Azadi Ka Amrit Mahotsav

INDIAN KNOWLEDGE SYSTEM AND ITS APPLICATION TEXTBOOK

Veda Vibhushan II Year / Uttar Madhyama - II Year / Class XII

MAHARSHI SANDIPANI RASHTRIYA VEDA SANSKRIT SHIKSHA BOARD

(Established and Recognized by the Ministry of Education, Government of India)

त्र्यम्बकं यजामहे सुगन्धिं पुष्टिवर्धनम्। ऊर्वारुकमिव बन्धनान्मृत्योर्मुक्षीय माऽमृतात्॥

सं ते मज्जा मज्ज्ञा भवतु समु ते परुषा परुः। सं ते मांसस्य विस्रस्तं समस्वयपि रोहतु॥

समदोषः समाग्निश्च समधातुमलक्रियः। प्रसन्नात्मेन्द्रियमनाः स्वस्थ इत्यभिधीयते॥

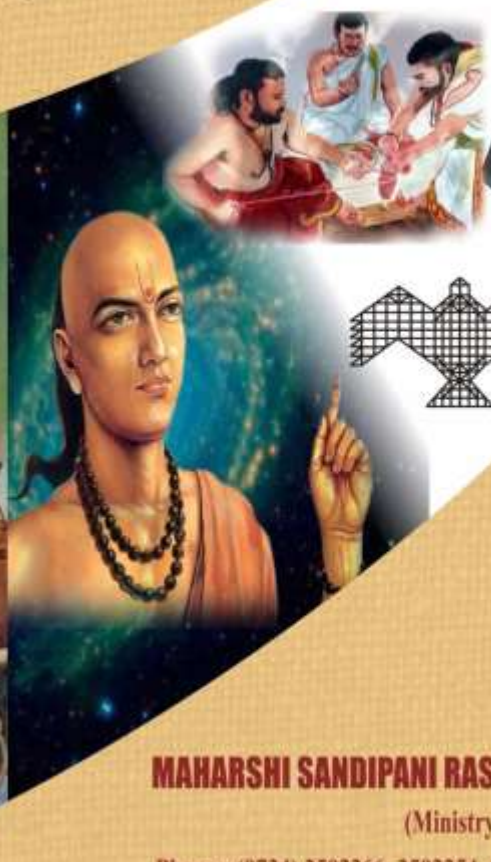
लवणेन सुवर्णं सन्दध्यात्, सुवर्णेन रजतं, रजतेन लोहं, लोहेन सीसं, सीसेन त्रपु।

यास्ते पूषन् नावो अन्तः समुद्रे हिरण्ययीरन्तरिक्षे चरन्ति।

त्रिपादूर्ध्व उदैत् पुरुषः, पादोऽस्येहाभवत् पुनः।

त्वामग्ने पुष्करादधि अथर्वा निरमन्थत ।

यत्र विश्वं भवत्येकनीडम् ।



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PREFACE

(In the light of NEP 2020)

The Ministry of Education (Department of Higher Education), Government of India established Rashtriya Veda Vidya Pratishthan in Delhi under the Chairmanship of Hon'ble Education Minister (then Minister of Human Resource Development) under the Societies Registration Act, 1860 (XXI of 1860) on 20th January, 1987. The Government of India notified the resolution in the Gazette of India vide no 6-3/85- SKT-IV dated 30-3-1987 for establishment of the Pratishthan for preservation, conservation, propagation and development of oral tradition of Vedic studies (Veda Samhita, Padapatha to Ghanapatha,Vedanga, Veda Bhashya etc), recitation and intonation of Vedas etc and interpretation of Vedas in scientific lines. In the year 1993 the name of the organization was changed to Maharshi Sandipani Rashtriya Veda Vidya Pratishthan (MSRVVP) and it was shifted to Ujjain, Madhya Pradesh.

The National Education Policy of 1986 and Revised Policy Formulations of 1992 and also Programme of Action (PoA) 1992 have mandated Rashtriya Veda Vidya Pratishthan for promoting Vedic education throughout the country. The importance of India's ancient fund of knowledge, oral tradition and employing traditional Guru's for oral education was also emphasized in the PoA.

In accordance with the aspirations of the nation, national consensus and policy in favour of establishing a Board for Veda and Sanskrit Education at national level, the General Body and the Governing Council of MSRVVP under the Chairmanship of Hon'ble Education Minister, Government of India, have set up "Maharshi Sandipani Rashtriya Veda Sanskrit Shiksha Board" (MSRVSSB) in tune with the mandate of the Pratishthan and its implementation strategies. The Board is necessary for the fulfillment of the objectives of MSRVVP as envisioned in the MoA and Rules. The Board has been approved by the Ministry of Education, Government of India and recognized by the Association of Indian

Universities, New Delhi. The bye-laws of the Board have been vetted by Central Board of Secondary Education and curriculum structure have been concurred by the National Council of Educational Research and Training, New Delhi.

It may also be mentioned here that the committee "Vision and Roadmap for the Development of Sanskrit - Ten year perspective Plan", under the Chairmanship of Shri N. Gopalaswamy, former CEC, constituted by the Ministry of Education Govt. of India in 2015 recommended for establishment of a Board of Examination for standardization, affiliation, examination, recognition, authentication of Veda Sanskrit education up to the secondary school level. The committee was of the opinion that the primary level of Vedic and Sanskrit studies should be inspiring, motivating and joyful. It is also desirable to include subjects of modern education into Vedic and Sanskrit Pathashalas in a balanced manner. The course content of these Pathashalas should be designed to suit to the needs of the contemporary society and also for finding solutions to modern problems by reinventing ancient knowledge.

With regard to Veda Pathashala-s it is felt that they need further standardization of recitation skills along with introduction of graded materials of Sanskrit and modern subjects so that the students can ultimately acquire the capabilities of studying Veda bhashya-s and mainstreaming of students is achieved for their further studies. Due emphasis may also be given for the study of Vikriti Patha of Vedas at an appropriate level. The members of the committee have also expressed their concern that the Vedic recitation studies are not uniformly spread all over India; therefore, due steps may be taken to improve the situation without in anyway interfering with regional variations of recitation styles and teaching method of Vedic recitation.

It was also felt that since Veda and Sanskrit are inseparable and complementary to each other and since the recognition and affiliation problems are same for all the Veda Pathashalas and Sanskrit Pathashalas throughout the country, a Board may be constituted for both together. The committee observed that the examinations conducted by the Board

should have legally valid recognition enjoying parity with modern Board system of education. The committee observed that the Maharshi Sandipani Rashtriya Veda Vidya Pratishthan, Ujjain may be given the status of Board of Examinations with the name "Maharshi Sandipani Rashtriya Veda Sanskrita Vidya Parishat with headquarters in Ujjain which will continue all programs and activities which were being conducted hitherto in addition to being a Board of Examinations.

The promotion of Vedic education is for a comprehensive study of India's glorious knowledge tradition and encompasses multi-layered oral tradition of Vedic Studies (Veda Samhita, Padapatha to Ghanapatha,Vedanga, Veda Bhashy aetc), recitation and intonation, and Sanskrit knowledge system content. In view of the policy of mainstreaming of traditional students and on the basis of national consensus among the policy making bodies focusing on Vedic education, the scheme of study of Veda stretching up to seven years in Pratishthan also entails study of various other modern subjects such as Sanskrit, English, Mathematics, Social Science, Science, Computer Science, Philosophy, Yoga, Vedic Agriculture, etc. as per the syllabus and availability of time. In view of NEP 2020, this scheme of study is with appropriate inputs of Vedic knowledge and drawing the parallels of modern knowledge in curriculum content focusing on Indian Knowledge System.

In Veda Pathashala-s, GSP Units and Gurukula-s of MSRVVP, affiliated to the Board transact the curriculum primarily based on oral tradition of a particular complete Veda Shakha with perfect intonation and memorization, with additional subsidiary modern subjects such as English, Sanskrit, Mathematics, Science, Social Science and SUPW. Gradually, the Veda Pathashala-s will also introduce other skill and vocational subjects as per their resources.

It is a well-known fact that there were 1131 shakha-s or recensions of Vedas; namely 21 in Rigveda, 101in Yajurveda, 1000 in Samaveda and 9 in Atharva Veda. In course of time, a large number of these shakhas became extinct and presently only 10 Shakhas, namely, one in Rigveda, 4

in Yajurveda, 3 in Samaveda and 2 in Atharvaveda are existing in recitation form on which Indian Knowledge System is founded now. Even in regard to these 10 Shakhas, there are very few representative Vedapathis who are continuing the oral Vedic tradition/ Veda recitation/Veda knowledge tradition in its pristine and complete form. Unless there is a full focus for Vedic learning as per oral tradition, the system will vanish in near future. These aspects of Oral Vedic studies are neither taught nor included in the syllabus of any modern system of school education, nor do the schools/Boards have the systemic expertise to incorporate and conduct them in the conventional modern schools.

The Vedic students who learn oral tradition/ recitation of Veda are there in their homes in remote villages, in serene and idyllic locations, in Veda Gurukulas, (GSP Units), in Veda Pathashala-s, in Vedic Ashrams etc. and their effort for Veda study stretches to around 1900 – 2100 hours per year; which is double the time of other conventional school Board's learning system. Vedic students have to have complete Veda by-heart and recite verbatim with intonation *(udatta, anudatta, swaritaetc),*on the strength of memory and guru parampara, without looking at any book/pothi. Because of unique ways of chanting the Veda mantras, unbroken oral transmission of Vedas and its practices, this has received the recognition in the UNESCO-World Oral Heritage in the list of Intangible Cultural Heritage of Humanity. Therefore, due emphasis is required to be given to maintain the pristine and complete integrity of the centuries old Vedic Education (oral tradition/ recitation/ Veda knowledge Tradition). Keeping this aspect in view the MSRVVP and the Board have adopted unique type of Veda curriculum with modern subjects like Sanskrit, English, Vernacular language, Mathematics, Social Science, Science, Computer Science, Philosophy, Yoga, Vedic Agriculture etc. as well as skill and vocational subjects as prescribed by NEP 2020.

As per Vedic philosophy, any person can become happy if he or she learns both *Para-Vidya and Apara-Vidya.* The materialistic knowledge from the Vedas, their auxiliary branches and subjects of material interest were called *Apara-Vidya*. The knowledge of supreme reality, the ultimate quest from Vedas, Upanishads is called *Para-Vidya.* In all the total

number of subjects to be studied as part of Veda and its auxiliaries are fourteen. There are fourteen branches of learning or *Vidyas* - four Vedas, Six Vedangas, Mimamsa (Purva Mimamsa and Uttara Mimamsa), Nyaya, Puranas and Dharma shastra. These fourteen along with Ayurveda, Dhanurveda, Gandharvaveda and Arthashastra become eighteen subjects for learning. All curriculum transaction was in Sanskrit language, as Sanskrit was the spoken language for a long time in this sub-continent.

Eighteen Shilpa-s or industrial and technical arts and crafts were mentioned with regard to the Shala at Takshashila. The following 18 skills/Vocational subjects are reported to be subjects of the study– (1) Vocal music (2) Instrumental music (3) Dancing (4) Painting (5) Mathematics (6) Accountancy (7) Engineering (8) Sculpture (9) Cattle breeding (10) Commerce (11) Medicine (12) Agriculture (13) Conveyancing and law (14) Administrative training (15) Archery and Military art (16) Magic (17) Snake charming (18) Art of finding hidden treasures.

For technical education in the above mentioned arts and crafts an apprenticeship system was developed in ancient India. As per the Upanishadic vision, the vidya and avidya make a person perfect to lead contented life here and liberation here-after.

Indian civilization has a strong tradition of learning of shastra-s, science and technology. Ancient India was a land of sages and seers as well as of scholars and scientists. Research has shown that India had been a Vishwa Guru, contributing to the field of learning (vidya-spiritual knowledge and avidya- materialistic knowledge) and learning centers like modern universities were set up. Many science and technology based advancements of that time, learning methodologies, theories and techniques discovered by the ancient sages have created and strengthened the fundamentals of our knowledge on many aspects, may it be on astronomy, physics, chemistry, mathematics, medicine, technology, phonetics, grammar etc. This needs to be essentially understood by every Indian to be proud citizen of this great country!

The idea of India like “Vasudhaiva Kutumbakam” quoted at the

entrance of the Parliament of India and many Veda Mantra-s quoted by constitutional authorities on various occasions are understood only on study of the Vedas and true inspiration can be drawn only by pondering over them. The inherent equality of all beings as embodiment of "sat, chit, ananda" has been emphasized in the Vedas and throughout the Vedic literature.

Many scholars have emphasized that Veda-s are also a source of scientific knowledge and we have to look into Vedas and other scriptural sources of India for the solution of modern problems, which the whole world is facing now. Unless students are taught the recitation of Vedas, knowledge content of Vedas and Vedic philosophy as an embodiment of spiritual and scientific knowledge, it is not possible to spread the message of Vedas to fulfill the aspiration of modern India.

The teaching of Veda (Vedic oral tradition/ Veda recitation/ Veda knowledge Tradition) is neither only religious education nor only religious instruction. It will be unreasonable to say that Vedic study is only a religious instruction. Veda-s are not religious texts only and they do not contain only religious tenets; they are the corpus of pure knowledge which are most useful to humanity as whole. Hence, instruction or education in Veda-s cannot be construed as only "religious education/religious instruction."

Terming "teaching of Veda as a religious education" is not in consonance with the judgment of the Hon'ble Supreme Court (AIR 2013: 15 SCC 677), in Civil Appeal no. 6736 of 2004 (Date of judgment-3rd July 2013). The Vedas are not only religious texts, but they also contain the knowledge in the disciplines of mathematics, astronomy, meteorology, chemistry, hydraulics, physics, science and technology, agriculture, philosophy, yoga, education, poetics, grammar, linguistics etc. which has been brought out in the judgment by the Hon'ble Supreme Court of India.

Vedic education through establishment of Board in compliance with NEP-2020

The National Education Policy-2020 firmly recognizes the Indian Knowledge Systems (also known as 'Sanskrit Knowledge Systems'), their

importance and their inclusion in the curriculum, and the flexible approach in combining various subjects. Arts' and Humanities' students will also learn science; try to acquire vocational subjects and soft skills. India's special heritage in the arts, sciences and other fields will be helpful in moving towards multi-disciplinary education. The policy has been formulated to combine and draw inspiration from India's rich, ancient and modern culture and knowledge systems and traditions. The importance, relevance and beauty of India's classical languages and literature is also very important for a meaningful understanding the national aspiration. Sanskrit, being an important modern language mentioned in the Eighth Schedule of Indian Constitution, its classical literature that is greater in volume than that of Latin and Greek put together, contains vast treasures of mathematics, philosophy, grammar, music, politics, medicine, architecture, metallurgy, drama, poetry, storytelling, and more (known as 'Sanskrit Knowledge Systems').These rich Sanskrit Knowledge System legacies for world heritage should not only be nurtured and preserved for posterity but also enhanced through research and put in to use in our education system, curriculum and put to new uses. All of these literatures have been composed over thousands of years by people from all walks of life, with a wide range of socio-economic background and vibrant philosophy. Sanskrit will be taught in engaging and experiential as well as contemporary relevant methods. The use of Sanskrit knowledge system is exclusively through listening to sound and pronunciation. Sanskrit textbooks at the Foundation and Middle School level will be available in Simple Standard Sanskrit (SSS) to teach Sanskrit through Sanskrit (STS) and make its study enjoyable. Phonetics and pronunciation prescriptions in NEP 2020 apply to the Vedas, the oral tradition of the Vedas and Vedic education, as they are founded upon phonetics and pronunciation.

There is no clear distinction made between arts and science, between curricular and extra-curricular activities, between vocational and academic streams, etc. The emphasis in NEP 2020 is on the development of a multi-disciplinary and holistic education among the sciences, social sciences, arts, humanities and sports for a multi-disciplinary world to

ensure the unity and integrity of all knowledge. Moral, human and constitutional values like empathy, respect for others, cleanliness, courtesy, democratic spirit, spirit of service, respect for public property, scientific temper, freedom, responsibility, pluralism, equality and justice are emphasized.

The NEP-2020 at point no. 4.23 contains instructions on the pedagogic integration of essential subjects, skills and abilities. Students will be given a large amount of flexible options in choosing their individual curriculum; but in today's fast-changing world, all students must learn certain fundamental core subjects, skills and abilities to be a well-grounded, successful, innovative, adaptable and productive individual in modern society. Students must develop scientific temper and evidence based thinking, creativity and innovation, aesthetics and sense of art, oral and written expression and communication, health and nutrition, physical education, fitness, health and sport, collaboration and teamwork, problem solving and logical thinking, vocational exposure and skills, digital literacy, coding and computational thinking, ethics and moral reasoning, knowledge and practice of human and constitutional values, gender sensitivity, fundamental duties, citizenship skills and values, knowledge of India, environmental awareness etc. Knowledge of these skills include conservation, sanitation and hygiene, current affairs and important issues facing local communities, the states, the country and the world, as well as proficiency in multiple languages. In order to enhance the linguistic skills of children and to preserve these rich languages and their artistic treasures, all students in all schools, public or private, shall have the option of learning at least two years in one classical language of India and its related literature.

The NEP-2020 at point no. 4.27 states that -"Knowledge of India" includes knowledge from ancient India and its contributions to modern India and its successes and challenges, and a clear sense of India's future aspirations with regard to education, health, environment, etc. These elements will be incorporated in an accurate and scientific manner throughout the school curriculum wherever relevant; in particular, Indian Knowledge Systems, including tribal knowledge and indigenous and

traditional ways of learning, will be covered and included in mathematics, astronomy, philosophy, yoga, architecture, medicine, agriculture, engineering, linguistics, literature, sports, games, as well as in governance, polity, conservation. It will have informative topics on inspirational personalities of ancient and modern India in the fields of medicinal practices, forest management, traditional (organic) crop cultivation, natural farming, indigenous sports, science and other fields.

The NEP-2020 at point no. 11.1 gives directions to move towards holistic and multidisciplinary education. India emphasizes an ancient tradition of learning in a holistic and multidisciplinary manner, including the knowledge of 64 arts such as singing and painting, scientific fields such as chemistry and mathematics, vocational fields such as carpentry, tailoring; professional work such as medicine and engineering, as well as the soft skills of communication, discussion and negotiation etc. which were also taught at ancient universities such as Takshashila and Nalanda. The idea that all branches of creative human endeavour, including mathematics, science, vocational subjects and soft skills, should be considered 'arts', has a predominantly Indian origin. This concept of 'knowledge of the many arts' or what is often called 'liberal arts' in modern times (i.e., a liberal conception of the arts) will be our part of education system.

At point No. 11.3 the NEP-2020 further reiterates that such an education system "would aim to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral in an integrated manner. Such an education will help develop well-rounded individuals that possess critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines."

The NEP-2020 at point no. 22.1 contains instructions for the promotion of Indian languages, art and culture. India is a rich storehouse of culture – which has evolved over thousands of years, and is reflected in its art, literary works, customs, traditions, linguistic expressions, artifacts, historical and cultural heritage sites, etc. Traveling in India, experiencing Indian hospitality, buying beautiful handicrafts and handmade clothes of India, reading ancient literature of India, practicing yoga and meditation, getting inspired by Indian philosophy, participating in festivals, appreciating India's diverse music and art and watching Indian films are some of the ways through which millions of people around the world participate in, enjoy and benefit from this cultural heritage of India every day.

In NEP-2020 at point no. 22.2 there are instructions about Indian arts. Promotion of Indian art and culture is important for India and to all of us. To inculcate in children a sense of our own identity, belonging and an appreciation of other culture and identity, it is necessary to develop in children key abilities such as cultural awareness and expression. unity, positive cultural identity and self-esteem can be built in children only by developing a sense and knowledge of their cultural history, art, language and tradition. Therefore, the contribution of cultural awareness and expression is important for personal and social well-being.

The core Vedic Education (Vedic Oral Tradition / Veda Path / Veda Knowledge Tradition) of Pratishthan along with other essential modern subjects- Sanskrit, English, Mother tongue, Mathematics, Social Science, Science, Computer Science, Philosophy, Yoga, Vedic Agriculture, Indian Art, Socially useful productive work etc., based on the IKS inputs are the foundations/sources of texts books of Pratishthan and Maharshi Sandipani Rashtriya Veda Sanskrit Shiksha Board. These inputs are in tune with the NEP 2020. The draft books are made available in pdf form keeping in view the NEP 2020 stipulations, requirements of MSRVVP students and the advice of educational thinkers, authorities and policy of Maharshi Sandipani Rashtriya Veda Vidya Pratishthan, Ujjain. These books will be updated in line with NCFSE in future and finally will be made available in print form.

The Teachers of Veda, Sanskrit and Modern subjects in Rashtriya Adarsh Veda Vidyalaya, Ujjain and many teachers of Sanskrit and modern subjects in aided Veda Pathshalas of Pratishthan have worked for last two years tirelessly to prepare and present Sanskrit and modern subject text books in this form. I thank all of them from the bottom of my heart. Many eminent experts of the national level Institutes have helped in bringing quality in the textbooks by going through the texts from time to time. I thank all those experts and teachers of the schools. I extend my heartfelt gratitude to all my co-workers who have worked for DTP, drawing the sketches, art work and page setting.

All suggestions including constructive criticism are welcome for the improvement of the quality of the text books.

आपरितोषाद् विदुषां न साधु मन्ये प्रयोगविज्ञानम्।
बलवदपि शिक्षितानाम् आत्मन्यप्रत्ययं चेतः॥

(Abhijnanashakuntalam 1.02)

Until the scholars are fully satisfied about the content, presentation, attainment of objective, I do not consider this effort to be successful, because even the scholars are not fully confident in the presentation without feedback from the stakeholders.

Prof. ViroopakshaV Jaddipal
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Maharshi Sandipani Rashtriya Veda Sanskrit Shiksha Board, Ujjain

FOREWORD

The presented textbook of Indian Knowledge System and Its Application for Class 12th /Ved Vibhushan Second Year/Uttar Madhyam-II/ School Education has been published in compliance with the guiding principles of the National Education Policy 2020. In this course, natural resources, biological resources in Vedic Vangmay Topics like diversity, matter, living world have been included. We have tried to include scientific concepts related to daily life in the curriculum. This book is based on activities, through which it is expected that students can acquire knowledge on their own.

Through this textbook, students will be given the knowledge of ancient Indian sages (Aryabhata, Varahamihira, Bodhayana, Charaka, Sushruta, Parashara, Bhaskaracharya, Brahmagupta, Chanakya, Chakrapani, Datta, Madhava, Panini, Patanjali) by connecting modern science with the broader scientific thinking tradition of Sanskrit literature. Nagarjuna, Gautam, Pingal, Shankardeva, Maitreyi, Gargi and Thiruvalluvar etc.) will be introduced.

The concepts of science contained in the Vedas will be made known to the students by linking them with modern science. The principles of modern science and their applications are available in our Sanskrit literature and they can be coordinated with the latest scientific rules. Not only this, new theories can also be conceptualized by detailed study, observation and analysis of these texts. Following this concept, this book has been written with the hope that students and curious people will develop curiosity about research after reading this book.

Solved examples are also given, wherever necessary, to clarify the concepts. To check the students' understanding of the subject, practice questions have been included at the end of each lesson, which include multiple choice questions and descriptive questions. Model question papers have been included at the end of the book so that students can self-evaluate themselves.

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Ayurveda for Life, Health and Well-being

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1.1 Definition of Ayurveda –

The word Ayurveda is made up of two words, namely Ayu meaning life and Veda meaning knowledge, from which the knowledge of life is obtained, it is called "Ayurveda".

एति गच्छति इति आयुः।

That, which is continuously moving is called age.

आयुर्जीवितकालः (अमरकोष 2.8.120)

Life span is called age. Alive means the period with life is called "Ayu".

चेतनानिवृत्तिर्जीवितमनुबन्धः॥ (च.सू. 30.22)

The period from birth till consciousness remains is called age.
Thus Ayurveda is the knowledge of life or the science of life.
The consciousness of the body is called "Ayu".

According to Acharya Charak, Ayurveda is the knowledge by which happiness, sorrow and honor (pramana) can be considered along with the benefits and harms of age.

हिताहितं सुखं दुःखमायुस्तस्य हिताहितम्।
मानं च तच्च यत्रोक्तमायुर्वेदः स उच्यते॥

(च.सू.1.41.)

According to Acharya Sushrut, Ayurveda is that knowledge of age which gives knowledge about age-related benefits and harms, about the pleasures and pains of age and about the value (evidence) of age.

Acharya Sushruta says -

आयुरस्मिन् विद्यते, अनेन वा आयुर्विन्दतीति आयुर्वेदः

(सुश्रुतसंहिता 1.15)

That is, in which the welfare of age is considered and whose teachings can achieve longevity, that is Ayurveda.

पश्येम शरदः शतम्।

(अथर्व. 19.67.1)

It has been told in this Atharvavedic mantra that we should keep looking at the sun for hundred years. That means our life span should be of hundred years.

जीवेम शरदः शतम्

(अथर्व. 19.67.2)

In this mantra of Atharvaveda, prayer has been made to the Sun God that we may live for a hundred years.

त्र्यम्बकं यजामहे सुगन्धिं पुष्टिवर्धनम्।
ऊर्वारुकमिव बन्धनान्मृत्योर्मुक्षीय मामृतात् ॥

(यजुर्वेद 3.60)

In this mantra of Yajurveda, prayer has been made to get rid of diseases by the treatment of aromatic restorative medicines.

1.2 Purpose of Ayurveda –

Ancient writers have given two purposes of Ayurveda medical science –

1) Protecting the health of a healthy person

2) Prevention of the disease of the diseased person

In this context, the quote from Charaka Samhita (Sutrasthan 30.26) is relevant –

प्रयोजनं चास्य स्वस्थस्य स्वास्थ्यरक्षणमातुरस्य विकारप्रशमनं च।

(च.सू. 30.26)

If a person is not able to protect his health for some reason due to wrong diet and becomes unwell, then the remedies for his disease are also described in Ayurveda. Even in the modern era, medicines are used for health protection and disease prevention. Through its various disciplines, Ayurveda tries to achieve both the above purposes. Its important purpose is to protect not only the physical but also the mental health of man . That's why Ayurveda is the science of preserving the whole life. It is believed that the health of the mind is also necessary for health. Ayurveda lays emphasis on physical and mental health as well as social health.

व्याध्युपसृष्टानां व्याधिपरिमोक्षः स्वस्थस्य रक्षणं च।

(सु.सू. 1.14)

Through Ayurvedic medicine, patients get relief from diseases and health of healthy persons is protected.

आयुः कामयमानेन धर्मार्थसुखसाधनम्।
आयुर्वेदोपदेशेषु विधेयः परमादरः॥

(अष्टाङ्गहृदयम् सू. 1.2)

By following the method and instructions of Ayurveda, there is benefit of age.

1.3 Integrated approach to healthcare –

The principles of Ayurveda served as the first medicine of the world. The definition of Ayurveda is in line with modern concepts of integrative medicine. Integrative medicine seeks to heal the body, mind and self at the same time, or heal the human being as a whole. Integrative medicine combines safe and high-quality alternative medicine treatments

with mainstream medical practice. According to Ayurveda, human life, mind and self tripod of the body . According to Ayurveda, there are many systems of treatment prevalent in the world, we should examine all the systems and make an integrated system.

1.4 Balance of the internal environment of the body –

Ayurveda defines health as the dynamic balance of the internal environment of the body . It has a positive effect on the senses, body parts, mind and self. Just as the sun, moon and air maintain the balance of the external environment, the body maintains itself by balancing anabolic and catabolic activities by self-regulation.

1.5 Coordination with the external environment -

Ayurveda states that the balance of the internal environment can be maintained by establishing coordination with the external environment. According to Ayurveda, human being is a symbol of the universe. The subtle world is a miniature representation of the gross world. Humans are made of the same elements that make up nature.

1.6 Principles of Ayurvedic Medicine –

Ayurvedic medicine deals with both preventive and curative medicine. In Ayurveda, by making provision for routine and rituals, instructions have been given through it to follow a systematic method from waking up in the morning till sleeping at night. In this there is mention of defecation, brushing teeth, abhyanga (massage), exercise, ubtan, bathing, wearing perfumes etc., after wearing clothes, taking proper diet and doing work to earn for living . This routine also changes according to the season. Therefore, the person who uses the daily routine keeping in mind the season, remains healthy. In this order, there are specific initiatives of Ayurveda – Panchakarma, Rasayana and Vajikarana. Rasayana and Vajikaran make the body more athletic.

याभिः क्रियाभिर्जायन्ते शरीरे धातवः समाः।
सा चिकित्सा विकारणां कर्म तद्भिषजां स्मृतम्॥

(च.सू. 16.34)

Those activities by which the equanimity of the defects in the body is created, that is the therapy and the duty of the doctors is also the same.

1.7 Pancmahabhuta theory –

The human body is made up of five elements of nature.

सर्वं द्रव्यं पाञ्चभौतिकमस्मिन्नर्थे । तच्चेतनावदचेतनं च।
तस्य गुणाः शब्दादयो गुर्वादयश्च द्रवान्ताः। (च.सू. 26.10)
सेन्द्रियं चेतनं द्रव्यं, निरिन्द्रियमचेतनम्। (च.सू. 1.48)

The physical universe is made up of the five elements, which are symbolically represented by earth, water (aap), fire (tejas), air and space. In simple terms, the material objects represent the solid, liquid, gas and thermal states and correspond to the five senses of sound, smell, taste, colour, and touch. The imbalance created in the body can be corrected by using the above substances from the environment.

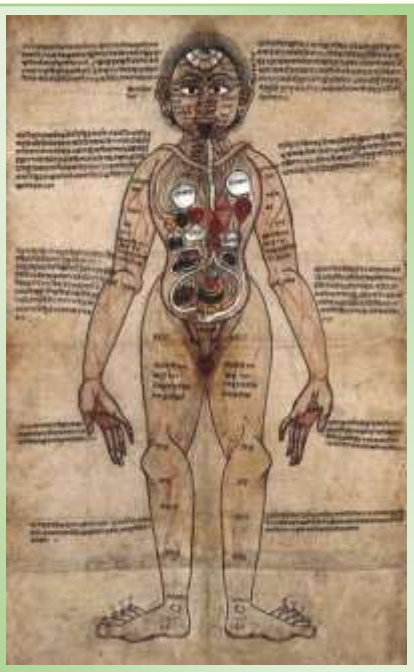


Figure 1.1 – Illustrated medical text in the Ayurvedic tradition

The practical form of the Panchamahabhutas in the body is through these three doshas, Vata, Pitta and Kapha. The balanced state of these doshas is the sign of health and their abnormal state is the symptom of disease. Vata, Pitta and Kapha are the functional units of the body. Kapha, a combination of the earth and water principles, represents the action of anabolism.

Figure 1.2 – Position of the cycle

Pitta is a combination of the water and fire principles, representing transformation and catabolism.

The food we consume is converted into the seven structural components (dhatus) of the body by the influence of the three doshas and the digestive fire. Rasa, blood, flesh, fat, bone, marrow and Shukra are the seven metals in the body. Waste products are excreted from the body in the form of faeces, urine and sweat. When this transformation is complete, the ojas or life force and the body's immunity build up to a higher level of health.

1.8 Treatment of diseases of the body –

Diseases arise when there is an abnormal state of the three doshas of the body, Vata, Pitta, and Kapha, and an imbalance of the dhatus of the body. Disease can be treated by proper combination of products of plant, animal and mineral salts and by change of diet and behavior. Medicine, diet and behavior are the three components of Ayurvedic treatment.

रोगस्तु दोषवैषम्यं दोषसाम्यमरोगता।

Asymmetry of defects is disease.

Curative treatment

Internal measures include methods used to improve quality of life through shodhana (detoxification) and shamana (pain-relieving treatments). External remedies, snehal (oil treatment), swodana (steam therapy using herbal steam) and use of herbal paste etc.

Surgical methods, these involve the removal of tissues, organs and any harmful physical growths.

Herbal remedies, including the use of rasashastra (mixtures of various herbal and trace amounts of metals).

Pachakarma is the most important treatment procedure in Ayurveda. It is the purification process of Ayurveda, in which five actions or methods

are adopted to remove the toxins from the body and to achieve a state of balance in the three doshas of the body. Pachakarma promotes restoration and healing of mental functions, digestive process and tissue channels.

1.9 Major texts of Ayurveda –

1. **Charaksamhita –** This is the oldest among the available texts of Ayurveda. There is a very systematic description of Pachakarma in it. Treatment of many diseases is available with detailed description by medicines.
2. **Sushruta Samhita -** This is the major text of surgery.
3. **Ashtangrahdaya –** In Ashtangahridaya, there is a special description of chemicals along with other subjects of Ayurveda.
4. **Bhavprakash –** It describes the treatment of all organs. Firang Rog and Shitla Rog have been described in this. This is a famous text of material properties.
5. **Madhavanidan –** It describes fever, diarrhoea, arsh, agnimandata, krimi, kamala, rajayakshma (T.B.), unmad, heart disease, ashmari, prameha etc.
6. **Shardgadhar Samhita –** There is also a description of the process of making ashes of chemicals and metals like gold. First of all pulse-examination has been explained in this book.

Practice questions

Q. 1 Select the correct option.

(1) The human body is made up of how many elements of nature?

a) 5 b) 4 c) 3 d) 6

(2) According to the Charak Sutra, the time period from birth till consciousness remains is called –

a) Ayu b) Ayurveda c) Hita d) Ahita

(3) According to the Charak Sutra, the actions which produce balance of doshas in the body are called –

a) Prevention b) Medicine c) Ayurveda d) None of these

Q. 2 Fill in the blanks.

1) Ayurvedic medicine deals with both prevention and …….. medicines.

2) By following the methods and instructions of Ayurveda, there is a benefit of …….

3) That which is continuously moving is called.....

Q. 3 Match the correct pair.

1)	Panchmahabhuta	–	life force
2)	Dosha	-	Body, mind, self
3)	Ojas	-	Seven Basic Components
4)	Metal	-	Panch System of Medicine
5)	Panchakarma	–	Five Elements
6)	Tripadas of human life	–	Vatta, Pitta, Kapha

Q. 4 Mark True (√) or False (X) against the following statements.

1) Sushruta Samhita deals with surgery.

2) The human body is made up of the five elements of nature .

3) Balanced state of Vata, Pitta, Kapha (tridoshas) is a sign of health.

Q. 5 Very short answer type questions

1) Which is the oldest book among the texts of Ayurveda ?
2) What is the name of the functional unit of the body ?
3) Write the names of 7 structural components of the body .

Q. 6 Short Answer Type Questions

1) Write the names of the major texts of Ayurveda.
2) Explain the concept of personalized medicine in Ayurveda.
3) What is Panchakarma method ?

Q.7 Long Answer Type Questions

1) Explain the Panchamahabhuta Siddhanta.
2) How are diseases treated in Ayurveda ? Explain in detail.

Project work

1) List five medicinal medicinal plants which are used in homes in the kitchen or as medicinal plants.
2) Plant 5 plants of medicinal importance in your pathshala .

Chapter - 2

Historical development of medical tradition in ancient India

Study points

2.1 Major parts of medical science

2.2 Tradition of surgery

2.3 Treatment of genetic diseases

2.4 Vaccine development for smallpox

2.5 Infectious diseases and epidemics

2.6 Medicines in Vedic vangmay

2.7 Ayurveda Research

2.1 Major parts of medical science –

The history of medical tradition in India dates back several thousand years. The context related to medical science is described in Rigveda. In the Atharvaveda, the names, symptoms, medicines and remedies for diseases have been described in detail, hence Ayurveda is called the Upaveda of the Rigveda.

Because of the importance of Ayurveda, Charaka Samhita (General Medicine), Sushruta Samhita (Surgery), Kashyapa Samhita (Pediatrics) were edited and revised more than a thousand times. Ayurveda is divided into eight branches – General Medicine, Surgery, Ophthalmology, Dentistry, Pediatrics, Psychiatry, Toxicology, Physiotherapy, Reproductive Medicine.

The eight parts are also known as Ashtanga Ayurveda.

2.2 Tradition of surgery –

यदि कर्तं पतित्वा संशश्रे यदि वाश्मा प्रहृतो जघान।
ऋभू रथस्येवाङ्गानि सं दधत्परुषा परुः॥

(अथर्व. 4.12.7)

In this mantra of Atharvaveda, it is mentioned to keep the human being healthy like a chariot by connecting the bones separated from the body like different parts of the chariot.

शीर्षक्तिं शीर्षामयं कर्णशूलं विलोहितम्।
सर्वं शीर्षण्यं ते रोगं बहिर्निर्मन्त्रयामहे॥

(अथर्व. 9.8.1)

In this Atharvavedic mantra, it is mentioned to remove head diseases and ear diseases.

This surgery has been described in detail in Sushruta Samhita. The set of instruments, actions and vranas to remove the contaminated substances entered or located in the body is called Shalyatantra.

महतस्तस्य तन्त्रस्य दुर्गाधस्याम्बुधेरिव ।
आदावेवोत्तमाङ्गस्थान् रोगानभिदधाम्यहम् ।
सङ्ख्यया लक्षणैश्चापि साध्यासाध्यक्रमेण च ।

(सुश्रुतसंहिता, सूत्रस्थान 1.9)

Sushruta has called surgery as the major part of Ayurveda because the miracle of deforming injury and restoration of severed organs takes place in it. Dissection of the organs of the body leads to quick healing. Along with Shastrakarma (operation), Kshar Prayog (Kshar Sutra), use of water, Agni Karma etc. are considered under Shalya. During the excavation of the Indus Valley Civilization, a structure of perforated teeth was found from the city of Mehrgarh, which indicates dentistry. Bronze Age skulls have been found from Harappa and Lothal which suggest surgical practice.

Figure 2.1 – Mesolithic rock painting in Bhimbetika (M.P.)

Trepanation was a common method of surgery practiced in prehistoric

societies. Which has been going on since the stone age. This method involves drilling of the skull through the vault. This method was used for head injury and removal of blood clots in the head.

Various cases of surgery have been described in Sushruta Samhita. Sushruta used 125 types of instruments for surgery . These devices were invented considering the complexity of the surgery. These instruments have special types of knives, needles, tweezers etc. Sushruta discovered 300 types of operation procedures. Sushruta had acquired special expertise in cosmetic surgery. Sushruta also used to do eye surgery. In Sushruta Samhita, the method of cataract operation has been explained in detail. He also had the knowledge of surgical delivery and had expertise in locating and setting broken bones. To reduce the pain during surgery, special medicines were used, in addition to this there was also information about diabetes and obesity. In the early stages, fruits, vegetables and wax mannequins were used for the practice of surgery . To explain the internal structure of the human body, Sushruta used to explain to his disciples by performing surgery on the dead body.

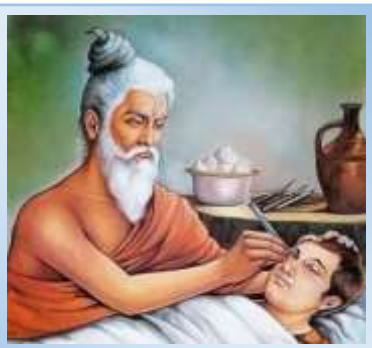


Figure 2.2 – Illustration of surgery on the eye.

Figure 2.3 – Instruments used in surgery

Treatment of the body (Surgery) -

रोहण्यसि रोहण्यस्थ्नश्छिन्नस्य रोहणी।

रोहयेदमरुन्धति॥ (अथर्व.4.12.1)

In this mantra of Atharvaveda, it has been mentioned to stop the blood flowing from the organ cut with iron edge by Rohani (Lakh) plant. This plant acts as a wound healer.

सं ते मज्जा मज्ज्ञा भवतु समु ते परुषा परुः।
सं ते मांसस्य विस्रस्तं समस्थ्यपि रोहतु॥

(अथर्व. 4.12.3)

Muscles and bones of the person injured due to injury have been joined through treatment. It is clear from this that our sages knew the process of surgery.

मज्जा मज्ज्ञा सं धीयतां चर्मणा चर्म रोहतु।
असृक् ते अस्थि रोहतु मांसं मांसेन रोहतु॥

(अथर्व. 4.12.4)

In this mantra, it has been mentioned to join broken skin to skin, bone to bone, flesh to flesh due to injury.

ऊरुभ्यां ते अष्ठीवद्भ्यां पार्ष्णिभ्यां प्रपदाभ्याम्।
यक्ष्मं भसद्यं श्रोणिभ्यां भासदं भंससो वि वृहामि ते॥

(अथर्व. 2.33.5)

In this mantra of Atharvaveda, various parts of the body such as thigh, knee, lower part of the knee, toes, waist, buttocks, kidney etc. have been told to get rid of tuberculosis (fever) or to protect these parts of the body from tuberculosis, is mentioned.

अस्थिभ्यस्ते मज्जभ्यः स्नावभ्यो धमनिभ्यः।
यक्ष्मं पाणिभ्यामङ्गुलिभ्यो नखेभ्यो वि वृहामि ते॥

(अथर्व. 2.33.6)

In this mantra of Atharvaveda, there is mention of taking out the disease of Yakshma (fever) from different parts of the body like bone, flesh, veins, artery, hand, hand finger, nail etc. or protecting these parts of the body from Yakshma disease.

2.3 Treatment of genetic diseases –

अपामार्गोऽप मार्ष्टु क्षेत्रियं शपथश्च यः। (अथर्व 4.18.7)

It is mentioned to remove hereditary diseases like leprosy, dysentery etc by Apamarg medicine. It is clear from this mantra that since ancient times we have knowledge of the medical system of hereditary diseases.

The description of genetic diseases is found in the Charaka Samhita. According to Sage Charak, the reproductive element is made up of seeds which are divided into parts and subdivisions.

Each part or subdivision of a seed represents a particular part of the body. Genetic diseases occurring in parents are transferred to the next generation through seeds. The description of the treatment of hereditary diseases is obtained from the Charaka Samhita.

2.4 Vaccine development for small pox –

Indian vaccination method was also practiced by Edward Jenner at the time of making smallpox vaccine, it was certified by Physician Holwell of London College.

Edward Jenner created the smallpox vaccine. Microorganism and parasite theory – In Charaka Samhita, bacteria are divided into two parts.

1) Pathogenic bacteria
2) Non pathogenic bacteria

Pathogenic bacteria include germs which we cannot see with the naked eye. A microscope is used to see microbes. The size and shape of the germ has also been described.

2.5 Infectious diseases and epidemics –

The description of infectious diseases is found in Sushruta Samhita. The transmission of these types of diseases occurs from person to person contact, through air, through exchange of clothes and through sexual

relations. In the Charak Samhita, measures to avoid epidemics and communicable diseases have been explained.

2.6 Medicines in Vedic vangmay –

अग्रमेष्योषधीनां ज्योतिषेवाभिदीपयन्। (अथर्व 4.19.3)

Apamarga is radiant and is major among medicines.

अजश्रृङ्ग्यऽराटकी तीक्ष्णश्रृङ्गी व्यृषतु। (अथर्व 4.37.3)

अथो अमीवचातनःपूतुद्रुर्नाम भेषजम्। (अथर्व 8.2.28)

Just as the Sun is the main source of light among the sources of light, in the same way, there is mention of using Ajshringi, Ashtaki and Tikshna Shringi medicines to protect the body from diseases.

In this Atharvavedic mantra, Putudru medicine has been described as a disease killer.

नडमा रोह न ते अत्र लोक इदं सीसं भागधेयं त एहि।
यो गोषु यक्ष्मःपुरुषेषु यक्ष्मस्तेन त्वं साकम धराङ् परेहि।

(अथर्व 12.02.01)

In this Atharvavedic mantra, it is mentioned to use Sis Asma for the prevention of (Yakshma) T.B. disease. It is mentioned to be treated by the fire of the roots (plants).

अथो बलासनाशनीः कृत्यादूषणीश्च यास्ता इहा यन्त्वोषधीः।

(अथर्व 8.7.10)

Some medicines are anti-inflammatory and some are inflammatory.

उतासि परिपाणं यातुजम्भनमाञ्जन।
उतामृतस्य त्वं वेत्थाथो असि जीवभोजनमथो हरितभेषजम् ॥

(अथर्व 4.9.3)

In this Atharvavedic mantra, it is mentioned to remove blackness caused by Pandu disease by Anjan medicine.

अपामार्ग त्वया वयं सर्वं तदप मृज्महे। (अथर्व 4.17.7)

It is clear from this mantra that Apamarg cures the diseases of hunger and thirst.

वेदाहं तस्य भेषजं चीपुद्रुरभिचक्षणम्। (अथर्व 6.127.2)

The medicine for Kapha disease is Chipudru (Pine). Its description has been given in this mantra of Atharvaveda.

2.7 Ayurveda Research –

Ayurveda research in India is done by the Ministry of AYUSH. Which is the national network for research institutes. It is an acronym for Ayurveda, Yoga and Naturopathy, Vibhag, Unani, Siddha and Homeopathy.

किलासं च पलितं च निरितो नाशया पृषत्।
आ त्वा स्वो विशतां वर्णः परा शुक्लानि पातय॥

(अथर्व. 1.23.2)

In this Atharvavedic mantra, it has been told about the treatment of leprosy and premature graying of hair with the help of medicine.

अप्स्वऽन्तरमृतमप्सु भेषजम्।

(अथर्व 1.4.4)

All medicines are located in water.

Practice questions

Q. 1 Select the correct option.

A) Who made the smallpox vaccine?

a) Robert Brown b) Edward Jenner

c) Leeuwenhoek d) none of these

B) Ayurveda is called Upaveda of which Veda?

a) Rigveda b) Atharvaveda

c) Samaveda d) Yajurveda

c) In which state is Bhimbetika situated?

a) Uttar Pradesh b) Rajasthan

c) Madhya Pradesh d) Punjab

Q. 2 Fill in the blanks.

1) T.B. There is a mention of using …… metal for the prevention of diseases.

2) In Charaka Samhita, bacteria are divided into …… parts.

3) Diseases that are transferred from one generation to another are called …….

Q. 3 Mark True (√) or False (X) against the following statements.

1) Pathogenic bacteria can be seen by the naked eye.

2) Infectious diseases spread by coming in contact with each other.

3) Some medicines are expectorant.

Q. 4 Match the correct pair.

1) Charaka Samhita - Surgery

2) Sushruta Samhita - Pediatrics

3) Kashyap Samhita - General Medicine

Q. 5 Very short answer type questions

1) What are the diseases that are transferred from one generation to another is called ?

Q. 6 Short Answer Type Questions

1) What is Ashtanga Ayurveda ?

2) Write the names of three basic texts of Ayurveda.

Q.7 Long Answer Type Questions

1) Explain the ancient Indian system of surgery.

Chapter - 3

Ancient Indian Sources of Physics

Study points

3.1 Introduction –

Vision of knowledge in vedic and Sanskrit vangmay is overall or comprehensive while the vision of modern science is specific. This is the reason why scientific facts are available in different sources in Vedic literature and Sanskrit vangmay.

3.2 Elements of physics in Vedic vangmay –

1. **Vedas –**

को अद्धा वेद क इह प्र वोचत् कुत आजाता कुत इयं विसृष्टिः ।

- ऋग्वेद 10.129.6

In the Nasadiya Sukta of the Rigveda, the origin of the world has been told. In this, the philosophical description of the origin of the universe has been done very well.

2. **Upanishads** - Upanishads have an important contribution in the development of Vedic science. Many signs have been received regarding sky, air, water, fire, life and mind etc.

3.3 Conversion of matter and energy –

अदितेर्दक्षो अजायतदक्षाद्वदितिः परि । (ऋग 10.72.4)

In this mantra of Rigveda, it is described that from Aditi (nature, matter) Daksha (energy) is generated and from Daksha (energy) Aditi (matter), it means that matter and energy can be transformed, i.e from matter to energy and energy from matter.

This principle was introduced in modern physics by Prof. Einstein has propounded that matter and energy can neither be destroyed nor created.

3.4 Gravitational Theory –

In the Brihat Jabal Upanishad, the principle of gravity is known as Aadharshakti. It has 2 parts.

(1) Urdhvashakti or Urdhvaga: Pulling upwards like - water going down or stone etc. coming down.

अग्नीषोमात्मकं जगत्

(बृ.जा.उप.24)

आधारशक्त्यावधृतः कालाग्निश्यमूर्ध्वगः। तथैव निम्नगः सोमः।

(बृ.जा.उप.28)

Maharishi Patjali (150 BC) in Vyakaran Mahabhashya describes the gravitational force of the earth by mentioning the principle of gravity that if a lump of earth is thrown upwards, it will not bend when it reaches the maximum velocity. He goes and does not climb up, he comes back to the earth.

लोष्ठः क्षिप्तो बाहुवेगं गत्वा नैव तिर्यग्च्छति, नोर्ध्वमारोहति।
पृथिवीविकारः पृथिवीमेव गच्छति, आन्तर्यतः।

(महाभाष्य स्थानेऽन्तरतमः 1.1.49 सूत्र)

Aakrishti Shakti – Bhaskaracharya II (1114) AD has used the word Aakrishti Shakti for gravity in his text Siddhanta Shiromani. Bhaskaracharya says that the earth has the power of attraction, so it pulls the heavy objects upwards towards itself. That object falls on the earth.

आकृष्टशक्तिश्च मही तथा यत् सस्थं गुरुं स्वाभिमुख स्वशक्त्या।
आकृष्यते तत् पततीव भाति समे समन्तात् क्व पतत्वियं इवे॥

सिद्धान्त भुवन 16

This principle of attraction was propounded by Newton in physics.

The power of attraction in the Sun – It is mentioned in the Rigveda and Yajurveda that the Sun has stopped the earth with its rays.

सविता यन्त्रैः पृथिवीमरम्णादस्कम्भने सविता द्यामदंहत।
अश्वमिवाधुक्षद्धुनिमन्तरिक्षमतूर्ते बद्धं सविता समुद्रम्॥

(ऋग. 10.149.1)

दाधर्त्थ पृथिवीम् अभितो मयूखैः। (यजु. 5.16)

3.5 Law of conservation of energy –

Energy can neither be created nor destroyed, it can be converted from one form to another. Einstein propounded this theory.

It is mentioned in Yajurveda –

अग्निरमृतो अभवद् वयोभिः। (यजु 12.25)

मर्त्येषुअग्निरमृतो नि धायि। (यजु. 12.24)

This mantra of Yajurveda states that Agni (energy) is immortal and inexhaustible. It has age, therefore it is immortal. Energy is not destroyed but transformed.

Indestructible energy in Vedas

यो देवानां नामधा एक एव तं संप्रश्नं भुवना यन्त्यन्या ।

(ऋग. 10.82.3)

It has been told in this Rigvedic mantra that the energy of fire is only one. It has the ability to do all the tasks.

स्तीर्णा अस्य संहतो विश्वरूपा घृतस्य योनौ स्रवथे मधूनाम् ।

(ऋग. 3.1.7)

In this mantra of Rigveda, fire (energy) has been described as having many forms, that is, energy can be expressed in different forms.

दुहाना धेनुर्वृजनेषु कारवेत्मना शतिनं पुरुरूपमिषणि । (ऋग. 2.2.9)

In this mantra of Rigveda, energy has been called Shatinam (100 horse power).

अग्निः प्रातःसवने पात्वस्मान् वैश्वानरो विश्वकृद् विश्वशंभूः । (अथर्व. 6.47.1)

In this mantra of Atharvveda, the universal energy has been called Vaishvavanar Agni (energy). Energy has been called the producer of everything in the universe.

यो हत्वाहिमारिणात् सप्त सिन्धून् यो गा उदाजदपधा वलस्य ।

(ऋग. 2.12.3)

It is mentioned in this mantra of Rigveda that fire (energy) can be generated by the rubbing of two stones.

Movement in atoms by fire (energy) –

अग्निर्मूर्धा दिवः ककुत्पतिः पृथिव्याऽअयम् ।
अपां रेतांसि जिन्वति ॥

(ऋग. 8.44.16, यजु. 3.12)

It has been told in this mantra that fire (energy) works to give speed to the atoms, it is through energy that the atom moves. Atoms expand only through energy. The word 'retas' has been used for the molecule.

Electromagnetic waves

There is no need of medium for the transmission of electromagnetic waves and these waves can also be transmitted in vacuum. These waves are generated by the oscillation of magnetic and electric fields.

Light waves, thermal radiation, X- rays, radio waves are examples of electromagnetic waves.

Electromagnetic waves have been mentioned in nine mantras of Rigveda's Avyamarudatareya Sukta (5.87) .

1. Electromagnetic waves are described as high energy and fast moving waves.
2. These waves are the waves generated by their own power.
3. There is a lot of light in these waves and these waves move like a flame of fire.
4. These rays travel with great speed.
5. These waves form a wide spectrum.

2) Different forms of energy –

Many forms of Agni (energy) are mentioned in the Rigveda. In Yajurveda, there is mention of sea energy, water energy, solar energy, celestial energy, geological energy, energy generated from trees etc.

दिवस्परि प्रथमं जज्ञे अग्निरस्मद् द्वितीयं परि जातवेदाः
तृतीयमप्सु नृमणा ऽ अजस्त्रमिन्धान ऽ एनं जरते स्वाधीः

(यजु. 12.18)

समुद्रे त्वा नृमणा ऽ अप्स्वन्तर्नृचक्षा ऽ ईधे दिवो अग्न ऽ ऊधन्
तृतीये त्वा रजसि तस्थिवा ꣳसमपामुपस्थे महिषा अवर्धन् ।

(यजु. 12.20)

अक्रन्ददग्निः स्तनयन्निव द्यौःक्षामा रेरिहद्वीरुधः समञ्जन्
सद्यो जज्ञानो वि हीमिद्धो अख्यदा रोदसी भानुना भात्यन्तः

(यजु. 12.21)

Agni (energy) from water churning – It is mentioned in Vedic vangmay that Atharva Rishi told about water electricity by churning the water of the pond.

त्वामग्ने पुष्करादध्यथर्वा निरमन्थत।

(ऋग. 6.16.13 यजु. 11.32 तैति. 3.5.11.3)

By making dams on the river and pond, water energy was converted into electrical energy by the hydroelectric power plant.

Solar Energy – The credit for the invention and successful use of solar energy in Rigveda and Yajurveda goes to Trit (Indra, Gandharva and Vasu).

यमेन दत्तं त्रित एनमायुनगिन्द्रऽ एणं प्रथमो अध्यतिष्ठत् ।
गन्धर्वो अस्य रशनामगृभ्णात्सूरादश्वं वसवो निरतष्ट ॥

(यजु. 29.13)

The energy obtained from the sun is called solar energy.

Sun is the source of energy – Atharvveda says that Sun is the source of all energy.

सविता प्रसवानाम अधिपतिः । (अथर्व 5.24.1)

3.6 Motion and its types –

"Moving action is called motion"

It is said in Raghuvansh composed by Kalidas that my motion has become like the thread drawn in threading a gem. This is an example of transfer rate. The movement of a body from one place to another is called translational motion.

Lord Sri Krishna moving round and round in Jayadeva 's Gitagovinda (1600 AD) and the description of deities going round in praise in the Harivamsa Purana are examples of rotational motion. Here the one who is being orbited is stable and those who are orbiting are rotating at a certain distance from it .

In Sanskrit vangmay, there is a description of Kalachakra rotating from place to place, which is similar to the rotation motion of our electric fans.

Oscillatory motion is mentioned in the Skandapurana (200 BC) in the swing festival of Lord Krishna in the month of Phalgun. The motion of a swing is an example of oscillatory motion.

Nyayadarshan (500–600 BC) in the context of the propagation of sound.

वीचितरङ्गन्यायेन तदुत्पत्तिः प्रकीर्तिता।

That is, sound is transmitted like waves rising in a pond.

In modern physics such waves are called transverse waves because the particles of the medium oscillate perpendicular to the motion of the wave.

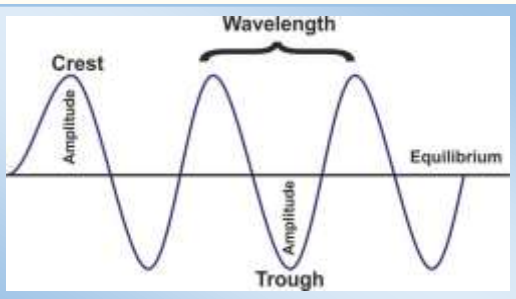


Figure 3.1 – Transverse wave

कदम्बकुसुमग्रन्थिकेसरप्रसरैरिव

The way saffron is spread in Kadamba flower, here the wave is running in the same direction of oscillation of the medium, hence compression and rarefaction takes place in it respectively. such waves are called longitudinal waves

In the explanation of Suryasukta, Sayanacharya has given the speed of light as 2202 yojana per ardhanimesh according to units in that period, which is approximately 186300 miles per second or 3,108 km / s. are similar to Maharishi Kanad gives an example in the establishment principle of Vaiseshik philosophy in the interpretation of motions, in which it is said that the more we pull the branch of the tree, the more it goes back.

In this example we see that

(1) EveryAction has equal and opposite reaction, here we get a glimpse of Newton's third law of motion.

(2) The twig is trying to stay in its former position, here we find an example of Newton's law of inertia.

(3) The quality of an object's effort to return to its previous state is called elasticity in modern science. Thus the above-mentioned positional principles are also the basis of Hooke's law of elasticity.

Earth's dynamics

अनुलोमगतिर्नौस्थः पश्यत्यचलं विलोमगं यद्वत् ।

अचलानि भानि तद्वत् समपश्चिमगानि लङ्कायाम् ॥ (आर्यभट्टीय गोलपाद – 9)

Aryabhatta has described the earth as dynamic. Just as a passenger traveling in a boat sees trees, plants, rocks etc. that are stationary on the shore moving in the opposite direction. Similarly, the fixed stars are seen moving from east to west in Lanka.

3.7 Different phenomena of light –

1) Description of the phenomenon of reflection of light –

Siddhanta Tatva is given in Vivek Kamlakar Bhatt's (1600 AD) earlier work. In the Surya Siddhanta also, in the Grahayuti chapter, there is a method of observing the planets by connecting mirrors at different angles and parallel. Yasaka's Nirukta (700 BC) in the seventh chapter, in the context of the form of Vaishvanara, there is an example of the burning of Gomaya (cow-dung) by concentrating the sun's rays with the help of Kansa or Mani. Which in modern science is an example of refraction of sun rays by a convex lens or reflection of sun rays by a concave mirror.

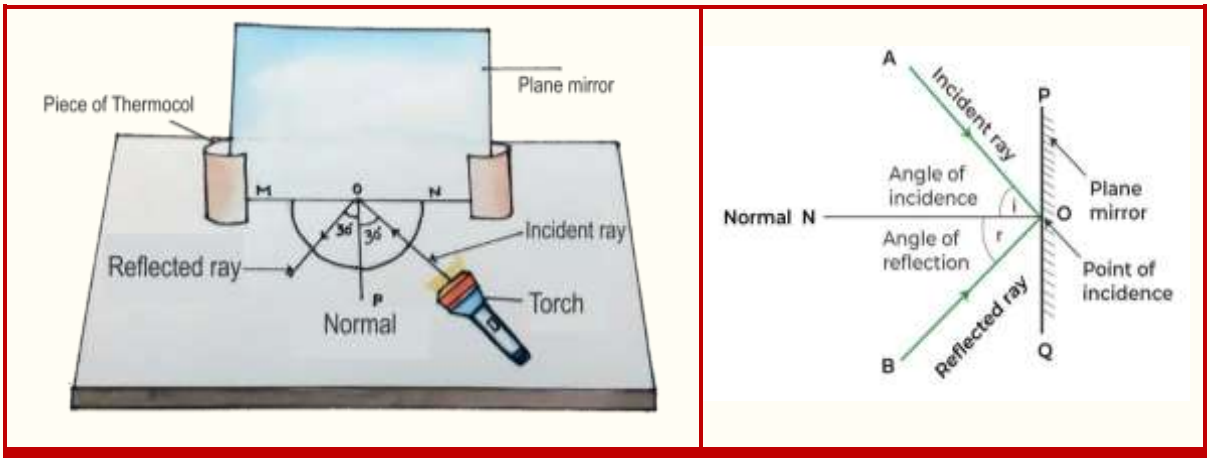


Fig. 3.2 – Reflection and refraction of light

Reflection of light in modern physics –

When a light ray after hitting a reflective surface returns back to the same medium, then this phenomenon is called reflection of light.

Refraction of light in modern physics – When a light ray enters from one medium to another, it deviates from its path, this phenomenon is called refraction of light.

2) **Formation of image –**

In the later Sanskrit text Buddhiryasya Balan Tasya, when the lion is led by a rabbit to the well, the lion roars on seeing its reflection in the water, where it is mentioned that the echo of its roar sounds doubled. In this way our Indian sages also had the knowledge of reflection and resonance.

3) **Formation of rainbow –**

Acharya Varahamihira has given the process of formation of rainbow in Brihatsamhita, how seven colored rays of sun make rainbow. Varahamihira says that when the sun's multi-colored rays collide with the air in the cloudy sky, they take the form of a bow. This is called rainbow.

सूर्यस्य विविधवर्णाः पवनेन विघट्टिता कराः साभ्रे।
वियति धनुः संस्थाना ये दृश्यन्ते तदिन्द्रधनुः॥

(बृहत्संहिता 35.1)

To calculate basic physical quantities and their measurement – Motion, force, work, energy etc. it is necessary that we have knowledge of length, mass and time. Indian scientists not only had the knowledge of these basic physical quantities, but they also knew the method to find their magnitude. Archaeologists have found evidence of the calculation of mass in the Indus Valley Civilization. In those days, there were metal made scales, which had copper pans. Some weights were found in the excavation, whose standard mass was about 13.64 grams and other weights were available as multiples of 2, 4, 6, 8, 16, 32, 64.

The number sixteen has a special significance in the Harappan culture. Its mention is also found in Prasnopanishad (2000-800 BC) and

Jataka texts (300-400 AD). It is well known that till a few years ago, in India there were 16 chhatoks in 1 seer and 16 annas in 1 rupee .

Mr. S.N. Sen writes in his book Vigyaner Itihas Volumes 1 and 2 that a scale was found at the time of the Indus Valley Civilization, which had five parts based on the decimal system. Larger lengths were measured in (2 miles) and yojans (4 kro or 13 km).

Kaal (time) is calculated from the movement of the Sun in the sky. Humanization of time was done on the basis of the movement of the Sun with respect to the Earth, the length of the shadow cast by the Sun, the direction etc. and in the night or when the sky was cloudy, a water trough or channel was used. By the time of a channel, it was meant that the time it takes for half of the water kept in a ghat to come out of a hole made in it, whose diameter is equal to the diameter of a 4 finger long gold wire of mass 4 mache . Suryaghatis were prevalent in medieval India, a sample of which can be seen in the observatory built by King Jai Singh in Jaipur.

In the context of time measurement, the division of time in Udayanacharya's Kiranavali has been done as follows –

2 moments = 1 Love
2 Love = 1 Nimesh
18 Nimesh = 1 Kashtha
30 Kashtha = 1 Kala
30 Kala = 1 Muhurta
30 Muhurta = 1 Day

Method of measurement of time in Siddhantashiromani

100 Errors = 1 Tatparya
30 Tatparya = 1 Nimesh
18 Nimesh = 1 Kashtha
30 Kashtha = 1 Kala
30 Kala = 1 Ghatika
2 Ghatika = 1 Moment

30 Moments = 1 Hour

3.8 Photospectral Meter (Spectrometer)

With the help of the light spectrum measuring instrument, the spectrums located in the sunlight have been measured. In 'Yatrasarvasya' written by sage Bhardwaj, a total of 13 sound measuring instruments ie light spectrum measuring instruments have been mentioned.

Different regions of electromagnetic radiations have been mentioned in Bhardwaj's Anshubodhini.

कंचकावरणभेदाद्वैविध्यं तमसः क्रमात्,
तदुक्तं शास्त्रतः पूर्वं तयोरावरणं तमः ।
तस्मात् त्रिधा तमोऽभूत् त्रिगुणकारणतः क्रमात्,
अन्धतमो गूढतमस्तमश्येति यथाक्रमम् ॥

- Anshubodhini, Page 85, Sutra 10

Explaining the above formula by Bodhananda, it has been said that three types of Tama – Gudhatam (ultraviolet radiation), Tama (visible radiation) and Andhatam (infrared radiation) are manifested by the combination of Dhwantdvaya i.e. Tama covering Dhwant and Kanchukavaran Dhwant .

All these three are the fields of electromagnetic radiation.

Description of the seven colors of visible light

आरोगो भ्राजः पटरः पतङ्गः ।
स्वर्णरो ज्योतिषीमान् विभासः ॥

(तैत्तिरीय आरण्यक 17.20)

In this mantra of Taittiriya Samhita of Yajurveda, seven colors of the visible light spectrum are mentioned such as – Aarog (red), Bhraj (orange), Swarna (yellow), Patang (green), Patar (blue), Jyotishiman (purple) and Vibhas: (purple).

अधुक्षत् पिप्युषीमिषमूर्जं सप्तपदीमरिः ।

सूर्यस्य सप्त रश्मिभिः ॥

(ऋग. 8.72.16)

The 7 Rashmi (rays) of the Sun have been mentioned in this Rigvedic mantra .

Description of ultraviolet and infrared radiations –

हिरण्यजिह्वस्सुविताय नव्यसे रक्षषा माकिर्नो अघशंस ईशत ।

तैत्तिरीय संहिता (1.4.24)

हिरण्यपाणिमूतये सवितारमुप ह्वये ॥

तैत्तिरीय संहिता (1.4.25)

In this mantra of Taittiriya Samhita of Yajurveda, two radiations named Hiranyajihva and Hiranyapani have been mentioned. Austrian scientist Victor Hess presented it in the year 1912 in the form of two radiations named ultraviolet and infrared.

3.9 Mechanical Science

It is that branch of physics in which the study of the behavior of bodies when applied or displaced is called mechanics or mechanical science.

There is a mention of mechanics in Vedas.

युवोर्हि यन्त्रं हिम्येव वाससोऽभ्यायंसेन्या भवतं मनीषिभिः ।

(ऋग्वेद 1.34.1)

In this mantra of Rigveda, we find the use of the word Yantra as the power to control.

पञ्चानान्त्वा वातानाय्यँन्त्राय धर्त्राय गृह्णामि
पञ्चानान्त्वर्तूनाय्यँन्त्राय धर्त्राय गृह्णामि
पञ्चानान्त्वा दिशाय्यँन्त्राय धर्त्राय गृह्णामि
ब्रह्मणस्त्वा तेजसे यन्त्राय धर्त्राय गृह्णामि
रक्षत्रस्य त्वौजसे यन्त्राय धर्त्राय गृह्णामि ।

(तैत्तिरीय संहिता 1.6.1.2)

Various types of instruments have been mentioned in this mantra of Taittiriya Samhita, which are as follows-

1. **Vata Yantra –** It was used to generate air and measure air pressure. At present, barometric instruments are used to measure air pressure.
2. **Ritu Yantra –** This instrument was used to measure winter and summer. At present, thermometers are used to measure temperature.
3. **Disha Yantra –** This instrument used to give knowledge of directions. At present, directions are detected with the help of magnetic compass.
4. **Tejas Yantra –** Tejas Yantra was used to generate light. At present, light emitting diodes are used to generate light.
5. **Ojo Yantra –** Ojo Yantra was used to generate energy and measure energy.

Currently, calorimeters are used to measure energy.

Some of the mechanical devices are as follows –

1. **Water mill -** Water mill is a mechanical device, this device was mostly used for grinding flour. With the help of this trick, by generating energy from flowing water or falling water, they used to operate some other machine.

Bhaskaracharya has told the method of construction of watermill in his book 'Siddhantshiromani', which is as follows -

ताम्रादिमयस्यांकुशरुपनलस्याम्बुपूर्णस्य ।
एक कुण्डजलान्तर्द्वितीयमर्ग्रं त्वधोमुखं च बहिः ।
युगपन्मुक्तं चेत् कं नलेन कुण्डाब्दहिः पतति ॥
नेम्यां बद्ध्वा घटिकाश्चक्रं जलयन्त्रवत् यथा धार्यम्
नलचकप्रच्युतसलिलं पतति यथा तद्वटीमध्ये ।

भ्रमति ततस्तत् सततं पूर्णघटीभिः समाकृष्टम्
चक्रच्युतं तदुदकं कुण्डे याति प्रणालिकया ।

-सिद्धान्त शिरोमणि, गोलाध्याय, सत्राध्याय 53-56

Made of copper, bent like a curb and immersing one end of the bottom filled with water in a water vessel and the end of the other vessel facing externally, if both the ends are left together, then the water in the vessel will go out completely through the tap. . By tying the ghatikas (water pot) in the circumference of the circle, both the ends of the axis of the wheel should be kept in such a way that the water falling from the tap falls inside the ghatika, in this way the circle rotates continuously drawn by the complete ghatiyas. And the water released by the wheel goes into the pool through the drain.

2. Hydraulic Yantra – It is a rotating machine, it rotates by taking energy from steam, gas, water and works to rotate the machines above it.

Practice questions

Q. 1 Select the correct option.

1) How many days are there in 30 Muhurta?

a) 1 day b) 2 days c) 4 days d) 5 days

2) How many moments are there in 1 Ahoratra –

a) 20 b) 25 c) 30 d) 20

3) How many Love are there in 1 Nimesh –

a) 4 b) 3 c) 2 d) 5

Q. 2 Fill in the blanks.

1) Udayanacharya's Kiranavali consists of 30 Muhurta days.
2) In Siddhant Shiromani there are …… moments in 2 ghatikas.
3) Sun is the source of all ……

Q. 3 Mark True (√) or False (X) against the following statements.

1) The conversion of matter and energy is mentioned in the 10 th Mandala of the Rigveda.
2) The action of moving is called motion.
3) We can see objects due to the phenomenon of reflection of light.

Q. 4 Match the correct pair.

1)	Nasdiya Sukta	- Kamlakar Bhatt
2)	Siddhantashiromani	- Kalidas
3)	Raghuvansham	Explanation of the power of attraction
4)	Siddhantatattvavivek	- Origin theory of the universe

Q. 5 Very short answer type questions

1) Hydroelectric power plant converts hydroelectric energy into which energy?
2) What is the energy obtained from the sun called ?

Q. 6 Short Answer Type Questions

1) In which book the method of observing the planets by adding mirrors has been explained ?

2) What was the speed of light according to Suryasukta ?

Q.7 Long Answer Type Questions

1) In the Nirukta of Yasak, explain the process of burning cow dung by concentrating the rays of the sun with the help of Kansa or Mani on the basis of refraction and reflection of light.

2) Give two examples of wave motion in the context of sound propagation in jurisprudence.

3) What is the law of conservation of energy ?

Chapter - 4

Botany and Animal Science in India

Study points

4.1 Introduction
4.2 Emergence of Botany
4.3 Importance of trees and plants
4.4 Germination
4.5 Plantation
4.6 Phytotherapy
4.7 Classification Jivas in Vedic Vangmay
4.8 Scientific Classification of animals
4.9 Veterinary Medicine

4.1 Introduction –

Internal structure of the plant world is studied is called botany. The general meaning of vegetation is from the trees, plants, vines etc. produced in the forest. In the Mahabharata, a plant devoid of flowers but having fruits is considered as a plant.

अपुष्पा फलवन्तो ये ते वनस्पतयः स्मृताः (महाभारत 1.141.16)

According to Bhavprakash -

नन्दी वृक्षोऽश्वत्थभेदः प्ररोहो गजपादपः,
स्थालीवृक्षः क्षयतरुः क्षीरी च स्याद् वनस्पतिः।

The shoots of some special trees, plants etc. have been called Vanaspati.

4.2 Origin of Botany –

From the beginning of creation, man used wood for fuel and grass for living. Medicines were used for medicine, fruits were used for food.

In Rigveda, Soma is considered to be forceful, energizing and refreshing.

अश्वावतीं सोमावतीमूर्जयन्तीमुदोजसम्।
आवित्सि सर्वा ओषधीरस्मा अरिष्टातये॥ ऋग्वेद (10.97.07)

The scientific study of trees has been given in Varahamihira's Brihatsamhita and in Agnipurana in Vrikshayurveda episode.

Here 'tree' is the vachak of the entire plant world.

किं स्विद्वनं क उ स वृक्ष आस यतो द्यावापृथिवी निष्टतक्षुः।
मनीषिणो मनसा पृच्छतेदु तद्यदध्यतिष्ठद्भुवनानि धारयन्॥

ऋग्वेद (10.81.4)

In the Rigveda, 'forest' and 'tree' are used as synonyms for vegetation.

इमां खनाम्योषधिं वीरुधां बलवत्तमाम्।
यया सपत्नीं बाधते यया संविन्दते पतिम्॥ (अथर्व. 3.18.1)

In this Atharvavedic mantra, there is mention of medicine in the form of creeper obtained by digging the land.

There is a description of Gulma-Vriksha Ayurveda in Kautilya Arthashastra. In all these, there is a detailed description of plant life such as germination, seed -setting, irrigation, protection from diseases, suitable land, fertility, weather, study of leaves, flowers, stems, flowers, fruits etc.

ऊष्मतो म्लायते वर्णस्त्वक् फलं पुष्पमेव च।
म्लायते शीर्यते चापि स्पर्शस्तेनात्र विद्यते॥

(महाभारत शान्ति पर्व 184.11)

In Shanti Parva, the life consciousness in plants has been explained. Due to heat in the trees or touching the trees, the leaves, bark, fruits, flowers of the trees wither and fall and due to lack of light in winter they wither and fall. So it is clear that plants feel touch.

वाखवभ्यशनिनिर्घोषैः फलं पुष्पं विशीर्यते।
श्रोत्रेण गृह्यते शब्दस्तस्माच्छृण्वन्ति पादपाः॥

(महाभारत शान्तिपर्व 184.12)

Strong winds, fire and vibrations of lightning, the flowers and fruits of the trees fall. So it is clear that trees listen to sound.

वल्ली वेष्टयते वृक्षं सर्वतश्चैव गच्छति।

न ह्यदृष्टेश्च मार्गोऽस्ति तस्मात् पश्यन्ति पादपाः॥

(महाभारत शान्ति पर्व 184.13)

It has been told in this shloka that the creeper wraps itself around the tree and climbs up to its upper part. So it is clear that the tree is also visible.

पुण्यापुण्यैस्तथा गन्धैर्धूपैश्च विविधैरपि।
अरोगाः पुष्पिताः सन्ति तस्माज्जिघ्रन्ति पादपाः॥

(महाभारत शान्ति पर्व 184.14)

According to this shloka of the Mahabharata, plants (trees) flower and bear fruit after being free from diseases, and due to the effect of polluted smell, plants become sick. So it is clear that plants smell too.

पादैः सलिलपानाच्च व्याधीनां चापि दर्शनात्।
व्याधिप्रतिक्रियत्वाच्च विद्यते रसनं द्रुमे॥

(महाभारत, शान्ति पर्व 184.15)

It is clear from this shloka of Mahabharata that our sages knew that plants get water and mineral salts from the soil through their roots and they get sick by consuming impure water and when they get sick, they get rid of plants by adding medicine to their roots. therapy is done. Hence it is proved that plants have taste buds.

वक्त्रेणोत्पलनालेन यथोर्ध्वं जलमाददेत्।
तथा पवनसंयुक्तः पादैः पिबति पादपः॥

(महाभारत शान्ति पर्व 184.16)

Trees drink the mineral elements and water present in the soil by pulling them through their roots with the help of air.

तेन तज्जलमादत्तं जरयत्यग्निमारुतौ।
आहारपरिणामाच्च स्नेहो वृद्धिश्च जायते॥ (महाभारत शान्ति पर्व 184.18)

The water that the plants get from the soil through their roots, the air and fire present in the plants digest that water, due to which the plants grow.

सुखदुःखयोश्च ग्रहणाच्छिन्नस्य य विरोहणात्।
जीवं पश्यामि वृक्षाणामचैतन्यं न विद्यते॥

(महाभारत शान्ति पर्व 184.17)

When the tree is cut, a new shoot is produced in them and they accept happiness and sorrow. From this it is clear that there is life in the trees.

आपोहि कललं भुत्वा यत्पिण्डस्थानकं भवेत्।
तदेवं व्यूहमानत्वात् बीजत्वधिगच्छति॥

(वृक्ष आयुर्वेद प्रथम अध्याय)

Water forms a nucleus by taking a jelly-like substance and receives energy and nutrients from the earth, in this way a seed is formed, this seed develops into a tree.

या बभ्रवो याश्च शुका रोहिणीरुत पृश्नयः।
आसिक्तीः कृष्णा ओषधीः सर्वा अच्छावदामसि॥ (अथर्व. 8.7.1)

In this Atharvavedic mantra, medicines have been told to be of different sizes, different colors like white, red etc. The use of these medicines has been told about the cure of the disease.

प्रस्तृणती स्तम्बिनीरेकशुङ्गाः प्रतन्वतीरोषधीरावदामि।
अंशुमतीः काण्डिनीर्या विशाखा ह्वयामि ते
वीरुधो वैश्वदेवीरुग्राः पुरुषजीवनीः॥

(अथर्व. 8.7.4)

According to this mantra of the Atharvaveda, medicinal plants are prastrnati (spreading), stambini (stemmed), ekshunga (one-horned), kandini (leaved) and visakha (branched).

मधुमन्मूलं मधुमदग्रमासां मधुमन्मध्यं वीरुधां भूव।

मधुमत् पर्णं मधुमत् पुष्पमासां मधोः संभक्ता
अमृतस्य भक्षो घृतमन्नं दुह्रतां गोपुरोगवम्॥

(अथर्व. 8.7.12)

In this Atharvavedic mantra, there is mention of the origin, front part, middle part, flowers, leaves, flowers and fruits of trees being sweet.

तस्यामृतस्येमं बलं पुरुषं पाययामसि।
अथो कृणोमि भेषजं यथासच्छतहायनः॥

(अथर्व. 8.7.22)

A diseased person can be treated by giving nectar-like medicine (vegetable) to him.

पुष्पवतीः प्रसूमतीः फलिनीरफला उत।
संमातर इव दुह्यास्मा अरिष्टतातये॥

(अथर्व 8.7.27)

Herbs with flowers, sprouts, fruits and non -fruits (plants) are beneficial for a patient in the same way as mother's milk is like nectar for an infant.

In the Brihadaranyaka Upanishad, equality has been told between humans and trees. Just as blood comes out when the skin of a human being is cut, in the same way rasa comes out when the skin of trees is cut. Growth and activities in plants are similar to humans. Nutrients are necessary for gradual development in plants-infancy, youth, sleep, wakefulness, depression due to injury, disease and conception.

Thus we can say that nature or plants also have life like human life.

In Kautilya's Arthashastra, the study of the plant world is found under Krishi Tantra.

सीताध्यक्षःकृषितन्त्रगुल्मवृक्षायुर्वेदज्ञस्तज्ज्ञसखो वा सर्वधान्यपुष्फलशाककन्दमूल पालीक्यक्षोमकार्पासाबीजानि यथाकालं गृह्णीयात्।

4.3 Importance of trees and plants –

(1) In the Aitareya and Kaushitaki Brahmanas, the plant is called Prana because it gives oxygen to the living beings for breathing.

प्राणो वनस्पतिः। (कौषी.ब्रा. 12.7)

प्राणो वै वनस्पतिः। (ऐत. ब्रा. 2.4)

(2) It is said in Yajurveda that trees remove pollution, hence they are called Shamita (reliever, pollution preventer).

वनस्पतिः शमिता। (यजु. 29.24)

(3) The meaning of medicine has been explained in Shatpath Brahmin, medicine destroys defects.

ओषं धयेति तत ओषधयः समभवन्। (शत. 2.2.4.5)

4.4 Germination

Fertile power is already present in the seed, which becomes visible in the form of a sprout with sufficient water and heat. After germination, there is a sequence of development of rootstock etc. In modern science it is called plant, sapling, bud.

4.5 Plantation -

it has been told about planting trees and protecting them. Because they protect the sources of water.

वनस्पतिंवन आस्थापयध्वं नि षू दधिध्वमनन्त उत्सम्।

(ऋग. 10.101.11)

Varahamihirakrit Brihatsamhita has given Vrikshayuravedhyay which mentions about tree plantation.

1. Selection of suitable place and land for trees -

प्रान्तच्छायाविनिर्मुक्ता न मनोज्ञा जलाशयाः ।
यस्मादतो जलप्रान्तेष्वारामान्विनिवेशयेत् ॥

(बृहत्संहिता वृक्षायुर्वेद 55.1)

Planting trees on the banks of water bodies is mentioned in this shloka of the Brihat Samhita.

मृद्वी भूः सर्ववृक्षाणां हिता तस्यां तिलान्वपेत् ।
पुष्पितांस्तांश्च मृद्वीयात् कर्मैतत्प्रथमं भुवः ॥

(बृहत्संहिता वृक्षायुर्वेद 55.2)

In this shloka of Brihatsamhita, it has been told that soft land should be selected for planting trees. In such a land, sesame seeds should be sown first, when flowers come in it, then that land should be plowed again and cow dung should be added to it.

2. Plantable tree -

अरिष्टाशोकपुन्नागशिरीषाः सप्रियङ्गवः ।
मङ्गल्याः पूर्वमारामे रोपणीया गृहेषु वा ॥

(बृहत्संहिता वृक्षायुर्वेद 55.3)

In this shloka of Brihatsamhita, it has been told that trees like Neem, Ashok Punnag, Shirish, Priyangu (Kakuni) etc. should be planted in the house and garden because all these trees are considered to be auspicious to remove the calamities.

3. Grafting method -

पनसाशोककदलीजम्बूलकुचदाडिमाः ।
द्राक्षापालीवताश्चैव बीजपूरातिमुक्तकाः ॥

(बृहत्संहिता वृक्षायुर्वेद 55.4)

एते द्रुमाः काण्डरोप्या गोमयेन प्रलेपिताः ।
मूलोच्छेदेऽथवा स्कन्धे रोपणीयाः परं ततः ॥

(बृहत्संहिता वृक्षायुर्वेद 55.5)

In this shloka of Brihatsamhita, the method of grafting trees has been explained. Jackfruit, Ashok, Banana, Jamun, Badhar, Pomegranate, Grapes, Palivat, Bijora lemon, Atimuktak can be grafted on the root or branch of the cut exotic tree by wrapping the branches of these trees with cow dung.

4. Planting season –

अजातशाखान् शिशिरे जातशाखान् हिमागमे ।
वर्षागमे च सुस्कन्धान् यथादिक्स्थान् प्ररोपयेत् ॥

(बृहत्संहिता वृक्षायुर्वेद 55.6)

In this shloka of Brihatsamhita, it has been mentioned about the season for planting different types of trees. Shishir season (Madya, Falgun month) for planting trees with Ajatshakha (other than cuttings), Hemant season (Margashirsha, Paush month) for planting trees with cuttings and rainy season (Shravan, Bhadrapada month) for long-branched trees.) is considered suitable.

5. Rules for planting trees –

घृतौशीरतिलक्षौद्रविडङ्गक्षीरगोमयैः ।
आमूलस्कन्धलिप्तानां सङ्क्रामणविरोपणम् ॥

(बृहत्संहिता वृक्षायुर्वेद 55.7)

In this shloka of Brihatsamhita, it has been told that the mixture of ghee, poppy seeds, sesame seeds, honey, cow dung, milk, cow dung should be applied on the tree from root to tip and planted in the ground.

6. Method of Plantation –

शुचिर्भूत्वा तरोः पूजां कृत्वा स्नानानुलेपनैः ।
रोपयेद्रोपितश्चैव पत्रैस्तैरेव जायते ॥

(बृहत्संहिता वृक्षायुर्वेद 55.8)

In this shloka of Brihatsamhita, it has been told that trees should be planted after worshiping them with sandalwood etc.

7. Irrigation of trees –

सायं प्रातश्च घर्मर्त्तौ शीतकाले दिनान्तरे ।
वर्षासु च भुवः शोषे सेक्तव्या रोपिता द्रुमाः ॥

(बृहत्संहिता वृक्षायुर्वेद 55.9)

In this shloka of Brihat Samhita, it has been told that planted trees should be irrigated in the morning and evening in summer, after one day in winter, when the land dries up in rainy season.

8. Order of planting trees –

उत्तमं विंशतिर्हस्ता मध्यमं षोडशान्तरम् ।
स्थानात् स्थानान्तरं कार्यं वृक्षाणां द्वादशावरम् ॥

(बृहत्संहिता वृक्षायुर्वेद 55.12)

should be planted at a distance of 20 hands from another tree.

4.6 Phytotherapy –

Varahamihirakrit Brihatsamhita and Agnipurana mention the treatment of trees. Just as the human body suffers from diseases, in the same way diseases also arise in trees.

Varahamihira and Kashyapa say that trees get sick due to excessive cold, sunlight and strong wind. Leaves turn yellow, shoots do not grow, branches dry up and rasa starts dripping.

शीतवातातपै रोगो जायते पाण्डुपत्रता।
अवृद्धिश्च प्रवालानां शाखाशोषो रसस्रुतिः ॥

(बृहत्संहिता वृक्षायुर्वेद 55.14)

For the treatment of a diseased tree, its diseased part should be cut off and a mixture of waiwing, ghee and pank (mud) should be applied on the tree. Then milk-mixed water should be irrigated.

चिकित्सितमथैतेषां शस्त्रैणादौ विशोधनम्।
विड–घृत–पङ्काक्तान् सेचयेत् क्षीरवारिणा॥

(बृहत्संहिता वृक्षायुर्वेद 55.15)

Treatment for not bearing fruit

फलनाशे कुलत्थैश्च माषैर्मुद्गैस्तिलैर्यवैः ।
श्रृतशीतपयःसेकः फलपुष्पसमृद्धये ॥

(बृहत्संहिता वृक्षायुर्वेद 55.16)

In this shloka of the Brihat Samhita, it has been said that if a tree does not bear fruit or is destroyed after bearing fruit, then for its treatment kulthi, urad, moong, sesame, barley should be boiled in milk, cooled and put in the root of the tree. With this the tree can be treated.

4.7 Classification of living beings in Vedic vangmay –

Many types of classifications have been made including both animals and birds.

a) 2 types of animals –

1) Gramya: Those living or domesticated in the village.

2) Aranya: Those who live in the forest.

वि ग्राम्याः पशव आरण्यैर्व्याऽपस्तृष्णयासरन्। (अथर्व.3.31.3)

पशूँस्तांश्चक्रे वायव्यानारण्या ग्राम्याश्च ये। (अथर्व.19.6.14)

b) Atharvaveda describes three types of animals.

c) There is a description of 5 types of animals in Shatapatha Brahmana .

1) Man 2) Horse 3) Cow 4) Aja (Goat) 5)Avi (Sheep)

एतान् पञ्च पशून् अपश्यत्। पुरुषमश्वं गामवियजम्, यदपश्यत् तस्यादेते पशवः।

(शत 62.1.2)

4.8 Scientific classification of animals –

Is divided into 2 parts.

1. **Protozoa** – Unicellular organisms come in this. About 50000 castes are found in this community, like amoeba
2. **Metozoa** – Multicellular organisms come in this. Whose body is made up of many cells.

4.9 Veterinary Medicine

Veterinary science was also known as Mrigayurveda in ancient times. The science related to the treatment of elephant and horse was called Hastyayurveda (Gajayurveda) and Ashvayurveda.

Gajchikitsa (Elephant Medicine) – Chapter 287 of Agnipuran deals with the treatment of various diseases of elephants. The treatment of some of those diseases is described as follows.

गोमूत्रं पाण्डुरोगेषु रजनीभ्यां घृतं द्विज ।
आनाहे तैलसिक्तस्य निषेकस्तस्य शस्यते ॥

(अग्निपुराण 287.8)

लवणैः पञ्चभिर्मिश्रा प्रतिपानाया वारुणी ।
विडङ्गत्रिफलाव्योषसैन्धवैः कवलान्कृतान् ॥

(अग्निपुराण 287.9)

मूर्च्छासु भोजयेन्नागं क्षौद्रं तोयं च पाययेत् ।
अभ्यङ्गः शिरसः शूले नस्यं चैव प्रशस्यते ॥

(अग्निपुराण 287.10)

नागानां स्नेहपुटकैः पादरोगानुपक्रमेत् ।
पश्चात्कल्ककषायेण शोधनं च विधीयते ॥

(अग्निपुराण 287.11)

In these shloka of Agnipuran, the treatment of elephant has been explained. If an elephant gets Pandu disease, it should be fed cow urine and ghee along with turmeric. In case of constipation, the stomach should be cleaned with oil and salt solution should be given. In case of fainting, diet containing vyvidag, triphala, trikatu and rock salt and honey should be given. If there is a disease in the feet of elephants, oil should be applied to their feet.

Ashwa Chikitsa (Horse Medicine) - In Agnipuran Chapter 288, 289, the treatment of various diseases occurring in the horse has been mentioned. The treatment of some of those diseases is described as follows.

गोमयं लवणं मूत्रं क्वथितं मृत्समन्वितम् ।

अङ्गलेपो मक्षिपकादिदंशश्रमविनाशनः ॥ (अग्निपुराण 288.57)
मध्ये भद्रादिजातीनां मण्डो देयो हि सादिना ।
दर्शनं भोततीक्षस्य निरुत्साहः क्षुधा हयः ॥ (अग्निपुराण 288.58)
यथा वश्यस्तथा शिक्षा विनश्यन्त्यतिवाहिताः ।
अवाहिता न सिध्यन्ति तुङ्गवक्त्रांश्च वाहयेत् ॥ (अग्निपुराण 288.59)

In these shloka of Agnipuran, the treatment of horse has been explained. When a horse is bitten by a fly etc. and the horse is tired, then to remove the tiredness of the horse, cow dung, salt, soil, cow urine should be applied on the horse's body. Parijat leaves should be mixed with rice and fed to the horse, so that the worms present in its stomach are destroyed.

Practice questions

Q. 1 Select the correct option -

1) Which of the following is a unicellular organism –

a) Lion b) Amoeba c) Deer d) Bear

2) Which of the following is not a domestic animal –

a) Rabbit b) Cat c) Dog d) Fox

3) Used as fuel in ancient times.

a) Gas b) Wood c) Both A and B d)Noneof these

Q. 2 Fill in the blanks.

1) In Shatapatha Brahmana there is a description of ……..types of animals.

2) Unicellular organisms have …… cells.

3) The gas required for the respiration of animals is …….

Q. 3 Mark True (✓) or False (✗) against the following statements.

1) Trees protect the environment from getting polluted.

2) The animals living in the forest are called Aranyaka animals.

3) By adding manure to the soil, the fertility of the soil increases.

Q. 4 Match the correct pair.

1) Vrikshayurveda - Related to the treatment of elephants

2) Mrigayurveda - Veterinary Medicine

3) Ashvayurveda - Treatment of plants

4) Gajayurveda - Treatment of Horses

Q. 5 Very short answer type questions

1) Into how many parts have animals been classified scientifically ?

Q. 6 Short Answer Type Questions

1) What is the importance of trees and plants ?

2) Explain the healing system of plants.

3) Explain the antiquity of the flora.

4) What is meant by Germination ?

Q.7 Long Answer Type Questions

1) Mention any three causes of disease in plants.

Chapter - 5

Chemistry in india

Study points

5.1 Introduction

5.2 Metals and minerals in vedic vangmay

5.3 Ore and Metallurgy

5.4 Alchemy

5.5 Matter, Types of Matter, Nature of Matter

5.6 Metallurgy

5.7 Electrical science

5.1 Introduction –

Chemistry has an ancient tradition in India. In Vedic and Sanskrit vangmay, there is a description of metals, ores, their mines, compounds and alloys, and equipment used in chemical processes is also described. Many types of pots, furnaces, bellows and crucibles are described in these. In the text named Rasaratna, there is a description of furnaces like Mahagajaput, Gajaput, Varahput for 2500 to 9000 degrees and Kukkutput, Kapotput etc. for providing the lowest temperature below 2000 degrees respectively. Bagbhatta has mentioned four furnaces named Angarkoshthi, Patalakoshthi, Garakoshthi and Mooshakkoshthi for the temperature above 9000 degree. Rishi Bhardwaj's Brihat Vimanshastra describes 532 types of bellows and 407 types of crucibles to obtain the highest temperature from furnaces for metal melting. Some of these are Panchasyak, Erti, Shundalak etc.

5.2 Metals and minerals in Vedic vangmay –

In Yajurveda, stone (ashman), soil (mritika), sand (sikta), hiranya (gold), ayas (iron or bronze), shyam (copper), loha (iron), sis (lead and trapu), ronga, wang or tin is mentioned.

अश्मा च मे मृत्तिका च मे गिरयश्च मे पर्वताश्च मे सिकताश्च मे वनस्पतयश्च मे हिरण्यञ्च मेऽयश्च मे श्यामञ्च मे लोहञ्च मे सीसञ्च मे त्रपु च मे यज्ञेन कल्पन्ताम्। (यजु. 18.13)

The Yajurveda mentions Ayastap who prepared the metal by heating iron ore with charcoal.

मन्यवे अयस्तापम्। (यजु. 30/14)

Preparation of metal by heating the ore and this indication is also in the Atharvaveda. Harit (gold), Rajat (silver), Ayas (gold) are the three words used.

नव प्राणान् नवभिः संमिमीते दीर्घायुत्वाय शतशारदाय।
हरिते त्रीणि रजते त्रीण्ययसि त्रीणि तपसाविष्ठितानि॥

(अथर्व. 5.28.1)

The mention of lead metal is found in Atharvaveda, it appears from its "Dhadhatva Sisam" Sukta. bullets made of lead were used in war.

यदि नो गांहंसि यद्यश्वं यदि पूरुषम्।
तं त्वा सीसेन विध्यामो यथा नोऽसो अवीरहा॥ (अथर्व. 1.16.4)
तस्माद्यज्ञात् सर्वहुतः संभृतं पृषदाज्यम् ।
पशून् ताँश्चक्रे वायव्या नारण्यान् ग्राम्याश्च ये ॥ (ऋग. 10.90.8)

In this Rigvedic mantra, there is mention about the nature and nature of atoms. In this mantra, the three natures of the atoms have been told in the form of Vayvayan, Aranyaan, Gramyan.

1. Vayavyan – Atoms that are continuously moving in space.
2. Aranyaan – always lonely (Atoms who stay apart) away from the cycle of creation
3. Gramyan – Atoms living in pairs or groups.

Atoms living in pairs or groups work to give shape to matter through mutual reactions.

तस्मादश्वा अजायन्त ये के चोभयादतः ।
गावो ह जज्ञिरे तस्मात् तस्माज्जाता अजावयः ॥ (ऋग. 10.90.10)

In this mantra of Rigveda, it has been told that the five elements like Aja (fire), Avi (water), Ashwa (air) etc. have originated from the combination of atoms.

5.3 Ore and Metallurgy –

The form in which metals are extracted from the earth is called ore. In Rigveda, the method of extraction of Ayas (Iron) metal has been explained. Those minerals or compounds from which metals can be obtained are called ores . The method of extraction of metals from these ores is called metallurgy. The names of ores of various metals have been found in our ancient texts. Like – Herbal (AS_2O_3) Arsenic Oxide and Shikhigriv ($CuSo_4$) or Copper Sulphate or Blue Thotha. Which are the ores of arsenic and copper respectively.

The ore of copper is $CuSo_4$ tutiya or copper sulphate inorganic compound which is given in Rastarangini for the extraction of pure copper from Nila Thotha. By adding iron powder to the water after dissolving the blue thread, pure copper gets collected at the bottom of the vessel, which can be easily separated.

Chemical equation

$$CuSo_4 + Fe \text{ --------> } FeSo_4 + Cu$$

Copper sulphate Iron Ferrous sulphate Copper

In a treatise called Rasayana Saar, Shikhigriva leaves the solution in an iron vessel, in this way the mass of copper powder obtained is 20 percent of the total mass of copper sulphate taken.

5.4 Alchemy –

A list of 127 texts of ancient chemistry has been given in the Marathi book named 'Rasmanjari' composed by T.G.Kale, some of them are as follows –

1. Nagarjuna - Rasaratnakar

2. Vagbhatta – Ashtanghridaya, Rasaratnasamuchaya
3. Govindacharya - Rasahridayatantra, Rasarnava
4. Somdev – Rasarnavalkalp, Rasendrachunamani

दरदः पारदःसस्यो वैक्रान्तं क्रान्तमभ्रकम् ।
माक्षिकं विमलं चेति स्युरेतेऽष्टौ महारसाः ॥

(धन्वन्तरीयनिघण्टु. पृ. 288)

Eight Maharasas have been described in the book Rasarnava, which are as follows – Makshik, Vimal, Shilajit, Chapal (Mercury), Rasak, Samyak (Tutiya), Dard and Stromandjan.

Mercury metamorphism

Nagarjuna has given methods to purify mercury and medicinal use of mercury. In his texts, Nagarjuna has explained the method of preparing mixtures of various metals, purification of mercury and other metals, purification of Maharasas and conversion of various metals into gold or silver.

Parad (Mercury) ash preparation method –

Bhasma is formed when the harmful properties of metals are removed by chemical action and converted into ash.

The method of preparing parad-bhasma has been explained in Yogchintamani.

Mercury Freezing

जम्बीरजेन नवसारघनाम्लवर्गः ।
क्षाराणि पञ्चलवणानि कटुत्रयं च ॥

(रस.अ.3.1 वै.वि.पृष्ठ 163)

Mixing mercury with lemon juice, Nausadaar (Navsar), acid, alkali, five salts, Trikatuk (dry ginger, chili, peepal), Shigru juice and Surbhi Suran tuber, it freezes with all the eight metals.

In Rasa Ratna set, the following chemicals which are considered as main Rasa have been mentioned –

(1) **Maharas** – It has 8 substances Abhrak (Pyrite), Vakrant, Bhashik, Vimala (Iron Pyrite), Shilajit, Sasyak (Copper Sulphate), Chapla (Bismuth), Rasak (Calamine or Zinc)

Figure 5.1 – Rasshala

(2) **Uparas** – Gandhak, Garik, Kasis (Green Thotha), Manahshila, Anjan, Kankushtha, Alum (Kankshi), Hartal

(3) **Ordinary rasa** – Coal, Gauripashan (Arsenic), Navsar, Varatak, Agnijar, Lajvart, Giri Sindoor, Hingule (Cinnabar), Muddi Shrangkam

(4) **Metals** – Gold, Silver, Copper, Iron, Nag (Lead), Vang (Tin), Yashad (Zinc)

Various types of poisons, acids and alkalis have been described and the incineration of metals has been described.

The description of the laboratory or Rasshala has been given in Chapter 7 of the Rasa Ratna Samuchaya . More than 32 instruments were used in this . Some of the main ones are -

1. **Koshthi Yantra** –

Sixteen fingers wide and one cubit long and a mouse of equal size is made, it is called Koshthiyantra. This instrument is useful in extracting the essence (essence) of metals and gems.

Figure 5.2 – Cell apparatus

षोडशाङ्गुलविस्तीर्णं हस्तमात्राऽऽयतं समम्।
धातुसत्त्वनिपातार्थं कोष्ठोयन्त्रमिति स्मृतम्॥ (रस रत्न समुच्चय 9.43)

2) Dhupyantra –

Figure 5.3 – Incense

Take an iron vessel eight fingers wide and eight fingers high. A base is made under its middle in a space two fingers wide and on this base a thin and slanting iron rod (shalaka) is placed obliquely. On top of these rods gold letters with small holes are placed. Sulfur, arsenic etc. are put in the iron pot beforehand . Let's cover this iron pot with each other. The pot is placed on the stove and the fire is lit from below. Affected by the smoke of Kajjali, the gold letters turn black, mercury mixed with such dead gold letters can quickly devour them. The eaten letters become quick in the mercury.

3) Damruyantra –

The shape of this instrument is similar to a damru. This equipment is useful in preparing bhasma of parad.

5.5 Matter, types of matter, nature of matter –

According to modern chemistry, matter is the substance from which physical objects are made. It is divided into element, compound, mixture. According to philosopher Sridharacharya in Sanskrit vangmay, matter is the basis of all physical objects, that is, all objects are either made of matter or are matter themselves.

According to Maharishi Kanad, the coordination of action and quality is matter. The same idea is given in the famous texts of Ayurveda, Charaksamhita and Sushrutasamhita. Matter is divided into two parts in Vaiseshik Darshana –

1) Anitya 2) Nitya

On dividing these four material components, earth, water, fire and air, they turn into eternal components. eg. When coal is broken, its original carbon atom cannot be separated by any method. Hence the atom cannot be separated.

According to Vaisheshika Darshan, in order to know each object, its quality and action, it is necessary to accept conscious authority i.e. soul and an intermediary instrument or mind and five externalities i.e. sense organs.

According to modern chemistry –

Element – Whose molecules are made of the same type of atoms.

Compound – Whose molecules are made up of definite proportions of different types of atoms.

Mixture – Which is formed by mixing two or more substances in any proportion.

Principle of Maharishi Kanad –

The basic element of earth, water, fire and air is atom. An atom is the smallest element, which cannot be divided further. Subtle particles are visible in the sunlight coming from the window, one-sixth of them are atoms.

जलान्तरस्थसूर्यांशौ यत्सूक्ष्मं दृश्यते रजः।
भागस्तस्य च षष्ठो यः परमाणु स उच्यते॥

(तर्कामृत)

Maharishi Kanad's principle in Dalton's atomic theory is a part of eternality, indivisibility, supersensibility of the atom.

The power of attraction of atoms – It is mentioned in this mantra of Rigveda that every atom always attracts other atoms.

एको अन्यच्चकृषे विश्वमानुषक् । (ऋग. 1.52.14)

That is, each atom, anyat vishwam, attracts all other atoms, anushak-continuing, chakrishé- towards itself.

5.6 Metallurgy –

1) Soldering of metals – The method of joining or soldering of metals has been given in GopathBrahman, Jainiya Upanishad, Brahman and Chhandogya Upanishad. According to the Gopathbrahmanam, salt (alkali) can be used to connect gold with gold, silver with silver, iron with iron.

लवणेन सुवर्णं सन्दध्यात्,सुवर्णेनरजतं, रजतेनलोहंलोहेन, सीसं सीसेन त्रपु।

(गोपथ पू. 1.14 जै. उ. ब्रा. 3.17.3)

According to the Chhandogya Upanishad, salt (alkali) changes from gold to gold, gold to silver, silver to trapu (ranga, tin), tin (ranga) to lead, lead to iron, iron to wood, wood to leather. can be added.

Alkali makes the substance soft, so metals are joined to each other by it.

लवणेन सुवर्णं संदध्यात्, सुवर्णेन रजतं, रजतेन त्रपु, त्रपुणा सीसं, सीसेन लोहं, लोहेन दारु, दारुणा चर्म।

(छान्दोग्य उप. 4.17.7)

2) Fire from bronze metal –When the Sun goes upwards, then if we keep a clean bronze metal or Suryakant gem in front of the Sun (focus), the heat emanating from it burns the dry cow dung kept nearby. If cotton is kept there, it will also burn.

अथादित्यात्, उदीचि प्रथमसमावृत्त आदित्ये कंसं वा मणिं वा,
परिमृज्य प्रतिस्वरे यत्र शुष्कगोमयम् अस्पर्शयन् धारयति तत् प्रदीप्यते ॥

(निरुक्त 7.23)

3) Purification of silver – Silver is purified by melting with lead and melting with ashes.

नागेन क्षारराजेन द्रावितं शुद्धिमिच्छति।
तारं त्रिवारनिक्षिप्तं पिशार्चीतैलमध्यमम् ॥

(रत्नाकर अ. 1.13)

4) **Metal Corrosion** – In Yagyavalkya Smriti, description has been given to purify the corroded metals with the help of acid or alkali.

It was also told in Rasarnav that the nature of spontaneous corrosion in Vanga, Lead, Iron, Copper, Silver and Gold decreases in the same order which is compatible with modern chemistry.

सुवर्णं रजतं ताम्रं तीक्ष्णवङ्गभुजङ्गमाः।
लोहकं षड्विधं तच्च यथापूर्वं तदक्षयम् ॥

(रसावर्ण 7.89-90)

Varahamihira's Brihat Samhita describes the use of Vajra Lepa and Vajra Sanghat to protect objects from corrosion. The methods of making Vajra Lepa from botanical and Vajra Sanghatta from organic components are described.

5) **Manufacturing of explosives from metal** –In Shukraneeti, coal, sulphur, saltpeter, red arsenic, yellow arsenic, oxidized lead, vermilion, steel sawdust, camphor, lakh, turpentine and gum in various types by heating the mixture in different proportions. The manufacture of explosives has been told.

6) **Alloy** – Two or more metals are mixed to form an alloy.

Brass alloy has been obtained from almost all the excavated sites and it is also mentioned in the Vedas. Zinc metal is combines with copper metal to form an alloy called brass.

Brass – Copper + Zinc

क्रमेण कृत्वाम्बुधरेण रञ्जितः ।
करोति शुल्वं त्रिपुटेन काञ्चनम् ॥

(रसरत्नाकर 3)

Brass alloy has been obtained when zinc and sulva (copper) (1:3) are mixed and heated.

In Kautilya's Arthashastra, four types of coin metals are described - mashkam, ardhmashkam, kakani and ardhakakni. All these were made

of silver, copper, iron, bronze and lead or antimony in various proportions. Similarly, many colored alloys of silver and mercury were also made. According to the Charaka Samhita, Pachaloha was used in the making of idols, in which there was a mixture of copper, iron, lead, iron and silver. According to the Rasaratna Samuchaya, brass was used instead of silver in the making of idols.

Copper and tin (wang) were mixed in various proportions for making bells in temples. At present, copper (80 percent) and tin (20 percent) are mixed for the manufacture of bell metal. Some other metals can be added in small amounts.

Bronze – Copper + Tin

It is mentioned in the Sanskrit vangmay that the chemicals and reagents required for the execution of chemical processes were obtained from botanical and biological sources. The sources of catalysts, acids and bases were also organic. Organic chemicals were used to destroy insects in agricultural work, which was less polluting than modern chemicals.

7) **Purification of metals –**

क्रमेण कृत्वाम्बुधरे पारिञ्जित: करोति शुल्बं त्रिपुटेन काचञ्नम् ।
सुवर्णं रजतं ताम्रं तीक्ष्णं वङ्गभुजङ्गमा: । लोहकं षड्विधं तच्च यथापूर्वं तदक्षयम् ॥

(रस रत्नाकर 3.7.89.10)

The order of metals in terms of stability is as follows –

Gold, silver, copper, iron, tin, lead, among them gold is the most renewable and iron, tin, lead get rusted quickly.

8) **Amalraj –**

कासीसं सैन्धवं माक्षी सौवीरं व्योषगन्धकम्,
सौवर्चलं व्योषका च मालती-रससम्भवः ।
शिग्रुमूलरसैः सिक्तो विडोऽयं सर्वजारणः ।

(रसावर्ण 1.2.3)

Kasis, Saindhav, Makshik, Sauveer, Vyosh (three spices – dry ginger, black pepper and chili), Sulfur, Sauvarchal (Shora), Malti juice moistened with Shigru juice, the 'vid' that is made can burn metals. . In this combination, sulfuric acid is formed by heating Cassis, which reacts with saltpeter to form nitric acid and reacts with Sindhav to give hydrochloric acid. The mixture of these two is called Amlaraj, in which gold and platinum metals can also dissolve.

5.7 Electrical Science –

Electric cell - Sage Agastya has explained about electric cell (battery) and electricity generation in 'Agastya Samhita'.

संस्थाप्य मृण्मये पात्रे ताम्रपत्रं सुसंस्कृतम् ।
छादयेच्छिखिग्रीवेन चार्दाभिः काष्ठपांसुभिः ॥
दस्तालोष्टो निधात्वयः पारदाच्छादितस्ततः ।
संयोगाज्जायते तेजो मित्रावरुणसंज्ञितम् ॥

- अगस्त्य संहिता

According to Agastya Samhita, copper plate and shikhigriva (copper sulphate) solution is put in an earthen vessel, wood sawdust is placed in between the two plates and mercury and zinc are placed on top of it, then electric current is generated in it by connecting with two wires. PP Hole Prof. of Electronics Department, Engineering College, Nagpur, constructed a cell on the basis of the above mantras of Agastya Samhita, which when measured by digital multimeter, the power of 1.38 volt and short circuit current was found to be 23 milli ampere. This battery (cell) based on the mantras of Agastya Samhita was also placed in the fourth annual meeting of the swadeshi vijyana samshodhan sanstha, Nagpur in 1990 . On the basis of this scientific experiment, we can say that sage Agastya has been the originator of the electric cell.

Electrolysis method –

Sage Agastya has explained the method of electrolysis in 'Agastya Samhita' –

अनेन जलभङ्गोस्ति प्राणो दानेषु वायुषु ।
एवं शतानां कुम्भानां संयोगाः कार्यकृत् स्मृतः ॥

-अगस्त्य संहिता

According to Agastya Samhita, if the power of 100 kumbhas (batteries) is used in water, then water will change into Prana Vayu (oxygen) and Udan Vayu (hydrogen) leaving its original form.

वायुबन्धकवस्त्रेण निबद्धो यानमस्तके ।
उदानः स्वलघुत्वे विभर्त्याकाशयानकम् ॥ -अगस्त्य संहिता शिल्पशास्त्रसार

The method of preserving the generated air (hydrogen) after the electrolysis method has been mentioned.

If the flying air (hydrogen) produced in the electrolysis method is stopped in air-restrictive fabrics, it can be used as fuel for aircraft.

Electroplating

The method of coating metals with other metals is called electroplating. Sage Agastya has explained in detail the method of electroplating in 'Agastya Samhita', the method of plating metals like copper, gold, silver with other metals by using electric battery (cell).

यवक्षारमयोधानौ सुशक्तजलसन्निधौ, आच्छादयति तत् ताम्रं स्वर्णेन रजतेन वा ।
सुवर्णलिप्तं तत् ताम्रं शातकुम्भमिति स्मृतम् ॥

- अगस्त्य संहिता

According to the Agastya Samhita, after keeping a copper rod mixed with dry water (acid) and Yavakshara (nitrate of gold or silver) in an iron vessel, a layer of gold or silver gets deposited on the copper. Copper coated with gold is called Shatkumbh.

कृत्रिमः स्वर्णरजतलेपः सत्कृतिरुच्यते । **- शुक्रनीति**

This process of electroplating has been called 'Satkriti' in Shukraniti.

Practice questions

Q. 1 Select the correct option –

1) The molecules of which substance are made up of only one type of atom –

a) Compound b) Mixture

c) Elements d) None of these

2) Which of the following is not a metal –

a) Gold b) Silver

c) Copper d) Bromine

3) The most renewable metal from the point of view of metal corrosion is –

a) Lead b) Iron

c) Gold d) Silver

Q. 2 Fill in the blanks.

1) In Vaiseshik philosophy, matter is divided into …….

2) In Rigveda, the method of extraction of …….. metal has been told.

3) Brass alloy is formed by a combination of copper and …….. metal.

Q. 3 Mark True (√) or False (X) against the following statements.

1) Atoms can be split.

2) Bronze is an alloy.

3) Lead metal is mentioned in Atharvaveda.

Q. 4 Match the correct pair.

	Column 'A'	Column 'B'
1)	Alloy	- Gold
2)	Metal	- Brass
3)	Damruyantra	- in extracting the essence of metals
4)	Koshthiyantra	- in making ashes of mercury

Q. 5 Very long answer type questions

1) What is the form in which metals are extracted from the earth called?
2) What is the other name of Shikhigriva ?
3) Bullets made of which metal is mentioned In the Atharvaveda?

Q. 6 Long answer type questions

1) Explain the Dhoopyantra Rasshala equipment with a labeled diagram.
2) Write the principle of Maharishi Kanad.
3) What is called alloy ? Write the Names two alloys.
4) Explain the process of producing fire from bronze metal.
5) What is bell metal?

Q.7 Long Answer Type Questions

1) What is meant by metal corrosion? State the measures to prevent metal corrosion.

Chapter - 6

Science of Marine and Boat Building

Study points

6.1 Introduction

6.2 Description of Boats in Vedic and Sanskrit vangmay

6.3 Boat building in the ancient text Yuktikalpataru

6.1 Introduction –

The art of building ships and boats in India is very ancient. Description of sea voyage is found in Vedic and Sanskrit vangmay. Maharishi Agastya has been described in Sanskrit vangmay as a traveler to the sea islands – Dweepantaras. The motto of the Indian Navy is "Shanno Varuna" which means May the God of Water bless us.

6.2 Description of boats in Vedic and Sanskrit vangmay –

The Rigveda mentions ships with a hundred or more rudders (aritras).

अनारम्भणे तदवीरयेथामनास्थाने अग्रभणे समुद्रे।
यदश्विना ऊहथुर्भुज्युमस्तं शतारित्रां नावमातस्थिवांसम्॥

(ऋग्वेद 1.116.5)

In this mantra of Rigveda, the ship (Yan) running inside the sea has been described, it gives information about the submarine. Pushadeva's boats used to run inside the sea and in space.

तिस्रः क्षपस्त्रिरहातिव्रजद्भि र्नासत्या भुज्युमूहथुः पतद्भैः ।
समुद्रस्य धन्वन्नार्द्रस्य पारे त्रिभी रथैः शतपद्भिः षळश्वैः ॥

(ऋग्वेद 1.116.4)

In this Rigvedic mantra, a boat that sails continuously for three days and three nights has been mentioned and a machine with hundred wheels for cutting water has also been mentioned in this boat.

अनु स्वधामक्षरन्नापो अस्या ऽवर्धत मध्य आ नाव्यानाम् ।
सध्रीचीनेन मनसा तमिन्द्र ओजिष्ठेन हन्मनाहन्नभि द्यून् ॥

(ऋग्वेद 1.33.11)

In this mantra of Rigveda, the word Navya has been used for the rivers that can be crossed by boat.

यास्ते पूषन्नवो अन्तः समुद्रे हिरण्ययीरन्तरिक्षे चरन्ति।

(ऋग्वेद 6.58.3)

It is described in Rigveda that King Varun knew the boats or ships running in the sea.

वेगसाम्याद् विमानौऽण्डजानामिति। (यन्त्रसर्वस्व 1.1.1)

The speed and velocity of the aircraft is mentioned to be similar to the speed of birds.

पृथिव्यप्स्वन्तरिक्षेषु खगवद् वेगतस्स्वयम्।
यस्समर्थो भवेद्गन्तुं स विमान इति स्मृतः॥

(यन्त्रसर्वस्व, 1.1.1 पर बोधायन, वृत्ति)

Explaining 'Yantra Sarvasva', Baudhayana has written that 'Vimana' is a vehicle, which is capable of traveling in sky and water with the speed of birds.

स्थानात्स्थानान्तरं गन्तुं यस्समर्थः खमण्डले।
स विमान इति प्रोक्तो यानशास्त्र विशारदैः॥

(दृष्टक, वैमानिकी प्रकरण)

Acharya Sankha has mentioned the Vimana as Akashachari i.e. a vehicle that moves in the sky.

राजलोह आदेतेषामाकर: रचना।

(दृष्टक, वैमानिकी प्रकरण 3.1.5)

In the aeronautical episode, there is a mention of the rajloha alloy used in the construction of aircraft. In the aeronautical episode, the method of making rajloh alloy has been described, according to which, by taking Som, Soudal and Mardaki metals in the ratio of 3, 8 and 2

respectively, the method of preparing rajloh alloy by melting the metals at 272° C temperature has been mentioned.

ऊष्मपास्त्रित्रलोहमयाः मेलनात्।

(वैमानिकी प्रकरण 1.10.1.23)

विमानार्हाणि लोहानि भारहीनानि षोडश।

(वैमानिकी प्रकरण 1.8.1)

There is mention of preparing 16 types of alloys by melting Som, Soudal and Mardaki metals . Which are mentioned to be used in making the structure of the aircraft. Among these metals, there is mention of maximum heat-absorption and weightlessness.

वेद नावः समुद्रियः। (ऋग्वेद 1.25.7)

Yajurveda and Atharvaveda also mention that there were huge sea ships and they had more than a hundred rudders (aritra).

सुनावमारुहेयमस्रवन्तीमनागसम् । शतारित्रा ꣳ स्वस्तये॥

(यजु. 21.7)

सूर्य नावमारुक्षः शतारित्रां स्वस्तये।

(अथर्व. 17.1.26)

In the Ayodhya Kand of Valmiki Ramayana also mentions such big boats in which hundreds of warriors used to ride.

नावां शतानां पञ्चानां कैवर्त्तानां शतं शतम् ।
सन्नद्धानां तथा यूनान्तिष्ठन्त्वित्यभ्यचोदयत्॥

(रामायण)

In the Mahabharata, a description of a machine-driven boat is found.

सर्ववातसहां नावं यन्त्रयुक्तां पताकिनीम्।

(महाभारत)

That is, a boat with a machine-mast which can withstand all kinds of winds.

The Kautilya Arthashastra deals with the management of boats and the 5th century Varahamihira's Brihat Samhita deals with shipbuilding.

6.3 Boat building in the ancient text Yuktikalpataru –

The 11th century king Raja Bhoja's work Yuktikalpataru throws light on shipbuilding.

अथ निष्पद्यानोद्धेशः

Vehicle without wheels.

नौकाद्यं निष्पदं यानं तस्य लक्षणामुच्यते।

(युक्ति. कल्प. नौयानयुक्ति 76)

अश्वादिकन्तु यद्यानं स्थले सर्वं प्रतिष्ठितम् ।
जले नौकैव यानं स्यादतस्तां यत्नतो वहेत् ॥

(युक्ति. कल्प. नौयानयुक्ति80)

A vehicle without wheels means a boat. He is established in water like a horse.

1) Shipbuilding time –

अथ कालः।
सुवारवेला तिथिचन्द्रयोगे,
चरे विलग्ने मकरादिषड्के।
ऋक्षेऽन्त्यसप्तण्यतिरेकतोऽन्ये
वदन्ति नौकाघटना दिकर्म॥

(युक्ति. कल्प. नौयानयुक्ति 81)

Auspicious date for shipbuilding, let's see the combination of Moon. When there is a movable lagna, Mars is sixth from Capricorn and other zodiac signs.

When the Moon is in the eastern horizon and its rays have not yet reached the zenith, when the Sun joins Dhanishtha in its displaced position. This combination of star, moon and date is auspicious for traveling.

2) Timber for ship building –

वृक्षायुर्वेदगदिता वृक्षजातिश्चतुर्विधा।
समासेनैव गदितं तेषां काष्ठं चतुर्विधम्॥

(युक्ति. कल्प.नौयानयुक्ति 83)

Vrikshayurveda, plant science, 4 types of wood have been described.

तद्यथा।
लघु यत् कोमलं काष्ठं सुघटं ब्रह्मजाति तत्।
दृढाङ्गं लघु यत् काष्ठमघटं क्षत्रजाति तत्॥

(युक्ति. कल्प. नौयानयुक्ति 84)

कोमलं गुरु यत् काष्ठं वैश्यजाति तदुच्यते।
दृढाङ्गं गुरु यत् काष्ठं शूद्रजाति तदुच्यते॥
लक्षणद्वययोगेन द्विजातिः काष्ठसंग्रहः॥

(युक्ति. कल्प. नौयानयुक्ति 85)

क्षत्रियकाष्ठैर्घटिता भोजमतेसुखसम्पदि नौका।
अन्ये लघुभिः सुदृढैर्विदधति जलदुष्पदे नौकाम्।

(युक्ति. कल्प. नौयानयुक्ति 86)

विभिन्नजातिद्वयकाष्ठजाता न श्रेयसे नापि सुखाय नौका।
नैषा चिरं तिष्ठति भुज्यते च विभिद्यते वारिणि मज्जते च।

(युक्ति. कल्प. नौयानयुक्ति 86)

The first type of wood is light, soft and easily joined. Another type of wood which is lightly hard and does not join easily.

The third type of wood is soft and heavy. The fourth type of wood is hard and heavy.

Composite wood shows 2 types of properties.

According to Raja Bhoj, a boat to cross fast flowing water should be made of light and hard wood.

According to Raja Bhoj, a boat made of light, soft and easy to join wood gives wealth and happiness, that is, it is pleasant in the journey.

A boat made of two types of wood is not beneficial. It does not last long and sinks in water.

3) Tying an iron nail in a ship –

न सिन्धुगाद्याऽर्हति लौहबन्धं, तल्लोहकान्तै र्हियते हि लौहम्।
विपद्यते तेन जलेषु नौका गुणेन बन्धं निजगाद् भोजः॥

(युक्ति. कल्प. नौयानयुक्ति 88)

Iron nails should not be tied to the ship because iron attracts magnetic waves, doing so can cause harm.

4) Classification of Boats – a) Normal b) Special

अथ लक्षणानि।
सामान्यञ्च विशेषश्च नौकाया लक्षणद्वहयम्॥ (युक्ति. कल्प. नौयानयुक्ति 89)

The boat is divided into 2 parts, general and special boats.

Fig. 6.1 – Boat

5) Other names, types and dimensions of ordinary boats -

तत्र सामान्यम्।
राजहस्तमितायामा तत्पादपरिणाहिनो।
तावदेवोन्नता नौका क्षुद्रेति गदिता बुधैः॥

(युक्ति. कल्प. नौयानयुक्ति90)

Common boat types -

The boat whose length is one rajhastha and width one quarter of the length and height is equal to the width is called small.

क्षुद्राऽथ मध्यमा भीमा चपला पटलाऽभया।

दीर्घा पत्रपुटा चैव गर्भरा मन्वरा तथा॥

(युक्ति. कल्प. नौयानयुक्ति 92)

Ten types of boats are mentioned.

Kshudra (diminutive), Madhyam, Bhima, Chapala, Patla, Abhaya, Deergha, Patraputa, Garbhara, Manthara.

The boat whose length is half of a rajhast and width is half of the length and height is one third of the length is called Madhyama.

अतः सार्द्धमितायामा तर्द्ध परिणाहिनी।
त्रिभागेणोन्निता नौका मध्यमेति प्रचक्षते॥

(युक्ति. कल्प. नौयानयुक्ति 91)

नौकादशंकमित्युक्तं राजहस्ताद्यनुक्रमत्
एकैकवृद्धैः सार्द्धैश्च विजानीयाद् द्वयं द्वयम्।

(युक्ति. कल्प. नौयानयुक्ति 93)

Measuring unit of these 10 boats is called Rajhasta. The length of these boats should be increased by half of the length in alternate order and width, height should be half of the given length.

6) Special boat –

अथ विशेषः।
दीर्घा चैवोन्नता चेति विशेषे द्विविधा भिदा॥

(युक्ति. कल्प. नौयानयुक्ति 96)

Special types of boat is made of layers of iron and copper. It is of two types - according to length and height.

In the Yuktikalpataru by Raja Bhoj, the measurements of special boats and the painting on the boats have also been told. Described about boats with room. The use of boats according to the season has also been told.

In a tall ship, the kaya or the bulkhead of the boat is narrow and long, and in an advanced ship, the kaya is high. Different types of cabins (rooms)

like kuti,kostha,shalika, shala and place etc. are divided into three classes on the basis of their position in the ship and their length etc.

1. Rajya -Kutiya used to bring treasurey and horses
2. Madhyamandir - In which there are cabins in the middle of the boat surface, such vessels were used for entertainment and luxury.
3. Agramandir – In this, cabins were made in the front of the deck, they were used for war.

In this way we see that the work of boat and ship building in ancient India was of high quality and there were many types of these ships.

Practice questions

Q. 1 Select the correct option.

1) Whom composed the text Yuktikalpataru?

A) Emperor Ashoka B) Emperor Vikramaditya

c) Raja Bhoj d) Raja Bhartrihari

2) A water vehicle without wheels is called –

a) Bus b) Train

c) Boat d) None of these

3) According to Yuktikalpataru, how many types of wood are used for ship building?

A) 4 B) 3 C) 5 D) 2

Q. 2 Fill in the blanks –

(1) According to Yuktikalpataru, the boat is of …… type.

(2) According to Yuktikalpatru, the normal boat is of ……type.

(3) In Sanskrit Vangmay, Maharishi …… has been described as a traveler of islands and islands.

Q. 3 Mark True (√) or False (X) against the following statements.

(1) The art of making ships and boats in India is very ancient.

(2) There is mention of sea vessels in Rigveda.

(3) There is a description of a mechanically propelled boat in the Mahabharata.

Q. 4 Match the correct pair.

	Column 'A'	Column 'B'
1)	Normal boat	a) 2
2)	Special boat	b) 10
3)	Shipbuilding timber	c) 4

Q. 5 Very long answer type questions

1) How many types of special boats are there ?

Q. 6 Long answer type questions

1) Mention the Samudrayan, ship building described in Rigveda.

Q. 7 Long Answer Type Questions

1) Explain in detail about the wood used for ship building as described in Yuktikalpataru.

Project work

Try to make a boat with the help of your Guruji.

Chapter - 7

Shulbasutra and Mitti

Study points

7.1 Introduction

7.2 Types of Shulbsutras

7.3 Uses of Shulbsutras

7.4 Vedi,Agnichiti,Mandap

7.5 Methods of determining Direction

7.6 Measurements used in Shulbasutra

7.7 Works given in Shulbasutras

7.8 Geometrical Concepts

7.9 Formulas for Finding Area

7.1 Introduction –

Shulb means thread, rope. With the help of rope, the rituals of setting up different types of altars, Agnichiti, mandap etc. are in the form of a formula is called Shulbasutra.

7.2 Types of Shulbasutra –

So far 8 Shulbasutras have been known. There are 7 Shulbasutras in Krishna Yajurveda . Katyayan Shulbasutra is the eighth Shulbasutra. Bodhayana, Apastambha, Satyashad, Vadhul, Manav, Maitrayani and Varahashulsutra under Shukla Yajurveda.

Among these Shulbasutra, Baudhayana Shulbasutra is the largest and oldest. Manav Shulbasutra, unlike other Shulbasutras, is mixed instead of formula. The sutras of Apastamba Shulbasutra are similar to those of Baudhayana Shulbasutra, but according to Apastamba Shulbasutra, the composition of Agnichiti, arrangement of bricks, etc., are different from the sources of Baudhayana Shulbasutra. The Manav, Maitrayani and Varaha Shulbasutras are the same. The Katyayana

Shulbasutra is the shortest and most recent in terms of time. It mainly contains information about Bhumiti.

7.3 Use of Shulbsutras

Mainly in the Shulbasutras, information has been given about vedi for yajna , measurement of agnichiti etc., many methods of configuration, composition of bricks etc. for their construction. Angul purush etc. dimensions, their interrelationship, altar(vedi), chiti, means for configuration of mandap such as rope, bamboo, shank (pegs), principles of geometry, many geometric creations, size of bricks, number, rules of construction of agnichiti, etc. information is given, there. The information related to the knowledge of Bhumiti given in Shulbasutra is explained below by example. There are three agnikund in the house of Agnihotri, Garhapatya, Ahavaniya and Dakshinagni, Garhapatya is circular, Ahvaniya is square and Dakshinagni is semi-circular. The area of all the three agnikund should be equal.

circles, squares, semicircles has been given and information about the relation between the side of the square and the radius of the circle has been given for the configuration of a square, a circle of area and a semicircle or a square of area of a circle by Shulbasutra.

In the construction of the vedi (altar), the sides on the east and west side of the altar should be parallel to each other. Therefore, the sides facing east and west should be at right angles to the axis of symmetry passing through the center of the altar. Information about right angle and Pythagoras theorem is available in Baudhayana Shulbasutra.

$$(\text{Hypotenuse})^2 = (\text{Perpendicular})^2 + (\text{Base})^2$$

the law of construction of altar, chiti, mandap for Yajna is given in Shulbasutra.

7.4 Vedi (Altar),Agnichiti and mandap -

Vedi (Altar) –

There are three main types of vedi. The Yajman's vedi is in the Pragvansh Mandap. It is also called Darshiti Vedi. Because it is used in Darshpurnamas Yajna. The Uttara Vedi is on the east side of the Yajna Kshetra and the third is Mahavedi.

Table 7.1

	Baudhayana Shulbasutra				Apastamba Shulbasutra				Manav Shulbasutra				
altar name	Prachi	East	West	Sutra	Prachi	East	West	Sutra	Prachi	East	West	Sutra	
Darsp oorna mont h's host altar	96	48	64	1.72	144	72	96	5.1-5	96	48	64	10.1.1.4	वेदिकी नापें बदल सकती है।
anima l bond altar	180	120	150	1.76	144	72	96	6.15	144	72	120	10.1.2.4	
Chari ot altar	188	86	104	1.77	188	86	104	6.7-8	188	86	104	10.1.2.1	
paren t altar taxon omy	भुजा 10 पद, 5 अं, 31 तिल 155 अं, तिल				1.82	भुजा 120 अंगुल		6.19	भुजा 120 अंगुल			10.1.2.6	कोण दिशाओं की तरफ रखते हैं।

Table – 7.1 Dimensions of altars (in fingers)

1 Angul = 1.9 cm

Agnichiti -

Different types of fire pits are made in Somayjna. Shyenchiti, Alajchiti and Kankachiti are in the shape of birds.

Triangular (prauga), Rhombus shaped, Drona shaped, Chariot wheel shaped circular, Tortoise shaped.

Table 7.2

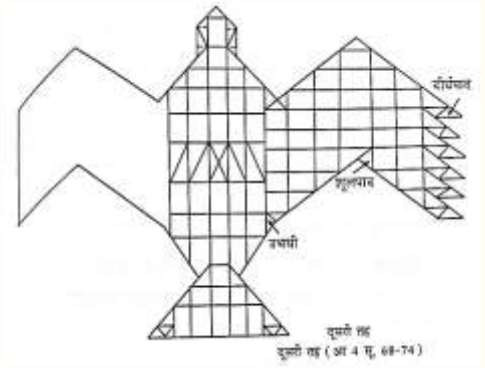
Shulbsutra	Aatma			Head			पंख			Tail		
	लम्बाई	चौड़ाई	कोण	लम्बाई	चौड़ाई	कोण	लम्बाई	चौड़ाई	बांक	पश्चिम भुजा	पूर्व भुजा	चौड़ाई
बौ.शु.सू 4.26-36	240	150	45	82 ½	60	30	210	150	90	240	60	90
बौ.शु.सू. 4.44-67	240	144	48	54	48	24	252	162	72	192	48	72
मा.शु.सू. 10.3.5.1-6	210	120	30	75	60	30	240	150	108	240	60	90
आ.शु.सू 15.1-25	240	180	60	60	60	30	187	120		180	60	120
आ.शु.सू 18.1-24	240	180	60	60	60	30	247 ½	120		240	60	90

Table – 7.2 Measurement of Chien Chiti (in Angul)

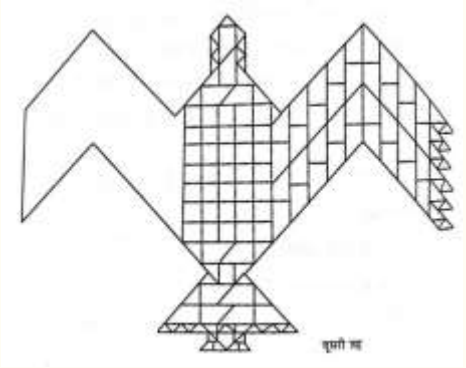
Chiti – Creation –

In the context of the study of later Vedic architecture, considering the construction of chiti (fire pit or altar) will also be very relevant. Stella Kramerish says that the oldest monuments of Indian religious architecture can be considered as Vedic altars. They represent the first Indian mass effort for religious construction. The literal meaning of Chiti (Chit + Ktin) is chosen, set, mass, mound or mound. It has also been used in the sense of Vedi (Vid + In) or Vedika (Vedi + Kan + Top), which were built for the purpose of performing religious acts. Ishtaka - The description of different categories of pits made is found in the Taittiriya Samhita. In Apastamba, Katyayana and Baudhayana Shulbasutra, the size and type of bricks have also been described, by which their construction was completed. The form of these pits was determined by the ideal of animals and birds or those sizes with which the Vedic people were familiar. The following birds, which bear resemblance in the form of animals and birds, become notable –

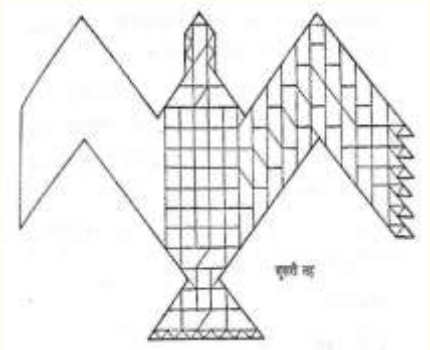
Shyen – Chiti: The shape of this chiti was similar to that of Shyen (Shy + Jhan). It was built with the desire to attain heaven (Svargakamaḥ). According to the Taittiriya Samhita, the person who creates it, takes the form of a shayen (falcon) and flies towards the svargalok(shayen eva bhutva svarga lokam patati).



Kank - Chiti: Kank (kank + ach) means stork. Therefore, the shape of the grave of this category must have been similar to the bird. According to the Taittiriya Samhita, the person who makes it attains the best place in the world (Kankchitam Chinvit Yah Kamayet).

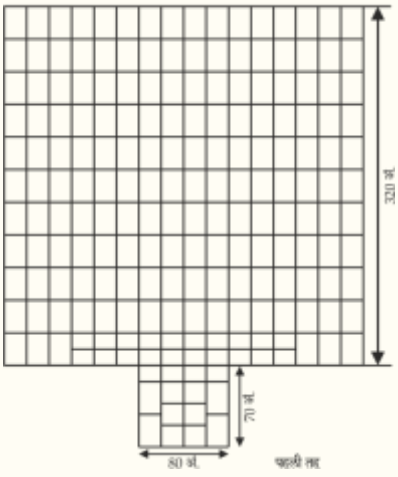


Alaj – Chiti: (Al + Jan + E) means heron bird. The form of this type of chiti must have been similar to the bird. Its creator gets ultimate power and unique fame (alaj-chitan chinvit chatuhseetam pratishthakaamh).



Drona – Chiti: (Druna + Ach) refers to Kaka. The shape of the pile of this category used to be similar to that of a crow. Its construction used to be for the attainment of abundant wealth (Dronachitam Chinvitannakamo).

द्रोण चिति

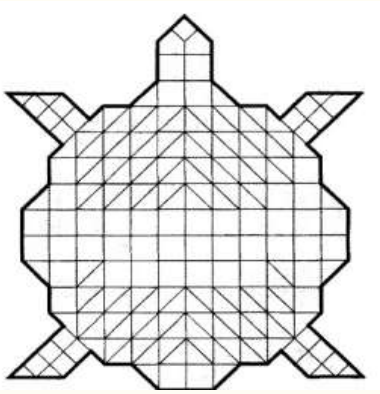


Area = 320x320 + 70x80

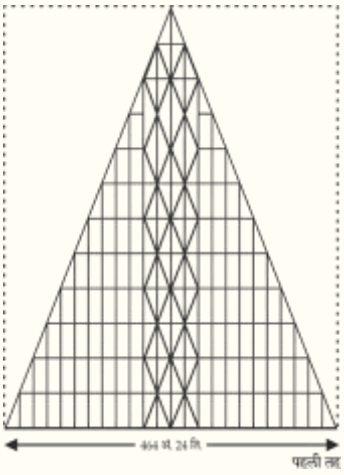
= 102400+5600

= 108000 sq.m = 7½ sq.m.

Kurma-Chiti: Its form used to be like that of a tortoise. The form of chitis sometimes corresponded to the popular symbols of the Vedic people and the habitual figures in their lives .

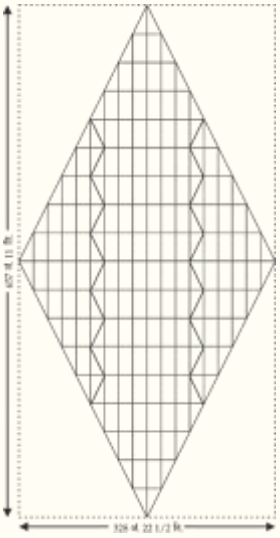


Prauga Chiti – Its shape was like an equilateral triangle. It was built with the intention of destroying the enemy (Prauganavitam Chinvit Bhatrivyavan).



Praug -Chiti -The form of this chiti used to be similar to the shape formed by joining two equilateral triangles on their base. The purpose of its construction was enemy-destruction (Ubhayat: Praugam Chinvit ya: Kamayet Prajatanbhatrivyanudeya).

Parichayya Chiti - The literal meaning of Parichayya - Chiti - Parichayya (Pari + Chi + Nyat) is 'Yagyagni ' or. It has to be established in the Kund. The meaning of such a altar comes out from this word itself, where religious acts were performed. The form of this pyre used to be equal in size to a central six circles. According to the Taittiriya Samhita, its creator desired to conquer more villages (Parichayyam chinvit gramakamo).



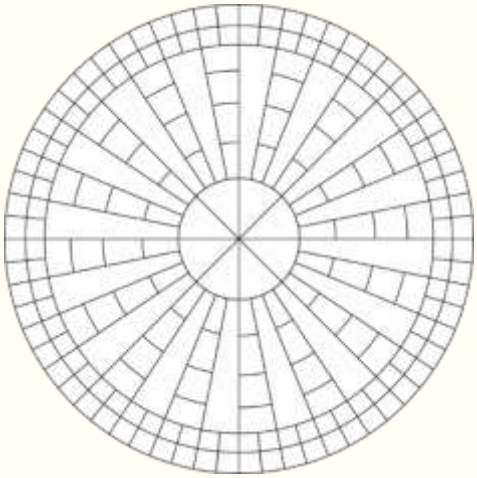
Group Chiti -The literal meaning of group - chiti - group (sam + ooh + nyat) is ' a kind of sacrificial fire ' . This word expresses the feeling of the altar built for the implementation of rituals. This altar was also circular, which was made of wet clay or bricks. The purpose of its configuration was the increase in animal numbers (**समूव्यं चिन्वीत पशुकामः**).

The place of the following cenotaphs was also important in the Rigvedic religious and cultural life .

1. **Shamshanchiti -** It is possible that its shape was also circular (round), because the shape of crematoriums used to be mostly round. Acting on this was considered to be the provider of patriarchy (crematorium chinveet yah kamayet pitrlokah).

2. **Chhandachiti -** The literal meaning of chhand is ' to please ' or ' to appease'. This Chiti was the provider of growth of cattle (छंडश्चितं चिन्वीत पशुकामः).

3. **Ratchakrachiti:** Its shape was like the wheel of a chariot. It was of two types. The spokes or arrows of the chariot were shown in the first type of figure. But there was a lack of them in the second category . According to the Taittiriya Samhita (in which the list of all these types of chitis is available) the purpose of this chiti was to destroy the enemies like a thunderbolt (Rathchakrachitam chinvit bhatrivyavan vajro vai ratho vajramev bhratrivyebhya: Praharti. The word Chaitya (Chitya + A) is related to the word Chiti . It seems from, Chaitya has been used in the sense of Stupa, monument, tombstone, Yagya-mandap, place of religious worship, altar and temple etc. Therefore, the relation of religious beliefs related to Chaitya is specified with the prevalent beliefs about Vedic Chiti. It seems quite natural to do.



Mandap -

Mandap is made of bamboo or cloth. Five mandap are required for Somayajna .

1) **Pragvansh Mandap –** This mandap is on the west side of the area. Bamboo as the support of its roof is towards east-west directions. The next head of the bamboo is kept towards the east. That's why it is called Pragvansh Mandap.

Its east-west length is 16 Prakram (480 Angul, 9.12 m.) or 12 Prakram (6.84 m.) and the north-west width is 12 or 10 Prakram (6.84 m. or 5.70 m.). According to the Manav Shulbasutra, this mandap is square and the length of its sides is 10 aartni (240 angul, 4.56 m). The eastern boundary of the Pragvansh Mandap is kept at a distance of 90 fingers (1.71 m) from the western side of the Mahavedi .

2) **Udgvansh Mandap or Sadas –**This is the main work place of Ritvijas of Yajna, their visions are here. This mandap is on the east side of the pragvansh mandap and near the west side of the Mahavedi. Its roof is kept north-south and because of the front head being on the north side, it is called Udgvansh Mandap.

Its north-west length is 27 aratni (648 angul, 12.39 m) or 18 aratni (432 angul, 8.21 m) and east-west width is 10 padas (150 angul, 2.85 m) or 10 prakram (300 angul, 5.70 m). Let's keep This measurement is according to Baudhayana Shulbasutra. According to the Apastamba Shulbasutra, the length of the Sadas is 27 or 18 Artni and the width is 9 Arli (216 Angul, 4.90 m.). The Na Apastamba given in Manav Shulbasutra is according to Shulbasutra. The western boundary of the Sadas is at a distance of 1 Prakram (30 Angul, 57 cm) from the western arm of the Mahavedi . It is kept on the east and west side doors. The pillars on the east and west sides of this mandap are small in height. It is kept so small that the roof will be at a height of 64 fingers from the ground. A rule has been given to keep the height of the roof up to the navel (64 fingers) in the Somayagya of the Yajman(host) who expects good rain.

3) **Havirdhan Mandap –** They keep Som Valli and other herbal ingredients in two carts and park them in this mandap. These vehicles are called Havirdhan.

From the eastern boundary of Sadas, the western boundary of Havirdhan Mandap is at a distance of 4 prakram (120 angul, 2.28 m.). This mandap is square in shape and the length of its sides is 10 or 12 prakarams. The Uttarvedi is at a distance of 6/2 Prakram (195 Angul, 3.70 m.) from the eastern border of the Havirdhan Mandap .

4) **Agnidhriya and Marjaliya Mandap –** On the north side of Havidhan Mandap there is Agnidhriya and Marjaliya Mandap on the south side.

There is a Dhishnya in these pavilions. The door of Agnidhri Mandap is kept towards the south and that of Marjaliya towards the north. Both the pavilions are square and their sides are 5 aratni (120 angul, 2.28 m.) According to the Manav Shulbasutra, there is no marjaliyya mandap and the length of the Agnidriya square mandap is 6 arli (144 angul, 2.73 m.). There are Chatwal and Uparv in the sacrificial area.

Chatwal :-

Dig a pit at some distance from the north altar. Soil is taken from this pit for making the north altar. It is square in shape and its length is one Shamya (32 Angul, 60.8 cm) or 36 Angul.

Uparv: - On the south side of Prachi in Havirdhan Mandap, at a distance of one step of Prachi, the pits of Uparv are dug. Uparv's pits are dug at the angles of a square of 24 fingers length and 12 fingers in diameter. They connect to the drain below the ground. This is the place where Somvalli is made into Somras. According to Manav Shulbasutra, the diameter of these pits can also be kept 9 fingers.

Table – 7.3 Mandap

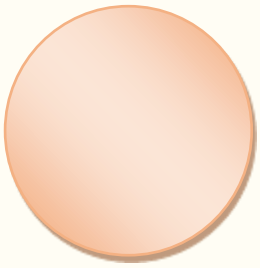
	Baudhayana Shulbasutra	Apastamba Shulbasutra	Manav Shubasutra	Havirdhan Mandap
Pragvansh Mandap	16 steps tall, 12 steps wide rectangular (1.88)		10 Artni square (10.1.3.1)	1) Havirdhan Mandap from Sadas is at a distance of 4 prakarams to the east (Bau.Shu.Su. 1.96, Ma.Shu.Su. 10.1.3.2)
Sadas Mandap	10 padas east-west, 27 aartni north-south (1.93-94) or 10 prakam x 18 aartni (1.95)	9 Artni, East-West 27 Artni, North-South (7.1.3)	9 Artni, East – West (10.1.3.2) 27 Artni, North – South (10.1.3.6)	
Havirdhan Mandap	10 or 12 step square (1.96)		12 Process quadrature (10.1.3.2)	
Aagnidhiya Mandap	5 Artni square (1.103)		6 Artni square (10.1.3.3)	
Marjaliya Pavilion	5 Artni Square (1.104-105)			.....

7.5 Shrauta-Agni

In the house of Agnihotri, three Agni are always there. These are the three Agni Kund: Garhapatya, Ahavaniya and Dakshinagni. Garhapatya is circular, Ahvaniya is square and Dakshinagni is semi-circular. The area of all the three Agni Kund should be same. The information about how to arrange circles, squares and semicircles on the ground is found in Shulbasutra, but Shulbasutra also gives information about the relation between the side of the square and the radius of the circle for the arrangement of a square, a circle and a semicircle or an

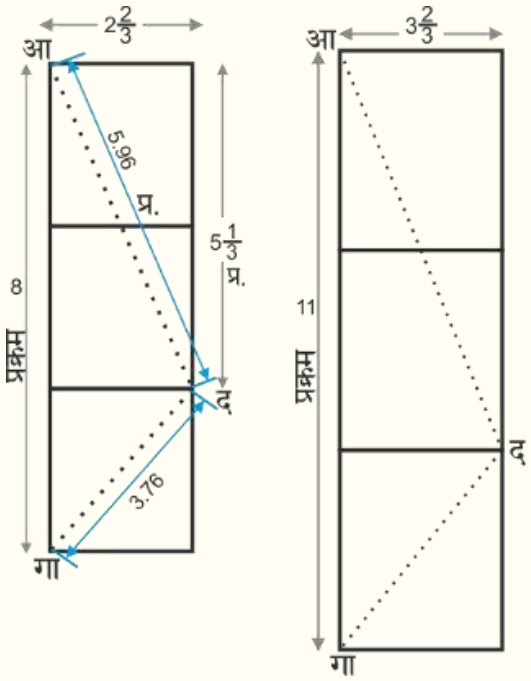
equilateral square of a circle. Are . While setting the vedi on the ground, the sides facing east and west of the altar should be parallel to each other.





Ahavaniya Agni Dakshinagni Garhapatya Agni

Distance between Garhapatya, Ahavaniya and Dakshinagni



While arranging the vedi on the ground, the sides facing east and west of the vedi should be parallel to each other. That's why the sides facing east and west should be at right angles to the axis of symmetry passing through the center of the altar. For this, knowledge of the configuration of right angles on the ground is necessary. Information about the very famous theory of Pythagoras is found in Shulbasutra. The first mention of this principle is in Baudhayana Shulbasutra, hence it should be called Baudhayana Siddhanta. On the strength of the study of Shulbasutra, in the Shrautasutra period, the introduction of the advanced state of Indian geological knowledge is obtained.

आयामतृतीयेन त्रीणि चतुरश्राणि अनूचीनानि कारयेद्। अपरस्योत्तरस्याꣳश्रोण्यां गार्हपत्यस्तस्यैव दक्षिणेꣳसेऽन्वाहार्यपचन पूर्वस्योत्तरेऽ :ꣳस आहवनीय इति ।

बौधायन शुल्बसूत्र(1.67)

Taking one-third of the long arm of the distance of the fire from the home, in such a way that it is in contact with each other, draw three such squares. On the north pelvis of the square on the west side of the arm is the place of the Garhapatya fire. Dakshinagni (Anvaharyapanchan) is on the south side of this square. And on the east side and from the east side of the square is Ahvaniya .

Description of many types of Yajnas is found in the Vedas, but only five Yajnas are considered important in them-

1. Agnihotram 2. Darshapurnamasya 3. Chaturmasya
4. Pashuyajna 5. Somayajna

1. Agnihotra Yajna

Agnihotra is a Vedic yajna. The description of this Yajna is found in Yajurveda. There is a law to get up from worship after performing Agnihotra in the morning and evening. There is a tradition of bringing samidha from the forest for the yajna and building the vedi of the yajna according to ' Shulbasutra ' (geometry) and performing Agnihotra.

2. Darshpurnamas Yajna

Darshapurnamas Yajna is a religious ritual performed in Hinduism. The Yajya performed on Amavasya and Purnima is called Darsha and Purnamas. The right of this yajna is with the wife. The ritual of this Yajna should be doning in all life. If someone is unable to do it throughout his life, then he should do it till the age of 30 .

3. Chaturmasya Yajna

Which is a type of Puranic fast, which is also known as Chaumasa, which takes place in four months . Its importance has been explained in the Katyayana Shrautasutra. It is said to start from Falgun. It can start from the full moon of Falgun, Chaitra or Vaishakh and there is a law to organize it on Ashadh Shukla Paksha Dwadashi or full moon. There are four festivals on this occasion - Vaishwadev, Varunghas, Shakmegh and

Sunashiriya. The importance of this fast has been explained in detail in Puranas.

4. Pashu yajna

The pashu yajna that is performed once every year in the rainy season or on the day of Sankranti in Dakshinayan or Uttarayan is called Nirudha pashu yajna.

5. Soma Yajna

The Yagya performed by Somlata is called Som Yajna . This happens in spring. This Yajna is completed in a single day. There are 16 Ritwija Brahmins in this yajna . The Yajna performed on Amavasya and Purnima is called Darsha and Purnamas. The wife has the right to perform this Yajna. The ritual of this Yajna should be doing in all life. If someone is unable to do it throughout his life, then he should do it till the age of 30 .

7.5 Methods of determining directions –

1) Determination of directions with the help of the Sun –

It is very important to have the knowledge of the direction before making the Yajna Mandap. In the ancient Katyayan Shulbasutra, Prachi and Udichi find out the means of action to get the right direction.

समे शकुं निखाय शङ्कुसम्मितया रज्वा मण्डलं परिलिख्य यत्र
लेखयोः शवग्रच्छाया निपतति तत्र शङ्कू निहन्ति सा प्राची ॥

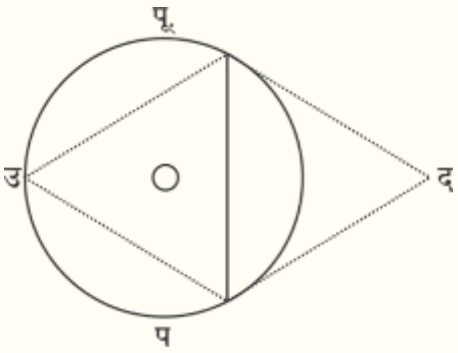
(कात्यायनशुल्बसूत्र 1.2)

Note: The place where the cone is placed should be flat to determine the directions like East etc. The cone is straight, circular and has a hole. They are 18 anguls long. The bottom six angul part is buried in the ground and the anidar tip is 12 anguls high above the ground. Take the radius of the circle as 12 anguls.

तदन्तरं रज्वाऽभ्यस्य पाशौ कृत्वा शङ्कोः पाशौ प्रतिमुच्य
दक्षिणायम्य मध्ये शङ्कुमेवमुत्तरतः सोदीची ॥

(कात्यायनशुल्बसूत्र 1.3)

After this, take a double length (24 angul) rope and tie knots on both its ends. Tie both the pegs to the ends of the rope and pull it towards the south from the middle mark. Where the middle point comes, put a peg there, this south direction, pull such a rope towards the north and fix the north direction there.



For this ritual, a cone is made of wood or ivory. The cone is buried in the ground up to half its length on a flat place. Taking a rope as long as it is above the ground of the cone and drawing a circle on the ground from the center of the cone. The tip of the cone is pointed. From sunrise to mid-day, the shadow of the cone starts decreasing gradually, where the shadow of the front part of the cone touches the circle, a peg is placed there. It is towards the west. From noon to evening, the shadow of the cone gradually increases. Where the shadow of the pointed front of the cone touches the circle, another peg is placed there, this is the east direction.

2) The method of determining directions by constellations –

Krittika, Shravan and Pushya constellations are towards the east. When the Nakshatra comes at the height of one Yuga (86 Angul, 1.63 m) from the horizon, then with the help of these, the east direction is determined. According to Manav Shulbasutra, the middle point of difference between Chitra and Swati Nakshatras shows the east direction.

7.6 Measurements used in Shulbsutra –

1 Anuk = 30 Angul, 1 Urvasthi = 20 Angul
1 Nabhi = 64 Angul, 1 Asya = 96 Angul
1 Pishil = 12 Anguls, 1 Krishnal = 3 Bhavas
1 measure = 3 krishnal, 1 nishk = 4 krishnal
1 arv = 6 angul

7.7 Works given in Shulbasutras –

Baudhayana, Manava, Apastamba and Katyayana Shulbasutras, separate geometrical works have been given for the configuration of simple lines of bhomitik kratiya.

7.8 Geometric Concept –

1) Dividing the rope –

प्रमाणमात्रं.... रज्जुमुभयतः पाशां करोति।

आपस्तम्ब शुल्वसूत्र (1.13)

When both the ends of the rope are taken at the mid point, there are four divisions of the rope.

2) Division of the circle - 6, 8, 12 with the help of the diameter of the circle is described in Shulbsutras. By drawing a small circle concentric with the circle, it can be divided into the remaining part. (Bau.Shu.Sutra 2.74-77)

3) The number of divisions of an isosceles square is equal to the number of divisions of the sides of that square. In the Baudhayana Shulbasutra (1.4 6-47), Baudhayana principle has been used to obtain the tertiyakarani and trikarani.

4) The hypotenuse of a rectangle or square divides it equally. This concept has been used to draw a rectangle of equal area of the square. (Bau.shu.su. 1.52)

5) Two hypotenuses of a square have equal area and four equal divisions and rectangles opposite two hypotenuses have equal area and equal. In Sutra 4.4 of Baudhayana Shulbasutra, the basis of this concept has been taken for making bricks of half and one fourth area of Pramana square bricks.

6) The sides of a rhombus cut at right angles. On the basis of this concept Prauga sets up the funeral pyre. (Bau.shu.su. 4.111.122)

7) The angles of a square intersect at right angles. The help of this hypothesis was taken to bring the head of the ancestral altar towards the main directions. (M.S.S. 10.1.26-7)

8) To divide a triangle into equal and congruent segments, divide its sides into equal parts and join them. In Baudhayana Shulbasutra (8.4) it has been used in making bricks for cremation pits.

9) The perpendicular line joining the vertex and the mid-point of the base of an isosceles triangle divides it into two identical and congruent segments. Ashtami brick 24 x 24 This concept has been used to make a brick having an area of 1/8 of the square finger area.

10) The line joining the vertex and the mid-point of the base of an isosceles triangle is perpendicular to the base.

11) The area of the triangle formed by joining the midpoint of the side of a square and the angle of the opposite side is half the area of the square.

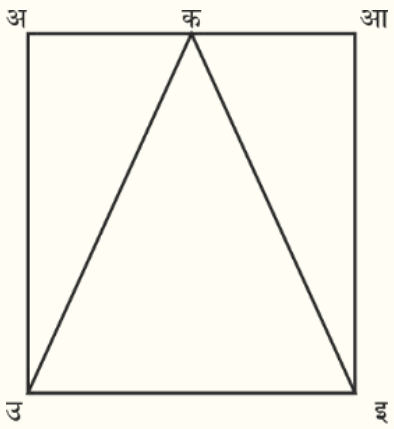
चतुरस्त्रं प्रउगं चिकीर्षन्यावच्चिकीर्षेद् द्विस्तावतीं भूमिं समचतुरस्त्रां कृत्वा पूर्वस्याःकरण्या मध्ये शङ्कुं निहन्यात् तस्मिन्पाशौ प्रतिमुच्य दक्षिणोत्तरयोः दक्षिणोत्तरयोः श्रोण्योर्निपातयेत् बहिः स्पन्द्यमपच्छिन्द्यात्। बौ.शु.सूत्र (1.56)

Explanation -

If you want to triangulate a square (equal area), then set up a square of twice the area of which the triangle is to be drawn. Tie the end of the rope to the peg at the midpoint of its east arm and keep the rope to the south and north pelvis. Take out the outer part of the rope.

The area of the square A A E E is twice the area of the triangle.

12) The area of the square formed by joining the midpoints of the sides is half of the area of the first square.



चतुरस्रमुभयतः प्रउगं चिकीर्षन्यावच्चिकीर्षेद् द्विस्तावतीं भूमिं दीर्घचतुरस्रां कृत्वा पूर्वस्या करण्यामध्ये शङ्कुं निहन्यात् तस्मिन् पाशौ प्रतिमुच्य दक्षिणोत्तरयोर्निपातयेत् बहिः स्पन्द्यं अपच्छिन्द्यात् एतेनापरं प्रउगं व्याख्यातम् ॥

(बौ.शु.सू. 1.57)

If a quadrilateral is to be made of a square , then take out a rectangle of twice the area of which the quadrilateral is to be arranged and put a peg on the middle point of the former side. Tie the ends of this rope and keep it to the south and north pelvis. (Use this method in another class.) Remove the outside of the ropes. From this, the method of configuration of second type of prong (of equilateral quadrilateral) was called.

13) The area of a rhombus formed by joining the midpoints of the sides of a rectangle is half of the area of the rectangle. It has been used for the configuration of Praug Chiti.

14) If the base and altitude of an isosceles trapezium and a rectangle are the same, then they are equilateral.

अध्यर्धेष्टकां चतुर्भिः परिगृण्हीयादर्धव्यायामेन द्वाभ्यामरत्निभ्यां अरत्नि सविशेषेणेति॥

(बौ.शु.सू. 4.89)

Explanation -

Take a quadrilateral half brick. (One arm of it) Ardhavayam (48 fingers) Two arms Aartni (24 fingers) And the fourth arm Artni's special ($24 \times \sqrt{2} = 33$ Angul 32 tila) long.

15) Two identical congruent sections of a rectangle are obtained by joining points equidistant from the opposite angles of the rectangle.

16) In two right-angled triangles, if the adjacent sides of the right angles are of trapezium, then those triangles are similar and equilateral.

17) The vertices of an adjusted large square of a circle lie on the circumference of the circle.

18) The area of a circle of diameter equal to the hypotenuse of the circle circumscribing the square of the proof square is twice the area of the proof square.

Square formation method

The first proof of the practice of making squares is found in our Bodhayana Shulbasutra. In addition to the Bodhayana Shulbasutra, Apastamba, Manav and Katyayan Shulbasutra have also explained the method of making squares. Here we will construct the square using the method available in the Bodhayana Shulbasutra (1.22 - 28).

चतुरस्रंचिकीर्षन्यावच्चिकीर्षेत्तावतीꣳरज्जुमुभयतःपाशांकृत्वामध्येलक्षणंकरोतिलेखामालिख्य॥

(बोधायन शुल्बसूत्र 1.22)

If you want to draw a square, take a rope as long as its length and tie a knot at both its ends and mark the middle of it (of the length of the rope). (East - West) draw the line (on the ground).

[by drawing this line 1-1 in the figure]

तस्यामध्येशङ्कुंनिहन्यात्तस्मिन्पाशौप्रतिमुच्यलक्षणेनमण्डलंपरिलिखेत्विष्कम्भान्तयोःशङ्कूनिहन्यात्

(बोधायन शुल्बसूत्र 1.23)

Drive a peg in the center of the drawn line. To this, by tying both the ends of the rope, remove circle 1 from the mark (made in the middle of the rope). Place two pegs where the line intersects the circumference of the circle (east-west). [A is the center of the circle. The circle intersects the line 1-1 at A and E. put pegs there]

पूर्वस्मिन्पाशंप्रतिमुच्यपाशेनमण्डलंपरिलिखेत्॥

(बोधायन शुल्बसूत्र 1.24)

By tying one end of the rope to the peg in the east direction, we will make 3 circles with the other end.

[Take the peg and center and draw circle 3.]

एवमपरस्मिꣳस्तेयत्रसमेयातांतेनद्वितीयंविष्कम्भमायच्छेत्॥

(बोधायन शुल्बसूत्र 1.25)

4 is drawn towards the west. Where these two circles intersect, connect them with a line (North-South) to get the diameter of circle 1 .

[By tying one end of a rope to this peg on the west side, circle 4 is made from the other end and the line joining circles 3 and 4, where they intersect, is the north-south line]

विष्कम्भान्तयोःशङ्कूनिहन्यात्॥

(बोधायन शुल्बसूत्र 1.26)

(Given in formula 23) Where this line intersects circle 1, put two pegs.

[tick the e and u]

पूर्वस्मिन्पाशौप्रतिमुच्यलक्षणेनमण्डलंपरिलिखेत्॥

(बोधायन शुल्बसूत्र 1.27)

Draw a circle from the mark (middle of the rope) by tying both ends of the rope to the peg in the east direction.

[Take the peg A as the center and draw a circle 6.]

एवंदक्षिणतएवंपश्चादेवमुत्तरतस्तेषांयेऽन्त्याः
संसर्गास्तच्चतुरस्रꣳसंपद्यते॥

(बोधायन शुल्बसूत्र 1.28)

In the same way, taking the South, West and North pegs as centers, draw a circle from the middle mark of the rope. Where these circles intersect, a square is obtained by joining them (these points).

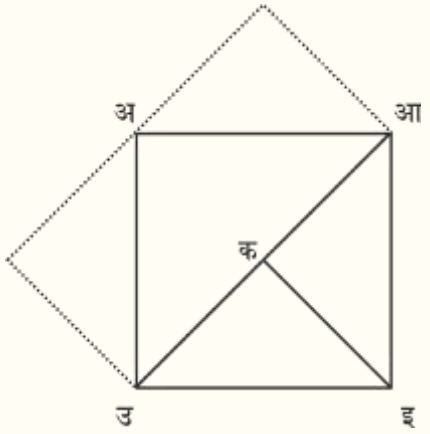
Converting one geometry structure to another while keeping the iso-area: how to make a rectangle of the iso-area of a square

समचतुरस्रंदीर्घचतुरस्रंचिकीर्षꣳस्तदक्ष्णयापच्छिद्यभागं

द्वेधाविभज्यपार्श्वयोरुपदध्यात्यथायोगम्॥ (बोधायन शुल्बसूत्र 1.52)

Keeping the area of the square the same, join the vertices to the midpoint of the diagonal of the square to form a rectangle, resulting in two triangles. Place those two (triangle) parts on either side of the square as required.

[The area of the squares A, B, E, U is to be drawn. U Aa Akshnaya (Karna) is there. Join the middle point K to E. Place the triangle E K A on the side A A of the square. Place the triangle E K U on the side A U of the square. Rectangles c, a, u, b are obtained. The rectangles C, A, U, B and the squares A, A, E, U are isosceles.]

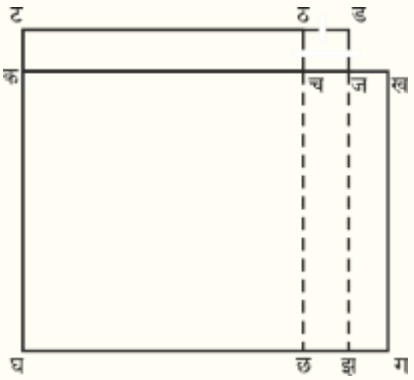


how to square the area of a rectangle

दीर्घचतुरस्रꣳसमचतुरस्रंचिकीर्षꣳस्तिर्यङ्मानींकरणींकृत्वाशेषंद्वेधाविभज्यपार्श्वयोरुपदध्यात्खंडमावापेन तत्संपूरयेत्तस्यनिर्हारउक्तः॥ (बोधायन शुल्बसूत्र 1.54)

Keeping the area of the rectangle the same (equal area), to make a square, we take the width of the measure equal to the length of the rectangle and divide the remaining part of the rectangle into two equal (even) divisions and keep the two divisions on either side of the square. are । The part that is left is completed by taking more squares. The areas of these two squares are subtracted and the area of the remaining square is equal to the area of the rectangle.

To find the square of the rectangle a, b, c, d. Let us add the rectangle K f = K d = G g = F g. h is the mid point of f b and z is the mid point of g c. Add jj. Place the rectangles h, b, c, z on the sides K (place such that J J will come on K and B C will come on T) . From which you get the classes th, d, j, f here.

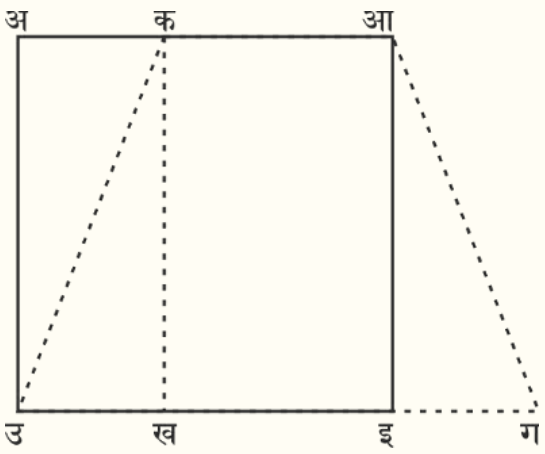


Rectangle K B C D = Sq T D J D - Sq T D J F

Method of making a trapezium of equal area of a square

चतुरस्रमेकतोऽणिमच्चिकीर्षन्नणिमतःकरणींतिर्यङ्मानींकृत्वाशेषमक्ष्णयाविभज्यविपर्यस्येतरत्रोपदध्यात् ॥ (बोधायन शुल्बसूत्र 1.55)

To make a trapezium from a square, by shortening one side of the square, put a perpendicular on the front side and put a diagonal on the front side from the top of the smaller side of the square. From which two triangular shapes are obtained . Let one part of the triangle obtained here remain in the same place, but by turning the other part upside down and placing it on the other side, a trapezium is obtained.



[Square A A E U, A K this smaller side is the side of the trapezium obtained. Perpendicular to K K on U E (A K = I B) is given. Make two divisions of the rectangle A, K, B, U K K, U Aksnaya (hypotenuse). Let the triangles a, b, u remain in their place and place the triangles a k u, a i on e such that the triangle a i c is obtained. Here you get trapezium K, A, C, U, whose area is the same as that of the squares A, A, E, U.]

The method of making a circle of the area of the square -

चतुरस्रंमण्डलंचिकीर्षन्नक्ष्णयार्धंमध्यात्प्राचीमभ्यापातयेद्यदतिशिष्यते तस्यसह तृतीयेनमण्डलंपरिलिखेत्॥ (बोधायन शुल्बसूत्र 1.58)

Keeping the same area (equal area) of the square, if a circle is to be made, then the distance of half the diagonal of the square is taken as the radius of the circle with one-third of the part (of lateral value) that remains outside when it is brought to the middle of the side of the square circle shape is obtained.

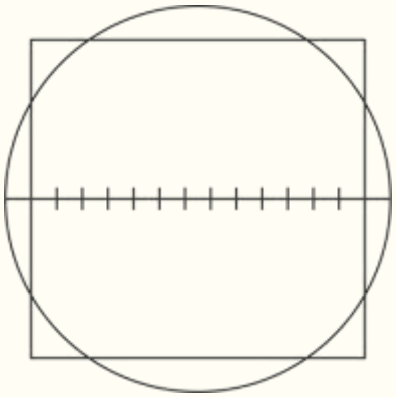
Radius of circle = distance of side from mid point of square + $\frac{1}{3}$p f

Method of squaring the area of a circle

मण्डलंचतुरस्रंचिकीर्षन्विष्कम्भमष्टौ वापञ्चदशभागान्
कृत्वाद्वावुद्धरेषानित्या चतुरस्रकरणी ॥

(बोधायन शुल्बसूत्र 1.59,60)

To make a square of the same area as the circle, divide it into 15 equal parts of the diameter of the circle and after subtracting two parts from it, the remaining length is the hypotenuse (side) of the square. From which we get the square shape very easily.



7.9 Formulas to get the area –

1) The area of a square or rectangle is obtained by multiplying the length and breadth.

मध्यात् कोटिप्रमाणेन मण्डलं परिलेखयेत्।
अतिरिक्तत्रिभागेन सर्वं तु सहमण्डलम्॥
चतुरस्रेऽक्ष्णया रज्जुर्मध्यतः संनिपतयेत्।
परिलेख्य तदर्धेनार्धमण्डलमेव तत्॥ मा.शु.सू. 10.1.1.8

2) The area of a right triangle is half the product of the base and the perpendicular side.

द्विपुरुषः करणी श्रोणी बाहुस्तु द्विगुणो भवेत् त्रिंकुष्ठवत् त्र्यवलम्बकः ततो यश्चतुरस्रे द्वाष्टमाः पुरुषाः॥ मा.शु.सू. 10.3.2.12

3) The product of a rhombus is obtained by multiplying its area and thickness.

मण्डलार्धं चतुःस्रक्ति रत्निनां विहिताः खराः।
अरत्निर्घन एतेषां भूयस्त्वे भूयसी विधौ॥

मा.शु.सू. 10.3.1.6

4) Value of Pi –

त्रिपदपरिणाहानि यूपोपराणीति।

बौधायन शुल्वसूत्र 1.113

5) Proof of √2 in ancient Indian Shulbasutra -

The theoretical and practical aspects of squares and square roots were known in ancient India at least from the time of Shulbasutra. The Shulb Sutras are said to have been composed from 800 BC to 500 BC, but they can be much older than this. In Baudhayana's Shulbasutra, a very accurate method has been given to find the square root of 2 and 3 . Aryabhata has given a method to find the square root of a multiple digit number in section 2.4 of Aryabhatiya.

Square root of 2

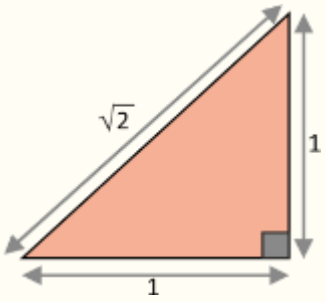
Square root of 2 (√2) is the number which when multiplied by itself gives 2 . It is an irrational number. Its value is approximately 1.41421 . If a square of side 1 meter is drawn, then the length of its diagonal (in metres) will be equal to the square root of 2 .

value of the square root of 2 up to 65 decimal places is as follows –

√ 2 = .41421356237309504880168872420969807856967187537694807317667973799…

Proof of √2 in Baudhayana Shulbasutra -

Baudhayana verse number 61-2 (which is elaborated in Apastamba 6) gives the method of finding the length of the diagonal of a square given the length of its sides. In other words, it explains the method of finding the square root of 2 .



प्रमाणं तृतीयेन वर्धयेत्तच्च चतुर्थेनात्मचतुस्त्रिंशोनेन ॥
सविशेषः ॥

(बौधायन शुल्बसूत्र 1.61-62)

To get the value of the diagonal of a square, adding one-third to the side, then adding one-fourth of it, then subtracting one-thirty fourth of it, is approximately the value of the diagonal.

ie

$$\sqrt{2} = 1 + \frac{1}{3} + \frac{1}{3.4} - \frac{1}{3.4.34} = \frac{577}{408} = 1.414216$$

This value is accurate to five decimal places.

Proof of √2 in Apastamba Shulbsutra -

समस्य द्विकरणी ।
प्रमाणं तृतीयेन वर्धयेत्तच्चतुर्थेनात्मचतुस्त्रिंशोनेन सविशेषः ।

(आपस्तंब शुल्बसूत्र 12)

Diagonal of a square (problem bisector) – Its value is obtained by adding one third of the side to the one fourth of it and subtracting the 34th part of it(the quarter of the third) from the side

In other words,

$$\sqrt{2} = 1 + \frac{1}{3} + \frac{1}{3.4} - \frac{1}{3.4.34} = \frac{577}{408} = 1.41\overline{4215686274509803 9}$$

Practice questions

Q. 1 Select the correct option –

1) Which of the following is Pythagoras theorem -

a) $(\text{Perpendicular})^2 = (\text{Hypotenuse})^2 + (\text{Base})^2$

b) $(\text{Base})^2 = (\text{Hypotenuse})^2 + (\text{Perpendicular})^2$

c) $(\text{Hypotenuse})^2 = (\text{Perpendicular})^2 + (\text{Base})^2$

d) None of these

2) The biggest Shulbsutra is –

a) Manav Shulbhasutra

b) Baudhayana Shulbhasutra

c) Apastamba Shulbsutra

d) none of these

3) The shortest Shulbsutra is –

a) Katyayana Shulbasutra

b) Baudhayana Shulbasutra

c) Manav Shulbsutra

d) Apastamba Shulbsutra

Q. 2 Fill in the blanks.

1) There are …… types of Shulbasutras.

2) 1 Angul in.....cm.

3) 1 Anuk are ……..Anguls.

Q. 3 Mark True (√) or False (X) against the following statements.

1) According to Manav Shulbsutra, the area of a square or rectangle can be obtained by multiplying the length and breadth.

2) The area of a right triangle is half the product of the base and the perpendicular side.

3) The area of the figure formed by joining the midpoints of the sides of the square is half of the area of the first square.

Q. 4 Match the correct pair.

Column 'A'		Column 'B'
1)	Agni Chiti	a) Use of bamboo or cloth
2)	Mandap	b) Similar to the shape of birds
3)	Rectangle	c) All four sides equal
4)	Square	d) Opposite sides equal

Q. 5 Very long answer type questions

1) On which principle is the Pythagorean theorem based ?
2) How many types of Vedi (altar) are there ?
3) How many types of Yajna Mandap are there ?

Q. 6 Long answer type questions

1) Write the proof of Shulbsutra to find the area of the square.
2) Write the proof of Shulbasutra to find the area of a right triangle.
3) State the geometrical concept of segmentation of a rope.
4) How can the direction be determined with the help of the Sun?

Q. 7 Long Answer Type Questions

1) Explain the method of making a square as mentioned in the Bodhayana Shulbasutra.
2) Explain with illustration the method of constructing the following figures keeping the area of the square as the same area.

   1) Rectangle 2) Trapezium
   3) Triangle 4) Equilateral quadrilateral

3) Explain with illustration the method of making a square from the equal area of a rectangle.
4) Explain with illustration the method of making a circle from the equal area of a square.

5) Explain the method of making a square out of equal area of a circle.

Project work

With the help of your Guruji, build the Yajnavedi with the help of Shulbasutras.

Chapter - 8

Yoga for Health and Happiness

Study points

8.1 Introduction

8.2 Definition

8.3 The meaning of health and Happiness

8.4 Importance of Ashtanga Yoga in terms of health and happiness

8.1 Introduction –

Since ancient times, India has been benefiting the whole world with its pure and eternal knowledge of spirituality, in which Vedas have played an important role. Vedas are the shelter of truth and eternal methods. That's why it has been said that "Vedokhilodharmamoolam" means Vedas are the root of all religion and knowledge. 'Yogvidya' is also one of these Brahmavidyas of Vedas. The aim of which is to provide complete health to the human race, refining it mentally, socially and spiritually and leading it towards the path of welfare in the form of bliss i.e. 'self-realization'. Yoga Vidya has been the root of Gurukuliya education since ancient times, taking whose shelter man has proved his life meaningful by benefiting from complete health.

8.2 Definition -

Probably, in the modern era, common people see yoga only in the form of exercises, asanas, pranayama etc., but in reality the scope and form of yoga is much wider than this. The meaning of the word 'Yoga' is to add / meet / gather or to be in harmony in any two or more aspects.

Therefore, the meaning of the above refers to - "harmony and balance between the body and the mind." Therefore, yoga is the condition by which the physical and mental side of man is united and as a result of the same unity, man attains happiness and bliss (self-realization) is realized.

8.3 Meaning of health and happiness –

Health is a very important part of human life, in the absence of which a person cannot enjoy any type of happiness and facilities happily. That's why it has been said - 'Pehla Sukh, Nirogi Kaya' Ayurveda has a very important place in achieving this health. The word 'Ayu' used in Ayurveda means life and 'Veda' means 'source of pure knowledge'. Therefore, the Veda which increases age and life, is called Ayurveda.

From the point of view of antiquity, Ayurveda has been called 'Upveda' of Rigveda, but due to the subject matter being mostly in Atharvaveda (Sushruta Sutra 1.6 and Ashtangahridayam), it is also known as 'Appendage' of Rigveda. Describing the definition of health in Sushruta Samhita of Ayurveda, it has been said that –

समदोषः समाग्निश्च समधातुमलःक्रियाः।
प्रसन्नात्मेन्द्रियमनाः स्वस्थ इत्यभिधीयते॥

सुश्रुत संहिता 15.4.1

The person in whose body the state of tridoshas (Vata, Kapha, Pitta) is balanced, Dehagni and Jathragni are equal, all the metals (rasa, blood, flesh, blood, bone, marrow, shukra) are in proper condition, feces (swede, hair, lom etc) should be proper and all bodily functions should be smooth. Along with this, such a person is said to be healthy if the mind, senses and soul are in a happy, diseaseless and blissful state.

On the basis of the above definition, it is clear that only being physically disease free does not mean complete health, but it is possible to attain complete health only when the happy state of the mind, soul and senses is included.

Indicating this fact, the World Health Organization has also defined health as:

"Health refers not only to the absence of diseases in the body, but also to physical, mental, social and spiritual happiness, freedom and calmness." - World Health Organization (1948)

It is interesting to know here that in the definitions given by Ayurveda and World Health Organisation, happiness and joy have been given equal importance along with health. But what is the meaning of this happiness and joy.

Happiness is the expression of positive emotions that are aroused in our mind and body during a favorite event or events. On the other hand, happiness is such a state, by taking shelter of which man always becomes positive, spontaneous and full of enthusiasm. He doesn't need any context or situation to be happy. Every day, every moment appears to him as a festival. Probably this is the meaning of 'happiness' in the context of health in the above definitions.

While wishing for health and happiness, it has been said in the Vedas that-

आयुर्यज्ञेनकल्पतां प्राणोयज्ञेनकल्पतांचक्षुर्यज्ञेनकल्पतां:श्रोत्रंयज्ञेनकल्पताम् पृष्ठं यज्ञेन कल्पतां यज्ञो यज्ञेन कल्पताम् । (यजुर्वेद.9.21)

In the said mantra, it has been said that man should remain engaged in public welfare (Yajna) while maintaining health and longevity and wished that his five vital organs, eyes and hearing (ears) etc. remain strong and healthy for aeons.

जीवेमशरदःशतम् (अथर्ववेद 19.67.2)

May we live for hundred Sharads (years) etc. Mantras are examples of the wish and concept of complete health, longevity in the Vedas. Yogic practices have a very important role in proving these concepts of health.

8.4 Importance of Ashtanga Yoga in terms of health and happiness –

In the modern era, human society is suffering from fatal mental and physical diseases, despite being enriched with immense material wealth and comforts . In such a situation, man is in great need of a practical

(experimental) as well as a means of 'Yoga' having spiritual harmony. Yoga therapy in itself is a standard medical method based on scientific facts. For thousands of years, along with the spiritual world, Yoga has been existing in the scientific perspective as well, which has been completely proved on the basis of many scientific investigations. The Ashtanga Yoga described in Yogdarshan can also be called a systematic subject based on the scientific aspect and a means of attaining complete health. Yama and Niyama - for proper social behavior, self-restraint and discipline, Asana and Pranayama - for physical and mental health, Pratyahara and Dharana - for increasing concentration, willpower or help in achieving the goal, Meditation and Samadhi - for attaining complete knowledge play a very important role.

word healthy(swastha) is made up of two words, 'Swa' and 'Stha'. Swa means 'self' and 'stha' can be derived from 'situated'. Therefore, to be 'situated' in oneself is the meaning of the word healthy.

Describing the fruit of Yoga Siddhi in Yogasutra, Maharishi Patjali has said that –

तदा द्रष्टुः स्वरूपेऽवस्थानाम्॥ योगसूत्र 1.3

After the attainment of Yoga, the soul becomes established in itself.

On the other hand, Yog Shastra (Hatha Yoga Pradipika) related to subjects like Asana, Pranayama, Meditation, Mudra, etc., states that as a result of Yogic actions being proven, that-

वपुःकृशत्वंवदनेप्रसन्नतानादस्फुटत्वंनयनेसुनिर्मले।
अरोगताबिन्दुजयोऽग्निदीपनंनाडीविशुद्धिर्हठसिद्धिलक्षणम्॥

हठयोगप्रदीपिका 2.78

Lightness in the body, a sense of happiness on the face, harmony in the voice, purity in the eyes (brightness), healthiness, control over bindu (discharge from the ajna chakra), illumination of the gastric fire and purity of the nerves (purity), all these There are signs of stubbornness.

The principles of Yama and Niyama are based on scientific facts. On following any part, the energy of man remains relative to the energy of nature and on working against them, it goes against the energy of nature as well. This opposite work is the reason for the origin of diseases within the person, and the work that is in harmony with nature is the means of achieving complete health and wellness. Compliance with Yama and Niyama is considered essential because they directly affect the chemical and biological processes occurring at the micro-atomic level in the body. Yama and Niyama are the principles of health based on Dharma Vigyan, which are related to all aspects of human body and mind and the chemical and electro-magnetic system prevailing inside them.

Through Yama, a person becomes self-controlled and able to imbibe social values properly. Man's energy becomes full of positivity only by following the truth mentioned in Yama. Ancient sages also used to worship this part with complete sincerity. Lying disturbs the chemical balance within the person and he suffers from many diseases like constipation, heart rate disorders, forgetfulness etc. Due to violence, meat-eating, theft etc., the discharge of negative hormones starts in the body, which adversely affect the digestive system, nervous system and every molecule, cell and tissue of the body. By following celibacy, students always remain eligible for learning and are full of strength, energy and vigor. On the other hand, working against it can lead to many incurable diseases. Yama is a high level of ethics in itself.

Similarly, Niyam is also the science of proper lifestyle. Cleanliness has always been followed in our civilization. Mental purification through Shatkriya involved in defecation and reading of scriptures are appropriate examples of this. The practice of Shatkarma cleans the eyes, larynx, respiratory organs, abdomen and intestines, gives relief from obesity, abdominal and respiratory diseases, vata and phlegmatic diseases. Defecation is very important in the present context. This is a special beneficial part in many viral and bacterial diseases. Following Santosh reduces the chances of dreaded diseases like depression, cancer etc. At the same time, physical, emotional and mental health benefits through penance . Self-study and devotion to God play a very important role in self-analysis and spiritual progress. In this way, after proper observance of Yama and Niyama, man becomes eligible for the practice of Yogasanas.

By the practice of Yogic actions like asanas, proper massage of all the organs and parts of the body takes place and blood circulation increases, due to which the body becomes strong. The digestive system, the nervous system, the functioning of the nerves, the release of hormones by the endocrine glands, the brain, etc. all work in a well-organized, smooth and coordinated manner, due to which physical health benefits are achieved. Through scientific research, the practice of asanas has shown an unprecedented improvement in the quality of life. Removal of toxic substances, increase in the functioning of the metabolic system, wonderful coordination between nerves and muscles, betterment of the immune system, health benefits of the heart and all other organs, and proper implementation of physical activities, etc., are proven through Yogasanas.

Through pranayama, regulation, expansion and control of prana is achieved, due to which harmony arises between pranic and emotional emotions. The efficiency of the respiratory system and lungs increases. At

the same time harmony is established between the physical and mental side. Scientists and researchers have found that a normal person consumes about 500 ml of oxygen, but the practitioners of Pranayama such as Anulom Vilom, Bhastrika etc. were found to consume four to six liters of oxygen. The practice of Pranayama leads to a flow of immense life force throughout the body, which positively affects all the organs of the body and the mind and senses, improves oxygen supply and increases blood corpuscles, organizes sleep and restores the body and mind. Amazing relaxation is achieved.

Pranayama is a medical science based on complete pulse science. By the practice of Nadi Shodhan Pranayama, the toxic substances present in all the veins and nerves of the body are removed, due to which the blockage of sewage in the flow path of the entire nervous system, circulatory system and nervous system is mitigated and the functioning of those institutions is orderly and smooth. With the practice of Pranayama, the emotional and electrical flow in the body starts moving in the Sushumna Nadi, due to which the transmission of energy starts in the chakras present in the body, which refines the human consciousness to a higher level.

By practicing Pranayama, the mind and senses get purified . Then the practice of withdrawing the external activities of the senses from all sides and merging them in the mind is called Pratyahara. The methods of modern psychiatry given by the western world, which are used for the problems of mental distress, depression, anger, forgetfulness, etc. arising as a result of incontinence of the mind, mainly treat the disease through ideological analysis, counseling and other introspective procedures. Yoga Darshan is a complete psychology and the practice of Pratyahara is focused on the mind. Many methods used in modern psychiatry can also be said to be modernization of various activities of Pratyahara like Tratak, Yoga Nidra etc. Therefore, Pratyahara has a very special role in

developing mental health and self-confidence. The practice of Dharana increases memory power, will power and concentration and the human aura / magnetic field becomes wide, healthy and positive.

The practices of meditation and mudra develop wonderful abilities in the brain. Positive changes in brain structures have been observed during meditation. With these changes, the origin of alpha waves became visible, which is fully capable of increasing intellectual development and memory and also developing creative and creative abilities. With the practice of meditation, the level of negative hormones in the body was found to decrease and the level of positive hormones increased. The practice of yoga nidra positively affects the part of the brain, which is very helpful in the form of stress management.

In this way, physical and mental health is achieved through Yogic practices, along with this Yogic practices have an important role in developing spiritually. Through samadhi, a person becomes self-centered. At the same time, he is inspired to do charitable and social productive work for the welfare of the society, while imbibing the spirit of 'Vasudhaivakutumbakam', he provides cooperation on his behalf in the welfare of the world. Through samadhi man attains his higher level of consciousness and integrates himself with the cosmic consciousness. In this way, man can attain the state of complete health and happiness by achieving his ultimate and main goal through yoga.

Practice questions

Q. 1 Select the correct option.

1) World Yoga Day is celebrated on -

A) 5th June B) 22nd June

c) 21st June d) 18th June

2) Which ministry organizes the International Yoga Festival in India?

a) Ministry of Ayush b) Ministry of Communications

c) Ministry of Education d) None of these

3) When was the first International Yoga Day celebrated in India

a) June 21, 2014 b) June 21, 2015

c) June 21, 2016 d) none of these

Q. 2 Fill in the blanks.

1) The regulation of breathing is done by …….

2) The …… components of health have been given.

3) Ayurveda has been called the Upaveda of …….

Q. 3 Mark True (✓) or False (✗) against the following statements.

1) Pranayama is useful in incurable diseases like cancer.

2) 'Gamma' waves are generated in meditation.

3) The circulation of blood in the body is regulated by the asanas.

Q.4 Match the correct pair -

	Column 'A'	Column 'B'
1)	Health	a. Stress Management
2)	Shatkarma	B. Aryugyen Kalpatam
3)	Samadhi	c. Purification
4)	Yoga Nidra	d. Attainment of Bliss
5)	Yajurveda	e. Four components

Q. 5 Very short answer type questions

1) Give the meaning of Vasudhaivakutumbakam.

2) Which subjects are described in Hatha Yoga scriptures?

3) Write the name of the author of Yogasutra.

Q. 6 Short Answer Type Questions

1) Write the importance of Nadishodhan Pranayama.

2) Describe the benefits of asanas.

3) Briefly describe meditation.

Q.7 Long Answer Type Questions

1) Explain the relationship between Ayurveda and the World Health Organization by explaining the definitions of 'health'.

2) Highlighting the subject of ' happiness', describe the symptoms of Hatha Yoga Siddhi.

3) Explain in detail ' Yoga in the context of health and happiness'.

Project work

1) Prepare a report knowing the changes and experiences in yourself through Yogic practices. Discuss related topics with classmates.

2) While practicing any five asanas continuously for 15 days, write down the time you stay in those asanas every day.

Sl.	Asan	Day														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1																
2																
3																
4																
5																

Chapter - 9
Ancient Indian Mathematics

Study points

9.1 Meaning and importance of Mathematics
9.2 Emergence of Mathematics
9.3 Different representations of number words
9.4 Different Fraction
9.5 What is Zero?
9.6 Geometry
9.7 Vedi(Altar) and Geometry
9.8 Aryabhatiya Method and Katpayadi Method
9.9 Units of Earth Measurement

9.1 Meaning and importance of Mathematics –

In the Indian education tradition, from the very beginning, mathematics is said to be at the top of all the scriptures.

यथा शिखा मयूराणां नागानां मणयो यथा।
तद्वद् वेदाङ्गशास्त्राणां गणितं मूर्ध्नि संस्थितम्॥

(वेदाङ्गज्योतिष 2)

The word Ganit is made up of the suffix Kt in the gan dhatu. The meaning of Gandhatu is – to count and thus the meaning of mathematics in which calculations are done.

9.2 Origin of Mathematics –

Gana, Ganapati, Garnashra, Ganani, Ganya etc. are found in the mantras of Rigveda and Yajurveda. The biggest gift of Vedic vangmay to the world is the invention of numbers and the decimal system.

सास्मा अरं प्रथमं स द्वितीयमुतो तृतीयं मनुषः स होता।

(ऋग्वेद 2.18.2)

1, 2, 3 are mentioned in this Rigvedic mantra .

सविता प्रथमेहन्नग्निद्वितीये वायुस्तृतीयऽआदित्यश्चतुर्थे चन्द्रमाः पञ्चमऽऋतुः षष्ठे मरुतः सप्तमे बृहस्पतिरष्टमे । मित्रो नवमे वरुणो दशमऽइन्द्रऽएकादशे विश्वेदेवा द्वादशे॥

(यजुर्वेद 39.6)

1 to 12 numbers have been mentioned in this mantra of Yajurveda .

अष्टौ व्यख्यत् ककुभः पृथिव्यास् त्री धन्व योजना सप्त सिन्धून्।
हिरण्याक्षः सविता देव आगाद् दधद्रत्ना दाशुषे वार्याणि॥

(ऋग्वेद. 1.35.8)

This Rigvedic mantra mentions writing numbers in the form of words. The numbers 8, 3, 7 are written in words.

सहस्रं व्यतीनां युक्तानामिन्द्रमीमहे।
शतं सोमस्य खार्यः॥ (ऋग्वेद. 4.32.17)

100, 1000 is mentioned in this mantra of Rigveda .

आ विंशत्या त्रिंशता याह्यर्वाङ्ग चत्वारिंशता हरिभिर्युजानः।
आ पञ्चाशता सुरथेभिरिन्द्राऽऽषष्टया सप्तत्या सोमपेयम्

(ऋग्वेद. 2.18.5)

30, 40, 50, 60, 80, 90, 100 are mentioned in this mantra of Rigveda .

चित्र इद् राजा राजका इदन्यके यके सरस्वतीमनु।
पर्जन्य इव ततनद्धि वृष्टया सहस्रमयुता ददत्॥ (ऋग्वेद. 8.21.18)

Sahastra (1000) and Ayut or Dasa Sahastra (10000) are mentioned in this mantra of Rigveda.

Names of numbers from one to Sahastra (100) and Arab (Arbud) numbers and perimeter(10^{12}) are mentioned in the Veda Samhitas.

इमा मे अग्न ऽ इष्टका धेनवः सन्त्वेका च दश च दश चशतं च शतं च सहस्रं च सहस्रं चायुतं चायुतं चनियुतं चनियुतं च प्रयुतं चचार्बुदं चन्यर्बुद चं समुद्रश्चमध्यं चान्तश्च परार्धश्चैता मे अग्न ऽ इष्टका धेनवः सन्त्वमुत्रामुष्मिल्लोके..। (यजु. 17.2)

The Taittiriya Samhita of Yajurveda mentions even and odd numbers and up to 100 tables are available.

Taittiriya Samhita has the following definitions.

शताय स्वाहा सहस्राय स्वाहाऽयुताय स्वाहा नियुताय स्वाहा प्रयुताय स्वाहाऽर्बुदाय स्वाहा न्यर्बुदाय स्वाहा समुद्राय स्वाहा मद्धयाय स्वाहाऽन्ताय स्वाहा पराद्धाय स्वाहोषसे स्वाहा व्युष्टयै स्वाहो देष्यते स्वाहोद्यते स्वाहोदिताय स्वाहा सुवर्गाय स्वाहा लोकाय स्वाहा सर्वस्मै स्वाहा ॥

(तैत्तिरीय संहिता 7.2.20)

$10^0 = 1$	$10^1 = 10$	
10^2 = hundred	10^3 = thousand	10^4 = ayut
10^5 = Niyut	10^6 = Prayut	10^7 = Arbud
10^8 = Nyarbud	10^{16} = Samudra	10^{17} = Madhya
10^{18} = Nyrbud	10^{19} = Antya	10^{20} = Mahantya
10^{21} = Paradh	10^{22} = Agni	10^{23} = Ishtika
10^{26} = Sanatvam	10^{27} = Lokam	

9.3 Number words mentioned in different ways –

1) Odd numbers - from 1 to 33

एका च मे तिस्रश्च मे तिस्रश्च मे पञ्च च मे पञ्च च मे सप्त च मे सप्त च मे नव च मे नव च मऽ एकादश च म ऽएकादश च मे त्रयोदश च मे त्रयोदश च मे पञ्चदश च मे पञ्चदश च मे सप्तदश च मे सप्तदश च मे नवदश च मे नवदश च म ऽएकविꣳशतिश्च म ऽएकविꣳशतिश्च मे त्रयोविꣳशतिश्च मे त्रयोविꣳशतिश्च मे पञ्चविꣳशतिश्च मे पञ्चविꣳशतिश्च मे सप्तविꣳशतिश्च मे सप्तविꣳशतिश्च मे नवविꣳशतिश्च मे नवविꣳशतिश्च म एकत्रिꣳशच्च म ऽएकत्रिꣳशच्च मे त्रयस्त्रिꣳशच्च मे यज्ञेन कल्पन्ताम्

(यजु. 18.24)

In this mantra of Yajurveda, odd numbers from 1 to 33 have been given. For example – 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33

Odd numbers are currently used in traffic management.

2) Even numbers 4 to 48 (table of 4 4 x 12 = 48)

चतस्रश्च मेऽष्टौ च मेऽष्टौ च मे द्वादश च मे द्वादश च मे षोडश च मे षोडश च मे विꣳशतिश्च मे विꣳशतिश्च मे चतुर्विꣳशतिश्च मे चतुर्विꣳशतिश्च मेऽष्टाविꣳशतिश्च मेऽष्टाविꣳशतिश्च मे द्वात्रिꣳशच्च मे द्वात्रिꣳशच्च मे षट्त्रिꣳशच्च मे षट्त्रिꣳशच्च मे चत्वारिꣳशच्च मे चत्वारिꣳशच्च मे चतुश्चत्वारिꣳशच्च मे चतुश्चत्वारिꣳशच्च मेऽष्टाचत्वारिꣳशच्च मे यज्ञेन कल्पन्ताम् । (18.25 .यजु)

4 x 1 =	4	4 x 7 =	28
4 x 2 =	8	4 x 8 =	32
4 x 3 =	12	4 x 9 =	36
4 x 4 =	16	4 x 10 =	40
4 x 5 =	20	4 x 11 =	44
4 x 6 =	24	4 x 12 =	48

3) Numbers from 1 to 100 –

एकस्मै स्वाहा त्रिभ्यस्स्वाहा पञ्चभ्यस्स्वाहा सप्तभ्यस्स्वाहा नवभ्यस्स्वाहैकादशभ्यस्स्वाहा त्रयोदशभ्यस्स्वाहा पञ्चदशभ्यस्स्वाहा सप्तदशभ्यस्स्वाहैकान्न विꣳशत्यै स्वाहा नवविꣳशत्यै स्वाहैकान्न चंत्वारिꣳशते स्वाहा नवंचत्वारिꣳशते स्वाहैकान्न षष्टयै स्वाहा नवषष्टयै स्वाहैकान्नाऽशीत्यै स्वाहा नवांशीत्यै स्वाहैकान्न शताय स्वाहा शताय स्वाहा सर्वस्मै स्वाहा ॥

(तैत्ति. सं. 7.2.11)

from 1 to 100 are mentioned in this mantra of Taittiriya Samhita like – 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 29, 39, 59, 69, 79, 89, 99, 100

4) Table of 2 up to 20 –

द्वाभ्याꣳस्वाहा चतुर्भ्यस्स्वाहा षड्भ्यस्स्वाहाऽष्टाभ्यस्स्वाहा दशभ्यस्स्वाहा द्वादशभ्यस्स्वाहा चतुर्दशभ्यस्स्वाहा षोडशभ्यस्स्वाहाऽष्टादशभ्यस्स्वाहा विꣳशत्यै स्वाहाऽष्टानवत्यै स्वाहा शताय स्वाहा सर्वस्मै स्वाहा ॥ (तैत्ति. सं. 7.2.13)

It is used in the construction of stairs, as the first stair is at 2 feet, then the next stair will be at 4 feet, and so on. In this mantra of Taittiriya Samhita, the mountain of 2 is mentioned up to 20 and the multiples of 2 are 98 and 100 .

2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 98, 100

5) Table of 4 and 5 up to 20 –

चतुर्भ्यस्स्वाहाष्टाभ्यस्स्वाहा द्वादशभ्यस्स्वाहा षोडशभ्यस्स्वाहा विꣳशत्यै स्वाहा षण्णवत्यै स्वाहा शताय स्वाहा सर्वस्मै स्वाहा ॥ (तैत्ति. 7.2.15)

In this mantra of Taittiriya Samhita, mountain of 4 is mentioned up to 20 and multiples of 4 are 96 and 100 . Like- 4, 8, 12, 16, 20, 96, 100

पञ्चभ्यस्स्वाहा दशभ्यस्स्वाहा पञ्चदशभ्यस्स्वाहा विꣳशत्यै स्वाहा पञ्चनवत्यै स्वाहा शताय स्वाहा सर्वस्मै स्वाहा ॥ (तैत्ति. 7.2.16)

In this mantra of Taittiriya Samhita, the mountain of 5 is mentioned up to 20 and the multiples of 5 are 95 and 100 . Like- 5, 10, 15, 20, 95, 100

6) Table of 10 to 100 –

दशभ्यस्स्वाहा विꣳशत्यै स्वाहा त्रिꣳशते स्वाहा चत्वारिꣳशते स्वाहा पञ्चाशते स्वाहा षष्टयै स्वाहा सप्तत्यै स्वाहाऽशीत्यै स्वाहा नवत्यै स्वाहा शताय स्वाहा सर्वस्मै स्वाहा ॥

(तैत्ति.7.2.17)

In the present time, the use of these sequence of numbers is commonly seen in many places.

Is. Multiples of 10 have been mentioned in this mantra of Taittiriya Samhita . Like - 10, 20, 30, 40, 50, 60, 70, 80, 90, 100

7) **द्विपदा याश्चचतुष्पदास्त्रिपदा याश्च षट्पदाः।**
विच्छन्दा याश्च सच्छन्दाः सूचीभिः शम्यन्तु त्वा ॥ (यजु. 23.34)

That is, in number sequences, those who advance according to Dwipada 2 + 2, those who advance according to Tripada 3 + 3, those who advance by keeping steps according to Chatushpada i.e. 4 + 4 and those who advance according to Shatpada i.e. 6 + 6, 'Suchibhi' keeps everyone tied in one thread respectively like a needle.

8) Ordinal numbers

प्रथमा द्वितीयेषु श्रयध्वम् । द्वितीयास्तृतीयेषु श्रयध्वम् । तृतीयाश्चतुर्थेषु श्रयध्वम्। चतुर्थाः पञ्चमेषु श्रयध्वम्। पञ्चमाः षष्ठेषु श्रयध्वम्।षष्ठाः सप्तमेषु श्रयध्वम् । सप्तमाः अष्टमेषु श्रयध्वम् । अष्टमाः नवमेषु श्रयध्वम्। नवमाः दशमेषु श्रयध्वम्। दशमा एकादशेषु श्रयध्वम्। एकादशा द्वादशेषु श्रयध्वम्। द्वादशास्त्रयोदशेषु श्रयध्वम्। त्रयोदशाश्चतुर्दशेषु श्रयध्वम्। चतुर्दशाः पञ्चदशेषु श्रयध्वम्। पञ्चदशाः षोडशेषु श्रयध्वम्। षोडशाः सप्तदशेषु श्रयध्वम् । सप्तदशाः अष्टादशेषु श्रयध्वम्। अष्टादशाः एकान्नविँशेषु श्रयध्वम् । एकान्नविँशाः विँशेषु श्रयध्वम्। विँशा एकविँशेषु श्रयध्वम्। एकविँशा द्वाविँशेषु श्रयध्वम्। द्वाविँशास्त्रयोविँशेषु श्रयध्वम्। त्रयोविँशाश्चतुर्विँशेषु श्रयध्वम्। चतुर्विँशाः पञ्चविँशेषु श्रयध्वम्। पञ्चविँशाः षड्विँशेषु श्रयध्वम्। षड्विँशास्सप्तविँशेषु श्रयध्वम्। सप्तविँशा अष्टाविँशेषु श्रयध्वम्। अष्टाविँशा

एकान्नविँशेषु श्रयध्वम्। एकान्नत्रिँशास्त्रिँशेषु श्रयध्वम्। त्रिँशा एकत्रिँशेषु श्रयध्वम्। एकत्रिँशा द्वात्रिँशेषु श्रयध्वम्। द्वात्रिँशास्त्रयस्त्रिँशेषु श्रयध्वम्। (तैत्तिरीयब्राह्मणम् -3 /11/2/1-4)

1st2-nd; 2nd-3rd; 3rd-4th; 4th-5th; 5th-6th; 6th-7th; 7th-8th; 8th-9th; 9th-10th; 10th-11th; 11th-12th; 12th-13th; 13th-14th ;14th-15th; 15th-16th; 16th-17th; 17th-18th; 18th-19th; 19th-20th; 20th-21st; 21st-22nd; 22nd-23rd; 23rd-24th; 24th-25th; 25th-26th; 26th-27th; 27th-28th; 28th-29th;29th-30th; 30th-31st;31st-32nd;32nd-33rd.

Those numbers which tell us the exact position of an object rather than its quantity are called ordinal numbers. In this above-mentioned Brahmin mantra, out of the serial numbers, the numbers up to Trayastrish (33) have been mentioned respectively. The knowledge of such ordinal numbers was a remarkable achievement in any culture of the world.

Fig. 9.1 - Position of planets in the solar system by ordinal numbers

9.4 Different Fractions

In Yajurveda, the word 'pad' has been used for Chaturthans i.e. ¼ .

त्रिपादूर्ध्व उदैत्पुरूषःपादोऽस्येहाभवत् पुनः। (यजु. 31.4)

God's three feet means ¾ part is outside the world and one foot means ¼ part is this world.

Kala 1/16, kushtha 1/12, Shaf 1/8, Pada or Pada ¼

Part: / Rig. 7.32.12 / Bhagam / Rig. 8.100.1

Fractions are used in calculus.

विन्यस्य भज्यमानं तस्याधःस्थेन भागहारेण।
सदृशापवर्तविधिना भागंकृत्वा फलं प्रवदेत् ॥

(गणित सार संग्रह. 2.18)

Separating the common denominator, write the denominator under the dividend to get the remainder.

प्रतिलोमपथेन भजेद् भाज्यमधःस्थेन भागहारेण।
सदृशापवर्तनविधिर्यद्यस्ति विधाय तमपि तयोः॥

(गणित सार संग्रह. 2.19)

The division operation is performed from left to right by the inverse method.

9.5 What is Zero?

The word 'kha' has been used in Vedas for zero. 'kha' means - sky, senses, empty space, hole, door, space.

"खे रथस्य।"(ऋग. 8.91.7) अर्थात् रथ के छिद्र में

"ओं खं ब्रह्म।"(यजु. 40.17)" अर्थात् ब्रह्म आकाशवत् शून्य हैं।

ऊँ पूर्णमदः पूर्णमिदं पूर्णात् पूर्णमुदच्यते ।
पूर्णस्य पूर्णमादाय पूर्णमेवावशिष्यते ॥

The number zero has been indicated in this paragraph. It is said in the mantra, this is also complete, that is also complete, the complete is born from the complete. When zero is added or subtracted from zero, it remains zero.

Zero is represented in the binary language of computers as (0,1) .

The computer first converts any number into binary language, then on it, executes the operation.

यदा सर्वे प्रमुच्यन्ते कामा येऽस्य हृदि श्रिताः ।

अथ मर्त्योऽमृतो भवत्यत्र ब्रह्म समश्नुते ॥

(कठोपनिषद्)

In Kathopanishad, there is mention about zero and infinity. If all the desires or wishes of a person's heart are fulfilled or nullified, then the person attains Moksha or Ananta and becomes equal to Brahma. In modern mathematics, the appropriate idea is expressed in the following way –

$$\lim_{W \to 0} \frac{R}{W} = \infty$$

where R = authority or possession

W = wishes or desires

If W = 0 then the sum R/0= ∞ (infinity or salvation)

9.6 Geometry –

कासीत् प्रमा प्रतिमा किं निदानमाज्यं किमासीत् परिधिः क आसीत्।
छन्दः किमासीत् प्रउगं किमुक्थं यद्देवा देवमयजन्त विश्वे॥

(ऋग. 10.130.3)

In this mantra of Rigveda these words are related to geometry.

1) Prama – name, magnitude
2) Pratima - map, outline
3) Nidanam – reason, root principle
4) Paridhi – circumference
5) Chhanda - measuring instrument, rope
6) Praug – Isosceles triangle in Shulbsutras

चतुर्भिः साकं नवतिं च नामभिःचक्रं न वृत्तं त्यतींरँवीविपित्।

(ऋग. 1.155.6)

4 × 90 = 360 degrees in a circle. Lord Vishnu turns such a wheel of time. There are 4 sector radii of 90 degrees in a circle .

द्वादश प्रधयश्चक्रमेकं त्रीणि नभ्यानि कउ तच्चिकेत।
तस्मिन् त्साकं त्रिशता न शङ्कवो ऽर्पिताःषष्टिर्न चलाचलासः॥

(ऋग. 1.164.48, अथर्व.10.8.4)

There is a circle, it has 12 rounds, that is, there are 12 rays at 30-30 degrees . There are 3 centers of 120 degrees in the whole circle. There are 360 degrees in the whole cycle .

तिरश्चीनो विततो रश्मिरेषामधः स्विदासी ३ दुपरि स्विदासी ३ त् ।

(यजु. 33.74)

This is a description of the rays of the sun. They come obliquely, then spread downward and then slant upwards. Thus the triangle has three sides. One line below and two diagonal lines on either side. In this way many shapes of triangle can be made.

Yajnavedi and geometry –

द्विप्रमाणा चतुः करणी, त्रिप्रमाणा नवकरणी, चतुः प्रमाणा षोडशकरणी अर्थप्रमाणेन पादप्रमाणं विधीयते। - कात्यायन शुल्बसूत्र

4 squares will be made from the doubled line, 9 squares will be made from the tripled line, 16 from the quadruple line.

A quarter square will be formed from the half line. As many units are in a line, there will be as many rows of squares in its square.

1) Knowledge of Pythagoras theorem is found in Bodhayana Shulbasutra.

दीर्घचतुस्रस्याक्ष्णयारज्जुः पार्श्वमानी तिर्यङ्मानी च।
यत्पृथग्भूतेकुरुतस्तदुभयं करोति॥ (बौधायन शुल्बसूत्र 1.48)

That is, the diagonal and lateral sides of the quadrilateral (rectangle) which form 2 squares, their, a single axon makes a quadratic equal to the sum.

2) Value of Pi – It is said in Manav Shulbasutra that a square of 2 cubits, is equal to a circle made on the radius of a cubit and three fingers.

यूपावटाः पदविष्कम्भाः त्रिपदपरिणाहानि यूपोपराणीति।

(बौ. शु 1-112-113)

Bodhayana had told a rule to convert the circle into a square, in which Aryabhata derived the value of Pi as 3.1416 .

चतुरधिकं शतमष्टगुणं द्वाषष्टिस्तथा सहस्त्राणाम् । अयुतद्वयविष्कम्भस्या आसन्नो वृत्तरिणाहः।

(आर्यभटीय गणितपाद)

The value of Pi may be obtained on adding 62 multiplied by 1000 and 104 multiplied by 8 then deviding it by 20000(diameter of a standard circle)

(1000x62) + (104x8) = 6200+832 = 62832

Pi (π) $= \frac{62832}{20000} = 3.1416$

Bhaskaracharya in Lilavati gave gross form of the value of π. By multiplying 22 divided by 7 by the diameter, the gross value of that circumference is obtained.

Archimedes later found the value of Pi to be 3.1428 .

3) **The knowledge of Karni is mentioned in Apastamba Shulbasutra –**
करणीं तृतीयेन वर्धयेत्तच्च चतुर्थेनात्मचतु स्त्रिंशोनेन सविशेषः।

(का.शु.सू. 2.13)

4) **Fractions**

1. Addition of Fractions

छेदगुणं सछेदं परस्परं तत् सवर्णत्वम्।

(आर्यभट्टीय, गणितपाद 27)

To get the sum of different fractions, multiply them by the appropriate number to make them common.

2. Properties of multiplication operation

शून्यर्णयो: ख धनयोः।
ख शून्ययोर्वा वधः शून्यम्॥ (ब्राह्मस्फुट सिद्धान्त कुट्टकाधाय,33)

Multiplication of a number, plus or minus, by zero gives zero.

ऋणमृणधनयोर्घातोधनमृणयोर्धनवधोधनं भवति।

शून्यर्णयोः ख धनयोः ख शून्ययोर्वा वधः शून्यम्॥

(ब्राह्मस्फुट सिद्धान्त कुट्टकाधाय,33)

On multiplying a negative number and a positive number, a negative number is obtained and on multiplying 2 negative numbers, a positive number is obtained and on multiplying 2 positive numbers, a positive number is obtained.

3. Addition Operation

तव च्यौत्नानि वज्रहस्त तानि नव यत् पुरो नवतिं च सद्यः।

(ऋग्वेद. 7.19.5)

Addition of two digit numbers is mentioned.

4. Subtraction -

ऊनमधिका द्विशोध्यंधनं (ब्रह्मस्फुट सिद्धान्त कुट्टकाधाय. 31)

On subtracting the smaller number from the larger number, the remainder is positive.

The principles of ancient Indian mathematics are used in modern mathematics at many places.

9.8 Aryabhatiya Method and Katpayadi Method

Aryabhatiya method –

वर्गाक्षराणि वर्गेऽवर्गेऽवर्गाक्षराणि कात् ङ्मौ यः ।

खद्विनवके स्वरा नव वर्गेऽवर्गे नवान्त्यवर्गे वा ॥

In hindi alphabates there are numbers from K to P class (5 x 5 = 25 from K to P) and in A class there are 30 to 100 numbers from Y to H. There are 9 vowels from A to A for units, tens etc. In this way, the number up to Paraddha can be told by letters like –

इ = 10^2 उ = 10^4 ऋ = 10^6

ऌ = 10^8 ए = 10^{10} ऐ = 10^{12}

ओ = 10^{14} औ = 10^{16}

We can write 43,20,000 with Khuyughri in Aryabhatiya method.

B = 2, U = 10 thousand times i.e. 20 thousand, Yu will mean 10 thousand times of 3 = 3 lakhs, D will mean 4 and Ri will mean 10 lakh times i.e. 40 lakhs. So the number can be written in this way.

खु	=	20,000	यु	=	3,00,000
घृ	=	40,00,000	योग	=	43,20,000

Its formula was given by Aryabhata I.

Cutpad method –

नञावचश्च शून्यानि, संख्याः कटपयादयः ।
मिश्रे तूपान्त्यहल् संख्या, न च चिन्त्यो हलस्वरः॥

(सद्रत्नमाला)

Na and J, the vowels tell the zero number. Consonants starting with K, T, P and Y denote the numbers 1, 2, 3 . In compound consonants, only the last consonant with vowels is numerical.

Table 9.1 - Code words used for numbers

Code words

Number	Word
0	Zero, kha, Amber, Gagan, Nabh, Viyat, Anant
1	Chandra, Indu, Vidhu, Som, Abj, Bhu, Dhara, Go, Roop, Tanu
2	Yama, Ashwin, Netra, Akshi, Karna, Kar, Paksha, Dwaya, Ayana, Couple
3	Ram, Guna, Triguna, Bhuvan, Kaal, Agni, Trinetra, Lok, Pur
4	Veda, Shruti, Sagar, Varna, Ashram, Yuga, Turya, Krit, Ay, Dish
5	Arrow, Shar, Ishu, Bhoota, Prana, Tattva, Indriya, Vishaya, Pandavas

6	rasa, organ, season, philosophy, ari, logic, factor, shanmukh
7	Stone, Fire, Mountain, Rishi, Muni, War, Swar, Chhand, Island, Metal, Horse
8	Vasu, Ahi, Nag, Gaj, Serpent, Siddhi, Bhuti, Anushtup
9	Number, Nand, Nidhi, Planet, Hole, Hole, Door, Durga
10	direction, direction, finger, line
11	Rudra, Ishwar, Har, Ish, Bhava, Mahadev, Akshauhini
12	Ravi, Sun, Arka, Mass, Zodiac, Expense, Bhanu, Diwakar
13	Vishvedeva: the world, the work, the superworld
14	Mind, Vidya, Indra, Sugar, Lok
15	Date, day, age
16	Nrip, Bhup, Bhupati, Ashti, Kala
17	excess
18	Dhriti, Purana
19	Atidhruti
20	Nakh, kruti
21	Excellence, nature, Svarg
22	Shape
23	Vikruti
24	Gayatri, Jinn, Arhat, Siddha
27	Nakshatra, Udu, Bha
32	Dental
33	Dev, Immortal, Sur, Tridasha
48	Jagati

49	Tan

9.9 Units of land measurement –

In ancient times, the following units were used to find the length and area of the land.

Table 9.2

8 atoms =	**1 trasrenu**	**24 Angules =**	**1 arm**
8 trasarenu =	1 Renu/Liksha	4 hands =	1 sentence
8 Renu/Liksha =	1 Balagra/Ukamadhya	10 Dand =	1 cord
8 balagra =	1 letter/intermediate	2 strings =	1 Paridesh
8 letters =	1 yuk	3 strings =	1 Nivartan
8 yuk =	1 yew	10 withdrawals / 300 penalties =	1 Sagittarius
8 yaw =	1 finger	1000 penalty =	1 mile
4 fingers =	1 Sagittarius	2000 penalty =	1 curse
8 fingers =	1 bow fist	4 kos =	1 plan
12 Angules=	1 Vitarisht	1 scheme =	5 miles = 8 kms
14 fingers =	1 post		

In the Surya Siddhanta, the circumference of the earth is given as 4 x 107 dandas. At present, the circumference of the earth is measured in 4 x 107 meters, which means 1 dand = 1 meter.

Practice questions

Q. 1 Select the correct option.

(1) In which language does the computer convert the instructions

a) Assembly language b) Binary language

c) Both a and b d) None of these

(2) How many degrees of angle is formed on the whole circle -

a) 90 b) 100

c) 45 d) 360

(3) An Ayuth is –

a) 102 b) 103

c) 104 d) 10

Q. 2 Fill in the blanks –

(1) The hole located in the chariot indicates the …… number.

(2) Binary number is …….

(3) The value of 102 is.....

Q. 3 Mark True (✓) or False (✗) against the following statements.

(1) 1, 3, 5, 7 are odd numbers.

(2) 2, 4, 6, 8 are even numbers.

(3) Aryabhata had calculated the value of Pi as 3.1416 .

Q. 4 Match the correct pair.

Column 'A'	Column 'B'
(1) Arbud	a) 102
(2) Niyut	b) 106
(3) Prayut	c) 105
(4) Shat	d) 107

Q. 5 Very long answer type questions

(1) On what sources is the construction of Yajnavedi based ?

(2) What is the use of even numbers and odd numbers ?

Q. 6 Long answer type questions

(1) Write Aryabhatta's method to calculate the value of Pi.

(2) Explain the Pythagorean theorem with the help of Baudhayana Shulbasutra.

Q.7 Long Answer Type Questions

(1) Explain geometry in the context of Vedic vangmay.

Chapter - 10

Concept of Social Forestry and Biodiversity

Study points

10.1 Introduction
10.2 Description of Plant Diversity in Valmiki Ramayan
10.3 Chitrakoot Forest
10.4 Panchwati Vatika
10.5 Nakshtra Vatika
10.6 Medicinal Mountains Alpine Zone (Himalayan Forest)
10.7 Ashok Vatika
10.8 Kishkindha Forestry
10.9 Dandakaranya Forestry
10.10 Biodiversity in Vedic vangmay

10.1 Introduction: -

Biodiversity is defined as the variability among organisms and plants, including all sources, systems and ecosystems of terrestrial, marine and other aquatic environments.

All the living beings, plants, organisms, micro-organisms, soil, water and ecosystems present on the earth make up biodiversity.

The ancient texts of Sanskrit vangmay, Ramayana and Kumarasambhavam, composed by the great poet Kalidas, etc. have given a vivid depiction of nature.

10.2 Description of variety of plants in Valmiki Ramayana -

In the famous epic Ramayana, Chitrakoot Vanam, Dandak Aranya Van, Kishkindha Van, Ashok Vatika and the forests located in the Himalayan mountain ranges have been described. Life-giving Himalayan Sanjeevani medicine is also mentioned.

Types of forests mentioned in Ramayana:-

1. Shantam

2. Madhur
3. Rudra
4. Gruesome

The above classification was done on the basis of nature of forests and four major ecosystems are included-

1. Tropical Deciduous Forest
2. Dry and moist deciduous forests
3. Evergreen Tropical Forest
4. Alpine Region Semi-forest (Himalayan)

In Ramayana, flora and fauna, water, forests, land have been described in detail. In terms of size, forests are divided into two parts.

1. Major Forests – Chitrakoot and Dandakaranya
2. Upvan – Panchawti Forest

Rivers, lakes, ponds and aquatic plants like lotus and water lily are mentioned in the Dandakaranya forest. All the elements together form the ecosystem and the water flowing from the springs helps in maintaining the moisture in the soil. Dense forests act as a conservation element in the water cycle.

10.3 Chitrakoot Forest:-

tropical deciduous forest

Figure 10.1- Chitrakoot Forest

Location- Situated on the border of Satna district of Madhya Pradesh and Chitrakoot district of Uttar Pradesh.

Climate- Due to the presence of sources of water like rivers, lakes, ponds etc. the cold water of this region is windy and dense forests provide protection to the water cycle.

Rainfall – This region receives rainfall from the south-west monsoon.

Vegetation-In terms of size, it used to come under the category of major forest. In this forest area there are rivers, ponds, waterfalls, water streams and plants of lotus, lily species. The continuous flow of water maintains the moisture in the atmosphere.

2 types of vegetation existed.

1. Edible Plants 2. Inedible Plants

Mango, Jackfruit, Amla and sour fruit which was known as Bhavya. Flowering plants Lodhra, Neepa, Tilka, Neem Bijaka etc.

Medicinal plants:- Vetakantakari, Brahmi, Katuka, Atis etc.

		
Fig. 10.2 - Brahmi	Fig. 10.3 - ShVedakantakari	Figure 10.4 - Atis

Fauna:- Among the fauna found in Chitrakoot forest were monkey, cuckoo, buffalo, peacock, bear, crane, wild boar, hyena, wolf, gokarna deer, lion etc.

Fig . 10.6 - Gokarna deer	Fig . 10.7 - Hyena

Figure 10.6 – Gokarna deer

Figure 10.7 – Hyena

10.4 Panchwati Vatika -

Scientific analysis of Panchavati described in Skanda Purana makes it clear that the knowledge of Ayurveda, forestry, psychology, architecture and environmental protection has been used in its construction.

1. Medicinal importance -

These 5 trees have unique medicinal properties. All those qualities are contained in them, by which man can cure all his diseases by living a long life. Amla is the richest source of Vitamin C and is a great medicine to make the body resistant to diseases. Banyan milk is very powerful. Its daily intake rejuvenates the body. There is a wonderful increase in life force and there is communication of new consciousness in the body. Peepal is an analgesic and anti-inflammatory that cures blood disorders. Bel is an infallible medicine for stomach related diseases, then Ashoka is the main medicinal tree to cure female disorders.

2. Environmental importance -

1. Banyan is a huge tree providing cool shade. In the afternoon of summer, when the strong rays of the sun provide unbearable heat and there is strong heat wave, then the banyan tree situated on the west side of Pachwati keeps the Pachwati cool and air-conditioned by generating dense shade.

2. Peepal is the best tree to exploit pollution and generate life air. In the morning, when the moon rises with a new aura, the Peepal tree creates a spiritual atmosphere with the pure rays of the sun and the intelligence of the creatures that come under its influence becomes intense. Probably it was obtained from this and its name was "Bodhi-tree".

3. Ashoka is an evergreen tree, it never remains leafless and always provides shade.

4. There are oil glands in the leaves, wood and fruits of Bael which keep the atmosphere fragrant.

5. Due to the strong winds of both Pachhua and Puruva, the amount of dust in the atmosphere increases, which is absorbed by the huge peepal and banyan trees located in the east and west and keep the atmosphere pure.

3. Religious importance -

Lord Shankar's abode is considered in Bel and Banyan, then Vishnu in Peepal and Amla. Ashoka is associated with the destroyer of grief and the memory of Sita.

4. Biodiversity Conservation -

Due to continuous availability of fruits in Panchvati, food is always available for birds and other animals and they reside permanently on it. The fruits of Peepal and Bael ripen in summer, while that of Banyan ripens during the rainy season and that of Amla in winter. Peepal and Banyan are soft wood trees which are suitable for making nests of birds. Pits and hollows are naturally abundantly available in them, in which birds and other animals reside, whose chirping always resonates and provides mental cheerfulness.

5. Shadow -

There may have been a concept of "combination" behind the structure of the peak. For example, by mixing different metals in a certain proportion, temperature and certain environment, a new metal “alloy” is formed which has specific properties. Such alloys have a special contribution in modern science and they are used in making the most difficult experiments, spacecraft, aircraft and defense equipment. Miracle medicines are obtained by mixing many chemicals and medicines in a certain proportion. This type of human welfare multipurpose tree group Panchawati has been discovered by our sages in ancient times through many experiments and experiences. The shade of the five trees of Pachvati acquires uniqueness by being in the light of sun and moon with a certain proportion, quantity and intensity of the shade, medicinal properties, environmental and other special properties.

Meaning of Pachavati - A group of five holy shady trees is called Pachavati.

Importance of five - The word "Panch" (five) has great importance in our mythological texts. The creation has been created from the “Panchabhoot” (five elements) earth, water, fire (fire), air and sky. The human body is completed by the five senses, the skin, the eyes, the nostrils, the tongue, the ear and the five organs of action. Similarly five species of Panchavati Peepal, Banyan, Bel Ashok and Amla are the symbol of environmental perfection.

Panchavti of Ramayana - In Ramayana a sacred place (forest area) is represented as Panchavti. Where Shri Ram along with Sita and Laxman spent the time of exile by building a leaf cottage. Presently this place is near Nashik.

"Kabandha Ramayana", five huge banyan trees (banyan trees) located in a circular circle on the south bank of river Godavari are called panchavati. At the time of exile, Shri Ram, Sita and Laxman had built a leaf cottage in the middle of these five trees. Shri Ram destroyed the carriers of sin and unrighteousness while residing in Panchavati itself.

Panchavati mentioned in Purana - According to the Hemadriya Vrat section of the mythological book 'Skanda Purana', the description of Panchavati is as follows-

1. **Panchawti -**

Peepal (Ashwath), Bael (Bilva), Banyan (Vat), Amla (Amalaki) and Ashoka (Anganpriya) these five trees are called Panchavati. It should be established in four directions. Avattha (Peepal) should be established in the east, Vat (Banyan) in the north, Amla in the west, Ashoka in the south for penance. After five years, the beautiful and beautiful altar of four hands should be established in the middle. It is the giver of eternal fruits and the giver of the fruits of penance.

2. **Big Panchawti -**

Four bel trees should be established in the center of the Brihad P९anchavati in all the four directions. After that four banyan trees should be planted in all the four corners. After this, plant twenty-five Ashoka trees in a circular shape. Two Amalaki (Amla) trees should be planted in the south direction and four Peepal trees should be established in all the four directions. In this way a large ridge is formed.

How to apply

Panchwati -

First of all, a flat place should be selected. Then put a mark on twenty cubits (10-10 meters) in all four directions from the center and put a mark in the middle on twenty cubits (10 meters) in the middle of the east and south direction, that is, on the angle of fire. Make pits at these marked places. In these, establish Peepal in the east, Amla in the south, Bael in the north, Banyan tree in the west and Ashoka tree at the fire angle with a pure mind. After five years, a beautiful square altar of four cubits long and four cubits wide (2 m. X 2 m.) should be constructed in the center. The altar should be flat on all sides and it should face in all the four directions.

Large Panchawti -

If more space is available, install a bigger platform. Planting method will be same as above. But its hypothesis is actually circular. Sundar Vati will be established as before.

Firstly 5 meters from the center all around . Radius 10 m. Radius, 20 m. Radius, 25 m. And make five circles (circumference) of thirty meter radius. 5 m inside Establish four vine trees in all the four directions on the circle of radius. After this 10 m. Establish four banyan trees in the four corners on the second circle of radius. 20 m Plant 25 Ashoka trees on the third perimeter of the radius at an interval of equal distance (about 5 m) . Fourth circle whose 25 m. On the circumference of the radius, there is a law to establish two Amla trees in the south direction at five meters each from the perpendicular to the south direction as shown in the picture. The distance between two Amla trees is 10 m. Will remain Fifth and last 30 m. Plant four Peepal trees in all the four directions on the circumference of the circle of radius. In this way a total of forty nine trees will be established. In which four trees will be of Bel, four Banyan trees, 25 Ashoka trees, two Amla trees and four Peepal trees.

10.5 Nakshatra Vatika (Planting of Nakshatra Trees)

Just as geographers mark the earth's surface in 36 latitude lines, similarly in ancient times the sky above the earth has been divided into 27 equal parts. Each part of which is called a Nakshatra. The identity of these Nakshatras is expressed in the position of the stars in the sky, in the longitude line, in the same way, the travel position of the bodies (planets) near the Earth is expressed in the Nakshatras, the names of twenty-seven Nakshatras of Indian recognition are as follows - 1. Ashwini, 2. Bharani, 3. Krittika, 4. Rohini, 5. Mrigashira, 6. Ardra, 7. Punarvasu, 8. Pushya, 9. Alesha, 10. Magha, 11. Purvaphalguni, 12. Uttaraphalguni, 13. Hand, 14. Chitra. 15. Swati, 16. Visakha, 17. Anuradha, 18. Jyestha, 19. Mula, 20. Purvashadha, 21. Uttarashadha, 22. Shravan, 23. Dhanishtha, 24. Shatabhisha, 25. Purvabhadrapada, 26. Uttara Bhadrapada, 27. Revati .

The names of the trees of these constellations are found in Ayurvedic, mythological, astrological and tantric texts, it is described in these texts that by serving and growing the tree of one's birth constellation, one gets welfare and the tree of one's birth constellation is protected from harm or loss. Causing harm destroys oneself in every way.

Nakshatra Vatika -

The picture of the Nakshatra of each tree and the name of the owner of that Nakshatra can be displayed by writing the name of the tree.

The brief introduction of the trees of the constellations is as follows -

1. Kuchila (Karskar) - medium height tree which is found in the forests of central India. The poison in its tick-like seeds is of great medicinal importance.
2. Amla (Dhatri) - Its fruit has been called nectar fruit which is the richest source of Vitamin 'C'.
3. Sycamore (Udumbar) - Large shade tree. Its compound is used in the peace of Venus.
4. Jamun (Jambu) - A tree that grows easily near flowing water areas. Best medicine for diabetes.

5. Khair (Khidir) - A thorny tree of medium height. Katha is made from its wood.
6. Sheesham/Tendu (Krishnaः) – Both the trees come in the meaning of the word Krishna, the Nakshatra tree mentioned for Ardra Nakshatra.

   Shisham - Important wood species with tall trees.

   Tendu – Black stemmed tree whose leaves are used to make beedis.
7. Bamboo (Vanshः) – It is called the timber of the poor.
8. Peepal (Ashvattha) – Very sacred tree. Lord Buddha attained enlightenment under this tree.
9. Nagkesar (Naagः) – A tree that grows naturally mainly in the humid areas of Assam. Its wood is very hard.
10. Banyan (Vatः) – Vat is a very large shady species worshiped by women in Savitri fast.
11. Palash (Palashः) – A tree of medium height growing in dry and barren areas.Those who play Holi make colors from flowers. It is also called Van Jwala (Flame of the Forest).
12. Pakad (Plakshः) – A tree famous for giving dense cool shade.
13. Reetha - A tree of medium height, whose fruit is used in washing works due to giving foam.
14. Bel (Bilva) - A tree of medium height with hard-shelled fruit, whose leaves are offered in the worship of Lord Shiva.
15. Arjuna (Arjuna) - is a tree that grows easily in areas with submerged or high water levels. Its bark is the best medicine for heart disease.
16. Kateri (Kantkari) – The thorns of this tree of small height are multi-branched, its fruits are tridosha-killer.
17. Maulishree - Shady-graceful tree growing naturally in South India.
18. Pine (Dedaru) – A tree growing in a straight height with needle-like leaves growing in cold mountainous areas, whose bark is thin.
19. Sal (Sarge) – Very important tree that grows naturally in Terai region of the state.

20. Vanjul (Jalvetus) - A tree of small height growing on the banks of flowing water sources.
21. Jackfruit (Panasः) – a tree of medium height whose large fruit is eaten as a vegetable.
22. Aakda (Arakः) – A shrub-like species that grows on barren dry land.
23. Shami - A tree of small height with small thorns, which is known as U.P. In India it is called Chyonkar and in Rajasthan it is called Khejdi.
24. Kadamba – A tall tree associated with the memory of Lord Krishna which grows easily in moist areas.
25. Mango (Aamr) - is known as the king of fruits in India.
26. Neem (Nimbः) – A tree of medicinal importance known as the village doctor.
27. Mahua (Madhuः) – A tree that grows in dry stony and sandy soil.

10.6 Medicinal Mountains Alpine Region (Himalayan Forest) -

Location - Trans Himalaya

Water - very cold in winter, with snowfall

Vegetation - It is situated on Mount Kailash and Mount Rishabh. Mount Kailash is located in the Himalayan region. This is confirmed by the reference of Hanuman in Valmiki Ramayana. There are three mountains in the Himalayan region-

1. Mount Kailash
2. Rishabh Parvat
3. Medicine Mountain

Many aromatic medicines were available in the Himalayan region, which have been described in Valmiki Ramayana. According to the description mentioned in the ancient epic, during the Ram-Ravana war, when Lakshman was injured, the doctor gave medicine from Dronagiri mountain. When Hanuman reached Dronagiri mountain, he saw 4 medicines there -

1. Mrit Sanjivani (life saving medicine)
2. Vishalkarno (Medicine capable of healing wounds inflicted by weapons)
3. Swarnakarni (a medicine capable of bringing the body back to a healthy state)
4. Sanghani (Medicine for joining broken limbs/bones)

There are three possible species that can be identified as lifesaving herbs.

1. Rudravanti or Rudanti (Cereta cretica)
2. Bhuti Sanjivani (Selaginella biopteris)
3. Jivanti or Jivka (Flickering Rhea fimbriata)

10.7 Ashok Vatika -

(Evergreen forest)

It was named Ashok Vatika because of the abundance of Ashoka tree. Among other plants Sarla, Karnikash, Kharjush, Priyala, Kutja, Ketki, Priyangu, Neepa etc. were the main plants in Ashok Vatika. Ashoka tree had 4 species of different colors. Champak, Sandana, Nagkesar Shala and Uddhalak etc. have been mentioned in Valmiki Ramayana.

Some common species of fauna like kokila (coal), mayura (peacock), mrig (deer) swan, stork, duck, crab etc. were found in Ashoka Vatika.

10.8 Kishkindha Forestry -

There was abundance of fruit trees in the Kishkindha forest area, among them Jambu, Priyala, Banyan, Peepal, Mango, Red Sandalwood, Ashoka etc. and many types of vines. Like - Malati, Mallika, Vasanti, Madhavi. Pampa Sarovar Lake was situated in this area. Common species of fauna were found in Kishkindha forest area like langur, monkey, bear, marich, fish etc.

10.9 Dandakaranya Forestry -

The region had tropical deciduous forests. Due to the huge rows of trees, it was named Dandak Aranya. Madhuka Sala (Sal tree), Bilba tree, Badri (Indian Plum) etc. were the main trees in this area.

Some common species of fauna like mahis (buffalo), spotted deer, Indian stork, wolf, tiger etc. were found in Dandak forest.

10.10 Biodiversity in Vedic Vangmay -

सत्यं बृहदृतम्रुग्रं दीक्षा तपो ब्रह्म यज्ञः पृथिवीं धारयन्ति।
सा नो भूतस्य भव्यस्य पत्न्युरुं लोकं पृथिवी नः कृणोतुः॥

(अथर्व. 12.1.1)

Tapa, Yajna Deeksha and vastly spread water are the ones who hold the earth, this earth had followed the creatures of the past and will also follow the creatures of the future, this type of earth will give us a place to live .

असंबाधं बध्यतो मानावानां यस्या उद्वतः प्रवतः समं बहु।
नानावीर्या ओषधीर्या बिभर्ति पृथिवी नः प्रथतां राध्यतां नः॥

(अथर्व. 12.1.2)

that land, which supports high, low and flat herbs on the ground, be received by us in every way and in full and all our wishes are mentioned.

गिरयस्ते पर्वता हिमवन्तोऽरण्यं ते पृथिवी स्योनमस्तु।

(अथर्व. 12.1.11)

Oh earth May your snow-capped mountains and dense forests give us happiness.

The forests of the Bafirli regions have been mentioned.

शिला भूमिरश्मा पांसुःसा भूमिः संधृता धृता.. । (अथर्व. 12.1.26)

Earth takes the form of rock, earth, stone and dust.

ये त आरण्याः पशवो मृगा वने हिताः सिंहा व्याघ्राः पुरुषादश्चरन्ति।
उलं वृकं पृथिवि दुच्छुनामित ऋक्षीकां रक्षो अप बाधयास्मत्॥

(अथर्व. 12.1.49)

wolves, bears etc. are mentioned in Aranya (forest) .

यां द्विपादः पक्षिणः संपतन्ति हंसाः सुपर्णाः शकुना वयांसि ।

(अथर्व. 12.1.51)

Two legged birds swans, crows, vultures etc. are mentioned.

Practice questions

Q. 1 Select the correct option.

(1) The number of Nakshatras is-

A) 20 B) 27 C) 22 D) 24

(2) Katha is made from which tree –

A) Banyan B) Palash C) Khair D) Sycamore

(3) Which of the following tree was named Bodhi tree –

A) Ashoka B) Banyan C) Peepal D) Mango

Q. 2 Fill in the blanks.

(1) Mainly there are total …….. trees in Panchavati Vatika.

(2) …… is the main source of Vitamin C.

(3) The number of plants planted in Nakshatra Vatika is …….

Q. 3 Mark True (√) or False (X) against the following statements.

(1) Rocks, stones, dust particles are present on the earth.

(2) Mango is called the king of fruits.

(3) Neem is a tree of medicinal importance.

Q. 4 Match the correct pair.

	Column 'A'	Column 'B'
(1)	Kalidas	a) Ramayana
(2)	Valmiki	b) Kumarasambhavam
(3)	Sycamore	c) Thorny tree of medium height
(4)	Well	d) Shady tree of large size

Q. 5 Short Answer Type Questions

(1) What is Biodiversity?

(2) Tell about Chitrakoot forest area.

(3) What is Nakshatra Vatika?

Q. 6 Very short answer type questions

(1) What types of forests were found in Dandak Aranya forestry?

Q.7 Long Answer Type Questions

(1) Throw light on biodiversity in Vedic literature.

Project work

(1) With the help of your Guruji, plant 5 Plants in the garden of your school.

सही विकल्प का चयन कीजिए / Choose the correct option - 10 × 2 = 20

नोट – दिए गए प्रश्नों मे आंतरिक विकल्पों (अ, ब, स, द) में से किसी एक का चयन करें –

Note – Select any one of the internal options (A, B, C, D) in the given questions -

1. आहवनीय अग्नि कुण्ड की आकृति किस प्रकार की है -

What is the shape of an Ahwaniya Agni Kund?

(i) वर्ग Square (ii) वृत्त Circle (iii) आयात Rectangle (iv) त्रिभुज Triangle

(अ) केवल (i) Only (i) (ब) केवल (ii) Only (ii)

(स) केवल (iii) Only (iii) (द) केवल (iv) Only (iv)

2. मानव शरीर प्रकृति के कितने तत्त्वों से मिलकर बना हुआ है -

The human body is made up of how many elements of nature -

(i) 5 (ii) 4 (iii) 3 (iv) 6

(अ) केवल (i) Only (i) (ब) केवल (ii) Only (ii)

(स) केवल (iii) Only (iii) (द) केवल (iv) Only (iv)

3. चरक सूत्र के अनुसार जिन क्रियाओं से शरीर में दोषों की समता उत्पन्न होती है, कहलाती है–

According to the Charak Sutra, the actions which produce balance of doshas in the body are called –

(i) निवारण Prevention (ii) चिकित्सा Medicine

(iii) आयुर्वेद Ayurveda (iv) स्वास्थ्य Health

(अ) केवल (i) Only (i) (ब) केवल (ii) Only (ii)

(स) केवल (iii) Only (iii) (द) केवल (iv) Only (iv)

4. **यदि कर्तं पतित्वा संशश्रे यदि वाश्मा प्रहृतो जघान।**

ऋभू रथस्येवाङ्गानि सं दधत्परुषा परुः ॥ (अथर्व. 4.12.7)

उपर्युक्त वेद मन्त्र में किस चिकित्सा का उल्लेख है –

Which treatment is mentioned in the above Veda Mantra?

(i) दन्त चिकित्सा
Dentistry

(ii) नेत्र चिकित्सा
Ophthalmology

(iii) शल्य चिकित्सा
Surgery

(iv) केश चिकित्सा
Hair Therapy

(अ) केवल (i)
Only (i)

(ब) केवल (ii)
Only (ii)

(स) केवल (iii)
Only (iii)

(द) केवल (iv)
Only (iv)

5. भीमबेटिका किस राज्य में स्थित हैं –

In which state is Bhimbetika situated?

(i) उत्तरप्रदेश
Uttar Pradesh

(ii) राजस्थान
Rajasthan

(iii) मध्यप्रदेश
Madhya Pradesh

(iv) पंजाब
Punjab

(अ) केवल (i)
Only (i)

(ब) केवल (ii)
Only (ii)

(स) केवल (iii)
Only (iii)

(द) केवल (iv)
Only (iv)

6. चेचक के टीके का निर्माण किसने किया था -

Who created the smallpox vaccine?

(i) राबर्ट ब्राउन
Robert Brown

(ii) एडवर्ड जेनर
Edward Jenner

(iii) ल्यूवेनहॉक
Leeuwenhoek

(iv) राबर्ट हुक
Robert Hooke

(अ) केवल (i)
Only (i)

(ब) केवल (ii)
Only (ii)

(स) केवल (iii)
Only (iii)

(द) केवल (iv)
Only (iv)

7. 1 अहोरात्र में कितने क्षण होते हैं –

How many moments are there in 1 Ahoratra –

(i) 20 (ii) 25 (iii) 30 (iv) 20

(अ) केवल (i) Only (i)

(ब) केवल (ii) Only (ii)

(स) केवल (iii) Only (iii)

(द) केवल (iv) Only (iv)

8. **को अद्धा वेद क इह प्र वोचत् कुत आजाता कुत इयं विसृष्टिः ।** - ऋग्वेद 10.129.6

उपर्युक्त वेद मन्त्र में भौतिकी के किस सिद्धान्त का उल्लेख है –

Which principle of physics is mentioned in the above Veda Mantra?

(i) ऊर्जा संरक्षण Conservation of energy

(ii) संवेग संरक्षण Conservation of momentum

(iii) ब्राह्मण्ड उत्पत्ति Universe Origin

(iv) द्रव्यमान संरक्षण Conservation of mass

(अ) केवल (i) Only (i)

(ब) केवल (ii) Only (ii)

(स) केवल (iii) Only (iii)

(द) केवल (iv) Only (iv)

9. कथन (A) – किसी वस्तु को ऊपर की ओर फेकने पर वह वस्तु पुनः पृथिवी पर लौट आती है।

Assertion (A) – When an object is thrown upwards, that object again returns to the earth.

कथन (R) – आकृष्टि शक्ति के कारण वस्तु पृथिवी पर पुनः लौट आती है ।

Reason (R) – Due to the force of attraction the object comes back to the earth.

(अ) A एवं R दोनों सही है । R, A की सही व्याख्या करता है ।
Both A and R are correct. R is the correct explanation of A.

(ब) A एवं R दोनों सही है । R, A की सही व्याख्या नही करता है ।
Both A and R are correct. R does not explain A correctly.

(स) A सही है परन्तु R गलत है ।
A is correct but R is incorrect.

(द) A गलत है परन्तु R सही है ।

A is wrong but R is correct.

10. कथन (A) सूर्य समस्त ऊर्जा का स्त्रोत है ।

Assertion (A) Sun is the source of all energy.

कथन (R) सूर्य से प्राप्त ऊर्जा, सौर ऊर्जा कहलाती है ।

Reason (R) The energy obtained from the sun is called solar energy.

(अ) A एवं R दोनों सही है । R, A की सही व्याख्या करता है ।

Both A and R are correct. R is the correct explanation of A.

(ब) A एवं R दोनों सही है । R, A की सही व्याख्या नही करता है ।

Both A and R are correct. R does not explain A correctly.

(स) A सही है परन्तु R गलत है ।

A is correct but R is incorrect.

(द) A गलत है परन्तु R सही है ।

A is wrong but R is correct.

रिक्त स्थानों की पूर्ति कीजिए / Fill in the blanks – $5 \times 1 = 5$

11. बहुकोशिकीय जीवों के शरीर का निर्माण ……से होता हैं।

The body of multicellular organisms is made up of …….

12. ..... दो या दो से अधिक धातुओं को मिलाकर बनाई जाती है।

..... is made by combining two or more metals.

13. विशेष नाव ..... धातु से बनाई जाती है।

The special boat is made of …… metal.

14. ..... शुल्बसूत्र सबसे छोटा शुल्बसूत्र है।

The ..... Shulbasutra is the smallest Shulbasutra.

15. राजाभोज द्वारा वर्णित नावों की मापन इकाई को ..... कहते हैं।

The measurement unit of boats described by Rajabhoj is called……

16. निम्नलिखित युग्मों पर विचार कीजिए – $5 \times 0.5 = 2.5$

Consider the following pairs –

	स्तम्भ क Column A		स्तम्भ ख Column B
(i)	स्वास्थ्य Swasthya	(अ)	तनाव प्रबन्धन Stress Management
(ii)	षट् कर्म	(ब)	आर्युयज्ञेन कल्पतां

	Shatkarma		Aryugyen Kalpatan
(iii)	समाधि	(स)	शुद्धिक्रिया
	Samadhi		Purification
(iv)	योगनिद्रा	(द)	परमानन्द की प्राप्ति
	Yoga Nidra		Attainment of bliss
(v)	यजुर्वेद	(य)	4 घटक
	Yajurveda		4 components
		(र)	2 घटक
			2 components

उपर्युक्त युग्मों के आधार पर सही विकल्प का चयन कीजिए –

Select the correct option based on the above pairs –

(A) (i) (स), (ii) (अ), (iii) (र), (iv) (य), (v) (द)

(B) (i) (ब), (ii) (र), (iii) (य), (iv) (अ), (v) (स)

(C) (i) (य), (ii) (स), (iii) (द), (iv) (अ), (v) (ब)

(D) (i) (द), (ii) (स), (iii) (ब), (iv) (अ), (v) (र)

17. निम्नलिखित युग्मों पर विचार कीजिए – 5 x 0.5 = 2.5

Consider the following pairs –

	स्तम्भ क Column A		स्तम्भ ख Column B
(i)	वृक्षायुर्वेद Vrikshayurveda	(अ)	हाथियों के उपचार से संबंधित Related to the treatment of elephants
(ii)	मृगायुर्वेद Mrigayurveda	(ब)	घोड़ों का उपचार Treatment of horses
(iii)	अश्वायुर्वेद Ashvayurveda	(स)	पौधों का उपचार Treatment of plants
(iv)	गजायुर्वेद Gajayurveda	(द)	पशु चिकित्सा Veterinary medicine
(v)	सुश्रुत संहिता Sushruta Samhita	(य)	दन्त चिकित्सा Dentistry
		(र)	शल्यचिकित्सा Surgery

उपर्युक्त युग्मों के आधार पर सही विकल्प का चयन कीजिए –

Select the correct option based on the above pairs –

(A) (i) (स), (ii) (द), (iii) (ब), (iv) (अ), (v) (र)

(B) (i) (ब), (ii) (अ), (iii) (द), (iv) (य), (v) (स)

(C) (i) (स), (ii) (अ), (iii) (र), (iv) (य), (v) (द)

(D) (i) (ब), (ii) (अ), (iii) (र), (iv) (स), (v) (य)

18. निम्नलिखित कथनों पर विचार कीजिए – 5 x 0.5 = 2.5

Consider the following statements –

(i) त्रिदोष की साम्य अवस्था स्वास्थ्य का परिचायक है।

Balanced state of the three doshas is a sign of health.

(ii) योगासनों से शरीर में रक्त संचरण सुव्यवस्थित होता है।

Blood circulation in the body is well organized by Yogasanas.

(iii) प्रणायाम की उपयोगिता कैंसर जैसे दुसाध्य रोगों मे है।

Pranayama is useful in incurable diseases like cancer.

(iv) असंक्रामक रोग आपसी सम्पर्क में आने से फैलते हैं।

Non-communicable diseases spread through physical contact.

(v) काँसा एक धातु है।

Bronze is a metal.

उपर्युक्त (i से v तक) कथनों में से कौन-से सही है ?

Which of the statements given above (i to v) are correct?

(A) i और iii
i and iii

(B) i, iii, iv
i, iii, iv

(C) i और v
i and v

(D) i, ii, iii
i, ii, iii

19. निम्नलिखित कथनों पर विचार कीजिए – 5 x 0.5 = 2.5

Consider the following statements –

(i) शरीर, मन एवं स्वयं मानव जीवन के त्रिपद है।

Body, mind and self are the trinity of human life.

(ii) ऊर्जा को नष्ट किया जा सकता है।

Energy can be destroyed.

(iii) रघुवंशम्, कालिदास द्वारा रचित ग्रन्थ है।

Raghuvansam is a text composed by Kalidas.

(iv) रसरत्नाकार, नागार्जुन की कृति हैं।

Nagarjuna is author of Rasratnakara

(v) क्षार, पदार्थ को मृदु बना देता है।

Alkali softens the material.

उपर्युक्त (i से v तक) कथनों में से कौन – से सही है ?

Which of the statements given above (i to v) are correct?

(A) i और iii
i and iii

(B) i, iii, iv
i, iii, iv

(C) ii और iv
ii and iv

(D) i, ii, iii
i, ii, iii

अति लघूत्तरीय प्रश्न (पूर्ण पक्ति में उत्तर लिखना है) 5 x 2 = 10

Very Short Answer Type Questions (Answer to be written in full line)

20. युक्तिकल्पतरु में वर्णित जहाज निर्माण की काष्ठ कितने प्रकार बताई गई है?

How many types of wood for ship building have been described in Yuktikalpataru?

---

21. बिना पहिए वाला जलवाहन क्या कहलाता है?

What is a water vehicle without wheels called?

---

22. सूर्यसूक्त के अनुसार प्रकाश की कितनी गति है?

What is the speed of light according to Suryasukta?

---

23. शरीर के 7 संरचनात्मक घटकों के नाम लिखिए।

Write the names of 7 structural components of the body.

---

24. त्रिदोष के नाम लिखिए?

Write the names of Tridoshas?

लघूत्तरीय प्रश्न 5 x 3 = 15

Short Answer Type Questions

25. **आयुर्वेद की परिभाषा लिखिए । आयुर्वेद से संबद्ध वेद मन्त्र या श्लोक लिखिए ।**

Write the definition of Ayurveda. Write Veda Mantra or Shloka related to Ayurveda.

मन्त्र या श्लोक / Mantra or Shloka

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26. **प्राचीन भारतीय शल्यचिकित्सा के बारे मे बताइए , सम्बद्ध वेद मन्त्र या श्लोक लिखिए ।**

Tell about ancient Indian surgery, write the associated Veda mantra or verse.

मन्त्र या श्लोक / Mantra or Shloka

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27. श्येन चिति को सचित्र समझाइए ।

Explain Sheen Chiti with diagram.

मन्त्र या श्लोक / Mantra or Shloka

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28. नाड़ीशोधन प्रणायाम को महत्त्व लिखिए ।

Write the importance of Nadi Shodhan Pranayama.

मन्त्र या श्लोक / Mantra or Shloka

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29. गणितीय संख्याओं से संबद्ध वेद मन्त्र या श्लोक लिखिए ।

Write Veda Mantra or Shloka related to mathematical numbers.

मन्त्र या श्लोक / Mantra or Shloka

विवरणात्मक प्रश्न 5 x 4 = 20

Descriptive Questions

30. पञ्चमहाभूत सिद्धान्त को समझाइए, सम्बद्ध वेद मन्त्र या श्लोक लिखिए ।

Explain the principle of Panchmahabhoot, write the related Veda mantra or verse.

मन्त्र या श्लोक / Mantra or Shloka

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31. वैदिक वाङ्मय में निहित औषधियों के बारे में बताइए, संबद्ध वेद मन्त्र या श्लोक लिखिए ।

Write about the medicines contained in the Vedic vangmay, write the associated Veda mantra or verse.

मन्त्र या श्लोक / Mantra or Shloka

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32. वैदिक वाङ्मय में वर्णित जीवों के बारे में बताइए, संबद्ध वेद मन्त्र या श्लोक लिखिए ।
Tell about the creatures mentioned in the Vedic literature, write the related Veda mantra or verse.

मन्त्र या श्लोक / Mantra or Shloka

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33. अग्निपुराण में वर्णित हाथी एवं घोड़े की चिकित्सा के बारे में बताइए, सम्बद्ध श्लोक लिखिए ।
Write about the treatment of elephant and horse described in Agnipuran, write the related shloka.

मन्त्र या श्लोक / Mantra or Shloka

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34. वैदिक वाङ्मय में वर्णित धातु एवं खनिज के बारे में बताइए, संबद्ध वेद मन्त्र या श्लोक लिखिए ।
Write about the metals and minerals mentioned in the Vedic vangmay, write the related Veda Mantra or Shloka.

मन्त्र या श्लोक / Mantra or Shloka

दीर्घ उत्तरीय प्रश्न 4 x 5 = 20

Long Answer Type Questions

35. आयुर्वेद के प्रमुख ग्रन्थों का विस्तारपूर्वक वर्णन कीजिए ।
Describe in detail the major texts of Ayurveda.

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36. आकृष्टिशक्ति सिद्धान्त को समझाइए, सम्बद्ध वेद मन्त्र या श्लोक लिखिए ।
Explain the principle of attraction, write the related Veda mantra or shloka.

मन्त्र या श्लोक / Mantra or Shloka

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37. ऊर्जा के विभिन्न रूपों के बारे में बताइए, सम्बद्ध वेद मन्त्र या श्लोक लिखिए ।
Explain the different forms of energy, write the associated Veda Mantra or Shloka.

मन्त्र या श्लोक / Mantra or Shloka

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38. बृहत्संहिता में वर्णित वृक्षारोपण की विधि को विस्तारपूर्वक समझाइए । सम्बद्ध वेद मन्त्र या श्लोक लिखिए।

Explain in detail the method of tree plantation mentioned in Brihatsamhita. Write the related Veda Mantra or Shloka.

मन्त्र या श्लोक / Mantra or Shloka

Rashtriya Adarsh Veda Vidyalaya Run and Proposed by
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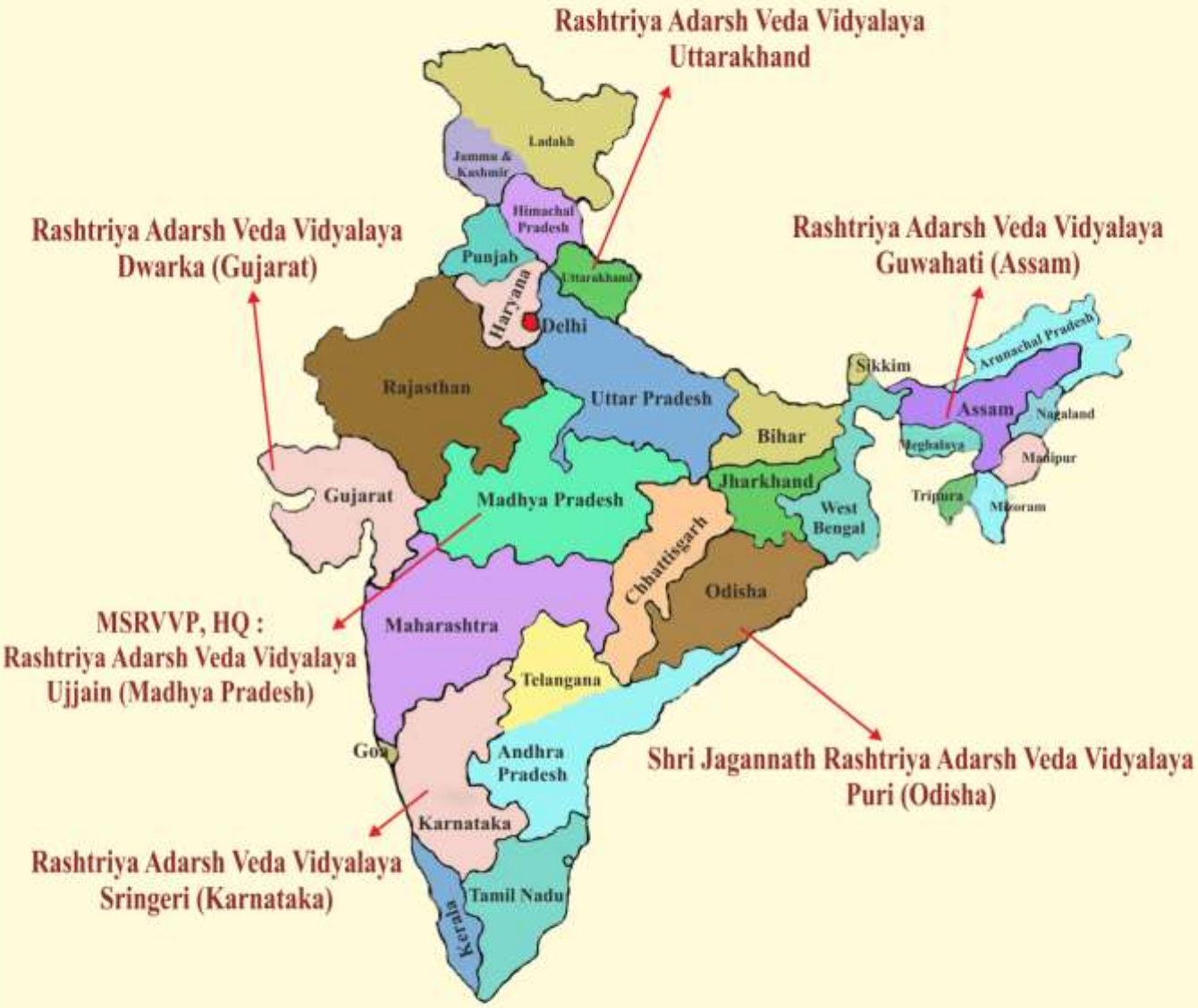
(Ministry of Education, Government of India)



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