

COURSE CODE: SGB24UC101VC



Value Added Course
For FYUG Programmes
Self Learning Material



SREENARAYANAGURU

SREENARAYANAGURU OPEN UNIVERSITY

The State University for Education, Training and Research in Blended Format, Kerala



Vision

To increase access of potential learners of all categories to higher education, research and training, and ensure equity through delivery of high quality processes and outcomes fostering inclusive educational empowerment for social advancement.

Mission

To be benchmarked as a model for conservation and dissemination of knowledge and skill on blended and virtual mode in education, training and research for normal, continuing, and adult learners.

Pathway

Access and Quality define Equity.



Indian Knowledge System

Course Code: SGB24UC101VC

Semester - IV

**Value Added Course
For FYUG Programmes (Honours)
Self Learning Material
(With Model Question Paper Sets)**



SREENARAYANAGURU
OPEN UNIVERSITY

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The State University for Education, Training and Research in Blended Format, Kerala



INDIAN KNOWLEDGE SYSTEM

Course Code: SGB24UC101VC
Semester- IV
Value Added Course
For FYUG Programmes (Honours)

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Message from Vice Chancellor

Dear Learner,

It is with great pleasure that I welcome you to the Four Year UG Programme offered by Sreenarayanaguru Open University.

Established in September 2020, our university aims to provide high-quality higher education through open and distance learning. Our guiding principle, 'access and quality define equity', shapes our approach to education. We are committed to maintaining the highest standards in our academic offerings.

Our university proudly bears the name of Sreenarayanaguru, a prominent Renaissance thinker of modern India. His philosophy of social reform and educational empowerment serves as a constant reminder of our dedication to excellence in all our academic pursuits.

It is my pleasure to introduce the course Indian Knowledge System as a core component of the Fourth Semester under the FYUG Programme, designed to provide learners with an understanding of the philosophical, scientific, and cultural foundations of ancient Indian civilisation. In the context of a rapidly changing global knowledge landscape, this course seeks to foster an appreciation of indigenous intellectual traditions and their enduring relevance by highlighting contributions in areas such as philosophy, language, art, mathematics, astronomy, medicine, and architecture. It reflects our commitment to nurturing culturally grounded, intellectually aware, and socially responsible graduates who can meaningfully integrate traditional wisdom with modern knowledge systems.

Our teaching methodology combines three key elements: Self Learning Material, Classroom Counselling, and Virtual modes. This blended approach aims to provide a rich and engaging learning experience, overcoming the limitations often associated with distance education. We are confident that this programme will enhance your understanding of statistical methods in business contexts, preparing you for various career paths and further academic pursuits.

Our learner support services are always available to address any concerns you may have during your time with us. We encourage you to reach out with any questions or feedback regarding the programme.

We wish you success in your academic journey with Sreenarayanaguru Open University.

Best regards,



Dr. Jagathy Raj V.P.
Vice Chancellor

01-04-2026

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BLOCK - 01

Development of Ancient Knowledge

Unit 1

Development of Knowledge Systems

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- ▶ facilitate the concepts of Indian traditional knowledge
- ▶ understand the importance of Indian Knowledge System.
- ▶ understand the structure of Vedas, Vedangas and Thirukural
- ▶ apply ancient Indian knowledge to address contemporary problems

Prerequisite

The Indian Knowledge System (IKS) constitutes a vast and profound corpus of knowledge that has evolved over millennia within the Indian subcontinent, traversing ancient, medieval, and modern phases of development. It embodies a distinctive and comprehensive epistemological framework that encompasses a wide range of disciplines, including philosophy, science, mathematics, medicine, the arts, literature, spirituality, and the social sciences. Deeply rooted in India's rich cultural and spiritual traditions, Indian Knowledge System offers significant insights into the nature of existence, human life, the cosmos, and the processes of knowledge acquisition. Characterized by a holistic and integrative orientation, it underscores the intrinsic interconnectedness of all dimensions of life and the universe.

In recent years, the Indian Knowledge System (IKS) has attracted increasing scholarly attention, particularly within the domain of higher education. This renewed engagement is largely driven by the recognition that Indian Knowledge System provides valuable epistemological frameworks and practical insights for addressing contemporary challenges across diverse fields such as management, leadership, ethics, sustainability, and education. Rather than being confined to the past as a mere historical legacy, Indian Knowledge System represents a dynamic and evolving intellectual tradition that continues to shape and inform various dimensions of modern life. Its rich repository of knowledge

offers significant potential for application in contemporary contexts, thereby contributing to the development of a more balanced, ethically grounded, and sustainable society

Meaning of Indian Knowledge System

The Indian Knowledge System (IKS) denotes the cumulative body of knowledge, intellectual traditions, and epistemic practices that have evolved, been codified, and transmitted across generations in the Indian subcontinent over several millennia. It encompasses a wide spectrum of disciplines, including Vedic sciences, Ayurveda, Yoga, classical arts, architecture, astronomy, and mathematics, among others. Characterized by its inherently interdisciplinary orientation, the IKS foregrounds a holistic understanding of knowledge and underscores the fundamental interconnectedness of human existence, nature, and the cosmos.

At its philosophical core, the Indian Knowledge System (IKS) is oriented towards the pursuit of ultimate truth (Satya) and the realization of the self (Ātma Bodha). Knowledge, within this framework, is not conceived merely as an instrument of intellectual advancement but as a transformative means leading to self-realization and the attainment of liberation (Moksha). Accordingly, IKS advances a holistic epistemology in which knowledge serves both cognitive and ethical purposes, fostering the moral and spiritual elevation of individuals as well as society. It emphasizes an integrative approach to human existence, wherein intellectual, emotional, and spiritual dimensions are harmoniously balanced.

Furthermore, the Indian Knowledge System is deeply embedded in the cultural and spiritual traditions of the Indian subcontinent. It embodies the enduring values, beliefs, and accumulated wisdom of Indian civilization, exerting a sustained influence on diverse domains such as health and wellness, artistic expression, literary production, and social practices. Far from being static, IKS constitutes a dynamic and evolving body of knowledge that has continually adapted to shifting social, cultural, and technological contexts, thereby maintaining its relevance across historical periods.

Romila Thapar critically examines the contemporary articulation of the Indian Knowledge System, arguing that it is often shaped by political motivations and tends to promote an uncritical and reductive representation of the past. According to her, such constructions frequently portray ancient Indian thought as monolithic, exclusively Hindu, and static in nature. In contrast, she advocates for a historically grounded approach that recognizes the plurality, dynamism, and critical traditions inherent in Indian knowledge systems, thereby emphasizing their evolutionary and heterogeneous character.

Romila Thapar contends that the contemporary framework of the Indian Knowledge System is often shaped by administrative and political actors rather than subject specialists, thereby prioritizing the construction of a “politically convenient” narrative over rigorous academic inquiry. She critically characterizes this tendency as methodologically unsound, arguing that it enables non-professionals to produce and disseminate historical



interpretations without adequate scholarly grounding. In her view, such practices constitute a significant epistemological challenge, amounting to a direct undermining of established norms of knowledge production and critical scholarship.

Romila Thapar critiques the conceptualization of the Indian Knowledge System as a homogeneous and unified tradition, arguing that such representations tend to obscure the historically embedded plurality of intellectual practices in the Indian subcontinent. She contends that the contemporary promotion of IKS often privileges a singular, Brahmanical or Sanskrit-centric narrative, thereby marginalizing diverse modes of knowledge production that emerged across varied cultural, linguistic, and social contexts. According to her, this reductive framing neglects the complex, heterogeneous, and regionally differentiated nature of knowledge traditions in India, undermining a more nuanced and historically grounded understanding of its intellectual heritage.

Key Words

jñān, vijñān, Jeevan Darshan, Bharatheeya Drushti, Indian Education, Rigveda, Yajurveda, Samaveda, Atharvaveda, Samhita, Brahmana, Aranyaka, Upanishad, Shiksha, Vyakarana, Chandas, Niruktha, Jyothisha, Kalpa, Gurukula system, Nalanda, Takshashila

Discussion

1.1.1 An Overview of the Indian Knowledge System

Indian Knowledge Systems encompass a vast and intricate tapestry of wisdom, philosophy, science, and art that has evolved over millennia. They present immense opportunities for research, education, and innovation. By exploring and understanding the depths of this knowledge system, we can gain valuable insights into our past, present, and future.

The National Education Policy 2020 emphasizes the integration of Indian Knowledge Systems (IKS) into the curriculum. "The rich heritage of ancient and eternal Indian knowledge and thought has been a guiding light for this Policy." The pursuit of knowledge (*jñān*), wisdom (*prajñāna*), and truth

(*Satya*) has always been regarded in Indian thought and philosophy as the highest human goal. In ancient India, the aim of education was not merely the acquisition of knowledge in preparation for life, either in this world or beyond schooling. Instead, it was focused on the complete realization and liberation of the self. Renowned institutions of ancient India, such as Takshashila, Nalanda, Vikramshila, and Vallabhi, set the highest standards for multidisciplinary teaching and research, hosting scholars and students from diverse backgrounds and countries. The Indian education system produced great scholars, including Charaka, Susruta, Aryabhata, Varahamihira, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani Datta, Madhava, Panini, Patanjali, Nagarjuna, Gautama, Pingala, Sankardev, Maitreyi, Gargi, and Thiruvalluvar, among many others. These

scholars made seminal contributions to world knowledge in fields such as mathematics, astronomy, metallurgy, medical science and surgery, civil engineering, architecture, yoga, fine arts, chess, and more. Indian culture and philosophy have profoundly influenced the world. It is essential not only to nurture and preserve these rich legacies for posterity but also to research, enhance, and apply them in new ways through our education system. The Policy recognizes the invaluable contributions of India's intellectual heritage and aims to revitalize it for the benefit of present and future generations. Furthermore, it encourages research and development in IKS to explore its contemporary relevance and aims to preserve and promote India's cultural heritage through IKS education.

1.1.2 Conceptual Framework: The Trilateral Foundation of IKS

The Indian Knowledge System (IKS) represents a unique and comprehensive structure of accumulated learning and experience, spanning millennia. It is not merely a collection of historical artifacts or scriptures but an active, integrated tradition designed for the welfare of all beings (*sarva loka hita*) and adherence to sustainable principles.

The IKS is conceptually founded upon a strategic trilateral framework:

1. *jñān* (Knowledge): The accumulated textual and oral traditions.
2. *Vignān viśeṣa-jñāna / śāstra* (Science) : The systematic investigation and application of knowledge.
3. *Jeevan Darshan* (Philosophy of Life): The ethical and moral principles guiding the practical implementation of knowledge.

This structured integration ensures that intellectual advancement is inherently coupled with ethical practice and societal harmony. A critical aspect of the IKS, often overlooked, is its methodology. This system of knowledge transmission evolved from experience, observation, experimentation, and rigorous analysis. This empirical foundation allowed the tradition of validating and implementing knowledge to impact nearly all aspects of ancient life, including education, arts, administration, law, justice, health (Ayurveda), manufacturing, and commerce. Knowledge, in this context, includes insights transmitted through textual, oral, and artistic traditions.

1.1.3 The Importance of the Indian Knowledge System

The Indian Knowledge System (IKS) represents a continuous civilizational tradition that integrates philosophical insight, scientific inquiry, ethical values, and lived experience. It offers holistic approaches to understanding nature, society, and human life. The objective of drawing from the past is not one of retrospective nostalgia, but rather to ensure that ancient systems, represented by an unbroken tradition and providing a unique perspective (*Bhāratiya Drishti*), are utilized to address the complex current and emerging challenges facing India and the world.

The New National Education Policy mandates the scientific incorporation of IKS into educational curricula, spanning both school and higher education. This policy marks a significant shift, reframing *Bhartiya Shiksha* (Indian education) as a dynamic and comprehensive basis for learning in the twenty-first century, rather than merely a static legacy. This movement, termed the journey "From Gurukul to Global," emphasizes traditional Indian educational systems rooted in principles such as experiential learning, critical thinking, ethical reasoning, and harmony with nature.



Key areas where IKS integration is strategic include mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, governance, polity, and conservation. The integration approach emphasizes multidisciplinary perspectives, including multilingualism, value-based education, and environmental sustainability.

Furthermore, the revival of IKS carries profound implications for global ethical development. The inclusion of *Jeevan Darshan* (philosophy of life) in the core definition of IKS implies that the pursuit of scientific and technical advancement (*Vignan*) must be ethically anchored. By integrating ethics and governance into the educational system from the outset, as was characteristic of ancient pedagogy, the objective is to guide the development of technology and governance toward balanced global outcomes. The intent is to produce a generation firmly grounded in cultural values yet equipped with the skills necessary to navigate a globalized society, creating an education system that is simultaneously authentically Indian and globally influential.

1.1.4 Vedas and Vedangas

1.1.4.1 Historical Context of the Vedas

The word "Veda," derived from the Sanskrit root "Vid" (to know), signifies authoritative and foundational knowledge. The Vedas constitute the oldest textual foundation and are considered the earliest records of ancient Indo-Aryan culture in the Indian subcontinent. Originating as a vast oral tradition, this knowledge was transmitted across generations before being systematically compiled in Vedic Sanskrit between approximately 1500 and 500 BCE. The Vedas consist of four major

collections, comprising hymns, mythological accounts, poems, prayers, and religious instruction. They remain sacred to the Vedic religion and laid the groundwork for subsequent Indian philosophy.

1.1.4.2 Vedic Literature – What are the Vedas?

The Vedas are large bodies of religious texts composed in Vedic Sanskrit that originated in ancient India. They form the oldest scriptures of Hinduism and represent the oldest layer of Sanskrit literature. The Vedas are said to have been passed down through verbal transmission from one generation to the next; therefore, they are also known as Shruti. The Vedic literature consists of four Vedas: Rig Veda, Sama Veda, Yajur Veda, and Atharva Veda.

The Vedas are systematically organized into four internal components, reflecting a pedagogical and philosophical progression within the Vedic tradition.

1. **The Samhitas :** These are the initial, continuous collections of *mantras*.
2. **The Brahmanas :** These extensive prose texts provide commentary and detailed explanations of solemn rituals, elaborating on the technical meanings and exact performance of these rites, often associated with *Karma Kanda*, the path of ritual action.
3. **The Aranyakas (Forest Treatises):** These texts serve as philosophical bridges, forming the final segments of the Brahmanas. Composed by reclusive individuals who meditated in forested environments, they transition the focus from external public rituals to internal, reflective meditation.

4. **The Upanishads:** Composed toward the end of the Vedic era (starting around 800 BCE), the Upanishads represent the culmination of Vedic thought, leading to the term Vedanta ("end of the Vedas"). These texts focus entirely on esoteric and metaphysical philosophy (*Jnana Kanda*), discussing the nature of the ultimate reality (*Brahman*) and the individual soul (*Atman*), often presented as dialogues between students and masters.

The systematic structuring of Vedic literature—from hymn collections to prose explanations, culminating in highly abstract philosophical discussions—illustrates an intellectual tradition committed to continuous self-critique. The progression from the Samhitas and Brahmanas (focused on ritual application) to the Aranyakas and Upanishads (focused on abstract knowledge and spirituality) demonstrates the inherent dynamism of the system. Contemplation and the critical reevaluation of ritual dogma were not merely permitted but were formalized and systematized within the canonical tradition itself, providing the philosophical foundations for subsequent Hindu schools like Vedanta and Samkhya.

1.1.4.3 The Four Vedas

The core of the Vedic corpus lies in the four Samhitas ("collections"), which represent the primary body of metrical texts (*mantras*):

Rigveda

Recognized as the oldest Veda, the Rigveda consists of 1,028 hymns dedicated to various natural and cosmic deities. It serves as the foundational source of Vedic literature, exploring fundamental themes such as cosmology, the creation myth, and the inherent workings of the natural world.

The Rigveda, one of the oldest texts of the Indo-Aryan civilization still extant, is an ancient Indian collection of Vedic hymns. The two Sanskrit words constituting its name—Rig and Veda—translate to 'praise' or 'shine' and 'knowledge,' respectively. This collection of 1,028 hymns and 10,600 verses is organized into ten different Mandalas (or books; Sanskrit). It is the principal and oldest of the four Vedas.

Cultural-linguistic records, mainly variations in the form of Sanskrit used (compared to present-day), indicate that the origin of the Rigveda was around 1600 BCE. However, a broader approximation of 1700–1100 BCE has also been suggested by experts. The earliest written Rigveda dates back to the 1st millennium BCE; however, the extant versions today are dated only between the 11th and 14th centuries, primarily due to the ephemeral nature of the manuscript materials, such as palm leaves and birch bark.

Like the other three Vedas, followers of Hindu dharma regard the Rig Veda as *Apauruseya*, meaning it is not of human origin or attributed to a specific author. The hymns and verses were composed by the Rishis (Sages), and ardent believers of Sanatana dharma assert that the revered Lord himself taught these Vedic hymns to the sages, who then transmitted them orally through generations.

The Rig Veda is sub-classified into four major text types: the Samhitas, which are hymns praising Rig Vedic deities such as Indra, a heroic deity and king of the highest heaven, Saudharmakalpa, who vanquished his enemy *Vrtra*; Agni, the sacrificial fire; Soma, the sacred potion or plant that was a fundamental offering in Vedic sacrifices; and Ishwara, the supreme god, among others. The Aranyakas provide the philosophical underpinnings of ritual sacrifice, while the Brahmanas contain commentaries on ancient sacred rituals. The Upasanas focus on worship.



The Mandalas of the Rig Veda, which number ten and were composed by poets from various priestly groups over several centuries, are structured according to clear principles. The Veda begins with a small book addressed to Agni, Indra, and other gods, singing their praises.

As the text progresses, the hymns, meticulously crafted with meters ranging from *jagati* and *trīṣṭup* to *anuṣṭup* and *Gayatri*, reveal the history of the Vedic period. They hint at primitive slash-and-burn agriculture, cattle raising, and horse racing, depicting a deeply aesthetic society practicing henotheism, where they believed in one God while acknowledging its manifested deities. This is vividly reflected in the central thought of Hindu dharma: '*Brahman is everywhere, God is within everybody.*'

What is particularly noteworthy are the predominant discussions on cosmology, mystic forces, the existence of the universe, and other metaphysical issues, encapsulating the central theme of metaphysics: 'not about what exists, but about what it is to exist.' The hymns shift from early *Mandalas* of *nāśadīyato* later ones, such as in the *sūkta*, posing philosophical questions about the origin of the universe and the nature of God, the virtue of *dāna* (charity), and the rituals considered the religious duties of human beings.

Speculation reaches its peak when questions such as 'Do even the gods know the answer?' arise. While one might expect religious scriptures to be the last place for doubt regarding God's omniscience, the Vedas seem to challenge this notion.

In contemporary India, the Rig Veda serves as a reminder of ancient cultural heritage, with some hymns still used in major rites of passage ceremonies. However, for some experts, the literal acceptance of much of its textual essence has diminished over time.

Yajurveda

The Yajurveda focuses on the procedural and technical aspects of religious rites and sacrifices (*Yajnas*). It contains detailed formulas and prose instructions (*Yajus*) necessary for the correct execution of these rituals, serving as a handbook for ritual specialists.

The Yajur Veda, of Sanskrit origin, is composed of Yajus and Veda; the two words translate to 'prose mantras dedicated to religious reverence or veneration' and 'knowledge.' This ancient Vedic text is a compilation of ritual offering formulas or prose mantras to be chanted or muttered repeatedly by a priest while performing the prescribed ritual actions before the sacrificial fire or the Yajna.

Since Vedic times, it has primarily served as a practical guidebook for priests, or Purohīts, providing information about sacrifices and associated rituals.

Scholarly consensus suggests that most of the Yajur Veda dates to 1200 or 1000 BCE. It is considered younger than the Rig Veda, which is estimated to have originated around 1700 BCE, but is contemporaneous with the hymns of the Sama Veda and the Atharva Veda.

The Yajurveda is broadly divided into two main categories: Krishna Yajurveda and Shukla Yajurveda, also known as the Black and White Yajurveda, respectively. The verses of the Krishna Yajurveda are often seen as unarranged, unclear, and disparate, leading to the collection being referred to as *Kṛṣṇayajurveda*. In contrast, the well-organized Shukla Yajurveda conveys a distinct meaning and is known as the *śuklayajurveda*.

The earliest and most ancient layer of the Yajur Veda Samhita contains about 1,875 verses that are distinct yet borrowed from and built upon the foundation of verses in the Rigveda. The middle layer includes the *śatapathabrāhmaṇa*, one of the largest Brahma-

na texts in the Vedic collection. The youngest layer of Yajur Veda text includes a significant collection of primary Upanishads, totaling six, which have been influential to various schools of Indian philosophy. These include *brhadāranyakopaniṣat*, *iśāvāsyopaniṣat*, *taittiriopaniṣat*, among others.

Sixteen recensions, or revised editions, of the *śukla yajurveda* are known, but only two have survived. The Krishna Yajurveda may have had as many as 86 recensions, of which only four have survived into modern times. The two surviving recensions of the Yajurveda, *mādhyandina* and *kaṇva*, are nearly identical, whereas the four surviving recensions of the Shukla Yajurveda are quite different from one another.

The text serves as a valuable source of information about agriculture, economics, and social life during the Vedic era. The following verse, translated from the Shukla Yajurveda, lists the types of crops considered important in ancient India:

May my rice plants and my barley, and my beans and my sesame, and my kidney beans and my vetches, and my pearl millet and my proso millet, and my sorghum and my wild rice, and my wheat and my lentils, prosper by sacrifice.

— *śukla yajurveda* 18.12.

Samaveda

Known as the "Veda of Melodies" (*Saman*), the Samaveda primarily draws its content from the Rigveda. However, its arrangement is unique, specifically structured for musical recitation and chanting during solemn rituals, thereby emphasizing the role of sound and rhythm in the religious experience.

The words of the Rigveda are set to music and are meant to be sung rather than merely read or recited. The Samaveda, also referred

to as the Veda of Melodies and Chants, is the third of the Four Vedas. It is divided into two major parts: the four melody collections, or *Saman*, which are the songs, and the *arcika*, or verse books, which consist of a collection (Samhita) of hymns, portions of hymns, and detached verses. As a liturgical text related to public worship, all but 75 verses of its 1,875 are derived from the Rigveda.

The ancient core Hindu scriptures have only three surviving recensions, with research scholars suggesting that the existing compilations originated in the post-Rigvedic period, approximately around 1200 or 1000 BCE. This period is contemporary with both the Atharvaveda and the Yajurveda.

Widely referred to as the "Book of Songs," the name derives from two Sanskrit words: *Saman*, meaning "song," and *Veda*, meaning "knowledge." The Samaveda has served as the foundational root of classical Indian music and dance traditions, which proudly claim to be the oldest in the world. Following tradition, the verses of the Samaveda are sung using specific melodies called Samagana by Udgata priests during rituals dedicated to various deities.

As the words of the Rigveda are set to music, it is no surprise that, similar to the Rigveda, the early sections of the Samaveda typically begin with hymns dedicated to Rigvedic deities such as Indra, the heroic king of the highest heaven known as Saudharmakalpa, who slayed his enemy Vritra; Agni, the sacrificial fire; Soma, the sacred potion or plant fundamental to Vedic sacrifices; and Ishwara, the supreme god. The latter sections, however, shift to abstract speculations and philosophy, questioning the nature and existence of the universe and God, as well as the social and religious duties of individuals within society. The purpose of the Samaveda is clearly liturgical.



Two of the 108 Upanishads are embedded in the Samaveda: the *Chāndogyaopaniṣat* and the *Kenopaniṣat*. The Upanishads, representing the essence of the Vedas, are ancient Sanskrit texts containing some of the central philosophical concepts and ideas of Hinduism, which are also shared by other religions like Buddhism and Jainism.

The *Chāndogyaopaniṣat* speculates about the origin of the universe, as well as concepts of space and time. In their Udgithas or chants, three proficient men present logical speculations that even modern science cannot outrightly reject. The *Kenopaniṣat* conveys that every person possesses an innate longing for spiritual knowledge and that true bliss comes only from spiritual attainment.

To quote the exact words of V. Raghavan, a Sanskrit scholar and musicologist:

"Our music tradition [Indian] in the North as well as in the South remembers and cherishes its origin in the Samaveda... the musical version of the Rigveda."

The influence of the Samaveda on Indian classical music and dance is profound. The very essence of classical Indian music and dance traditions is rooted in the sonic and musical dimensions of the Samaveda itself. In addition to singing and chanting, the Samaveda discusses instruments and outlines the specific rules and regulations for playing them, ensuring the preservation of these ancient instruments' sanctity.

Atharvaveda

This Veda stands apart from the others due to its focus on the practical, everyday life of the people. Its content is diverse, covering practical concerns such as healing, traditional medicine, domestic rituals, and protective spells. The Atharvaveda emphasizes applied knowledge relevant to immediate human existence.

The fourth and final revered text of the Vedas, the Atharvaveda, is depicted as a "knowledge storehouse of Atharvāṇas," where Atharvāṇas refers to formulas and spells intended to counteract diseases and calamities, or to provide "the procedures for everyday life."

As a late addition to the Vedic scriptures, the term has roots in Sanskrit, and it is commonly referred to as "the Veda of Magic formulas." It aligns more with the popular culture and traditions of its time rather than focusing solely on religious and spiritual teachings. Consequently, it is often viewed not in connection with the three other Vedas but as a distinct scripture.

In popular contexts, the Atharvaveda is widely recognized as the Veda of Magic formulas and comprises a mixture of hymns, chants, spells, and prayers. It addresses issues such as healing illnesses, prolonging life, and, as some claim, black magic and rituals for alleviating maladies and anxieties.

However, many sections of the Atharvaveda are dedicated to rituals devoid of magic and to theosophy, a philosophy asserting that knowledge of God can be achieved through spiritual practice or intuition.

It is a collection of 730 hymns containing about 6,000 mantras, divided into 20 books, with three Upanishads embedded within it: *Muṇḍakopaniṣad*, *Māṇḍūkyaopaniṣad*, and *Praśnopaniṣad*. While a considerable portion is an adaptation of the Rigveda, the most ancient of all Vedic scriptures, believers of Hindu dharma regard the Atharvaveda as Apauruṣeya, meaning it is not of a human origin or attributed to a specific author.

The hymns and verses were composed by the Rishis (or Sages), and as ardent believers of Hindu dharma claim, the revered Lord himself taught the Vedic hymns to the sages, who then transmitted them orally through generations.

However, no definite date can be ascribed to the composition of any Veda, as the generational descent of the texts during the Vedic period was through an oral literary tradition. The core text of the Atharvaveda falls within the classical mantra period of Vedic Sanskrit, during the 2nd millennium BCE, making it younger than the Rigveda and roughly contemporaneous with the Yajurveda mantras and the Sāmaveda.

The Samhitas in the Atharvaveda contain written accounts of surgical and medical practices; they include mantras and verses for treating various ailments. For instance, the verses in hymn 4.15 of the recently discovered Paippalada version of the Atharvaveda discuss how to deal with an open fracture and advise wrapping the wound with the Rohini plant (*Ficus infectoria*), which is native to India. Speculations also arise regarding remedies from herbal medicines, the nature of man, life, good and evil, and even spells and prayers to gain a lover.

Some hymns address peaceful prayers and philosophical speculations concerning the origin of the universe and the existence of God. It is indeed a collection of diverse speculations that often leaves us bewildered.

The Atharvaveda remains relevant in today's contemporary society. It has significantly influenced modern medicine and healthcare, culture and religious celebrations, and even literary traditions in the Indian subcontinent. It contains the oldest known references to the Indic literary genre. As the fourth and final Veda, it continues to be one of the most cherished texts for any Vedic scholar.

1.1.4.4 The Vedangas

The Vedangas, translated as the "limbs of the Vedas," are six essential auxiliary disciplines created to ensure the accurate preser-

vation, interpretation, and application of the complex Vedic texts. These disciplines reflect the ancient Indian commitment to rigorous, formalized methods for maintaining textual integrity, effectively forming the foundation of various scientific fields, including linguistics, mathematics, and astronomy.

Metaphorically, the Vedangas are likened to the limbs of a Veda Purusha (a cosmic being representing the Veda), indicating that a complete understanding requires the integrated application of all six disciplines.

The six disciplines of the Vedangas are characterized by their systematic and technical nature:

1. **Shiksha (Phonetics)** : This discipline focuses on the precise study of sound, pronunciation, and accentuation associated with each syllable. Texts like the Paniniya Shiksha detail how syllables should be pronounced, including tonal variations known as Udatta and Anudatta. Precision in sound is critical because altering the pronunciation fundamentally changes the meaning of the chanted mantra and its intended effect.
2. **Vyakarana (Grammar)**: Vyakarana is the science of linguistic structure, addressing word and sentence formation. Panini's Astadhyayi is the definitive text, establishing formal rules for Sanskrit grammar through a highly formalized meta-language (Upadesa) expressed in approximately 8,000 sutras (rules). This meticulous work established Sanskrit as the primary language of ancient India and is globally recognized for laying the groundwork for modern descriptive linguistics.



3. **Chandas (Prosody/Meter):** This discipline involves mastery of rhyme and meter. It classifies syllables into Guru (heavy) and Laghu (light) sequences, defining the various meters, such as Gayatri and Trishtup, used in Vedic composition. Beyond poetic structure, the science of Chhanda served a critical functional purpose: it acted as an institutionalized error-correcting mechanism. By adhering to a specific metrical sequence, any aberration or error in the text or vocalization (swara) during oral tradition could be immediately identified and rectified, ensuring knowledge fidelity over long periods.
4. **Nirukta (Etymology):** Nirukta is the science dedicated to explaining the derivation and meaning of complex Vedic words and phrases. Yaska's Nirukta provides the foundational text for this methodology, allowing scholars to trace words back to their roots and understand subtle changes in context and application.
5. **Jyotisha (Astronomy/Calendrics):** Jyotisha, the science of celestial objects, involves the study of heavenly bodies. In the context of the Vedangas, its purpose was pragmatic: determining the auspicious time for the performance of rituals. Textual resources like Lagadha's Vedanga Jyotisha outline the necessary astronomical and calendrical calculations required for the proper timing of religious events.
6. **Kalpa (Rituals/Procedure):** This discipline addresses the ethical, moral, and procedural instructions necessary for conducting sacrifices and rituals as a way of life. Central to Kalpa are the Sulba Sutras, which contain specific

geometric principles and mathematical deductions required for the construction of precisely measured and shaped altars. The meticulous rules for ritual performance necessitated the development of advanced applied geometry.

Implications for Scientific Credibility

The Vedangas collectively represent a profound commitment to knowledge preservation and intellectual structure. The combination of Vyakarana (linguistic structure), Shiksha (sound precision), and Chanda (textual integrity check) created a self-correcting system for data preservation that established rigorous methodologies recognized today within fields such as computational linguistics.

The integration of applied mathematics within ritual, exemplified by the Kalpa Vedanga and the Sulba Sutras, demonstrates that complex mathematical thought, specifically geometry, was not merely an abstract pursuit but was developed and formalized as an indispensable component of ritual execution. This linkage confirms the IKS principle that Vignana (systematic science) often emerged directly from the demands of Jnan (knowledge tradition), highlighting a culture that prioritized logical structure and empirical application across various domains.

1.1.5 Ancient Education System in India

Ancient Indian education was characterized by a sophisticated dual system encompassing personalized moral training and large-scale specialized institutional learning. This architecture ensured both character development and advancement in diverse intellectual fields.

1.1.5.1 The Gurukul System: Character and Holistic Development

The Gurukul model, dating back to the Vedic period (approximately 1500–500 BCE), served as the foundational educational structure. This residential system centered around holistic learning and character development, building its pedagogy on three fundamental pillars:

1. **The Acharya/Guru :** The teacher and spiritual guide.
2. **The Shishya :** The student or disciple.
3. **The Ashram :** The physical and spiritual environment for learning.

1.1.5.2 Pedagogy and Curriculum

Students (shishyas) lived closely with the guru, learning through oral instruction, practical experience, and moral teaching. This system emphasized personalized mentorship and strict discipline, with values rooted in respect, self-reliance, and community service. Academic learning was intrinsically linked with moral and spiritual growth. The curriculum was comprehensive, encompassing the Vedas, scriptures, philosophy, arts, and sciences.

Crucially, ancient Vedic education did not prioritize intellect in isolation; morality was considered equally essential, and learning divorced from morality was deemed useless. Students were expected to live a simple, disciplined life (Brahmachari), focused on high ideals and good behavior. The purpose of education extended beyond producing productive members of society to include spiritual enlightenment. Students were taught that they owed three debts (to the gods, past gurus, and ancestors), which were discharged through service, learning, and raising educated children, respectively, thereby ensuring the preservation and transmission of cultural and literary traditions.



1.1.5.3 Institutionalized Higher Learning: Scaling and Specialization

As Indian civilization advanced, educational methods evolved from the personal Gurukul to large, institutionalized universities, reflecting the civilization's capacity to manage transnational centers of specialized learning.

Takshashila (5th Century BCE onwards)

Takshashila, strategically located on the Grand Trunk Route, was one of the earliest and most renowned centers of learning, functioning as a melting pot for Indian, Persian, Greek, and Central Asian cultures.

- **Administration and Structure :** Unlike modern universities, Takshashila operated as a decentralized network of autonomous schools (pathshalas) run by individual teachers (Acharyas). Students had the freedom to select their teachers based on their chosen discipline, emphasizing individual mentorship and intellectual freedom.
- **Curriculum :** Takshashila offered an exceptionally broad curriculum, spanning over 60 disciplines. Core areas included the Vedas and Vedangas, Grammar, Logic, Philosophy, Medicine and Surgery (with notable alumnus Jivaka), Political Science and Economics (Chanakya's Arthashastra), Astronomy, Mathematics, Architecture, and Military Science. Pedagogy relied on oral discourse, debate, and critical inquiry, attracting international students from across Asia.

Nalanda (c. 5th Century CE onwards)

Nalanda, established later, represented a shift toward a highly structured, residential university model, hosting over 10,000 students and 2,000 scholars.

- **Administration and Global Influence :** Nalanda was a monastic institution that maintained rigorous academic standards. Its vast library, Dharmaganja, contained extensive collections of manuscripts on diverse subjects. It served as a major hub for international scholars, particularly from China, Korea, and Central Asia, documenting its crucial role in the global exchange of ideas.
- **Curriculum :** The curriculum was advanced and specialized, centered on six primary disciplines: Buddhist Studies (covering multiple schools), Logic and Philosophy (Nyaya and Samkhya), Grammar and Linguistics, Medicine and Ayurveda, Astronomy and Mathematics, and Arts and Literature.

this system effectively applied deep academic learning to practical fields like political science and linguistics.

The subsequent decline of these institutions, particularly Nalanda and Takshashila, resulted in a significant global intellectual loss. The halt in sustained, systematic development in fields already advanced in India—such as the concept of zero, algebraic formulations, and astronomical advancements—may have delayed scientific revolutions worldwide by centuries. Had this intellectual leadership been maintained, it is posited that India could have balanced the global narrative and influenced world education systems to prioritize ethical reasoning and interdisciplinary study alongside technical skills.

Comparison of Ancient Indian Education Models

1.1.5.4 The Significance of Pedagogical Dualism

The ancient Indian educational system successfully maintained a pedagogical dualism: the personalized, morally immersive Gurukul (focused on character and foundational knowledge) and the global, specialized research environment of the Universities (focused on intellectual refinement and Vignan). This structure ensured that specialized intellectual pursuits were grounded in the robust moral and ethical framework provided by foundational Vedic education.

The foundational training provided by the Vedas and Vedangas—requiring linguistic precision and mathematical analysis—was a prerequisite for entering the highly specialized intellectual environment of institutions like Takshashila, thereby creating a vertical educational hierarchy. The emergence of scholars such as Chanakya and Panini illustrates how

1.1.6 The Tirukkural

The Tirukkural (or Kural), a classic Tamil language text, is regarded as one of the greatest works on ethics and morality in the world. Traditionally attributed to the author Thiruvalluvar, the text is dated variously between 300 BCE and the 5th century CE. It is composed of 1,330 short couplets (kurals), each consisting of precisely seven words.

Praised for its universality and secular nature, the Tirukkural serves as a detailed and aphoristic guide to the morality of common people, earning it the epithet "the Tamil Veda." Its structure is systematically organized, divided into three books that address the three essential goals of human life (Trivarga).

1.1.6.1 Structural Analysis: Aram, Porul, and Inbam

The comprehensive nature of the Kural is established by its tripartite division, covering

the integrated demands of virtue, socio-political life, and emotional well-being:

1. **Aram (Virtue/Dharma) :** The first book lays the moral foundation for individuals and the domestic sphere. It provides aphoristic teachings on virtue, emphasizing core moral tenets necessary for a principled life. Key teachings include the necessity of non-violence, moral vegetarianism, truthfulness, gratitude, hospitality, kindness, and self-restraint. It also elevates the "goodness of wife" and underscores the importance of duty and giving, highlighting the view that domestic life serves as the primary arena for practicing virtue.
2. **Porul (Wealth/Artha/Statecraft) :** The second book systematically addresses the practical, political, and economic aspects of societal management and governance. This section moves beyond individual morality to analyze social and political order. The topics covered are exhaustive and practical, detailing the necessary attributes of the king (Royalty, Chapters 39–63), the role of ministers, and the relationship between subjects and rulers (Chapters 64–73).

Furthermore, Porul discusses critical components of statecraft, including taxation policies, the administration of justice (including the "death sentence for the wicked"), the construction and defense of forts, and the strategic importance of war, the greatness of the army, and soldiers' honor. It extends to fundamental civil practices such as agriculture, the role of education, and public health policies, including abstinence from alcohol and intoxicants.

3. **Inbam (Love/Kama) :** The final book addresses the emotional and relational dimensions of human existence, recognizing that a complete life must balance ethical conduct (Aram) and political engagement (Porul) with emotional fulfillment. This book includes chapters on friendship, concealed love, wedded love, sexual union, and the intricacies of domestic life.

1.1.6.2 Integrated Ethics and Governance

The sophisticated analysis presented in the Tirukkural, particularly in the Porul section, demonstrates a mature political philosophy that demands an ethical grounding for power. The structure insists that the domain of governance (Artha) is intrinsically linked to and must be subservient to the moral domain (Dharma/Aram). By dedicating detailed chapters to political necessities like taxation and military strategy and placing them alongside imperatives such as justice and non-violence, Thiruvalluvar provides a comprehensive ethical compass for leadership.

This integration is a defining feature of the IKS approach to societal organization. It mandates that statecraft should not be viewed as merely transactional or pragmatic (as in certain subsequent Western political philosophies) but must remain tethered to humanistic ethics, ensuring that the pursuit of wealth and power serves the ultimate goal of virtuous conduct. The Kural's secular universality ensures that these principles of integrity, responsibility, and effective leadership remain highly relevant for modern legal, administrative, and ethical frameworks globally.



Recap

- The IKS is defined by the synthesis of Jnan (knowledge), Vignan (scientific observation), and Jeevan Darshan (ethical living). It relies on empirical observation and rigorous, logical analysis to understand the world.
- Modern policy aims to integrate IKS principles to address contemporary global challenges.
- The Vedic corpus provided the structural foundation, growing from external rituals (Brahmanas) to deep philosophical inquiry (Upanishads).
- The Vedangas (auxiliary sciences) ensured that knowledge was accurate and reliable. Vyakarana Created high-level descriptive linguistics. Sulba Sutras Developed advanced applied geometry. These methods led to major mathematical breakthroughs, such as the decimal system and the concept of zero.
- Gurukulas Focused on character development and personal growth. Institutions like Takshashila and Nalanda provided specialized, high-level learning.
- Texts like the *Tirukkural* offered a universal guide for morality. The system insisted that governance and statecraft (Porul) must always be grounded in ethics (Aram).

Objective Questions

1. What does the Sanskrit root word *Vid* mean?
2. Which Veda is considered the oldest textual foundation of Indian culture?
3. What is the specific term for the "Philosophy of Life" in the trilateral foundation of the Indian Knowledge System (IKS)?
4. Name the four components into which each Veda is organized.
5. Which Vedanga is known as the science of linguistic structure or grammar?
6. What does the term *Vedanta* literally mean?
7. Which ancient university operated as a decentralized network of autonomous schools?
8. Which Veda is primarily known as the "Veda of Melodies"?
9. How many Vedangas are there?
10. Which book is known as the Veda of Tamil?

Answers

- | | |
|--|---------------------|
| 1. To know | 6. End of the Vedas |
| 2. Rigveda | 7. Takshashila |
| 3. Jeevan Darshan | 8. Samaveda |
| 4. Samhita, Brahmana, Aranya-
ka, and Upanishad | 9. Six |
| 5. Vyakarana | 10. Tirukkural |

Self Assessment Questions

1. What are the four Vedas?
2. What is Niruktha?
3. How did Vedangas ensure "scientific credibility" for the Vedas?
4. What are the trilateral foundations of the Indian Knowledge System?
5. What is Upanishad?
6. What are the names of the Vedangas?
7. Explain Aaram, Porul, and Impam in Tirukkural.
8. What are the characteristics of the Gurukula system in India?
9. What are the characteristics of Nalanda and Takshashila?

Assignments

1. Discuss the relevance of the Indian Knowledge System in modern education.
2. Explain the importance of the Vedas and Vedangas in Indian culture.
3. Analyze the Gurukula system as sustained in India.



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Unit 2

Ancient Indian Philosophy and Literature

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- ▶ understand the meaning and significance of Indian Philosophy
- ▶ analyze the multifaceted Indian philosophical perspectives to life
- ▶ resolve the problems of daily life by incorporating the principles of Indian philosophy.
- ▶ evaluate the various philosophical systems that existed in India.

Prerequisite

Indian philosophy is a vast treasure trove of diverse perspectives, showcasing the intellectual capacity of ancient Indians. Indian philosophical thought continues to significantly influence modern human life. Scholars of Indian philosophy deeply contemplated the nature of humanity, the purpose of life, the reasons for birth and suffering, the creation and destruction of the world, the nature and production of knowledge, and the validity of knowledge. They developed various theories on different issues, as well as multiple theories on the same issue.

Key Words

Orthodox, heterodox, perception, inference, comparison, testimony, categories, abhava, purusha, prakriti, dharma, maya, Advaita, dvaita, four noble truths, fate.



Discussion

1.2.1 Divisions Of Indian Philosophical Systems

The Indian philosophical systems are broadly classified into two categories: orthodox (āstika) and heterodox (nāstika). The six philosophical systems that fall under the orthodox division are *Mimamsa*, *Vedanta*, *Sankhya*, *Yoga*, *Nyaya*, and *Vaiśeṣika*. These systems are classified as āstika not because they believe in God, but because they accept the Vedas as authoritative. Among the six systems, *Mimamsa* and *Sankhya* do not acknowledge the existence of God. Therefore, we cannot classify the philosophical systems as orthodox or heterodox solely based on their belief in God.

Under the heterodox classification, there are three philosophical systems: *Carvaka*, *Bauddha*, and *Jaina*. The Vedas have significantly influenced the development of Indian philosophical thought. *Mimamsa* and *Vedanta* are direct continuations of Vedic culture. *Mimamsa* philosophy emphasizes the ritualistic aspects of the Vedas and develops a philosophy to justify the performance of Vedic rituals. In contrast, *Vedanta* focuses on the speculative aspects of the Vedas and elaborates detailed philosophical ideas.

1.2.2 Brief Description of the Indian Philosophical Systems

1.2.2.1 Nyaya Philosophy

Sage Gautama is the founder of Nyaya philosophy. Nyaya holds a realistic view based on logic and is known as Indian logic, the science of reasoning, and the science of argument. Its most significant contributions include studies on knowledge and the means of valid knowl-

edge. Nyaya accepts four pramanas (sources of valid knowledge): perception (pratyaksha), inference (anumana), comparison (upamana), and testimony (sabda).

Perception is the direct knowledge that arises from the contact of the sense organs with objects. Inferential knowledge arises through the perception of a sign (hetu) that is invariably related to the object to be proved (sadhya). The invariable relation between two things is known as vyapti. For example, smoke is invariably connected with fire, establishing vyapti between these two. An example of inference is: "The hill has fire because it has smoke; where there is smoke, there is fire, as in a kitchen; therefore, the hill has fire."

Comparison refers to the knowledge of the relationship between a name and the object that possesses that name. This knowledge arises based on the similarity to a familiar object. For instance, a person who does not know the object indicated by the word 'gavaya' learns that gavaya is similar to a cow, which is a familiar object. Later, when he sees an animal resembling a cow, he identifies it as the object referred to by the word gavaya.

Sabda, or verbal testimony, is the knowledge that arises from the statements of authoritative persons.

The Nyaya Philosophy accepts 16 categories (padarthas): Pramana, prameya, samsaya, prayojana, drishtanta, siddhanta, avayava, tarka, nirnaya, vada, jalpa, vitanta, hetvabhasa, cchala, jati, and nigrasthana. The prameya, or object of knowledge, includes the self, body, senses, objects of the senses, cognition (buddhi), mind, activity, mental defects (dosa), rebirth (pretyabha), feelings of pleasure and pain (phala), suffering (duhkha), and apavarga (freedom from liberation). The ultimate aim of the study of Nyaya Philosophy is to

attain moksha (liberation). The self or soul is distinct from the body, mind, and sense organs. The body is composed of matter, while the mind is eternal and atomic in nature, considered the internal sense organ. The soul attains knowledge of pleasure and pain through the mind. Although the soul is the abode of knowledge, consciousness is not an essential quality of the soul. In the state of moksha, the soul is free from knowledge. The soul is eternal and all-pervading. Due to ignorance, desire, aversion, and infatuation, the soul acts for both good and bad ends, becoming connected with the world of sin and suffering, birth, and death. Liberation means the removal of all pain through right knowledge.

In Nyaya Philosophy, the soul is divided into two categories: the individual soul (jivatma) and the supreme soul (paramatma). The supreme soul, or God, is one, omniscient, and omnipotent. God is the instrumental cause (nimittakarana) of the world. At the time of creation, according to God's wish, atoms are joined together in a particular manner, producing worldly objects. The world is created with the aim of experiencing pleasure or pain according to the dharma or adharma residing in each jivatma.

The existence of God is proven by inference. The main argument for this is as follows: Objects in the universe, such as the earth and sun, are produced by a producer because they are effects, like a cloth. The individual soul cannot be the producer of the earth and similar objects, as they have limitations in power and knowledge. Only an intelligent agent, who is not limited in knowledge and power, can be the creator of this world. Such an intelligent agent is God, the creator of the world.

1.2.2.2 The Vaiseshika Philosophy

Sage Kanada, also known as Uluka, is the founder of Vaiseshika Philosophy. Nyaya and

Vaiseshika Philosophies are allied systems. Like Nyaya, Vaiseshika also aims for liberation as the highest end of life.

To study the word, the Vaiseshika divided the world into seven categories. These categories are substance (dravya), quality (guna), action (karma), generality (samanya), particularity (visesha), inherence (samavaya), and non-existence (abhava). Substance is the abode of quality and action. It is further divided into nine types: earth, water, fire, air, ether (akasa), time (kala), space (dik), soul, and mind. Earth, water, fire, air, and ether are known as the physical elements. Each of these five bhutas possesses unique qualities: smell, taste, color, touch, and sound, respectively. The earth, water, fire, and air are produced from the atoms of each bhuta. Atoms are eternal, indivisible, and imperceptible. Akasa and space are eternal and all-pervading substances. The mind is atomic in size and eternal. It serves as the internal sense organ involved in all knowledge production, acting as a mediator between the soul and external sense organs. Because the mind is atomic, it can only interact with one sense organ at a time, which is why we cannot have multiple pieces of knowledge simultaneously. The soul is eternal and all-pervading, serving as the substratum of knowledge. The individual soul is perceived by the mind, while the supreme soul is inferred as the creator of the world.

Quality is the second category (padartha), inherent in substance. A quality does not contain another quality, nor does it involve action. Quality (guna) is divided into twenty-four types: color, taste, smell, touch, sound, number, magnitude (pariman), distinctness (prithaktva), conjunction (sam yoga), disjunction (vibhaga), remoteness (paratva), nearness (aparatva), fluidity (dravatva), viscosity (sneha), cognition (buddhi), pleasure, pain, desire, aversion, effort (prayatna), heaviness (gurut-



va), impression (samskara), merit (dharma), and demerit (adharma).

The third category is action (karma), which resides in substance. Action is classified into five types: upward movement (utkshepana), downward movement (apakshepana), contraction (akunchana), expansion (prasarana), and motion (gamana). The fourth category, samanya (generality), represents the common factor (samana dharma) that remains in a group of the same class. For example, in cows, there is a common factor that identifies them as cows, despite differences in color, shape, etc. This common factor is known as cowness (gotva). Samanya is eternal, singular, and resides in many individuals. There are two kinds of samanya: more comprehensive (param) and less comprehensive (aparam). The samanya that pervades a larger area is param, while the one that covers a smaller area is aparam. For instance, according to Vaiseshika theory, a cow falls under the category of dravya, which means it possesses both samanya dravyatva and samanya cowness. Among these, dravyatva is param, while cowness is aparam.

The fifth category is visesha (particularity), which forms the basis of the differences among things. The atoms of the four bhutas and the eternal, all-pervading substances are distinguished by particularity (visesha). Thus, visesha resides in eternal substances. This system is called Vaiseshika because of its special acceptance of visesha as a separate padartha (category) in this philosophy.

The sixth padartha is inherence (samavaya), known as the eternal relation. This relation exists between parts and the whole, generality and the individual, substance and guna, substance and action, etc. For example, the relationship between cloth and threads exemplifies inherence, as does the connection between cowness and the cow.

The last padartha is Abhava (non-existence). Statements such as "there is no smell in the flower" and "there is no sweetness in the fruit" refer to the absence of something. Vaiseshika divides abhava into four categories: pragabhava (prior non-existence), pradhvamsabhava (post non-existence), atyantabhava (absolute non-existence), and anyonyabhava (mutual non-existence). The first three divisions of abhava are referred to as samsargabhava (absence of relation between two things). Pragabhava refers to the absence of a thing before its production; for example, the absence of a cloth before it is made. Atyantabhava refers to the absence of a thing after its destruction; for instance, the absence of a cloth after it has been destroyed. Atyantabhava exists at all three times, limited by relation; for example, a pot is absent on the ground. Here, the absence is based on the relation of samavaya: through samavaya, a pot cannot exist on the ground. Therefore, the absence of the pot on the ground, according to the relation of inherence, exists in all three times (past, present, and future).

1.2.2.3 The Sankhya Philosophy

Sage Kapila is said to be the founder of Sankhya Philosophy, which primarily discusses two independent realities: Purusha and Prakriti. Consciousness is the essence of Purusha, distinct from the body, mind, and senses. Purusha witnesses all types of changes in the world but does not undergo any change itself and is not part of any activity. It is the enjoyer of the products of Prakriti. Sankhya posits the existence of many purushas or souls, corresponding to the many bodies, with some being happy while others are unhappy at any given time.

Prakriti represents the equilibrium of the three gunas: sattva, raja, and tama. It is the root cause of the world, undergoing change

and working for the satisfaction of Purusha. Sattva, raja, and tama are the fundamental elements of Prakriti, inferred from the experiences of pleasure, pain, and indifference, respectively. According to Sankhya, cause and effect are identical, with the effect manifesting from the cause under suitable conditions. For example, oil exists in a seed but is only manifested when the conditions are right.

Sankhya teaches that the world is produced through the process of evolution. The evolution of prakriti manifests as the various objects in the world. When Purusha associates with Prakriti, the equilibrium of Prakriti is disturbed, prompting it to act. The first effect, known as Mahat, originates from Prakriti. Although Prakriti itself lacks consciousness, this consciousness is reflected in it due to the close presence of Purusha. Similarly, the consciousness of Purusha is reflected in Mahat, resulting in Mahat being perceived as conscious. Thus, Mahat is also referred to as Buddhi in Sankhya philosophy.

From Buddhi, Ahamkara evolves, which serves to create the sense of 'I' and 'mine.' Due to its close association with Ahamkara or Mahat, Purusha mistakenly identifies itself as the doer, though it is not a doer. From Ahamkara arise the five sense organs, the five organs of action, and the mind, all of which are predominately influenced by the element of Sattva.

With an excess of Tamas, Ahamkara generates the five tanmatras: sound, touch, color, taste, and smell. From these tanmatras, the five gross elements—Akasha, Air, Fire, Water, and Earth—emerge. In this manner, Sankhya outlines twenty-five principles, with Prakriti serving as the uncaused cause of all things. Mahat, Ahamkara, and the five tanmatras function as both causes and effects, while the jnanendriyas, karmendriyas, and the five gross elements are solely effects.

Sankhya asserts that the self is eternal and free from all sorrows. However, due to ignorance, it mistakenly identifies itself with the body and senses. This failure to distinguish between self and not-self is the root of all suffering for Purusha. When Purusha recognizes its distinctness from the body and mind, it becomes unaffected by worldly suffering. In this state, the self exists as a dispassionate observer of all things. This condition is known as Moksha, or liberation, according to Sankhya. One can achieve this state while alive or after death, leading Sankhya to accept both Jivanmukti (liberation while alive) and Videhamukti (liberation after death). To attain Moksha, one must engage in spiritual practices like meditation, accompanied by the discriminative knowledge of self and not-self. Sankhya does not address the concept of God; instead, it explains the production of the world solely through Prakriti.

1.2.2.4 Yoga Philosophy

Yoga Philosophy was founded by Sage Patanjali. The Yoga and Sankhya systems are allied. This philosophy accepts all twenty-five principles of Sankhya and, in addition, acknowledges the existence of God. It emphasizes the practice of yoga, which means the removal of all mental functions (chittavrittinirodha). The mental functions have five states: kshipta, mudha, vikshipta, ekagra, and niruddha. The ekagra and niruddha states of mind are particularly useful for practicing yoga. The highest level of yoga is Samadhi, which is classified into two categories: Samprajnata and Asamprajnata. In Samprajnata Samadhi, the mind is fully concentrated on the object of meditation. In Asamprajnata Samadhi, all mental functions completely cease, resulting in no awareness of anything during this state.



Yoga Philosophy presents an eight-step practice that is essential for attaining the highest aim of yoga. These eight steps are known as Ashtanga Yoga and include Yama, Niyama, Asana, Pranayama, Pratyahara, Dharana, Dhyana, and Samadhi. Yama emphasizes restraint from falsehood, theft, lack of self-control, and desire. Niyama encourages good habits such as purification, contentment, and penance. Steady and comfortable postures are included in Asana. Pranayama refers to the inhalation, exhalation, and retention of breath. Pratyahara means the withdrawal of the sense organs from their objects. Dharana involves fixing the mind on a specific focus. Dhyana is the constant contemplation of an object without interruption. In Samadhi, the awareness of the act of contemplation itself is lost. According to Yoga Philosophy, God is the perfect being—eternal, all-pervading, omniscient, and free from all defects.

1.2.2.5 Mimamsa Philosophy

Mimamsa (Purva Mimamsa) was founded by Jaimini. The primary aim of Mimamsa is to protect and justify Vedic rituals, such as yagna. To explain the efficacy of Vedic activities, this philosophy has been developed. All Vedic performances are based on the validity of the Vedas. Hence, Mimamsa scholars assert that the Vedas are eternal and not the creation of any individual; they are self-existing, with sages merely being the seers of the pre-existing Vedas. In this manner, the Vedas are considered free from error. According to Mimamsa, knowledge is self-valid; there is no need for any external factor to prove its validity. Since all knowledge is self-evident, the knowledge of the Vedas is also self-evident. Any doubts regarding the Vedas can be resolved through Mimamsa's arguments, so the authority of the Vedas cannot be questioned.

The Vedas insist on performing dharma (righteous actions). They prohibit wrongdoing. One should do what the Vedas instruct and refrain from what they deny. Duties must be performed without expectation, as enjoined by the Vedas. Those who carry out the rituals prescribed by the Vedas without seeking rewards will be freed from karmas and attain liberation.

Mimamsa posits that the soul is eternal, and consciousness is not an intrinsic attribute of the soul. In a state of liberation, the soul is free from consciousness. The Prabhakara Mimamsa explains five kinds of valid knowledge: perception, inference, comparison, testimony, and postulation (arthapatti). The Kumarila Bhatta sect of Mimamsa accepts six kinds of valid knowledge, adding anupalabdhi to the five types of pramanas recognized by the Prabhakara Mimamsa sect.

Mimamsa acknowledges the reality of the external world, making it realistic in nature. It does not accept the existence of God. Instead, it adheres to the karma theory, believing that karma governs the world. Each action generates an apurva (an unseen property) in the soul, which serves as the basis for future results.

1.2.2.6 The Vedanta Philosophy

Vedanta philosophy is rooted in the Upanishads, which constitute the final part of the Vedas. The knowledge conveyed by the Upanishads is considered the culmination of understanding, hence the name, as it pertains to the concluding portion of the Vedas while also embodying the ultimate level of knowledge. The Brahmasutra of Badarayana is the foundational text of this philosophy. This text has been commented on by many scholars, among whom Sankaracharya and Ramanuja are prominent figures. In Vedanta philosophy,

the supreme soul, or Brahman, pervades the entire universe. There exists one reality in the world: Brahman. The supreme soul is infinite consciousness and bliss.

Sankara asserts that there is one God in everything, with no multiplicity within God. When one perceives God, that individual gains understanding of all things. God creates this world through his magical power known as maya. The world is an appearance, not reality, akin to mistaking a rope for a snake. In truth, only the rope exists, not the snake; however, we perceive it as a snake due to ignorance. Similarly, in the case of the world, there is no world—only Brahman. Our ignorance leads us to misinterpret Brahman as the world. This ignorance conceals reality and causes it to appear as something else.

Sankara distinguishes between two kinds of entities: empirical (vyavaharika) and transcendental (paramarthika). Vyavaharika entities are unreal, and as long as ignorance persists, one experiences these entities. In contrast, the paramarthika entity is real and can be experienced by an enlightened person. At the vyavaharika level, God appears to possess qualities (sagunabrahma), but at the paramarthika level, God is realized as devoid of qualities (nirguna Brahma). The paramarthika state is attained through the removal of ignorance. To eliminate ignorance (avidya), one must acquire the knowledge conveyed by Vedanta.

Those who want to attain moksha must control their sense organs and be free from attachments to worldly objects. Vedanta points out four great sentences (mahavakya) that explain the essential nature of Brahman. These sentences are: "Prajnanam Brahma, Ayam Atma Brahma, Tat Tvam Asi, Aham Brahmasmi." Aham Brahmasmi represents the final state where one identifies with the statement 'I am the Brahman.'

Subdivisions of Vedanta Philosophy

1. **Advaita Vedanta** : This philosophy, founded by Sankaracharya, posits that there is only one reality in the universe, which is Brahman. The world is an unreal appearance, and the truth is non-duality (advaita). There is no difference between the jiva and God; there are not many souls. Ignorance creates the illusion of duality.
2. **Dvaita Vedanta** : Founded by Madhavacharya, this school maintains that Brahman, Atman, and matter are eternal and separate entities. In this philosophy, God is identified as Brahman, with Vishnu or Krishna being the manifestation of Brahman. Bhakti is the path to liberation.
3. **Visishtadvaita Vedanta** : This division was founded by Ramanuja, who believed that Brahman possesses attributes. Bhakti is essential for perceiving God Vishnu. Ramanuja teaches that worshipping God Vishnu is necessary to attain moksha, making bhakti the path to liberation.

1.2.2.7 The Jaina Philosophy

The Jaina faith was transmitted by the twenty-four Tirthankaras, or liberated souls, the last of whom was Vardhamana Mahavira. Jaina philosophy is realistic and pluralistic; since it denies the existence of God, it is considered atheistic. Jainas oppose the Charvaka view that perception alone is a valid source of knowledge. They accept inference and testimony as additional sources of valid knowledge. According to Jainas, if one dismisses inference and testimony as valid means of knowledge due to potential misleading information, then perception cannot be considered



a valid source either, as it can also lead to illusion. The Charvaka philosophy requires inference to demonstrate the invalidity of inference and testimony as sources of knowledge. Jainas believe that the teachings of the Jinas or Tirthankaras provide accurate knowledge about spiritual matters, as sense organs cannot directly acquire knowledge of such matters.

The Jaina view of the universe is based on three kinds of Pramana (valid sources of knowledge): perception, inference, and testimony. Knowledge of material things produced from the four elements is attained through perception. Jainas use inference to explain the existence of substances like space (akasa), time (kala), dharma, and adharma—the causes of movement and cessation in things. By using both perception and inference, they prove the existence of the soul. When we know the attributes of a fruit, such as color, taste, and touch, we are perceiving the fruit itself. Similarly, when we internally experience qualities like pleasure and pain, which are associated with the soul, we can conclude that we are also perceiving the existence of the soul.

According to Jainas, consciousness is not produced by matter. They argue that Charvaka cannot provide any examples where consciousness is generated from matter. The existence of the soul can be inferred from the fact that without a conscious agent, the body and sense organs cannot function properly. Jainas believe that there are as many souls as there are living bodies. According to Jaina belief, souls exist not only in animals but also in plants and even in particles of dust. The consciousness of souls varies: some, like those in plants, have only one sense organ (touch) and possess only tactual knowledge. Among animals, some have two senses, others three, and some have four senses. Human beings and certain animals possess five senses. The souls residing in bodies experience limitations

in knowledge and power and endure various forms of suffering.

A soul can acquire unlimited consciousness, pleasure, and power. The nature of the soul is characterized by consciousness and pleasure; however, due to karma, this nature is not fully experienced by the soul. The forces of passion and desire within the soul attract it to matter. In other words, karma, passions, and desires lead the soul into bondage. When the soul is freed from this bondage, it can regain its natural perfections.

Tirthankaras demonstrated the attainment of liberation through their teachings. According to Jaina philosophy, three factors are necessary to remove bondage: complete belief in the teachings of the Jaina Teachers, genuine knowledge of those teachings, and right conduct. Right conduct entails self-control over all forms of misery, including falsehood, stealing, sensuality, and attachment to worldly objects. By following right faith, right knowledge, and right conduct, one can control passions and eliminate karmas (forces of passions and desires). Once these karmas are removed, the soul is illuminated by its inherent qualities: infinite faith, infinite knowledge, infinite power, and infinite bliss. This natural state of the soul is referred to as liberation. In Jaina philosophy, Tirthankaras are regarded as omniscient and omnipotent, occupying a divine status, with no other gods recognized in Jainism.

Jaina philosophy emphasizes sympathy towards all living beings and respect for diverse opinions. Jaina philosophers instruct that every object has numerous aspects depending on different points of view. Therefore, one judgment of a thing is valid only in relation to a particular aspect and perspective. As a result, one cannot assume that their viewpoint on a specific matter is perfect.

1.2.2.8 The Baudha Philosophy

Gautama Buddha is the founder of Baudha Philosophy. Recognizing the presence of disease, old age, death, and other miseries in human life, Buddha became aware of human suffering. He began to contemplate the causes of this suffering and the means to alleviate it. With this in mind, he spent many years in penance and meditation. Ultimately, he attained enlightenment and developed a framework known as the "Four Noble Truths" (Chatvari Arya Satyani). The four noble truths are: there is suffering, there is a cause of suffering, there is a cessation of suffering, and there is a path leading to the cessation of suffering. Among these truths, the first—suffering exists—is universally accepted. Buddha asserts that all things perceived as pleasant are, in fact, sources of pain.

The second noble truth, "there is a cause of suffering," stems from his understanding of causation. He explains that everything in the universe is subject to change, and nothing is permanent. Each phenomenon has its conditions, and the condition for human suffering is birth. The desire for worldly objects is the root cause of birth, and ignorance gives rise to that desire. When one acquires true knowledge of worldly things, recognizing them as temporary and painful, desire will cease, and thus birth will cease, leading to the removal of suffering.

The third noble truth, "the cessation of suffering," states that when the conditions of suffering are eliminated, human suffering will also cease.

The fourth noble truth, which is the path leading to the cessation of misery, emphasizes controlling the conditions that cause suffering. In this context, the Buddha introduced eight steps, collectively known as the Eight-fold Noble Path. These eight steps are: right

views, right determination, right speech, right conduct, right livelihood, right endeavor, right mindfulness, and right concentration. By following these eight steps, one can overcome ignorance and desire, leading to an enlightened mind and a state of equanimity. Consequently, suffering is completely alleviated, and the cycle of rebirth is halted. There is no soul, no God, and nothing is permanent.

Subdivisions of Bauddha Philosophy

1. **The Madhyamika School (Sunyavada School) :** The Madhyamika school asserts that the world is not real but is instead sunya (emptiness). Both physical and mental phenomena are considered unreal. This perspective is referred to as nihilism or sunyavada.
2. **The Yogachara School (Vijnavada School) :** The Yogachara school posits that external things are not real; only the mind is real. Thought is an activity of the mind, and thus one cannot deny the existence of the mind. This theory is known as idealism or vijnanavada.
3. **The Sautrantika School :** Followers of the Sautrantika school believe that both physical and mental phenomena are real. However, external objects are inferred based on the mind's perception. Our experience of external things relies on factors beyond the mind. If perceptions of external objects were not real, they could not depend on anything outside the mind. Therefore, external objects are real, and this school infers their existence from the mind's perceptual ideas.
4. **The Vaibhashika School :** The Vaibhashika school accepts that both internal and external things are real.



External objects can be directly perceived rather than inferred. If external objects are not perceived, they cannot be inferred. The Vaibhashika theory is known as bahya pratyaksha vada.

The Hinayana and Mahayana Sects of Buddhism

In terms of religious classification, Buddhism is divided into two main sects: Hinayana and Mahayana. The Madhyamika and Yogachara schools fall under the Mahayana sect, while the Sautrantika and Vaibhashika schools belong to the Hinayana sect. The primary difference between these two schools relates to the object of nirvana. Hinayana teaches that nirvana must be attained to end one's suffering. In contrast, Mahayana asserts that one should seek nirvana not only to alleviate personal suffering but also to attain complete wisdom and, through that wisdom, work toward the salvation of all beings.

1.2.2.9 Ajivika Philosophy

Ajivika philosophy is an ancient Indian doctrine centered on absolute determinism, or niyati (fate), which holds that all events are preordained and that free will is an illusion. It rejects the concept of karma, believing that a soul's path is already mapped out and that all beings possess an eternal soul (atman) ultimately guided to a predetermined nirvana. The sect was founded by Makhali Gosala in the 5th century BCE and is now extinct, though its influence can be seen in some architecture, such as the Barbar Caves.

Core Tenets of Ajivika Philosophy

- **Niyati (Fate) :** The central tenet is that everything in the universe, including the path to liberation, is predetermined. Human effort is considered ineffective in changing one's fate.

- **Rejection of Karma:** Ajivikas dismissed karma as a fallacy, believing that good and bad actions do not influence one's destiny. Instead, they viewed suffering as a consequence of fate.
- **Atomism:** The philosophy includes a theory of atomism, similar to that of the Vaiseshika School, positing that all matter is composed of tiny atoms whose combinations create characteristics, influenced by cosmic forces.
- **Atman (Soul):** Ajivikas believed in the existence of an eternal soul (atman) that is material in nature, a tenet shared with other Indian religions like Hinduism and Jainism.
- **Predetermined Liberation:** They believed that every being has an atman that will eventually achieve its predestined liberation (moksha or nirvana) after a fixed number of rebirths, a process not influenced by individual choices.
- **Atheistic Elements:** While non-theistic and rejecting a creator deity, Ajivikas acknowledged a cosmic order and believed the universe operates according to set principles.

1.2.2.10 Ajnana

Ajnana philosophy was an ancient Indian school of radical skepticism, or "agnosticism," that held knowledge about metaphysical truths to be impossible and, even if attainable, meaningless or harmful for salvation. As a rival to early Buddhism and Jainism, the Ajnana school focused on challenging other viewpoints rather than presenting a positive, constructive philosophy of its own.

- **Radical Skepticism:** The core belief is that it is impossible to know meta-physical truths or the "true value of philosophical propositions."
 - **Focus on Negation:** Ajnana philosophers concentrated on refuting the positive claims of other schools rather than offering their own positive doctrines.
 - **Antagonistic to Other Schools:** Ajnana was a major rival to early Buddhism, Jainism, and the Ajivika school.
 - **Harmful Knowledge:** The school also believed that even if knowledge could be obtained, it was useless and even detrimental to achieving ultimate salvation.
 - **Founder:** Sanjaya Belatthiputta is identified as a key proponent of this school of thought.
 - **Recorded in Other Scriptures:** The views of the Ajnana school are recorded in Buddhist texts like the [Brahmajala Sutta](#) and the Jain text [Suyagadamga](#).
- inference, testimony, or other means as reliable. They believe only in what can be known directly. The material world is composed of four elements: air, fire, water, and earth, which we can perceive directly through our senses. There is no proof for the existence of the soul; when we refer to "I" or "you," we are simply indicating the human body, as in "I am lean" or "you are thick." Thus, the individual is identical with the body. In the living body, consciousness arises from matter. While consciousness is absent in the individual elements, it is produced in a living body, which is a combination of these elements. For example, when betel leaf, nut, and lime are chewed together, they produce a red color that is not present in any of the individual components. Similarly, consciousness emerges in a living body from the specific combination of the four elements.

After death, there is no life because we cannot prove the existence of such a life. Additionally, there is no proof for the existence of God; we do not perceive God through our senses. God is not the creator of the world; instead, the world arises from the combination of material elements. Engaging in religious activities to attain pleasure after death or to please God is seen as foolishness. The Vedic priests exploit the followers of the Vedic tradition. The ultimate aim of life is to experience extreme pleasure from worldly existence. Every person should strive to maximize pleasure and minimize pain.

1.2.2.11 Charvaka Philosophy

The word "Charvaka" means materialist. Charvakas accept only perception as a valid source of knowledge and do not recognize

Recap

- Indian philosophy is a rich tapestry of thought, traditionally divided into two main streams: Orthodox (Astika) and Heterodox (Nastika) systems.
- The Orthodox branch consists of six systems (Shad-darshana): Nyaya , Vaisesika , Sankhya , Yoga, Mimamsa , and Vedanta.



- The Heterodox systems are Charvaka, Jaina, and Bauddha (Buddhism)
- Beyond these well-known schools, ancient India also hosted radical ideologies such as Ajivika and Ajnana. Ajivika, founded by Makkhali Gosala, was based on Niyati (absolute determinism), arguing that free will is an illusion and that karma has no power over a predestined fate.
- The orthodox schools focus on the relationship between the individual soul (Atman) and the ultimate reality (Brahman)
- The heterodox schools emphasize ethical conduct and mental liberation.
- Collectively, these systems seek to understand the nature of existence and the path to Moksha or Nirvana (liberation from suffering).

Objective Questions

1. Who is the founder of the Nyaya philosophical system?
2. Which term is used for schools that accept the authority of the Vedas?
3. How many categories (Padarthas) are accepted by the Vaiseshika system?
4. Which specific category makes the Vaiseshika system unique from Nyaya?
5. Who is the founder of the Yoga Philosophy?
6. How many steps are there in the practice of "Ashtanga Yoga"?
7. Who is the founder of the Dvaita Vedanta school?
8. Which school of Mimamsa accepts six kinds of valid knowledge (pramanas)?
9. In Yoga, what is the term for the highest level of concentration or mental cessation?
10. Who was the 24th and last Tirthankara of Jainism?
11. According to Charvaka, what is the only valid source of knowledge?
12. Which school of ancient Indian skepticism was led by Sanjaya Belatthiputta?
13. What is the central tenet of Ajivika philosophy ?
14. Which Buddhist school is also known as "Sunyavada"?

Answers

- | | |
|----------------------|--------------------------|
| 1. Sage Gautama | 8. Kumarila bhatta |
| 2. Astika (Orthodox) | 9. Samadhi |
| 3. Seven | 10. Vardhamana Mahaveera |
| 4. Vishesha | 11. Perception |
| 5. Sage Patanjali | 12. Ajivika |
| 6. Eight | 13. Niyathi |
| 7. Madhvacharya | 14. Madhyamika |

Self Assessment Questions

1. What is the primary difference between Astika and Nastika schools?
2. How does Nyaya define 'Perception' (Pratyaksha)?
3. What are the three Gunas in Sankhya philosophy, and what do they represent?
4. How does Yoga Philosophy define 'Yoga'?
5. What is the difference between 'Samprajnata' and 'Asamprajnata' Samadhi?
6. Why is the Mimamsa school considered realistic?
7. Define 'Apurva' according to Mimamsa.
8. What is the 'Eightfold Noble Path' in Buddhism?
9. What is the main difference between the Hinayana and Mahayana sects?
10. What is the Ajivika view on human effort?
11. Explain the evolution of the world according to Sankhya Philosophy.
12. Describe the four types of 'Abhava' (Non-existence) in Vaisesika.
13. Compare the focus of Mimamsa and Vedanta regarding the Vedas.
14. What is the Mimamsa view on the authority and validity of the Vedas?
15. Why does Charvaka reject the concepts of God, Soul, and the Afterlife?



Assignments

1. Describe the eight steps of 'Ashtanga Yoga'
2. Explain the concept of Brahman and the World in Sankaracharya's Advaita Vedanta.
3. Describe the Jaina view of the Soul and its liberation.
4. Explain the Four Noble Truths of Buddhism.

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Unit 3

Language and Art

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- ▶ understand the Sanskrit language that enriched Indian languages, and its rich literature.
- ▶ understand the epics that influenced Indian culture.
- ▶ analyze Indian mural painting, sculpture, and Mughal art
- ▶ understand the basic concepts and Historical background of Indian music

Prerequisite

The Indian Knowledge System delves into the foundational pillars of India's rich and multifaceted heritage, beginning with the linguistic bedrock of Sanskrit and its literary traditions, particularly the epic narratives chronicled in the Itihasa (epics like the *Mahabharata* and *Ramayana*). Central to the evolution of this classical language is the monumental work of Pāṇini on grammar, specifically his *Aṣṭādhyāyī*, which systematically standardized Sanskrit and influenced linguistic studies globally. We will also examine the emergence of vernacular tongues like Prakrit, which served as the language of the common people and early Buddhist and Jain texts. The journey then transitions into the realm of visual and performing arts, highlighting the vibrant narratives captured in ancient mural paintings (such as those at Ajanta) and the development of intricate sculptures. We will trace the evolution of sculptural art through the influential Gandhāra School of Art, known for blending Hellenistic and Indian styles, and contrast this with the imperial patronage that fostered the elegance and synthesis found in Mughal art. Finally, we will explore the profound and diverse traditions of music that have shaped the devotional and cultural life of the subcontinent for millennia.



Key Words

Indo-Aryan family, Prakrit, Shauraseni, Adikavya, seven kandas, fifth Veda, eighteen parvas, Bhagavad Gita, Aṣṭādhyāyī, karaka theory, Kerala murals, Shilpasutra, Mughal art, udatta, anudatta, svaritha.

Discussion

1.3.1 Sanskrit

Sanskrit is an ancient and classical language of India in which the world's first book, the Rigveda, was compiled. Scholars date the Vedas from 6500 B.C. to 1500 B.C., suggesting that Sanskrit must have evolved to its expressive capability prior to that. It is presumed that the language used in the Vedas existed in various dialects, differing somewhat from present-day Sanskrit. This form is referred to as Vedic Sanskrit. Each Veda had its own book of grammar known as Pratishakhya, which explained the forms of words and other grammatical points. Over time, numerous schools of grammar developed. During this period, a vast body of literature—including the Vedas, Brahmana-Granthas, Aranyakas, Upanishads, and Vedangas—emerged, collectively termed Vedic Literature, and was written in Vedic Sanskrit.

Pāṇini (circa 500 B.C.) marked a significant milestone in the development of the Sanskrit language. Concising the ten grammar schools prevalent during his time, he authored the masterwork of grammar titled *Aṣṭādhyāyī*, which served as a beacon for future linguistic study. Both literary and spoken Sanskrit followed Pāṇini's linguistic system. Today, the correctness of the Sanskrit language is measured against the standards established in Pāṇini's *Aṣṭādhyāyī*.

Sanskrit is considered to belong to the Indo-Aryan or Indo-Germanic family of languages, which includes Greek, Latin, and similar languages. William Jones, who was

already familiar with Greek and Latin, remarked upon encountering Sanskrit that it is more perfect than Greek, more copious than Latin, and more refined than either. He stated, "Sanskrit is a wonderful language." Notably, although ancient and classical, Sanskrit is still used as a medium of expression by scholars throughout India and in some other parts of the world, such as America and Germany. Sanskrit is included in the list of modern Indian languages in the eighth schedule of the Constitution of India.

Sanskrit has been the source of later languages and literature in India. Pali and Prakrit were the first languages to develop from Sanskrit. Pali was adopted as a means of expressing Buddhist ideas, while Prakrit was used for the dissemination of Jain doctrines. Most Buddhist literature is written in Pali, whereas that of the Jain tradition is written in Prakrit. A vast amount of Buddhist and Jain literature was also produced in Sanskrit during the same period. The Prakrit language exhibited different variations in various regions of India, leading to names such as Paishachi, Shouraseni, Magadhi, Ardha-Magadhi, and Maharashtri. These Prakrits were utilized for composing ornate poetry, such as Gaha Saptashati and Karpur Manjari, as well as in Sanskrit drama for the dialogues of women and illiterate characters. From each type of Prakrit, various Apabhramsha languages developed, retaining the same names, like Paishachi Apabhramsha and Shauraseni Apabhramsha. Modern Indian languages have evolved from these Apabhramsha languages.

Hindi, the official language of India, has developed from Shauraseni Apabhramsha. It is said that all the modern Indian languages used in northern India have evolved from Sanskrit, while the modern Indian languages of South India—Tamil, Malayalam, Kannada, and Telugu—have evolved from the Dravidian family of languages. The South Indian modern Indian languages are well enriched and nourished by the Sanskrit language.

Sanskrit literature is as vast as human life itself. The four aims of human life, known as Purusharthas, are Dharma, Artha, Kama, and Moksha. Dharma represents the duties and responsibilities of individuals, Artha pertains to financial needs, Kama encompasses all human desires, and Moksha signifies liberation from birth, rebirth, and worldly attachments. All literature is centered around these four aims of human existence.

At the core of Sanskrit literature are the Vedas, which serve as the foundation for Dharma. The Vedas are the root of Dharma, consisting of four texts: Rigveda, Yajurveda, Samveda, and Atharvaveda. The Brahmanas elaborate on Vedic literature and provide detailed processes for performing Yajnas. The Aranyakas and Upanishads explore the internal meanings of the Vedas and the path to renunciation—Moksha. The Pratishakhyas address grammatical issues related to the Vedas. The six Vedangas—Shiksha, Vyakarana, Kalpa, Chhandas, Nirukta, and Jyotish—aid in understanding the Vedas. According to Indian tradition, the Vedas were not authored by any individual; rather, they are considered the breath of God, perceived by the seers known as Rishis. Later, they were compiled into four Samhitas by the great sage Vyasa. Some scholars believe that different seers authored the Vedas, estimating their composition between 6500 BC and 1500 BC, while the remainder of the Vedic literature was likely completed before 600 BC.

Valmiki was the first to write secular poetry, known as Loka-Kavya. He authored the Ramayana, a great epic that profoundly influenced later literature. Even today, contemporary poetry continues to draw inspiration from Valmiki's work. The Ramayana was written around 500 BC.

The second epic, the Mahabharata, was composed by Krishnadwaipayana Vyasa and is regarded as an encyclopedia of knowledge.

Later, poets such as Kalidasa and Ashvag-hosa made significant contributions during the Gupta period. Bharavi, Bhatti, Kumardasa, and Magha all wrote Mahakavya. Harishe-na and Vatsabhatti were also notable writers. Other divisions of classical literature include historical Kavyas by Kalhana and Bilhana, while Bhartruhari, Amaruka, Bilhana, Jayadeva, and Somadeva are celebrated as lyric poets. The Brihatkatha, along with romantic and didactic fables, erotic poetry, Champu Kavyas, works on poetics, anthologies, gnomic, and didactic poetry, comprise an unparalleled segment of Sanskrit literature.

The scientific literature encompasses lexicography, metrics, grammar, law, political science, love, philosophy, religion, medicine, astronomy, astrology, mathematics, and more.

1.3.2 Itihasa

The Itihasa, primarily represented by the Mahabharata and Ramayana, is an ancient tradition of historical and legendary narratives creatively employed to convey profound spiritual, religious, ethical, and ideal meanings, fundamentally shaping the Indian ethos. The poets, viewing themselves as architects of national life, designed these vast epics not merely as beautiful tales but as comprehensive expositions of India's cultural identity, religion, ethics, and philosophy. Due to their scope and moral authority, the epics are often referred to



as the "fifth Veda" and are considered Dharmaśāstras, embodying comprehensive social, ethical, and political teachings—earning them the title of the "Bible of the Indian people." Their central purpose was to popularize high philosophical and cultural ideas. By framing abstract principles within great poetic stories featuring memorable characters, they transformed complex doctrines, normally confined to the Veda, Upanishad, and Śāstras, into vivid, accessible representations of life. Delivered to the masses by Kathakas (reciters and interpreters), these narratives, in their various linguistic forms, became the chief instruments of popular education and culture, molding the thought, character, and religious mindset of the populace while imparting essential wisdom to all strata of society.

1.3.2.1 The Ramayana

The Ramayana (the path of Rama) is both a work of art and a mirror of a perfect human soul. This unique piece of poetry flowed from the pen of Valmiki at a time when no kavya had yet been written in any form. Hence, it is called Adikavya, and its author Valmiki is referred to as the Adikavi. The Ramayana begins with an outburst of a curse against a hunter for killing a male bird while it was courting its partner. This outburst is regarded by the creator as an indication of the poet's power to craft a poem reflecting deep human compassion for the fullness of life. This epic has served as a guide for poets and artists of later periods. The characters of the Ramayana deserve individual study due to their varied natures. Rama embodies Dharma through the perfection of his human qualities and self-sacrificing nature, never violating the laws of truth and merit.

The Ramayana was composed in Sanskrit by the poet Valmiki, and its present form consists of 24,000 couplets divided into seven kandas: Balakanda, Ayodhyakanda, Ara-

nyakanda, Kishkindakanda, Sundarakanda, Yudhakanda, and Utharakanda. The epic enjoys such great popularity that its recitation is considered an act of great merit. Many of its translations are themselves notable works of literary merit, including the Ramcharit Manas of Tulsidas, the Tamil version by Kamban, the Malayalam version by Thunchathozhuthachan, and the Bengali version by Krittibas.

The story has also spread in various forms throughout Southeast Asia, especially in Cambodia, Indonesia, and Thailand, serving as themes in traditional Japanese and Balinese theatre, dance, and shadow play. Incidents from the Ramayana are carved on many Indonesian monuments. In Thailand, even today, the king is called King Rama, and the main highways are named King Rama Roads.

Ramayana displays a code of ideal human rights. Rama does not seek to capture Lanka; instead, he appoints Vibhishana to take over the power. Rama is committed to removing enmity and establishing virtues. Hence, it is said that the Ramayana Katha will flourish in this world as long as mountains and rivers exist on earth.

1.3.2.2 Summary of the Ramayana

Rama, the eldest and most beloved son of King Dasharatha of Ayodhya, wins the hand of the beautiful princess Sita in a swayamvara (contest of strength) by stringing and breaking Shiva's mighty bow. Just before his coronation, his stepmother Kaikeyi, influenced by her maid Manthara, demands that the king fulfill two past boons: that Rama be exiled to the forest for fourteen years and that her son, Bharata, be crowned king instead. A dutiful Rama accepts the exile without protest and is accompanied by his devoted wife Sita and loyal brother Lakshmana. King Dasharatha dies of grief shortly thereafter.

While living a simple life in the forest, a demoness named Shurpanakha attempts to seduce the brothers and attack Sita; Lakshmana wounds her, cutting off her nose and ears. Her brother, Ravana (the ten-headed demon king of Lanka), vows revenge. He sends a magical golden deer, Maricha, to lure Rama and Lakshmana away from their hut, allowing Ravana to kidnap Sita and take her to his kingdom in Lanka.

Rama and Lakshmana search for Sita and eventually encounter the dying eagle Jatayu, who informs them of the abduction. They form an alliance with the monkey king Sugriva and his loyal general, the powerful monkey warrior Hanuman.

Hanuman leaps across the vast ocean to Lanka, finds Sita in the Ashoka grove, gives her Rama's signet ring, and reassures her that Rama will come to rescue her. Before returning, he sets fire to the city of Lanka with his burning tail.

Rama, Lakshmana, and the monkey army build a bridge (Rama Setu) across the sea to Lanka. A fierce war ensues, during which many warriors fall, including Ravana's formidable son Indrajit and his giant brother Kumbhakarna.

Ultimately, Rama slays Ravana, a major event celebrated during the festival of Dussehra. Sita is rescued and undergoes an ordeal by fire (*Agni Pariksha*) to prove her purity to the people; the fire god Agni restores her unharmed, testifying to her chastity. With the period of exile over, Rama, Sita, and Lakshmana return to Ayodhya and are crowned king and queen, an event celebrated during the festival of Diwali.

1.3.2.3 Mahabharata

The Mahabharata, the largest epic in the history of mankind, is one of the two major

epics of India, alongside the Ramayana. It is termed *vishvakosha*, meaning "encyclopedia of wisdom," due to its high literary merit and religious inspiration. It serves as an exposition on Dharma—a code of conduct that includes the proper behavior of a king, a warrior, a person living in times of calamity, and an individual seeking emancipation from rebirth.

This epic contains one lakh couplets (100,000) divided into 18 parvans, with a supplement called the *Harivamsha* (Genealogy of God Hari, i.e., Vishnu). The traditional author is the sage Vyasa, who likely compiled the existing material that reached its present form around 400 A.D.

1.3.2.4 The Bhagavad Gita

The Bhagavad Gita is an immensely important religious and philosophical treatise of universal wisdom. Its central message calls for the development of all potential within human personality. It is part of the Bhishma Parva of the Mahabharata. Comprising only 700 shlokas, its content is vast. The Gita goes far beyond the ethical questions with which it begins, considering broadly the nature of God and the means by which humanity can know Him. It beautifully harmonizes the philosophies of action, devotion, and knowledge.

The Gita teaches us to engage in selfless service to all, regardless of their religion. The truly learned person views all beings with equanimity, whether they are saints, wrongdoers, or even animals. It encourages us to be active rather than passive and idle.

1.3.2.5 Summary of the Mahabharata

The Mahabharata is a sacred epic poem that narrates the struggles between two groups of cousins vying for supreme power: the Kauravas (the hundred sons of King Dhritarashtra) and the Pandavas (the five sons of Pandu).



These rival families clashed in a war for control of their ancestral Bharata kingdom and the capital, Hastinapur.

The story begins with Pandu, a skilled king in warfare and archery. His cousin-brother, Dhritarashtra, was the eldest but was barred from kingship due to his blindness. While the political and social affairs of the kingdom were running smoothly under Pandu's rule, he decided to hand over state affairs to his blind brother Dhritarashtra and retreated into the forest with his two wives for a time. Upon their return, Pandu and his wife Madri had died. Kunti, Pandu's other wife, returned to the kingdom with her five sons, known as the Pandavas. These sons were fathered by five gods, as a curse had prevented Pandu from fathering children. Meanwhile, King Dhritarashtra had 100 sons, the Kauravas, who were considered human incarnations of demons according to the text. The Kauravas were jealous and treated their cousins, the Pandavas, brutally.

Yudhishthira, the eldest of the Pandavas, was next in line for the throne since he was older than Duryodhana. Duryodhana, the eldest of the Kauravas, did not approve of this decision. Hostility and enmity developed among the cousins, forcing the Pandavas to leave the kingdom. During their first exile, the Kauravas conspired to kill the Pandavas by setting fire to a mansion made of highly flammable materials. Although this plan failed, the Kauravas remained desperate to destroy the Pandavas.

The Pandavas were deceived by Duryodhana's uncle, Shakuni, in a gambling game called Chaturanga. Yudhishthira was invited to play and lost miserably, forfeiting his possessions and kingdom. Consequently, the Kauravas took advantage of the situation and exiled the Pandavas for 12 years. This incident set the stage for the war between the Pandavas

and the Kauravas. Upon their return from exile, Duryodhana, the eldest son of the Kauravas, refused to restore the kingdom to his cousins and was prepared to battle for it. Although the Pandavas sought a peace treaty, the Kauravas rejected all their requests, leading to the battle of Kurukshetra, where the cousins fought against one another. Many kingdoms allied with both the Pandavas and the Kauravas in this conflict. After 18 brutal days of slaughter, the Pandavas emerged victorious but at the cost of their beloved companions. Following the war, Yudhishthira faced a test at the gates of Heaven, where he had to choose between blissful eternity without his brothers or joining them in hell. Unbeknownst to him, his brothers were already in Heaven; this was a test of his character. He chose to remain with his brothers, wherever they might be.

The main narrative, which covers about one fifth of the total work, is interwoven with many famous episodes such as Nala-Damayanti, Savitri-Satyawan, and Shakuntala-Dushyanta, as well as descriptions of pilgrimage sites, myths, moral teachings, genealogical accounts of ruling dynasties, and a conceptual history of creation. It captures the totality of life as it is lived in the present, while also reflecting a strong human desire to transcend it and enter the realm of eternity.

This gem of our cultural heritage has been perpetuated not only in numerous works in Sanskrit but also in various other Indian languages, as well as the languages of Burma, Malaysia, Thailand, Cambodia, Laos, and many others. The story achieved immense popularity, with its various episodes depicted in stone, notably in the sculptured reliefs at Angkor Wat and Angkor Thom in Cambodia, and by many Indian miniature painters.

Thus, it has served as a thematic source for countless poems, dramas, novels, and even

television serials. It is said that in the realms of Dharma, Artha, Kama, and Moksha, whatever is written here can be found elsewhere, but that which is not here cannot be found anywhere else.

1.3.3 Panini's Work on Grammar

Sanskrit grammar is highly systematic and structured, codified in the ancient grammarian Panini's work "Aṣṭādhyāyī," composed around the 4th century BCE. The structure of Sanskrit grammar is marked by precision, logical organization, and comprehensive coverage of linguistic elements.

Panini's "Aṣṭādhyāyī" is a linguistic marvel and a cornerstone in the evolution of grammatical studies. This ancient Sanskrit text is composed of eight meticulously crafted chapters, each containing aphorisms (सूत्राः) that succinctly encapsulate the rules governing the language's phonetics, morphology, and syntax. Panini's approach, utilizing a generative grammar model, offers a systematic framework for understanding the intricacies of Sanskrit, with rules so comprehensive that they account for the entire language. The enduring influence of the "Aṣṭādhyāyī" transcends its historical and cultural significance, extending into modern linguistic theory and even computational linguistics, where its rule-based structure has inspired researchers exploring applications in natural language processing. Panini's linguistic legacy continues through the Paninian tradition, with scholars and grammarians studying and contributing to the understanding of Sanskrit grammar and its broader implications in the realm of language.

1.3.3.1 Aṣṭādhyāyī

Panini's "Aṣṭādhyāyī" is organized into eight chapters, each referred to as an "Adhyāya." The structure of the "Aṣṭādhyāyī" is highly systematic, and each chapter is further divided into sections and rules.

1.3.3.2 Structure Within Adhyāyas

Pāda

Each "Adhyāya" is divided into four quarters called "Pādas." These Pādas contain groups of sutras that address specific aspects of grammar.

Sūtra

The core of the "Aṣṭādhyāyī" is the sūtra, which is an aphorism or a rule. Panini's sūtras are concise and employ a symbolic notation that requires interpretation and commentary for complete understanding.

Five Parts of Panini's Vyākaraṇa

Panini's vyākaraṇa is divided into five parts: one main section and four supplementary sections that provide additional information and classifications to aid in understanding the grammatical rules presented in the main text.

The five parts, known as "pañcāṅgaṃ vyākaraṇam," are Sūtrapāṭha, Dhātupāṭha, Gaṇapāṭha, Uṇāḍipāṭha, and Liṅgānuśāsana.

Sūtrapāṭha

Sūtrapāṭha, or Śabdānuśāsana, is divided into two parts: Śivasūtras and Aṣṭādhyāyī Sūtrapāṭha.

The Śivasūtras are a set of fourteen aphorisms that appear as an appendix to the "Aṣṭādhyāyī." These sutras, also called "Māheśvara Sūtras," are distinct from the main body of Panini's work and provide a phonological and morphological code, offering a concise summary of certain aspects of Sanskrit phonetics and grammar.

The second part is the Aṣṭādhyāyī, the eight chapters composed by Panini.



Gaṇapāṭha

The Gaṇapāṭha is an appendix found at the end of Panini's "Aṣṭādhyāyī." It lists various groups of words based on specific criteria, such as patterns of derivation or similarities in sound. In Panini's sūtras, he refers to the gaṇa names and consults the Gaṇapāṭha to obtain the list of words. The Gaṇapāṭha serves as a helpful reference guide for understanding the application of grammatical rules in different contexts.

Dhātupāṭha

The Dhātupāṭha is a systematically organized list of roots (dhātus). It provides a comprehensive catalog of verb roots, aiding in the understanding of various forms and conjugations of verbs in Sanskrit. The Dhātupāṭha is divided into ten classes according to the forms of the dhātus, making it an essential resource for students and scholars studying Sanskrit morphology.

Uṇāḍipāṭha

The uṇāḍipāṭha, or uṇāḍisūtras, is an additional set of aphorisms that appears as an appendix. It focuses on nominal stems, particularly those derived from the roots mentioned in the dhātupāṭha. The uṇāḍisūtras enhance the understanding of the formation and variations of nominal forms in Sanskrit.

Linganuśāsana

The "linganuśāsana" section in Panini's grammar provides rules for determining the gender of nouns based on certain characteristics, such as their endings, meanings, or inherent gender. Panini's systematic approach to gender assignment is one aspect that makes his grammatical work highly detailed and structured.

These pañcāṅgas enhance the completeness of Panini's grammatical work by providing additional insights, explanations, and references. They are crucial for scholars and students seeking a deeper understanding of the grammatical rules presented in the main body of the "Aṣṭādhyāyī."

1.3.3.3 Panini's Approach to Sanskrit Grammar

Panini developed a grammar for Sanskrit and recorded the concepts within it as a universal framework to write grammar for other languages.

His approach to Sanskrit grammar is generative, meaning that his rules are formulated to generate all possible correct forms of a Sanskrit sentence. The generative power of grammar refers to its ability to produce a vast and varied set of well-formed structures within a language. This systematic approach distinguishes the "Aṣṭādhyāyī" as a pioneering work in linguistics.

1.3.3.4 Features of Paninian Grammar

Paninian grammar focuses on deriving grammatically correct sentences and phrases. It is based on the spoken language of Panini's time and includes rules on Vedic usage and regional variants. Panini employs various techniques to create a derivational grammar.

1.3.4 Prakrit Language

Prakrit refers to a group of Middle Indo-Aryan vernacular languages spoken in ancient India. These languages served as a bridge between Vedic Sanskrit and modern Indian languages, representing the speech of common people. Prakrit was used in Jain and Buddhist scriptures (such as Pali), as well as

in Sanskrit plays for lower-caste characters. This reflects a rich cultural heritage and is foundational to many contemporary Indian languages. Prakrit literature sheds light on ancient Indian life, philosophy, and knowledge systems, providing insights often overlooked in studies focused on Sanskrit.

Recently, Prakrit was granted Classical Language status in India, recognizing its deep cultural and historical value.

Prakrits hold significant importance in the history of Indian languages and culture, fundamentally serving as the vernaculars—the spoken languages of the general populace—contrasting with the more scholarly and "perfected" Sanskrit. This accessibility made Prakrits the chosen medium for major religious texts; for instance, Ardhamagadhi was used for key Jain texts, and Pali for Theravada Buddhist scriptures, ensuring these faiths were accessible to the masses. Their literary role was prominent, particularly in classical Sanskrit dramas, where they were often used for the dialogue of commoners and women, with Maharashtri and Shauraseni being significant examples. Historically, Prakrits provide vital evidence through the earliest readable Indian inscriptions, such as the Ashokan Edicts, which predate extensive Sanskrit inscriptions by centuries. Crucially, Prakrits form a vital linguistic link in the evolutionary chain, connecting ancient Indo-Aryan to the development of modern Indian languages, including Marathi, Gujarati, Hindi, and Bengali.

1.3.5 Mural Paintings

Murals are large wall or ceiling paintings that date back to the 2nd century BC in India, with early examples found at Ajanta and Ellora. Kerala's mural tradition flourished between the 16th and 18th centuries, influenced by Nayaka and Vijayanagara styles, Kathakali, and ritual floor art. Common themes include

those from the Ramayana and Mahabharata. These murals, located in palaces like the Dutch Palace and temples such as Vadakkumathan, preserve Kerala's vibrant artistic and cultural heritage.

1.3.5.1 Raw Materials and Tools

The materials used in mural creation include natural pigments, lime, minerals, and organic dyes. Tools consist of fine brushes, cloth for blending, spatulas, and polishing stones.

Design and Color

Traditional Indian murals utilize natural pigments sourced from minerals and plants—red and yellow from ochre and clay, green from leaves, blue from indigo, and black from charcoal. These vibrant hues bring intricate designs and storytelling to life. Murals depict mythology, history, and daily life, often focusing on religious themes, legendary tales, and traditional customs, preserving and celebrating India's rich cultural heritage.

Process

The mural-making process begins with surface preparation to prevent flaking. Artists sketch a rough design directly on the wall as a guide. Background colors are applied first, followed by foreground details. Highlights and intricate elements add depth, while final touches ensure durability. A protective coating is applied to preserve the mural's vibrancy and longevity.

Product Range

The range of mural products includes temple murals, palace wall paintings, heritage site restorations, decorative home murals, storytelling panels, festival backdrops, and cultural exhibition artworks.



Major Historical Periods and Sites

The history of Indian murals can be divided into distinct periods, each leaving a lasting mark on the art form.

Ancient & Early Medieval Period (2nd Century BC - 8th/10th Century AD)

This phase represents the classical period of Indian mural art, establishing the aesthetic standards for subsequent centuries.

- **Ajanta Caves, Maharashtra (UNESCO World Heritage Site):** These caves contain some of the most famous and oldest surviving murals in the Indian subcontinent, dating from the 2nd Century BC to the 5th Century AD.
- **Theme:** Primarily Buddhist, the paintings vividly narrate the Jataka stories (tales of the Buddha's previous lives) and episodes from the life of the Buddha.
- **Style:** Renowned for their extraordinary elegance, fluid lines, and graceful poses, the figures also exhibit expressive mudras (hand gestures). A key characteristic is the creation of volume through skillful contouring, which imparts a three-dimensional quality to the figures.
- **Bagh Caves, Madhya Pradesh:** The murals here extend the Ajanta style but feature human figures that are more tightly modeled and possess a distinctly "earthy" quality.
- **Ellora Caves, Maharashtra:** This site uniquely showcases murals that represent the confluence of the three major religions: Buddhism, Hinduism, and Jainism. Significant fragments of

paintings can be observed, particularly in the awe-inspiring Kailasa Temple (Cave 16).

- **Sittanavasal Cave, Tamil Nadu:** Featuring paintings based on Jainism, this style closely resembles the aesthetic and technique found in the Ajanta and Bagh murals.

1.3.5.2 Later Dynastic Traditions (6th Century CE onwards)

As the classical period waned, mural painting continued to thrive and evolve under the patronage of various powerful dynasties, transitioning from caves into structural temples and palaces.

- **Badami Murals (Chalukyas):** These early dynastic paintings depict palace scenes and successfully carry forward the stylistic legacy established at Ajanta.
- **Pallava Paintings:** Found at sites like Panamalai and Kanchipuram, these works began to exhibit increased ornamentation in the depiction of figures and settings.
- **Chola and Nayaka Paintings:** The tradition was sustained in major temple complexes. The Brihadisvara Temple features extensive Chola murals, while sites like Thiruparankundram house Nayaka works, often narrating grand scenes from Hindu epics like the *Ramayana* and the *Mahabharata*.
- **Vijayanagara Murals:** Sites like the Lepakshi (Veerabhadra Temple) contain vast murals that vividly depict courtly life, religious stories, and vibrant festivals.

- **Kerala Murals:** This distinct and vibrant tradition, found in ancient temples and palaces like the Mattancherry Palace, is one of the most unique in India. The style draws inspiration from the dramatic poses of Kathakali dance and depicts Hindu mythology using natural pigments and the traditional Panchavarana (five colors) palette, resulting in powerful and luminous compositions.

1.3.6 Sculptures

Sculpture was the favored medium of artistic expression on the Indian subcontinent. Indian buildings were profusely adorned with it and are often inseparable from it. The subject matter of Indian sculpture typically features abstracted human forms designed to instruct people in the truths of Hinduism, Buddhism, or Jainism. The nude was employed both to represent the body as a symbol of spirit and to reveal the imagined shapes of the gods. Individuality is almost completely suppressed in Indian sculpture; this arises from the conception of figures as shapes that embody a perfection and finality beyond the transient appearances of human models. The multiple heads and arms of sculpted Hindu divinities were deemed necessary to display the manifold attributes of these gods' power.

The tradition of Indian sculpture extends from the Indus Valley civilization of 2500 to 1800 BCE, during which time small terracotta figurines were produced. The great circular stone pillars and carved lions of the Mauryan period (3rd century BCE) gave way to mature Indian figurative sculpture in the 2nd and 1st centuries BCE, where Hindu and Buddhist themes were already well-established. A wide range of styles and traditions subsequently flourished in various parts of India over the

succeeding centuries, but by the 9th to 10th centuries CE, Indian sculpture had attained a form that has endured with little change to the present day. This sculpture is characterized not by a sense of plastic volume and fullness but by its linearity; the figure is conceived from the standpoint of its outline, resulting in graceful, slender forms with supple limbs. From the 10th century onward, this sculpture was predominantly used as part of architectural decoration, leading to the production of vast numbers of relatively small figures of mediocre quality.

1.3.6.1 The Śilpaśāstra-s:

The *Śilpaśāstra-s* (literally "treatises on art") are specialized texts focusing on the construction of sacred architecture and images. These works provide a detailed framework for creating the images of gods, covering aspects from their physical proportions to the materials used in their construction. Prominent texts in this tradition include the *Mayamata*, *Mānasāra*, *Viśvakarmīyaparakāśa*, and *Rūpamaṇḍana* by Maṇḍana. These texts establish the rules for building temples, crafting statues, and ensuring that every element of the image adheres to sacred standards.

India's sculpture tradition is an ancient and vibrant art form deeply tied to religion (Hinduism, Buddhism, Jainism), spanning 5,000 years from Indus Valley terracotta to modern works. It is characterized by expressive human forms, divine symbolism (such as multiple arms and heads), intricate detailing, and themes of spiritual reality. This tradition evolved from stylized early figures (like the Ashoka Pillars) to the sensuous Gupta period, the Chola bronzes (such as the Nataraja), and the exuberance of Khajuraho, reflecting a quest for divine connection and inner life.



1.3.7 Gandhara School of Art

The Gandhara School of Art was one of the major art movements in the history of ancient India. As an intricate part of Indian history, it is uniquely associated with the Greco-Roman style of art. The combination of Greco-Roman and Indian ideas, along with influences from other foreign traditions such as those from China and Iran, resulted in the formation of a distinct style known as the Gandhara School of Art. This style was closely connected with Mahayana Buddhism, with the main themes centering on Lord Buddha and Bodhisattvas. Thus, it can be conjectured that, in concept, this style was Indian, while in execution, it was foreign. One notable example of the Gandhara style is the Bamiyan Buddha statues, which flourished primarily in areas of Afghanistan and present-day northwestern India. Prominent locations included Taxila, Peshawar, Begram, and Bamiyan. The Gandhara School of Art thrived from the 1st century BCE to the 4th century CE, featuring extensive use of black stone and stucco. Stucco, a type of plaster, was employed in various structures, including free-standing ones in this artistic style. These free-standing structures encompassed many chaityas, viharas, and stupas. A striking characteristic of the Gandhara School of Art is its realistic and natural depiction of features. Although it primarily focused on Lord Buddha, images of other subjects, such as the Greek god Apollo and certain kings, were also created. The Greco-Roman influence on Gandhara art can be traced through features such as:

- The halo around the head of Lord Buddha
- Buddha's wavy hair
- Forehead lines
- Ornaments
- The drape and style of garments

Thus, the Gandhara School of Art represents a fusion of both Indian and foreign traditions due to its strategic location.

Indian mural painting stands as a monumental testament to the subcontinent's artistic, religious, and social history. With a lineage stretching back to the 2nd century BCE, these large-scale artworks—typically adorning the walls and ceilings of natural caves, rock-cut chambers, and temples—have flourished for millennia. They are celebrated not only for their sheer scale but also for their profound emotional depth, intricate technique, and comprehensive portrayal of life, belief, and myth.

1.3.8 Mughal Art

The Mughal Empire, which ruled South Asia from the early 16th to the mid-19th century, gave rise to the Mughal art movement. Characterized by its detailed and intricate nature, as well as the use of vibrant colors and ornate patterns, this movement emerged from a creative fusion of Indian, Persian, and Islamic artistic traditions and methods.

Painting, architecture, textiles, jewelry, and ceramics are just a few of the many mediums used in Mughal art. The Taj Mahal, regarded as one of the finest examples of Mughal architecture, along with the intricate miniature paintings created during this period, are among the most well-known manifestations of Mughal artistry.

The imperial court and the patronage of the Mughal emperors, who were avid art lovers, significantly influenced Mughal art. Over time, fashion evolved as various emperors and artists infused their distinctive perspectives and techniques into the art.

Mughal art is still celebrated for its beauty and intricacy worldwide and remains a vital component of South Asia's cultural heritage.

It is characterized by several notable features, including a focus on naturalism and realism, achieved through meticulous detailing and lifelike depictions of humans, animals, and landscapes. A hallmark of Mughal art is the tradition of miniature painting—delicate and detailed works that often portray scenes from court life, battles, and portraits of the emperor and his courtiers, typically executed on small pieces of paper. Additionally, Mughal artworks frequently incorporate symmetry and balance in their compositions, complemented by a vivid color palette dominated by hues such as red, blue, and green. The use of Islamic calligraphy adds both meaning and visual interest, reflecting a fusion of Persian, Indian, and Islamic styles that together produced a unique and original aesthetic. Finally, the incorporation of ornate patterns—highly detailed and elaborate—enhances visual appeal and texture, solidifying Mughal art's reputation for intricate detail, striking colors, and the seamless blending of artistic traditions.

Mughal art encompasses a diverse range of artistic genres and media. Among the most famous and recognizable forms is miniature painting, characterized by tiny, intricate works that often depict court scenes, battle scenarios, or portraits of the emperor and his courtiers. Islamic calligraphy plays a significant role as well, used across various media such as manuscripts, paintings, and textiles to convey messages or enhance visual appeal. Mughal architecture is noted for its symmetry, proportion, and elaborate decorations, with renowned examples including the Taj Mahal, the Red Fort, and the Jama Mosque. Textiles are celebrated for their complex patterns, vibrant colors, and geometric motifs, often crafted from luxurious materials like silk and velvet, adorned with fine beading and stitching. Lastly, jewelry features intricate designs,

utilizing precious metals and gemstones, frequently incorporating floral motifs, geometric patterns, and delicate filigree work. Overall, the wide variety of styles and media in Mughal art collectively demonstrates the originality and inventiveness of its creators.

Mughal art holds significant importance for several reasons. As a profound example of the artistic traditions fostered by the Mughal Empire, it represents a crucial part of South Asia's cultural heritage. Its historical significance is undeniable, offering a valuable window into the courtly life, religious practices, and social mores of the region during the Mughal era. Distinguished by its artistic originality, Mughal art is a unique synthesis of Persian, Indian, and Islamic aesthetic traditions, showcasing the creativity and ingenuity of its artists. Beyond its scholarly value, the deft attention to detail, vivid colors, and overall aesthetic appeal ensure its recognition for beauty by art admirers worldwide. Finally, Mughal art has greatly influenced contemporary art in South Asia, inspiring countless artists to develop modern interpretations of this rich aesthetic history. Overall, Mughal art is paramount for its cultural, historical, and artistic significance, reflecting the profound originality and inventiveness of its creators.

1.3.9 Indian Music

The rich tradition of Indian music is deeply rooted in its ancient texts, spiritual practices, and intricate systems of theory. Musicology in India traces its origins back to the Vedic period, where the Vedas themselves embodied musical elements through their distinct tones—*Udāṭṭa*, *Anudāṭṭa*, and *Svarita*. These tones form the foundation of the melodic system in Indian classical music, which continues to influence contemporary practices.



1.3.9.1 The Vedic Roots of Indian Music

The three Vedic tones—*Udātta* (high tone), *Anudātta* (low tone), and *Svarita* (middle tone)—are foundational in shaping the system of notes in Indian music. According to the *Nārādīya-śikṣā*, the seven notes of classical Indian music can be traced to these tones:

- *Udātta* corresponds to the modern note Ga (with its consonant note) or Ni.
- *Anudātta* corresponds to Ri, which includes its consonant Dha.
- *Svarita* corresponds to Sa, with its consonants Ma and Pa.

The *Svarita* is described as a note higher than *Udātta*, a concept in agreement with the actual practice in Vedic chant. The *Sāmaveda* further elaborates on the musical system, featuring a descending scale beginning with Ma, with notes named *Kruṣṭa*, *Prathama*, *Dvītiya*, *Tṛtīya*, *Caturtha*, *Mandra*, and *Atisvārya*. It also differentiates between two parts: the *Ārcika* (single stanzas) and the *Uttarārcika* (three-stanza chants used in sacrifices). These chants, known as stotra-s, are sung in rituals, and several melodies like *Vāruṇa*, *Saubhadra*, and *Vinadri* are employed. The *Puṣpasūtra* provides detailed manuals on the singing of *Sāman*.

1.3.9.2 The Nāṭyaśāstra and Early Music Theory

Though the Vedic hymns represent an early form of musical notation, it is Bharata's *Nāṭyaśāstra* that serves as one of the first comprehensive texts on musicology in India. Bharata's work, particularly in chapters 28–33, covers the seven notes (Sa, Ri, Ga, Ma, Pa, Dha, Ni), the twenty-two *śruti*-s (micro-

tones), and their positions in the system of śuddha and vikṛta varieties. It also introduces the *Sthāyi* or voice registers, the *Ṣaḍjagrāma* and *Madhyamagrāma* scales, and the systems of *Jāti*-s (melodic forms) and *Tāla*-s (rhythmic cycles). The text further explores the use of instruments, traditional songs, and the structure of Dhruva songs. A critical commentary on the *Nāṭyaśāstra*, the *Abhinavabhāratī* by *Abhinavagupta* (11th century), has become an essential source for understanding ancient Indian music theory.

1.3.9.3 The Development of Music Theory and Systems

Over time, several texts expanded upon the foundations laid by the *Nāṭyaśāstra*. For instance, *Dattilamuni's Dattilam* focuses on *Śruti*, *Svara*, and *Grāma* (scales), largely following the principles of Bharata's work. Similarly, *Mātanga's Brhaddeśī* (7th century) analyzes popular music (Desi music) and contrasts it with the sacred music of the *Mārga* tradition. Mātanga also introduces the *Mātāṅgamata*, which differs from *Bharatamata* by including twelve notes in a scale instead of the standard seven.

The *Nārādīya* tradition, attributed to Nārada, includes several works, such as the *Nārādīya-śikṣā*, which discusses the *Gandharagrāma*, a scale that later texts deemed obsolete. The *Nārādīya-rāga-nirūpaṇa* describes approximately 140 *rāga*-s, while the *Śaṅgītamakaranda* (11th century) categorizes ragas into male, female, and neuter forms, marking a significant development in the classification of ragas according to the time of day.

1.3.9.4 Classical Music Texts and the Evolution of Rāga Theory

The *Śaṅgītamakaranda* (12th century) by Śārṅgadeva is one of the most exhaustive treatises

tises on Indian music. It covers a wide range of topics, including *Nāda* (sound), *Śruti*, *Svara*, *Grāma*, *Mūrcchanā* (melodic modes), *Jāti*, *Rāga*, *Tāla*, and *Prabandha* (musical compositions). The text provides an in-depth analysis of the components of *rāga*, such as the *Graha* (starting note), *Amśa* (repeating note), *Nyāsa* (resting note), *Mandra* (lowest note), and *Tāra* (highest note). This work is crucial for understanding the development of ragas, modes, and compositions in Indian classical music. It is complemented by two important commentaries: the *Sudhānidhi* of *Simhabhūpāla* and the *Kalānidhi* of *Kallinātha* (15th century).

1.3.9.5 The Influence of Persian Music and the Rise of Hindustani Music

The influence of Persian music on Indian classical music, particularly in the Hindustani tradition, is documented in works like *Rāga-taraṅgiṇī* (14th century), *Ṣadrāgacandrodaya*, and *Rāgamālā*. These texts describe the evolution of the Janaka-Janya system of ragas, which replaced the earlier *Grāma-Jāti-Mūrcchanā* system. *Puṇḍarīkaviṭṭhala* (16th century) is credited with formalizing Hindustani music as a distinct system. His *Svara-melakalānidhi* discusses *Śruti*, *Svara*, *Vīṇā* (lute), and the concept of *Meḷa* (parent scale), detailing 20 parent scales and 64 derivative ragas.

1.3.9.6 South Indian Music Theory: The Caturdaṇḍiprakāśika

The development of South Indian music theory is closely associated with Venkata-makhi's *Caturdaṇḍiprakāśika* (17th century). This work introduced the *Meḷa* system, classifying 72 parent ragas that serve as the foundation for derivative ragas. The text covers *Nāda*, *Śruti*, *Svara*, *Meḷa*, and *Rāga*, providing a detailed account of the classification of ragas and their relationship to specific scales.

This system paved the way for further developments in Carnatic music, including the classification of ragas into *Grāma* and *Uparāga*, as well as the formalization of *ālāpana* (improvised elaboration of a raga).

The Modern Era and Contemporary Contributions

In the 18th century, King Tulaja of Tanjore authored the *Saṅgītasārāmṛta*, which presents an extensive catalog of ragas and their historical development. The *Saṅgrahacūdāmaṇi*, attributed to Govindācārya, also documents the ragas in use at the time. In the modern period, scholars such as Āttūr Kṛṣṇa Piṣāroṭi have made significant contributions to the understanding of music theory, particularly through the *Saṅgītacandrikā*, which presents a unique system of *Meḷakartā* and raga classification.

13.9.7 The Purpose of Music in Indian Tradition

A distinctive feature of Indian music is its philosophical and spiritual depth. While music serves as entertainment, its ultimate aim is the purification of the self, leading to *mokṣa* (liberation). The concept of *rāga* (melody) is central to this goal, with each *rāga* intended to evoke specific emotional states (*rasa*), facilitating spiritual upliftment. The intricate use of *gamaka*-s (graces), which incorporate microtones and semitones, adds a layer of expressiveness unique to Indian classical music. *Tāla*-s (rhythmic cycles) exhibit intricate patterns that challenge the performer to maintain rhythmic precision while expressing the emotional essence of the music.

Folk music, while distinct from classical traditions, is seamlessly absorbed into the classical fold, enriching the broader musical culture. This inclusivity demonstrates the fluid and evolving nature of Indian music, where



various regional styles and traditions contribute to a unified musical heritage.

The study of musicology in India offers a window into a rich and complex tradition that spans millennia. From its early roots in Vedic chants to the sophisticated theoretical frameworks established by Bharata, Sārṅgadeva, and other scholars, Indian music has evolved into a vast system of ragas, talas, and expres-

sive musical forms. At its core, Indian music is not merely a tool for entertainment but a profound means of spiritual and emotional expression, with the ultimate aim of achieving liberation. The extensive literature and continuous development of music theory highlight the depth and diversity of this ancient tradition, which remains relevant and vibrant in the contemporary world.

Recap

- Sanskrit is an ancient and remarkable Indo-Aryan language, renowned for its linguistic perfection and serving as the foundational vessel for India's vast spiritual and scientific heritage.
- Evolving from the Vedic Sanskrit of the Rigveda to the refined Classical Sanskrit standardized by the grammarian Panini, it has given rise to later languages such as Pali, Prakrit, and modern North Indian tongues.
- The epics, Ramayana and Mahabharata, translate complex philosophical truths into accessible narratives of ideal conduct, exemplified by the righteousness of Rama and the selfless duty taught in the Bhagavad Gita.
- The grammatical work of Pāṇini, specifically the Aṣṭādhyāyī, represents a pinnacle of intellectual achievement, providing a generative and rule-based framework that codified Sanskrit into a highly systematic language.
- Parallel to the scholarly perfection of Sanskrit, the Prakrit languages served as the vibrant vernacular of the masses, bridging the gap between ancient Indo-Aryan and modern Indian languages while acting as the primary medium for Jain and Buddhist scriptures.
- This cultural richness is further mirrored in India's visual arts, particularly its mural paintings and sculptures. From the classical, fluid elegance of the Ajanta Caves to the dramatic "Panchavarna" (five-color) palette of Kerala murals, these artworks narrate religious epics and historical life with profound emotional depth.
- Similarly, Indian sculpture evolved from the terracotta figurines of the Indus Valley to the iconic Chola bronzes and the Greco-Roman influenced Gandhara school, consistently seeking to represent the divine through idealized, symbolic human forms.

- Mughal art is a magnificent creative fusion of Indian, Persian, and Islamic traditions that flourished between the 16th and 19th centuries, characterized by intricate naturalism, vibrant palettes, and a seamless blend of media ranging from the iconic white marble architecture of the Taj Mahal to delicate miniature paintings.
- Similarly, Indian music represents an ancient and evolving tradition deeply rooted in the spiritual framework of the Vedas. Its melodic system (*Ragas*) and rhythmic cycles (*Talas*) were first formalized in Bharata's *Nāṭyaśāstra*.
- Both Mughal art and Indian classical music transcend mere aesthetics; they serve as profound vehicles for cultural identity and spiritual liberation (*Moksha*), maintaining vibrant relevance in the modern world.

Objective Questions

1. What is the earliest book in the world, compiled in Sanskrit?
2. Which language is the official language of India and developed from Shauraseni Apabhraṃśa?
3. What is the term for the "first poem" (*Adikavya*)?
4. How many *parvans* (books) are there in the *Mahabharata*?
5. Who is the traditional author of the *Mahabharata*?
6. What is the name of Panini's masterwork on Sanskrit grammar?
7. What is the term for the 14 phonological aphorisms revealed to Panini?
8. Which part of Panini's grammar provides a comprehensive catalog of verb roots?
9. Which ancient cave site in Maharashtra contains the oldest surviving Indian murals?
10. What is the traditional palette of five colors used in Kerala murals called?
11. Which school of art is famously known as the Greco-Buddhist school?
12. Which Mughal monument is considered the finest example of its architecture?
13. Name the foundational Vedic tone that corresponds to a "high tone."
14. How many *śruti-s* (microtones) are identified in the *Nāṭyaśāstra*?
15. Which text introduced the system of 72 *Meḷa* (parent ragas) for South Indian music?



Answers

- | | |
|--------------------------------------|-----------------------------|
| 1. Rigveda | 8. Dhātupāṭha. |
| 2. Hindi. | 9. Ajanta. |
| 3. Ramayana | 10. Panchavarana. |
| 4. 18 | 11. Gandhara School of Art. |
| 5. Vyasa. | 12. Taj Mahal. |
| 6. Aṣṭādhyāyī. | 13. Udātta |
| 7. Śivasūtras (or Māheśvara sūtras). | 14. 22. |
| | 15. Caturdaṇḍiprakāśika. |

Self Assessment Questions

1. What are the four *Purusharthas* (aims of human life) mentioned in Sanskrit literature?
2. What is the difference between Vedic Sanskrit and Classical Sanskrit?
3. What is the *Bhagavad Gita* and where is it found?
4. What is the "Kāraka theory" in Paninian grammar?
5. What role did Prakrit languages play in ancient Indian society?
6. How does Indian sculpture typically represent the human form?
7. What is the primary theme of the Gandhara School of Art?
8. What defines the "fusion" nature of Mughal art?
9. What is the ultimate purpose of music according to Indian tradition?
10. What is the difference between *Mārga* and *Desi* music as analyzed by Mātanga?
11. Explain the role of Panini in the development of the Sanskrit language.
12. Briefly summarize the conflict at the heart of the *Mahabharata*.
13. What are the characteristics of the Kerala mural tradition?
14. Discuss the significance of the Ajanta Caves in the history of Indian Murals.
15. What are the key characteristics of Mughal Miniature paintings?
16. How did Persian influence lead to the formalization of Hindustani music?

Assignments

1. Explain the significance of the *Ramayana*
2. Explain the structure of the *Aṣṭādhyāyī*.
3. Describe the geographical and historical context of the Gandhara School of Art.
4. Analyse the evolution of South Indian (Carnatic) music theory.

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BLOCK - 02

Ancient Indian Knowledge

Unit 1

Astronomy and Mathematics

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- ▶ understand the ancient Indian decimal place value system
- ▶ discuss the accomplishments of ancient India in algebra, geometry, and trigonometry
- ▶ analyse the ancient Indian zodiac framework
- ▶ comprehend the ancient Indian ways of timekeeping
- ▶ examine the efforts of ancient Indian scholars to predict the accurate position and motion of celestial bodies
- ▶ familiarize with the major figures in ancient Indian mathematics and astronomy

Prerequisite

Ancient India made important contributions to mathematics and astronomy. The decimal number system, including the concept of zero, was developed and widely used in calculations. Geometry, especially in the Śulbasūtras, was applied in constructing altars, and the value of π was estimated with considerable accuracy. Indian scholars also made advances in trigonometry, introducing tables for sine values, and in algebra by addressing linear, quadratic, and indeterminate equations. Ancient Indians conceived the apparent motion of celestial bodies through the zodiac framework. Units of time measurement and different calendars were developed accordingly by the Indian astronomers for both ritual and practical purposes. Positions and movements of the celestial bodies were estimated with mathematical precision. Astronomical phenomena like eclipses were predicted with accuracy. This unit discusses all these significant achievements of ancient India in mathematics and astronomy.



Key Words

Decimal number system, zero, Śulbasūtras, time, calendar, zodiac, planetary motion, eclipse, Āryabhaṭa, Brahmagupta, Bhāskara II

Discussion

2.1.1 Introduction

Since ancient times, the sky has been a source of wonder and awe for human beings. The phases of the moon, the phenomena of sunrise and sunset, the appearance of stars, and eclipses have encouraged human speculation. In the ancient period, people often enveloped these phenomena in mystery, attempted to explain them through myths, and incorporated them into the domain of religion. Early astronomy relied primarily on naked-eye observations. With time, more sophisticated instruments were developed, and today astronomy has emerged as a branch of science that makes use of powerful telescopes, space probes, and sophisticated theoretical models to understand celestial objects and phenomena.

The stars and planets are visible from all parts of the world, and it is therefore not surprising that parallel developments in astronomical knowledge occurred in different cultures. Important contributions to astronomy were made by several ancient civilizations, including the Greek, the Babylonian, the Chinese, and the Mayan. Ancient Indian astronomy, noted for its mathematical sophistication and philosophical reflections on the cosmos, occupies an important place in this global tradition. Indian scholars devised advanced methods of calculation to predict the movements of celestial bodies with considerable accuracy and developed mathematical models to explain the motions of the sun, the moon, the planets, and the stars.

Developments in astronomical knowledge in ancient India were closely connected with advances in mathematics. Indian civilisation engaged deeply with both the abstract and practical dimensions of mathematical knowledge. Foundational contributions of ancient India to mathematics include the development of the decimal number system, the concept of zero, methods for arithmetic operations, geometrical insights, approximations of the value of pi, algebraic ideas, trigonometric functions, and techniques resembling ideas later associated with calculus.

For convenience, the first part of this unit outlines some important engagements of ancient India with mathematics, and the second part highlights notable contributions of ancient Indian scholars to astronomy. The unit does not attempt to provide an exhaustive historical account of the development of ancient Indian mathematics and astronomy, nor does it undertake a detailed comparison with other traditions. Instead, it aims to introduce some of the significant achievements of ancient Indian scholars in these fields.

2.1.2 Mathematics in Ancient India

The earliest engagements of Indian scholars with mathematics can be seen in the context of Vedic ritual practices. Geometrical problems and analyses developed in connection with the construction of sacrificial altars that

had to be built in prescribed shapes and sizes for particular rituals. The Śulbasūtras preserve many such geometrical insights. Later, with the growing need to understand celestial phenomena, advances in astronomy required increasingly sophisticated mathematical methods. It may therefore be noted that many of the major mathematicians of ancient India were also astronomers, and several important mathematical results appear in astronomical treatises. Ancient Indian architecture likewise provides clear evidence of the practical application of mathematical principles.

Among the noteworthy achievements of ancient India in mathematics are the development of the decimal number system, the conceptualisation of zero (*śūnya*), geometrical theorems resembling the Pythagorean theorem, approximations of the values of pi and other irrational numbers, and algebraic insights. Recent research has also drawn attention to the remarkable work of scholars from the Kerala region of India, whose studies in infinite series, trigonometric functions, and techniques resembling calculus appear to anticipate similar developments that later emerged in other parts of the world. These achievements highlight the depth and sophistication of early Indian mathematical thought.

In the following sub-sections, learners will be provided with a brief account of some important engagements of ancient Indian scholars with mathematics.

2.1.2.1 Numeral Terminology and Scales in Ancient Indian Literature

Ancient Indian literature preserves a rich terminology for numbers, reflecting a system-

atic understanding of numerical scales. The Vedic Saṃhitās, epics, Purāṇas, as well as Jain and Buddhist works, mention the terminology used in the ancient period to denote numbers.

The terms *eka*, *dvi*, *tri*, *catur*, *pañca*, *ṣaṭ*, *sapta*, *aṣṭa*, and *nava* denote the cardinal numbers from one to nine. The terms *daśa*, *viṃśati*, *triṃśat*, *catvāriṃśat*, *pañcāśat*, *ṣaṣṭi*, *saptati*, *aṣṭi*, and *navati* denote multiples of ten up to ninety. Terms from these lists were combined to denote other numbers. For example, the number 24 is termed *caturviṃśati*, while the number 29 is termed *ekona-triṃśat*, meaning “one less than thirty.” Ordinal numbers were expressed as *prathama* (first), *dviṭīya* (second), *trīṭīya* (third), and so on.

The Śulbasūtras use the terms *pāda* and *ardha* to refer to the fractions one-fourth and one-half respectively. The term *pūrṇa* refers to one or the whole. Fractions were also denoted by terms such as *aṃśa* and *bhāga*. Thus, *pañcadaśa-bhāga* denotes one-fifteenth and *nava-aṃśa* denotes one-ninth.

Different terms were also used to denote large numbers corresponding to powers of ten. For example, the *Vājasaneyī Saṃhitā* of the *Yajurveda* contains a list of terms used to denote powers of ten up to 10^{12} (*parārdha*), as shown in Table 2.1.1. In the *Vālmīki Rāmāyaṇa*, while describing the strength of Rāma’s army, several large numerical scales are mentioned (see Table 2.1.2). The Buddhist work *Lalitavistāra* also refers to multiples of 100 ranging from 10^7 to 10^{53} . The specific names given to certain numbers vary across texts, but these lists demonstrate the high level of abstraction and systematic organisation achieved by ancient Indian scholars.



Table 2.1.1

10	<i>Daśa</i>	1,00,00,000	<i>Arbuda</i>
100	<i>Śata</i>	10,00,00,000	<i>Nyarbuda</i>
1000	<i>Sahasra</i>	1,00,00,00,000	<i>Samudra</i>
10,000	<i>Ayuta</i>	10,00,00,00,000	<i>Madhyama</i>
1,00,000	<i>Niyuta</i>	1,00,00,00,00,000	<i>Anta</i>
10,00,000	<i>Prayuta</i>	10,00,00,00,00,000	<i>Parārdha</i>

Table 2.1.2

$10^5 \dot{Śata} = 1 Koṭi = 10^7$
$10^5 Koṭi = 1 \dot{Śaṅkha} = 10^{12}$
$10^5 \dot{Śaṅkha} = 1 Mahāśaṅkha = 10^{17}$
$10^5 Mahāśaṅkha = 1 Vṛnda = 10^{22}$
$10^5 Vṛnda = 1 Mahavṛnda = 10^{27}$
$10^5 Mahavṛnda = 1 Padma = 10^{32}$
$10^5 Padma = 1 Mahāpadma = 10^{37}$
$10^5 Mahāpadma = 1 Kharva = 10^{42}$
$10^5 Kharva = 1 Mahākharva = 10^{47}$
$10^3 Mahākharva = 1 Samudra (ogha) = 10^{50}$
$10^3 Ogha = 1 Mahaugha = 10^{53}$

2.1.2.2 Decimal Place-value System and the Concept of Zero

The decimal place-value system that expresses every possible number using a set of ten symbols (the numerals one to nine and a symbol for zero) is one of the most influential contributions of ancient India to mathematics.

Early indications of decimal grouping can be found in the Vedic literature. Jain works also refer to *aṅka-sthāna*, or place values of digits. The Bakhshālī manuscript demon-

strates the use of positional notation. By the time of Āryabhaṭa (476-550 CE), a fully developed decimal place-value system was in use, wherein each place is considered to have a value ten times that of the previous place – “*sthānāt sthānaṃ daśaguṇaṃ syāt*” (*Āryabhaṭīya: Gaṇitapāda*, verse 2).

In number systems that developed in other parts of the world, such as the Roman numeral system, it was difficult to represent large numbers. For example, the number two thousand three hundred and thirty-eight when expressed

in Roman numerals becomes MMCCCXXXVIII. In the decimal place-value system, the same number can be written simply as 2338, where the digit 2 represents thousands, 3 represents hundreds, 3 represents tens, and 8 represents ones. The French mathematician Pierre-Simon Laplace observed: “The ingenious method of expressing every possible number using a set of 10 symbols (each symbol having a place value and an absolute value) emerged in India. The idea would seem so simple nowadays that its significance and profound importance is no longer appreciated.”

An essential component of the place-value system is the concept of zero. The development of zero in ancient India had a profound impact on the world of numbers and calculations. Early mathematical manuscripts such as the Bakhshālī manuscript used a dot as a placeholder to indicate an empty position in a number. Although Āryabhaṭa (476-550 CE) did not explicitly use a symbol for zero in his notation, the positional system employed in his work clearly reflects the conceptual framework within which the use of zero as a placeholder later became standard. Later, Brahmagupta (7th century CE), in his work *Brāhmasphuṭasiddhānta*, provided explicit rules for arithmetic operations involving zero, thereby giving the concept of zero a firm mathematical foundation. These developments contributed significantly to the advancement of mathematical knowledge. As Prof. Halsted wrote in *On the Foundation and Technique of Arithmetic* (1912), “The importance of the creation of the zero mark can never be exaggerated. This giving to airy nothing not merely a local habitation and a name, a picture, a symbol, but helpful power, is the characteristic of the Hindu genius from which it sprang.”

2.1.2.3 Systems for Encoding Numbers

Ancient Indian scholars developed sophisticated numerical encoding systems to represent numbers using words, syllables, or letters. These systems allowed large and complex numbers to be memorised easily in verses or texts, thereby facilitating the transmission of astronomical and mathematical knowledge across generations. Such methods also reflect the deep integration of language, mathematics, and mnemonic techniques in the Indian intellectual tradition.

One such encoding system is the *Bhūta-saṅkhyā* system, which assigns numerical values to familiar objects, elements, or concepts. For example, *nayana* (eye) represents 2, *Veda* represents 4, and *indriya* (sense organ) represents 5. This system allowed numbers to be encoded in meaningful phrases or verses, making it easier to memorise large numbers or astronomical data while preserving poetic and literary elegance.

Another important method of encoding numbers was developed by Āryabhaṭa (476-550 CE). He devised a place-value based numeral system in which numbers could be represented using syllables of the Sanskrit alphabet. In this system, consonants represent numerical values while vowels indicate different place values. Table 2.1.3 shows with an example the manner in which encoding is done in this system. This way of encoding allowed very large numbers to be expressed compactly in verses, making them easier to memorise and transmit orally. Using this method, Āryabhaṭa encoded astronomical constants, planetary positions, and large calculations in poetic form, thereby combining mathematics, language, and astronomy.



Table 2.1.3
Āryabhaṭa's System of Encoding

Value	10^0	10^2	10^4	10^6	10^8	10^{10}	10^{12}	10^{14}	10^{16}
Vowels	अ/a, आ/ā	इ/i, ई/ī	उ/u, ऊ/ū	ऋ/r	ॠ/lr	ए/e	ओ/o	ऐ/ai	औ/au
Value	1	2	3	4	5	6	7	8	9
Consonants	क/k	ख/kh	ग/g	घ/gh	ङ/ṅ	च/c	छ/ch	ज/j	झ/jh
Value	11	12	13	14	15	16	17	18	19
Consonants	ट/t	ठ/th	ड/d	ढ/dh	ण/ṇ	त/t	थ/th	द/d	ध/dh
Value	21	22	23	24	25				
Consonants	प/p	फ/ph	ब/b	भ/bh	म/m				
Value	30	40	50	60	70	80	90	100	
Consonants	य/y	र/r	ल/l	व/v	श/ś	ष/ṣ	स/s	ह/h	

Example: Consider the word ख्युघृ (*khyughṛ*). The first part contains two consonants ख/kh and य/y along with the vowel उ/u. The values of the two consonants are 2 and 30 respectively. As they are in the conjunct form, we should take the sum that gives 32. The place value denoted by the vowel is 10^4 . So, the total value of the first part becomes $32 \times 10000 = 320000$. Similarly, the second part with the consonant घ/gh and the vowel ऋ/r gives the value $4 \times 1000000 = 400000$. Now the total value denoted by ख्युघृ (*khyughṛ*) becomes $320000 + 400000 = 720000$.

Another well-known encoding technique is the Kaṭapayādi system. In this system, the consonants beginning with *ka*, *ṭa*, *pa*, and *ya* denote the numbers 1, 2, 3,...and so on in a particular sequence. In the case of conjunct consonants, only the final consonant represents the numerical value. The vowels while standing alone represent zero and while attached to a consonant are not counted. According to the rule *aṅkānām vāmato gatiḥ*, the numbers are to be read from right to left. Table 2.1.4 illustrates how vowels and consonants are encoded, along with an example.

Table 2.1.4
Encoding in the Kaṭapayādi system

Vowels while standing alone	अ/a, आ/ā, इ/i, ई/ī, उ/u, ऊ/ū, ऋ/r, ए/e, ऐ/ai, ओ/o, औ/au, अं etc. Value = 0									
Number	1	2	3	4	5	6	7	8	9	0
Consonants	क/k	ख/kh	ग/g	घ/gh	ङ/ṅ	च/c	छ/ch	ज/j	झ/jh	ञ/ṇ
	ट/t	ठ/th	ड/d	ढ/dh	ण/ṇ	त/t	थ/th	द/d	ध/dh	न/n
	प/p	फ/ph	ब/b	भ/bh	म/m					
	य/y	र/r	ल/l	व/v	श/ś	ष/ṣ	स/s	ह/h		

Example: In the word *abhayam*, ‘a’ stands for 0, ‘bha’ stands for 4, and ‘yam’ stands for 1. Since the numbers are to be read from right to left, *abhayam* stands for 140.

and applied in practice. Methods for addition, subtraction, multiplication, division, and the extraction of square and cube roots formed an essential part of mathematical learning.

2.1.2.4 Methods for Calculation

Ancient Indian mathematicians developed several systematic methods for performing arithmetic operations. These procedures were designed to make calculations efficient and were often expressed in concise rules or verses so that they could be easily remembered

A number of such computational techniques are described in works associated with Indian mathematical astronomy. For example, Āryabhaṭa, in his Āryabhaṭīya (Gaṇitapāda, verses 4-5), prescribes methods to extract square roots and cube roots of given numbers. Table 2.1.5 explains how the square root of 4624 can be calculated using Āryabhaṭa’s method.

Table 2.1.5
Steps to calculate the square root of 4624

☐ Step 1: Classify the digits from the units place (right side) as odd place digit and even place digit alternatively. (4-even, 6-odd, 2-even, 4-odd)
☐ Step 2: Consider the number formed by the digits from left up to the last odd place from right. Here it is 46.
☐ Step 3: Find the greatest possible square less than or equal to the number obtained in the previous step. 36 is the greatest square less than 46.
☐ Step 4: The square root of 36 is the first digit in our answer.
☐ Step 5: Subtract 36 from 46. We will get 10.
☐ Step 6: Write down the next even place digit also, So the number to be considered becomes 102.
☐ Step 7: After writing down the even place digit, divide the number obtained by twice the square root in Step 3. (i.e., twice the number 6, which is 12).
☐ Step 8: The quotient obtained in the division in Step 6 is the second digit of our answer. 102 when divided by 12 gives 8 as quotient.
☐ Step 9: Along with the remainder obtained in the division in Step 6, write down the next odd place digit. The remainder when 102 is divided by 12 is 6 and the next odd place digit is 4. Now the number to be considered becomes 64.
☐ Step 10: Now repeat steps 3 and 4. 64 itself is the greatest possible square and it when subtracted from itself gives 0 and there is no digit left to consider.
☐ Step 11: From steps 4 and 8, we get our answer, i.e. the square root of 4624, as 68.

□



The development of such calculation techniques played an important role in supporting advances in astronomy, algebra, and trigonometry, since accurate numerical work was essential for predicting celestial phenomena and solving mathematical problems.

2.1.2.5 Geometry

Geometry in ancient India was closely tied to ritual practice and precise measurement. The Śulbasūtras, composed between roughly 800 BCE and 500 BCE, contain detailed instructions for constructing altars (*vedi*) and arranging the sacred fire (*agni*) according to exact shapes and areas. (The word *śulba* refers to the cord or rope used for measurement. Such cords were used to lay out sacrificial altars and other geometric constructions.) These texts reveal a remarkable integration of ritual, mathematics, and spatial reasoning, showing that geometry was applied not merely as an abstract discipline but as a practical and culturally meaningful science.

Several Śulbasūtras are known today, the most prominent being those attributed to Baudhāyana, Āpastamba, Kātyāyana, and Mānava. Although primarily ritual manuals, these texts systematically codify geometric principles that guided altar construction and precise measurement.

Ritual practices in ancient India required two main types of altars: household altars, which were simple squares or circles, and public altars, which were larger and more elaborate, often combining rectangles, triangles, and trapezia. One of the most intricate designs described in the texts is the *śyena-citi* (Figure 2.1.1), the falcon-shaped altar, symbolizing the soul's ascent to heaven when a sacrifice was performed upon it.

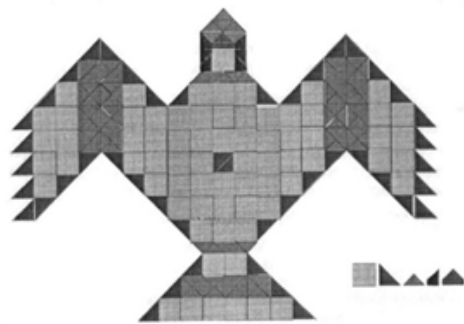


Figure 2.1.1 – First layer of *Śyena-citi* or the Falcon fire altar, for which five types of bricks as shown in the picture are used.

Source: <https://th.bing.com/th/id/R>.

The Śulbasūtras demonstrate knowledge of several important geometric principles, including:

- Properties of diagonals in rectangles where diagonals bisect each other and divide shapes into equal areas.
- Construction of perpendiculars from the vertex of an isosceles triangle, dividing it into two equal halves.
- Properties of similar rectilinear figures.

Among the most remarkable results found in these texts is a geometric rule commonly associated with Pythagoras. In the Indian tradition it is known as the *bhujā-koṭi-karṇa-nyāya*. The Baudhāyana Śulbasūtra (1.12) states:

“*dīrghacaturaśrasyākṣṇayārajjuh pārs-vamānī tiryakmānī ca yat prthagbhūte kurutastadubhayam karoti.*”

This can be translated as: “The rope stretched across the diagonal of a rectangle produces an area equal to that produced separately by the longer side and the shorter side.” In other words, the square of the diagonal of a rectangle is equal to the sum of the squares of its two sides. The Śulbasūtras also make use of Pythagorean triples such as (3,4,5) and

(5,12,13), and they include approximations involving irrational quantities like $\sqrt{2}$ indicating a practical understanding of incommensurable magnitudes required for altar construction.

The texts also describe a variety of geometric constructions, such as:

- Creating a square that is a multiple of the area of a given square
- Constructing a square equal to the sum or difference of two squares
- Constructing a square equal in area to a given rectangle

These procedures were performed using cords, stakes, and careful measurement, reflecting a combination of arithmetic reasoning and spatial intuition.

In contrast to the Greek tradition, which later emphasized axioms, postulates, and formal deductive proofs, the geometry of the Śulbasūtras was primarily practical and construction-oriented, embedded within ritual contexts. Nevertheless, the geometric reasoning underlying these constructions reveals a sophisticated understanding of space, proportion, and measurement.

In summary, the Śulbasūtras demonstrate that ancient India developed geometry not merely as an abstract intellectual pursuit but as a practical science of measurement, proportion, and precision. By blending ritual practice with mathematical reasoning, these texts illustrate the ingenuity of early Indian scholars in applying geometric ideas to concrete and culturally meaningful tasks.

2.1.2.6 Value of pi (π)

The value of pi (π) – the ratio of the circumference of a circle to its diameter – became important in ancient Indian mathematics in

connection with geometric constructions, especially those found in the Śulbasūtras. Ritual altar construction often required transforming one geometric shape into another while preserving the same area. In particular, mathematicians were concerned with the problem of constructing a square equal in area to a given circle. Since the area of a circle depends on the value of π , any attempt to transform a circular altar into an equivalent square necessarily required an approximation of this constant.

The Śulbasūtras provide practical rules for such constructions. Instead of presenting π directly as a numerical constant, they describe geometric procedures that implicitly correspond to approximate values. These approximations allowed ritual practitioners to construct altars of equivalent area using cords and measurements. For example, rules given in texts such as the Baudhāyana Śulbasūtra yield values that correspond to approximate values of π very close to 3, which were sufficiently accurate for ritual and geometric purposes.

A more precise value appears in the work of Āryabhaṭa (476-550 CE). In his *Āryabhaṭīya* (*Gaṇitapāda* verse 10), he gives the circumference of a circle whose diameter is 20,000 as approximately 62,832. This implies that the value of π is approximately 3.1416. This value is used by later scholars like Varāhamihira, Lalla, and Bhāskara II in the form of a fraction. Bhāskara II mentions it as $\frac{3927}{1250}$. It should be noted that the value is remarkably close to the modern value of π .

2.1.2.7 Value of Surds

Ancient Indian mathematicians also dealt with surds, i.e., irrational quantities like $\sqrt{2}$. Such quantities frequently appeared in geometric constructions, especially in problems involving diagonals of squares and rectangles.



Since these values could not be expressed precisely using whole numbers or simple fractions, mathematicians developed methods to obtain close approximations.

One of the earliest and most well-known examples appears in the Śulbasūtras, which provide an approximation for the value of $\sqrt{2}$. This value was required in geometric constructions such as determining the diagonal of a square or constructing a square with twice the area of a given square. The Baudhāyana Śulbasūtra (2.12) gives a rule from which we can calculate the value of $\sqrt{2}$ as:

$$\sqrt{2} \approx 1 + \frac{1}{3} + \frac{1}{3 \times 4} - \frac{1}{3 \times 4 \times 34}$$

This yields a value of approximately 1.4142, which is remarkably close to the modern value of $\sqrt{2}$ (i.e. 1.414213...). The accuracy of this approximation demonstrates the high level of numerical insight achieved by early Indian mathematicians.

2.1.2.8 Algebra

In determining lengths, areas, and proportions as part of the construction of sacrificial altars and the arrangement of bricks required for them, the authors of the Śulbasūtras encountered problems equivalent to linear, simultaneous, and indeterminate equations. Although these texts expressed the results in geometric terms, they reflect an early stage in the development of algebraic thinking.

Algebra gradually emerged as a distinct branch of mathematics from about the time of Brahmagupta (7th century CE). He used the terms *kuṭṭaka* and *kuṭṭaka-gaṇita* to refer to algebraic methods, particularly those dealing with indeterminate equations. Later scholars used the term *bījagaṇita*, meaning “the science of calculation with unknown quantities (*bīja*)”. Indian mathematical texts used sever-

al expressions to denote unknown quantities, including *yāvat-tāvat*, *yadrcchā*, *gulika*, and *avyakta*.

Indian texts mention the classifications of equations (1) according to the powers of the unknown quantity into simple equations (*yāvat-tāvat*), quadratic equations (*varga*), cubic equations (*ghana*) etc., and (2) according to the number of unknown quantities into *eka-varṇa-samīkaraṇa* (equations containing one unknown quantity), *aneka-varṇa-samīkaraṇa* (equations containing many unknown quantities), and *bhāvita* (equations containing products of unknown quantities).

Linear equations were often solved using methods similar to the Rule of False Position, in which trial values were substituted and adjusted to obtain the correct result. Traces of this method appear in early Indian works such as the *Sthānāṅgasūtra* and the Bakhshālī Manuscript.

Problems leading to quadratic equations appear in the Śulbasūtras as well as in later mathematical works. Clear rules for solving such equations are found in the writings of Āryabhaṭa and Brahmagupta. These rules were applied to practical problems such as the calculation of interest and the determination of the number of terms in an arithmetic progression.

A particularly remarkable achievement of Indian algebra is the systematic study of indeterminate equations. The rules prescribed in the Baudhāyana Śulbasūtra for the construction of a sacrificial fire altar comprise indeterminate equations of types such as $x + y = 21$. Indian mathematicians like Brahmagupta and Bhāskara II also dealt with indeterminate equations of the second degree of the form $Nx^2 \pm c = y^2$, which later came to be known in Europe as the Pell equation. Bhāskara II described the elegant procedure known as the

cakravāla or cyclic method for solving such equations. Historians of mathematics have recognized this technique as one of the most sophisticated achievements of medieval algebra.

2.1.2.9 Trigonometry

Trigonometry in ancient India developed primarily in connection with astronomy, where precise calculations of planetary positions, eclipses, and celestial movements were required. As astronomical observations became more systematic, mathematicians devised methods to measure arcs and angles of

circles, which led to the development of trigonometric functions and tables.

Indian mathematicians used three principal trigonometric functions: *jyā*, *koṭi-jyā* (or *kojyā*), and *utkrāma-jyā*. These relate respectively to the modern functions – sine, cosine, and versed sine. When an arc subtends an angle at the centre of a circle, it looks like a bow (*dhanus* or *cāpa* in Sanskrit). The straight line joining the two endpoints of the arc becomes the bowstring (*jyā* in Sanskrit) and is a chord of the circle. The *koṭi-jyā* is the complement at 90° to the *jyā*, and the *utkrāma-jyā* is the inverted-*jyā* which looks like the arrow with respect to the bow. See Figures 2.1.2 and 2.1.3.

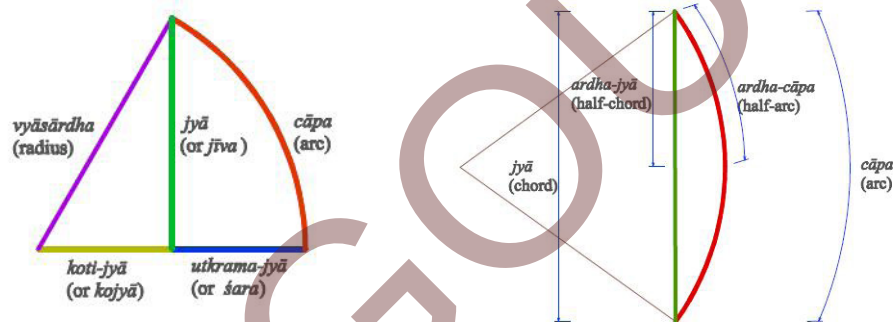


Figure 2.1.2, 2.1.3 – arc (*cāpa*), *jyā* (sine), *koṭi-jyā* (cosine) and *utkrāma-jyā* (versed sine)

Sources: https://en.dharmapedia.net/w/images/9/92/Jya_and_ardhajya.jpg; https://en.dharmapedia.net/w/images/5/5a/Jya_and_kotijya.jpg

If the circle is of radius R , then the function *jyā* represents $R \sin \theta$, *koṭijyā* represents $R \cos \theta$, and *utkrāmajyā* represents $R - R \cos \theta$. Thus, it can be understood that the Indian sine is the modern sine multiplied by the radius.

A major feature of Indian trigonometry was the preparation of sine tables to facilitate astronomical calculations. The tables usually listed the values of the sine function at intervals of $3^\circ 45'$, although other intervals were sometimes used. The earliest of such tables is seen in the *Āryabhaṭīya* (*Gīṭikāpāda*, verse 12). The Indian mathematicians derived sev-

eral other important trigonometric relations as well. Bhāskara II in his *Siddhāntaśiromaṇi* states: (1) the cosine of an arc of 45° is of the same length as the sine of that arc, (2) the cosine of an arc of 30° is the sine of an arc of 60° , and so on.

Thus, trigonometry in India evolved as an essential tool for astronomy and gradually developed into a sophisticated mathematical discipline. From the formulation of trigonometric functions and tables to the discovery of advanced series expansions, Indian scholars made enduring contributions to the study of trigonometry.



2.1.2.10 Calculus

Some early ideas resembling the principles of calculus appear in the works of Brahmagupta and Bhāskara II. These ideas developed mainly in connection with astronomical calculations and geometric problems involving areas, volumes, and changing quantities.

Bhāskara II used a method similar to integration to determine the surface area and volume of a sphere. He imagined the surface of a sphere as being divided into many thin circular bands and obtained the total area by summing the areas of these bands. Likewise, the sphere was divided into many small pyramids whose bases lay on the surface and whose apices met at the centre; the total volume was obtained by adding the volumes of these pyramids. This process of summing many small quantities resembles the modern concept of integration.

Bhāskara II also discussed the idea of *tatkālika gati* (instantaneous motion) while studying planetary movements. In attempting to determine the velocity of a planet at a particular instant, he introduced reasoning that reflects an elementary understanding of rate of change, which is closely related to the modern idea of differentiation.

Although these ideas were not developed into a formal system as in modern calculus, they demonstrate the analytical insight of Indian mathematicians and their efforts to address complex astronomical and geometric problems.

2.1.2.11 The Kerala School of Mathematics

An important development in the later history of Indian mathematics is associated with the Kerala School of Mathematics, which flourished between the fourteenth and sixteenth centuries in the region of present-day

Kerala. This scholarly tradition is generally traced to Mādhava of Saṅgamagrāma (c. 14th century), whose work laid the foundation for several advances in trigonometry and mathematical analysis. Scholars belonging to this school were primarily concerned with improving the accuracy of astronomical calculations, and in doing so they developed a number of sophisticated mathematical techniques.

Among their important achievements was the derivation of infinite series expansions for trigonometric functions such as sine and cosine, which allowed increasingly accurate numerical computations. They also obtained series for determining the value of π and introduced correction terms that improved the precision of these calculations. Some of these series are mathematically similar to results that later became well known in modern mathematics. For instance, certain expansions resemble series studied in Europe during the seventeenth century by mathematicians such as James Gregory and Isaac Newton. Later scholars in this tradition continued to refine these analytical methods and produced additional expansions, including those sometimes referred to as the Puthumana series.

The results and procedures of this school are preserved in several important mathematical and astronomical works such as the *Tantrasaṅgraha*, *Karaṇapaddhati*, *Yuktibhāṣā*, and *Sadratnamālā*, which present detailed explanations of the reasoning behind many computational methods.

2.1.3 Astronomy in Ancient India

Ancient Indian astronomy was closely connected with the cultural, ritual, and philosophical life of the society. Many of the rituals prescribed in the Vedas had to be performed according to precise rules, and it was believed that only when these rules were fol-

lowed properly would the rituals produce the desired results. Among these rules, accurate determination of time was particularly important. Rituals had to begin and end at specific moments, and many were required to be performed during particular seasons of the year or at definite hours of the day. In some cases, the positions of certain stars or planets as observed from the earth were also considered in determining the appropriate time for conducting a ritual.

Astronomical observations also played an important role in the organization of social and religious life. Many traditional festivals were associated with particular astronomical events such as sunrise, sunset, new moon (*amāvasyā*), and full moon (*pūrṇimā*). Planetary movements were widely believed to influence human life and activities. Consequently, time was often classified into auspicious and inauspicious periods based on the positions and motions of celestial bodies. Events such as solar and lunar eclipses were also regarded with great significance, and rulers and scholars sought to predict their occurrence in advance. These practical and cultural needs encouraged systematic attempts to observe and predict various astronomical phenomena.

The study of such phenomena came to be known as *Jyotiṣa*, which later developed into the broader discipline called *Jyotiḥśāstra*. *Jyotiṣa* was regarded as one of the six Vedāṅgas, or auxiliary disciplines necessary for the proper understanding and preservation of Vedic knowledge. The other five Vedāṅgas are *Śikṣā* (phonetics), *Vyākaraṇa* (grammar), *Chandas* (meter), *Kalpa* (ritual procedures), and *Nirukta* (etymology). In traditional descriptions, *Jyotiṣa* is metaphorically described as the “eyes of the Vedas,” since accurate knowledge of time was essential for the correct performance of rituals.

The necessity for measuring time and observing celestial movements encouraged ancient Indian scholars to develop different units of measuring time, systems of calendar calculation, methods for determining the positions and motions of the sun, moon, and planets, and techniques for predicting eclipses. These efforts gradually led to significant advances in astronomical observation and mathematical computation.

Astronomical knowledge in India was frequently expressed in Sanskrit verses according to the different encoding systems mentioned in the earlier section. Rules for calculating time intervals and astronomical positions were often composed in metrical form. This made it easier for students and scholars to memorize complex numerical relationships and computational procedures.

The following sub-sections introduce some of the notable endeavours of ancient Indian astronomers.

2.1.3.1 Celestial Bodies and the Zodiac Framework

Ancient Indian astronomers observed the sky carefully and developed systematic ways of describing the positions of celestial bodies. Since observations were made from the Earth, the movements of heavenly bodies were understood in terms of their apparent motion across the sky. These bodies were seen to move along a fixed path. This path was recognised as the zodiac, a circular band in the sky that served as the main reference framework for locating celestial bodies.

The zodiac was divided into twelve equal sections called *rāśis*, each representing one-twelfth of the full circle of 360 degrees. These twelve divisions provided a convenient way to specify the position of celestial bodies at any given time. When a body was said to be



in a particular *rāśi*, it meant that its apparent position when observed from earth lay within that section of the zodiac. The names of the

twelve *rāśis* and their modern equivalents are given in Table 2.1.6.

Table 2.1.6

***Rāśis* and Modern Equivalents**

<i>Rāśis</i>	Modern Equivalents	<i>Rāśis</i>	Modern Equivalents
<i>Meṣa</i>	Aries	<i>Tulā</i>	Libra
<i>Vṛṣabha</i>	Taurus	<i>Vṛścika</i>	Scorpio
<i>Mithuna</i>	Gemini	<i>Dhanu</i>	Sagittarius
<i>Karkidaka</i>	Cancer	<i>Makara</i>	Capricorn
<i>Simha</i>	Leo	<i>Kumbha</i>	Aquarius

In addition to this twelvefold division, the zodiac was also divided into 27 *nakṣatras* or lunar mansions (See Table 2.1.7). Each *nakṣatra* corresponds to a smaller portion of the zodiac associated with a prominent star or group of stars. This division was particularly useful for tracking the motion of the Moon, which moves relatively quickly across the sky. Each

nakṣatra was further divided into four equal parts called *pādas*, giving a total of 108 *nakṣatra-pādas* across the zodiac ($2\frac{1}{4}$ *nakṣatras* or 9 *nakṣatra-pādas* in each of the 12 *rāśis*). These finer divisions allowed astronomers to describe celestial positions with greater precision.

Table 2.1.7
27 *Nakṣatras*

No:	<i>Nakṣatra</i>	No:	<i>Nakṣatra</i>	No:	<i>Nakṣatra</i>
1	<i>Aśvinī</i>	10	<i>Maghā</i>	19	<i>Mūlā</i>
2	<i>Bharanī</i>	11	<i>Pūrvaphālgunī</i>	20	<i>Pūrvāṣāḍhā</i>
3	<i>Kṛttikā</i>	12	<i>Uttaraphālgunī</i>	21	<i>Uttarāṣāḍhā</i>
4	<i>Rohiṇī</i>	13	<i>Hastā</i>	22	<i>Śravaṇā</i>
5	<i>Mṛgaśīrṣa</i>	14	<i>Citrā</i>	23	<i>Dhanisthā</i>
6	<i>Ādrā</i>	15	<i>Svātī</i>	24	<i>Śatabhiṣaj</i>
7	<i>Punarvasū</i>	16	<i>Viśākhā</i>	25	<i>Pūrvabhādrapadā</i>
8	<i>Puṣyā</i>	17	<i>Anurādhā</i>	26	<i>Uttarabhādrapadā</i>
9	<i>Āśleṣā</i>	18	<i>Jyēṣṭhā</i>	27	<i>Revatī</i>

The apparent motion of the Sun through the twelve *rāśis* formed the basis for the concept of the solar month. Each time the Sun en-

tered a new *rāśi*, a new solar month was said to begin. However, the motion of the Moon along the whole zodiac gave rise to the lunar

month, i.e., one lunar month is one complete cycle of the Moon covering all the 12 *rāśis* or 27 *nakṣatras*.

The daily rising and setting of the Sun were explained through the relation between the Earth and the zodiac. Because the Earth rotates on its axis, different parts of the zodiac appear to rise in the eastern horizon and set in the western horizon during the course of a day. As this rotation continues, the Sun appears to move across the sky from east to west, producing the regular cycle of day and night.

Ancient Indian astronomy also recognised several important celestial bodies (*grahas*) whose positions were observed and studied. In the traditional framework, the Sun and the Moon were included along with other visible planets such as *Maṅgala* (Mars), *Budha* (Mercury), *Guru* or *Br̥haspati* (Jupiter), *Śukra* (Venus), and *Śani* (Saturn). These bodies were treated together as members of the same observational category, since the classification was based on their apparent movement in the sky rather than on the modern distinction between planets, stars, and satellites.

It should be noted that the knowledge that the apparent daily movement of the stars is in fact caused by the rotation of the Earth on its axis was not alien to ancient India. Āryabhaṭa (476–550 CE) is known to have proposed the

same in his work *Āryabhaṭīya* (*Golāpāda*, verse 9). He says, “Just as a man in a boat moving forward sees the stationary objects (on either side of the river) as moving backward, just so are the stationary stars seen by people at *Laṅkā* (on the equator) as moving exactly towards the west.” Although later Indian astronomers differed in their acceptance of this theory, Āryabhaṭa’s insight remains a remarkable example of the intellectual sophistication of early Indian astronomy.

2.1.3.2 Measurement of Time

The measurement of time formed one of the most important concerns of ancient Indian astronomy. Accurate reckoning of time was necessary for fixing the proper moments for rituals, maintaining calendars, and predicting astronomical phenomena. Indian astronomers therefore developed a systematic framework for measuring time across different scales, beginning with extremely small units and extending to vast cosmic cycles.

Ancient Indian scholars conceived a hierarchy of smaller time units that ultimately build up to a full day. These units were used in astronomical calculations as well as in ritual contexts. The smallest measurable units were progressively combined to form larger intervals, eventually culminating in the day (*ahorātra*), which represents a complete cycle of day and night. See Tables 2.1.8 and 2.1.9.

Table 2.1.8
Smaller Units of Time - 1

1 <i>gurvākṣara</i>	Time taken to pronounce 10 long syllables
10 <i>gurvākṣara</i>	1 <i>prāṇa</i> (1 respiration, about 4 seconds)
6 <i>prāṇas</i>	1 <i>vināḍī</i> (24 seconds)
60 <i>vināḍīs</i>	1 <i>nāḍī</i> or <i>nāḍikā</i> or <i>ghaṭikā</i> (24 minutes)
60 <i>nāḍīs</i>	1 day (24 hours)



Table 2.1.9

Smaller Units of Time - 2

1 <i>truṭi</i>	$\frac{1}{33750}$ of a second
100 <i>truṭis</i>	1 <i>tatpara</i>
30 <i>tatpara</i>	1 <i>nimeṣa</i> (time for the blink of an eye)
18 <i>nimeṣas</i>	1 <i>kāṣṭhā</i>
30 <i>kāṣṭhās</i>	1 <i>kalā</i>
30 <i>kalās</i>	1 <i>ghaṭikā</i> (24 minutes)
2 <i>ghaṭikās</i>	1 <i>kṣaṇa</i> or <i>muhūrta</i> (48 minutes)
30 <i>muhūrtas</i>	1 <i>dina</i> or day (24 hours)

Beyond the day, time was organised into larger units that corresponded to the periodic motions of celestial bodies. One such unit is the week (*vāra*), which consists of seven days. Each day of the week is associated with a celestial body visible to the naked eye. The names of the weekdays reflect these associations: Ravivāra (Sun), Somavāra (Moon), Maṅgalavāra (Mars), Budhavāra (Mercury), Guruvāra (Jupiter), Śukravāra (Venus), and Śanivāra (Saturn). This is calculated in an interesting manner. An *ahorātra* (24 hours) is divided into 24 *horās* (hours) and for each *horā* a celestial body is considered as the lord (*horādhipati*) in the order Saturn, Jupiter, Mars, Sun, Venus, Mercury, and Moon. The *horādhipati* present at the sunrise of a day is the lord of the day. Proceeding this way, we find that the *horādhipati* at sunrise on each 7-day cycle has the pattern Sun, Moon, Mars, Mercury, Jupiter, Venus, and Saturn.

Another important unit is the *pakṣa*, or lunar fortnight. A lunar month is divided into two *pakṣas* corresponding to the phases of the Moon. The *śukla-pakṣa* represents the waxing phase of the Moon from new moon (*amāvāsī*) to full moon (*pūrṇimā*), while the *kṛṣṇa-pakṣa*

represents the waning phase from full moon (*pūrṇimā*) to the next new moon (*amāvāsī*). Each *pakṣa* consists of fifteen *tithis* – *prati-padā*, *dviṭīyā*, *tritīyā*... and so on – which are lunar days defined by the changing angular separation between the Sun and the Moon.

Two *pakṣas* together constitute a *māsa*, or month. Indian astronomical tradition recognises both lunar months and solar months. A lunar month corresponds to the synodic cycle of the Moon and lasts about 29.5 days. A solar month, on the other hand, is defined by the Sun's passage through one zodiac section (*rāśi*). Since twelve lunar months ($29.5 \text{ days} \times 12 \text{ months} = 354 \text{ days}$) fall short of the solar year (365 days) by about eleven days, an additional intercalary month (*adhikamāsa*) is occasionally inserted to maintain alignment between the lunar calendar and the solar cycle.

Months were further grouped into *ṛtus*, or seasons. Classical Indian tradition recognises six seasons (two months each) in a year: *Vasanta ṛtu* corresponds to spring, *Grīṣma ṛtu* to summer, *Varṣā ṛtu* to the rainy season (monsoon), *Śarad ṛtu* to autumn, *Hemanta ṛtu* to early winter, and *Śiśira ṛtu* to late winter.

The year was also divided into two major halves known as *ayanas*, which correspond to the apparent northward and southward movement of the Sun along the ecliptic. *Uttarāyana* begins when the Sun appears to move northward after the winter solstice and continues until the summer solstice. The complementary period, *Dakṣiṇāyana*, marks the apparent southward movement of the Sun from the summer solstice to the winter solstice. These divisions were closely connected with seasonal changes and were also considered significant in ritual traditions.

A full cycle of the Sun through the zodiac constitutes a year (*varṣa*). Ancient Indian astronomy recognised different types of years depending on the method of measurement, such as the solar year, lunar year, and sidereal year. The reconciliation of solar and lunar cycles led to the development of the luni-solar calendrical system, which became the basis of traditional Indian calendars.

Beyond the yearly cycle, Indian cosmological thought introduced very large units of time known as *yugas*. There are four *yugas* – *Kṛta-yuga*, *Tretā-yuga*, *Dvāpra-yuga*, and *Kali-yuga*. The durations of the four *yugas* follow the ratio 4:3:2:1. The duration of *Kṛta-yuga* is 17,28,000 years, that of *Tretā-yuga* is 12,96,000 years, that of *Dvāpra-yuga* is 8,64,000, and that of *Kali-yuga* is 4,32,000. Together these four *yugas* form a *Mahāyuga* lasting 43,20,000 years.

Indian cosmology further extends this framework by introducing even larger cycles of time. A *Kalpa*, sometimes described as a “day of *Brahmā*,” represents an immense cosmic period lasting 1000 *Mahāyugas* (4.32 billion years). Such vast temporal scales reflect the grand cosmological perspective within which ancient Indian astronomers and philosophers understood the universe.

In summary, the ancient Indian system of time measurement extends from extremely small units used in practical calculations to vast cosmic cycles spanning billions of years. This elaborate hierarchy demonstrates the close connection between astronomy, ritual practice, calendrical science, and cosmological thought in the Indian intellectual tradition.

2.1.3.3 Calendrical Systems

The systematic measurement of time led naturally to the development of calendrical systems in ancient India. Calendars were essential for regulating rituals, organising social and agricultural activities, and predicting astronomical phenomena. Since many religious observances were linked to specific lunar phases, stellar positions, and seasonal changes, Indian astronomers carefully studied the motions of the Sun and the Moon in order to construct reliable calendrical frameworks. As a result, three principal types of calendars came to be recognised in the Indian tradition: the solar calendar, the lunar calendar, and the luni-solar calendar.

Solar Calendar

The solar calendar is based on the apparent motion of the Sun along the ecliptic. In this system, the year is defined by the Sun’s passage through the twelve divisions of the zodiac known as *rāśis*. Each solar month begins when the Sun enters a new *rāśi*, and twelve such transitions complete the solar year. Recall the names of *rāśis* from the Table 2.1.6. Because this system is closely connected with the seasonal cycle, solar calendars were particularly useful in regulating agricultural activities and seasonal observances. Variants of the solar calendar have been followed in several regions of India and continue to influence certain regional calendrical traditions.



Lunar Calendar

The lunar calendar is based on the phases of the Moon. A lunar month corresponds to the synodic cycle of the Moon, that is, the interval between two successive new moons. Each lunar month is divided into two halves corresponding to the waxing and waning phases of the Moon. As mentioned earlier, one lunar month is also the time taken by the Moon to apparently pass through the whole zodiac. Twelve such lunar months form a lunar year of approximately 354 days. However, since this lunar year is shorter than the solar year by about eleven days, a purely lunar calendar gradually shifts with respect to the seasons.

Luni-solar Calendar

To resolve this discrepancy between the solar and lunar calendars, Indian astronomers developed the luni-solar calendar, which combines elements of both solar and lunar reckoning. In this system, the months are determined according to the lunar cycle, while adjustments are made to ensure that the year remains aligned with the solar seasons. This adjustment is achieved through the periodic insertion of an intercalary month (*adhikamāsa*) whenever the difference between the lunar and solar reckonings becomes significant. The inclusion of this additional month helps maintain the correspondence between the lunar months and the seasonal cycle governed by the Sun.

Pañcāṅga or the Indian Almanac

Pañcāṅga, literally meaning “five limbs.” The *pañcāṅga* serves as an astronomical almanac that provides the calendrical parameters necessary for determining the characteristics of each day. It integrates several astronomical elements derived from the relative motions of the Sun and the Moon and is used to identify auspicious times for rituals and social activi-

ties. The five components of the *pañcāṅga* are – *tithi*, *nakṣatra*, *vāra*, *yoga*, and *karaṇa*. The first three have been explained earlier. *Yoga* and *karaṇa* are also specific combinations of the positions of the Sun and the Moon. There are 27 *yogas* and 11 *karaṇas*.

By combining careful observation of celestial cycles with mathematical methods of time reckoning, Indian astronomers created a flexible and sophisticated calendrical framework capable of coordinating lunar phases, solar motion, and seasonal rhythms. The integration of astronomical knowledge with cultural needs ensured that the calendar served both scientific and practical purposes in the Indian intellectual tradition.

2.1.3.4 Computation of Planetary Positions and Motions

Ancient Indian astronomers developed systematic mathematical methods to calculate and predict the positions of celestial bodies. Continuous observations of the sky showed that planets do not move uniformly across the zodiac. Their apparent motion varies in speed, and at times they appear to slow down or move faster than usual. In order to describe and predict such irregularities, astronomers devised mathematical models that allowed them to determine planetary positions with considerable accuracy.

Mean Position and Manda-Śighra Corrections

A basic step in these calculations was to determine the mean position of a planet. This was obtained by assuming that the planet moves at a uniform rate along the zodiac. However, actual observations revealed deviations from this uniform motion. To account for these differences, Indian astronomers introduced correction procedures that transformed the mean position into the true position of the

planet. Two important corrections used in this process were known as the *manda* and *śīghra* corrections. The *manda* correction accounted for variations in the apparent speed of a planet along its path, while the *śīghra* correction was related to the planet's position relative to the Sun. Together, these corrections enabled astronomers to explain and predict important phenomena such as the temporary reversal of planetary motion, commonly known as retrograde motion (*vakra-gati*).

The principles of planetary motion and the computational procedures used to determine planetary positions are discussed in several important astronomical works. Āryabhaṭa (476-550 CE), in his work *Āryabhaṭīya*, presented systematic rules for calculating planetary longitudes and for applying corrections to mean motions. His work marked an important stage in the mathematical treatment of planetary motion in India. Brahmagupta (7th century CE), in the *Brāhmasphuṭasiddhānta*, further elaborated planetary calculations and improved several computational procedures. Later astronomers continued to expand these ideas. Bhāskara I wrote detailed commentaries explaining the methods found in earlier works, while Bhāskara II, in his *Siddhāntaśiromaṇi*, presented comprehensive discussions of planetary motions and the mathematical techniques used in astronomical calculations.

Karaṇa and Vākya Systems

Indian astronomers also developed practical computational systems that made these calculations easier to apply. One such approach was the *karaṇa* system, which consisted of simplified manuals derived from the more detailed *siddhānta* (theoretical) texts. These works provided concise rules and numerical constants that enabled astronomers to determine planetary positions for particular periods. Texts such as the *Karaṇakutūhala* of

Bhāskara II presented computational rules in a brief and practical form so that astronomers could directly calculate planetary positions needed for calendrical purposes without dealing with the complex geometrical proofs given in the *siddhānta* texts.

Another widely used method was the *vākya* system. In this system, astronomical constants and computational rules were expressed in the form of short Sanskrit sentences or mnemonic verses (*vākyas*). These verses encoded numerical values in a form that could be memorised and used directly for calculations. This is possible because of the idea of astronomical cycles. The ancient Indian astronomers observed that the motion of celestial bodies showcase some patterns and hence created ready-made tables for easy calculations.

Traditional astronomical schools preserved collections of such mnemonic statements that represented numerical constants for planetary positions on particular days. For example, Vararuci developed the *Candravākyas*, a collection of mnemonic verses in which the Moon's positions for 248 daily longitudes of the Moon over 9 anomalistic months are encoded. By remembering such *vākyas*, astronomers could determine the position of a planet without performing lengthy calculations. This method was especially useful for preparing regional calendars and almanacs as well as for predicting events such as eclipses.

2.1.3.5 Eclipses

Solar and lunar eclipses were among the most striking celestial events observed by ancient astronomers. Because of their dramatic appearance and cultural importance, considerable effort was devoted to understanding and predicting these phenomena.

Earlier mythological traditions explained eclipses through the figures of *Rāhu* and *Ketu*.



Astronomical texts later interpreted these figures in a more scientific manner as representing the points where the path of the moon intersects the apparent path of the sun. These points, known as lunar nodes, are the locations where eclipses can occur. A lunar eclipse occurs when the earth comes between the sun and the moon, causing the earth's shadow to fall on the moon. A solar eclipse occurs when the moon passes between the earth and the sun and partially or completely blocks the sunlight reaching the earth.

Indian astronomers developed mathematical methods to calculate the positions of the sun, moon, and lunar nodes. Using these calculations, they were able to predict the occurrence and timing of eclipses and estimate their magnitude. Such predictions were important not only for astronomical purposes but also for social and ritual activities.

Recap

- ▶ The earliest engagements of Indian scholars with mathematics can be seen in the context of Vedic ritual practices.
- ▶ The decimal place-value system that expresses every possible number using a set of ten symbols is one of the most influential contributions of ancient India to mathematics. The development of zero in ancient India had a profound impact on the world of numbers and calculations.
- ▶ Ancient Indian scholars developed sophisticated numerical encoding systems to represent numbers using words, syllables, or letters.
- ▶ Geometrical problems and analyses developed in connection with the construction of sacrificial altars. The Śulbasūtras preserve many such geometrical insights.
- ▶ Ancient Indian literature contains attempts to estimate the values of pi (π) and other irrational quantities.
- ▶ Indian texts deal with algebraic problems involving linear, quadratic, and indeterminate equations.
- ▶ A major feature of Indian trigonometry was the preparation of sine tables to facilitate astronomical calculations.
- ▶ *Jyotiṣa* is metaphorically described as the “eyes of the Vedas,” since accurate knowledge of time was essential for the correct performance of rituals.
- ▶ Ancient Indian scholars conceived the movements of the celestial bodies through the zodiac belt divided into 12 *rāśis* and 27 *nakṣatras*.
- ▶ Indian astronomers therefore developed a systematic framework for measuring time across different scales, beginning with extremely small units and extending to vast cosmic cycles.

- ▶ Indian astronomers carefully studied the motions of the Sun and the Moon in order to construct reliable calendrical frameworks.
- ▶ The principles of planetary motion and the computational procedures used to determine planetary positions are discussed in several important astronomical works like *Āryabhaṭīya* of Āryabhaṭa, *Brāhmasphuṭasiddhānta* of Brahmagupta, and the *Siddhāntaśiromaṇi* of Bhāskara II.

Objective Questions

1. What is the term used for 10^4 (10,000) in the system of powers of ten in ancient Indian mathematics?
2. Which number does the word *nāyaṇa* represent according to the bhūta-saṅkhyā system of encoding?
3. Which text provides important geometrical insights while prescribing the construction of altars in ancient India?
4. Who is the author of *Āryabhaṭīya*?
5. Which *vedāṅga* is metaphorically described as the “eyes of the Vedas”?
6. How many *rāśis* are there in the zodiac?
7. How many *nakṣatras* are there in the zodiac?
8. What is the name for a full moon day?
9. In which *ayana* the Sun apparently moves northwards from the winter solstice?
10. Which astronomical phenomenon, earlier explained through mythology, later got understood with respect to the alignment of the sun, moon, and earth?
11. Who wrote the *Siddhāntaśiromaṇi*?

Answers

- | | |
|---------------|-----------------|
| 1. Ayuta | 7. 27 |
| 2. two | 8. Pūrṇimā |
| 3. Śulbasūtra | 9. Uttarāyaṇa |
| 4. Āryabhaṭa | 10. Eclipse |
| 5. Jyotiṣa | 11. Bhāskara II |
| 6. 12 | |



Self Assessment Questions

1. What is the ancient Indian term for the number \$10,000\$ (ten thousand)?
2. Which number does the word *nāyaṇa* represent in the *bhūta-saṅkhyā* system?
3. Explain the significance of the word "*śulba*" in the context of ancient Indian geometry.
4. Identify the author of the *Āryabhaṭīya* and the *Siddhāntaśiromaṇi*.
5. Which Vedāṅga is metaphorically described as the "eyes of the Vedas"?
6. How many *rāśis* (zodiac signs) and *nakṣatras* (lunar mansions) are recognized in the Indian zodiac?
7. Briefly explain the *Uttarāyaṇa* and its relationship to the winter solstice.
8. Describe how ancient Indian astronomers scientifically reinterpreted the mythological figures of Rāhu and Ketu.
9. Discuss the importance of the decimal place-value system and the conception of zero in the Indian mathematical tradition.
10. Outline the ancient Indian accomplishments in the fields of algebra and trigonometry.

Assignments

1. Discuss the importance of the decimal number system and the conception of zero prevalent in the Indian tradition.
2. Shed light on the different systems developed by ancient Indian scholars for encoding numbers.
3. Outline the ancient Indian insights into geometry.
4. Write a short note on the ancient Indian accomplishments in algebra and trigonometry.
5. Analyse the features of the zodiac framework.
6. Elaborate upon the measurement of time in the ancient Indian tradition.
7. Describe the Indian calendrical system.
8. Write about the ancient Indian ways of computing planetary positions and motions including the prediction of astronomical events.
9. Give a brief account of the major figures in ancient Indian astronomy and mathematics.

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Unit 2

Engineering and Architecture

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- ▶ highlight the accomplishments of the Indus Valley civilisation in civil engineering
- ▶ understand the features of ancient Indian religious architecture
- ▶ analyse the metallurgical activities in ancient India
- ▶ acquaint with the ideas applied by ancient Indians in agriculture and irrigation

Prerequisite

Ancient India developed remarkable expertise in planning and constructing urban centres, with well-laid streets, standardized brick construction, and sophisticated drainage and water-management systems, as seen in the Indus Valley Civilization. Religious architecture, including stupas, viharas, and temples, combined practical utility with artistic, symbolic, and cosmological expression. Metallurgical knowledge encompassed the extraction and processing of copper, bronze, iron, and steel, which were used in tools, ornaments, and monumental structures. Ancient agricultural practices embedded the careful selection of crop varieties, classification of land and soil, ploughing techniques, seed preservation, irrigation, and pest and disease management. This unit provides a brief account of ancient Indian achievements in architecture, urban planning, metallurgy, and agriculture, highlighting the integration of practical knowledge, technology, and aesthetic vision across different periods.

Key Words

Indus Valley Civilization, town planning, engineering, architecture, pottery, stupas, viharas, temples, metallurgy, agriculture

Discussion

2.2.1 Introduction

Vāstuvidyā or *śilpaśāstra* were traditional terms used in ancient India to denote the knowledge systems related to architecture, construction, and crafts. These formed part of the technical disciplines studied in classical Indian traditions.

Ancient India developed a rich and diverse tradition of architecture and engineering collectively indicated by archaeological discoveries, material remains, inscriptions, and textual traditions. Ranging from the well-planned urban centres of the Harappan Civilization (3rd and 2nd millennium BCE) along with its remarkable achievements in town-planning, building construction, water management systems, and drainage networks, to the remarkable metallurgical works and monumental temple architecture in the later period, the Indian tradition has left a significant mark on the history of architecture and engineering.

The Indian models of architecture and engineering reflect practical knowledge, ecological sensitivity, and mathematical precision. Religious architecture often incorporated spiritual and cosmological symbolism. The built environment – cities, temples, stupas, irrigation systems, and metallurgical works – was not merely functional but also embodied broader cultural and philosophical ideas.

This unit briefly discusses some major accomplishments in ancient Indian architecture and engineering, beginning with the urban achievements of the Harappan Civilization and extending to religious architecture and medieval developments. It also provides a brief account of the ancient Indian knowledge in metallurgy and agriculture.

2.2.2 Civil Works in the Indus Valley (Harappan) Civilisation

The Indus Valley Civilization that flourished mainly in the 3rd millennium BCE is celebrated for its accomplishments in civil engineering. The sophisticated urban planning of the period reflects advanced engineering, social organization, and environmental adaptation. Excavations at Harappa (now in Punjab, Pakistan), Mohenjo-Daro (now in Sindh, Pakistan), Lothal and Dholavira (now in Gujarat), and Kalibangan (now in Rajasthan) reveal that the civilization had a level of urban sophistication that rivalled the contemporary civilizations of Egypt and Mesopotamia.

A few features of the urban centres during the Indus Valley Civilization are as follows:

- The cities of the civilization were laid out in a grid pattern that not only enhanced aesthetics but also ensured order and accessibility. This grid-based layout simplified land allocation and infrastructure maintenance as well. Well-burnt and standardized bricks were used for construction purposes.



Figure 2.2.1 – Archaeological site of Mohenjo-Daro
(Source: <https://www.worldhistory.org/uploads/images/12856.jpg>)

- The roads were aligned in east-west and north-south directions. Each road intersected the other almost at right angles. The roads had varying width depending on the traffic requirements.
- The division of a city into different functional zones – the upper platform that housed the Citadel for administrative purposes and the lower town that occupied the residential and commercial areas – was yet another feature of the town planning.
- The cities had numerous wells and reservoirs with appropriate channels to divert floodwater as well as to store rainwater for dry seasons.



Figure 2.2.2 – Well and bathing platform at Harappa
(Source: <https://www.worldhistory.org/uploads/images/3324.jpg>)

- The residential houses were closely built. Most of the houses had more than one floor. A typical house occupied a central courtyard, living rooms, private wells, bathrooms, and drainage facility that connected with the drainage network in the streets.
- The drains were covered with baked bricks. They were sloped in order to ensure smooth flow and prevent clogging.

- An example of remarkable public architecture is the Great Granary at Harappa. Its division into blocks, halls, and corridors along with its proper ventilation system suggests advanced planning in food storage.
- The Great Bath (see Figure 2.2.3) situated in the citadel at the Mohenjo-daro is one of the remarkable structures discovered among the ancient remains of the Indus Valley Civilization. The overall dimension of the Great Bath is 55m. x 33m. It has a swimming pool that measures 12m. x 7m. in the centre with verandahs on all sides. At either end of the pool, there are platforms and staircases. The exact purpose of the Great Bath is still debated, but the structure and construction style of the same have attracted historians and tourists.



Figure 2.2.3 – The Great Bath at Mohenjo-daro
(Source: <https://www.worldhistory.org/uploads/images/12854.jpg>)

The studies have shown that the Indus Valley Civilization's civil works emphasized public welfare. The town planning embodied precision and uniformity and ensured functionality, hygiene, environmental adaptation, and resilience.

2.2.3 Pottery

Pottery was one of the most important crafts in ancient India and provides valuable information about the technological skills and daily life of early communities.

Archaeological excavations at sites belonging to the Indus Valley Civilization have revealed a wide variety of pottery used for cooking, storing food, carrying water, and performing ritual activities. Many of these vessels were made using the potter's wheel, which allowed artisans to produce well-shaped and uniform pots. Harappan pottery is especially known for its red surface with black painted designs, which often include geometric patterns, plants, and animal figures. These decorative elements show both artistic creativity and careful craftsmanship.



Figure 2.2.4 – Harappan Ceremonial Vessel, Los Angeles County Museum of Art

Source: <https://www.worldhistory.org/uploads/images/3322.jpg>

The production of pottery required knowledge of selecting suitable clay, shaping vessels, and firing them in kilns at controlled temperatures. Archaeological evidence suggests that potters used specially constructed kilns to bake the vessels, making them strong and

durable. In addition to household vessels, terracotta objects such as figurines, toys, beads, and small models have also been discovered at many sites. These objects indicate that clay was widely used not only for practical purposes but also for artistic and cultural expression. Over time, different regions of India developed their own pottery traditions, such as Black-and-Red Ware and Painted Grey Ware, which help historians understand the cultural and technological developments of different historical periods.

Pottery thus represents an important example of early material technology and craft skill in ancient Indian society.

2.2.4 Religious Architecture

Religious architecture forms an important part of the architectural heritage of ancient India. From the early centuries of the historical period, different religious traditions such as Buddhism, Jainism, and Hinduism inspired the construction of various sacred structures. These buildings served not only as places of worship but also as centres for teaching, meditation, and community activities. Over time, religious architecture developed distinctive forms and styles that reflected regional traditions, available building materials, and evolving artistic ideas.

Among the most important forms of religious architecture in ancient India were stupas, viharas, and temples. Each of these structures had a specific purpose and architectural design, and together they represent important achievements in ancient Indian architecture and engineering.

Stupas

The stupa is one of the earliest forms of Buddhist religious architecture in India. Orig-

inally, stupas were built as burial mounds to preserve the relics of the Buddha or important Buddhist monks. Over time, they became important centres of pilgrimage and devotion.

Architecturally, a stupa usually consists of a hemispherical mound known as the *anda*, which is built on a circular base. At the top of the mound there is a square railing called the *harmika*, from which rises a central pillar supporting one or more umbrella-like structures known as *chatras*. Around the stupa there is often a circular path used by devotees for ritual circumambulation (*pradakṣiṇa*). The Sanchi Stupa (Figure 2.2.5) is one of the most famous examples of this architectural form. It also features beautifully carved gateways (*torāṇas*) that depict scenes from the life of the Buddha and other symbolic motifs.



Figure 2.2.5 – The Great Stupa of Sanchi
Source: <https://cdn.britannica.com/36/155836-050-89E7AA9E/Great-Stupa-Sanchi-India.jpg>

Stupas demonstrate both engineering skill in masonry construction and artistic excellence in sculpture and decorative elements.

Viharas

Viharas were residential monasteries for Buddhist monks and played an important role in the spread of Buddhist learning and religious practice. In their earliest form, viharas were simple structures built to provide shelter for monks during the rainy season. Over time, they developed into well-planned monastic complexes.

Architecturally, a typical vihara consisted of a central hall surrounded by small rooms or cells where monks lived and studied. Many viharas were constructed as rock-cut caves, especially in western India, where entire monasteries were carved into hillsides. The caves at Ajanta Caves contain several examples of such monastic structures. Later Buddhist centres such as Nalanda Mahavihara (Figure 2.2.6) developed large monastic complexes with multiple buildings, lecture halls, temples, and libraries.



Figure 2.2.6 – Excavated remains of Nalanda Mahavihara
Source: <https://whc.unesco.org/en/documents/141219>

These structures show careful planning and organization, reflecting the importance of monasteries as centres of education and intellectual activity.

Temples

Temple architecture became a major feature of religious architecture in India from the early medieval period onward. Temples were built as sacred spaces dedicated to different deities and served as important centres of ritual worship and community life. Over time, regional styles of temple architecture developed. Two of the most well-known styles are the Nagara style of northern India and the Dravida style of southern India.

The Nagara style is commonly found in northern and central India. Temples of this style are characterized by a tall, curved tower called the *shikhara* that rises above the sanc-

tum (*garbhagriha*). The base plan is usually square, and the temple often includes a hall (*mandapa*) in front of the sanctum. The temples of the Khajuraho Group of Monuments (Figure 2.2.7) are well-known examples of the Nagara style, with richly decorated walls and multiple rising spires. Another famous example is the Konark Sun Temple, built in the thirteenth century. This temple is designed in the form of a giant chariot dedicated to the Sun God and is known for its impressive stone carvings and symbolic architectural design.



Figure 2.2.7 – Khajuraho Group of Monuments
Source: <https://whc.unesco.org/en/documents/118911>

The Dravida style developed mainly in southern India. In this style, the temple tower above the sanctum is called the *vimana*, which has a pyramidal shape made up of several stepped levels. Large gateway towers known as *gopurams* are often found at the entrance to temple complexes. A famous example of this style is the Brihadeeswara Temple (Figure 2.2.8), built during the Chola period. This temple demonstrates advanced stone construction and careful architectural planning.



Figure 2.2.8 – Brihadeeswara Temple
Source: https://www.tamilnadutourism.tn.gov.in/img/pages/large-desktop/brihadeeswara-temple-1654763464_bfe471b31611964a6a2c.webp

Temple architecture in India therefore reflects both regional diversity and technical skill. These structures combined engineering knowledge, artistic expression, and religious symbolism, making them some of the most impressive achievements of ancient Indian architecture.

2.2.5 Metallurgy

Ancient India made significant contributions to the field of metallurgy. Archaeological excavations and literary evidence are the two sources through which we come to know about the metallurgical knowledge of the ancient period. The usage of copper and bronze in making artifacts, the production of iron and steel, and the extraction of gold, silver, zinc etc. represent significant metallurgical achievements of ancient Indians. This section highlights some important aspects of metallurgical knowledge in ancient India.

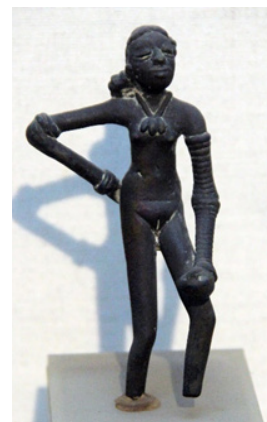


Figure 2.2.9 – Dancing girl statuette made up of bronze
Source: https://smarthistory.org/wp-content/uploads/2023/03/Dancing_girl_of_Mohenjo-daro-scaled.jpg

- Archaeological evidence shows extensive usage of copper and bronze during the Indus Valley Civilization. Tools, ornaments, and weapons made of these metals were used by the inhabitants of the civilization. This indicates the then-existing knowledge in the smelting of copper and its

alloying with tin or other elements to produce bronze. Figure 2.2.9 shows the bronze-made statuette famously known as the Dancing girl statue from the Indus Valley Civilization.

- Ancient India was particularly notable for its production and use of iron and steel. Archaeological evidence suggests that iron was in use in many parts of the Indian subcontinent by the early first millennium BCE. Indian metallurgists became particularly known for the production of high-quality steel, often referred to as wootz steel, which was exported to West Asia and later became famous as the material used in Damascus swords. A well-known example of ancient Indian iron technology is the Iron Pillar of Delhi (Figure 2.2.10), which has resisted corrosion for many centuries and demonstrates the sophisticated metallurgical skills of ancient Indian craftsmen.



Figure 2.2.10 – Iron Pillar of Delhi, at the Qutb Minār complex, Mehrauli, Delhi

Source: <https://www.britannica.com/topic/Iron-Pillar-of-Delhi>

- *Arthaśāstra* of Kautilya mentions the ores of gold, silver, copper, tin, lead, and mercury along with the processes of mining, purification and

preparation of alloys. The text lists different names for gold (*jāmbūnad-am*, *śātakūṃbham*, *jātarūpaṃ* etc.) according to the sources from which it is obtained. The text also classifies gold as superior (*śreṣṭham*), mediocre (*madhyamam*), and inferior (*avaram*) according to certain qualities.

- The process of heating gold in order to remove the impurities is mentioned in religious texts like the *purāṇas* as well. It is said that the soul, through devotion, gets rid of the impurities and embraces its true nature just as how gold, when heated, gets rid of other impurities.
- Knowledge about metals is part of the texts in ancient Indian medicine as well. *Caraka Saṃhitā* mentions substances that can be identified as compounds of copper and compounds of iron. The text describes the roasting of metals like iron and copper as the ‘killing’ of these metals, which actually means their transformation into medicinal compounds. *Sūśruta Saṃhitā* mentions the preparation and properties of alkali carbonates and caustic alkali. The text also points at the neutralisation of alkali by an acid.
- *Rasaratnākara* is a text traditionally attributed to the Buddhist alchemist Nāgārjuna of 8th century AD. It includes descriptions of alchemical processes and preparations of many mercurial compounds. It mentions several chemical processes like the extraction of zinc, mercury, and copper, and the preparation of crystalline red sulphide of mercury. The text describes many apparatuses (*yantra*) for various processes like distillation, sublimation,

evaporation etc. *Rasārṇava* is a text of anonymous author and period written in the form of conversation between Lord Śiva and Pārvatī. In its 4th chapter, while describing different apparatuses, it describes how different metals like copper, tin, lead, iron etc. produce distinct flame colours. *Rasaratnasamuccaya* is a later text that cites *Rasārṇava* and other earlier works. The author of this text is said to be Vāgbhaṭa and the period is estimated to be 1300-1400 AD. The text describes several laboratory setups, for example, *tapta-khalva-yantra*, *bālukā-yantra*, *ḍamarukā-yantra* etc. The text also outlines the design of furnaces, the placement of materials, and safety measures for handling chemicals. The abovementioned texts indicate a significant understanding of chemical processes in ancient and medieval India.

2.2.6 Agriculture

In India, agriculture played a crucial role since ancient times in sustaining livelihoods and supporting large populations. The familiarity with several grains, analysis and classification of land and soil, prediction of rainfall, water management, development of ploughing techniques and tools for the same, disease and pest management etc. are important aspects of agricultural knowledge in the ancient India. This section highlights a few major accomplishments of ancient India in agriculture.

- **Knowledge of crop varieties:** Names of several grains are mentioned in the Vedas – *yava* (barley), *māṣa* (pulses), *mudga* (pulses), *tila* (sesame), *masura* (lentil), *godhuma* (wheat), and so on.

This suggests extensive knowledge in crop varieties that are essential for sustaining human life.

- **Classification of land and soil:** Pāṇini's *Aṣṭādhyāyī* differentiates between cultivated land (*karṣa*) and two kinds of uncultivated land – *ūṣara* (wasteland), and *gocara* (pasture). Kautilya's *Arthaśāstra* speaks about different kinds of land – *kṛṣṭa* (cultivated), *akṛṣṭa* (uncultivated), *sthala* (high and dry ground), *kedāra* (field sown with crops), *mūlāvāpa* (field for growing roots) etc. *Caraka Saṃhitā* and *Śuśruta Saṃhitā* divide land into three categories – *jāṅgala* (barren), *anūpa* (moist), and *sādhāraṇa* (ordinary). *Kāśyapīya-kṛṣṣūkti* of unknown date attributed to Kāśyapa speaks of five kinds of land – *brāhmaṇa*, *kṣatriya*, *vaiśya*, *śūdra*, and the land of mixed qualities. Classifications of soil were made in accordance with the colour of the soil as black, red, yellow, brown etc. and in accordance with the taste of the soil as sweet, sour, bitter, pungent etc. Another classification of soil was into *ūrvara* (fertile), *ūṣara* (non-fertile), and *maru* (desert). The best soil was suggested as that which is dark in colour, full of organic matter, and lies within the proximity of water.
- **Proper care of seeds:** *Kṛṣi Pārāśara* suggests that seeds should be collected in Magha (January-February) or Phalguna (February-March). After exposure to the sun and night dew, they should be carefully stored in containers made of straw. Care should be taken that the different varieties of seeds are not mixed. Neither should they come in contact with ghee, oil,



or salt. This last advice is probably based on the knowledge that acid and salt solutions destroy the germinating power of seeds and fats retard it.

- **Manure, disease, and pest management** : Kautilya's *Arthaśāstra* mentions bone and cow-dung as manure. *Brhat Samhitā* and *Agni Purāṇa* suggest the application of animal excreta, fish, bone etc. as manure. The *Vṛkṣāyurveda* of Surapāla classifies the diseases of the plants into those caused by internal and external factors. The diseases caused by external factors were further classified as those caused due to environmental factors like rains, cold, high temperatures, lightening etc. and those caused by biological factors such as pests. The internal causes of diseases include the imbalance of the three *doṣas* – *vāta*, *pitta*, and *kapha*. Pests were mostly managed rather than killed with harsh chemicals. Techniques involving the use of smoke to repel insects and pests, was a common practice in the fields. By burning specific elements, harmful pests could be cleared off without harming the environment.
- **Ploughing** : Kautilya's *Arthaśāstra* mentions about ploughing fields three times in heavy rains. Patañjali's *Mahābhāṣya* refers to ploughing that is done with the help of oxen. *Amara-kośa* lists a number of agricultural implements and accessories which must have been in use in the post-Vedic period. A detailed description of the plough is found in the *Kṛṣi Pārāśara*.
- **Rainfall and irrigation**: Śatapatha Brāhmaṇa describes the hydrological

cycle as – fire creates vapors, vapors create clouds, clouds give rain (*agner vai dhūmo jāyate, dhūmād abhraḥ, abhrād vṛṣṭiḥ*). *Kṛṣi Pārāśara* says that all agriculture has its root in rainfall, and life itself is rooted in rain (*vṛṣṭimūlā kṛṣiḥ sarvā vṛṣṭimūlaṃ ca jīvanam*). Different methods for predicting rainfall were prevalent in the ancient times. Patañjali's *Mahābhāṣya* notes that periodic watering of the fields is necessary for the growth of crops. It suggests the employment of canals for this purpose (*śālyārthaṃ kulyāḥ praṇīyante*).

2.2.7 Developments in the Medieval Period

The medieval period witnessed significant developments in architecture and engineering across the Indian subcontinent. This period was marked by regional diversity, technological progress, and cultural interaction. Different political powers and cultural traditions contributed to new architectural forms and construction techniques. While earlier traditions of temple construction and hydraulic engineering continued, new styles and structural methods also emerged.

One important feature of medieval architecture was the development of Indo-Islamic architectural forms, which introduced elements such as arches, domes, and large minarets. The Qutub Minar (Figure 2.2.11), built in the early Delhi Sultanate period, is an example of tall masonry construction and decorative stonework. The use of true arches and domes allowed builders to create large, enclosed spaces that were different from earlier trabeated (beam-based) architectural systems.



Figure 2.2.11 – The Qutub Minar

Source: <https://whc.unesco.org/en/documents/130025>

Engineering skills were also evident in large domed structures. The Gol Gumbaz (Figure 2.2.12), built in the seventeenth century, is famous for its massive dome and its “whispering gallery,” where sound travels clearly across the circular hall. Such structures required careful planning of load distribution and structural balance

At the same time, regional kingdoms continued earlier architectural traditions. The city of Hampi, the capital of the Vijayanagara Empire, shows an impressive combination of temples, market streets, fortifications, and water

management systems. The remains of tanks, canals, and aqueducts in this region demonstrate the continued importance of hydraulic engineering for urban life and agriculture.



Figure 2.2.12 – The Gol Gumbaz

Source: <https://www.culturalindia.net/iliimages/Gol-Gumbaz-2.jpg>

Medieval architecture in India therefore reflects both continuity and change. Older building traditions were preserved in many regions, while new architectural ideas and technologies were introduced through cultural interaction and political change. Together, these developments enriched the architectural and engineering heritage of the Indian subcontinent.

Recap

- India developed a rich tradition of architecture and engineering, from Harappan urban planning to monumental temples and advanced metallurgy.
- Cities of Indus Valley Civilization such as Harappa and Mohenjo-Daro were laid out in grid patterns with functional zones, roads, wells, reservoirs, drains, and public buildings like the Great Granary and Great Bath, showing advanced urban planning, engineering skill, and concern for hygiene and environmental adaptation.
- Religious architecture forms an important part of the architectural heritage of ancient India. Among the most important forms of religious architecture in ancient India were stupas, viharas, and temples. Each of these structures had a specific purpose and architectural design, and together they represent important achievements in ancient Indian architecture and engineering.

- Ancient India used copper, bronze, iron, and high-quality steel (wootz). The Iron Pillar of Delhi demonstrates corrosion-resistant ironworking. Texts such as the *Arthaśāstra* and *Rasaratnākara* describe mining, alloying, purification, and chemical processes, showing advanced metallurgical knowledge.
- Agricultural knowledge included crop varieties, soil classification, seed care, ploughing, irrigation, and pest management.
- Medieval architecture combined continuity and innovation. Indo-Islamic forms introduced arches, domes, and minarets, seen in the Qutub Minar and Gol Gumbaz, while regional kingdoms preserved earlier traditions, as in Hampi with temples, fortifications, and water management systems.
- Ancient Indian architecture, engineering, metallurgy, and agriculture together reflect technical skill, aesthetic expression, practical knowledge, and cultural values, forming a remarkable material and intellectual heritage.

Objective Questions

1. What is the famous bathing structure in Mohenjo-Daro called?
2. What material was used to make the “Dancing Girl” statuette of the Indus Valley?
3. What is the hemispherical Buddhist monument at Sanchi called?
4. What were residential monasteries for Buddhist monks, such as Nalanda, called?
5. Which northern Indian temple style is exemplified by the Khajuraho monuments?
6. Which southern Indian temple style is exemplified by the Brihadeeswara Temple?
7. Which metallurgical text describes laboratory apparatus like *tapta-khalva-yantra* and *bālukā-yantra*?
8. Which high-quality steel from ancient India was exported and used for swords?
9. Which iron structure in Delhi demonstrates corrosion-resistant metallurgy?
10. Which text describes the hydrological cycle as – fire creates vapors, vapors create clouds, clouds give rain?
11. Which medieval Indian monument is known for its massive dome and whispering gallery?

Answers

- | | |
|---------------|------------------------|
| 1. Great Bath | 7. Rasaratnasamuccaya |
| 2. Bronze | 8. Wootz |
| 3. Stupa | 9. Iron pillar |
| 4. Vihara | 10. Śatapatha Brāhmaṇa |
| 5. Nagara | 11. Gol Gumbaz |
| 6. Dravida | |

Self Assessment Questions

1. Identify the specific structure in Mohenjo-Daro known for its advanced hydraulic engineering.
2. Distinguish between the *Nagara* and *Dravida* styles of temple architecture.
3. What are the primary differences between a *Stupa* and a *Vihara* in Buddhist architecture?
4. Name the high-quality Indian steel that was world-renowned in antiquity.
5. Identify the text that discusses chemical and metallurgical processes under the title *Rasaratnasamuccaya*.
6. Explain why the Iron Pillar of Delhi is considered a significant achievement in ancient metallurgy.
7. Which ancient text provides detailed information about various types of crops like rice, barley, and beans?
8. Briefly describe the architectural significance of the *Gol Gumbaz*.
9. Analyze the peculiarities of town planning observed in the Indus Valley civilization.
10. Give an account of the discussion regarding mining and chemical activities found in ancient Indian literature.

Assignments

1. Analyse the peculiarities of town planning in the Indus Valley civilization.
2. Outline the features of stupas and viharas.
3. Distinguish between Nagara and Dravida temples.
4. Give an account of the discussion of metallurgical activities in ancient Indian literature.
5. Shed light on the ancient Indian knowledge in agriculture.

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SGOU

Unit 3

Life and Health

Learning Outcomes

The content, assignments, and assessments for this unit are aligned to the following learning outcomes:

- examine the ancient Indian conceptions of matter and life
- reflect upon the attitude of ancient Indians towards flora and fauna
- discuss the features of Āyurveda as a system of medicine
- familiarize with the Unani and Siddha systems of medicine
- acquaint with the tradition of Yoga

Prerequisite

In the Indian tradition, diverse approaches to understanding matter, life, and health developed, reflecting an integrated view of the body, mind, and environment. Plants, animals, and all elements of nature were seen as interconnected with human life, forming an ecological and holistic perspective in which living beings are part of a shared network rather than separate entities. From these ideas, various systems of medicine and well-being emerged, each with its own theoretical framework and practical methods, including Āyurveda, Siddha, Unani, and Yoga. These traditions continue to shape contemporary approaches to health in India and form the foundation of AYUSH, the government-supported framework integrating these systems into modern healthcare and preventive medicine. This unit provides a brief account of these conceptions, systems, and practices, highlighting their principles and continuing relevance.

Key Words

Matter, life, ecology, health, medicine, Āyurveda, Siddha, Unani, Yoga

Discussion

2.3.1 Introduction

Ancient Indian knowledge systems offer a holistic understanding of life and health. In many modern scientific approaches, the human body is often treated mainly as a biological system, and health is defined as the absence of disease. In contrast, Indian traditions understand life as a unified whole that includes the body, mind, environment, and consciousness. Human beings are not considered separate from nature. The individual is seen as a microcosm of the larger universe. Therefore, health depends not only on physical balance but also on mental stability, ethical conduct, and harmony with the natural world. The ecological philosophy of Indian tradition observes the harmonious co-existence with flora and fauna as essential for human survival. Āyurveda, Unani, Siddha, and Yoga are different approaches to health and well-being that reflect a civilizational effort to understand life in a comprehensive way.

This unit discusses the concept of matter and life, the importance of flora and fauna, and the major traditional systems of health and well-being in the Indian context.

2.3.2 Conception of Matter in Indian Tradition: The Pañcamahābhūtas

Ancient Indian thinkers sought to understand the nature of the physical world and the human body through broad philosophical reflection. One of the most influential explanations of matter in Indian thought is the doctrine of the Pañcamahābhūtas, or the five great elements. According to this theory, the entire material universe is composed of five fundamental elements: earth (pṛthvī), water

(ap), fire (tejas or agni), air (vāyu), and space (ākāśa).

These elements should not be understood as chemical substances in the modern scientific sense. Rather, they represent basic principles or qualities that help explain the properties of material objects. Earth represents solidity and stability; water signifies fluidity and cohesion; fire is associated with heat, light, and transformation; air represents movement and dynamism; and space provides the field or openness in which all things exist.

Indian philosophical and medical traditions use these elements as a conceptual framework for understanding both the external world and the human body. Every physical entity is thought to contain all five elements, though in different proportions. The body's structure reflects the earth element, bodily fluids reflect the water element, metabolic processes relate to fire, bodily movement corresponds to air, and the cavities and spaces within the body are associated with space.

Because the same elements constitute both the human body and the surrounding environment, ancient Indian thought emphasizes the close relationship between humans and nature. Changes in climate, seasons, and environmental conditions are believed to influence the balance of elements within the body. This idea later became central to classical medical traditions such as Āyurveda and Siddha, which explain health and disease in terms of balance and imbalance among these elemental principles.

Thus, the theory of the five elements is not merely a cosmological idea; it also forms the basis of practical reflections on physiology, health, and the relationship between human beings and the natural world.



2.3.3 Conception of Life in Indian Tradition

While the theory of the five elements explains the structure of matter, Indian philosophical traditions also reflected deeply on the nature of life itself. A central question was what distinguishes a living being from an inanimate object. Different schools of thought offered different answers to this question, and together they present a rich diversity of perspectives.

Many philosophical traditions in India explain life in terms of the presence of consciousness within a physical body. For example, the Sāṃkhya system describes reality as consisting of two fundamental principles: Purusha, which represents pure consciousness, and Prakṛti, which represents primordial matter. Life arises when consciousness becomes associated with material structures such as the body and mind. In this view, the living being is a complex interaction between these two principles.

Vedāntic traditions also emphasize the role of consciousness. They identify the inner self (Ātman) as the true essence of a living being. The body and mind are seen as instruments through which this inner self experiences the world. From this perspective, life is not limited to physical processes but is rooted in a spiritual principle that transcends the body.

Medical traditions such as Āyurveda adopt a more practical formulation. They describe life as the harmonious combination of four components: the body (śarīra), the senses (indriya), the mind (manas), and the self (ātma). When these components function together in a balanced manner, a living person experiences health and vitality. Disturbance in any of these dimensions may lead to illness.

Not all Indian thinkers, however, accepted

the idea of a separate soul or spiritual principle. The materialist school known as Cārvāka presented a very different view. According to the Cārvāka philosophers, reality consists only of material elements, and consciousness is a property that arises from the physical body itself. They rejected the existence of an independent soul and denied the idea of life after death. For them, life is simply the functioning of the material body, and knowledge should be based primarily on direct perception.

These differing perspectives show that Indian thought did not present a single uniform theory of life. Instead, it included both spiritual and material explanations. This diversity reflects a long tradition of philosophical debate and inquiry. At the same time, most medical traditions in India adopted a broadly holistic understanding in which physical, mental, and sometimes spiritual factors were considered together in explaining life and health.

2.3.4 Flora and Fauna in Indian Tradition

Ancient Indian knowledge traditions display a deep awareness of the interconnectedness of life. Plants, animals, and human beings were not regarded as separate domains but as parts of a larger natural order. This perspective shaped not only philosophical reflection but also everyday cultural practices and medical traditions.

Many aspects of Indian culture reflect a strong sense of respect for nature. Forests, rivers, mountains, plants, and animals were often regarded as sacred or worthy of reverence. Forest areas were protected as sacred groves associated with temples or local deities. These groves often preserved biodiversity and served as important ecological zones. Rivers such as the Gaṅgā were revered as life-giving forces, while mountains and forests were

often described in literature as places of spiritual significance.

Certain trees, such as the *aśvattha* (peepal) and *vaṭa* (banyan), were venerated and frequently associated with religious rituals. Plants such as neem (*nimba*), *tulasī*, *aśvagandhā*, and aloe vera have long been used in traditional medical practice. Neem is known for its antimicrobial properties and is widely used in skin care and dental hygiene. *Tulasī* is valued for its role in supporting respiratory health and immunity. *Aśvagandhā* is traditionally regarded as a rejuvenating herb, while aloe vera has been used for skin treatment and digestive health.

Animals also occupied an important place in Indian cultural imagination. Many deities were symbolically associated with animals, reflecting an understanding of the close relationship between human beings and other forms of life. Ethical principles such as *ahiṃsā* (non-violence) encouraged respect toward living beings and influenced dietary practices and attitudes toward animal life. In medical traditions, certain animal products were used as ingredients in medicinal preparations. Milk, ghee, honey, and occasionally other substances derived from animals were included in therapeutic formulations.

All these reveal an ecological sensibility that recognized the dependence of human life on the balance of the natural world.

2.3.5 Āyurvedic System of Medicine

Āyurveda is one of the most ancient and systematic traditions of medicine that developed in India. The term *āyurveda* is derived from the Sanskrit words *āyus* (life) and *veda* (knowledge), meaning “the knowledge or science of life.” Āyurveda aims not only at curing disease but also at preserving health and promoting a balanced way of living. It emphasizes preventive care, proper diet, ethical conduct, and harmony between the body, mind, and environment. This section discusses some of the major features of the Āyurvedic system, including its classical branches, important texts, ethical principles, diagnostic methods, and key theoretical concepts.

Branches of Āyurveda

Classical Āyurvedic literature describes eight major branches, collectively known as *aṣṭāṅga āyurveda* (“the eight limbs of Āyurveda”). Each branch deals with a specific area of medical knowledge.

8 Branches of Āyurveda	
<i>kāyacikitsā</i>	general medicine dealing with diseases of the body
<i>śalyatantra</i>	surgery
<i>śālākya-tantra</i>	diseases of the head and neck, particularly those related to the eyes, ears, nose, and throat
<i>kaumāra-bhṛtya</i>	pediatrics and care of children
<i>bhūtavidyā</i>	mental and psychological disorders traditionally associated with unseen influences
<i>agada-tantra</i>	toxicology and treatment of poisoning
<i>rasāyana</i>	rejuvenation therapies aimed at promoting longevity and vitality
<i>vājīkaraṇa</i>	therapies related to reproductive health and vitality



These branches illustrate the wide scope of Āyurveda, which addresses different aspects of health, disease, prevention, and rejuvenation.

Important Classical Texts

The knowledge of Āyurveda has been preserved in a number of classical Sanskrit texts. Among the most influential are the Caraka Saṃhitā, the Suśruta Saṃhitā, and the Aṣṭāṅgahṛdaya.

The Caraka Saṃhitā, associated with the physician Caraka, is one of the foundational texts of Āyurvedic internal medicine (kāya-cikitsā). It contains detailed discussions on physiology, pathology, diagnosis, diet, and therapeutic methods. The text emphasizes the importance of preventive healthcare and balanced living.

The Suśruta Saṃhitā, attributed to the surgeon Suśruta, is renowned for its systematic treatment of surgical procedures. It describes numerous surgical instruments, operative techniques, and methods of wound treatment. The text also includes important discussions on anatomy and medical training.

Another influential work is the Aṣṭāṅgahṛdaya, composed by the scholar Vāgbhaṭa. This text presents Āyurvedic theory and practice in a concise and systematic form and integrates the teachings of earlier traditions.

Health, Ethical Living, and the Concept of Sadvṛtta

Āyurveda emphasizes that the preservation of health depends not only on medical treatment but also on disciplined and ethical living. One important concept in this regard is sadvṛtta, which refers to proper conduct in daily life. The classical texts recommend habits such as moderation in eating, cleanliness, truthfulness, control of harmful emotions, and respectful interaction with others.

These ethical guidelines are considered important for maintaining both physical and mental well-being. By regulating behaviour and cultivating healthy habits, individuals can help maintain balance within the body and prevent disease.

The Medical Catuṣpāda: The Four-fold Foundation of Treatment

Āyurvedic texts emphasize that successful medical treatment depends on the proper functioning of four essential components. These are collectively known as the catuṣpāda (the “four supports” or “four pillars”) of medical practice. The four components are the physician, the medicine, the attendant, and the patient. When these four elements possess the necessary qualities and work together effectively, treatment is more likely to lead to the restoration of health.

The first component is the physician (bhiṣak), who is responsible for diagnosing diseases and prescribing appropriate treatment. Classical Āyurvedic texts describe the ideal physician as one who possesses thorough knowledge of medical theory, practical experience in treating patients, skill in applying therapeutic methods, and ethical conduct in professional practice.

The second component is substance (dravya), which includes the various substances used in treatment. Āyurvedic medicines are derived from natural sources such as plants, minerals, and animal products. The texts emphasize that medicines should be properly selected, prepared, and administered according to the condition of the patient and the nature of the disease.

The third component is the attendant or nurse (upasthātā), who assists the physician in administering treatment and caring for the patient. The attendant is expected to be knowledgeable about medical instructions, attentive

to the needs of the patient, and capable of carrying out therapeutic procedures carefully and responsibly.

The fourth component is the patient (rogī), whose cooperation and adherence to medical advice are essential for successful treatment. Āyurvedic texts emphasize that the patient should follow the prescribed diet, medicines, and lifestyle recommendations given by the physician.

These four elements together constitute the fundamental framework of Āyurvedic medical practice. The effectiveness of treatment depends not only on the physician and medicines but also on the proper cooperation between all four components involved in the healing process.

Methods of Diagnosis

Āyurvedic physicians employ several methods to diagnose diseases. Three fundamental diagnostic approaches are frequently mentioned:

- darśana – observation or visual examination of the patient
- sparśana – examination through touch
- praśna – questioning the patient about symptoms and medical history

These methods of examination are generally referred to as forms of parīkṣā. Through careful observation, physical examination, and inquiry, the physician seeks to understand the nature of the disease and the condition of the patient.

In classical Āyurveda these methods are often grouped under trividha-parīkṣā (three-fold examination). Later Āyurvedic practice also developed more elaborate diagnostic frameworks such as aṣṭavidha-parīkṣā (eight-fold examination), which includes examination of the pulse, urine, stool, tongue, voice,

touch, eyes, and overall appearance of the patient. Such diagnostic procedures help the physician identify the underlying imbalance of the doṣas.

Concept of the Three Doṣas

One of the central theoretical ideas in Āyurveda is the concept of the three doṣas: vāta, pitta, and kapha. These are considered fundamental physiological principles that regulate the functioning of the body.

- vāta governs movement and is associated with functions such as breathing, circulation, and nervous activity.
- pitta is related to digestion, metabolism, and transformation within the body.
- kapha provides stability, structure, and lubrication.

According to Āyurvedic theory, health is maintained when these three doṣas remain in equilibrium. When their balance is disturbed, disease may arise. Āyurvedic treatment (cikitsā) is therefore primarily directed toward restoring equilibrium among the doṣas. This is achieved through appropriate diet, medicines derived from plants and minerals, regulation of daily habits, and therapeutic procedures intended to remove accumulated imbalances in the body.

The three doṣas – vāta, pitta, and kapha – serve as a common interface between the body, mind, environment, food, daily and seasonal cycles, and therapeutic interventions, linking the theory of health with practical applications in daily life. The relationships between the doṣas, seasonal variations, daily physiological cycles, and the qualities of food form an important part of Āyurvedic theory. These relationships are often summarized in tabular form for clarity and ease of understanding. (See Tables 2.3.2, 2.3.3, and 2.3.4)



Table 2.3.2
Relationship between Vāta, Pitta, Kapha and the daily cycle

2am – 6am	Vāta increases
6am – 10am	Kapha increases
10am – 2pm	Pitta increases
2pm – 6pm	Vāta increases
6pm – 10pm	Kapha increases
10pm – 2am	Pitta increases

Table 2.3.3
Relationship between Vāta, Pitta, Kapha and the six seasons

Śiśira ṛtu	accumulation of kapha
Winter season	
Vasanta ṛtu	aggravation of kapha
Spring season	
Grīṣma ṛtu	accumulation of vāta, pacification of kapha
Summer season	
Varṣa ṛtu	aggravation of vāta, accumulation of pitta
Rainy season	
Śarat ṛtu	pacification of vāta, aggravation of pitta
Autumn season	
Hemanta ṛtu	pacification of pitta
Pre-winter season	

Table 2.3.4
Relationship between Vāta, Pitta, Kapha and the six food tastes

Madhura (sweet)	Milk, sugar, wheat, rice, mangoes, coconut etc.	Increases kapha, decreases pitta and vāta
Amla (sour)	Sour curd, tamarind, lemon, citrus fruits etc.	Increases kapha and pitta, decreases vāta
Lavaṇa (salt)	All types of salt	Increases kapha and pitta, decreases vāta
Kaṭu (pungent/hot)	Pepper, chilli, ginger, onion, garlic etc.	Increases vāta and pitta, decreases kapha
Tikta (bitter)	Neem, bitter melon, bitter gourd, fenugreek etc.	Increases vāta, decreases pitta and kapha
Kaṣāya (astringent)	Black plum, banana peel and flower, areca nut, figs, bibitaki (baheda/bahera) etc	Increases vāta, decreases pitta and kapha

Dinacaryā and Ṛtucaryā

Āyurveda emphasizes the importance of regulating daily life and dietary habits in accordance with natural cycles. Two important concepts in this regard are *dinacaryā* (daily regimen) and *ṛtucaryā* (seasonal regimen). These practices are based on the understanding that the balance of the *doṣas* is influenced by natural cycles such as the progression of the day and the changing seasons. By adjusting one's habits, diet, and activities in accordance with these cycles, it is believed that the equilibrium of the body can be preserved. The theoretical relationships between the *doṣas*, daily physiological cycle, seasons, and food tastes have been summarized earlier in Tables 2.3.2-4.

Dinacaryā refers to the recommended daily routine intended to promote physical and mental well-being. Classical texts advise practices such as waking up early, maintaining personal cleanliness, engaging in moderate exercise, consuming food at appropriate times, and ensuring adequate rest. These habits help maintain harmony between bodily functions and the natural rhythm of the day.

Closely related to this is the concept of *ṛtucaryā*, which involves adapting one's lifestyle and diet according to seasonal changes. Āyurveda recognizes that the influence of *vāta*, *pitta*, and *kapha* varies with the seasons, and therefore specific dietary and lifestyle practices are recommended for different times of the year.

Diet plays a particularly important role in seasonal regulation. Āyurveda recommends that food be selected and prepared according to climatic conditions and digestive capacity. In colder seasons, nourishing and warming foods are generally advised to support strength and digestion. During hotter seasons, lighter and cooling foods are preferred to counterbalance

the increased influence of *pitta*. Methods of food preparation – such as boiling, roasting, or fermenting – may also vary according to seasonal requirements.

These recommendations illustrate how Āyurvedic theory is applied in everyday life through appropriate dietary choices, food preparation, and lifestyle practices.

Āyurveda in Contemporary Times

In modern times Āyurveda continues to play an important role in healthcare in India and in many other parts of the world. Educational institutions, hospitals, and research centres provide training and treatment based on Āyurvedic principles. In India the system is supported by a network of universities, colleges, and hospitals dedicated to Āyurvedic education and practice.

Government initiatives have also contributed to the development and promotion of traditional systems of medicine, particularly through institutions associated with the Ministry of AYUSH, which supports Āyurveda, Yoga, Unani, Siddha, and other traditional medical systems.

The holistic approach of Āyurveda, with its emphasis on preventive care, balanced diet, and healthy lifestyle, has attracted increasing global interest. As part of the broader heritage of Indian knowledge systems, Āyurveda continues to contribute to contemporary discussions on health, preventive medicine, and sustainable living.

2.3.6 Unani System of Medicine

Unani is a traditional system of medicine that traces its origins to ancient Greek medical thought and was later developed by scholars in the Arab and Persian intellectual world. The term “Unani” comes from the Arabic word



Yūnān, meaning Greece. The foundations of this system were laid by early Greek physicians such as Hippocrates and Galen, whose ideas about health, disease, and the functioning of the human body shaped medical traditions for many centuries.

These ideas were further elaborated by scholars of the medieval Islamic world. Among them, the Persian physician and philosopher Ibn Sina (980–1037 CE) played a particularly influential role. His famous medical encyclopedia *Al-Qānūn fī al-Ṭibb* (The Canon of Medicine) became one of the most widely studied medical texts in Asia and Europe for several centuries.

Unani medicine came to the Indian subcontinent during the medieval period, especially with the arrival of Persian and Central Asian scholars under the Delhi Sultanate and later the Mughal Empire. Over time the system adapted to the climatic conditions, plants, and medical practices of India. As a result, Unani medicine gradually became an important component of the plural medical traditions of the Indian subcontinent.

Theory of the Four Humours

The theoretical foundation of Unani medicine is the doctrine of the four humours. According to this theory, the human body contains four fundamental fluids:

- Blood
- Phlegm
- Yellow bile
- Black bile

Each humour possesses specific qualities such as heat, coldness, dryness, and moisture. Health is understood as a condition in which

these humours remain in proper balance. When the balance is disturbed, disease arises.

Closely related to this theory is the concept of *mizāj* (temperament). Every person is believed to possess a particular temperament determined by the relative dominance of certain humours. Diagnosis and treatment in Unani medicine therefore consider the individual constitution of the patient and aim to restore balance in the body.

Methods of Treatment

Unani medicine uses several therapeutic approaches. One important method is regimantal therapy, which includes practices such as exercise, massage, bathing, cupping, and other procedures intended to regulate bodily functions.

Another important aspect of treatment is dietotherapy, which emphasizes the role of appropriate food habits in maintaining health and preventing disease. Dietary regulation is considered an essential component of therapy.

Medicinal preparations in Unani practice are primarily based on plant substances, though mineral and animal-derived ingredients may also be used. In some cases, minor surgical procedures are recognized, although surgery is not the main focus of the system.

Overall, Unani medicine places strong emphasis on moderation in lifestyle, proper diet, and the strengthening of the body's natural healing capacity.

Development of Unani Medicine in Modern India

During the nineteenth century, attempts were made to institutionalize the teaching of Unani medicine in India. One of the earliest educational institutions was established

in 1872 as the Oriental College at Lahore in undivided India. This institution played an important role in the organized teaching of Unani medicine and helped train practitioners in a systematic manner.

After India gained independence in 1947, Unani medicine received increased support from the government through programmes aimed at promoting Indian systems of medicine. Educational institutions, hospitals, and research centres were gradually established across the country to strengthen both training and medical practice.

Today many colleges in India offer degree programmes in Unani medicine, producing trained physicians each year. The system is also supported by hospitals and dispensaries where Unani treatment is provided to patients. An important institution in this field is the National Institute of Unani Medicine, established in 1983 at Bengaluru in the state of Karnataka in collaboration with the Government of Karnataka. The institute functions as a centre for higher education, clinical training, and research in Unani medicine.

Research activities are also supported by the Central Council for Research in Unani Medicine, which undertakes scientific studies on Unani drugs and therapies. Through such institutions, Unani medicine continues to be practiced, studied, and developed as an important part of India's traditional healthcare heritage.

2.3.7 Siddha System of Medicine

Siddha is a traditional system of medicine that developed primarily in the Tamil-speaking regions of South India. The word “Siddha” is derived from siddhi, meaning attainment or perfection. The system is associated with the teachings of the Siddhars, a group of ancient sages who were believed to have

attained spiritual knowledge as well as mastery over medicine and alchemy. According to traditional accounts, the Siddhars explored methods for maintaining health, preventing disease, and prolonging life. Their knowledge was recorded in Tamil texts, many of which were written on palm-leaf manuscripts. These works discuss medical treatment, pharmacology, diet, and the relationship between physical health and spiritual discipline. This section provides a brief account of the Siddha tradition of medicine.

Siddhars and Classical Texts

The Siddha medical tradition is closely associated with the teachings of the Siddhars, a group of mystical sages who are believed to have attained extraordinary spiritual insight along with deep knowledge of medicine, alchemy, and yoga. Traditional accounts often speak of 18 principal Siddhars, who played an important role in developing and transmitting Siddha knowledge. Among the Siddhars frequently mentioned in the tradition are Agastya, Tirumular, Bogar, and Theraiyar. These figures are traditionally regarded as pioneers who systematized medical knowledge and composed important works on pharmacology, diagnosis, and therapeutic practices.

Siddha medical knowledge is preserved in a large number of Tamil texts. Many of these works were originally written on palm-leaf manuscripts and transmitted through generations of practitioners. Some texts deal with herbal and mineral medicines, while others discuss diet, diagnosis, and methods of maintaining health. Among the important works associated with the Siddha tradition is the Tirumantiram attributed to Tirumūlar. Although primarily a spiritual text related to Śaiva Siddhānta, it also contains discussions on yoga, the human body, and health. Other Siddha medical works traditionally attributed



to Agastya and other Siddhars discuss medicinal preparations, toxicology, and rejuvenation therapies.

The texts reflect the close relationship between medicine, philosophy, and spiritual discipline within the Siddha tradition. Knowledge of the body, according to the Siddhars, was not only important for treating disease but also for supporting the spiritual progress of human beings.

Fundamental Concepts

The theoretical framework of Siddha medicine is based on the doctrine of the five elements (pañcamahābhūta): earth (pṛthvī), water (āpas), fire (tejas), air (vāyu), and space (ākāśa). All physical substances, including the human body, are believed to be composed of these elements.

Siddha medicine also recognizes three fundamental bodily humours: vātam, pittam, and kapham. These correspond broadly to the vāta, pitta, and kapha principles known in Āyurveda. Health is maintained when these humours remain in proper balance within the body.

Siddha texts further describe a complex philosophical system involving 96 tattvas. These principles explain the structure and functioning of the body, the senses, and the mind, and they reflect the close relationship between medical knowledge and philosophical thought in the Siddha tradition.

Therapeutic Practices

Siddha medicine uses a wide range of therapeutic methods. Herbal medicines form an important component of treatment, but the Siddha system is particularly known for its use of mineral and metallic preparations. These substances are carefully processed through purification and calcination techniques before being used in medicinal formulations.

In addition to medicinal preparations, Siddha medicine emphasizes proper diet, disciplined lifestyle, and physical practices that help maintain balance within the body.

A distinctive feature of the Siddha tradition is its focus on rejuvenation and longevity. Certain formulations are believed to strengthen the body and delay the aging process. At the same time, Siddha teachings often emphasize that physical health and spiritual development are closely related. According to this view, the body should be preserved and maintained in good condition so that a person may pursue higher spiritual goals.

2.3.8 Yoga and Well-being

Yoga occupies an important place in the Indian knowledge traditions concerned with life, health, and human well-being. Over many centuries, yoga developed as a comprehensive discipline aimed at harmonizing the body, mind, and consciousness. It combines ethical principles, physical practices, breath regulation, and meditation in order to cultivate physical health, mental stability, and spiritual insight.

Meaning and Early Development of Yoga

The word yoga is derived from the Sanskrit root yuj, which means “to join,” “to unite,” or “to yoke.” In a broad sense, yoga refers to the process of integrating different aspects of human existence – body, mind, and consciousness. In philosophical traditions, the term often refers to the union of the individual self with a higher reality or the realization of one’s true nature.

Ideas and practices associated with yoga can be traced to ancient Indian literature. Early references to meditation, breath con-

tol, and discipline of the senses appear in the Vedic and Upaniṣadic texts. Over time these practices were further developed and systematized in various philosophical and spiritual traditions. The concept of yoga also appears in the Bhagavad Gita, where different paths such as karma-yoga, jñāna-yoga, and bhakti-yoga are described as ways of attaining spiritual realization. Among the classical formulations of yoga, one of the most influential is found in the Yogasūtras.

Aṣṭāṅgayoga in the Yogasūtras of Patañjali

A systematic presentation of yogic philosophy and practice is found in the Yogasūtras attributed to Patañjali. This concise work, adopting the concepts of Sāṃkhya philosophy, organised yoga teachings into a structured philosophical framework.

In the Yogasūtra, yoga is defined through the well-known aphorism: “yogaḥ citta-vṛtti-nirodhaḥ.” This statement may be translated as “Yoga is the cessation of the fluctuations of the mind.” According to this view, the human mind is constantly influenced by thoughts, emotions, and sensory impressions. These mental modifications disturb inner clarity and prevent a person from perceiving reality accurately. The goal of yoga is therefore to discipline the mind and bring it into a state of calm and concentration.

Patañjali outlines a systematic path known as Aṣṭāṅgayoga, or the “eight-limbed path” to achieve the goal of mental discipline. These eight limbs represent stages of practice that guide the practitioner toward self-discipline, mental control, and deeper states of awareness.

1. *Yama* – ethical restraints governing one’s conduct toward others. These

include principles such as non-violence (ahiṃsā), truthfulness (satya), non-stealing (asteya), refraining from sensual indulgence (brahmacarya) and non-possessiveness (aparigraha).

2. *Niyama* – personal observances that cultivate inner discipline. Examples include cleanliness (śauca), austerity (tapas), contentment (santoṣa), and self-study (svādhyāya), and devotion to God (īśvarapraṇidhāna). Here God is not the creator-preserve-destroyer of the world. He is the supreme soul without any mental disturbances and hence our teacher.
3. *Āsana* – physical postures that stabilize and strengthen the body. In classical yoga, the purpose of āsana is to prepare the body for meditation.
4. *Prāṇāyāma* – regulation of breathing. By controlling inhalation, exhalation, and retention of breath, practitioners regulate the vital energy (prāṇa).
5. *Pratyāhāra* – withdrawal of the senses from external objects, enabling the mind to turn inward.
6. *Dhāraṇā* – concentration on a chosen object or point of focus.
7. *Dhyāna* – meditation, characterized by continuous flow of attention.
8. *Samādhi* – deep absorption in meditation, where the distinction between the observer and the object of meditation gradually disappears.

Through these stages, yoga leads the practitioner from ethical discipline and bodily control to higher states of mental concentration and inner awareness.



Development of Haṭha Yoga

While the classical yoga described in the Yoga Sūtra emphasizes mental discipline and meditation, later traditions recognized that direct control of the mind may be difficult for many practitioners. As a result, another important stream of yogic practice known as Hatha Yoga developed during the medieval period.

Haṭha Yoga places greater emphasis on physical and physiological techniques as a means of preparing the body and mind for meditation. It includes a variety of āsanās (postures), prāṇāyāma (breathing techniques), and purification practices intended to cleanse and strengthen the body.

Texts of the Haṭha Yoga tradition also describe subtle aspects of the human body, such as nāḍīs, the channels through which vital energy flows, and cakras, the centres of energy within the body. By regulating the body and breath, practitioners seek to harmonize the flow of vital energy (prāṇa) and create favourable conditions for higher states of awareness.

Yoga and Well-being in the Modern World

In modern times yoga has gained world-wide recognition as an effective method for promoting health and well-being. Many people practice yoga for its benefits in improving flexibility, posture, and physical fitness, as well as for reducing stress and anxiety. Scientific research has also explored the role of yogic practices in supporting mental health and overall quality of life.

The global significance of yoga was formally acknowledged when the United Nations declared 21 June as the International Day of Yoga in 2014, with the first observance taking place in 2015. This initiative reflects the growing international recognition of yoga as a valuable contribution of Indian knowledge traditions to global well-being.

At the same time, traditional teachings emphasize that yoga is more than a system of physical exercise. It is a holistic discipline that integrates ethical conduct, bodily health, breath regulation, and mental concentration. Practiced in this broader sense, yoga offers a path toward balanced living, inner harmony, and overall well-being.

Recap

- Ancient Indian knowledge systems view life and health as a unity of body, mind, environment, and consciousness, emphasizing that humans are not separate from nature. Health depends on physical balance, mental stability, ethical conduct, and harmony with the natural world.
- Plants, animals, and humans are interconnected, forming an ecological order essential for survival, and influencing medical and philosophical thought.
- The *pañcamahābhūtas* doctrine explains that all matter, including the human body, consists of five elements—earth (*pṛthivī*), water (*ap*), fire (*tejas*), air (*vāyu*), and space (*ākāśa*). Life arises from the balanced functioning of body, senses, mind, and self, with health maintained when these components are in harmony.

- Indian thought presents diverse perspectives on life, ranging from spiritual views (*Sāṃkhya*, *Vedānta*) to materialist views (*Cārvāka*), reflecting holistic approaches in medical traditions.
- *Āyurveda* emphasizes prevention, balance, and harmony, with eight branches covering medicine, surgery, pediatrics, mental health, toxicology, rejuvenation, reproductive health, and head and neck diseases, supported by classical texts like *Caraka Saṃhitā*, *Suśruta Saṃhitā*, and *Aṣṭāṅgahṛdaya*.
- Ethical conduct (*sadvṛtta*) and the fourfold foundation of treatment (*catuspāda*)—physician, medicine, attendant, and patient—are central in *Āyurveda*. Diagnosis relies on observation (*darśana*), touch (*sparsana*), questioning (*praśna*), and examination (*parīkṣā*).
- The three *doṣas*—*vāta*, *pitta*, and *kapha*—form the common interface linking body, mind, diet, seasons, daily cycles, and treatment. Daily (*dinacaryā*) and seasonal (*ṛtucaryā*) routines, along with food selection and preparation, help maintain balance with natural cycles.
- Unani medicine came to the Indian subcontinent during the medieval period. It focuses on balancing four humours – blood, phlegm, yellow bile, black bile – and considers individual temperament (*mizāj*). Unani medicine uses several therapeutic approaches like regimental therapy and dietotherapy.
- The Siddha system is associated with the teachings of the *Siddhars*, a group of ancient sages who were believed to have attained spiritual knowledge as well as mastery over medicine and alchemy. The Siddha works discuss medical treatment, pharmacology, diet, and the relationship between physical health and spiritual discipline.
- *Yoga* integrates body, mind, and consciousness through ethical practice, postures (*āsanas*), breath control (*prāṇāyāma*), and meditation. Patañjali's *Yogasūtras* present the eight-limbed path (*Aṣṭāṅgayoga*), while Haṭha Yoga emphasizes physical preparation for mental control. Yoga promotes holistic health and well-being, recognized globally and practiced widely.
- These diverse Indian systems of medicine and well-being emerged from philosophical and ecological conceptions of matter, life, and health, and continue to have relevance today through AYUSH and modern health practices.



Objective Questions

1. Which among the *pañcamahābhūtas* represents heat, light, and transformation?
2. Which *doṣa* governs movement and is associated with functions such as breathing, circulation, and nervous activity?
3. What is the name for the Āyurvedic branch that deals with surgery?
4. What is the first component in the *catuspāda* fundamental to Āyurveda?
5. In which season *pitta* pacifies?
6. What are the four humours mentioned in Unani medicine?
7. How many *tattvas* are described in the complex philosophical system of Siddha medicine?
8. Who is the author of *Yogasūtras*?
9. What is the last step in *Aṣṭāṅgayoga*?
10. Which day is celebrated as International Yoga Day since 2014?

Answers

- | | |
|-------------------------|---|
| 1. <i>Agni</i> (fire) | 6. Blood, phlegm, yellow bile, black bile |
| 2. <i>Vāta</i> | 7. Ninety six |
| 3. Śalyatantra | 8. Patañjali |
| 4. Bhiṣak (physician) | 9. Samādhi |
| 5. Hemanta (pre-winter) | 10. June 21 |

Self Assessment Questions

1. Which of the *pañcamahābhūtas* (five elements) is responsible for heat, light, and transformation?
2. Define the three *doṣas* (*vāta*, *pitta*, and *kapha*) and identify which one governs movement.
3. Name the branch of Āyurveda that specifically focuses on surgery (*Śalyatantra*).

4. What are the four components of the *catuspāda* (fourfold foundation of treatment) in Āyurveda?
5. Explain the concepts of *dinacaryā* (daily routine) and *ṛtucaryā* (seasonal routine).
6. Identify the four humours that form the basis of Unani medicine.
7. How many *tattvas* (principles) are recognized in the Siddha system of medicine?
8. Who is the author of the *Yogasūtras*, and what is the final step of *Aṣṭāṅgayoga*?
9. Discuss the diverse Indian philosophical perspectives on life, from spiritual (Sāṃkhya) to materialist (Cārvaka) views.
10. Describe the eight-limbed path of Yoga (*Aṣṭāṅgayoga*) and its role in promoting holistic health.

Assignments

1. Reflect upon the concept of life and health in Indian tradition.
2. Explain *dinacaryā* and *ṛtucaryā*.
3. Describe the *catuspāda* fundamental to Āyurveda?
4. Discuss the features of Unani medicine.
5. Give a brief account of the Siddha system of medicine.
6. Shed light on the *Aṣṭāṅgayoga* systematized by Patañjali.

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SREENARAYANAGURU OPEN UNIVERSITY

QP CODE:

Reg. No :
Name :

FYUG FOURTH SEMESTER EXAMINATION VALUE ADDED COURSE

COURSE - SGB24UC101VC - INDIAN KNOWLEDGE SYSTEM

2025 – 26 Admission Onwards

MODEL QUESTION PAPER (SET- A)

Time: 1 Hour

Max Marks: 23

SECTION A

Answer any five questions in a word or sentence. Each question carries one mark

(5 x 1 = 5)

1. What is the literal meaning of the Sanskrit root word 'Vid'?
2. Name the ancient text on ethics written by Thiruvalluvar.
3. Which ancient university was known for its 'Dharmaganja' library?
4. Who authored the foundational Sanskrit grammar work 'Aṣṭādhyāyī'?
5. What does the term 'Shulba' signify in ancient geometry?
6. Which system of medicine is known for the surgical procedures described by Sushruta?
7. Identify the three categories (Trivarga) mentioned in Tirukkural.
8. What is the 'Decimal Place-value System'?

SECTION B

Answer any four questions in two or three sentences each. Each question carries two marks.

(4 x 2 = 8)

9. Explain the three pillars of IKS: Jñān, Vignān, and Jeevan Darshan.
10. Describe the architectural components 'Anda' and 'Harmika' of a Stupa.
11. What is the 'Katapayadi' system of numerical notation?
12. Define 'Prakrit' and its significance as a common language.



13. Mention two features of Indo-Islamic architecture in the medieval period.
14. Briefly explain the concept of irrigation and agriculture in ancient India.

SECTION C

Answer any two questions. Each question carries five marks.

(2×5 = 10 Marks)

15. Compare the Gurukul system with the Ancient University system of education.
16. Discuss the major contributions of ancient Indian scholars to Mathematics (Algebra and Geometry).
17. Explain the evolution of Mughal Art and its synthesis of diverse traditions.

SGOU



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FYUG FOURTH SEMESTER EXAMINATION VALUE ADDED COURSE

SGB24UC101VC - INDIAN KNOWLEDGE SYSTEM

2025 – 26 Admission Onwards

MODEL QUESTION PAPER (SET- B)

Time: 1 Hour

Max Marks: 23

SECTION A

Answer any five questions in a word or sentence. Each question carries one mark

(5 x 1 = 5)

1. In which language is the primary Buddhist literature written?
2. Define the 'Pancha-mahabhutas' in Indian science.
3. Who systematized the eight-step practice of Yoga?
4. Name the famous physician-scholar associated with Nalanda and Takshashila.
5. What are the 'Four Noble Truths' in Buddhist philosophy?
6. Identify the art school that blended Indian and Greco-Roman styles.
7. Which medical system focuses on the balance of elements in the 'Unani' tradition?
8. Name the astronomer-mathematician who estimated the value of Pi (π) to four decimal places.

SECTION B

Answer any four questions in two or three sentences each. Each question carries two marks.

(4 x 2 = 8)

9. Distinguish between the roles of Sanskrit and Prakrit in ancient literature.
10. What are the 'manda' and 'shighra' corrections in ancient astronomy?
11. Briefly explain the concept of 'Siddha' medicine.
12. Define the terms 'Raga' and 'Tala' in Indian classical music.



13. Explain the significance of the 'Syenaciti' (falcon altar) in geometry.
14. Mention the contribution of the Kerala School of Mathematics to infinite series.

SECTION C

Answer any two questions. Each question carries five marks.

(2×5 = 10 Marks)

15. Examine the diverse heterodox (Nastika) schools of philosophy like Jainism and Buddhism.
16. Discuss the achievements of ancient Indian astronomy in timekeeping and planetary motions.
17. Evaluate the history and unique characteristics of the Kerala Mural painting tradition.

SGOU

സർവ്വകലാശാലാഗീതം

വിദ്യായാൽ സ്വതന്ത്രരാകണം
വിശ്വപൗരരായി മാറണം
ഗ്രഹപ്രസാദമായ് വിളങ്ങണം
ഗുരുപ്രകാശമേ നയിക്കണേ

കുതിരുട്ടിൽ നിന്നു ഞങ്ങളെ
സൂര്യവീഥിയിൽ തെളിക്കണം
സ്നേഹദീപ്തിയായ് വിളങ്ങണം
നീതിവൈജയന്തി പാറണം

ശാസ്ത്രവ്യാപ്തിയെന്നുമേകണം
ജാതിഭേദമാകെ മാറണം
ബോധരശ്മിയിൽ തിളങ്ങുവാൻ
ജ്ഞാനകേന്ദ്രമേ ജ്വലിക്കണേ

കുരിപ്പുഴ ശ്രീകുമാർ

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**DON'T LET IT
BE TOO LATE**

**SAY
NO
TO
DRUGS**

**LOVE YOURSELF
AND ALWAYS BE
HEALTHY**



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