geometric progressions, earth's circumference.</li> </ul> <p>Basic operations of his famous book "Lilavati" addition, subtraction, multiplication, division,</p>

		fractions, ratios, square roots and cube roots, volume and area calculations.
III	<ul style="list-style-type: none"> <li>➤ Introduction, meaning and significance of Sutras and Up-sutras for Geometry.</li> <li>➤ Contributions of Swami Bharati Krishna Tirtha Ji in geometry.</li> <li>➤ Life and contributions by Kaparekar.</li> <li>➤ Life and contributions by Ramanujan</li> </ul>	<ul style="list-style-type: none"> <li>• Interdisciplinary applications of geometry by sutras and up-sutras</li> <li>• Able to know contribution in geometry by Swami ji.</li> <li>• Kaprekar's constant, Kaprekar numbers, self-numbers, Harshad Numbers, cyclic numbers.</li> </ul> <p>Ramanujan prime and highly composite numbers, mock theta functions and modular form, partition theory, continued fractions.</p>
IV	<ul style="list-style-type: none"> <li>➤ Introduction and Applications of Shulva-sutras in Geometry.</li> <li>➤ Introduction to Leelavati.</li> <li>➤ Introduction to Bhartiya Kal Ganana and its applications.</li> </ul>	<ul style="list-style-type: none"> <li>• Baudhayana, Apastamba, Katyayana, Manava and their fundamental geometry, Approximation of <math>\sqrt{2}</math>, Circles and their transformations, Application in construction of temples.</li> <li>• Introduction to different sections of Lilavati and their applications</li> <li>• Division of Time, lunar and solar calendars, yugas and large time cycles and its applications in astronomy.</li> </ul>

- Exam pattern as per the rules of CSU, New Delhi as revised from time to time. With 60% Written and 40% internal/seminar/viva/practical etc. in all papers

Course No.	Subject/Topic	Credits
Paper 01	Vedic Arithmetic	04
Paper 02	Vedic Algebra	04
Paper 03	Vedic Geometry	04
Paper 04	Contribution of Indian Mathematician	04

#### Eligibility for admission –

- For admission diploma course, the candidate must have passed minimum +2 or equivalent examination from any recognized university/board.

*D. Dargah*

## Reference and Text Books

1. Puri, N. (1990). Ancient Vedic Mathematics band 1, 2, 3, 4 & 5 Maths of smiles, Spiritual Study Group, Roorkee.
2. Swami Bharti Krishna Maharaj Tirth ji, (1951). Diary of Vedic Mathematics on website "Vedic mathsindia.org" from 01-01-1951 to 31-12-1951.
3. Swami Bharti Krishna Maharaj Tirth ji, (1965). Vedic Mathematics, Moti Lal Banarasi Das, New Delhi.
4. Unkalkar, V.G. (2019). Excel With Vedic Mathematics, Vandana Publishers, Bangalore.
5. Unkalkar, V.G. (2017). Magical World of Mathematics (Vedic Mathematics), Vandana Publishers, Bangalore.
6. Vishwakarma, K. (2011). Vedic Mathematics Vihangum Drishti-3, Sanskriti Utthan Nyas, New Delhi.
7. Fundamental and Applications of Vedic Mathematics, SCERT, Delhi
8. Vertically and Crosswise by Kenneth William, UK
9. Patwardhan K. S. Lilavati of Bhaskracarya: A Treatise of Mathematics of Vedic Tradition, Moti lal Banarasi Das Publisher, New Delhi
10. Vidyadhar S, Sulba Sutra, Chaukhamba Publisher, New Delhi
11. Brahmgupt, Brahmguptasidhant(Volume3), Indian Institute of Astronomical and Sanskrit Research, New Delhi
12. Phanindralal G, The Surya Siddhanta: A Text Book of Hindu Astronomy, Moti lal Banarasi Das Publisher, New Delhi
13. Deshpande S. P., Kaprekar Mathemagic, Narendra Prakashan, Bharati Bhawan, Bajirao Road, Pune
14. Venugopal D.H. Brahmagupta's Ganita (Ganitadhyaya of Brahmasphuta Siddhanta), Chinmay International Shodh Sansthan, Ernakulam, Kerla

D. D. Singh