

UNIT – V

EDUCATION SYSTEM IN INDIA

5.1 Education in ancient, medieval and modern India, aims of education, subjects, languages

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EDUCATION IN THE ANCIENT PERIOD

- **VEDIC PERIOD**

- Learning in ancient India was imparted by the teachers called Gurus to the pupils who gathered around them and came to live with them in their house as members of the family and a place was called Gurukul. Followed Guru – Shishya Parampara
- The Gurukul functioned as a domestic school, an ashrama, where the children's learning was developed by the Guru who gave personal instruction as well as attention to the . Education was primarily the privilege of the upper castes.
- Indigenous education was imparted at home, in temples, pathshalas, tols, chatuspadis and gurukuls.
- The process of learning generally began with a religious ceremony, 'Upanayana' (sacred thread ceremony).
Education was normally imparted orally.

AIMS OF EDUCATION

- To development of pupil's overall personality.
- To develop inner growth and self-fulfilment techniques
- Primarily, to training his/her mind as the instrument of acquiring knowledge.
- To develop his/her creative capacity
- To develop manana shakti i.e. the thinking which is the higher order thinking

- **THE CURRICULA OF STUDIES**

- **Arthashastra** refers primarily to the education of princes.
- **Upanayana** the prince learnt the four Vedas and the Vedic study included a study of sciences. They also learnt logic, economics and politics.
- **Ramayana** for the princes was Dhanurveda (Knowledge of archery), Nitishastra (ethics), Siksha (lore of elephants and chariots), Alekhya (Painting), Lekhya (writing), Langhana (jumping) and Tairana (swimming).

- **THE ROLE OF GURU OR TEACHER**

The Maitrayani Upanishad teaches

- **Gyan:** the supreme knowledge
- **Vidya:** the result of learning
- **Chintan:** reflection
- **Tapas:** austerity (political-economic policies)

• THE ROLE OF SHISHYA OR LEARNER

- **Atma Vishleshana:** Introspection
- **Satva:** one was to attain goodness, purity of mind and satisfaction of the soul in stages.
- **Guru Dakshina:** honorarium paid in respect towards teachers
- Memorization of texts like Vedas and Dharmashastras, fully or partially. Later subjects like Grammar, Logic, and Metaphysics came to be taught and studied.
- During this time self-education was regarded as the proper method of attaining the highest knowledge.

- **ROLE OF COMMUNITY**

- At that time, knowledge was considered sacred and no fee was charged. Contributions towards education were considered the highest form of donation. All members of the society contributed in some form or the other.
- Financial support came from rich merchants, wealthy parents and society.
- Besides gifts of buildings, the universities received gifts of land. This form of free education was also prevalent in other ancient universities like Valabhi, Vikramshila and Jagaddala.

- **MAURYAN PERIOD**

- During the **Mauryan and the post-Mauryan periods**, the Indian society went through a phase of intensive change.
- The growth of urban centres and trade, the mercantile community came to acquire an important position.
- They became centres of technical education and fostered the knowledge of mining, metallurgy, carpentry, weaving and dyeing.
- There were new formulations in building and architecture. With the emergence of city life, new architectural forms evolved.

- **GUPTA PERIOD**

- In the Gupta period, the Jain and Buddhist systems of education assumed a different dimension.
- **Buddhist System:** monasteries admitted for ten years.
- Learning began with the oral method. Later they shifted to the reading of literary texts.
- The monasteries had libraries, manuscripts were copied and stored
- The monasteries were normally maintained by grants from kings and the rich mercantile class. They attracted scholars from far and near.

- **GUPTA PERIOD**

- Nalanda University was known all over Asia for its high standards of scholarship.
- The Jains used Sanskrit literature like ‘Adipurana’ and ‘Yashatilaka’ for educational purposes in the earlier phase. But to make education more popular, the medium was changed to Prakrit and other regional languages like Tamil, Kannada and so on.
- Books in the Jain and Buddhist libraries were written on palm leaves that were tied together and were known as “granthas”.

• **POST GUPTA PERIOD**

- Art and education made great strides in the reign of Harsha. He encouraged education at all levels; education was given in temples and monasteries and higher education in universities of Taxila, Ujjain, Gaya and Nalanda.
- Entry to these temple colleges was open only to the upper castes or ‘dvijas’

• SUBJECTS TAUGHT

- Both Vedic and Buddhist systems of education had different subjects of study

- **The Vedic system** comprised of

1. The four Vedas (Rig Veda, Sama Veda, Yajur Veda and Atharva Veda),
2. Six Vedangas (Siksha, Chhanda, Vyakarana, Nirukta, Jyotisha and Kalpa. Shiksha = phonetics, Vyakarana = grammar, Chandas = metre, Nirukta = etymology, Kalpa = ritual, Jyotishya = astronomy)

Buddhist systems of education emphasized on

1. Three Pitakas (Vinaya, Abhidhamma and Sutta), the most recognized works of all 18 Buddhism schools.

Common Subjects common to both the systems were arithmetic, military science, law, performing arts, ethics, and art and architecture

- **LANGUAGE**

- **Sanskrit** enjoyed a position of privilege in ancient India. It served as a medium of Brahmanical education.
- **Prakrit** as a language developed with the rise of Jainism. It became the language of the masses.
- **Pāli Canon** is the sacred language of Buddhism.
- **Apabhramsha** (non – grammatical language) was used by Jain writers in Gujarat and Rajasthan for the composition of poetry.
- **Dravidian languages** Tamil, Telugu, Kannada and Malyalam were in use in the southern parts of India. They found expression in the literature of this period as well.

• CENTERS OF LEARNING IN THE SOUTH OF INDIA

1. Hindu Centers:

- **Agraharas:** centers of learning and teaching, whole settlement of learned brahmins, with its own powers of government and was maintained by generous donations from the society.
- **Temples:** academies where more advanced subjects were taught
- **Mathas:** centers of Vedanta studies
- **Brahmapuri:** cultural institutions
- **Ghatika** was a centre of learning including religion and was small in size.

2. Jain Centers:

- **Basadis:** testimony to rich Jain culture

3. Buddhist Centre:

- **Viharas** also existed as other sources of learning during this period.

EDUCATION IN THE MEDIEVAL PERIOD

- With the establishment of the Delhi Sultanate, Islamic system of education was introduced.
- Education in medieval India was designed on the lines of the tradition of education developed under the Abbasids of Baghdad.

- **EDUCATION SYSTEM**

- The institutions that provided school education were known as ‘makhtabs’, while those of higher learning were called ‘madrasas.
- The ‘makhtabs’ were generally run by public donations while ‘Madrasas’ were maintained by the rulers and nobles.
- **There were six different types of institutions:**
 - (i) those established and maintained by nobles and rulers,
 - (ii) those which were started by individual scholars with the help of state assistance or donations,
 - (iii) those that were attached to the mosques,
 - (iv) those that were attached to the tombs,
 - (v) those that were started and maintained by individual scholars,
 - (vi) those that were attached to the Sufi hospices.

- **SUBJECTS**

- The education were taught in the Madarsas like Jurisprudence (takmil ifta), Arabic Literature (Takmil Adab) and hadith (Takhassus fil Hadith) or Qirat which was a method of recitation, punctuation and vocalization of the text Quran etc.
- The curriculum was broadly divided into two categories:
- **The transmitted science (manqulat):** law and history and literature came under the traditional sciences
- **The rational science (maqulat) :** Logic, philosophy, medicine, mathematics and astronomy

- **EDUCATION SYSTEM UNDER THE GREAT MUGHALS**

- The Mughal period made immense contribution in the field of learning and education.
- The Mughal emperors had great love for learning and they contributed more in the field of spreading education through Pathshalas, Vidyapeeths, Makatabs and Madarsas.
- Akbar gave grants to educational institutions.
- He started a College near Jama Masjid. At that time, education was not a state subject.
- There was no provision for women's education. The women of the royal and rich families got education at home

- **LANGUAGE**

- Urdu as a language which came out of a long contact between Persian and Hindi i.e. the Turks and the Indians
- Sanskrit and Persian were taught in temples and mosques.

EDUCATION IN THE MODERN PERIOD

- **EIGHTEENTH CENTURY: THE BEGINNING OF MODERN PERIOD**

- According to Thomas in 1891 ‘The English found in India, a widespread style of elementary education and higher education, of which the former was mainly practical while the latter mainly literary, philosophical and religious.
- For about 150 years, the British were involved in trade and conquest in India. So, they maintained a distance from all kinds of cultural activities including education.
- The beginning of oriental scholarship was made by Warren Hastings in 1781 when he started the Calcutta Madrasa.
- His endeavour was primarily due to administrative reasons.
- Eleven years later, in 1792, Jonathan Duncan, a Resident of Varanasi started a Sanskrit college to educate native Hindus to assist the Europeans.

- Meanwhile, Christian missionaries were making efforts to introduce Western education by opening elementary schools and providing education to the humbler sections of the society, including the so-called untouchable castes.

- **NINETEENTH CENTURY**

- The first half of the nineteenth century can be called a period of educational experiments.
- The East India Company's Charter Act of 1813 enabled the Company to set aside one lakh rupees for “the revival and improvement of literature and the encouragement of learned natives of India and for the introduction and promotion of a knowledge of sciences among the inhabitants of the British territories in India”.
- A debate ensued between the Orientalists and the Anglicists which was finally settled by Macaulay's Minutes and Bentinck's Resolution of 1835.
- It was decided that this fund would be utilised to promote European literature and sciences.

- **NINETEENTH CENTURY**

- **Lord Hardinge in 1844**, decided to grant employment to Indians who had received English education.
- **Wood's Despatch of 1854** underlined the objective of educational policy which was the diffusion of “the improved arts, sciences, philosophy and literature of Europe” through English or other modern Indian languages as the medium and started Universities in Bombay (modern Mumbai), Madras (modern Chennai) and Calcutta (modern Kolkata).
- It emphasized the development of private enterprise, a system of grants-in-aid, training teachers in the schools, women's education and so on

- **BEGINNING OF 20TH CENTURY**

- The Indian Universities in 1904 act was passed that enabled the Universities to assume teaching, inspection of colleges and undertake measures for qualitative improvement in higher education.
- The examination system was emphasised in both high schools and Universities.
- The positive aspect was that it produced a breed of educated political leaders and social reformers who played important roles in the freedom struggle of the country.
- The publication of newspapers and pamphlets brought about an awakening among the masses.

• **IMPACT OF ENGLISH EDUCATION**

- The British encouraged the teaching of English language in schools and colleges as they needed people to work in the administrative offices either as clerks or babus.
- English books and newspapers brought to them new ideas like freedom, democracy, equality and brotherhood from across the sea, i.e. other countries.
- The educated Indians now thought of getting freedom from British rule.

- **EDUCATION IN POST-INDEPENDENCE INDIA**

- To achieve the goals of personal, economic, social, political and cultural development, it is necessary to make appropriate provisions for an integrated programme of education for people who happen to be living at different levels of development, possessing different linguistic, social and cultural attributes.
- **In 1966, the Report of the Education Commission (1964- 66)** (popularly known as **Kothari Commission**) referred to education as the only instrument of peaceful social change.
- **The Constitutional Amendment of 1976** included education in the concurrent list, that is, the centre and states both assume joint responsibility of education.

- **Elementary Education**

- Elementary education is the most crucial stage of education, spanning the first eight years of schooling (class I to VIII) and laying the foundation for the development of the pupils.
- The Constitution under Article 45 provided for the State to introduce compulsory and free education for children up to the age of fourteen. The period of elementary school is now also recognised as a period of free and compulsory schooling
- The National Policy on Education 1986 emphasized that thrust areas in elementary education will be universal access and enrolment. universal retention of children up to fourteen years of age in the school.
- Sarva Shiksha Abhiyan was a flagship programme of the Central Government for universalization of elementary education started in 2001.

• **Secondary Education**

- It covers children of age group 14-18 (classes 9th to 12th). According to 2001 census 88.5 million children are enrolled in secondary education.
- While a great increase has taken place in number of schools and in enrolment, there has been a lesser increase in the number of teachers and the decline has adversely affected the teacher-pupil ratio. The pressure for expansion will most certainly continue and may indeed increase as the country progresses towards the universalisation of education.

- **Technical and Vocational Education Training (TVET)**
- Technical and management curriculum was targeted on current as well as the projected needs of industry.
- Technically trained persons have already been a source of strength for scientific and industrial development.
- There are several centres of excellence in technical and professional education in India like the Indian Institutes of Technology (IIT) and Indian Institutes of Management (IIM)

- **Higher Education**

- Higher education begins after a student completes senior secondary (class XII) stage.
- While few colleges and universities are playing a crucial role in academic excellence, the general condition of universities and colleges is a matter of great concern to the nation.
- The first Prime Minister of India, late Pt. Jawaharlal Nehru, who laid the foundation of the process of India's modernisation, declared that if all is well with the Universities, all would be well with the nation.
- The number of in the age group of 18-20 years enrolled for higher education is low. The proportion is even more adverse in some regions, particularly in case of women, scheduled castes and tribes. Rural areas have been touched only marginally by higher education of quality.

• **Adult Education**

- Removal of adult illiteracy has also been accepted as an imperative goal, Adult education particularly in the age group of 15-35 years has been included as part of the minimum needs programme in the sixth plan.
- In this regard National Literacy Mission (NLM) objective is to impart functional literacy to 80 million illiterate persons.

• **Open and Distance Learning System**

- There are many learners who are compelled to discontinue their studies in the formal system. This may be because of financial, geographical, academic or medical reasons.
- Open and Distance Learning (ODL) system is meant for such learners. In this system the learner can learn through lessons sent by the institutions of distance learning without attending classes.
- These can keep themselves engaged in service or business while studying.
- The learner is not in direct touch with the teacher. He is at a distance.
- Open School at present offers both secondary (Class X) and senior secondary (Class XII) education.

• **RECENT DEVELOPMENTS IN EDUCATION**

Right to Education Act

- The 86th Constitutional amendment, making education a fundamental right was passed by Parliament in 2002. The Right of Children to Free and Compulsory Education Act, a law to enable the implementation of the fundamental right, was passed by the Parliament in April 2010.
- The law makes it obligatory on part of the state governments and local bodies to ensure every child in the age group 6-14 gets free elementary education in a school in the neighbourhood.

• **National Education Policy (1986)**

- Since independence, the Nation has invested a large part of its resources in education. It, therefore, has a right to expect the efficient functioning of educational institutions.
- **The first National Education Policy of 1968** marked a significant step in the history of education in post-independence India.
- It laid stress on the need for a radical reconstruction of the education system, technology, the cultivation of moral values and a closer relation between education and the life of the people.
- **The new National Policy of Education (1986)**, was formulated on the strength of considerable achievements in the last few years.

- **Rastriya Madhyamik Shiksha Abhiyan (RMSA)**

- It is a centrally sponsored scheme for Universalisation of access to and improvement of quality education at Secondary stage was implemented during 11th five-year plan period.
- The goal of RMSA is to make secondary education of good quality available, accessible and affordable to all young in the age group 15-16 years (classes IX and X).
- To improve the quality of RMSA scheme it has been proposed that following work should be carried out.
 - a) Construction of science lab, libraries
 - b) In service training of teachers
 - c) Leadership training of school head
 - d) Curricular reforms

UNIT – V

5.2 SCIENCE AND SCIENTISTS

Ancient India

SCIENTISTS OF ANCIENT INDIA

MATHEMATICS & ASTRONOMY

- Science and Mathematics were highly developed during the ancient period in India.
- Ancient Indians contributed immensely to the knowledge in Mathematics as well as various branches of Science.

Baudhayan

- Baudhayan was the first one ever to arrive at several concepts in Mathematics like Pythagoras theorem: π is useful in calculating the area and circumference of a circle was already found in Baudhayan's Sulva Sutra, which was written several years before the age of Pythagoras.

Aryabhatta

- Aryabhatta was a fifth century mathematician, astronomer, astrologer and physicist.
- At the age of 23, he wrote Aryabhattiya, which is a summary of mathematics of his time. There are four sections in this scholarly work.
- First section he describes the method of denoting big decimal numbers by alphabets.
- Second section, such as number theory, geometry, trigonometry and Beejganita (algebra)
- The remaining two sections are on astronomy.
- Showed that zero was not a numeral only but also a symbol and a concept and find out the exact distance between the earth and the moon.
- The discovery of zero also opened up a new dimension of negative numerals.
- He also gave a scientific explanation for solar and lunar eclipse clarifying that the eclipse was not because of Rahhu and/or Ketu or some other rakshasa (demon), but explained that our planet earth is 'Achala' (immovable), Aryabhatta stated his theory that 'earth is round and rotates on its own axis'

Brahmgupta

- In 7th century, Brahmgupta took mathematics to heights far beyond others.
- In his methods of multiplication, he used place value in almost the same way as it is used today. He introduced negative numbers and operations on zero into mathematics.
- He wrote Brahm Sputa Siddantika through which the Arabs came to know our mathematical system.

Bhaskaracharya

Bhaskaracharya was the leading light of 12th Century.

He was born at Bijapur, Karnataka.

He is famous for his book Siddhanta Shiromani.

It is divided into four sections: Lilavati (Arithmetic), Beejaganit (Algebra), Goladhyaya (Sphere) and Grahaganit (mathematics of planets).

Bhaskara introduced Chakrawat Method or the Cyclic Method to solve algebraic equations.

Mahaviracharya

- There is an elaborate description of mathematics in Jain literature (500 B.C -100 B.C).
- Jain gurus knew how to solve quadratic equations.
- He have also described fractions, algebraic equations, series, set theory, logarithms and exponents in a very interesting manner.
- Jain Guru Mahaviracharya wrote Ganit Sara Sangraha in 850A.D., which is the first textbook on arithmetic in present day form.
- The current method of solving Least common Multiple (LCM) of given numbers was also described by him.

Kanad

- Kanad was a sixth century scientist of Vaisheshika School, one of the six systems of Indian philosophy.
- His original name was Aulukya.
- He got the name Kanad, because even as a child, he was interested in very minute particles called “kana”.
- His atomic theory can be a match to any modern atomic theory
- According to Kanad, material universe is made up of kanas, (anu/atom)

Varahamihira

- He lived in the Gupta periods. Varahamihira made great contributions in the fields of astrology, hydrology, geology and ecology
- He was one of the first scientists to claim that termites and plants could be the indicators of the presence of underground water.
- He gave a list of six animals and thirty plants, which could indicate the presence of water.
- He gave very important information regarding termites (Deemak or insects that destroy wood), that they go very deep to the surface of water level to bring water to keep their houses (bambis) wet.
- The earthquake cloud theory given by Varahmihira in his Brihat Samhita.
- The thirty second chapter of this samhita is devoted to signs of earthquakes.
- He has tried to relate earthquakes to the influence of planets, undersea activities, underground water, unusual cloud formation and abnormal behaviour of animals.
- Varahamihira was one of the nine gems, who were scholars, in the court of Vikramaditya. Varahamihira's predictions were so accurate that king Vikramaditya gave him the title of 'Varaha'.

Nagarjuna

- Nagarjuna was a tenth century scientist.
- The main aim of his experiments was to transform base elements into gold, like the alchemists in the western world.
- Even though he was not successful in his goal, he succeeded in making an element with gold-like shine.
- Till date, this technology is used in making imitation jewelry.
- In his treatise, Rasaratnakara, he has discussed methods for the extraction of metals like gold, silver, tin and copper.

MEDICAL SCIENCE IN ANCIENT INDIA (AYURVEDA & YOGA)

Ayurveda

- The word Ayurveda literally means the science of good health and longevity of life.
- This ancient Indian system of medicine not only helps in treatment of diseases but also in finding the causes and symptoms of diseases.
- It defines health as an equilibrium in three doshas, and diseases as disturbance in these three doshas. The doshas derive from the Five Elements and their related properties.
- **Vata** is composed of Space and Air, **Pitta** of Fire and Water, and **Kapha** of Earth and Water.
- While treating a disease with the help of herbal medicines, it aims at removing the cause of disease by striking at the roots.
- A treatise on Ayurveda, Atreya Samhita, is the oldest medical book of the world.
- Charak is called the father of ayurvedic medicine and Susruta the father of surgery.
- Susruta, Charak, Madhava, Vagbhatta and Jeevak were noted ayurvedic practitioners.

Susruta

- Susruta was a pioneer in the field of surgery and very accurate step-by-step description of these operations was mentioned
- Susruta's greatest contribution was in the fields of Rhinoplasty (plastic surgery) and Ophthalmic surgery (removal of cataracts). In those days, cutting of nose and/or ears was a common punishment.
- Restoration of these or limbs lost in wars was a great blessing.
- In Susruta Samhita, over 1100 diseases are mentioned including fevers of twenty-six kinds, jaundice of eight kinds and urinary complaints of twenty kinds.
- Over 760 plants are described. All parts, roots, bark, juice, resin, flowers etc. were used. Cinnamon, sesame, peppers, cardamom, ginger are household remedies even today.
- The method of selecting and preserving a dead body for the purpose of its detailed study has also been described.
- Susruta Samhita also gives a description of 101 instruments used in surgery.
- Some serious operations performed included taking foetus out of the womb, repairing the damaged rectum, removing stone from the bladder, etc.

Charak

- Charak is considered the father of ancient Indian science of medicine.
- He was the Raj Vaidya (royal doctor) in the court of Kanishka.
- His Charak Samhita is a remarkable book on medicine.
- It has the description of a large number of diseases and gives methods of identifying their causes as well as the method of their treatment
- He was the first to talk about digestion, metabolism and immunity as important for health and so medical science
- In Charak Samhita, more stress has been laid on removing the cause of disease rather than simply treating the illness.
- Charak also knew the fundamentals of Genetics.

Yoga & Patanjali

- The science of Yoga was developed in ancient India as an allied science of Ayurveda for healing without medicine at the physical and mental level.
- The term Yoga has been derived from the Sanskrit work Yoktra. Its literal meaning is “yoking the mind to the inner self after detaching it from the outer subjects of senses”
- It defines chitta i.e. dissolving thoughts, emotions and desires of a person’s consciousness and achieving a state of equilibrium.
- It sets in to motion the force that purifies and uplifts the consciousness to divine realization.

- Yoga is physical as well as mental wellness.
- Physical yoga is called **Hatha yoga** and it aims at removing a disease and restoring healthy condition to the body.
- **Rajayoga** is mental yoga. Its goal is self-realization and liberation from bondage by achieving physical mental, emotional and spiritual balance.
- Yoga was passed on by word of mouth from one sage to another.
- The credit of systematically presenting this great science goes to Patanjali.
- In the Yoga Sutras of Patanjali, Aum is spoken of as the symbol of God.
- He refers to Aum as a cosmic sound, continuously flowing through the ether, fully known only to the illuminated.
- Besides Yoga Sutras, Patanjali also wrote a work on medicine and worked on Panini's

UNIT – V

SCIENCE AND SCIENTISTS

5.3 MEDIEVAL INDIA

SCIENCES IN MEDIEVAL PERIOD

- The medieval period marks the coming of Muslims in India.
- The pattern of education as prevalent in Arab countries was gradually adopted during this period.
- As a result, Maktabas and Madrasas came into existence.
- These institutions used to receive royal patronage. A chain of madrasas, opened at several places, followed a set curriculum.
- The two brothers, Sheikh Abdullah and Sheikh Azizullah, who were specialists in rational science, headed the madrasas at Sambal and Agra
- Apart from the talent available locally in the country, learned men from Arabia, Persia and Central Asia were also invited to take charge of education in madrasas.

- The Muslim rulers attempted to reform the curriculum of primary schools.
- Some important subjects like Arithmetic, Mensuration, Geometry, Astronomy, Accountancy, Public Administration and Agriculture were included in the courses of studies for primary education.
- Efforts were made to seek a kind of synthesis between the Indian traditional scientific culture and the prevalent medieval approach to science in other countries
- Large workshops called karkhanas were maintained to supply provision, stores and equipment's to royal household and government departments
- The karkhanas not only worked as manufacturing agencies, but also served as centres for technical and vocational training to young people
- The karkhanas trained and turned out artisans and craftsperson's in different branches, who later on set up their own independent karkhanas.

- **Mathematics**
- Narayana Pandit, son of Narsimha Daivajna was well known for his works in Mathematics – Ganitakaumudi and Bijaganitavatamsa.
- Ganesa Daivajna produced Buddhivilasini - a commentary on Lilavati - containing a number of illustrations.
- Krishna of the Valhalla family brought out Navankura on the Bijaganit of Bhaskara-II and elaboration of the rules of indeterminate equations of the first and second orders.
- Nilakantha Jyotirvida compiled Tajik, introducing a large number of Persian technical terms
- Faizi, at the behest of Akbar, translated Bhaskara's Bijaganit
- Akbar ordered to make Mathematics as a subject of study, among others in the education system
- Naisiru'd -din-at -tusi, was another scholar of Mathematics and he is often considered the creator of trigonometry

Biology

- Hamsadeva compiled a work in the field of Biology entitled Marga-paksi-sastra in the thirteenth century. This gives a general, though not always scientific, account of some animals and birds of hunting.
- Akbar had a special interest in producing good breeds of domestic animals like elephants and horses.
- Jahangir, in his work - Tuzuk-i-Jahangiri recorded his observations and experiments on breeding and hybridization. He described about 36 species of animals.
- His court artists, specially, Mansur, produced elegant and accurate portraitures of animals. Some of these are still preserved in several museums and private collections.
- As a naturalist, Jahangir was also interested in the study of plants. His court artists have drawn around 57 plants in their floral portraitures.

Chemistry

- An important application of Chemistry was in the production of paper.
- Kashmir, Sialkot, Zafarabad, Patna, Murshidabad, Ahmedabad, Aurangabad and Mysore became well known centres of paper production.
- The paper making technique was more or less the same throughout the country differing only in preparation of the pulp from different raw materials.
- The Mughals knew the technique of production of gunpowder and its use in gunnery, another application of Chemistry.
- The Indian craftsman's learnt the technique in evolved suitable explosive composition
- The work Sukraniti attributed to Sukracarya contains a description of how gunpowder, sulphur and charcoal in different ratios for use in different types of guns.
- The principal type of fireworks included those which pierces through air, produce sparks of fire, blaze with various colours and end with explosion.
- The work Ain –I-akbari speaks of the regulation of the Perfume office of Akbar.
- The attar (perfume) of roses was a popular perfume, which is supposed to have been discovered by Nurjehan

Astronomy

- Astronomy was another field that flourished during this period. In astronomy, a number of commentaries dealing with the already established astronomical notions appeared.
- Mehendra Suri, a court astronomer of Emperor Firoz Shah, developed an astronomical instrument 'Yantraja'.
- Paramesvara and Mahabhashkariya, both in Kerala, were famous families of astronomers and almanac-makers.
- Nilakantha Somasutvan produced commentary of Aryabhatiyaa. Kamalakar studied the Islamic astronomical ideas.
- He was an authority on Islamic knowledge.
- Maharaja Sawai Jai Singh-II of Jaipur was a patron of Astronomy.
- He set up the five astronomical observatories in Delhi, Ujjain, Varansasi, Mathura and Jaipur.

Medicine

- The Ayurveda system of medicine did not progress as vigorously as it did in the ancient period because of lack of royal patronage. However, some important treatises on Ayurveda like the Sarangdhara Samhita and Chikitsasamgraha by Vangasena, the Yagaratbajara and the Bhavaprakasa of Bhavamisra were compiled.
- The Sarangdhara Samhita, written in the thirteenth century, includes use of opium in its material medical and urine examination for diagnostic purpose. The drugs mentioned include metallic preparation of the rasachikitsa system and even imported drugs.
- The Rasachikitsa system, dealt principally with a host of mineral medicines, both mercurial and non-mercurial.
- The Siddha system mostly prevalent in Tamil Nadu was attributed to the reputed Siddhas, who were supposed to have evolved many life-prolonging compositions, rich in mineral medicines.

- The Unani Tibb system of medicine flourished in India during the medieval period. Ali-bin-Rabban summarized the whole system of Greek medicine as well as the Indian medical knowledge in the book, Firdausu-Hikmat.
- The Unani medicine system came to India along with the Muslims by about the eleventh century and soon found patronage for its growth
- Hakim Diya Muhammad compiled a book, Majiny-e-Diyae, incorporating the Arabic, Persian and Ayurvedic medical knowledge.
- Firoz Shah Tughalaq wrote a book, Tibbe Firozshahi.
- The Tibbi Aurangzebi, dedicated to Aurangzeb
- The Musalajati-Darshikohi of Nuruddin Muhammad, dedicated to Darashikoh, deals with Greek medicine

Agriculture

- In the medieval period, the pattern of agricultural practices was more or less the same as that in early India.
- Some important changes occurred in the introduction of new crops, trees as well as horticultural plants by foreign traders.
- The principal crops were wheat, rice, barley, millets, pulses, oilseeds, cotton, sugar-cane and indigo.
- The Western Ghats continued to yield black pepper of good quality and Kashmir maintained its tradition for saffron and fruits, Ginger and cinnamon from Tamil Nadu, cardamom, sandalwood and coconut from Kerala, were becoming increasingly popular. Tobacco, chillies, potato, guava, custard apple, cashew and pineapple were the important plants which were introduced to India during the sixteenth and seventeenth centuries.

- It was during this period that the production of opium from poppy plants began in Malwa and Bihar regions.
- Improved horticultural methods were adopted with great success.
- The systematic mango-grafting was introduced by the Jesuits (Roman Catholic) of Goa in the middle of sixteenth century.
- For irrigation, wells, tanks, canals, rahat, charas and dhenkli charas (a sort of a bucket made of leather used to lift water with the help of yoked oxen) were used.
- Persian wheel was used in the Agra region.
- In the medieval period, agriculture was placed on a solid foundation by the State by introducing a system of land measurement and land classification, beneficial both to the rulers as well as the tillers.

UNIT – V

SCIENCE AND SCIENTISTS

5.4 MODERN INDIA

- **SRINIVAS RAMANUJAN (1887-1920)**
- Srinivasa Aiyangar Ramanujan (FRS) better known as Srinivasa Iyengar Ramanujan, one of India's greatest mathematical genius, was born at Erode in Tamil Nadu on 22 December, 1887. Later on, his parents shifted to Kumbakonam, 160 kilometres from Chennai.
- Three of his research note books are available to us. They are called Ramanujan's Frayed Notebooks
- He published many papers in London.
- He was the second Indian to be elected Fellow of the Royal Society of London and the first Indian to be elected Fellow of Trinity College.
- In 1917, he fell seriously ill, but the numbers remained his friend, though his body betrayed him.
- Unfortunately, his health became worse and he returned to India in 1919, "With a scientific standing and reputation".
- He died in 1920.
- His mathematical genius is a proof that India indeed is the birthplace and source of great mathematical ideas.

CHANDRASEKHARA V. RAMAN (1888-1970)

- Chandrasekhara V. Raman, popularly known as C.V. Raman, he won the Nobel Prize for Physics in 1930. He was the first Asian to receive this award.
- C.V. Raman was born on 7 November 1888 in Tiruchirapalli, in Tamil Nadu. His father was a professor of Physics and Mathematics.
- He stood first in the Indian Audit and Accounts (IAAS) Examination and was appointed as Assistant Accountant General in the Finance Department in Calcutta at the age of nineteen.
- In 1921, he read a paper on the theory of Stringed Instruments before the Royal Society of London.
- In 1924, he was made Fellow of the Royal Society.
- On his journey to England, he was greatly attracted by the blue colour of the sea. He was curious to know why it remained blue even when big waves rolled up. Then he got the intuitive flash that it was due to the breaking up of sun's light by water molecules. He conducted many experiments and prepared a long paper on molecular scattering of light and sent it to the Royal Society of London.

Raman Effect

- When a beam of monochromatic (having single colour) light passes through a transparent substance, it scatters. Raman studied the broken light.
- He found that there were two spectral lines of very low intensity (strength) parallel to the incident monochromatic light.
- This showed that broken light was not monochromatic, though the incident light was monochromatic.
- Thus, a great phenomenon hidden in nature was revealed to him.
- This phenomenon became famous as Raman Effect and spectral lines in the scattered light as Raman Lines.
- While scientists had been debating over the question whether light was like waves or like particles, the Raman Effect proved that light is made up of particles known as photons.
- He proved through the example of his life, how our ancestors formulated great theories using the power of their mind.

JAGDISH CHANDRA BOSE 1858-1937

- J.C. Bose another great scientist of modern India brought glory and respect for the country.
- He was born on 30 November, 1858 at Mymensingh, now in Bangladesh, where he had his early education.
- He had his higher education at St. Xavier's College, Calcutta.
- In 1885 he was appointed Assistant Professor of Physics at the Presidency College but refused to take salary because it was nearly half of that of an Englishman.
- He made an apparatus to study the properties of electric waves. For his paper on "The Electromagnetic Radiation and Polarization of Electric Ray", he was made a Knighting 1917 and Fellow of the Royal Society of London in 1920.
- He was the first Indian scientist in Physics to receive this honour.

- Dr. Bose is famous all over the world as the inventor of Cresco graph that can record even the millionth part of a millimetre of plant growth and movement.
- Dr. Bose proved through graphs taken by the Cresco graph that plants have a circulatory system too.
- Cresco graph has also shown that the upward movement of sap in plants is the activity of living cells.
- Dr. Bose also made many other instruments famous all over the world as Bose instruments, to prove that even metals react to outward stimuli. Bose's instruments have shown, how even steel and metals used in scissors and machinery get tired and regain efficiency after a period of rest.
- Besides Cresco graph and other Bose instruments, his wireless inventions

HOMI JEHANGIR BHABHA (1909-1966)

- Dr. Homi Jehangir Bhabha was a great scientist. He led India into atomic age. He is called the father of Indian Nuclear Science. He was born on 30 October, 1909 in a famous Parsi family. Even as a boy, he showed his intelligence and won many prizes. He did his early studies in Mumbai.
- He took a degree in Mechanical Engineering in First Class from Cambridge, completed research work there and received his doctorate in 1935. Till 1939, he carried outstanding original research relating to cosmic radiation. He returned to India when the Second World War started.
- He took a very bold decision and wrote a letter to Sir Dorab Ji Tata suggesting that an institution should be established which would lay the foundation of India as a world nuclear power. This institute would produce its own experts and the country would not have to depend on outside sources. As a result, Tata Institute of Fundamental Research (TIFR) was started in 1945, at Dr. Bhabha's ancestral home.
- India's first atomic research centre now called Bhabha Atomic Research Centre (BARC) was established at Trombay.
- India's First atomic reactor, Apsara was also established under his expert guidance. Bhabha became the first chairman of the Atomic Energy Commission set up in 1948.
- His studies in the field of atomic energy are considered of great importance in international circles. He served as the chairman of on peaceful uses of atomic energy, supported by the United Nations.
- The Government of India honoured him with Padma Bhushan. In 1966, Dr. Bhabha died in a plane crash.

DR. A.P.J. ABDUL KALAM

- Dr. A.P.J .Abdul Kalam, the eleventh President of India was born on 15 October, 1931, in the island town of Rameshwaram, in Tamil Nadu. He was awarded the Bharat Ratna, India's highest civilian honour in 1997 for his contributions in the field of science and engineering.
- Dr. Kalam served in Indian Space Research Organisation (ISRO) from 1963 to 1982.
- Vikram Sarabhai Space Centre, he developed the Satellite Launch Vehicle (SLV 3), which put the satellite Rohini into orbit.
- In 1982, as Director, Defence Research Development Organisation (DRDO), he was given the responsibility of Integrated Guided Missile Development Programme (IGMDP).

- He developed five projects for defence services - Prithvi, Trishul, Akash, Nag and Agni. He led India into an era of self-dependence. The light weight carbon material designed for Agni has been used to make calipers for the polio-affected. The material has reduced the weight of calipers to 400 grams from 4 kgs. It is a great blessing for human beings.
- The material has also been used for making spring like coils called stents, which are used in Balloon Angioplasty for treating heart patients.
- Dr. Kalam says, “I have no belongings in the worldly sense. I have acquired nothing, built nothing, possess nothing, no family, sons, daughters.”

UNIT – V

5.5 THE ROLE OF GURUKULAS IN EDUCATION SYSTEM

PREPARED BY: NOOR UL HUDA - ASSISTANT PROFESSOR

INTRODUCTION

- The Gurukul was a type of school in ancient education and learning system during the vedic times.
- They will gather there and learn Vedas from their Guru. They were treated equally irrespective of their social standards.
- They were treated as a part of Guru families and followed Guru – Shishya Parampara

Ceremonies to Start Education

Hindu System:

The Vidyarambha ceremony: included worshiping of Goddess Saraswati and learning alphabets for the first time.

Upanayana: Leaving home and starting to live with a teacher required the child to conduct another ceremony. Boys and Girls practiced this ceremony

Buddhist system:

Pabbajja or Prabrajya: a child started his education at the age of eight, with this ceremony. This initiation ceremony could be practiced by boys of all castes. After this, the child would leave home and go to live in a monastery under the guidance of his teacher (a monk).

SOURCES OF EDUCATION

The ancient system of education was the education of the Vedas, Brahmanas, Upanishads and Dharmasutras.

Sources of learning were drawn from various disciplines such as

Itihas (history), Anviksiki (logic), Mimamsa (interpretation) Shilpashastra (architecture), Arthashastra (polity), Varta (agriculture, trade, commerce, animal husbandry) and Dhanurvedya (archery).



Visual mapping of the various disciplines encompassed in the Vedas

Education for women in Gurukula System

Educated women were divided into two classes –

Sadyodwahas: those who pursued their education just until they got married

Brahmavadinis: those who never married and continued studying throughout their lives

Aim of Education

- **Chitta-britti-nirodha** control of the mental waves by which the individual soul merges in the universal or over soul.
- **Sattva** light
- **Rijuta** straight forwardness

The objective of education

Is summarized in a triple formula which informs the about their higher self:

- 1. Asato ma sadgamaya** - lead me from falsehood to truth;
- 2. Tamosorma jyotirgamaya** - lead me from darkness to light;
- 3. Mriturma amrit gamaya** - lead me from death to immortality

Methods of Learning:

- **Sravana-** knowledge heard: listening to words or texts as they are uttered by the teacher.
- **Manana-** assimilation, deliberation-reflection on the topic taught or intellectual apprehension of its meaning.
- **Nidhidhyasana-** meditating on what was taught: complete comprehension of the truth: the realization of the intrinsic unity underlying all diversity: realization of the Self.

Education System

- **Swaddhyaya pravachane cha** - Education is a continuous activity in life (**self-study**) **discourse** and conversation (**uncover yourself to discover**)
- A teacher acts as a cognitive guide and creates environments in which the learner interacts meaningfully with academic material and adopts a method to impart and imbibe education that can balance:
 1. Mind and heart
 2. Body and spirit.
- During residential pupil age the student had to live a controlled life determined by the institution of **brahmacharya**.
- **First Duty of the Student:** to walk to the woods and collect fuel.
- **Second Duty of the Student:** to tend the teacher's house and cattle and live with his teacher as his antevasin (companion).

The Academic Sessions Started With A Special Ceremony

Upkarman: on the Guru Purnima (Full month of Shravana)

Utsarjan: as solemnly closed on Rohini (Fullmoon month of pausha)

- The whole session was punctuated with holidays especially on new moon full moon days of the month.

Preservation of knowledge & culture were divided into three categories like

- **Vasu-** those obtaining education up to the age of 24.
- **Rudra-** those obtaining education up to the age of 36.
- **Aditya-** those obtaining education up to the age of 48.
- **Samavartana-** the end of formal education and the Brahmacharya asrama of life

Characteristics of Gurukul System of Education

- Guru was: **Om iti Brahma** - There is only one Supreme Reality
- **Anandam Brahmano vidvan na vibhati kadachana** - The one who realizes the blissfulness of The Supreme Reality fears none
- They recognized 1) **Adhyayana** – instruction 2) **Siksha** – training 3) **Vinaya** - social motivation
- Acquisition of knowledge through experiences and reflection which conducts a student to go beyond
 1. —knowing about to
 2. —knowing how to
 3. —being able to do

Core Teaching In Gurukulas System

- Life is —cause and effect
 - Life has a —beginning and an end of a cycle
1. **Value based education** —cost/benefit|| based education system/goals/ideals (satya, goals/ideals values less dharma, shanti, prema, ahimsa)
 2. **Character building** it is to building skill and expertise(value given to skill and expertise)
- **Sama-drishti** equal mindedness

Role of a Guru

- An acharya or Guru is like a drill master, demonstrating the values in their lives before asking the to follow and practice whatever they profess.
 - (i) his own thinking
 - (ii) his discipline of mind
 - (iii) refinement of taste that he is able to pass on to his
- Thus all these external practices operate as aids to knowledge by strengthening the potency of the mind as an instrument for acquiring knowledge, by making it less objective and less open to contamination by contact with matter.

Role of the Shishya

- Student is not a passive but active participant in the learning process.
- The spirit of enquiry, questioning and requisitioning was a dominant part of the ancient system:
- **Prasnena**: straight questioning
- **Pariprasnena**: when the student is not satisfied, he asks again
- **Pratiprasnena**: when the student may say, I accept your answer but can there be another answer to the query
- **Tad viddhi pranipatena, pariprasnena sevaya**: learn by humble reverence, by enquiry and by service (questioning or requisitioning should not display the student's false ego or insolence)

Analysis Of The Ancient Education System To The Modern Education System

1. Ancient system followed the immersion technique (away from family one is totally immersed in education in a gurukul.
2. Usually one guru takes charge of both secular and non-secular education (**para and apara vidya**) in ancient system.
3. In the ancient system Guru decides the course and duration- depending upon his assessment of ‘ needs and abilities.

UNIT – V

5.6 - VALUE BASED EDUCATION

Introduction:

- Values education is the process by which people give values to others.
- Another definition of value education is "learning about self and wisdom of life" in a self-exploratory, systematic and scientific way through formal education.
- Values education can take place at home, as well as in schools, colleges, universities, jails and voluntary youth organisations.

ETYMOLOGY

- The word “value” is derived from the Latin root “Valere” meaning “to be strong and vigorous”

Definitions of Value Education:

- **Perry** (1968), “Value means the relation of an object to a valuing subject.”
- **Hindzay** (1966), “ By values we mean a person’s idea of what is desirable, what he actually wants”
- **John Dewey** (1966), “Value education means primarily to prize to esteem to appraise, holding it dear and also the act of passing judgment upon the nature and amount of its value as compared with something else”

Concept of Values

- To be a value, is to have a certain value that is the power to be some specific thing.
- People can love only what is dear to them (i.e. of very high value) and only what is felt to be of high value can give rise to the energy and motivate for possession.
- Life is a matter of choices. In human life there are certain things looked upon as admirable, honourable, to be approved of and there are other things which entertain and please us but we may view them as not admirable, not honourable and not to be approved of.

The need of Value Education are:

- to teach the values of the culture and society
- to enable them to distinguish between right and wrong
- to form the conscience of youngsters
- to continue the traditions of the society
- to make meaningful the practices and beliefs
- to connect to every human being in the right way

Approaches to value education:

There are two main approaches to values education –

1. Some see it as inculcating or transmitting a set of values which often come from societal or religious rules or cultural ethics
2. While others see it as a type of Socratic dialogue where people are gradually **brought to their own realisation** of what is good behaviour for themselves and their community.

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Purpose of value-based education

- Value based education instils educational and cultural values among and aims at achieving multi-faceted development of a human being namely intellectual, physical, spiritual and ethical development.
- In planning for good values and objectives, one has to cooperate and work together.
- It can bring about a widespread renewal of individual commitment to an active life of principle and this renewal is imperative.
- Values like truth, right action, love, peace and non-violence include in a balanced way the profound moral insights of the great civilizations.

Types of Values: Values however are either innate or acquired.

- 1. Innate values** are our inborn divine virtues such as love, peace, happiness, mercy and compassion as well as the positive moral qualities such as respect, humility, tolerance, responsibility, cooperation, honesty and simplicity.
- 2. Acquired values** are those external values adopted at your “place of birth” or “place of growth” and are influenced by the immediate environment. Examples of acquired values are one’s mode of dress, cultural customs, traditions, habits and tendencies.

Types of values and its nature:

Dr Gawande (1994) tried to investigate types of value and their areas. He noticed the following types of value and their areas:

Type of value - Area of value

- Human value - Human behaviour
- National or constitutional value - Constitutional rule
- Social value - Rules about society
- Vocational value - Ideals in various professions
- Religious value - Ideals related to religious
- Aesthetic value - Value in arts and literature

Categorization of Values

There are a number of different categories into which values can be placed.

- 1. Personal values:** Personal values are those you take for yourself
- 2. Social values:** Social values are those which put the rights of wider groups of people first
- 3. Political values:** Political values are ideological beliefs about the best way to govern a country or organization
- 4. Economic values:** Economic values are those around money, and may include beliefs around ownership of property,
- 5. Religious values:** Religious values are spiritual in nature and include beliefs in how we should live.

Factors Influencing the Learning of Values:

Hogan (1973) believes that moral behaviour is determined by five factors:

- 1. Socialization**
- 2. Moral judgment**
- 3. Moral feelings**
- 4. Empathy**
- 5. Confidence and knowledge**

Value Education in India

- Ancient India. Value Education in India from the ancient times has held a prime place of importance. From the gurukul stage the child not only learnt skills of reading and archery but more the philosophy of life in relation with its impermanence. Hence education in India was born of this vision to achieve one's experience in the absolute as a spark of the divine and in this process practice of one's duty accompanies the acquisition of knowledge.
- In the modern school system value education, was termed moral education or moral science.
- British were absolutely neutral in their policy towards religion and value education.

How to acquire Values Education:

- **During the process of socialization** e.g.: immediate family, friends, school teachers, peer group, neighbourhood etc.
- **Contact with the broader community** e.g.: family network, mass media, work places etc.
- **Habits imbibed as we grow up** e.g.: prohibitions, commands and identification with family and friends, approval and disapproval of actions, deeds etc.
- **Obligations and norms of the environment around us** e.g.; shift from „must consciousness to ought consciousness.“ I must not give way to anger reflect compulsion whereas statements like, I ought to respect my elders reflect the sense of obligation rather than fear or compulsion”.

Values are essential to ethics

- Ethics is concerned with human actions, and the choice of those actions.
- Ethics evaluates those actions, and the values that underlie them. It determines which values should be pursued, and which shouldn't be.
- Ethics is a set of beliefs about right and wrong behavior within a society.
- Ethical behavior conforms to generally accepted norms many of which are almost universal.

- However, although nearly everyone would agree that certain behaviors such as lying and cheating are unethical, opinions about what constitutes ethical behavior can vary dramatically.
- For example, attitudes toward software piracy—a form of copyright infringement that involves making copies of software or enabling others to access software to which they are not entitled—range from strong opposition to acceptance of the practice as a standard approach to conducting business.