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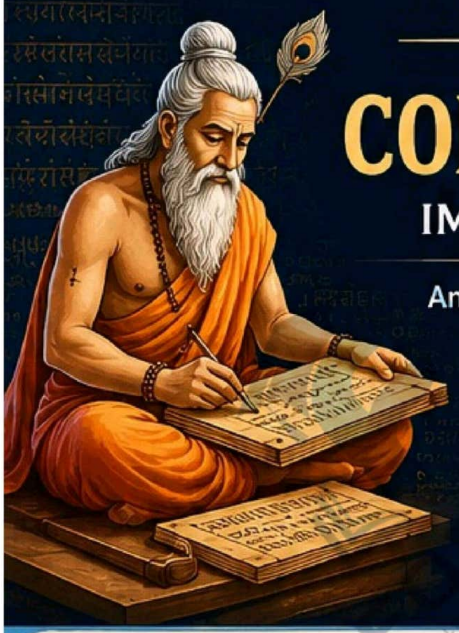
Infographics
Visual Learning
Better understanding through visual content.
Simplified Concepts
Complex topics explained in simple and visual form.
Quick Revision
Easy to revise important points and diagrams.
Exam Ready
Helps in faster revision and better exam preparation.
DATA STRUCTURES
ALGORITHMS
COMPUTER NETWORKS
DATABASE SYSTEMS

Unit-I


DATA STRUCTURES
ALGORITHMS
COMPUTER NETWORKS
DATABASE SYSTEMS
#include <iostream>
using nameepace std;
int main()
{
cout << "Hello, World!";
return 0;
}



IKS IN COMPUTATIONAL SCIENCES

IMPORTANCE OF ANCIENT KNOWLEDGE

Ancient Wisdom • Timeless Logic • Modern Innovation

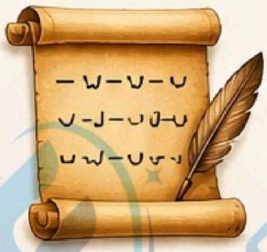
IKS (Indian Knowledge Systems) offers deep insights, logical frameworks and problem-solving approaches that align with the core of **Computational Sciences.**

ANCIENT ROOTS OF COMPUTATIONAL THINKING

PANINI'S ASHTADHYAYI

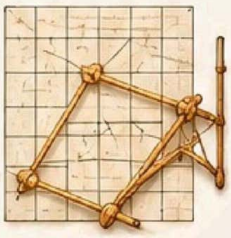
The grammar rules form a generative system, similar to modern formal languages and automata theory.

CHHANDAS (PROSODY)



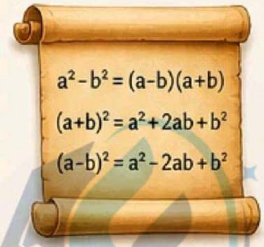
Binary patterns in Sanskrit meter resemble sequences and combinatorial structures used in coding theory.

SULBA SUTRAS (GEOMETRY)



Algorithms for constructing altars involve precise geometric computations, similar to algorithmic problem solving.

VEDIC MATHEMATICS



Provides mental math techniques and fast algorithms still useful in optimization and complexity reduction.

NYAYA LOGIC

Logical reasoning frameworks in Nyaya are the foundation of inference systems and AI reasoning.

RELEVANCE IN COMPUTATIONAL SCIENCES

Algorithms & Problem Solving
Ancient methods in mathematics and logic inspire efficient algorithms.

Data Representation & Compression
Sanskrit grammar and prosody show advanced encoding concepts.

Formal Languages & Automata
Panini's grammar is a model for rule-based systems in CS.

Artificial Intelligence & Reasoning
Nyaya logic supports knowledge representation, expert systems and inference engines.

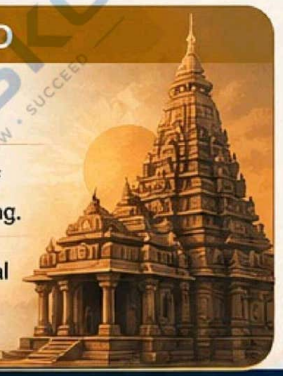
Optimization & Heuristics
Vedic Mathematics provides fast methods for optimization and resource efficiency.

WHY IT MATTERS?

- IKS promotes a holistic and sustainable approach to computing.
- It strengthens algorithmic thinking with time-tested wisdom.
- It bridges ethics, logic and innovation.
- It gives India a unique perspective in global technology.

THE WAY FORWARD

- Integrate IKS concepts in CS curriculum.
- Encourage research at the intersection of ancient knowledge and modern computing.
- Preserve and propagate India's intellectual heritage for future innovations.



From Rishis to Algorithms –
A Legacy of Knowledge, Logic & Infinity

Rooted in IKS,
Rising in Innovation.

DEFINING INDIAN KNOWLEDGE SYSTEM

A Timeless Heritage. A Sustainable Future.

WHAT IS INDIAN KNOWLEDGE SYSTEM (IKS)?

Indian Knowledge System (IKS) is the collective knowledge, wisdom and practices developed in India over thousands of years. It is holistic, value-based and experience-driven knowledge that encompasses the understanding of the self, society, nature and the universe.

Holistic | Value-based | Experience-driven | Universal | Timeless

KEY CHARACTERISTICS

- Rooted in ancient wisdom yet relevant today.
- Promotes harmony between individual, society and nature.
- Transmitted through oral traditions, texts, practices and lived experiences.
- Interdisciplinary and interconnected in its approach.
- Aims for the well-being of all (Sarve Bhavantu Sukhinah).

CORE PILLARS OF IKS

DHARMA
The foundation of righteous living, ethics and duties.

JNANA
Pursuit of knowledge through study, reflection and wisdom.

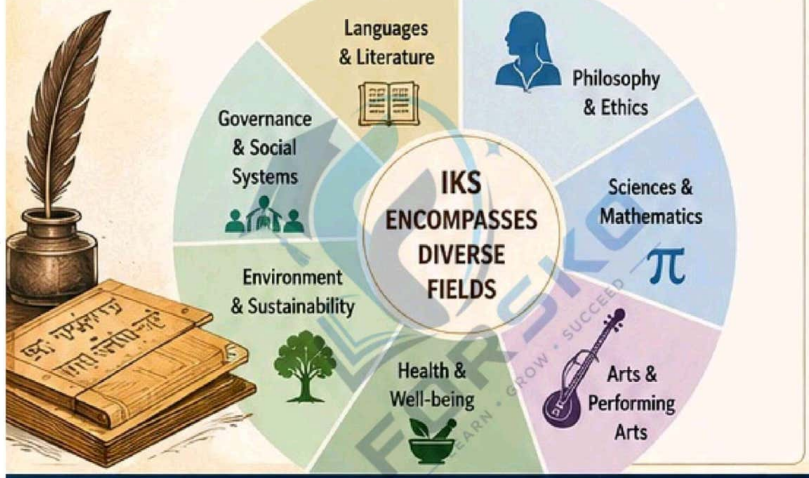
KARMA
Action with responsibility and selflessness for the welfare of all.

YOGA
Union of body, mind and spirit for inner and outer balance.

VASUDHAIVA KUTUMBAKAM
The world is one family promoting unity and compassion.

RITA
The cosmic order that sustains life and harmony.

DOMAINS OF INDIAN KNOWLEDGE SYSTEM



WHY IKS MATTERS TODAY?

- Provides sustainable solutions to modern challenges.
- Enhances mental well-being and holistic development.
- Inspires innovation through traditional wisdom and practices.
- Promotes cultural identity and global harmony.
- Supports inclusive and value-based education and research.

"From the wisdom of the past, for the innovation of the future.
IKS – Our Legacy, Our Strength, Our Future."

Ancient in Origin | Timeless in Wisdom | Relevant in Every Age | For a Better Tomorrow

THE IKS CORPUS – A CLASSIFICATION FRAMEWORK

Systematizing Ancient Wisdom for Knowledge, Research and Innovation

WHAT IS THE IKS CORPUS?

The **IKS Corpus** is a structured collection of knowledge resources derived from India's ancient wisdom traditions. This classification framework organizes diverse knowledge systems into coherent categories to facilitate understanding, accessibility, research and application in modern contexts.

- Preserves Civilizational Wisdom
- Enables Interdisciplinary Research
- Promotes Sustainable Solutions
- Empowers Future Generations

THE IKS CORPUS CLASSIFICATION FRAMEWORK

1 SOURCE LITERATURE

Primary texts and original scriptures that form the foundation of IKS.

Examples

- Vedas & Upanishads
- Itihasas & Puranas
- Agamas & Tantras
- Sutras & Samhitas

2 KNOWLEDGE DOMAINS

Broad knowledge areas that encompass the various dimensions of Indian wisdom.

Examples

- Dharmic Sciences
- Life Sciences (Ayurveda)
- Mathematics & Logic
- Arts, Aesthetics & Culture
- Ecology & Environment
- Governance & Ethics

3 SUB-DOMAINS & DISCIPLINES

Specific disciplines within each domain with distinct bodies of knowledge.

Examples

- Ayurveda (under Life Sciences)
- Vyakarana (under Linguistics)
- Shilpa Shastra (under Arts & Architecture)

4 CONCEPTS & PRINCIPLES

Fundamental ideas, theories and principles that explain natural, social and spiritual phenomena.

Examples

- Panchamahabhutas
- Karma & Dharma
- Rta (Cosmic Order)
- Triguna Theory

5 PRACTICES & APPLICATIONS

Methods, techniques and systems applied in daily life, professions and societal well-being.

Examples

- Yoga & Meditation
- Agriculture Practices
- Architectural Techniques
- Medical Therapies
- Conflict Resolution Models

6 TOOLS, SYSTEMS & TECHNOLOGIES

Indigenous tools, systems and technologies developed through traditional knowledge.

Examples

- Water Management Systems
- Temple Architecture
- Metallurgy (Wootz Steel)
- Astronomical Instruments

CROSS-CUTTING PERSPECTIVES (APPLICABLE ACROSS ALL CATEGORIES)

- Sustainability
- Holistic & Integral View of Life
- Ethics & Righteousness
- Interconnectedness of All Beings
- Spiritual & Consciousness Dimensions

STRUCTURE AT A GLANCE

WHY THIS FRAMEWORK MATTERS

- Organizes vast and diverse knowledge in a systematic manner.
- Enhances discoverability, accessibility and usability.
- Supports interdisciplinary research and innovation.
- Bridges ancient wisdom with modern challenges.
- Strengthens cultural identity and knowledge sovereignty.

> *"IKS is not just knowledge of the past, but a living wisdom that can light the path to a harmonious and sustainable future."*

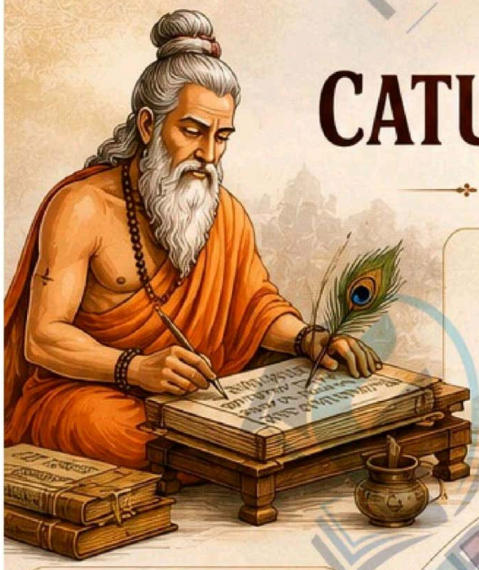
Preserve our Heritage | Advance Knowledge | Serve Humanity | Inspire the World

॥ लोकाः समस्ताः सुखिनो भवन्तु ॥

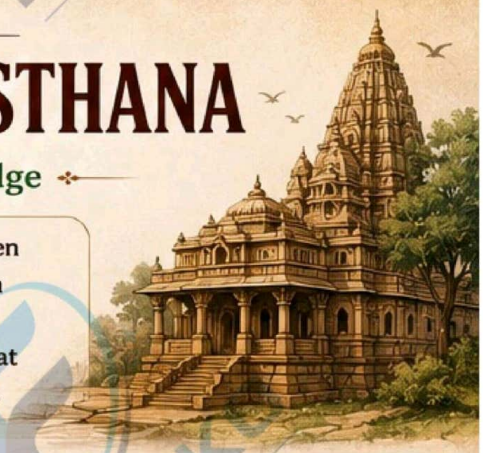
May all beings be happy and free.

CATURDASA – VIDYASTHANA

The Fourteen Abodes of Knowledge



Caturdasa – Vidyasthana refers to the fourteen traditional fields of knowledge described in Indian Knowledge Systems (IKS). They represent a holistic vision of learning that nurtures the body, mind, intellect and spirit.

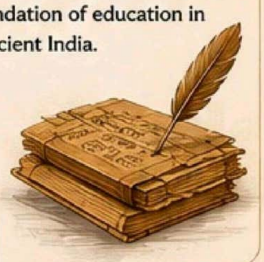


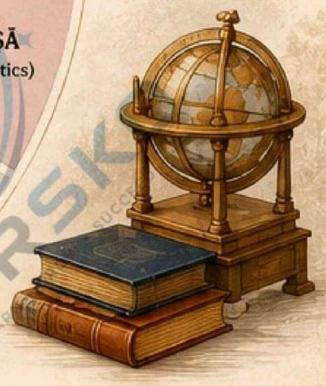
"यत्र विश्वं भवत्येकमीडम्
— ज्ञानं परम् बलम्

Where the world becomes one nest – Knowledge is the highest strength.

ROOTS IN TRADITION

These 14 vidyasthanas are mentioned in ancient texts like Kāśyapa Śikṣā, purāṇas and smṛtis. They were the foundation of education in ancient India.





THE 14 VIDYASTHANA – CATEGORIES

VICHARA (SACRED KNOWLEDGE)

1. Ṛg Veda
2. Yajur Veda
3. Sāma Veda
4. Atharva Veda

The Four Vedas – foundation of dharma, rituals, wisdom and spiritual understanding.

VEDĀNGA (AUXILIARY DISCIPLINES)

5. Śikṣā (Phonetics)
6. Vyākaraṇa (Grammar)
7. Nirukta (Etymology)
8. Chanda (Metrics)
9. Jyotiṣa (Astronomy)

Supporting sciences that help in understanding and preserving the Vedic wisdom.

UPANGA (APPLIED DISCIPLINES)

10. Kalpa (Rituals & Procedures)
11. Śāstra (Logic & Knowledge Systems)
12. Darśana (Philosophy)

Practical and philosophical knowledge for living a meaningful and righteous life.

JĪVIKĀ (LIFE APPLICATIONS)

13. Āyurveda (Medical Science)
14. Dhanurveda (Martial Science)

Knowledge for health, protection and overall well-being of individual and society.

SIGNIFICANCE

- Promotes holistic development of body, mind and spirit.
- Integrates spiritual, intellectual and practical knowledge.
- Encourages harmony between individuals, society and nature.
- Forms the base of India's rich cultural and scientific heritage.
- Still relevant for modern education, research and innovation.

"सा विद्या या विमुक्तये"

"That is knowledge which liberates."

TIMELESS RELEVANCE

The Caturdasa – Vidyasthana shows that Indian Knowledge Systems are universal, integrated and eternally relevant.

One Knowledge – Many Dimensions. One Goal – Human Excellence.

HISTORY OF IKS

The Timeless Journey of INDIAN KNOWLEDGE SYSTEMS

> IKS is the collective wisdom, knowledge and practices developed in India over thousands of years. It reflects a holistic understanding of life, nature and the universe.

IKS – OUR HERITAGE, OUR STRENGTH

- Ancient in Origin
- Timeless in Wisdom
- Holistic in Approach
- Universal in Relevance
- Sustainable in Nature
- Innovative in Spirit

JOURNEY THROUGH TIME

1. VEDIC PERIOD (1500 – 600 BCE)

Knowledge preserved in oral traditions and scriptures like the Vedas. Focus on rituals, philosophy, nature worship and holistic living.

2. EPIC & SHASTRIC PERIOD (600 BCE – 200 CE)

Expansion of knowledge through Upanishads, Itihasas, Puranas and Shastras. Growth of dharma, ethics, polity, Ayurveda, grammar, architecture and arts.

3. CLASSICAL AGE (200 CE – 1200 CE)

Flourishing of universities (Nalanda, Takshashila, Vikramashila). Advancements in mathematics, astronomy, medicine, metallurgy, logic, literature and performing arts.

4. MEDIEVAL PERIOD (1200 CE – 1750 CE)

Knowledge continued in gurukuls, mathas, temples and craft guilds. Synthesis of indigenous knowledge with new ideas in science, arts, language, spirituality and society.

5. COLONIAL PERIOD (1750 CE – 1947 CE)

IKS faced challenges due to colonial education systems. Many knowledge traditions were underrepresented, yet preserved by scholars, saints and communities.

6. MODERN ERA & BEYOND (1947 – PRESENT)

Revival, research and integration of IKS in education, science, technology, policy and daily life for a sustainable and inclusive future.

CORE DIMENSIONS OF IKS

Spiritual & Philosophical	Scientific & Rational	Ethical & Values Based	Practical & Experiential	Sustainable & Ecological	Artistic & Cultural
Explores consciousness, self-realization and the purpose of life.	Based on observation, experimentation and logical reasoning.	Promotes dharma, compassion, harmony and responsibility.	Learning through experience, practice and application.	Lives in balance with nature and supports sustainability.	Nurtures creativity, beauty, aesthetics and expression.

EXAMPLES OF IKS CONTRIBUTIONS

- **Mathematics** – Zero, Decimal System, Algebra, Trigonometry
- **Astronomy** – Planetary Movements, Eclipses, Calendars
- **Medicine (Ayurveda)** – Holistic health, herbs, wellness, yoga
- **Architecture** – Vastu Shastra, temple architecture, urban planning
- **Metallurgy** – Iron pillar of Delhi, Zinc distillation
- **Agriculture** – Crop rotation, irrigation, soil management
- **Language & Literature** – Sanskrit grammar, classical literature, poetry, drama
- **Arts & Performing** – Music, dance, painting, sculpture, theatre

WHY KNOWING OUR HISTORY MATTERS?

- Builds pride in our rich intellectual heritage.
- Strengthens cultural identity and continuity.
- Inspires innovation by learning from the past.
- Supports sustainable and inclusive development.
- Shares India's wisdom for global well-being.

> "Take up one idea. Make that one idea your life – think of it, dream of it, live on that idea. Let the brain, muscles, nerve, every part of your body be full of that idea, and just leave every other idea alone. This is the way to success."
>
> – Swami Vivekananda

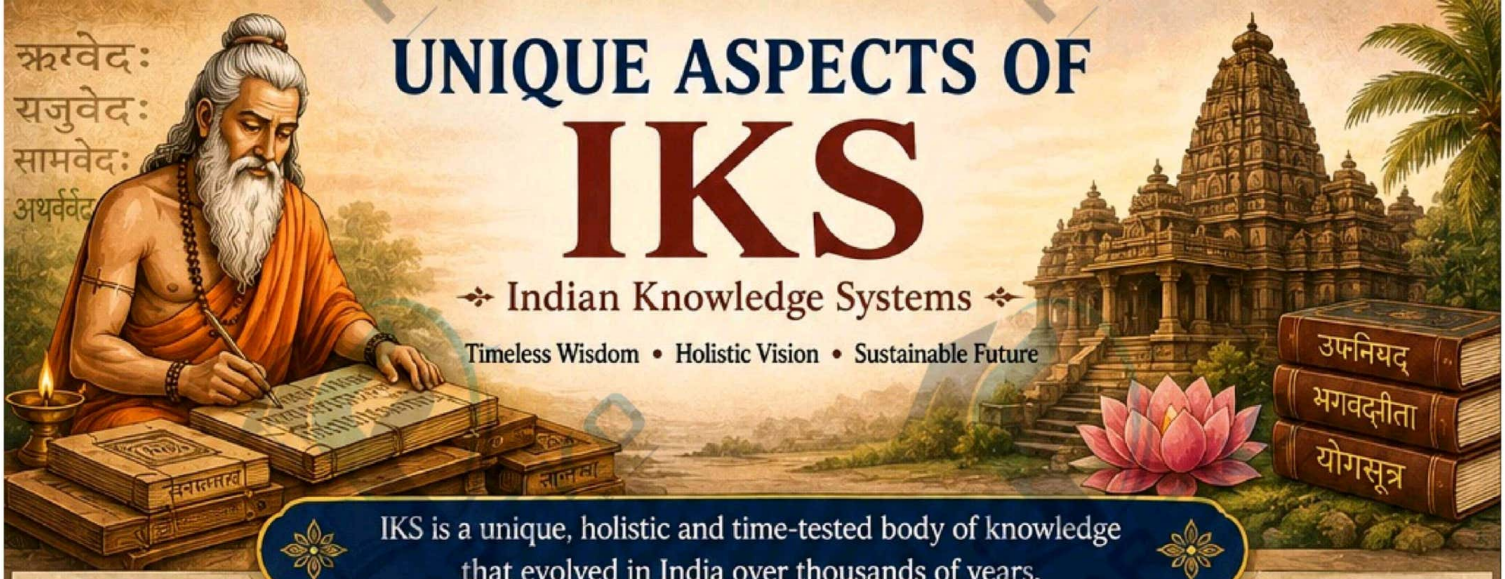
IKS is not just history – it is a living tradition. By understanding our past, we can create a better, wiser and compassionate future.

Learn our roots · Live our values · Lead our future

"From eternal wisdom to endless possibilities."

IKS – Past, Present & Future United.

"सा विद्या या विमुक्तये" – That is knowledge which liberates.



UNIQUE ASPECTS OF IKS

Indian Knowledge Systems

Timeless Wisdom • Holistic Vision • Sustainable Future

IKS is a unique, holistic and time-tested body of knowledge that evolved in India over thousands of years.

Holistic

IKS integrates physical, mental, intellectual, emotional and spiritual well-being to achieve complete human development.

Value-Based

Rooted in ethics, dharma and moral principles, IKS promotes righteous living, responsibility and harmony in society and nature.

Interdisciplinary

IKS encompasses multiple disciplines including philosophy, science, medicine, arts, engineering, astronomy, governance and more.

Timeless

IKS has been continuously practiced and refined for thousands of years, demonstrating its enduring relevance.

Sustainable

IKS advocates living in harmony with nature, promoting sustainable lifestyles, conservation and responsible use of resources.

Innovative

IKS encourages curiosity, creativity and exploration, leading to innovative solutions for contemporary challenges.

Contextual

IKS evolved from India's unique cultural, social and geographical context, making it deeply relevant to Indian society.

Ancient Yet Relevant

While ancient in origin, the principles of IKS remain highly relevant for addressing modern world problems.

People-Centric

IKS places the individual and society at the center, aiming for the well-being of all (Sarve Bhavantu Sukhinah).

Global Appeal

The universal values of IKS such as peace, harmony, compassion and sustainability have global relevance and applicability.

IKS is not just a legacy of the past, but a guiding light for a knowledge-driven, value-based and sustainable future.

From Vedas to Modern Innovation

From Self to Society

From Nature to Sustainability

From India to the World

वसुधैव कुटुम्बकम्

One Earth • One Family • One Future

COMPONENTS OF A LANGUAGE

Hello! नमस्ते! வணக்கம்!

Language is a system of communication made up of interconnected components that work together to convey meaning.

THE MAIN COMPONENTS

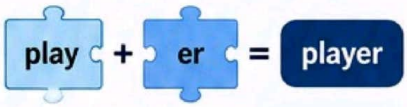
1 PHONOLOGY

The system of speech sounds in a language and the rules for their combination.

Example:
Sounds: /p/ /a/ /t/
Combine to form: "pat"

2 MORPHOLOGY

The study of the structure of words and how meaningful units (morphemes) form words.



Example:
Root: play
Morpheme: -er (one who)
Word formed: player

3 SYNTAX

The set of rules that govern the arrangement of words to form phrases, clauses and sentences.

Example:
Correct Order = Meaning
Change in order can change the meaning.

4 SEMANTICS

The study of meaning in language – the meanings of words, phrases and sentences.

Example:
The word "tree" refers to a large plant with a trunk, branches and leaves.

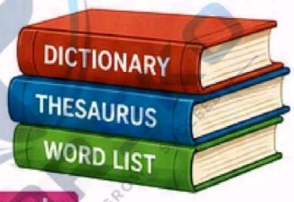
5 PRAGMATICS

The study of how context influences meaning in communication.

Example:
The same sentence can be a request, an offer or a question depending on the context.

6 LEXICON

The vocabulary of a language – the words and their meanings stored in a speaker's mind.



Example:
Words like: run, happy, quickly, beautiful, computer, knowledge.

7 DISCOURSE

The use of language beyond the sentence level to create coherent and meaningful spoken or written texts.

Example:
A paragraph, story or conversation that has a beginning, middle and end.

8 GRAPHOLOGY

The system of writing – the symbols and rules used to represent language in written form.

Example:
Alphabets, scripts (Devanagari, Latin, Tamil, etc.) and punctuation used in writing.

9 SOCIO-LINGUISTICS

The study of the relationship between language and society, including dialects, registers, varieties and language change.

Example:
Different languages, accents and styles used in different social situations.

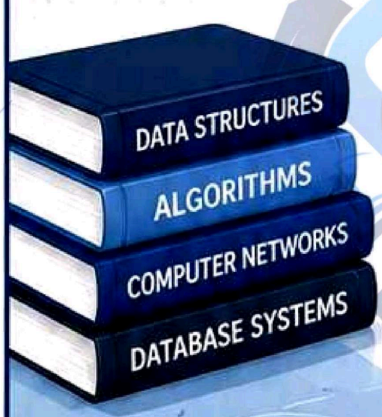
HOW THEY WORK TOGETHER

All components interact to help us produce, understand and interpret meaningful communication.

Sounds (Phonology) → Build Words (Morphology) → Form Sentences (Syntax) → Convey Meaning (Semantics) → Use in Context (Pragmatics) → Create Discourse (Discourse) → Write (Graphology) → Vary with Society (Socio-linguistics)

IN A NUTSHELL: Language is a complex system made of many parts.
Understanding these components helps us understand how human communication works so beautifully!

Unit - II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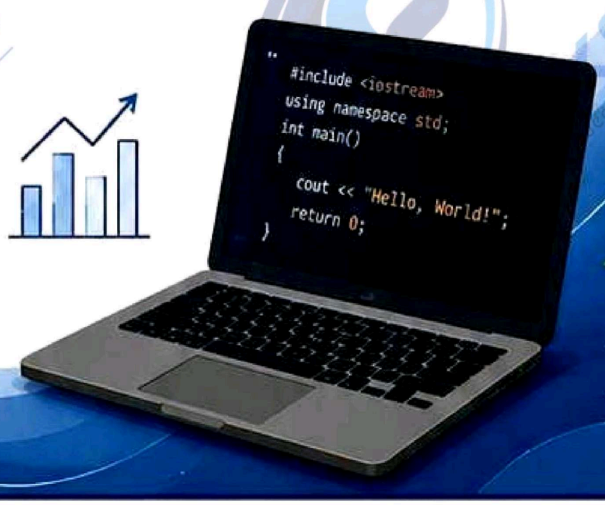
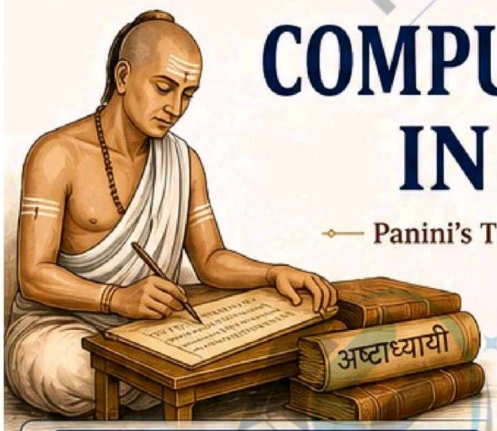
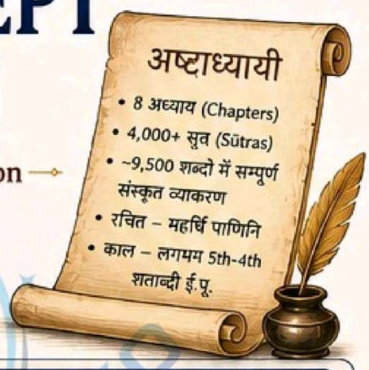

#include <iostream>
using namespace std;
int main()
{
cout << "Hello, World!";
return 0;
}

COMPUTATIONAL CONCEPT IN AṢṬĀDṚHYĀYĪ



Panini's Timeless Grammar – A Masterpiece of Computation

> Aṣṭādhyāyī is not just a grammar, it is an algorithmic system that generates infinite correct sentences from finite rules.



WHAT IS AṢṬĀDṚHYĀYĪ?

A systematic and generative grammar of Sanskrit composed by Maharshi Pāṇini. It precisely describes how words are formed and combined using a set of compact rules (sūtras). It is a perfect example of a formal system – like a computer program.

WHY IS IT COMPUTATIONAL?

- Rule-based System
- Generative Power
- Handles Recursion
- Highly Structured & Compact

ASTĀDHYĀYĪ AS AN ALGORITHM

Input (Dhātu / Prātipadika) → Apply Rules (Sūtras) → Output (Word / Sentence)

Recursive Application of Rules

KEY COMPUTATIONAL CONCEPTS IN AṢṬĀDḤYĀYĪ

1. RULE BASED SYSTEM

Pāṇini uses thousands of sūtras (precise rules) to generate words and sentences.

Example (1.3.2)
हलन्त्यम्
(halantyam)
– The last letter is a consonant.

Like instructions in a computer program.

2. FORMAL LANGUAGE

Aṣṭādhyāyī is a formal system with a well-defined syntax (sūtra structure) and semantics (meaning).

Sūtra Structure:
प्रत्याहार + अधिकार + विधि
(Pratyāhāra + Adhikāra + Vidhi)

Like the syntax of a programming language.

3. META RULES AND OPERATORS

Use of markers like अधिकार (scope), अनुवृत्ति (ellipsis), इत् (markers) to control rule application.

Example:
Anuvṛtti (eillipsis) reduces repetition → Saves space & time

Like control statements and operators.

4. RECURSION

Rules can be applied repeatedly until no more rules are applicable.

Example:
धातु → प्रातिपदिक → सुप्/तिङ् प्रत्यय → शब्द → वाक्य

Like recursive functions in programming.

5. COMPACTNESS & OPTIMIZATION

Pāṇini achieves maximum output with minimum input (few words – maximum coverage).

A highly optimized system – like efficient code.

6. ABSTRACT REPRESENTATION (PRATYĀHĀRA SYSTEM)

Pāṇini uses pratyāhāras (e.g., अच्, हल्) to represent large sets of sounds with short symbols.

Example: अच् = अ, इ, उ, ऋ, ऌ, ए, ओ, औ ...

अ इ उ ऋ ऌ ए ओ ओ → अच्

Like using variables or arrays.

7. CONDITIONAL APPLICATION (ADHIKĀRA)

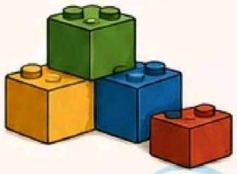
Rules are applied only in a particular context or domain.

Example (2.3.1)
सुपां सुलुक्
(supāṃ suluk)
– The affix 'su' is deleted.

Like if-else conditions.

8. MODULAR DESIGN

The grammar is divided into 8 chapters, 4 pādas each, with logical grouping.



Like modular programming.

9. DETERMINISM & NON-AMBIGUITY

Every valid input has a unique output. The system removes ambiguity using rule priority (परिभाषा rules).

Deterministic algorithm.

EXAMPLE: DERIVATION OF THE WORD "गच्छति" (gacchati)

Step	Operation	Sūtra Used (Example)	Result
1	Take root (धातु)	गम् (gam)	गम्
2	Add लट् लकार (present tense)	लट् (lat) – 3rd person singular	गम् + लट्
3	Add तिङ् प्रत्यय	तिप् (tip)	गम् + तिप्
4	Apply phonetic rules	गुण, वृद्धि, संधि, आदि	गच्छति (gacchati)

LIKE A PROGRAM EXECUTION

```
root = "gam";
tense = "laṭ"; // present
affix = "tip"; // 3rd person singular
word = applyRules(root, tense, affix);
output = "gacchati";
```

WHY IT MATTERS TODAY

- Inspires Natural Language Processing and AI.
- Basis for rule-based systems and formal grammars.
- Shows the power of human intellect in creating algorithms.
- A bridge between ancient wisdom and modern computation.

IN A NUTSHELL

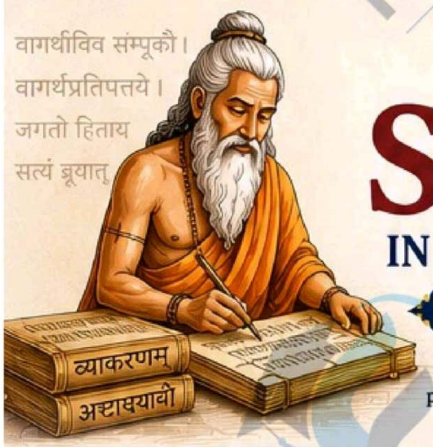
Aṣṭādhyāyī is a genius computational system that:

- ✔ Accepts input (roots)
- ✔ Applies rules (operations)
- ✔ Generates output (words/sentences)
- ✔ Ensures correctness (constraints)
- ✔ Works efficiently (optimization)

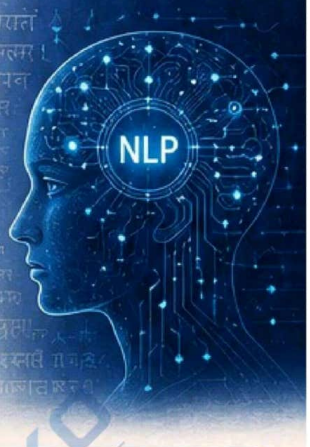
> Pāṇini was not just a grammarian, he was the world's first programmer.
>
> – A timeless contribution to computational thinking.

यथा पाणिनिना भाषायाः सूत्ररूपेण व्यवस्था कृता ।
तथा अद्य तस्माद् विज्ञानं कम्प्यूटरशास्त्रं प्रेरणा लभते ॥

As Pāṇini structured language in the form of rules, today computer science gets inspiration from it.



ROLE OF SANSKRIT IN NATURAL LANGUAGE PROCESSING



Ancient Wisdom. Modern Intelligence.

Sanskrit – a highly structured, precise and logical language – provides a strong foundation for the science and technology of language.

WHAT IS NLP?

Natural Language Processing (NLP) is a branch of Artificial Intelligence that enables computers to understand, interpret and generate human language.

WHY SANSKRIT MATTERS FOR NLP?

- Highly structured and rule-based
- Unambiguous and precise
- Rich morphological system
- Well-defined grammar by Pāṇini
- Phonetic consistency (sound-to-script mapping)
- Large knowledge base in literature and science

KEY FEATURES OF SANSKRIT THAT BENEFIT NLP

1. FORMAL GRAMMAR

Pāṇini's Aṣṭādhyāyī is a rule-based generative grammar – like an algorithm.

Example:
Rules generate infinite correct sentences.

2. MORPHOLOGICAL RICHNESS

Words are formed using roots, prefixes, suffixes and inflections in a systematic way.

Example:
गम् (gam – go)
+ ति (ti – 3rd person sing.)
= गच्छति (gacchati – goes)

3. COMPOUNDING (SAMĀSA)

Sanskrit allows creation of precise compound words that capture complex meanings.

Example:
राजपुरुषः (rāja-puruṣaḥ)
= King's minister

4. FREE WORD ORDER

Meaning is preserved due to rich inflectional endings, enabling flexible word order.

Example:
रामः वनं गच्छति
रामं वनं गच्छति
वनं रामः गच्छति
(All mean: Rama goes to the forest)

5. PHONETIC PRECISION

One sound = one symbol.
One symbol = one sound.
No ambiguity in pronunciation.

Example:
"क" is always /ka/
"ग" is always /ga/

6. SEMANTIC CLARITY

Words have well-defined meanings with relations between concepts clearly expressed.

Example:
धर्मः (dharma) – duty, righteousness

APPLICATIONS OF SANSKRIT IN NLP

1. MACHINE TRANSLATION

Sanskrit's clarity and structure improve accuracy in translation systems.

2. MORPHOLOGICAL ANALYSIS

Rule-based morphological analyzers are highly effective for Sanskrit word forms.

3. PART-OF-SPEECH TAGGING

NOUN
VERB
ADJ

Well-defined word classes and endings help in accurate POS tagging.

4. PARSING & SYNTAX ANALYSIS

Sanskrit grammar provides clear rules for building parse trees and dependencies.

5. INFORMATION EXTRACTION

Structured texts (e.g., śāstras, purāṇas) can be mined for knowledge.

6. TEXT SUMMARIZATION

Compound structures and semantic clarity help in better abstractive summarization.

7. SPEECH TECHNOLOGY

Phonetic consistency helps in accurate ASR (Automatic Speech Recognition) and TTS systems.

8. ONTOLOGY & KNOWLEDGE GRAPHS

Sanskrit's rich conceptual system supports building ontologies and knowledge graphs.

EXAMPLE: SANSKRIT STRUCTURE IN NLP

Sanskrit Expression	Analysis	NLP Benefit
गच्छति (gacchati)	gam (root) + laṭ (tense: present) + ti (3rd person singular)	Easy morphological parsing and generation
बालकः पठति	bālakaḥ (boy) + paṭhati (reads)	Clear subject-verb relation detection
राजपुरुषः आगच्छति	rāja-puruṣaḥ (king's minister) + ágacchati (arrives)	Compound word understanding
सर्वे जनाः सुखिनो भवन्तु	sarve janāḥ sukhino bhavantu (May all people be happy)	Sentiment & intent recognition

BENEFITS OF USING SANSKRIT IN NLP

- Reduces ambiguity in language understanding
- Improves accuracy of parsing and generation
- Enhances low-resource language technologies
- Preserves India's linguistic heritage in AI
- Bridges ancient knowledge with cutting-edge technology

THE FUTURE IS ROOTED IN OUR HERITAGE

Sanskrit is not just a classical language; it is a computationally perfect language. By integrating Sanskrit with NLP, we can build smarter, more reliable and culturally rooted AI systems.

WHERE ANCIENT MEETS INTELLIGENCE

Language Technology | AI & Machine Learning | Cultural Preservation | Knowledge Discovery | Human-Centric AI

॥ यत्र विश्वं भवत्येकनीडम् ॥
"Where the world becomes one nest."

IKS IN SCIENCE, ENGINEERING AND TECHNOLOGY

Ancient Wisdom • Timeless Principles • Modern Innovations

सा विद्या या विमुक्तये

That knowledge which liberates and leads to well-being for all.

The Indian Knowledge System (IKS) integrates observation, experimentation, logic and ethics for the welfare of all beings and the environment.

1. IKS IN SCIENCE

IKS provides a holistic understanding of the natural world through systematic observation, experimentation and empirical reasoning.

Astronomy (Jyotiṣa)
Accurate calculations of planetary motions, eclipses and calendars.
Examples: Āryabhaṭīya, Sūrya Siddhānta

Mathematics (Gaṇita)
Concepts of zero, decimals, place value, algebra, permutations, combinations and infinite series.
Examples: Baudhāyana, Bhāskara II

Physics (Bhautika)
Insights into matter, energy, sound, light and motion.
Examples: Vaiśeṣika Sūtra, Nyāya Sūtra

Chemistry (Rasaśāstra)
Metallurgy, alchemy, herbal chemistry, nano-particles and sustainable processes.
Examples: Rasa Ratna Samuccaya

Biology & Life Sciences (Jīva Vigyāna)
Ayurveda, plant sciences, ecology and understanding of life processes.
Examples: Caraka Saṃhitā, Suśruta Saṃhitā

2. IKS IN ENGINEERING

IKS texts describe advanced engineering principles, sustainable design and large-scale infrastructure for societal needs.

Architecture (Vāstu & Śilpa)
Scientific principles of planning, orientation, load management, aesthetics and harmony with nature.
Examples: Mānasāra, Mayamata

Civil Engineering
Dams, step wells, canals, roads and urban planning with environmental balance.
Examples: Bāori, Irrigation systems, Rāja-mārga

Mechanical Engineering
Machines, mechanisms, robotics and automated systems.
Examples: Yantra-s, Vaimānika Śāstra

Aerospace Engineering
Concepts of flight, aerodynamics, aircraft design and propulsion.
Examples: Vaimānika Śāstra

Materials & Metallurgy
High-quality steels (Wootz), corrosion resistant alloys and metal treatment.
Examples: Zinc distillation, Iron pillar of Delhi

3. IKS IN TECHNOLOGY

IKS inspires innovative technologies that are sustainable, human-centric and aligned with ethical responsibility.

Information Technology
Algorithms, compression, data structures and knowledge representation.
Examples: Pingala's binary, Panini's grammar as a generative system

Communication Technology
Acoustics, signal systems, encryption and wireless ideas.
Examples: Nāda (sound) science, Gūḍhya sūtras (coded messages)

Energy Technology
Solar, wind, biogas and water energy systems for sustainable living.
Examples: Sūrya upāsanā, Biomass usage, Water wheels

Medical Technology
Surgical instruments, prosthetics, herbal formulations and diagnostics.
Examples: Suśruta's instruments, Ayurvedic formulations

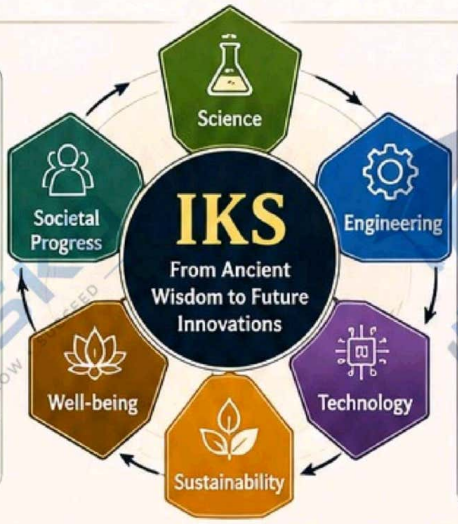
Environmental Technology
Waste management, water purification, afforestation and biodiversity conservation.
Examples: Sacred groves, Traditional water purification

CORE PRINCIPLES OF IKS

- **Holistic & Integrated** — Harmony of body, mind, society and nature
- **Empirical & Experiential** — Observation, experimentation and validation
- **Logical & Analytical** — Strong reasoning, systematic thinking and modeling
- **Ethical & Sustainable** — Knowledge for the welfare of all and future generations
- **Timeless & Universal** — Applicable across time, place and disciplines
- **People-centric & Value-based** — Focus on dharma, well-being and social harmony

EXAMPLES OF IKS TO MODERN APPLICATIONS

IKS Contribution	Modern Relevance
Zero (Śūnya)	Computing, Cryptography, Digital Systems
Decimal System & Place Value	All modern mathematics and computing
Pingala's Binary (Chandas Śāstra)	Binary code in computers, digital logic
Vāstu Principles	Green buildings, sustainable architecture
Ayurveda & Rasaśāstra	Pharmaceutical research, nanomedicine
Ancient Water Systems	Sustainable water management practices
Panini's Grammar	Natural Language Processing, AI, Linguistics
Dhātu Science & Metallurgy	Advanced materials, corrosion resistance



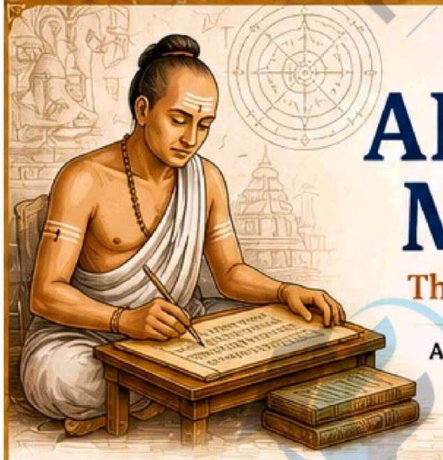
WHY IKS MATTERS TODAY

- Provides sustainable and eco-friendly solutions
- Encourages innovation with indigenous thinking
- Strengthens self-reliance in science and technology
- Supports ethical AI and human-centric technology
- Preserves cultural heritage while solving modern challenges
- Builds a harmonious and resilient future

लोकाः समस्ताः सुखिनो भवन्तु
May all beings be happy and free.

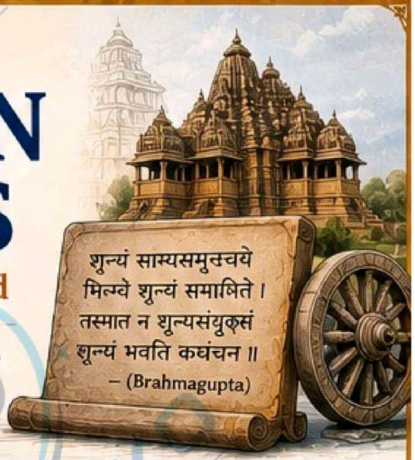
IKS is not just our past, it is the foundation for a better and wiser future.

When ancient wisdom meets modern science, innovation becomes meaningful and progress becomes sustainable.



INTRODUCTION TO ANCIENT INDIAN MATHEMATICS

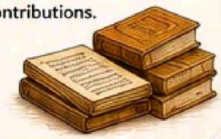
The Timeless Legacy of Numbers and Beyond



Ancient Indian mathematics is a rich tradition of logical thinking, abstract reasoning and practical application that shaped the world's mathematical knowledge.

HISTORICAL OVERVIEW

- Indian mathematics has a history of more than 2000 years.
- It developed not only for theoretical curiosity but also for practical needs in astronomy, engineering, trade, architecture and daily life.
- Great mathematicians like Āryabhaṭa, Brahmagupta, Bhāskara II and others made priceless contributions.



KEY FEATURES

- **Place Value System** – The systematic use of place value.
- **Concept of Zero (Śūnya)** – India gave the world the idea of zero.
- **Positive & Negative Numbers** – Early understanding and rules.
- **Advanced Algebra** – Solving linear, quadratic equations and indeterminate equations.
- **Trigonometry** – Accurate values of trigonometric functions.

PROMINENT MATHEMATICIANS

Āryabhaṭa (476–550 CE)
Father of Indian mathematics and astronomy. He calculated the value of π and explained place value system.

Brahmagupta (598–668 CE)
Gave rules for operations with zero and negative numbers. Wrote *Brahmasphutasiddhānta*.

Bhāskara II (1114–1185 CE)
Author of *Siddhānta Śiromaṇi*. Made important work in algebra, calculus concepts and astronomy.

Varāhamihira, Lalla, Mahāvira, Nīlakaṇṭha and others also made remarkable contributions.

MAJOR CONTRIBUTIONS OF ANCIENT INDIAN MATHEMATICS

1. THE NUMBER SYSTEM

Development of the decimal place value system.

1	2	3	4
10	20	30	40
100	200	300	400
1000	2000	3000	4000

Use of 0 as a placeholder changed the world.

2. ZERO (ŚŪNYA)

India gave the world the concept of zero.

"Śūnya is the root of all number systems."
– Brahmagupta

3. ARITHMETIC

Rules for arithmetic operations including with zero and negative numbers.

- $a + 0 = a$
- $a - 0 = a$
- $a \times 0 = 0$
- $a + (-b) = a - b$
- $a - (-b) = a + b$

4. ALGEBRA (BĪJA GANITA)

Solving linear and quadratic equations.

Example:

Solve $x^2 + 10x = 39$

$x^2 + 10x - 39 = 0$

$(x + 13)(x - 3) = 0$

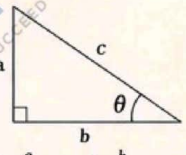
$x = -13$ or $x = 3$

5. TRIGONOMETRY

Accurate values and identities.

Example:

$\sin^2\theta + \cos^2\theta = 1$



$\sin\theta = \frac{a}{c}$, $\cos\theta = \frac{b}{c}$, $\tan\theta = \frac{a}{b}$

APPLICATIONS IN DAILY LIFE AND SCIENCE

- **Astronomy** – Calculating planetary positions, eclipses and calendars.
- **Architecture** – Measurement, design and construction of temples, cities and structures.
- **Trade & Commerce** – Calculations in weights, measures, interest and exchange.
- **Engineering** – Water management, irrigation systems, bridges and mechanical devices.

NOTABLE WORKS

Āryabhaṭīya – By Āryabhaṭa (Astronomy and Mathematics)

Brahmasphutasiddhānta – By Brahmagupta (Mathematics and Astronomy)

Siddhānta Śiromaṇi – By Bhāskara II (Mathematics, Algebra, Calculus)

Līlāvatī – By Bhāskara II (Arithmetic and Algebra)

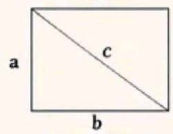
UNIQUE ASPECTS

- **Holistic approach** – Mathematics connected with astronomy, philosophy and nature.
- Highly systematic and logical methods.
- Emphasis on problem solving and generalization.
- Development of infinite series and early ideas of calculus.
- **Universal impact** – Influenced Arabic, Persian and European mathematics.

BEAUTIFUL EXAMPLES FROM ANCIENT INDIAN MATHEMATICS

1. SULBA SUTRAS
(Geometry)

Pythagoras theorem was known to Indians long before Pythagoras.



$a^2 + b^2 = c^2$

2. INFINITE SERIES
(Āryabhaṭa)

Sum of natural numbers:

$1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$

Sum of squares:

$1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1)}{}$

3. APPROXIMATION OF π
(Āryabhaṭa)

$\pi \approx 3.1416$

(Correct up to 4 decimal places)

4. KUTTĀKA METHOD
(Brahmagupta)

A method to solve indeterminate equations of the form:

$ax + by = c$

Used in algebra and number theory.

65. BINOMIAL COEFFICIENTS
(Meru Prastāra)

Early study of combinations.

Pascal's triangle was known as *Meru Prastāra*.

1
1 1
1 2 1
1 3 3 1
1 4 6 4 1

OUR HERITAGE, OUR PRIDE

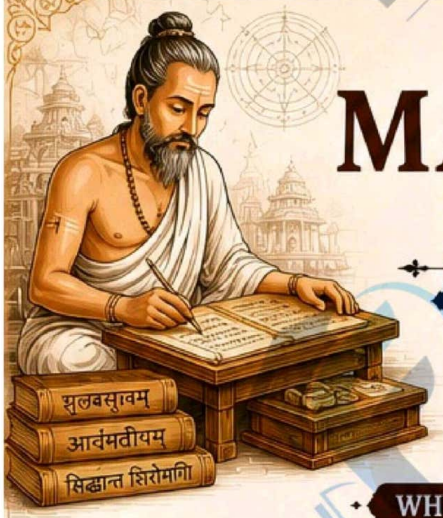
Ancient Indian mathematics is not just our past, it is a guiding light for the future of mathematics, science, technology and innovation.

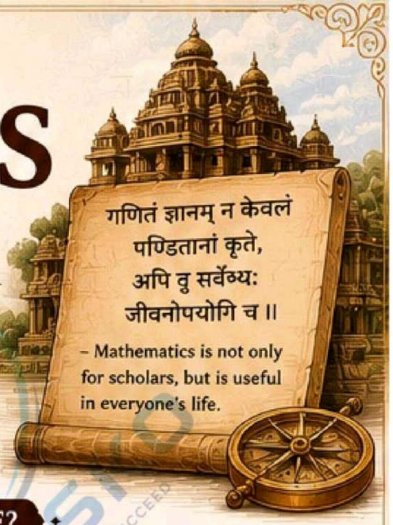
> "The genius of Indian mathematicians continues to inspire the world.
> Let us preserve, learn and innovate."

LEGACY FOR THE FUTURE

From zero to infinity, from numbers to the stars – Indian mathematics continues to empower humanity's progress.

IMPORTANCE OF MATHEMATICS IN ANCIENT TIME





THE LANGUAGE OF LOGIC THAT BUILT A CIVILIZATION

In ancient India, mathematics was not just a subject, it was a way of life. It helped in understanding the universe, solving real-life problems and building a prosperous society.

WHY MATHEMATICS WAS IMPORTANT IN ANCIENT TIME?

1. UNDERSTANDING THE UNIVERSE

Mathematics helped ancient scholars study the movement of planets, stars, eclipses and seasons with great accuracy.

2. DAILY LIFE APPLICATIONS

Used in counting, measuring, trading, farming, cooking, division of land and sharing of resources.

3. ARCHITECTURE AND ENGINEERING

Essential in designing and constructing temples, palaces, stepwells, forts, roads, bridges and irrigation systems.

4. TRADE AND COMMERCE

Mathematics enabled fair trade, calculation of profit, interest, weights, measures and currency exchange.

5. SCIENCE AND TECHNOLOGY

Foundation for astronomy, medicine, metallurgy, navigation, calendar making and many scientific fields.

6. SPIRITUAL AND PHILOSOPHICAL VALUE

Mathematics was seen as a path to truth, order and harmony in the universe.

MATHEMATICS IN ACTION – REAL LIFE EXAMPLES

CALENDARS

Used for Panchang, festivals, eclipses and agricultural planning.

LAND MEASUREMENT (SULBA SUTRAS)

Accurate measurement of land, construction of altars and buildings.

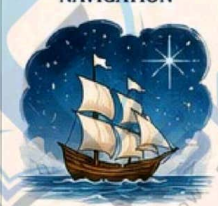
IRRIGATION SYSTEMS

Designing canals, reservoirs and stepwells using geometry and calculation.

ACCOUNTING & RECORD KEEPING

Use of place value system, fractions and arithmetic in accounts and records.

NAVIGATION



Mathematics helped in finding directions, distance and time while traveling.

GAMES & PUZZLES

Development of logic, patterns and strategies through games.

GREAT INDIAN MATHEMATICIANS

ĀRYABHATA (476–550 CE)
Introduced zero, place value system, trigonometric tables and astronomy.

BRAHMAGUPTA (598–668 CE)
Gave rules for zero and negative numbers, solutions of equations, area of cyclic quadrilateral.

BHĀSKARA II (1114–1185 CE)
Work on algebra, calculus concepts, sine approximation and astronomical calculations.

VARĀHAMIHIRA (505–587 CE)
Used mathematics in astronomy, calendar and weather prediction.

MAJOR MATHEMATICAL ACHIEVEMENTS

PLACE VALUE SYSTEM
Revolutionary system that forms the base of modern mathematics.

THE CONCEPT OF ZERO (ŚŪNYA)
A unique gift to the world that changed mathematics forever.

FRACTIONS AND DECIMALS
Use of proper and improper fractions, and early ideas of decimals.

ALGEBRA (BĪJA GANITA)
Solving equations, indeterminate equations and quadratic problems.

TRIGONOMETRY
Development of sine, cosine, versine tables and trigonometric identities.

IMPACT ON THE WORLD

Indian mathematical ideas spread to the Arab world and Europe.

Influenced modern mathematics, science and technology.

Built the foundation for innovation, discovery and progress.

Improved quality of life and societal development.

IN SUMMARY

- Mathematics was the backbone of ancient Indian knowledge and progress.
- It connected science, society, spirituality and daily life.
- It reflects the wisdom, creativity and practical thinking of our ancestors.

Mathematics was not just calculated... It was celebrated!

A TIMELESS LEGACY

From counting grains to calculating the cosmos, from building temples to exploring infinity – mathematics was the key to knowledge and the engine of civilization.

Our heritage. Our pride.

ANCIENT WISDOM, ETERNAL RELEVANCE

The numbers may change, but the importance of mathematics remains forever.

GREAT INDIAN MATHEMATICIANS AND THEIR CONTRIBUTIONS

Brilliant Minds • Timeless Ideas • Global Impact

Ancient India produced some of the world's greatest mathematicians whose ideas laid the foundation of modern mathematics and continue to inspire the world.

MATHEMATICIAN	PERIOD	MAJOR CONTRIBUTIONS	KEY ACHIEVEMENTS / EXAMPLES
1 ĀRYABHAṬA (476 – 550 CE) Author of *Āryabhaṭiya*	5th – 6th Century	• Gave the value of π (pi) approximately. • Introduced place value system. • Explained zero as a number. • Worked on algebra, trigonometry and astronomical calculations.	Key Achievements / Examples • Value of $\pi \approx 3.1416$ • Place value: Units, Tens, Hundreds... • Solved linear equations. $\pi \approx 3.1416$ $1002 = 1\times10^3 + 0\times10^2 + 0\times10^1 + 2\times10^0$
2 BRAHMAGUPTA (598 – 668 CE) Author of *Brahmasphuṭasiddhānta*	7th Century	• Systematically described arithmetic operations with zero. • Gave rules for positive and negative numbers. • Solved quadratic equations. • Worked on geometry and cyclic quadrilaterals.	Key Achievements / Examples • Rules for operations with zero. • Solution of $ax^2 + bx = c$. • Area of cyclic quadrilateral: $\sqrt{(s-a)(s-b)(s-c)(s-d)}$ (Brahmagupta's Formula) + − 0 a b c d
3 BHĀSKARA I (7th Century) Author of *Mahābhāskarīya*	7th Century	• Explained arithmetic, algebra, and mensuration. • Worked on indeterminate equations (kuttaka method). • Calculated sine tables.	Key Achievements / Examples • Kuttaka method for solving $ax + by = c$. • Improved value of π. $ax + by = c$ (Kuttaka Method) θ: 0° 30° 45° 60° 90° sin θ: 0 $\frac{1}{2}$ $\frac{1}{\sqrt{2}}$ $\frac{\sqrt{3}}{2}$ 1
4 BHĀSKARA II (1114 – 1185 CE) Author of *Siddhānta Śiromaṇi*	12th Century	• Made great advances in algebra, calculus and trigonometry. • Gave the concept of derivatives (differential calculus). • Solved complex equations.	Key Achievements / Examples • Concept of derivative: $\frac{d(y)}{dx}$ • Chakravāla method for Pell's equation. Pell's Equation $x^2 - Dy^2 = 1$ jya (sine) kojya (cosine) O V P
5 MĀDHAVA OF SAṄGAMAGRĀMA (1340 – 1425 CE) Founder of the Kerala School	14th – 15th Century	• Developed infinite series for π, sine, cosine, arctangent. • Worked on approximations with great accuracy. • Laid foundation for calculus.	Key Achievements / Examples • Series for π: $\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots$ • Infinite series expansions.
6 NĪLAKAṆṬHA SOMAYĀJĪ (1444 – 1544 CE) Author of *Tantra Saṅgraha*	15th – 16th Century	• Refined astronomical models. • Calculated accurate value of π. • Worked on infinite series and planetary motions.	Key Achievements / Examples • Value of π correct to 7 decimals: $\pi \approx 3.1415926$ • Improved sine tables.
7 JAGADĪŚA & NĀRĀYAṆA PANDITA (16th Century) Authors of *Gaṇita Kaumudī*	16th Century	• Wrote an important text on mathematics. • Covered arithmetic, algebra, geometry, mensuration and astronomy. • Helped preserve and teach Indian mathematical knowledge.	Key Achievements / Examples • Comprehensive mathematics textbook. • Simplified complex topics for learners.

LEGACY

- Indian mathematicians introduced concepts that were centuries ahead of their time.
- Their work influenced Arab scholars and later reached Europe.
- Their ideas continue to inspire modern mathematics, science and technology.

CONTRIBUTIONS THAT CHANGED THE WORLD

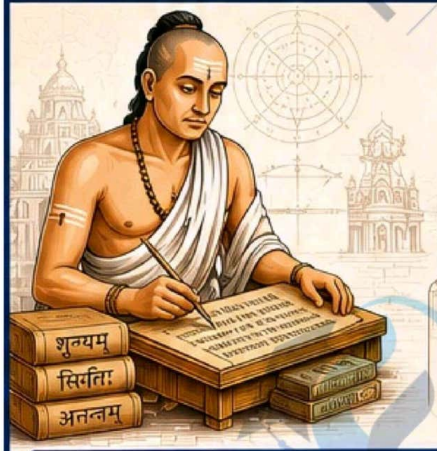
0 Zero	Place Value System	$ax^2 + bx + c = 0$ Algebra	$\sin\theta = \frac{y}{r}$ $\cos\theta = \frac{x}{r}$
$\sum_{n=1}^{\infty} a_n$ Infinite Series	$\frac{d(y)}{dx}$ Calculus (early ideas)	Astronomy & Planetary Models	π Approximations of π

A TIMELESS INSPIRATION

These brilliant minds from ancient India proved that when curiosity meets logic, the possibilities are infinite.

Their wisdom is our pride.
Their knowledge is our future.

"From ancient wisdom to modern innovation – Indian mathematics lights the path of knowledge."



NUMBER SYSTEM
AND ITS SIGNIFICANCE

THE LANGUAGE OF MATHEMATICS & THE FOUNDATION OF ALL COUNTING

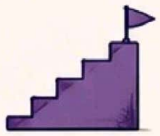
शून्यं समाप्यते सर्वः
तस्माद् शून्यं प्रसस्यते ।
शून्याद् अन्यत् न किञ्चन्
शून्याय विश्वं प्रतिष्ठितम् ॥
– (Brahmagupta)

A Number System is a way to represent numbers using a set of digits or symbols according to specific rules.
It is the base of all mathematical calculations and real-life applications.

TYPES OF NUMBER SYSTEMS

1. NATURAL NUMBERS
Counting numbers starting from 1.

1, 2, 3, 4, 5, ...



Used in counting objects.

2. WHOLE NUMBERS
Natural numbers including zero.

0, 1, 2, 3, 4, 5, ...

Used in counting and numbering.

3. INTEGERS
Whole numbers and their negatives.

..., –3, –2, –1, 0, 1, 2, 3, ...

Used in real-life situations like loss, profit, temperature, etc.

4. RATIONAL NUMBERS
Numbers in the form p/q where $p, q \in Z, q \neq 0$

$\frac{1}{2}, -\frac{3}{4}, \frac{5}{7}, \ldots$

Used in fractions, decimals (terminating or repeating).

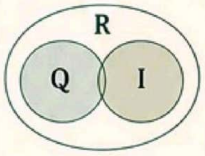
5. IRRATIONAL NUMBERS
Numbers that cannot be expressed in p/q form.

$\sqrt{2}, \sqrt{3}, \pi, e, \ldots$

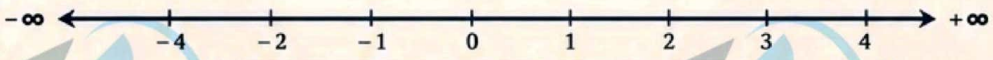
Used in geometry, advanced mathematics and real measurements.

6. REAL NUMBERS
All rational and irrational numbers.

$R = Q \cup (I - Q)$



Covers all numbers on the number line.



SIGNIFICANCE OF NUMBER SYSTEM

1. FOUNDATION OF MATHEMATICS


All mathematical operations, formulas and theories are built upon number systems.

2. USED IN EVERYDAY LIFE


Counting, money, measurement, time, age, distance – everything is based on numbers.

3. SCIENCE & ENGINEERING


Essential in physics, chemistry, computer science, engineering, and data analysis.

4. TECHNOLOGY & COMPUTING


Binary number system is the base of computers, digital devices and modern electronics.

5. FINANCE & ECONOMICS


Used in banking, accounting, trading, statistics and economic modeling.

6. MEASUREMENT & NAVIGATION


Used in surveying, GPS, space science, astronomy and mapping.

Zero (0) – The greatest gift of ancient India to the world. It made complex calculations possible and led to the development of modern mathematics, science and technology.

KEY FEATURES OF NUMBER SYSTEMS

- Provide a systematic way to represent and organize numbers.
- Make calculations easier, faster and more accurate.
- Help in solving real-life problems and making decisions.
- Allow us to work with very large or very small numbers.

PLACE VALUE SYSTEM – OUR UNIQUE CONTRIBUTION

The place value system with 10 digits (0–9) allows us to represent any number using fewer symbols.

Thousands	Hundreds	Tens	Ones	Tenths	Hundredths
1	2	3	•	4	5
↓	↓	↓	↓	↓	↓
1000	200	30	4	0.5	0.05

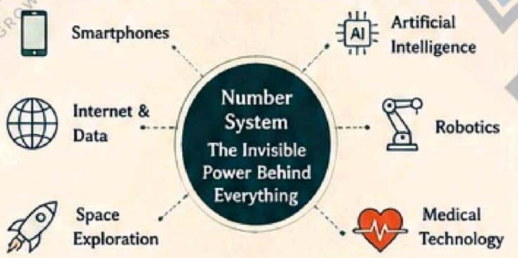
Example:
1234.45
means
$1\times1000 + 2\times100 + 3\times10 + 4\times1 + 4\times0.1 + 5\times0.01$

This system was first clearly explained in ancient Indian texts by mathematicians like Brahmagupta, Bhāskara II and others.

INTERESTING FACTS

- The concept of Zero was first discovered in India.
- The decimal (base-10) number system originated in India.
- Indian mathematicians worked with very large numbers and infinite series.
- Our number system spread to the Arab world and later to Europe.

IMPORTANCE IN MODERN WORLD



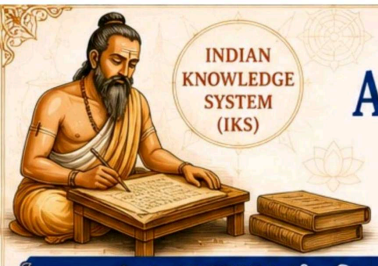
CONCLUSION

Number system is not just about numbers, it is the cornerstone of human progress.

From ancient calculations to modern technology, it continues to shape our world and future.

Understand numbers, Understand the world.

"Where there are numbers, there is order; where there is order, there is progress." – Āryabhaṭa



INDIAN KNOWLEDGE SYSTEM (IKS)

IKS CONCEPT OF ALGEBRA, ARITHMETIC AND GEOMETRY

Ancient Indian Wisdom • Timeless Mathematics • Universal Relevance

गणितं मूलं विज्ञानानाम् । अर्थशास्त्रस्य मूलं गणितम् ॥

Mathematics is the root of all sciences and the foundation of all knowledge.

यथा पिण्डे तथा ब्रह्माण्डे
(As in the microcosm, so in the macrocosm)

1. ALGEBRA (बीजगणित)

The art of generalization using symbols and letters.
It deals with unknowns, relationships and equations.

KEY IDEAS

- Use of variables (बीज) to represent unknown quantities.
- Formulation of equations.
- Manipulation of expressions.
- Generalization of patterns.

EXAMPLE

If a number is x, then three times the number added to five is

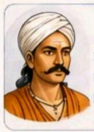
$$3x + 5$$

If this is equal to 20,

$$3x + 5 = 20 \Rightarrow x = 5$$

IKS PERSPECTIVE

Our ancient texts used sophisticated algebraic thinking.



BHĀSKARA II (12th Century)

In his book *Siddhānta Śiromaṇi*, he solved indeterminate equations known as *"Kuṭṭaka"* (pulverizer method).

Example of Kuṭṭaka Problem

Find positive integers x, y such that:

$$13x - 7y = 1$$

(Used for solving linear Diophantine equations)

IKS SOURCES

- Bakhshali Manuscript – algebraic rules and equations
- Aryabhatiya – quadratic equations
- Siddhānta Śiromaṇi – advanced algebraic methods

APPLICATIONS (THEN & NOW)

Trade & Commerce | Astronomy (Celestial calculations) | Cryptography & Coding | Engineering & Technology | Computer Algorithms | Data Science & AI

2. ARITHMETIC (अंकगणित)

The science of numbers and operations.
It is the foundation of all calculations.

KEY IDEAS

- Number system (मूल्य value, decimals)
- Operations: +, −, ×, ÷
- Fractions, ratios, proportions
- Percentages, averages
- Series and progressions

EXAMPLE

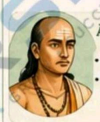
A merchant buys 120 items at $\frac{3}{4}$ of the price and sells them at $\frac{5}{6}$ of the price.

$$\text{Profit \%} = \left(\frac{5}{6} - \frac{3}{4}\right) \times 100$$

$$= \frac{1}{12} \times 100 = 8\frac{1}{3}\%$$

IKS PERSPECTIVE

Indian mathematicians developed place value system, zero and powerful calculation techniques.



ĀRYABHAṬA (5th Century)

- Gave the place value system.
- Introduced the concept of ZERO (0) as a number.

The Decimal System

Thousands	Hundreds	Tens	Ones
1	2	3	4
↓	↓	↓	↓
1000	100	10	1

IKS SOURCES

- Sulba Sūtras – early arithmetic rules
- Aryabhatiya – place value & operations
- Līlāvatī (by Bhāskara II) – arithmetic problems

APPLICATIONS (THEN & NOW)

Accounting & Finance | Calendar Calculation | Construction & Architecture | Measurement & Weights | Business & Commerce | Banking & Data Analysis

3. GEOMETRY (ज्यामिति)

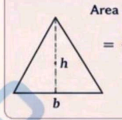
The study of shapes, sizes, positions and properties of space.
It connects the physical world with mathematical reasoning.

KEY IDEAS

- Points, lines, angles, planes
- Triangles, quadrilaterals, circles
- Area, perimeter, volume
- Congruence and similarity
- Coordinate geometry

EXAMPLE

Area of a triangle



$$= \frac{1}{2} \times base \times height$$

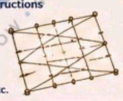
IKS PERSPECTIVE

Geometry was extensively used in altar construction, town planning, astronomy and sacred architecture.

SULBA SŪTRAS (800–200 BCE)

They describe geometric constructions for altars, including:

- Right angles
- Squares
- Diagonals
- Approximations of $\sqrt{2}$, $\sqrt{3}$ etc.



Approximation of $\sqrt{2}$ (Sulba Sūtra Rule)

The diagonal of a unit square is approximately $\sqrt{2}$.

They used:

$$1 + \frac{1}{3} + \frac{1}{3 \times 4} - \frac{1}{3 \times 34}$$

$$\approx 1.414$$

IKS SOURCES

- Sulba Sūtras – geometry for Vedic altars
- Vedānga Jyotiṣa – geometric astronomy
- Mānasāra & Śilpa Śāstra – architecture & design

APPLICATIONS (THEN & NOW)

Temple Architecture | Land Surveying | Astronomy & Navigation | Civil Engineering | Computer Graphics | Space Technology

THE IKS APPROACH

Mathematics in IKS is not just about calculation, it is about understanding patterns in nature, harmony in the universe and solving real-life problems.

WHY IT MATTERS TODAY

Builds logical thinking | Strengthens problem solving | Drives innovation & technology → | Connects us with our roots | Creates a better future

OUR ANCIENT WISDOM, OUR FUTURE

From the wisdom of our sages to modern discoveries, the spirit of inquiry continues.

Learn, preserve and innovate – यही है भारतीय ज्ञान परंपरा ।