SCIENCE AND CIVILIZATION

UG Third year

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FOREWORD

Since its establishment in 1976, Acharya Nagarjuna University has been forging ahead in the path of progress and dynamism, offering a variety of courses and research contributions. I am extremely happy that by gaining a B++ (80-85) grade from the NAAC in the year 2003, the University has achieved recognition as one of the front rank universities in the country. At present Acharya Nagarjuna University is offering educational opportunities at the UG, PG levels apart from research degrees to students from about 300 affiliated colleges spread over the three districts of Guntur, Krishna and Prakasam.

The University has also started the Centre for Distance Education with the aim to bring higher education within reach of all. The Centre will be a great help to those who cannot join in colleges, those who cannot afford the exorbitant fees as regular students, and even housewives desirous of pursuing higher studies. With the goal of bringing education to the doorstep of all such people, Acharya Nagarjuna University has started offering B.A., and B.Com courses at the Degree level and M.A., M.Com., M.Sc., M.B.A. and L.L.M. courses at the PG level from the academic year 2003-2004 onwards.

To facilitate easier understanding by students studying through the distance mode, these self-instruction materials have been prepared by eminent and experienced teachers. The lessons have been drafted with great care and expertise within the stipulated time by these teachers. Constructive ideas and scholarly suggestions are welcome from students and teachers involved respectively. Such ideas will be incorporated for the greater efficacy of this distance mode of education. For clarification of doubts and feedback, weekly classes and contact classes will be arranged at the UG and PG levels respectively.

It is my aim that students getting higher education through the Centre for Distance Education should improve their qualification, have better employment opportunities and in turn facilitate the country's progress. It is my fond desire that in the years to come, the Centre for Distance Education will grow from strength to strength in the form of new courses and by catering to larger number of people. My congratulations to all the Directors, Academic Co-ordinators, Editors and Lesson - writers of the Centre who have helped in these endeavours.

Prof. A. Rajendra Prasad
Vice - Chancellor

Acharya Nagarjuna University

UG III YEAR : SCIENCE AND CIVILISATION

SYLLABUS

1. Science

   i) Observation, Hypothesis, experiment, theory, proof
   ii) Great discoveries result from : the method the man
   iii) Modern Science : Sophisticated equipment, term work

2. Evolution of civilization : Paleolithic, Neolithic, Age of Metals (copper –bronze, early iron) rehistoric, Historic (Ancient, Medieval and Modern)

3. Significant discoveries and inventions with their prime areas of impact

   I. Vaccination, Pencillin, x-rays, Antibiotics, Vitamins, Anesthesia, DDT, Detergents, Contraceptives, Radium therapy, Insulin Cortisones, Antiseptics etc. (HEALTH)

   II. Wheel, Compass, Surveying, Steam Engine Auto-mobile, Ship, Aeroplane etc. (TRANSPORT)

   III. Radio, Telephone, Wireless, Camera, Teleprinter, Radar, Television, Satellites etc. (COMMUNICATIONS)

   IV. Hybridisation, Green Resolution, Artificial insemination, Fertilizers, Insecticides, Pesticides (AGRICULTURAL & ANIMAL HUSBANDRY)

   V. Synthetic Fibres, Electric Lamp, Paper, Printing, Refrigeration, Cinema etc (SOCIAL WELL BEING)

   VI. Gunpowder, Gun Metallurgy, Sources of Energy, (Wood Coal, Oil, Electricity, Atomic Power, Non-conventional sources (Wind, Water, Solar Cell, biogas theothermal) Clock, Computer (INDUSTRY)

4. Relations between Science and Society: Complementary and occasionally adverse also. Capitalism – leading to better means of communication to over exploit resources.

   Warfare : Development of gunpowder, bomb, jeep radar, ICBM, biological killers etc

5. Society: Goals – Welfare, Freedom, Security, Social Justice

CONTENTS

Lesson - 1

SCIENCE

Objective:

The aim of the lesson is to gain knowledge on :

- Meaning of science
- To know about the various stages in scientific method

Structure:

1.1 Science:

In Latin '*scientia*' means knowledge. Science is a systematic enterprise that builds and organizes knowledge in the form of testable explanations and predictions about the universe. In modern use, "science" more often refers to a way of pursuing knowledge. Not only the knowledge itself, it is often treated as synonymous with 'natural and physical science'. Thus it is restricted to those branches of study that relate to the phenomena of the material, universe and their laws, sometimes with implied exclusion of pure mathematics. This is now the dominant sense in ordinary use. This narrower sense of "science" developed by scientists such as Johannes Kepler, Galileo Galilei and Isaac Newton began formulating laws of nature such as Newton's laws of motion. Over the course of the 19th century, the word "science" became increasingly associated with scientific method, a disciplined way to study the natural world, including physics, chemistry, geology and biology. It is in the 19th century also that the term scientist was created by the naturalist-theologian William Whewell to distinguish those who sought knowledge on nature from those who sought knowledge on other disciplines.

Science may also be defined by some as a large collection of facts. But it is not so. If it is so, it must contain only a jumble of disorderly and meaningless data. This is clearly understood by a fable by Ka Popper. Suppose a man dedicated his life to Science. He recorded day in and day out everything that he observed

humidity, temperature, level of cosmic radiation, race results, fall and rise of governments at state and centre level etc., without leaving anything. His observations were perfectly correct. He left his work in the custody of his friends, who sent it to the Royal Society after his death. Perusing it, they threw it into the dust bin. It was a little use of it for the advancement of Science. His effort was a sheer waste. So a collection of data is not a Science.

Science is the search for unity in hidden likeness. Scientists were keen on understanding as to how a nucleus remains stable, when the protons in them experience mutual forces of repulsion. They must fly apart. In 1935, Yakawa published a paper, which can give still heart to a young scientist. He started with the well established fact that light behaves sometimes as pellets which are mass less, from this he reasoned that the forces which hold the nucleus of an atom together might some times also be observed as if they were solid pellets. Most of the scientists highly criticized his theory. Yet, he was not dispirited. He calculated the mass of the pellet, the meson was discovered and a range of other mesons, whose existence on nature was not even suspected before made their appearance felt.

The scientist looks for order in the appearances of nature by exploring such likeliness. Science is thus, the search to discover unity in the wild variety of nature or exactly in the variety of our experience. Science is the organization of our knowledge in such a way that it commands more of the hidden potential in nature. It admits no sharp boundaries between knowledge and use. There is no practice of confining the practice of science in this or another way. Science is full of inventions.

Thus, the word science means 'knowledge', so that in its broadest sense it means all the knowledge that man has gained and arranged in orderly manner. But, we generally use the word with more limited meaning of our knowledge and understanding the world around us as it is shown to us through our senses. Science finds out order and meaning in our experience and sets about this task in different way. Science grows from comparison. Science is arranging and classifying our knowledge to notice similarities and differences between various parts and making general statements. Science is arranging and classifying our knowledge, notice similarities and differences between various parts and making general statements.

1.2 Scientific Method:

A scientific method seeks to explain the events of nature in a reproducible way. An explanatory thought, experiment or hypothesis is put forward, as explanation, from which we arrive at predictions. The predictions are to be posted before a confirming experiment or observation is sought, as proof that no tampering has occurred. Disproof of a prediction is evidence of progress. This is done partly through observation of natural phenomena, but also through experimentation, that tries to simulate natural events under controlled conditions, as appropriate to the discipline. A scientific method allows for highly creative problem solving, while minimizing any effects of subjective bias on the part of its users.

To achieve best results in whatever we do, we must follow a method. This method that is followed in scientific investigation is called scientific method. The scientific method of solving a problem is a definite and special procedure. In order to obtain dependable, accurate solutions to the problems they undertake to solve, scientists must be careful patient and efficient workers. The various stages in scientific method are 1) Observation 2) Hypothesis 3) Experiment 4) Theory and 5) Proof.

1.2.1 Observation: The first stage in Scientific method is observation. Scientists are always curious. They keep their eyes open to all the phenomena occurring in nature. For example, when Sir. C. V. Raman was going to England in a ship, he found the waters of the Mediterranean sea having a deep blue color. This arose a curiosity in his mind, which ultimately led to the discovery of the Raman Effect. In the same way, Henry Becquerel accidentally found that a salt sulphate of uranium and potassium wrapped in a piece of paper destroyed photographic plates covered in black paper and kept in a cardboard box in a drawer into which sunlight cannot penetrate. His observation led to the discovery of the phenomenon of Radioactivity which has helped man to cure the deadly disease of cancer. These observations motive the scientists to proceed to solve the problem and lift the veil off the mystery behind it. The second stage in the scientist's method is the hypothesis.

1.2.2 Hypothesis: A hypothesis is a statement temporarily formulated by a scientist in the light of what is at the time, know about a phenomenon if employed as a basis for action in the search for new truth. It is a tentatative assumption drawn fron knowledge and theory, which is used as a guide in the investigation of other facts and the themes that are yet unknown. A hypothesis, in general states that we are looking for, it is a proposition, which will be put to test to determine its validity. It may prove to be correct or incorrect. Science employs hypothesis in guiding the thinking process. When our experience tells us that a given phenomenon follows a regularly upon the appearance of certain other phenomena, we conclude that the former is connected with the latter by some sort of relationship and we form an hypothesis concerning this relationship. A hypothesis is therefore a shrewd and intelligent formulation, a supposition, inference, hunch, professional statement or tentative generalization as to the existence of some fact, condition or relationship relative to some phenomena, which serves to explain already known facts in given area of knowledge and guides the search for new truth on the basis of experimental evidence.

Sir C. V. Raman believed that light from the sun is scattered by the tiny droplets of water and that the blue part of the spectrum is more readily scattered than the rest and that the blue colour is due to this predominant scattering property of the blue colour. Such a belief is called a hypothesis. Henry believed that some substances like uranium give out highly penetrating invisible radiations, which can destroy a photographic plate. But, a hypothesis is never a law unless tested thoroughly by a series of experiments.

1.2.3 Experiment: The next stage is conducting experiment. Experiment is the back bone of scientific investigation. Sir C. V. Raman after reaching England went through the work done on scattering of light along with Thomson, Rayleigh, Stokes and others. He conducted a series of experiments on scattering of light using many organic liquids. He found that the scattered light contains wavelengths of higher and lower wavelengths compared to that incident light. Henry Becuqerel's hypothesis was actively pursued by Madam Marie Curie and Lord Rutherford. They showed that the radiations from radioactive materials such as uranium are complex in nature. The radiations consist of X-rays, beta-rays, gamma-rays and soon the phenomenon was used for understanding the structure of the atom.

1.2.4 Theory: The next stage in scientific method is theory. When the hypothesis is repeatedly tested and confirmed and when no deviations are observed, then it becomes a theory. Theory is a tool in science in many ways. It relates two or more findings. Theories explain scientific findings in an efficient way. They also help in broadening original ideas by suggesting additional applications. But, the theory is open to modification by any experiment conducted at a later date and in the light of the results arrived at them. The three fundamental quantities mass, length and time were considered as absolute in

classical physics. Sir Albert Einstein's theory of relativity showed that they are not absolute, but relative. To give an example, a physics professor aged 40 wanted to marry his laboratory assistant a young girl of sixteen. But the society did not agree for such a marriage, where the age difference was high. So, the professor of physics went into space at Einsteinium speed reapproching the velocity of light and returned after one year according to his watch. But for the laboratory assistant it took 20 years. Soon after his return the professor was 41 and his bride was 36, who could object to their marriage? Science has come to the rescue of the professor and has presented him the live for whom his heart pined. Science admits any modifications and corrections.

1.2.5 Proof: The scientist must give a proof to his theory. When Sir Issac Newton tried to establish the properties of light, he failed because he got contradictory result. Every one knew that glass is less transparent to light than water i.e., refractive index of water must be less than that of glass. Unfortunately, Newton result showed that the refractive index of water was more than that of glass. His theory had to be abandoned. But in the formulation of theory of gravitation, he met with success. For his calculation, he needed the following information. They are

i) The distance of the moon from the earth.

ii) The time taken by the moon to make one complete rotation.

iii) The distance through which any body falls towards the earth in one second.

From (i) and (ii) Newton calculated how far the moon moved towards the earth in one second if it agreed with (iii), it must be correct. But, it was not that easy, because they are not correlated. He again made calculations. More perfect measurements of the distances between moon and earth showed that the value Newton used in his calculation not correct. When correct value was substituted to found that the fall of moon towards the earth every second was just what it was every other body attracted towards earth. It was correct. Now he formulated the theory because it was based on a firm ground. The universal law of gravitation has come as rule to all planets and the whole universe. It has became a theory.

The discovery and use of penicillin discovered accidentally by Alexander Flemming is one of the illustrations of the scientific method. This discovery shows that conclusions are not always accepted as final. Scientists continue to question and test the conclusions accepting no conclusion as final, until all evidences support it.

1.3 Summary:

Science is not collection of facts. It is search for unity in hidden likenesses. The scientist looks for order in the appearance of nature. Science means knowledge and all the knowledge that man has gained is to be arranged in an orderly manner. Science grows from comparison. The method followed by scientists in investigation is called scientific method. The various stages in scientific method are observation, hypothesis, experiment, theory and proof.

1.4 Technical Terms:

Observation

Hypothesis

Experiment

Theory

Proof

Radioactivity

1.5 Self Assessment Questions:

1) What is science?

2) Write an account on scientific method.

Lesson Writer

Dr. T. Srivalli

Lesson - 2

GREAT DISCOVERIES - ROLE OF MAN AND METHOD

Objective:

To understand the role of man in achieving greatest discoveries and method followed by him.

Structure:

2.1 Introduction:

New inventions and discoveries are stepping stones for society. They are the result of enormous achievement by scientists. The two objectives observed in scientists while they are performing scientific research are social welfare and for his own profit. The own profit may be for his satisfaction or to get name and fame in the society. But for achieving this, sometimes he may have tocstruggle a lot. The scientists can get fruitful results, when they follow some values.

2.2 Role of man in achieving great discoveries and method:

Science is creation of concepts and their exploration in the facts. There is no other test of the concept than its empirical truth of fact. Truth is the device at the centre of science. It must be based on truth not as a dogma but as a process. In this pursuit, scientists have been compelled to form a society in which the values grow themselves. These values are

2.2.1: Independence in thought and observation: Scientists should have independence in their thought and research. The world would never change if people do not question their elders if they commit mistakes, and also their beliefs which are stale. No one can be a scientist if he does not have independence in observation and thought.

2.2.2 Criticism or Dissent: Some times scientists should face criticism if anybody does not satisfies. At times criticism has got the scientist into a good deal of trouble. Galelio was imprisoned for his opinion that planets revolve round the sun. But, he did not yield. Truth prevails. He should prove it.

2.2.3 Tolerance: Tolerance is more important to a scientist. They should first listen what other person is saying, respect reality, and to accept what he does not know. Some times during research scientists may get differences. At those timings should stand on justice and respect each others. Tolerance among scientists can't be based on difference; it must be based on respect. Respect as a personal value implies the public acknowledgements of justice and due honour.

2.2.4 Sacrifice: We can see different types of people in the society. Some people wonder around without doing any thing. Some may think of only about themselves. But scientist should always work forgetting himself and his own people, Then only he can get fruitful results.

2.3 Scientific Method - One Example:

Alexander Flemming discovered penicillin accidentally. Fleming noticed a Petri dish containing *staphylococcus* plate culture which he have mistakenly left open. It was contaminated by blue-green mould, which formed a visible growth. There was a halo of inhibited bacterial growth around the mould. Fleming concluded the mould released a substance that repressed the growth and death the bacteria. This is the first phase in Flemming's research In the second phase Flemming decided to do research on 3 aspects

i) Which substance is released by Penicillium to destroy microorganisms?

ii) Can we obtain that substance in pure form?

iii) Can this substance destroy microorganisms in animals without causing harm to them?

For knowing these he grew a pure culture and discovered it was a Penicillium mould, now known to be Penicillium notatum. Fleming coined the term "penicillin" to describe the filtrate of a broth culture of the Penicillium mould. Even in these early stages, penicillin was found to be most effective against Gram-positive bacteria, and ineffective against Gram-negative organisms and fungi.

He has done many experiments to contain it in purified form from food materials. But as the experiments are not successful, he stopped doing experiments.

After further experiments, Fleming was convinced penicillin could not last long enough in the human body to kill pathogenic bacteria Appropriately after 10 years, Penicillin is extracted in purified form during Second World War by some other scientists.

2.4 Great Discoveries - Role of Man:

By following scientific methods scientists have discovered many things. Some of them are stated below.

Telephone:

Graham Bell is a school teacher. One of his girl student was deaf, but she is interest in studying. By seeing her interest, Graham Bell wished to make an instrument for her, which could enable her to hear. For this he has done many experiments with the help of his scientist friend Thomas Watson. One day when Watson threw one metal piece on a wire, then the wire made vibrations. Bell was doing experiments with the end at that time, received sound from the wire. He observed that the sound came from the wire. This led to the discovery of the Telephone.

Dynamite:

Few inventions, save perhaps the atomic bomb, can claim to have shaken the world in quite the same way as nitroglycerine. And few inventions can have claimed so many lives. The first to succumb to the explosive force of Dynamite was the inventor's brother; Alfred Nobel's youngest sibling perished when an early experiment to stabilise nitroglycerine by adding a chalky material called kieselguhr, went horribly wrong. In 1896, he got Nobel prize for that one.

Clock:

The time on the earliest clocks could be heard and not seen, indeed the word "clock" comes from the Latin clocca (bell). The most elaborate early examples date to 11th-century China, when a monk described a water-powered time keeping device. The first known public clock appeared on the Viscount of Milan's palace in 1335. The big revolution in clock design came with the introduction of the pendulum in the 17th century, allowing everyone from traders to farmers and military commanders to know precisely what the time was.

Electric Lamp:

Thomas Alva Edison (1847-1931) was an American inventor (also known as the Wizard of Menlo Park) whose many inventions revolutionized the world. His work includes improving the incandescent electric light bulb and inventing the phonograph, the phonograph record, the carbon telephone transmitter, and the motion-picture projector.

Edison experimented with thousands of different light bulb filaments to find just the right materials to glow well, be long-lasting, and be inexpensive. In 1879, Edison discovered that a carbon filament in an oxygen-free bulb glowed but did not burn up for quite a while. This incandescent bulb revolutionized the world.

Electric Shaver:

For sensitive-skinned men who daily face the choice between tearing their cheeks to shreds or growing a scraggly beard, the electric razor is a godsend. They can thank a retired American soldier for the invention. While working in Alaskan mines before returning to service in the First World War, Lieutenant Colonel Jacob Schick struggled with foam and blades in the sub-zero temperatures. His prototype electric alternative resembled modern razors, but it was attached to a bulky external motor: self-contained shavers appeared in 1928.

Table: Great discoveries by scientists

INVENTION	YEAR	INVENTOR	COUNTRY
Aeroplane with motor	1903	Wilbur & Orville Wright	America
Aeroplane with jet engine	1930	Whittle	Britain
Automated Teller Machine (ATM)	1968	Don Wetzel	America
Ball Point Pen	1888	John Land	America
Fountain pen	1884	Waterman	America
Battery	1800	Alessandro Volta	Italy
Braille system	1824	Louis Braille	France
beer	before 6000 BC	Sumerians, Babylonians	Mesopotamia
bicycle	1818	Baron Karl de Drais de Sauerbrun	Germany
Barometer	1643	Evangelista Torricelli	Italy
Petrol Car	1888	Karl Benz	Germany
Cinema	1895	Nicolas, Jean Lumair	France
Computer	1824	Alan Thring	Britain
Pendulum Clock	1725	J. Thing, Lingthasn	China
Diesel engine	1895	Rudolph Diesel	Germany
Dynamo	1832	Hypolite Pixci	France
Dynamite	1862	Alfred Nobel	Sweden
DNA fingerprinting	1984	Alec Jeffreys	UK
dynamite	1867	Alfred Nobel	Sweden
Electric bulb	1879	Thomas Alva Edison	America
Electromagnet	1824	Willaim Sturgeon	Britain
Electron	1904	Thompson	Britain
Electron microscope	1931	Knol, Rusca	Germany
Nylon	1937	Wallace Carothers	America
Parachute	1797	Garneren	France

Penicillin	1928	Alexander Flemming	Britain
Photography on metal	1826	Naipse	France
Photography on paper	1835	Falsetalbat	Britain
Photography on film	1888	John Carbet	America
Polaroid camera	1948	Land	America
Printing Press	1455	Johan Guten Berg	Germany
Ship propeller	1837	Fransis Smith	Britain
Radio Activity	1896	Henry Beckeral	France
Radio	1901	Marconi	Italy
Radar	1922	Talor, Young	America
Radium	1898	Curie, Pierrie	France
Rayon	1883	Joseph Swan	Britain
Electric razor	1931	Jacob Sheek	America
Safety razor	1895	Gillette	America
Refrigerator	1834	Perkins	America
Revolver	1835	Samuel Colt	America
Volcanized rubber	1841	Good Year	America
Safety lamp	1816	Humpry Devi	Britain
Match stick	1826	John Walker	Britain
Sewing machine	1829	Barthelime Thimmonmire	France
Steam ship	1775	Perrier	France
Turbine ship	1894	Parsons	Britain
Stainless steal	1913	Briarlie	Britain
Submarine	1776	David Bushnel	America
Steam engine	1712	Thomas Nucoman	Britain
Tape recorder	1899	Palson	Denmark
Telegraph	1787	Lammand	France
Telegraph code	1837	Samuel Morse	America
Telephone	1876	Alexander Graham Bell	America
Telescope	1608	Hans Lipper Shy	Netherlands

Television	1926	Galeluio Galeli	Britain
Thermometer	1714	John Logi Baird	Germany
Transformer	1831	Fahren Heat	Britain
Transistor	1948	Barteen, Shakel, Brattain	America
Tractor	1900	Holt	America
Type writer	1808	Shails	Italy
X - Rays	1895	Rontzen	Germeny
vaccination	1796	Edward Jenner	England

2.5 Summary:

New inventions and discoveries are stepping stones for society. They are the result of enormous achievement by scientists. Science is creation of concepts and their exploration in the facts. It has no other test of the concept than its empirical truth of fact. Truth is the device at the centre of science. The scientists can get fruitful results, when they follow some values such as Independence in thought and observation, Dissent Tolerance and Sacrifice. By following scientific methods scientists discovered many things.

2.6 Technical Terms:

Independence in thought and observation

Dissent

Tolerance

Sacrifice

Scientific Method

Telephone

Radio

Electric Shaver

Clock

2.7 Self Assessment Questions:

1) Describe the scientific methods followed by scientists in their research

2) Write an account on great discoveries by scientists

Lesson Writer
Dr. T. Srivalli

Lesson - 3

MODERN SCIENCE
SOPHISTICATED EQUIPMENT - TEAM WORK

Objective:

- To understand modern science
- To know about Complex and efficient sophisticated equipment
- To understand team work in the advancement of science
- To study about major contribution of modern science to human welfare

Structure:

3.1 Modern Science:

Science is working wonders. Science is present in all fields. Continuous efforts in the field of science and technology resulted in a number of new discoveries. Depending upon the utility of the discovery made to human beings as well as to the nature there occurred the development of a number of new fields in science which have again provided further inventions to be made to lead better life in the society. The following are the various fields of science where enormous amount of research is going on to invent new things.

3.2 Various fields of science:

1.	Acoustics	:	The study of sound
2.	Aeronautics	:	The study of flight

3.	Agronomy	:	Science of soil management and the production of field crops
4.	Anatomy	:	Science dealing with the internal structure of animals, plants or human body
5.	Anthropology	:	Science dealing with the origin, physical and cultural development of mankind
6.	Archaeology	:	Study of antiquities
7.	Astronomy	:	Study of heavenly bodies
8.	Bacteriology	:	Study of bacteria
9.	Biochemistry	:	Study of chemical processes of living things
10.	Biology	:	Study of living things
11.	Botany	:	Study of plants
12.	Chemistry	:	Study of elements, their laws of combination and behaviour
13.	Ceramics	:	Technology of making objects with clay
14.	Criminology	:	Study of criminals
15.	Cryptography	:	Structure of forms, forms and properties of crystals
16.	Ecology	:	Study of behaviour of plants and animals with respect to environment
17.	Embryology	:	Study of development of embryos
18.	Epidemiology	:	Branch of medicine dealing with epidemic diseases
19.	Genetics	:	Branch of biology dealing with phenomenon of heredity and the laws governing it
20.	Geography	:	Study of earth's surface, physical features, climate , population etc.
21.	Microbiology	:	Study of minute living organisms
22.	Physics	:	Study of matter and energy
23.	Psychology	:	Study of human and animal behaviour
24.	Radiology	:	Study of X - rays and radioactivity
25.	Seismology	:	Study of earthquakes and related phenomena
26.	Selenology	:	Scientific study of moon
27.	Sericulture	:	Study of raising silk worms for the production of raw silk
28.	Toxicology	:	Study of poisons

29. Virology : Study of viruses

30. Zoology : Study of animal life

3.3 Complex and efficient sophisticated equipment:

Great inventers have used the principles of different fields of science to design equipment for the good of man. Some of the examples are given below.

1.	Steam Engine	:	This is used for converting heat energy into mechanical energy using steam (water). It is used in trains and ships.
2.	Automobile	:	Transport device using diesel oil or petrol as fuel
3.	Submarine	:	Transport device for travel under water
4.	Aeroplane	:	Transport device for travel in air
5.	Rocket	:	Transport device for travel in space
6.	Artificial Satellite	:	A man made satellite traveling around the earth, used for communication, survey and mapping of natural resources and measurements on outer space
7.	Cine Projector	:	For taking pictures of moving objects, recording of sound simultaneously and projecting them on a screen
8.	Generator	:	For generation of electricity
9.	Electric Motor	:	For conversion of electrical energy into mechanical energy
10.	Power Loom	:	For weaving clothes from yarn working with electric power
11.	Radar	:	Detection and ranging with radio waves
12.	Sonar	:	Detection and ranging with sound waves of high frequency
13.	Radio Transmitter	:	For generation of radio waves
14.	Radio Receiver	:	For reception of radio waves
15.	Television	:	Transmission and reception of programmes usually along with sound
16.	Tape Recorder	:	For recording and reproduction of sound on magnetic tapes
17.	Video-Cassette Recorder	:	Recording and reproduction of video signals along with sound
18.	Telephone	:	For transmission of speech and reception over lines

19.	Teleprinter	:	For transmission and reception of matter printed over a key board
20.	Refrigerator	:	Production and maintenance of cold in a limited enclosure
21.	Electrocardiograph	:	For recording electrical variations during contraction of heart
22.	Electroencephalograph	:	For recording electrical variation in brain
23.	Seismograph	:	For recording earthquakes and their intensity
24.	Vacuum Pump	:	For production of vacuum
25.	Electric Cranes	:	For lifting heavy loads
26.	Air Conditioner	:	For controlling temperatures of a room
27.	Robots	:	Artificial machines working like men and according to a programme
28.	Radio Telescope	:	For viewing distant objects using radio waves
29.	Electron Microscope	:	For viewing small objects using electron waves
30.	Nuclear Reactor	:	For the production of nuclear energy from nuclear fission

3.4 Team work:

'Necessity is the mother of invention' is the old saying. Civilization made man to invent new techniques and new things to lead better life. Science comes into existence when the invention starts. Present day equipment is highly sophisticated one and is used in several fields to develop new technologies. The fruits of research we are enjoying now are the efforts of several persons who worked and ended their lives to the cause of science and society.

Team work is the best means to attain dependable result in researches. One man cannot be perfect with the all equipment he has and with all the branches of sciences he is surrounded by. Interdepartmental coordinated research gives best results. The thinking of one man should be assisted by the other. Interpretations of the results by combined effort will be of great value. Division of labour at every step in scientific investigation definitely helps in taking quick decisions. A work which is completed in a year by a single person can be completed in few weeks by i) dividing it into different topics ii) assigning them to different specialists iii) by using modern sophisticated equipment

A team working on a subject does much better than a single individual. James Chadwiek discovered the neutron in 1932. In 1934 Enrico Fermi believed that the neutrons on might make good bullets and began bombarding uranium atoms with neutrons. In 1939 Professer Otto Hahn and his associates Lise Meitner and O.R.Frisch reported actual splitting of uranium atoms. The results of this work were made available to scientists all over the world. The device for obtaining energy from uranium was constructed at the university of Chicago in 1942 under Dr. Fermlis

supervision. All this could be done in just 10 years due to team work while the perfection of camera took 110 years. This is the advantage behind team work. Many people put their heads together to solve the difficulties they face, one supplements that in which the other lacks.

Another example-Total Solar eclipse is visible at some places for a very short duration. A number of experiments are to be carried out during that short duration. So scientists form teams and each team conducts a specific experiment at a specific place. Finally all the results can be coordinated and summarized to arrive at facts and figures.

Barometer is another example of team work. The Duke of Tuxany wished to have a new well made. A deep well forty feet down to the water was dug. The next problem was to fit a pump to bring the water to the surface of the earth. The pump was used the water did not gush out of the pump. Galileo was called for and asked to solve the problem. He saw that water rose to a height of 34 ft and never beyond. He struggled hard but the water did not yield to rise higher. Evangllista Torricelli (1608-1647) was Gelileo's pupil. He wanted to solve the riddle. He devised an experiment in which he used mercury instead of water. Mercury is heavier than water and so occupies less space, weight for weight. He closed them at one end. He filled the tube with mercury, closed the open end with his thumb and carefully inverted it in a trough of mercury. The mercury in the tube fell down and reached a steady height of 30 inches above that in the trough. This was what he expected to happen thus the barometer came to existence. The space above mercury in the tube is perfect it vacuum. The 30 inches column of mercury was held in position by the atmospheric pressure outside. He showed that the column of 30 inches of mercury in his tube weighed the same as 34ft. of water in a tube of the same area of cross section. He gave the explanation that the atmospheric pressure could not hold up a column of water longer than 34ft. He thus explained why the pump failed to work in Tuxany's well. Many people sneered at him for his explanation. Torricelli was not be slighted down by such an opposition. He wrote letters to some of his friends in Paris about the predicament in which he was placed and Blaise Pascal (1623-1662) came to know about it. Pascal thought about the problem and reasoned that if the column of mercury really was held up by the atmospheric pressure, any alteration in atmospheric pressure should bring a change in the height of the mercury column. To make himself sure of his idea, he shared do the experiment at higher altitudes. If Torricelli was correct, at higher altitudes the level of mercury should be less than that at mean sea level. The highest place in Pascal's place was only a Cathedral tower. So he repeated Torricelli's experiment with mercury at the foot and the top of Cathedral. The mercury column at the top was certainly shorter but not enough to satisfy him. He wanted to repeat the experiment at still greater altitudes. Unfortunately there were no mountains in his place. Pascal was a weak man and he could not undertake the arduous journey. So he wrote to Perrier, his brother-in-law who lived in the mountainous district of Auvergne to repeat his experiment at the foot and top of one of the mountains there. Perrier gladly accepted. He constructed two barometers of the Torricelli type one at the foot and the other at the top of a mountain. He found the heights of the mercury columns at the foot and top of the mountain. The column at the top was 3cm less than that at the foot. The news of this experiment was received by Pascal with pleasure and he was certain that Torricelli was correct. Thus by the combined efforts of Galileo, Torricel Pascal and Perrier the scientific world was presented with a instrument the barometer and this took various other forms like the aneroid barometer used in aeroplanes to measure height and as one of the components in weather-forecasting. Now the riddle was solved. The tube connecting the cylinder in the pump used in Tuxany's well should be less than 34 ft in

height and that the water could be lifted in two stages-from the well into tank at a lower level from the ground and from that tank to the ground level by another pump. Now we use pumps driven by electric motors and water can be lifted to any height using lift pumps.

Invention of atomic bombs, nuclear bombs, hydrogen bombs, a number of high yielding new varieties of crops, hybrid animals, new drugs added to the existing list in medicine, genetic engineering to cure heritable diseases etc. are the results from the coordinated work among the scientists. Thus team work results in accurate and dependable results utilizing minimum time. In science it helps to a larger extent in the advancement of science. The difficulties one face might be over come by another placed in better circumstances.

3.5 Major contribution of modern science to human welfare:

It is the age of science. Without scientific knowledge, one cannot advance further. One cannot live successfully in this ever changing society without depending upon scientific inventions. Science has made man's life, a comfortable one. It has solved the problems of time and distance; it has made the life easier and worth living. But if the science is used in a proper way it is boon to mankind, otherwise it is a bane to the society. Science is having merits and demerits.

3.5.1 Merits: Scientific revolution has changed the man's environment. It has done great service to the society such as

Transport: Invention of automobile, steam engines, aeroplanes, railways, cars, buses, road ways etc. made man to travel thousands of kilometers in few hours. Though cars are limited to the upper strata of society, present day mopeds, buses, railways are providing the cheapest transport system at his disposal. Large ships carry the passengers as well as cargo across the rivers, seas and oceans. By using supersonic aeroplanes one can have his breakfast at one place and lunch at another place which is far away.

Communications: Better means of communication systems available today are the Telegraph, Telephone, wireless, Teleprinters etc. Man is able to send the messages of urgency to any place within minutes. Launching of satellites improved the communication systems. Utilizing no delay services, one can talk with his friends or relatives living in far off countries within no time. Invention of Radio, Television made man to learn about several things by sitting at home. He is able to witness the advancements made through TV. He is able to become master of many things through the effective communication systems. Various happenings in the world and native land are known through the powerful broad casting system viz., Radio and Television.

Comfortable home life: Home life is made comfortable and easily manageable. Various electrical appliances like refrigerator, air coolers, air conditioners, fans, electrical bulbs, irons, stoves, water heaters, washing machines, grinders, etc. make our life comfortable.

Recreation: Cinema, Television are the systems of recreation for the tired body. Besides their recreation, they are used as a means of educational aids to change the illiterates to literates. Open Universities and other institutes of learning are using these audio-visual aids to uplift the society.

Medicines: Invention of wonderful drugs, vaccines and life saving drugs improved the living conditions of human beings. He is able to fight against several diseases of dreadful nature with the available drugs. Through computerized scanners and X-rays man is able to study functioning of various internal systems of the body. He is able to diagnose the diseases and getting them cured using various techniques like surgical operations, radio therapy etc.

Making use of all these inventions and scientific technologies, man is able to save his time, energy to the maximum extent possible.

3.5.2 Demerits: Besides providing all the amenities to man for his comfortable living, science has adverse effects also on the society

Electric shocks, short circuits lead to the dangerous situations and finally death of the individual itself. Improper management of the electrical goods cause this situation. Several machines used in industries are becoming death traps due to improper maintenance and unsafe measures of their use.

Scientific knowledge provides intelligence in that particular field but his broad thinking never improved against individuals in particular and in nation in general. This has lead to the development of misunderstanding and narrow behaviour.

Atomic bombs produced for peaceful purposes are used to destruct whole life to ashes in Hiroshima, Nagasaki of Japan. Their power is so great that even now the disastrous effects are felt upon. The power of the nuclear bombs is such that if a world war breaks out, the whole human race may be wiped out. The invention of these weapons is a great disservice of science to mankind.

Use of pesticides and insecticides which are the inventions of scientific researches definitely increased productivity. But mismanagement and free availability are taking so many lives in the form of suicides. Indiscriminate use of non degradable substances like DDT, Rogar etc. is resulting in their appearance in non target organisms like fishes, prawn and even in man. Such substances accumulate in them and cause incurable diseases like heart attack, cancer and so on.

Bhopal tragedy a clear example where human negligence resulted in leakage of highly poisonous gas called Methyl Iso Cyanide (MIC) from the Union carbide industry. This has not only taken thousands of lives but also caused mental disorders exposed to high quantities of this gas

Great environmental disorders are caused due to rapid industrial growth, speedy deforestation, and large scale utilization of non-renewable resources leading to the environmental pollution. These disorders may reach ultimate elimination of life from this great planet Earth.

When such a great loss occurs through atomic bombs, one can conclude that science is more a curse than a boon to the society, though it helped in improving society to a larger extent.

3.6 Summary:

Science is working wonders. Science is present in all fields. Continuous efforts in the field of science and technology resulted in a number of new discoveries. Depending upon the utility of the discovery made to human beings as well as to the nature there occurred the development of a number of new fields in science which have again provided further inventions to be made to lead better life in the society. Civilization made man to invent new techniques and new things to lead better life. Present day equipment is highly sophisticated one and is used in several fields to develop new technologies. The fruits of research we are enjoying now are the result of team work of several persons who worked and ended their lives to the cause of science and society. Science has solved the problems of time and distance; it has made the life easier and worth living. But if the science is used in a proper way it is boon to mankind, otherwise it is a bane to the society. Science is having merits and demerits.

3.7 Technical Terms:

Modern Science

Sophisticated Equipment

Team Work

3.8 Self Assessment Questions:

1) What is scientific method? Discuss the various stages of scientific methodology.
2) What are the modern scientific sophisticated equipments that are in regular use?
3) How team work leads to more accuracy in scientific research?
4) Explain the major contribution of modern science to human welfare.

Lesson Writer

Dr. T. Srivalli

Lesson - 4

STONE AGE

OLD STONE AGE

Objective:

The aim of this lesson is to make the student

- Gain knowledge on the evolution of human beings in the old stone age
- How people lived in the Old Stone age.
- What kind of instruments and impliments they used and how they lived.

Structure:

4.1 Introduction

The Paleolithic Age or Old Stone Age is a prehistoric period of human. It extends from the earliest known use of stone tools, probably by Hominid such as Australopithecines, 2.6 million years ago, to the end of the Pleistocene around 10,000 BP. The term Paleolithic was coined by archaeologist John Lubbock in 1865. It is derived from Greek word palaios which means "old" and lithos means "stone". So the literal

meaning is "old age of the stone" or "Old Stone Age." The Paleolithic climate consisted of a set of glacial and interglacial periods. The climate of the Paleolithic Period spanned two geologic epochs known as the Pliocene and the Pleistocene. Both of these epochs experienced important geographic and climatic changes that affected human societies. The ice age ended with the end of the Paleolithic era and resulted in the Earth's climate became warmer.

Paleolithic age in India is divided into three phases:

Early or Lower Paleolithic (50,000 - 100,000 BC) : It covers the greater part of the Ice Age and its characteristic feature is the use of hand-axe, cleaners and chopper.

Middle Paleolithic (100,000 - 40,000 BC): The Middle Paleolithic culture is characterized by flakes. The principal tools are variety of blades, points and scrappers which made of flakes.

Upper Paleolithic (40,000 - 10,000 BC) : It marks the appearance of Homo sapiens and new flint industries. The widespread appearance of a figurines and other artifacts reflecting art and rituals. The appearance of wide range of bone tools, including needles, fishing tools, harpoons, blades and burin tools.

The economy of a typical paleolithic society was a hunter-gatherer economy. Civilization refers to the material and instrumental side of human cultures that are complex in terms of technology, science, and division of labour. Humans hunted wild animal for meat and gathered food, firewood, and materials for their tools, clothes, or shelters. Human population density was very low, around only one person per square mile. This was most likely due to low body fat, infanticide, women regularly engaging in intense endurance exercise, late weaning of infants and a nomadic lifestyle. Like contemporary hunter-gatherers, Paleolithic humans enjoyed an abundance of leisure time unparalleled in both neolithic farming societies and modern industrial societies. At the end of the paleolithic, specifically the Middle and or Upper paleolithic, humans began to produce works of art such as cave paintings, rock art and jewellery and began to engage in religious behavior such as burial and ritual.

4.2 Development of Homosapiens:

Anthropologists believe that modern man, or Homo sapiens, emerged as a distinct species by about 100,000 years ago. Extensive studies of ancient human remains and shelters seem to show that groups of Homo sapiens left Africa and entered Asia via the Middle East around 65,000 years ago. As hominids developed into humans (Homo sapiens), they underwent various physical changes. Most obviously, our ancestors learned to walk upright on two legs, rather than alternating between two legs and four legs. Early hominids, like Australopithecus robustus, were clearly vegetarian plant-eaters, based on their teeth and jaw structure. But later hominids, including Australopithecus aphaeresis and Homo erectus, developed to eat even non-vegetarian food items. There were mental changes too. As the brain power increased smelling sense diminished and more brain power was reserved for looking, listening and talking. The modern Homo sapiens brain is actually smaller than neandethalensis, but paleoanthropologists theorize that once the brain reached an optimum size for certain kinds of work, it began specializing, miniaturizing, and integrating. The result is that the modern human brain may be smaller, but its critical functions are much more closely packed into a narrower space, for more efficient functioning. In this way, the process of evolution continued in early humans.

4.3 Scientific and Technological Changes:

4.3.1 Tools used in Paleolithic period: In the early Paleolithic period, from about 3 million years ago until 1 million years ago, the hominids from which we arose lived much like other animals, they hunted and

gathered food from natural sources, and ate only the food that was immediately edible and unducive for the human digestive system. No one appears to have had any tools at all. Some early hominids were vegetarian; others were meat-eaters. Yet neither group cooked their food, consuming it raw. This placed significant limitations on their diets - a number of plants and animals cannot be consumed and digested raw.

About two million years ago, our predecessor, a hominid known as Homo habilis used his hands with opposable thumbs to construct a crude tool from stone. This tool, called a hand axe was with a sharp point. The hand axe was used for breaking open bones to scoop out the rich marrow inside, a popular food item among hominids. It also served as a weapon. The hand axe was formed by taking a nodule of flint, and gradually breaking away all the pieces of flint, which did not match the shape of the ideal hand-axe. This process is called core-formed flint-knapping, because it takes a lump of flint and gradually disposes of all of the flint, which does not match the desired shape. However, Homo erectus hit upon a new method for producing hand axes. Instead of chopping away at a flint nodule until it looked like a hand axe, the new tool-makers would knock a piece of flint off a core, and then shape the splinter, or flake to the desired shape. This process created numerous microliths, or sharp pieces of flint, which could be used as small knives or as scrapers on hides or bone.

Within 100,000 years, nearly all peoples in the world were using the new technique for making hand axes. As the technique of flaking spread, new forms of flaking appeared as well. Hominids began creating a whole series of new tools out of flint and quartzite and chert and obsidian, burins, or drills, for putting holes in wood. They used awls for punching holes in leather and scrapers for cleaning the meat off of hides and bones. Knives for cutting meat or vegetables and the points for spears (and later still, arrows); whereas chisels for working stone, wood and bone.

Hominids were sewing leather or plant material together, to make baskets and bags and clothing. They were drilling holes in wood, to make houses or boats. They were scraping hides because they wished to make leather. They were making knives for use in their kitchen areas because they were preparing more complex types of food. They were made spears because they hunted for large animals - and defended themselves against human predators as well.

4.3.2 Use of Fire: Sometime between 300,000 and 1.5 million years ago, humans also tamed fire. Taming fire may not be the same as controlling it. Some scientists believe that the hominid Homo erectus stumbled upon a lightning-struck tree or a forest fire, and captured a few coals in a basket, a bag or an animal horn. It may not have been able to put out the fire and re-start it, but it at least had some coals from which it could keep a hearth fire alive.

Homo erectus used fire in a number of interesting ways.

1. Fire was used to keep animals away.
2. Fire heat was used to cook food.
3. The heat and light on a torch could be used to start large fires, and drive animal prey towards a trap or ambush site.
4. The fire could be used to drive away predators.
5. Fire probably stimulated the creation of language.

Yet all of these and many benefits of fire would been have lost if the people failed to keep their

fire fed. The coals would go out, and all the benefits of having fire would be lost, for the hominids had no way to restart the flame once it was extinguished and the coals turned to ash.

Sometime between 500,000 and 1 million years ago, one of the hominids (probably Homo erectus) discovered that some stones gave off sparks when they were struck together. They also discovered that friction can produce heat, and heat can produce sparks which then generate flame. Four techniques developed for mastering friction and sparks, to generate fire in those days. With four methods for generating fire, hominids no longer needed to fear the loss of their coals. Bow drilling or stick rubbing were slow and inefficient ways of starting a fire, but they worked reliably and well. Hominids controlled fire, because they could light the fire, whenever they required.

4.3.3 Development of Shelter and Clothing: Shelter - Most early hominids probably lived in the open air, near to sources of food and water. Many such locations could be found near rivers, lakes and streams, perhaps with low hilltops nearby that could serve as refuges in troubled times. Our understanding of Paleolithic dwellings is limited. Even so, a few examples of Paleolithic houses exist, although they only come to light very recently in the Paleolithic era, no more than 200,000 years ago. These "houses" are more frequently campsites within caves or in the open air, with little in the way of formal structures for living in. However, as the Paleolithic era progressed, dwellings became more sophisticated, more elaborate, and more house-like. The oldest examples are shelters within caves, followed by houses of wood, straw and rock; a few examples exist of houses built out of bones.

Clothing - Most clothing is made out of perishable materials like leather and cloth, which readily decay in the ground after only short periods of time. Modern scientists can only postulate the existence of clothing in the Paleolithic Age from the existence of needles and other tools for sewing and preparing hides. Archaeologists find one possible sign of clothing in the Paleolithic era, though in some very ancient grave sites, a thin layer or halo of coloured earth surrounds the skeleton. Some believe this coloured earth to be the remains of clothing at burial.

4.3.4 Food Gathering in Paleolithic Age: The ape like first man, who lived in the Paleolithic age was a food gatherer. He used eoliths as his tool for hunting. Early humans in the Lower Paleolithic lived in mixed habitats, which allowed them to collect and hunt animals like fishes, lizards, seafood, eggs, nuts, of large animals killed by other predators or carcasses from animals that died by natural causes. Hunting and gathering was presumably the subsistence strategy employed by human societies beginning some 1.8 million years ago. It remained the only mode of subsistence until the end of the Mesolithic period. So, basically the early humans were food gatherers rather than food producers.

and fruits besides scavenging. Rather than killing large animals themselves for meat, they used carcasses

NEW STONE AGE

4.4 Neolithic age or New Stone Age:

The word 'Neolithic' was first coined by Sir John Lubbock in 1865. Miles Burkit enumerated four characteristics of Neolithic culture -

1. Animal domestication,
2. Agricultural practice,
3. Grind and Polished stone tools and
4. Pottery manufacture.

4.5 Civilization in Neolithic Age:

The civilization and culture of the Neolithic age shows distinct traces of progress. The Neolithic men had a settled life. Neolithic man changed from a food gatherer to a food producer. They practiced agriculture and grew fruits and corn. Animals, such as the cow, dog, ox, goat etc. were domesticated. The art of producing fire by the friction of bamboos or pieces of stones was known to them. Instead of eating the uncooked flesh of various animals, they now started roasting it. Besides this, bows and arrows were invented and were used for the purpose of hunting. They also learnt pottery, at first by hand and then with the potter's wheel. They painted and decorated their pots. They lived in caves, the walls of which were polished and painted with the scenes of hunting and dancing. They also learnt the art of spinning and weaving clothes.

4.6 Neolithic Tools:

The stone tools of the Neolithic were well polished either all over the tools or at the butt end and working-end, or only at the working end. They fashioned their tools out of fine-grained dark-green trap. Neolithic people added more complex tools, like fishing baskets and nets, using plant stems and fibers. These people could use wooden sticks for catching fish in the shallow water.

4.7 Occupation:

Neolithic settlers were cattle-herders and agriculturists. They produced ragi, wheat, barley, etc. Though remains of elephant, rhino, buffalo, ox, were found in plenty, but there is no specification of domestication of animals. But in the last part of Neolithic era, we find that Neolithic man had tamed animals for milk, skin or wool. Hand-made pottery is also found in the early stages of this era. As a result new class namely potters class emerged in this period. Though pottery was not much polished but it was practiced.

Tools making was another important occupation. The Neolithic (New Stone Age) was a period in the technological development of Homo sapiens that started at the end of the Ice Age, 10,000 years ago. It was the period, when first human settlements appeared. People left caves for huts made of branches, stones, adobe or bricks, depending on the resources of the place. The main reason for the settling of the people was the emergence of the agriculture during the Neolithic. They turned out to be food producers in this age.

4.8 Social Organization:

During most of the Neolithic age, people lived in small tribes composed of multiple bands or lineages. Most Neolithic societies were relatively simple and egalitarian. However, Neolithic societies were noticeably more hierarchical than the Paleolithic cultures. The domestication of animals resulted in social inequality. Possession of livestock allowed competition between households and resulted in inherited inequalities of wealth. There is evidence of settlements of the tribes in the river banks in small societies and this was the beginning of civilization. This has resulted the Neolithic man to develop agriculture and transform his profession from food gatherer to food producer.

4.9 Farming:

The Neolithic Revolution or Neolithic Demographic transition was the first agricultural revolution. It was the wide-scale transition of many human cultures from a lifestyle of food hunting and gathering to one of agriculture and settlement which supported an increasingly large population. Archaeological data indicates that various forms of plants and animal domestication evolved independently in six separate locations worldwide circa 10,000-7000 years BP (8,000-5,000 BC). The earliest known evidence exists in the tropical and subtropical areas of southwestern/southern Asia. Farming of various crops like wheat, barley, ragi, etc., were quite common in this era. People settled in societies near river beds as this was favourable place for agriculture. The alluvial soil, which is available near the river beds is fertile soil and it is useful for cultivation. The Neolithic man used to migrate from one place to another for better cultivation and in this process he use to clear the forests. Forest clearance was done with the help of polished stone axe.

4.10 Technology:

Neolithic peoples were food producers (farmers), manufactured a range of tools necessary for the tending, harvesting and processing of crops such as sickle blades and grinding stones. Pottery was also practiced in this era as a profession among some groups. They were also skilled manufacturers of a range of other types of stone tools and ornaments, including projectile points, beads, and statuettes.

4.11 Clothing:

Most clothing appears to have been made of animal skins, as indicated by finds of large numbers of bone and antler pins, which are ideal for fastening leather, but not cloth. However, wool cloth and linen might have become available during the British Neolithic.

4.12 Self Assessment Questions:

1. Explain the life of human beings in the Stone Age.
2. How was fire used?
3. Explain the evolution of human civilization in Neolithic age.
4. How was the civilization in Paleolithic times?
5. Write an essay on the mode of living and instruments used by Paleolithic man.
6. "The activities of Neolithic man have contributed to the formation of village communities" - discuss.
7. What are the tools used by the Paleolithic man?
8. Stone Age man was food gather rather than food producer. Explain.

Lesson Writer

Dr. M. Syamala

Lesson - 5

METAL AGE

5.0 Objective:

The aim of this lesson is to make the student gain knoledge on -

- How humans developed their civilization in metal age.
- How they have used various metals for various purposes.

Structure of The Lesson:

5.1 Introduction:

Metal age is called as Chalcolithic age. Chalcolithic is sometimes referred to as the 'Copper Age'. The word Chalcolithic is derived from the Greek for copper (chalcos) and stone (lithos).This period also known as the Eneolithic. It is a phase of the Bronze Age in which the addition of tin to copper to form bronze during smelting remained yet unknown by the metallurgists of the times. The Copper Age was originally defined as a transition between the Neolithic and the Bronze Age. The Chalcolithic is the name given to the period after the Neolithic and before the Bronze Age, roughly between about 4500 and 3500 BC. Some historians stated that metal age has started in 4000BC. The first 1000 years was called copper age and the next 1000 years was called the bronze age and the last 1000 years was called the iron age. In between the bronze and the Iron Age is the period called as "Dark period".

5.2 Chalcolithic Age:

There is not a great deal of information about the economy in the Chalcolithic, due to the lack of widely available botanical and faunal data from this period, so the Chalcolithic as a whole is very difficult to assess as a functioning economy.

Towards the end of the Neolithic period began the use of metals. The first metal to be used was

copper and the culture of that time is called Chalcolithic culture. The transition from use of stone to the use of metals was slow and long. There is no doubt that there was an overlapping period when both stone and metals were used. This is proved by the close resemblance of metallic tools and implements with those made of stone. The Chalcolithic i.e. Copper Bronze Age or stone-copper age of India produced a splendid civilization in the Indus Valley, which spread in the neighbouring regions.

5.3 Occupation:

Chalcolithic economy was based on subsistence agriculture, stock-raising, hunting and fishing. Their tools consisted of a specialized blades and flakes. Copper and bronze tools were present in a limited number. The most important cereals were wheat and barley etc., which were found in some locations. Tools like sickles and grinding stones indicate cultivation or at least plant exploitation Legumes, most importantly lentils and vetch, were also cultivated. Wild fruits include desert broom acorns and pistachio were grown. Flax was also grown, and was probably used for making items of linen. There was painted pottery in this age.

5.4 Cattle rearing:

The remains indicate that sheep and goat were dominant in this age. Pig and cattle make up the rest of the domesticated species. Less common animals which were also domesticated were - camel, horse and donkey, commonly used for transportation.

5.5 Tools used:

The Chalcolithic industry was largely based on stone. However, for the first time, copper appeared. The Chalcolithic is characterized by the processing of diverse raw materials, sometimes from distant locations into items which often displayed expert craftsmanship, indicating the presence of specialists like copper smiths and ivory craftsmen. Axes, adzes and chisels were used for wood working. Hammers are rounded implements made on modified cores. Blades include knives and sickles which were used. Some remaining was found in the trees, plant remaining and even in the bone remaining. Scrapers were also used in different shapes.

Bone was used to make needles, pins, awls and the handles of other tools. Elephant ivory and hippopotamus ivory were used to make more specialized and apparently non-secular items.

5.6 Copper Age:

Copper age was between 3500-2300 BC. The Copper age is distinguished from the older phases of the Neolithic Age, which is characterized by a purely agriculture way of life. During the Copper Age humans discovered metal as a raw material for fashioning tools, weapons and jewellery. This has brought about a social change. The mining and working copper gave rise to new occupations and social groups. Trade in copper and copper objects fostered far-reaching cultural contacts.

Copper was employed for the first time in the Chalcolithic period. There were very few domestic items made of copper like - awls, picks, axe blades and chisel blades. But, most copper tools which appeared in this time were used more in rituals. Two types of copper were employed - pure copper and arsenical copper. Raw materials were not converted into tools at the mining sites. Instead, they were taken to settlement sites, where they were worked in specialized industrial and manufacturing workshops.

Earliest experiments were confined to smelting and molding - probably in sand molds, as stone or other materials do not survive. Later, annealing was introduced, and in the hoard from Nahal Mishmar, the use of

the lost-wax techniques was employed. This technique could only be used, if non-pure copper was employed because it required a viscosity not present within pure copper.

5.7 Science and Technology in Copper Age:

We could find a good technological growth in this age. Use of wind energy was done in an abundant manner for various purposes. Oxen, horses, asses were used in agriculture. Wheeled cart were used in the agriculture and trade. Copper was used to make a various varieties of tools. Wheel was invented in this age. With the invention of wheel mechanization has progressed. Trade and commerce has improved and this has led to navigation. Pottery and carpentry was modernized. Solar calendar was used in this age.

5.8 Bronze Age:

The Bronze Age is a period in a civilization's development, when the most advanced metalworking consisted of techniques for smelting copper and tin to cast bronze. The Bronze Age is more advanced than the Stone Age, in which artifacts and tools are largely made from carved stone. The Stone Age, Bronze Age, and Iron Age make up the traditional three-age system for classifying prehistoric cultures. In some areas of the Earth, like Africa, certain groups went straight from the Stone Age to the Iron Age. Rare groups, such as isolated Amazonian tribes in Brazil, have not yet progressed past the Stone Age.

The Bronze Age primarily took place between 3500 BC and 1200 BC, and is traditionally divided into the Early Bronze Age (c.3500-2000 BC), Middle Bronze Age (c.2000-1600 BC), and Late Bronze Age (c.1600-1200 BC), with progressively more sophisticated metallurgy which culminates in the discovery of ironworking. The Bronze Age was important to mankind because it allowed us to create more durable tools and artifacts for productive use. Bronze is preferable to stone for a wide variety of applications - whether you are making a knife, an axe, armor, pottery, or artwork, Bronze is harder and longer-lived.

During the Bronze Age, there were thousands of tribes living in different groups. Small nations did exist, but it took many centuries before these countries resembling to look like what they do now.

5.9 Science and Technology in Bronze Age:

In this age, the principles of metallurgy were identified. Extensive progress was achieved in the areas of mechanics and physics. Balance was invented in this age to record the weights and units of weights were also established at this time. The introduction of numbering, symbols and even writing developed in this age. Foundation for theoretical astronomy and cosmology were laid. Man has advanced in studying anatomy and this has helped in understanding various diseases. Medical improvement was also seen in this era. Besides metallurgy and purification of metal various alloys were synthesized and various compounds were successfully produced. Bronze Age has brought about an extensive use and manufacturing of various varieties of tools and utensils. We also find many temples been constructed in this age.

5.10 Early Iron Age:

The Iron Age is divided into two subsections, Iron I and Iron II. Iron I (1200-1000) illustrates both continuity and discontinuity with the previous Late Bronze Age. There is evidence that shows strong continuity with Bronze Age culture, although as one moves later into Iron I the culture begins to diverge more significantly from that of the late second millennium. Iron II (1000-550) witnessed the rise of the states of Judah and Israel

in the tenth-ninth century. These small principalities exercise considerable control over their particular regions due in part to the decline of the great powers, Assyria and Egypt, from about 1200 to 900.

5.11 Science and Technology in Bronze Age:

Iron Age is considered to be the last phase of the metal age. In this age, iron occupied an importance role in the human life. It has replaced both copper and bronze which were used in the previous years. In this age writing has developed to a great extent. It has helped the human society to have a better expression and clarity in expression. It was in this period that man started understood the nature and this in turn leads to not only the origin but also the development of philosophy and science. As the man in this age understood nature, he started worshipping idols. He studies and understood the techniques of logical reasoning through principles and created a history. And this actually laid a foundation for the industrialization.

5.12 Self Assessment Questions:

1. Explain the evolution of civilization in Chalcolithic Age.
2. Write the advancement of technology in the Metal Age.
3. Explain the progress achieved by man from the Stone Age to metal age.
4. Explain the living style of man in Copper and Bronze Age.
5. Write a note on the human progress in the Iron Age.
6. Explain Chalcolithic Age or Metal Age.
7. How was the civilization in Bronze Age?

Lesson Writer

Dr. M. Syamala

Lesson - 6

EVOLUTION OF HUMAN BEINGS

6.0 Objective:

The aim of this lesson is to make the student gain knowledge on

- The evolution of human beings.
- How human beings have developed physically and mental from an ape to the modern human being.

Structure of The Lesson:

6.1 Introduction:

Evolution or the origin of human beings can be understood in three stages - ancient, medieval and the modern ages. These ages are important as they show how the human civilization has developed and how the scientific discoveries have taken place to help the growth and development of the humans. The modern theory concerning the evolution of man proposes that humans and apes evolved from an apelike ancestor that lived on earth a few million years ago. The theory states that man, through a combination of environmental and genetic factors, emerged as a species to produce the variety of ethnicities seen today.

Charles Darwin (1809-82) author of The Origin of Species (1859) has described the theory of evolution. It was based largely on observations, which he made during his 5-year voyage around the world aboard the HMS Beagle (1831-36).

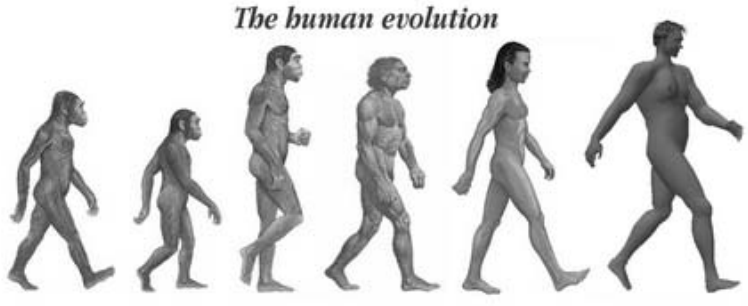
6.2 Theory of evolution of Human beings:

The currently-accepted theory of the evolution of man rests on three major principles.

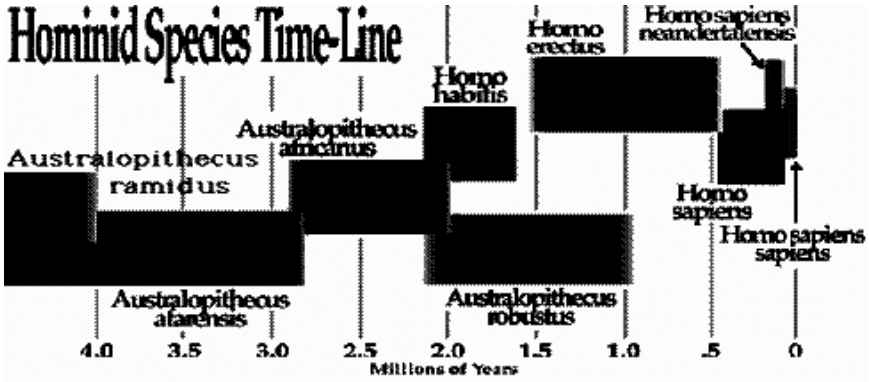
The first principle is microevolution, it refers to the occurrence and build-up of mutations in the genetic sequence of an organism. The second principal of evolution is natural selection. Natural selection is a natural mechanism by which the fittest members of a species survive to pass on their genetic information, while the weakest are eliminated because they are unable to compete in the wild. Natural selection is often termed "survival of the fittest" or "elimination of the weakest." The third principal of evolution is speciation, which occurs when members of a species mutate to the point, where they are no longer able to breed with other members of the same species.

Many scientists prefer to believe the theory about humans having developed from human like creatures or animals that were called australopithecines that existed about four million years ago. The scientific name for the genus of these creatures is Australopithecus or southern ape. The first of these prehistoric animals is said to have existed in Africa. Studies of fossils found in Ethiopia have suggested that these creatures walked upright most times and climbed trees when there was danger.

According to scientists, the earliest species of man were Homo habilis, skilled people who made stone tools and lived in groups. Their appearance was similar to that of the smaller type of Australopithecine, thought the size of the brain was two times bigger than that of an Australopithecine's. A more advanced type of Homo habilis was the Homo erectus or the erect human being. This group had a chinless jaw, a large sloping forehead and the size of the brain was bigger than that of the Homo habilis. It is believed that they were the first form of human beings to wear clothing. A development on the Homo erectus was the Homo sapiens or the wise human being. The shape of the Homo sapiens skull was similar to that of modern man and his brain was larger than that of his predecessor. Modern human beings began to appear on the earth nearly forty thousand years ago. The picture below shows how the great ape has got modified into the modern human.



The evolution of the hominids species over the time can also be understand through the following graph, which shows the time span also for this development.



Hominid Evolution:

Hominids are the "great apes" like - Chimpanzees, gorillas, humans, and orangutans. Numerous intermediary fossils have been found. But scientists disagree on which are human ancestors and which are evolutionary dead ends

Human Evolution:

The various developmental stages of the human beings is listed below -

Homo Habilis:

- They lived 2.4 to 1.4 million years ago.
- Fossils are found in southern and eastern Africa.
- Used simple bone and stone tools in their daily routine.
- They are Nicknamed as "handy man".

Homo Erectus:

- They lived 1.8 million years ago to 70,000 years ago.
- They are the first human ancestor to walk fully upright.
- Some of them made complex stone tools for various uses.
- Descendants of these were humans and Neanderthals.

Neanderthals:

- They are the Homo sapiens neanderthalensis.
- They lived in the time of Circa 400,000 to 30,000 years ago.
- They lived in Europe and Asia.
- Comparison of human and Neanderthal DNA shows that humans are not descended from Neanderthals.

Humans - Homo sapiens:

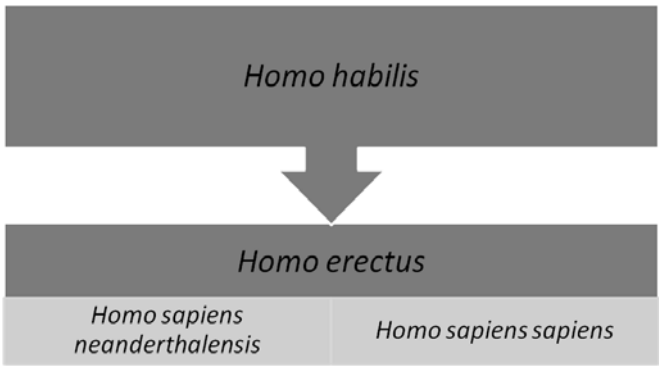
- "Homo" is derived from Latin which means "man" or "human".
- "Sapiens" which is also derived from Latin means "wise" or "intelligent".
- "Homo sapiens" means "wise man" or "wise human".
- Humans and Neanderthals both are considered as "sapiens"
- Anatomically of modern humans in Africa by 200,000 years ago are that of the present humans.

Humans - Homo sapiens in the middle Paleolithic period:

- They were the fully modern humans (like us) in Africa by around 60,000 years ago. They are the Descendants of Mitochondrial Eve and Y-chromosomal Adam.
- Analysis shows that humans began spreading throughout, and out of, Africa in the beginning around 60,000 years ago.

- Early human migrations had left southeastern Africa and spread throughout the continent.
- Humans traveled along the Indian Ocean to reach Australia.
- By 10,000 years ago, modern human beings had spread all over the globe.

The diagram below shows the evolution of the humans into the present man.



6.3 Self Assessment Questions:

1. Write an essay on the origin of life on earth
2. How did the primitive man developed into the modern man?
3. Give an account of the chronological sequences occurred during the evolution of human beings.
4. Write a brief note on the evolution of man.

Lesson Writer

Dr. M. Syamala

Lesson - 7

ANCIENT MEDIEVAL AND MODERN CIVILIZATION IN INDIA

Objective:

The aim of this lesson is to make the student gain knowledge on-

- The society, culture, and civilization in all the three ages.
- The process of civilization of human beings in ancient period and they changed in the medieval period.
- Salient features of the modern age are highlighted.

Structure of The Lesson:

7.1 Introduction:

History of India is known worldwide as it is famous for its richness and diversity. India has been the home to some of the oldest civilizations, dynasties and kingdoms which have been of interest to historians from all across the world. The history of India can be broadly divided into five parts -

- Prehistoric History of India
- Ancient History of India
- Medieval History of India
- Modern History of India

Civilization is a state of development in human society. This mainly includes the progress attained in science and arts. It gives rise to many political institutions and social organizations. Thus, civilization also means the culture or society that developed in a certain region. The process of civilizing a region or obtaining a civilized state is known as civilization. This word could also mean 'modern society along with its conveniences. Other words that could be used for 'civilization' are: culture or cultivation or refinement. The word is taken from the word civil. In past, civil was used to mean politeness and propriety. But, today civilization is used for any society. This society may be simple or complex dwelling.

7.2 Prehistoric History of India:

Prehistoric Era in the history of India has been speculated by historians across the globe. The exact

time when the Prehistoric settlements evolved in India is hard to determine, but it is believed that settlements were evolved in between 200000 and 3500 BC. Prehistoric evidences in India include several Mesolithic sites which have been excavated in the Chota Nagpur region. These sites are believed to have flourished between 8000 and 4000 BC.

7.3 Ancient History of India:

Ancient history of India is marked by the Indus Valley Civilization, which is one of the earliest known civilizations to mankind. Indus Valley Civilization had flourished around the basin of river Indus in the northwestern part of our country. This civilization is believed to have flourished around 3300 BC and it existed for about 2000 years. This civilization ended in around 1300 BC and its end was marked with the emergence of the Harappa Civilization. The Harappa Civilization existed between 1900 BC and 2600 BC. After Harappa, it was the Vedic Civilization which flourished. This civilization was mainly spread over the fertile lands of the great Gangetic plains.

Bronze Age in the Indian subcontinent began around 3300 BC with the early Indus Valley Civilization. It was centered on the Indus River and its tributaries which extended into the Ghaggar-Hakra River valley, Gujarat, and southeastern Afghanistan. The civilization was primarily located in Gujarat, Haryana, Punjab and Rajasthan provinces and Pakistan. It is one of the world's earliest urban civilizations, along with Mesopotamia and Ancient Egypt. Inhabitants of the ancient Indus river valley, the Harappans, developed new techniques in metallurgy and handicraft and produced copper, bronze, lead, and tin.

The developed Indus valley civilization flourished from about 2600 to 1900 BC. The civilization included urban centers such as Dholavira, Kalibangan, Rupar, Rakhigarhi, and Lothal in modern-day India, and Harappa, Ganeriwala, and Mohenjo-daro in modern-day Pakistan. The civilization is noted for its cities built of brick, roadside drainage system, and multistoried houses. Agriculture was the make activity of this civilization. Barley and wheat were the main food crops. Cultivation of cotton was the most remarkable thing to be noted in this time. The people ate, cereals, vegetables and fruits, fish, fowl, mutton, beef and pork. There is also evidence of the domestication of cats, dogs, goats, sheep and perhaps, the elephant.

The Indus people made extensive use of bronze and copper, but lacked the usage of fire. The people were very artistic. Evidence can be found in the pottery, stone sculpture and seal making. The pottery was made up of well-fired clay, with painting in black pigment. People worshipped natural forces like the tree, humped bull and Mother Goddess. To ward off evil spirit, the people even used amulets and charms. Indus people had trade relations with Afghanistan, Persia, Egypt, Mesopotamia and the Samaritans. Trade was in the form of 'barter system '. There was a cleverly organized system of weights and measures. The script during this time, which was seemingly pictographic, has not yet been deciphered. This civilization was very advanced and modern unlike the other civilizations which flourished in the rest of the world.

After 2000 BC, the Mohenjo-daro and Harappan culture slowly declined and gradually faded out. Some ascribe this to the decreasing fertility of the soil on account of the increasing salinity, caused by the expansion of the neighboring desert. Others attribute it to some kind of depression in the land, which caused floods. Still others point out that the Aryans destroyed it. Even though there are various theories for the downfall of this civilization, there is no clear picture as to how or why it came to an end.

Between 300 and 400 BC, all the major parts of the Indian Sub-Continent came under the rule the Maurya Dynasty. Asoka the great, Indian emperor formed this dynasty. It was during this period that the whole nation came into one man's control. In the other side the Gupta Dynasty existed in country between 300 BC to about 550 BC. This period is sometimes also referred as the 'Golden Age of India'. It was also during

the Gupta Period when Hinduism flourished in the region.

At that time southern India was ruled by the Chalukyas, the Cholas, the Pallavas and the Pandyas. These dynasties, like the Gupta Dynasty, were the prominent powers and economies of that time. It was during this phase of the history of India that India begun to spread its impact to most parts of Asia.

By the end of the Chalcolithic period, the rural settlements had come up in all parts of India. However, the major changes in the material culture were brought about with the use of iron. The 'Iron Age' in the world context began about 1300 BC. We have evidence of Iron at Pirak belonging to c. 1000 BC, at Mundigak and in the graves of Gandhara (1000 BC). At Timargarha, an iron cheek piece was found. In south India also Iron appeared around 1000 BC in Dharwar district of Karnataka. The evidence regarding use of Iron comes from Punjab, northern Rajasthan and the Ganga-Yamuna Doab this period is known as the later Vedic Age. At Jakhera, apart from wheat, barley, rice, cattle, pig and horse a large number of Iron implements have been discovered. At Hastinapur copper objects have been unearthed apart from glass beads and bangles, bone disc etc. At Atranjikhera iron tools include arrow and spearheads, chisels, axes and knives. Copper seem to be less common and includes antimony rods, nail parers, pins, bangles, fish-hooks and dishes. Bangles of glass, terracotta and faience are also reported. In the Karnataka region, excavations at Brahmagiri, Piklihal, Sanganakallu, Maski, Hallur and Paiyampalli show that iron was introduced at the close of the Neolithic-Chalcolithic period. It appears that the Iron Age peoples of the south were Dravidian speakers of different groups.

7.4 Medieval History of India:

The medieval history of India was mainly dominated by the Mughal Dynasty and several other Muslim rulers. The Mughal Dynasty was the most prominent dynasty during this phase of the history of India. The Mughal Empire gave country some of its great rulers such as Jalal-ud-din Mohammad (Akbar the great), Jahangir and a few more. Mughal Dynasty is famous for its architecture. Monuments build under the Mughal rule includes the Red Fort, the Jama Masjid etc. In fact, the Taj Mahal, one of the wonders of the world, was constructed by a Mughal emperor in the memories of his beloved wife.

In the medieval period, when the Mughals ruled the major part of the nation there were some independent kingdoms like- Rajput kingdoms of Rajasthan, the Maratha kingdom of Maharashtra, the Sikh provinces in Punjab and a few small dynasties. In south India Vijayanagara Empire was also a prominent during medieval phase. The nation also witnessed several Afghan invasions in this period.

The word medieval has its origins in the Latin term medium aevum which means "middle age". Though the ideal of Middle Ages was long ago, but its use came into existence in 19th century. At that time, scholars considered the medieval period to follow the fall of the Roman Empire and precede the Renaissance. Initially, the middle Ages were dismissed as a "dark age" of brutality and ignorance, but later scholars began to appreciate medieval architecture, medieval philosophy, and the particular brand of religious devotion that caused some 19th-century scholars to label the era "The Age of Faith." Medieval historians of the 20th century recognized some seminal developments in legal history, technology, economics, and education that took place during the medieval era. Many of our modern western moral viewpoints, some medievalists would argue today, have their origin (if not their full fruition) in medieval times, including the value of all human life, the merit of all social classes and the right of the individual to self-determination.

Dark Ages - Dark Age is an era of ignorance, superstition, or social chaos or repression. There is currently no true consensus among historians, authors, and educators for the precise dates -- or even the general dates -- that mark the beginning and end of the medieval era. It is believed that the dark ages are between 500-

1500 BC.

The term Dark Ages was originally used to describe the perceived lack of learning during the middle Ages. The exact period covered by the term has always been somewhat fluid. At times it has been applied to whole of the middle Ages. The term now is reserved, when it is used at all, for the period of social collapse after the fall of Roman Empire, when there was little in the way of historical or literary production. One implication of this that there are very few sources for this era, hence it is difficult for historians to reconstruct what happened in the era. In this sense term is limited only to the early middle Ages.

The term the "Dark Ages" refers to unusual levels of violence, cruelty, or disease in the era, this is not the case. The Roman Empire had almost constant warfare on its border throughout its existence, and had fairly high level violence within the Empire. The Renaissance, produced a great deal of great literature and art, was also a violent, war-torn society. During the Dark Ages many changes took place.

- Less writing, education, trade (called the Dark Ages)
- Political fragmentation.
- There were many barbaric tribes.
- The Church preserved ancient writings and Biblical writings.
- The Church unified the people because it was the only constant.
- There were many superstitions.
- People did not have individuality

Renaissances:

The word "Renaissance" means "rebirth "or a "reconstruction". This period saw a rebirth in Knowledge. It was that period when the man who pretends to be God has turned himself to the real man again. He has developed thinking power and individuality. Science and Arts became very important. The printing press was invented during the Renaissance. Christopher Columbus discovered America and Michelangelo was painting the Sistine Chapel. William Shakespeare was writing his famous plays. One of the most famous persons from the Renaissance was Leonardo da Vinci. He was known as a Renaissance man because he could do many things well. He was a painter, architect, inventor, scientist, poet, musician, and teacher.

The Renaissance was a great cultural movement that began in Italy during the early 1300's. It spread to England, France, Germany, the Netherlands, Spain and other countries in the late 1400's and ended in 1600. It is one of the most beautiful, if not misleading, names in history. It is beautiful because it implies an awakening of intellectual awareness. It is misleading because it suggests a sudden rebirth of learning and art after the presumed stagnation of the Middle Ages. The Renaissance era encompasses Western music history from 1400 to the beginning of the 1600's. This period in time marked the rebirth of humanism, and the revival of cultural achievements for their own sake in all forms of art, including music.

During this time, artists and musicians produced works that displayed more artistic freedom and individualism. This creativity allowed artists to abandon the stricter ways of the Medieval Era. Their art forms rediscovered the ancient Greek ideals. The great masters of the Renaissance were revered in their own lifetimes (rather

than after their deaths), which was different from most of their Medieval predecessors. With the new printing techniques, music and musical ideas were able to be preserved and distributed to the people.

7.5 Modern History of India:

The modern history of India is primarily marked by the East India Company, British Raj, Revolt of 1857 and the Indian Struggle of independence. After the later Mughals and several other dynasties and kingdoms including the Delhi Sultanate and the Sikhs, came the East India Company. In the history of India, this revolt is famously known as the 'Revolt of 1857'. After the Revolt of 1857, the rule of India was snatched from the hands of the British East India Company and the governance of the nation came under the direct rule of Britain. Soon an independence struggle was launched in the country. This independence struggle was mainly non-violent in form and was conducted under the leadership of leaders like Mohandas Karamchand Gandhi or Mahatma Gandhi. Under the British rule in India, there were only two major nationalist political parties in the country namely - the Muslim League and the Indian National Congress. After a long struggle, India finally achieved its independence from Britain after the Second World War in 1947. At the same time the partition of the country took place and the nation was divided into Pakistan and the Union of India.

7.6 Self Assessment Questions:

1. Write an essay on medieval civilization and its impact on human beings.
2. Explain civilization existed in India during prehistoric or ancient period.
3. Explain the evolution of civilization during pre-historic period.
4. Describe the process of evolution during the modern age.
5. What is dark period?
6. Why the medieval age is called the Dark Age?
7. What do you mean by Renaissances?

Lesson Writer

Dr. M. Syamala

Lesson - 8.I

VACCINATION

Objective:

- To know the importance of vaccination
- To know preparation and different types of vaccines

Structure:

8.I.1 Introduction:

Blood is the vital fluid present in the body of vertebrates. It is composed of watery plasma, red blood corpuscles and white blood corpuscles. Among them white blood corpuscles act as protective cells. They fight against the disease producing micro-organisms like bacteria, protozoa and other organisms. They are produced in bone marrow and reticulate endothelial system of the body.

8.I.2 Definition:

Vaccines are the suspensions of dead or attenuated micro-organisms that cause diseases in human beings. These organisms stimulate the reticulo-endothelial system inside the body of the organisms resulting in the development of resistance against diseases when administered (immunity). Development of immunity to infectious diseases by inoculation of such organisms in a stipulated dose is called vaccination. Vaccines are prepared either from killed organisms or from exposed pathogenic micro organisms to UV rays or X-Rays. Such vaccines when injected into the blood act as antigens.

Edward Jenner, the 18th century English physician was the pioneer of vaccination. Today basing on the principle of vaccination, the physicians have been employing effective immunizing agents to protect every one of us against from small pox, diphtheria, tetanus, polio, and many other infections which caused death to defenseless persons to former times. World Health Organization (W.H.O.) is successful in eradicating small pox in the world. Travelers should get themselves vaccinated for prevention of diseases like yellow fever, cholera and small pox or many other prevalent epidemics.

8.I.3 Preparation of Vaccines:

Vaccines are prepared in different ways

1) Disease causing organisms are killed and vaccine are prepared

2) Disease causing organisms are weakened (attenuated) to produce vaccines

3) Detoxified vaccines of disease causing organisms will be given as vaccines

8.I.4 Types of Vaccines:

When these vaccines are given to the organisms they act as antigens. They stimulate the body of the organism to produce antibodies. When real germs enter this organism, the antibodies already present will kill them and protect the organism from disease. Thus immunity will be developed. Bacteria and viruses are generally used in the preparation of vaccines. Pertusis vaccine against woophing cough from Haemophilus pertussi, typhoid and paratyphoid vaccine against typhoid from Salmonella typhi, cholera vaccine from Cholera vibrio, plague vaccine from Pasteurella pestis are bacterial vaccines. Vaccines for small pox, yellow fever, measles, polio, mumps, influenza, rabies etc. are produced from viruses. All these types of vaccines are used to stimulate and produce immunity in children right from their birth.

Bacterial Vaccines:

1) **Pertussia Vaccine:** This is a sterile suspension of wooping cough bacilli caused by Haemophilus pertussi. It is usually administered along with tetany and diphtheria toxoins. It is not advisable to be used for those over 6 years ago. The complications with this vaccine are provocation of poliomyelitis and convulsions.

2) Typhoid and Paratyphoid 'A' and 'B' Vaccine: This is the sterile suspension of Salmonella typhi A and B bacilli. The vaccine usually gives mild reactions, causing pain, body ache and headache. Intra dermal inoculation has been demonstrated to have a lower incidence of adverse reactions. Para typhoid vaccine combined with typhoid vaccine has been shown ineffective.

3) Cholera Vaccine: This is a suspension of heat killed suitable strain of Cholera vibrio. Immunity appears within 7 to 10 days and lasts for 5 to 6 months. Reactions are usually minimal.

4) Cholera Vaccine Vormulaised: This is prepared from the uncontaminated culture of vibrios, killed by the addition of formaldehyde. In general cholera vaccine available at present provides only about 50% effectiveness for about 3 to 6 months even with 2 doses.

5) Plague Vaccine: This is a sterile suspension of suitable strain of Pastairella pestis. In an emergency, single dose of 3 ml may be administered. Formalysed plague vaccine is prepared by killing an uncontaminated P. pestis culture by the addition of formaldehyde.

6) Rickettsia Vaccine: It is a sterile suspension of epidemic typhus Rickettsias grown in chick cultures. The vaccine may reduce mild allergic reaction.

Viral Vaccines:

1) Small pox Vaccine: It contains the living virus of the disease kept below the freezing point. The immunity against small pox developed by this vaccine lasts for 5 to 7 days. However, in countries like India where the disease is endemic, revaccination is advised every 4th year and in the event of special risk, small pox vaccine of 0.06 ml is inoculated intra-derminally.

2) Yellow Fever Vaccine: First the chick embryo tissue is injected with yellow fever virus. Then the dried product is reconstructed with saline or some other appropriate dilutant before use.

3) Measles Vaccine: Two types of measles vaccine are available in Western countries.

a) The inactivated measles vaccine

b) The attenuated measles vaccine, containing the attenuated live measles virus.

4) Polio Myelitis Vaccine: Two types of vaccine are available.

a)The inactivated polio myelitis vaccine and

b)Live oral vaccine

The vaccine is given by subcutaneous or by intramuscular injection. Live oral polio myelitis vaccine is the most favoured anti polio vaccine at present and is available either in monovalent or in trivalent form. The former is an aqueous suspension either types types i.e., 1, 2 or 5 substrain of the attenuated polio myelitis virus, while the latter contains all the three attenuated strains. The main indications to the use of oral polio vaccine are the presence of acute infection infection and diarrhea.

5) Mumps Vaccine: It is a suspension of Jeryl strain in chick embryo tissue culture.

6) Influenza Vaccine: It contains antigens from inactivated influenza virus A and virus B. It produces immunity with in three weeks. A single dose may give protection for 6 months in adults.

7) Rubiella Vaccine: This vaccine contains the attenuated strain of Rubiella virus. This has been administered prophylactically by subcutaneous method. The vaccine administered internally in the form of drops has been demonstrated to produce a comparable immunity.

8) Carbolised Rabies Vaccine: This is a sterile suspension of brain substance containing fixed virus of Rabies, inactivated by the addition of phenyl. The vaccine is used for the prevention of rabies in patients who have been bitten by the suspected rabies animals. The vaccine is given subcutaneously into the cellular tissue on the side of the abdominal wall below the coastal margin. Immunity conferred by the vaccine lasts for three months. The dose vaccine for a child less than 12 years of age is half or three quarters that of the dose given to the adult.

8.I.5 Summary:

Vaccines are the suspensions of dead or attenuated micro-organisms that cause diseases in human beings. These organisms stimulate the reticulo-endothelial system inside the body of the organisms resulting in the development of resistance against diseases, when administered. Injection of such organisms in a stipulated dose is called vaccination. When thesevaccines are given to the organism, they act as antigens. Edward Jenner, the 18th century English physician was the pioneer of vaccination. Vaccines are prepared in different ways. When these vaccines are given

to the organisms they act as antigens. They stimulate the body of the organism to produce antibodies. When real germs enter this organism, the antibodies already present will kill them and protect the organism from disease. Thus immunity will be developed. Bacteria and viruses are generally used in the preparation of vaccines. Pertusis vaccine against woophing cough from Haemophilus pertussi, typhoid and paratyphoid vaccine against typhoid from Salmonella typhi, cholera vaccine from Cholera vibrio, plague vaccine from Pasteurella pestis are bacterial vaccines. Vaccines for small pox, yellow fever, measles, polio, mumps, influenza, rabies are produced from viruses. All these types of vaccines are used to stimulate and produce immunity in children right from their birth.

8.I.6 Technical Terms:

Vaccine

Vaccination

Antigen

Antibody

Bacterial Vaccine

Viral Vaccine

Immunity

Cholera Vaccine

Plague Vaccine

Rickettsia Vaccine

Smallpox Vaccine

Yellow Fever Vaccine

Measles Vaccine

Polio Myelitis Vaccine

Mumps Vaccine

Influenza Vaccine

Rubiella Vaccine

Carbolised Rabies Vaccine

8.I.7 Self Assessment Questions:

1) Give an account of vaccines
2) Describe the role of vaccination in developing immunity
3) Write an account on preparation and types of vaccines

Lesson - 8.II

ANTIBIOTICS

Objective:

- To know the importance of antibiotics
- To study about classification of antibiotics
- To understand the mechanism of action of antibiotics

Structure:

8.II.1 Introduction:

Antibiotics are the chemical substances produced by various species of micro-organisms, such as fungi, Actinomycetes and bacteria. They suppress the growth of other micro-organisms and may ultimately destroy them. Most of antibiotics are obtained from fungi like Penicillin, streptomycin, Nystalin et. Some like Bacteracin, Colistin, Polimyxin B and Tyrothricin are obtained from bacteria. The antibiotics which are obtained from fungi or bacteria are called natural antibiotics. Certain antibiotics are synthesized from chemical substances like Chloromphenicol, terramycin etc. by chemical methods. They are called synthetic antibiotics. Both are in common use at present.

8.II.2 Discovery:

Penicillin was the first antibiotic discovered by Alexander Flemming in 1928. It was produced from Penicillium notatum, a mould, capable of killing pathogenic bacteria causing boils and poisoning.

8.II.3 Therapeutic Use:

Antibiotica are widely used to cure Transillitis, Pneumonia, Meningitis, Bronchitis, urinary infections, sexual and congenital diseases, wounds and burns, cuttings and bullet shots etc. They act tremendously over the bacteria and drive the person towards immunity. Now a days, the germs are also becoming resistant to these drugs due to indiscriminate and improper usage of these antibiotics. Hence double strength drugs are in practice to cure the diseases effectively and quickly. Besides the human beings, live stock also responds well to antibiotics treatment against diseases. Medicines are given orally along with food.

8.II.4 Classification:

Depending upon their action, antibiotics may be classified in the following 8 groups.

1) Antibiotics mainly effective against gram positive bacteria.

   Ex: Penicillin, Erythromycetin, Lincomycetin, Olendomycetin etc...

2) Antibiotics mainly effective against gram negative bacteria.

   Ex: Streptomycin, Kennamycin, Gentamycin etc...

3) Antibiotics effective both against gram positive and gram negative bacteria.

   Ex: Ampicillin, Amoxycillin, Tyroyhricin and Bitamycin.

4) Antibiotics effective against Rickettsia and Chlamydea.

   Ex: Tetracyclin and Chloramphenicol.

5) Antibiotics effective against acid fast bacilli.

   Ex: Streptomycin, Cyclocrine.

6) Antibiotics effective against protozoa.

   Ex: Paramomycin, Tetracyclin, Fumagillin.

7) Antibiotics effective against Fungi.

   Ex: Nystalin, Amphoterin B, Grisopulvin

8) Antimalignancy antibiotics.

   Ex: Actinomycin D, Mitomycin etc...

8.II.5 Important Antibiotics:

Among several antibiotics in use, the following antibiotics are important and commonly used.

Penicillin:

This is the most important of the antibiotics. Alexander Flemming discovered this in

1928. It is derived from a mold Penicillium notatum which grows over the surface of nutrient. Howard and Ernst Chain discovered another unusual strain which can grow inside the nutrient environment and solved the problem of difficulty in the large scale production of the drug by discovering the unusual mould growing inside the environment. These two scientists along with Alexander Flemming shared the Nobel Prize in 1945 for their outstanding discovery. Penicillin G or Benzyl Penicillin is the most commonly used drug. This drug is effective against multiplying bacteria. By making the bacterial membrane vulnerable to the medium, the drug damages the microorganisms.

Benzyl Penicillin:

It is available in the form of its water soluble sodium and potassium salts. Penicillin is bioassayed by its anti-bacterial activity against Bacillus subtilis or Carcina lutea. Benzyl Penicillin is mainly effective against gram positive and gram negative cocci and gram negative bacilli. Majority of streptococci with the exception of C - strains (Enterococci) are susceptible.

Mechanism of Action:

Penicillin is a bactericidal drug effective mainly against multiplying organisms. The lethal action of penicillin on bacteria is a slow process with a constant rate and extends over a period of many hours. Penicillin acts by interfering with the synthesis of the cell wall mucopeptides of gram positive cocci. This makes the cell membranes of the organism vulnerable to damage by solutes in the surrounding medium.

Indigestion, diahorrea, dearness and loss of balance are the side effects commonly observed when the antibiotics are administered. Penicillin produces rash and allergy. Some are more dangerous. If given without testing, they may even lead to death of the organism. Hence they should be tested by subcutaneous injection before the drug is administered.

Erythromycin:

It is a fermentation product of the fungus Streptomyces erythrus. It is effective against the gram positive cocci including the Streptococci, Staphylococci and Pneumococci. The drug is mainly absorbed from the small intestine.

Spiramycin:

This is another microbial antibiotic derived from Streptomyces ambofaciences, with a spectrum similar to that of erythromycin.

Bactracin:

It is a polypeptide antibiotic obtained from Bacillus subtilis. It resembles Penicillin in antibacterial action. It is effective against gram positive organisms like Staphylococci, Pneumococci and Enterococci. It is not much absorbed orally.

Streptomycin:

It is obtained from Streptomyces griscus, in an organic base. It was discovered by Selman A Waksman to fight against Pneumonia, Tuberculosis along 15 other diseases. Streptomycin is useful in urinary tract infections caused by E. coli. It is also employed in the treatment of meningitis due to H. influenzae.

Kannamycin:

This is a water soluble aminoglycoside antibiotic. It is derived from Streptomyces kannamyceticus. It is effective against many gram negative organisms including E. coli, Klebsiella, and Salmonella etc.

Gentamycin:

This is another powerful aminoglycoside antibiotic. It is produced from Micromonospora purpura. It is effective against Pseudomonas, E. coli, Proteus., A. aerogenes, K. pneumoniae, Salmoncilae and Group A Betahemolytic Streptococci.

Tetracyclin:

It is an oral drug. It is used to fight against several disease causing germs. Wide range of bacterial diseases of urinary and respiratory systems, bone infections and skin diseases are treated with this drug.

Rifampicin:

It acts on leprosy and T.B.

Thus antibiotics play an important role in controlling bacterial diseases.

8.II.6 Summary:

Antibiotics are the chemical substances produced by various species of micro-organisms, such as fungi, Actinomycetes and bacteria. They suppress the growth of other micro-organisms and may ultimately destroy them. Most of antibiotics are obtained from fungi like Penicillin, streptomycin, Nystalin etc. Some like Bacteracin, Colistin, Polimyxin B and Tyrothricin are obtained from bacteria. The antibiotics which are obtained from fungi or bacteria are called natural antibiotics. Certain antibiotics like Chloromphenicol, Terramycin etc. are synthesized from chemical substances like Chloromphenicol, terramycin etc. by chemical methods. They are called synthetic antibiotics. Both are in common use at present. Penicillin was the first antibiotic discovered by Alexander Flemming in 1928. It was produced from Penicillium notatum, a mould, capable of killing pathogenic bacteria causing boils and poisoning. Besides the human beings, live stocks also respond well to antibiotics treatment against diseases. Medicines are given orally along with food. Depending upon their action, antibiotics may be classified in the 8 groups. Important antibiotics using include Penicillin, Erythromycin, Spiramycin, Bactracin, Streptomycin, Kannamycin, Gentamycin, Tetracyclin, Rifampicin etc.

8.II.7 Technical Terms:

Antibiotic
Bacteria
Fungi
Penicillin
Streptomycin
Nystalin
Bacteracin

Colistin
Polymyxin B
Chloromphenicol
Tetramycin
Transillitis
Pneumonia
Meningitis
Bronchitis
Urinary Infections
Sexual and Congenital Diseases
Erythromycetin
Lincomycetin
Olendomycetin
Kennamycin
Gentamycin
Ampicillin
Amoxycillin
Tyroyhricin and Bitamycin
Tetracyclin
Chloramphenicol
Streptomycin
Cyclocrine
Paramomycin
Tetracyclin
Fumagillin
Nystalin
Amphoterin B
Grisopulvin
Actinomycin D
Mitomycin

8.II.8 Self Assessment Questions:

1) Write an account on antibiotics

2) What are different antibiotics and how they are used?

Lesson - 8.III

PENICILLIN

Objective:

- To study the importance of penicillin
- To study the discovery of penicillin
- To know types of penicillin

Structure:

8.III.1 Introduction:

Any substance produced by a living organism which under natural conditions inhibits the growth of another organism is called an 'antibiotic'. These antibiotics are popularly called 'wonder drugs'.

Antibiotics are one of the most frequently prescribed medicines in modern medicine. Antibiotics cure disease by killing or injuring bacteria. Today up to 100 different antibiotics are available which can be used to cure minor ailments as well as life threatening infections. Although antibiotics are useful in a wide variety of infections it is important to realize that antibiotics are use only to treat bacterial infections. Antibiotics are useless against viral infections (Ex: Common cold) and fungal infections (Ex: Ring worm).

Penicillin refers to a group of beta-lactum antibiotics used in the treatment of bacterial infections caused by susceptible, usually Gram-positive organisms. It is the most common antibiotic used in medical care. It is produced from a mould Penicillium notatum. This was accidentally identified by Alexander Flemming in 1928. He shared Nobel Prize for his discovery of this wonderful drug in 1945.

8.III.2 Discovery:

While studying bacteria causing boils and blood poisoning, Alexande Flemming noticed that some dishes having bacteria were infected with a mould (a form of fungus). All the bacteria around the bacteria were killed. This mould was identified as Penicillium notatum. Basing on this, Flemming found that Penicillium mould can kill other types of harmful bacteria also.

8.III.3 Production:

Antibiotic received from Penicillium was not sufficient to meet the demand. Howard Florey and Earnest Chain solved the problem of its large scale production and shared the Nobel Prize along with Flemming in 1945.

The only available method for manufacturing Penicillin was the basic laboratory technique. The mold was grown on the surface of liquid nutrient placed in thousands of glass containers. Once the colony is established, it is taken off by filtration. The liquid contains crude penicillin which is in dissolved state. The dissolved penicillin is taken off and purified for further use. But the amount of the antibiotic obtained is very small. Possibility of contamination by substances formed by other micro-organisms that were present in the nutrient is more.

Large Scale Production:

Later people of the United States developed a new technique for large scale production of the drug. An unusual type of Penicillium was discovered accidentally which could grow inside the medium. This mould was placed in deep fermentation tanks where the mould grows enormously in the nutrient. The filtered fluid yields large amounts of Penicillium drug. Cultures, sub-cultures are grown using pure strains of Penicillium from a master culture medium. Larger and larger vessels for fermentation processes were used to produce enormous amounts of the drug. This is meeting the demands from the people.

8.III.4 Types of Penicillin:

Benzyl penicillin, Phenoxymethyl penicillin, Procainebenzyl Penicillin, Semi-synthetic Penicillins, Narrow spectrum Penicillins Moderate spectrum Penicillins, Extended spectrum Penicillins are specifically used in the treatment of severe and chronic diseases and infections like Gonorrhea, Meningitis, Aspiration Pneumonia, Pneumonia, Syphilis, Tonsillitis, Pharyngitis, Skin infections, Gingivitis, Anthrax etc.

Depending on the strain of Penicillium used many types of antibiotics are produced Ex: Penicillin B is produced by Penicillium notatum, Penicillin is produced by P. chrysogenum, Griseoflavin is produced by P. gensem.

When corn steep liquor is used in this medium, Benzyl penicillin (Penicillin G) is obtained. It is less toxic and has more antibiotic properties. It cannot be taken orally. It destroys in acetic state. Hence, new types of penicillins were discovered. When the growing mould gets less toxicity, it adds acetic acid into penicillin. Such penicillin is called phenoxy methyl penicillin. It can be taken orally. Now a days, 6'amino penicillic acid is made to undergo acylation and phenoxy methyl penicillin is produced in large quantities.

8.III.5 Uses:

Penicillium and other related antibiotics are effective against many types of bacteria. It is used successfully in treating acute bacterial infections in human beings. Penicillin is also used to treat gram positive bacteria, including most of the species such as Streptococcus, Stephylococcus, Micrococcus, Clostridium, Borrella, Corynobacterium and Bacillus. It cures fever, cough, pulmonary diseases diseases, sex diseases etc. Its outstanding pharmaceutical characteristic is that it is non-toxic to human beings. (Now-a-days it is giving reaction and also becoming fatal to other animals)

8.III.6 Adverse Effects:

Common adverse drug reactions in less than 1% of individuals observed with the use of the penicillin include diarrhea, nausea, rash, fever, vomiting, dermatitis etc. Since reaction is observed now a days in many patients, it is tested with a minimum dose before administering the actual dose.

8.III.7 Summary:

Penicillin refers to a group of beta-lactum antibiotics used in the treatment of bacterial infections caused by susceptible, usually Gram-positive organisms. It is the most common antibiotic used in medical care. It is produced from a mould Penicillium notatum. The only available method for manufacturing Penicillin was the basic laboratory technique. Later people of the United States developed a new technique for large scale production of the drug. Benzyl penicillin, Phenoxymethyl penicillin, Procainebenzyl Penicillin, Semi-synthetic Penicillins, Narrow spectrum Penicillins Moderate spectrum Penicillins, Extended spectrum Penicillins are specifically used in the treatment of severe and chronic diseases and infections like Gonorrhea, Meningitis, Aspiration Pneumonia, Pneumonia, Syphilis, Tonsillitis, Pharyngitis, Skin infections, Gingivitis, Anthrax etc. Penicillium and other related antibiotics are effective against many types of bacteria. It is used successfully in treating acute bacterial infections in human beings. Penicillin is also used to treat gram positive bacteria, including most of the species such as Streptococcus, Stephylococcus, Micrococcus, Clostridium, Borrella, Corynobacterium and Bacillus. It cures fever, cough, pulmonary diseases diseases, sex diseases etc. Common adverse drug reactions in less than 1% of individuals observed with the use of the penicillins

8.III.8 Technical Terms:

Penicillin

Beta-Lactum Antibiotics

Gram-Positive Organisms

Benzyl Penicillin

Phenoxymethyl Penicillin

Procainebenzyl Penicillin

Semi-Synthetic Penicillins

Narrow Spectrum Penicillins

Moderate Spectrum Penicillins

Extended Spectrum Penicillins

Gonorrhea

Meningitis

Aspiration Pneumonia

Pneumonia

Syphilis

Tonsillitis

Pharyngitis

Skin Infections

Gingivitis

Anthrax

Streptococcus

Stephylococcus

Micrococcus

Clostridium

Borrella

Corynobacterium and Bacillus

8.III.9 Self Assessment Questions:

1) Describe the importance of penicillin

2) What is an antibiotic? Describe briefly how penicillin acts as an antibiotic?

Lesson - 8.IV

ANTISEPTICS

Objective:

- To know about antiseptics
- To study types of antiseptics
- To study about application of antiseptics
- To understand mechanism of action and therapeutic efficacy of antiseptics

Structure:

8.IV.1 Definition:

An antiseptic is a substance that prevents or arrests the growth or action of microorganisms either by inhibiting their activity or by destroying them. Antiseptics are generally distinguished from antibiotics that destroy microorganisms and from disinfectants which destroy microorganisms on nonliving objects.

Antiseptics and disinfectants are probably the drugs most widely used by the public including a lay man. The term antiseptic was first used by John Pringle in1750 to describe substances that prevent putrefaction. Germicides include only those antiseptics that kill microorganisms. Some common antiseptics are Acids, Alkalies, alcohol, Aldehydes, Surfactants, Phenols, iodine, hydrogen peroxide, ammonium compounds and boric acid. Halogens and halogen containing oxidizing agents, dyes, heavy metals and gases like ethylene oxide, Iodine, Formaldehyde etc. are the most common antiseptics that are commonly used by the public. Now a days a number of soaps added with antiseptic and disinfectant materials are also being marketed. Important dyes include Crystal violet, Brilliant green, Methylene blue etc.

8.IV.2 Types of antiseptics:

1) Hydrogen Peroxide: A 3% aqueous solution of hydrogen peroxide is used to treat minor cuts and abrasions on certain parts of the body.

2) Inorganic Chemicals: Several inorganic substances such as Potassium permanganate, potassium chlorate, sodium hypochlorite are used as antiseptics. All these are oxidizing agents. They indiscriminately attack both the microorganisms and human cells. Due to this they were replaced by organic compounds.

3) Phenols: Phenols such as Cresol, Chlorocresol, Thymol etc. are used against gram positive bacteria.

4) Organic Mercurals: In the mercury atom is linked to a carbon atom by covalent bond. These are less irritating and do not allow the bacteria to grow. Hence these are called bacteriostatic.

There is a great variation in the ability of antiseptics to destroy microorganisms and in their effect on living tissue. For example mercuric chloride is a powerful antiseptic, but it irritates delicate tissue. In contrast silver nitrate kills fewer germs but can be used on the delicate tissues like eyes and throat. There is also a great difference in the time required for different antiseptics to work. Iodine, one of the fastest working antiseptics, kills bacteria with in 30 minutes. Other antiseptics have slower, more residual action. The bacteriostatic action of an antiseptic compared to that of phenol is known as its phenol coefficient.

8.IV.3 Application of Antiseptics:

- **Skin Antiseptic:** It is a safe, non-irritating, antimicrobial containing preparation that prevents many skin infections. A patient preparative skin preparation is a safe, fast acting, broad spectrum, antimicrobial containing preparation that significantly reduces the number of microorganisms on the intact skin.

- **Surgical Hand Scrub:** It is a safe, nonirritating, antimicrobial containing preparation that significantly reduces the number of microorganisms on the intact skin.

- **Health Care Personnel Hand Wash:** It is a safe nonirritating preparation designed for frequent use that reduces the number of transient microorganisms on intact skin to an initial baseline level after adequate washing, rinsing and drying.

- **Skin Wound Cleaners:** It is a safe, nonirritating, liquid preparation assisting in the removal of foreign material from small superficial wounds and does not delay wound healing.

- **Skin Wound Protectant:** It is a safe, nonirritating preparation applied to small cleansed wounds to provide a protective barrier (physical, chemical or both). It neither delays healing nor favors the growth of microorganisms.An antimicrobial soap contains an active ingredient with in-vitro and in-vivo activity against skin microorganisms.

8.IV.4 Mechanism of Action:

The chemical antiseptics and disinfectants act on the microorganisms by one or more of the following mechanisms.

- Coagulation of the bacterial proteins
- An alteration in the properties of the bacterial cell walls.
- Binding of free sulphydral (SH) groups essential for enzyme action
- Competition with essential substances for the important enzymes in the bacterial cell.

In general antiseptics bind readily to bacteria. The extent of killing of the bacteria is governed by

a) concentration of the antiseptic

b) bacterial cell density and

c) time of contact

Though they are mainly bactericidal in action, at low and rather narrow concentrations, they act as bacteriostatic. In the presence of higher concentrations of antiseptic, disruption of the normal cellular functions may occur.

8.IV.5 Therapeutic Efficacy:

The therapeutic efficacy of the antiseptics is determined by

- Drug concentration and its therapeutic index: In general antiseptics effects increases with a rise in concentration.
- Species insusceptibility
- Temperature and other physical parameters

Thus one can conclude the importance of these antiseptics in preventing the germ injections, thus giving a better life to the human living.

8.IV.6 Summary:

An antiseptic is a substance that prevents or arrests the growth or action of microorganisms either by inhibiting their activity or by destroying them. Antiseptics are generally distinguished from antibiotics that destroy microorganisms and from disinfectants which destroy microorganisms on nonliving objects. Some common antiseptics are Acids, Alkalies, alcohol, Aldehydes, Surfactants, Phenols, iodine, hydrogen peroxide, ammonium compounds and boric acid. Halogens and halogen containing oxidizing agents, dyes, heavy metals and gases like ethylene oxide, Iodine, Formaldehyde etc. are the most common antiseptics that are commonly used by the public.

8.IV.7 Technical terms:

Antiseptic

Acids

Alkalies

Alcohol

Aldehydes

Surfactants

Phenols

Iodine

Hydrogen Peroxide

Ammonium Compounds

Boric Acid

Halogens

Halogen Containing Oxidizing Agents

Dyes

Heavy Metals

Gases Like Ethylene Oxide

Iodine

Formaldehyde

8.IV.8 Self Assessment Questions:

1) What are antiseptics?

2) Give an account of different substances that are used as antiseptics?

Lesson - 8.V

ANESTHETICS

Objective:

- To know about types of anesthetics
- To study methods of administering anesthetics
- To study characteristics of ideal anesthetics

Structure:

8.V.1 Definition:

Anesthetics are the chemicals used to produce loss of sensation. These are used during surgical operations so as to enable the patient not to feel pain. General anesthetics are the agents which bring about loss of all modalities of sensation, particularly pain along with reversible loss of consciousness.

The first inhalation anesthetic called nitrous oxide was discovered by Priestly in 1974. Hoarce Wells, a dentist in UK used it for the first time in 1824. Gas anesthetic was reported and used by Hill Hickman.

8.V.2 Types of Anesthetics:

There are two main types of anesthetic General anesthetic and local anesthetic.

General Anesthetic:

A general anesthetic causes the patient to loss consciousness. All senses are temporarily cut off. General anesthetics are of two types. Volatile general anesthetics and non-volatile general

anesthetics.

Volatile General Anesthetics:

Both liquids and gases are used as volatile general anesthetics. Liquids among volatile general anesthetics are Diethylether, Chloroform, Holothane, Ethyl Chloride, Trichloromethylene, Methoxyfurance, Fluroxene etc. Volatile gases are Cyclopropane, Nitrous Oxide, Ethylene etc..

Non-Volatile General Anesthetics:

Non-volatile general anesthetics mainly include ultra short acting Barbiturates and non-barbiturates.

Local Anesthetic:

A local anesthetic affects only part of the body. It leaves the patient awake and conscious. This is one which is restricted to particular part of the body. The drug produces numbness only at the place of application while the patient is in conscious condition. It is administered by injection or by surface application. The drug dreadens the nerves of that area so that pain signals are not carried to the brain. These may be in liquids, jelly like, spongy or in the form of ointments. Here the patients can co-operate with the doctor to make the operation easier. Procaine, Novacaine, Ethylchloride and Sodium Pentothal are the local anesthetics.

8.V.3 Different Substances Used as Anaesthetics:

Many substances such as Ether, Nitrous oxide, Holothane, Fluroxene, Isoflurane, Cocaine, Procaine etx. Are used as anaesthetics.

1) Ether: Diethyl ether was the first general anesthetic. Inhalation of ether vapour produces unconsciousness by depressing the activity of the central nervous system. Ether is relatively safe. The disadvantage of this is its high flammability and its side effect nausea.

2) Nitrous Oxide or Laughing Gas: This was discovered by Joseph Priestley in 1772. Earlier it was widely used at laughing gas parties among the nobility. Nitrous oxide mixed with oxygen is used as anesthetic in surgery. It is quick acting but not very potent. When it is mixed with ordinary air instead of oxygen, not enough oxygen gets into the patients blood and permanent brain damage may result.

3) Chloroform: It is a powerful volatile anesthetic used previously. But it has a number of serious drawbacks such as narrow safety margin, causes liver damage and its effective dose is close to the lethal dose. Hence it is no longer recommended as a general anesthetic.

4) Holothane: (Fluthane) It is a fluorinated volatile, heavy, colourless liquid with characteristic sweet odour. It has structural similarities to chloroform. It is a non-inflammable one and is supplied in amber coloured bottles. It does not irritate the respiratory passage. Induction of anesthesia and recovery are reasonably quick. Halothane inhibits laryngeal and pharyngeal reflexes. It may be employed to induce controlled hypotension.

5) Fluroxene: This is a colourless, volatile liquid which boils at 43oC. It is inflammable but non-irritant. Induction of anesthesia and its recovery are rapid.

6) Isoflurane: This is a new, non-inflammable liquid related to enflurance with uptake and excretion being rapid than holothane.

7) Cocaine: For dental work and minor surgery, it is usually desirable to deaden the pain in a particular part of the body only. For this purpose local anesthetic cocaine is used. It is also a powerful stimulant. Hence it is misused as a drug.

8) Procaine (Novacaine): This is also used as a local anesthetic. It also can be injected into the spinal column to dreaden the entire lower portion of the body. It works by blocking nerve impulse to the brain. When the block involves the spinal cord, messages of pain from the lower parts of the body are prevented from reaching the brain.

8.V.4 Methods of Administering General Anesthetics:

Four methods of administering these anesthetics are in practice. They are as follows:

- Open Circuit Method
- Semi Open Method
- Semi Closed Method
- Closed Method

Open Circuit Method:

This is a simple method of administering a volatile anesthetic. A simple mask like schimmsibusch covered with six to ten layers of gauze, which does not contour face is held on the face and other some anaesthetic is poured in drops.

Semi-Open Method:

Here dilution with air is prevented by using either a well fitting mask like ogastows mask or layers of gauze between the face and the mask.

Semi-Closed Method:

This method allows some rebreathing of the anesthetic drug with the help of a reservoir. This method involves accumulation and rebreathing of carbondioxide.

Closed Method:

This method essentially employs a chemical agent to reabsorb the carbondioxide present in the exhaled air.

8.V.5 Characteristics of Ideal Anesthetics:

- It should bring loss of sensation smoothly and quickly
- It should bring muscular relaxation
- It should be non irritant on mucous membranes
- It should be non-toxic to heart, liver, kidneys and brain

Anesthetics can be sent through the respiratory system or it can be induced into vein. The anesthetic sent into the body through respiratory system brings muscular relaxation and gives quick effect on the patient. The anesthetic which is injected into the vein will not bring muscular relaxation.

Stages in Loss of Consciousness:

It is administered in the form of intravenous injection or a gas to be breathed. Both should be administered carefully by a trained anesthetist only.

- Induction - Patient feels drowsy and feels restlessness during induction.
- Unconsciousness stage - Breathing is irregular but muscles are responsive.
- Totally unconsciousness with a regular breathing and relaxed muscles - Before general anesthesia is given a mixture of drugs given as anesthetic to prepare the patient for operation and relax muscles.

The drug should be controlled in use as too much is dangerous and too little cannot give desired effect. For long lasting action, Buptyacaine is used but commonly used is lighocaine.

Boyle's apparatus is the common anesthetic apparatus used. It is fixed in a trolley near the operation table. It has three gas cylinders marked in different colours. Usually the oxygen cylinder (black), liquid nitrogen oxide (grey), small cylinder of cyclopropane (orange) is used. CO_2 stimulates breathing. Cyclopropant enters the apparatus at low pressure while other gases enter at high pressure. Their pressure is reduced by passing them through reducing volves.

Basing on the patient's health and age, anesthetist decides the quantity of gases to be given to the patient. All those gases are connected to a common chamber which has a mark. This is provided with an outlet for exhaled gases Thus CO_2 produced in the body is sent out immediately preventing suffocation. CO_2 leaves the cylinders in open circuit system. In closed circuit system, exhaled gases are passed through another cylinder. Here CO_2 is absorbed by soda lime and the gases are reduced. Besides the above, spinal (epidural) anaesthetic gives pain relief without loss of consciousness. During child birth, gynecological and spinal operations injection into epidermal layer of spinal cord gives numbness in minutes.

8.V.6 Side Effects:

Vomiting, drowsiness and sickness are the side effects observed in general.

8.V.7 Summary:

Anesthetics are the chemicals used to produce loss of sensation. These are used during surgical operations so as to enable the patient not to feel pain. There are two main types of anesthetic General anesthetic and local anesthetic. General anesthetics are of two types. Volatile general anesthetics and non-volatile general anesthetics. Four methods of administering these anesthetics are in practice viz., open circuit method, semi open method, semi closed method and closed method. Ether, Nitrous oxide, Holothane, Fluroxene, Isoflurane, Cocaine, Procaine etc. are used as anesthetics.

8.V.8 Technical Terms:

Anesthetics

General Anesthetics

Local Anesthetics

Open Circuit Method

Semi Open Method

Semi Closed Method

Closed Method

Ether

Nitrous Oxide

Holothane

Fluroxene

Isoflurane

Cocaine

Procaine

8.V.9 Self Assessment Questions:

1) Give an account of anesthetics ?

2) What is anesthetic and describe various anesthetics ?

Lesson - 8.VI

VITAMINS

Objective:

- To study different vitamins
- To know deficiency symptoms of vitamins
- To study various sources of vitamins

Structure:

8.VI.1 Introduction:

Food is essential to the body to grow and to conduct normal metabolic activities of the body. Along with food materials, body requires organic substances of special nature in minute quantities. These special substances cannot be synthesized in the body. They are taken along with the food. They are called vitamins. Vitamins and minerals are substances that are found in foods we eat. Our body needs them to work properly. Leafy vegetables, cereals, pulses, raw fruits, milk and eggs are the main sources of these vitamins. The name vitamin was coined by Casimir Funk. Deficiency of these vitamins produce serious diseases and malformations in the body.

Nothing is known about these vitamins until 1900 though Lime, Orange fruits were administered to cure scurvy for the for the first time in 1750 by a doctor James Lind. Now we know their chemical structure, use and synthetic methods in detail. In 1913 the chemical nature of Vitamin A was identified for the first time. Later different vitamins were identified, studied in detail and their structures were proposed. In general, all the vitamins work as co-enzymes in metabolic activities to accelerate the functioning of enzymes.

8.VI.2 Classification of Vitamins:

Vitamins are broadly classified into two groups. Fat soluble vitamins and water soluble vitamins.

1. Fat Soluble Vitamins: Vitamin A, D, E and K. When fat soluble vitamins are taken, the vitamins are stored in the fat tissues in the body and in liver. They remain in the body till fat is needed by the body or organ systems. They are carried to different parts of the body by special carrier substances.

2. Water Soluble Vitamins: Vitamin C, F and B complex group. Water soluble vitamins are different. These vitamins are not stoted in the body. Instead, they travel through the blood stream and are eliminated if not needed. So these are to be replaced often because they are not stored.

Our body is one powerful machine capable of doing all sorts of things by itself. But it can not make vitamins. Our body is able to get vitamins from the foods we eat because different foods contain different vitamins. Depending upon their source, activity and deficiency diseases, vitamins can be explained in the following way.

8.VI.3 Characteristics of different vitamins:

Vitamin Name	Vitamin Chemical	Deficiency Disease	Good Sources
Vitamin A	Retinol	Night-blindness, Hyperkeratosis, Keratomalacia.	Orange, ripe yellow fruits, leafy vegetables, carrots, pumpkin, squash, spinach, liver.
Vitamin B1	Thiamine	Beriberi	Pork, oatmeal, brown rice, vegetables, potatoes, liver, eggs.
Vitamin B2	Riboflavin	Ariboflavinosis	Dairy products, bananas, popcorn, green beans, sparagus.
Vitamin B3	Niacin, Niacinamide	Pellagra	Meat, Fish, Eggs, many vegetables, mushrooms, tree nuts.
Vitamin B5	Pantothenic acid	Paresthesia	Meat, broccoli, avocados.
Vitamin B6	Pyridoxine,	Anemia,	Meat, vegetables,

	pyridoxamine, pyridoxal	peripheral neuropathy	tree nuts, bananas.
Vitamin B7	Biotin	Dermatitis, enteritis	Raw egg yolk, liver, peanuts, certain vegetables
Vitamin B9	Folic acid, Folinic acid	Megaloblast and Deficiency during pregnancy is associated with birth defects, such as neutral tube defects	Leafy vegetables, pasta, bread, cereal, liver.
Vitamin B12	Cyanocobalamin, hydroxycobalamin, methylcobalamin.	Megaloblastic anemia	Meat and other animal products
Vitamin C	Ascorbic acid	Scurvy	Many fruits and vegetables, liver
Vitamin D	Cholecalciferol	Rickets and Osteomalacia	Fish, eggs, liver, mushrooms.
Vitamin E	Tocopherols, Tocotrienols.	Deficiency is very rare; mild hemolytic anemia in newborn infants	Many fruits and vegetables
Vitamin K	phylloquinone, menaquinones	Bleeding diathesis	Leafy green vegetables such as spinach, egg yolks, liver

8.VI.4 Summary:

Food is essential to the body to grow and to conduct normal metabolic activities of the body. Along with food materials, body requires organic substances of special nature in minute quantities. These special substances cannot be synthesized in the body. They are taken along with the food. They are called vitamins. Vitamins are broadly classified into two groups. Fat soluble vitamins and water soluble vitamins. Our body is one powerful machine capable of doing all sorts of things by itself. But it can not make vitamins. Our body is able to get vitamins from the foods we eat because different foods contain different vitamins.

8.VI.5 Technical Terms:

Vitamins

Water Soluble Vitamins

Fat Soluble Vitamins

Vitamin A

Vitamin B1

Vitamin B2

Vitamin B3

Vitamin B5

Vitamin B6

Vitamin B7

Vitamin B9

Vitamin B12

Vitamin C

Vitamin D

Vitamin E

Vitamin K

Fruits

Vegetables

8.VI.6 Self Assessment Questions:

1) Write an account on vitamins.

2) Write an account on vitamins with a note on deficiency symptoms

Lesson - 8.VII

INSULIN

Objective:

- To study about insulin hormone
- To know different aspects of insulin such as insulin synthesis, storage, transport, secretion.
- To study functions and deficiency symptoms of insulin

Structure:

8.VII.1 Introduction:

Insulin is the sugar regulating hormone produced by the groups of cells namely Islets of Langerhans or Islet cells of pancreas. The pancreas is an organ that is attached to the duodenum and has many functions in addition to insulin production. The pancreas also produces digestive enzymes and other hormones. Carbohydrates absorbed from the intestine into the blood stream are converted to glycogen by the action of this hormone.

Insulin is the hormone directly released in to the blood in minute quantities as when required by the body. The ? cells of the exocrine part of pancreas secrete this hormone. Its name is derived from a Latin word insula. The term insulin was first coined by Mayer (1909), long before the extraction by Banting and Best in 1922. Insulin is a polypeptide with a molecular weight of about 6900. It consists of two amino acid chains A and B linked by two disulphide bridges. The action centre of insulin has not yet been identified but the disulphide bridges are essential for its biological activities.

8.VII.2 Synthesis and storage:

The islets constitute 1% of the weight of pancreas and there are some 2 million islets in the human pancreas. The alpha cells secrete glucogen, while the beta cells secrete insulin. A normal man probably secrete about 50 units of insulin daily much of which is metabolized in the liver.

8.VII.3 Insulin Release:

Glucose is the specific and most potent stimulus for the synthesis of this hormone in to the blood. Difference in glucose concentration in the pancreatic artery leads to a release of performed insulin and then to a stimulation of synthesis of more insulin by the ? cells of pancreas. Amino acids especially arginine stimulates insulin release probably by amplifying the action of glucose in the ? cells.

8.VII.4 Transport and Secretion of Insulin:

Insulin disappears rapidly from plasma. The liver, kidneys and skeletal muscles take up most of the insulin. In the presence of antibodies insulin may be strongly bound to them. Insulin is completely degraded by liver, kidneys, pancreas, testes and placenta.

8.VII.5 Functions of Insulin:

- It accelerates the phosphorylation of glucose, which is used in the respiratory cycle.
- It promotes the formulation of glycogen from glucose in the liver and muscles.
- It reduces the production of glucose from non-carbohydrate sources like proteins and fats.
- It stimulates protein synthesis and growth.
- It brings down the accumulation of excess fat in blood and liver.

8.VII.6 Deficiency of Insulin:

Insulin formation is affected if the pancreas gets damaged. The deficiency of insulin causes a serious disease called diabetes mellitus. Our bodies desire blood glucose to be maintained between 70 mg to 110 mg per 100 ml of blood. Below 70 is termed 'hypoglycemia' and above 110 is termed 'hyperglycemia'. Hypoglycemia is a common adverse effect of insulin and is an extension of its pharmacological action. Hyperglycemia has two effects. Cerebral and sympathetic. Diabetes ia of two types Type I and Type II. It is characterized by

1) **Hyper Glycemia:** rise in blood sugar level above normal level
2) **Glycosuria:** Glucose is lost with urine
3) **Dehydration:** The victim will excrete large quantities of urine frequently. It is called polyuria. Because of this the victim looses much water and electrolytes and dehydration is caused.
4) **Loss of weight:** The victim looses weight because of excessive breakdown of protein in the body.

5) **Diabetic coma:** Acetoacetic acid is produced faster than it can be metabolized and the victim develops acidosis. If the patient is not treated, he will become unconscious and dies.

Type I Diabetes:

In the absence of the insulin, one eats lot of food and actually be in a state of starvation since many of our cells cannot utilize the calories contained in the glucose very well without the action of insulin. This is the Type I diabetes, in which who do not make insulin can become very ill without insulin shots or pumps. The major draw back of insulin is its ineffectiveness when given orally. Type I diabetes is much less common and typically affects younger individuals leading to hyper glycemia. It usually begins before age 40 although there are exceptions. They often experience weight loss and the onset of these symptoms may be abrupt or gradual.

Type II Diabetes:

Type II diabetes is also present, in which people will develop insulin resistance rather than true deficiency of insulin. In this case the levels of insulin in the blood are similar or even a little higher than in normal. They are non diabetic individuals. However, many cells of Type II diabetes respond slowly to the insulin in their body. Hence their cells cannot absorb the sugar molecules well. This leads to increased blood sugar. Occasionally Type II diabetics will need insulin shots but most of the time other methods of treatment will work. Type II diabetes or adult on set diabetes is more common and usually develops in middle age or later. The type II diabetic patient is over weight although there are exceptions. It is associated with insulin resistance rather than the lack of insulin and is hereditary.

Persons who have been suffering from diabetes take insulin through injection. It gives temporary relief to the patients. Insulin should not be injected after a period of exercise or long after a meal. If injected in these conditions the blood sugar level decreases and the patient may become unconscious. It is called 'insulin shock'.

8.VII.7 Summary:

Insulin is the sugar regulating hormone produced by the groups of cells namely Islets of Langerhans or Islet cells of pancreas. Carbohydrates absorbed from the intestine into the blood stream are converted to glycogen by the action of this hormone. The beta cells of Islets of Langerhans secrete insulin. A normal man probably secrete about 50 units of insulin daily much of which is metabolized in the liver. Glucogen secreted by alpha cells stimulates insulin release. Insulin disappears rapidly from plasma. The liver, kidneys and skeletal muscles take up most of the insulin. In the presence of antibodies insulin may be strongly bound to them. Insulin is completely degraded by liver, kidneys, pancreas, testes and placenta. Insulin formation is affected if the pancreas gets damaged. The deficiency of insulin causes a serious disease called diabetes mellitus. Is is characterized by Hyper glycemia, Glycosuria, polyuria, Loss of weight and finally Diabetic coma. Persons who have been suffering from diabetes take insulin through injection. It gives temporary relief to the patients.

8.VII.8 Technical Terms:

Insulin

Pancreas

Islets of Langerhans

Hyper Glycemia

Glycosuria

Polyuria

Diabetic Coma

8.VII.9 Self Assessment Questions:

1) Write an account on Insulin

2) What is the role of insulin in human body ? Add a note on deficiency symptoms.

Lesson - 8.VIII

CORTISONE

Objective:

- To study the cortisone hormone
- To know about functions and deficiency symptoms of cortisone hormone

Structure:

8.VIII.1 Introduction:

There are two wrinkled pads of yellowish brown tissue lying on the top of the human kidneys and these are called adrenal glands. Each of them weighs about one quarter of an ounce. Cortisone is a steroid hormone produced by these adrenal gland located on top of the kidney. It is essential to the proper functioning of the body, particularly when under stress. The lack of cortisone hormone causes a dangerous disease called addision's disease and can be rarely kept alive except by injections of adrenal hormones. If not cured, it is fatal. Each adrenal gland consists of an inner core called medulla and an outer covering called cortex. Medulla manufactures only one hormone adrenalin whereas cortex turns about 20 to 30 different compounds. Cortisone is one of the important compounds manufactured by cortex, the outer covering of the adrenal gland.

8.VIII.2 History:

Dr. Hench, in 1929 had noticed that men or women with arthritis received relief from arthritis when they suffered from jaundice. Philip S discovered that woman suffering from arthritis were temporarily relieved from this trouble during their pregnancy. Rheumatic patients who had surgical operations for other reasons were also temporarily benefited. In these cases it was observed that there was an increased secretion of hormones from adrenal gland and cortisone

was identified to be the active component of the cortical secretions. It is responsible for relief from arthritis. Adrenal glands are particularly active in pregnant women, jaundice patients and in persons who have undergone surgical treatment.

Edward C. Kendall, Chief of the biochemical laboratories of Mayo Foundations for medical education and research isolated and crystallized cortisone from adrenal glands of cattle and also from bile juice which is secreted by liver. In the beginning, the compound could be prepared in very small quantities and so its properties could not be studied thoroughly. It was synthesized in sufficiently large quantities since 1948. It was tested on human beings, and its clinical properties were discovered.

Arthritis patients treated daily injection of 103 mg of cortisone was completely relieved from the symptoms of arthritis as long as this dose was maintained through. It is not a permanent cure. Cortisone dramatically relieved the symptoms of quite dissimilar diseases like arthritis, asthma, TB and Pneumonia suggesting a unified new approach to the problems of how the body reacts to stress and damage.

The secretion of cortisone was found to be controlled by another compound ACTH (Adreno Cortico Tropic Hormone) secreted from pituitary gland suspended within the bone cavity below the brain. Injections of ACTH covered a wide range of diseases than cortisone. Cortisone and ACTH were found to be miracle drugs that can save many patients from their agonizing pain of those diseases mentioned previously. It is an important observation that these drugs provide temporary relief but a permanent remedy is still to be used for complete cure. High blood pressure and increase of blood sugar are some of the effects produced by prolonged treatment of these diseases with cortisone and so the treatment should be continued under the guidance of an expert physician.

8.VIII.3 Functions of Cortisone:

- Cortisone suppresses inflammation in the short term, and in the long term dissolves scar tissue, stabilizes body's defense, speeds up the healing process and even dissolves certain cysts. The hormone is extremely effective and too many doses are not needed.
- Cortisones are used for treating arthritis, asthma.
- It gives temporary relief from blood pressure.

8.VIII.4 Cortisone Injections:

The cortisone injections used in medical practice fall into three broad categories articular injections, trigger point injections and epidural steroid injections. Some cortisone injections can be painful at the joints of hand and foot. Other areas such as the knee and shoulder are only moderately uncomfortable. Cortisone shots are generally accompanied by an anesthetic such as Carbocaine or Lidocaine which relieves of the pain.

8.VIII.5 Summary:

Cortisone is a steroid hormone produced by adrenal gland located on top of the kidney. It is essential to the proper functioning of the body, particularly when under stress. The lack of cortisone hormone causes a dangerous disease called addision's disease and can be

rarely kept alive except by injections of adrenal hormones. Cortisones are used for treating arthritis, asthma. It gives temporary relief from blood pressure. The cortisone injections used in medical practice fall into three broad categories articular injections, trigger point injections and epidural steroid injections.

8.VIII.6 Technical Terms:

Cortisone

Adrenal Gland

Steroid Hormone

Addison's Disease

Adrini Cortico

Trophic Hormone

8.VIII.7 Self Assessment Questions:

1) Write an account on functions of cortisone hormone.

2) What is cortisone? How it is discovered and point out its importance?

Lesson - 8.IX

X - RAYS

Objective:

- To study an account on X - rays
- To understand effects caused by X - rays
- To study utilization of X - rays

Structure:

8.IX.1 Introduction:

The solar light radiation has different waves with different lengths. These which are able to see are called visible rays. They form the colour spectrum viz., VIBGYOR i.e., Violet, Indigo, Blue, Green, Yellow, Orange and Red with wave length between 3000-7600 Ao. Besides higher frequencies, there are a number of rays emitted with either lower or higher frequencies of wave length. Such invisible rays include Ultraviolet rays, Infrared rays, Micro waves and X-Rays. Thus X-Rays are omitted from sunlight and they have lesser wave length than ultra violet radiation. All these rays are dangerous to live objects on earth. They are prevented from reaching the ground by the presence of Ozone layer around the earth.

8.IX.2 Definition:

X-Rays are energy rich electromagnetic rays and form a very strong type of radiation. They can pass through soft tissues like muscles and also through hard surfaces such as thin iron sheets, card board, paper etc. But at the same time, they cannot pass through harder substances like bones, thick iron plates, bones and steel etc.

X-Rays belong to the same family of radiation as those of light waves and radio waves. They are a form of invisible Electromagnetic radiation.

8.IX.3 Discovery:

In 1895 German physicist Wilhelm Roentgen identified these rays coming out from an electric apparatus inside a card board box, when they made the fluorescent paper to glow. These rays could pass through card board box. He called them X-Rays as their nature was not clearly known.

8.IX.4 Properties of X - rays:

1) X-Rays are energy rich powerful rays
2) They can pass through soft tissues like muscles and also through hard surfaces such as thin iron sheets, card board, paper etc.
3) When exposed to photographic films, they can blacken the exposed part of the film.
4) They have a short wave length between 0.0001-10 nm i.e., 1/100000 mm. This is much shorter than the ordinary sun rays. Because of their shorter wave length, they are able to pass through skin, muscles, paper etc.
5) They can be placed between ultraviolet and gamma rays.

8.IX.5 Production of X - rays:

X-Rays are artificially produced in a Coolidge tube or Cathode ray tube invented by David Coolidge in 1913. The Coolidge tube is a highly evacualated glass tube containing a filament of cathode which is heated by a 12v battery to produce electrons. The filament is surrounded by a cylindrical metal tube called the shield which is kept at negative potential with respect to the anode. The electrons emitted by the filament are focused to a point on the target called anode. It is kept in an inclination of 45o to the direction of the electron beam and is made platinum or tungsten of high melting point. In order to cool the target, cold water is circulated at the end of the other end of target. When a high potential is applied between the filament and the target, the electron beam is accelerated toward the target and falls on it producing X - rays. The Coolidge tube is enclosed in a lead box having a small window through which these X - rays emerge.

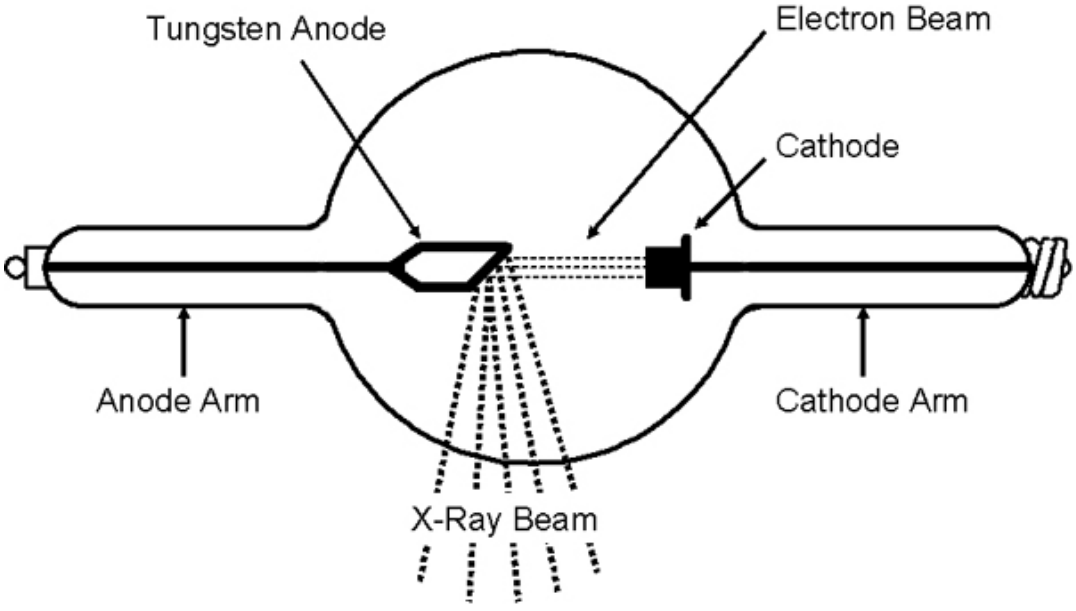


Fig. Coolidge Tube

By adjusting the electricity in the cathode filament, emission of X- Rays can be controlled. Wave length is controlled by voltage. In hospitals and X - ray units, high voltage of 154000 volts is applied to generate X - rays.

8.IX.6 Uses of X-rays:

X-Rays are taken at different rates by different materials. Denser the tissue, it absorbs more X-Rays, and hence it appears white in colour on the film. Light tissues absorb less X-Rays. Hence the areas appear black in colour. Radiologists are the specialists to be consulted to read X-Ray films. By observing the X - rays taken from a patient, radiologist can identify the ailments. The X - ray photograph is called radio graph. X - rays are used in medicine, industry, science and in radium therapy.

i) Medical:

X - rays can pass through soft tissues while they cast shadows of certain substances like bones, metal bodies etc. This property of X - rays is used in medical diagnosis.

- They are used to identify the cracks in the bones, bone fractures, cancerous growths, blackened blood vessels, abnormalities in various organs, joint break downs to locate foreign bodies such as pins, nails, bullets etc.
- Dental X-Rays are taken to investigate dental problems. It shows extent of decay, abscesses and infections in the tooth.
- Without any operation, one can identify the internal diseases through X - rays. X - rays can cure even cancers on regular treatment in scheduled doses.
- During 1970s computerized brain scanner is developed in this field. Whole body scanners, computerized axial tomography scan are the still more recent developments. They show details of the soft tissues as well as the bones. For example, blood clots, tumors and swollen tissues in the brain can be seen. They create less risk than ordinary medicines.

ii) Industry:

They can be used to know the damage inside the pipes. Radiography is useful in examining aeroplane welds. Using motion picture radiography, the internal machine parts can be seen. X-Ray crystallography is used to study the structure of complex molecules of living cells, double helical structure of DNA etc. X - rays are used for the detection of defects in castings and welds, explosions, gold and silver. Genuineness of diamonds and other precious stones and of old paintings can be found.

iii) Science:

X - rays are used to study the structure of crystals and metals and the internal structure of atom. X - rays are also used to produce useful mutations. New permanent and useful characters can be developed in the organism by careful manipulation of these X-Rays. By exposing plants to these X-rays, high yielding varieties of plants can be produced. X-Rays mutations were induced and explained by Muller.

8.IX.7 Dangers of X - rays:

When the intensity of X - rays is more, they damage the tissues. Over exposure cause skin burns and eye damage, genetic damage to the children whose mother is X-rayed. They can even promote the growth of the cells and thus may produce cancer. Lead plates are used to protect the other parts of the body which are not tested,

On one side over-exposure cause damage and on the other side calculated dosage of X-Rays not only reveals the presence but also cure the internal tumors. This is called radium therapy.

Thus X-Rays can find what we cannot see without causing damage to body. When properly used, they cure many health problems without being operated surgically.

8.IX.8 Summary:

X - rays are electromagnetic radiation of short wave length. These were discovered by Roentgen. X-Rays are artificially produced in a Coolidge tube or Cathode ray tube invented by David Coolidge in 1913. X - rays can pass through soft tissues while they cast shadows of certain substances like bones, metal bodies etc. X - rays are used in medicine, industry, science and in radium therapy. They are very dangerous to the fast growing cells, but controlled usage of X-Rays is highly needed.

8.IX.9 Technical Terms:

X - rays

Electromagnetic Radiation

Coolidge Tube

Cathode ray tube

Radiograph

8.IX.10 Self Assessment Questions:

1) What are X - rays? How are they produced?

2) Write an account on X - rays?

Lesson - X

CONTRACEPTIVES

Objective:

- To know about different birth control methods

Structure:

8.X.1 Introduction:

India is a largest democratic country with a population of 85 crores approximately. Since independence, the country's population has been increasing and it has become a threat to the survival of the human being. The total economy in the country is facing doldrums because of the increasing population. Food productivity could not meet the demands of the growing population. This made Government to implement the family planning measures since 1965. A number of incentives for undergoing family planning operations were implemented and are still being implemented. Besides the Government, a number of social service organizations are also taking up this as a national problem and trying to reduce the population to the possible extent.

Besides, higher standards and increased cost of living, lack of accommodation and great reduction of infant mortality are some of the constraints that are making the people to limit their families. Ideally a child should be born because it is wanted, not because it cannot be prevented. This can be made possible by planned usage of contraceptives.

8.X.2 Definition:

Contraceptives are the controlling methods of birth. Any method or system which allows the normal married life to occur and reduce the rate of conception (giving birth) may be considered to be a method of contraception.

8.X.3 Various Methods of Birth Control:

In order to control population growth many contraceptives are developed. In order to check population growth in India, the Government of India started family planning programme from 1965. The family planning is of two types.

1) Vasectomy and Tubectemy

2) Contraceptives

8.X.3.1 Vasectomy and Tubectomy: Vasectomy is a surgical method in which the vasdeferentia ducts carrying sperms to the outside during intercourse are tied or cut and tied so that the sperm release is stopped. It is done in males. Tubectomy is done in females. In tubectemy the fallopian tubes will be cut or tied with thread and prevent the eggs from reaching the uterus or from being fertilized. Removing the ovaries, total or part of the fallopian tubes, uterus also comes under this category. These are the permanent birth control measures.

8.X.3.2 Contraceptives: By using contraceptives the pregnancy is postponed. It is a temporary method of family planning. These are four types.

1) General Methods

2) Chemical Contraceptives

3) Oral Contraceptives

4) Intrauterine Contraceptives

8.X.3.2.1 General Methods:

1) Abstinence: Preventing from participating in sexual intercourse but enjoying the same from external touches. In humans for every 28 days menstruation occurs, it takes 12 to 14 days for the egg to be released. Hence preventing the sexual intercourse between 9th to 17th days after menstruation may prevent the possibility of conception. So this period is said to be the safe period.

2) Coital Interruption: During intercourse, when ejaculation is on, penis is taken out so that the sperm release in the vagina is prevented. This is the safe and common practice. But emotion feelings are not satisfied in this method.

3) Condom Sheath: Here the penis is covered by a rubber sheath popularly called Nirodh during intercourse. Semen released enters the condom which is to be thrown out. This condom should be changed every time.

8.X.3.2.2 Chemical Contraceptives:

4) **Spermicides:** Certain chemical substances were experimentally proved to kill or immobilize the spermatozoa released during copulation. Such are called spermicides. By placing these spemicides which are available in the form of jelleys, creams or pessaries of foaming tablets in the vagina, fertilization can be prevented.

5) **Douching:** Washing the vagina with spermicidal solution immediately after intercourse may help to a certain extent.

6) **Altering Cervical Mucus:** Continuous usage of chlormadinone acetate changes the nature of cervical mucus which actually helps in impairing sperm cells, preventing the speedy movement of the sperm cells,

8.X.3.2.3 Oral Contraceptives:

7) **Suppression of Ovulation:** The release of ovum is suppressed by using oral contraceptives prepared from the hormones. Thus the ovulation may be stopped. Certain serious side effects are observed due to the oral contraceptives. Hence they should be used only under the supervision of a doctor.

8) **Suppressing Spermatogenesis:** Several drugs are there which highly suppress or reduce sperm mobility. No reliable drug is manufactured yet.

8.X.3.2.4 Intrauterine Contraceptives:

9) **Occlusive Diaphragms:** These are the cap like structures coated with spermicidal creams. They are kept in vagina before intercourse. They help in killing the sperm cells when they are released. Various types of such caps are available in the market may be used.

10) **Intra-uterine Contraceptive Device:** Grafenberg was the first man to popularize this method of keeping coiled wire, rings, loops inside the uterus, thus preventing the conception. Japanese circular wheel, Lippes loop, Margulies spiral, Birnberg bow, a soft T coil or Copper T loop are the devices used in practice. Prolonged bleeding at menstruation up to a certain periods, intermittent bleeding for the next few days of insertion are the side effects. The loop once inserted should be changed for every three years.

Mechanism of Function:

a) It changes the pH of the cervical canal

b) The mobility of the sperm cells is impaired.

c) Failure of the implantation of the ovum in the wall of the uterus.

d) Endometrial preparation for holding the pregnancy is prevented.

e) Uterine wall is irritated to such an extent that the egg is expelled out.

The above methods of contraceptives help in the conception to certain extent. Since there are both temporary as well as permanent methods, one can plan the family in the way he wants. This helps not only the planning their family but also the planning of the country.

8.X.4 Summary:

Contraceptives are the controlling methods of birth. Any method or system which allows the normal married life to occur and reduce the rate of conception (giving birth) may be considered to be a method of contraception. In order to control population growth many contraceptives are developed. In order to check population growth in India, the Government of India started family planning programme from 1965. The family planning is of two types. Vasectomy and Tubectomy, and contraceptives. Vasectomy and Tubectomy are the permanent birth control measures. By using contraceptives the pregnancy is postponed. It is a temporary method of family planning. These are four types. General methods, oral contraceptives, chemical contraceptives and Intra-uterine contraceptive devices. The above methods of contraceptives help in the conception to certain extent. Since there are both temporary as well as permanent methods, one can plan the family in the way he wants. This helps not only the planning their family but also the planning of the country.

8.X.5 Technical Terms:

Contraceptives

Vasectomy

Tubectomy

Abstinence

Coital Interruption

Condom Sheath

Spermicides

Douching

Occlusive Diaphragms

Intra-uterine Contraceptive Devices

8.X.6 Self Assessment Questions:

1) Write an account on different birth control methods ?

2) Enumerate the role of contraceptives in the population control.

Lesson - 8.XI

D.D.T.

Objective:

- To know about the effects of insecticide D.D.T.

Structure:

8.XI.1 Introduction:

India is a third world country striving for self sufficiency in food production. Green revolution has brought a number of changes in the usage of land, use of fertilizers and modern instrument for agriculture etc. The need for over food production is due to increase in population. When artificial fertilizers are greatly used, a number of new varieties of insects and pests have appeared on the fields and caused a lot of damage to the crops. It is to escape from these insect pests, man has learnt to use pesticides and insecticides. Modern developments in science and researches have brought a number of pesticides and insecticides into the market. Insecticides are primarily used to destroy insects and of importance because of their toxicological properties. Different insecticides which were used and being used are D.D.T., Methoxychlor, Toxaphene, Hexachlorocyclo hexane, Endrine, Dieldrin, Aldrin, Endosulfan etc. There are insecticidal chloro hydrocarbons also. The organophosphorous compounds being used are Malathion, Parathion, Tepp and Diazinon. Insecticides of plants origin are Pyrethrum and Rotenone.

8.XI.2 Definition:

Among all these most commonly known insecticide is D.D.T. (Dichloro Diphenyl Trichloro Ethane). D.D.T. is the first chlorinated organic insecticide. It was originally peppered in 1873, but it was used in 1939 by Paul Muller, who discovered the effectiveness of D.D.T. as insecticide. He was awarded with Noble Prize in Medicine and Physiology in 1948 for this discovery. It is used indiscriminately to eradicate insects but it has become a dangerous without being degraded. Though the Western countries have banned this potential insecticide, our country is still using it for our agricultural purposes.

8.XI.3 Properties:

It is lethal to many arthropods like mosquitoes, insects, and fleas including Colorado beetles, fleas and house flies. It is absorbed both through chitinous exoskeleton and the gastrointestinal tract of the insect. D.D.T. because of its low volatability, retains its action for a long time. Following absorption, large amounts of D.D.T. are stored in body for deposits and in the liver. The drug is excreted unchanged along with milk to some extent but most of it is slowly degraded in the tissue. The end products are eliminated through urine.

Acute D.D.T. poisoning of this insecticide to humans is characterized by vomiting, diarrhea, giddiness, fatigue followed by tremors and convolutions. Early symptoms of chronic poisoning in humans are loss of appetite, muscular weakness, fine tremors and mental apprehension. Treatment of acute poisoning is symptomatic and includes gastric cleaning, saline purgation, administration of short acting barbiturates for the treatment of convulsions, artificial respiration and oxygen

8.XI.4 Degradation products:

Major metabolites formed during the degradation of D.D.T. are D.D.D., D.D.E., and D.D.S. The last one upon dechlorination forms E. DDE.

8.XI.5 Uses:

- As a pesticide, DDT was first used during Second World War. It was so effective as an insect killer that it is popularly called as the 'atom bomb' of pesticides.
- DDT seemed to be the ideal insecticide. It is cheap and of relatively low toxic to mammals. DDT could successfully reduce the commonly developing material Anopheles.
- Though it is used in larger amounts on crops, its use on crops is criticized as it stays in the soil for long periods without degradation.
- For eliminating fleas, bugs, mosquitoes, cockroaches, plant lice, lady bugs, lace wings and green fleas, it is used enormously. Caterpillars of the hawk moth called tobacco worm is effected a lot by the continual action of this drug.
- A mixture of DDT with a suitable inert dilutant is employed. DDT is a widely used pesticide in agriculture, and is sprayed both in the form and in powdered form.

8.XI.6 Disadvantages:

- Some problems are there due to extensive use of this insecticide. Many species of insects developed resistance to DDT and DDT was also discovered to have a high toxicity towards fish.
- The chemical stability of DDT and its fat solubility compounded the problem. DDT is not metabolized very rapidly by animals. Instead it is deposited and stored in the fatty tissues. It takes about 8 years for an animal to metabolize half of the amount it assimilates. If ingestion continues at a steady rate, DDT builds up within the animal over time through bio accumulation.
- DDT is remarkably stable in the environment. This is not a desirable property. Some of the DDT sprayed from planes is carried into the upper atmosphere and comes down eventually in rain water. This causes much harm to the biosphere.
- DDT is a nerve poison. Acute DDT poisoning causes tremors, convulsions, respiratory or cardiac failure. Chronic exposure to DDT leads to the degradation of the central nervous system.
- DDT is insoluble in water but soluble in fat. Thus it is retained in the body. It interferes with calcium metabolism, essential to the formation of healthy bones, teeth and egg shells in birds.

The use of DDT was banned in United States in 1973 as it is a non degradable organo chlorine insecticide causing cancer in human beings, declining bird and fish populations; although it is still in use in our country and other developing and developed countries.

8.XI.7 Summary:

D.D.T. is the first chlorinated organic insecticide. It was originally peppered in 1873, but it was used in 1939 by Paul Muller, who discovered the effectiveness of D.D.T. as insecticide. He was awarded with Noble Prize in Medicine and Physiology in 1948 for this discovery. It is used indiscriminately to eradicate insects but it has become a dangerous without being degraded. It is lethal to many arthropods like mosquitoes, insects, and fleas including Colorado beetles, fleas and house flies. It is poisonous to human beings.

8.XI.8 Technical Terms:

D.D.T. (Dichloro Diphenyl Trichloro Ethane)

Organo Chlorine Insecticide

Acute Poisoning

Chronic Poisoning

8.XI.9 Self Assessment Questions:

1) Write an account on D.D.T.

2) What is D.D.T. ? Write an account on uses and disadvantages of D.D.T. ?

Lesson - XII

DETERGENTS

Objective:

- To study different detergents used in daily life

Structure:

8.XII.1 Introduction:

Health is wealth is the old saying which emphasizes the need to be healthy. To be healthy, one must be clean so that he can fight against diseases. Soaps and detergents are the cleaning agents which are in use since 5000 years. A number of new types of non-dangerous detergents are invented.

Because of surface tension, water cannot be a good cleaner. It does not make things wet. When water is poured on the body, it forms a number of streams and leaves the body keeping it dry. Over a piece of also, it forms a number of droplets instead of soaking it quickly. If the surface tension of water is broken, it will be a good cleaning agent. This can be done by adding surface active agents (surfactants) like detergents.

8.XII.2 Definition:

The substances used as cleaning agents are called detergents. A detergent is a formulation comprising essential constituents (surface active agents) and subsidiary constituents (builders, boosters, fillers and auxiliaries). They are round molecules with a tail like end. Head is attached towards water (Hydrophilic) while tail is repelled (Hydrophobic) by water.

8.XII.3 History:

In primitive societies, even today, clothes are cleaned by beating them with rocks in the nearest streams. Some times plants such as soap worts or the soap barriers are used as cleaning agents. These plant products contain saponins, chemical compounds that produce a soapy lather. These saponins were probably the first detergents used. Ashes of plants reacts with water to form alkaline solution. This solution have detergent properties. These are used by Babilonians in 4000 years ago. Europeans were using plant ashes to wash their clothes. Soap was in common use by the middle of the 19th century. Initially soap was prepared by Romans using goat fat and ashes. American pioneers made soap in the same manner. Sodium hydroxide was added to animal fat in big iron kettle. The mixture was cooled over a wood fire for several hours. The soap rises to the surface and upon cooling solidified. Now a days it is manufactured by using vegetable oils like coconut oil, ground nut oil etc. Thus chemically soaps are sodium or potassium salts of fatty acids. Toilet soaps usually contain a number of additives such as dyes, perfumes, creams and oils. Deodorant soaps contain just a cover up perfume that quickly fades from the skin.

8.XII.4 Mode of Action:

Dirt usually adheres to skin, clothing and other surfaces because they are combined with grease and oils. When detergents are mixed with water, the molecules attach water keeping their tails away. This breaks up the surface tension of water. Such water can easily sink in to the wave of a cloth.

During washing the hydrophobic tails of the detergents quickly attach with the particles of grease. When this cloth is shaken the detergent held grease molecules will be dislodged. They scatter in the form of an emulsion in water to be mixed away. The detergent must be too strong to form micellers i.e., detergent held grease molecules. In this way the dirty matter along with oil or fat is removed by soap and cleans the surface.

Synthesis:

The first detergents were made by mixing animal fats and wood ash. When heated, the acids from fats react with alkali from wood ash to form soap and glycerine. The former is used as a solvent and in lotions and explosives. This process is called saponification.

8.XII.5 Manufacturing of Soaps:

Large scale synthesis of soaps is done by a continuous method. Here the mixture is heated to a high temperature under pressure. A continuous stream of fat and caustic soda is fed through pumps into pressurized columns. The hot liquid is tapped, mixed and cooled further.

Continuous hydrolysis is another process of making soap. Here the chemicals are broken by adding water.

Irrespective of the method of manufacturing, additives to improve the cleaning action are added in a process called 'crutching'. Some additives like sodium silicate preserve it for longer times. Some other additives include bleaching powders, colouring agents. Creamy fats and antiseptics to kill the germs.

Abrasives are the tiny particles of sand or tale. They are added to the soaps which are used to clean heavy greases from hands, cloth, pans etc. Further the hard soap cakes are produced by spray drying and pressing into bases having 25% of water.

8.XII.6 Synthetic Detergents:

Soap has two disadvantages. In acidic solution, they cannot remove dirt from the surface and the soap does not work very well in hard water. To overcome the disadvantages of soap, shortage in animal fats and oils made the scientists to invent the production of synthetic detergents. The first synthetic detergent seem to have been developed by Germans during the first world war period to allow fats to be utilized for other purposes. These detergents were of the short chain alkyl naphthalene sulphonate type which appeared under the general name of Nekal. Each of these basic materials has its advantages and disadvantages, but in considering the feasibility of production the factors such as availability of raw materials, ease of manufacture, cost of raw materials, cost of manufacture, suitability of finished product etc. are taken to be in to consideration. Petrochemical industries produce vast quantities of synthetic detergents which work like that of soap.

The molecular structure consists of a long chain of hydrophobic (water repellents) hydrocarbons bonded to hydrophilic (water attractive) group. If the hydrophilic end contains negative charge, it is called anionic soap. If it has positive, it is cationic soap. Anionics are better washers while cationics are better wetter rather than washers. The former are used as cleaning agents while the latter are used to soft the fabrics (Fabric conditioners).

Many synthetic detergents are anionic. They are produced by the reactions between two chemicals viz., sulphuric acid and alkyl benzene. Caustic soda is added to separate soap layers. Then the process of drying, crutching etc. is continued. Synthetic detergents are better than soaps because they can remove dirt on the surfaces by using hard water or water with acidic nature.

Seponin ox-bile, fullers are the natural detergents used since historic ages. Sodium palmetic sulphates and soaps are the present day widely used synthetic detergents.

8.XII.7 Uses:

Detergents are used primarily as cleaning agents. They are used in surgical and medical manufacturing, cosmetics, industrial lubricants, manufacturing paints, dispersal of oils, rust prevention, jewel polishing etc. They are proved to be valuable in breaking up oil spills at sets which, if present is a great threat to wild life.

8.XII.8 Harmful Effects:

- Foamy detergents contain surfactant which could not be naturally broken down. Though surface and factory drains, the foam is carried to rivers and lakes. This foam is a poison to animal and plant life. It is again a nuisance to shipping.
- Additives like phosphates when enter the lakes along with sewage, stimulates the growth of surface algae. The thick layers of algae formed from the addition of phosphates destroy other life in water.
- Bio-degradable detergents are better ones in the place of synthetic detergents as they could easily be broken down.
- Thus the detergents, though useful in cleaning, cause health hazards. If the utensils are not cleaned with water properly, caustic soda enter our system and cause heavy damage to the body parts and shifts the metabolic pathways.

8.XII.9 Summary:

The substances used as cleaning agents are called detergents. A detergent is a formulation comprising essential constituents (surface active agents) and subsidiary constituents (builders, boosters, fillers and auxiliaries). They are round molecules with a tail like end. Head is attached towards water (Hydrophilic) while tail is repelled (Hydrophobic) by water. Dirt usually adheres to skin, clothing and other surfaces because they are combined with grease and oils. When detergents are mixed with water, the molecules attach water keeping their tails away. This breaks up the surface tension of water. Such water can easily sink in to the wave of a cloth. Large scale synthesis of soaps is done by a continuous method or continuous hydrolysis method. Soap has two disadvantages. In acidic solution, they cannot remove dirt from the surface and the soap does not work very well in hard water. To overcome the disadvantages of soap, shortage in animal fats and oils synthetic detergents are invented. Seponin ox-bile, fullers are the natural detergents used since historic ages. Sodium palmetic sulphates and soaps are the present day widely used synthetic detergents.

8.XII.10 Technical Terms:

Detergent

Surfactant

Hydrophilic

Hydrophobic

Continuous Hydrolysis

Hydrolysis

Saponification

Anionic

Cationic

Synthetic Detergents

Seponin ox-bile

Fullers

Sodium Palmetic Sulphates

8.XII.11 Self Assessment Questions:

1) What are detergents ?
2) What is soap ? How it works in removing dirt and what are iys disadvantages ?
3) Write an account on synthetic detergents ?

Lesson - 8.XIII

RADIUM THERAPY

Objective:

- To study about radium therapy

Structure:

8.XIII.1 Introduction:

Radium is a natural radio active element. It emits out alpha, beta and gamma radiation. It was discovered by Madam Marie Curie and her husband Pierre. It is self luminescent metal. The radiations emitted from radium causes serious burns on the skin. These burns also are difficult to cure.

8.XIII.2 Uses:

Radiations emitting from radium metal are used for treating certain diseases. This treatment is called radium therapy.

- Radium therapy is used for treating cancer. When malignant tissues are exposed to radiations emitted from radium, their growth is controlled.
- If healthy tissues are exposed to the radiations they cause burns.
- Madam Curie and her daughter Joliot used radium therapy for treating the cancer patients.
- Needles with small amounts of radium salts on impregnating in to the cancerous tissue, gives relief to the patients by preventing the spreading cancerous growth.

Since radium metal is not available in plenty (1/10 gm of Radium chloride can be separated from one ton of pitch blend) it is replaced by other radio active isotopes such as cobalt.

8.XIII.3 Summary:

Radium is a natural radio active element. It emits out alpha, beta and gamma radiation. Radiations emitting from radium metal are used for treating certain diseases. This treatment is called radium therapy.

8.XIII.4 Technical Terms:

Radium

Alpha Radiation

Beta Radiation

Gamma Radiation

Cobalt

8.XIII.5 Self Assessment Questions:

1) Write an account on radium therapy ?

Lesson Writer

Dr. T. Srivalli

Lesson - 9.I

WHEEL

Objective:

- To study about types and uses of wheels

Structure:

9.I.1 Introduction:

A wheel is a circular device, capable of rotating on its axis, facilitating movement of transportation while supporting a load (mass) or performing labor in machines. Common examples are found in transport applications. A wheel together with an axis overcomes friction by facilitating motion by rolling. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity or by application of another external force.

9.I.2 History:

Wheel is regarded as one of the oldest and most important inventions. Wheel was an important invention of the Bronze age of Mesopotomia in the 5th millennium BC. Mesopotonians used cart wheel early in the 5500 years back. Oldest rear wheels are found in the Mesopotonian tombs. Those wheels are made of three planks side by side so that knot whole comes to the centre. A later wooden rim was placed around it and gear effect. Mesopotonians studded copper nails in the rim.

9.I.3 Types of Wheels:

There are many types of wheels such as pulley, potters wheel, Spoked wheel, spinning wheel etc.

9.I.3.1 Pulley: A pulley is a small grooved wheel which turns smoothly on its area. It is generally fixed in a frame which can be tied to a support. A rope is tied to a transformer and it is passed over the pulley. When we pull the rope, the transformer gets lifted. If we arrange two pulleys, we require we require only half the weight of the transformer to lift it. With six pulleys, we require only 1/6th of the force and so on. Thus large forces can be overcome with small forces. The transformer can be lifted to the desired height by a single worker, while it will be beyond him to lift it up without any help.

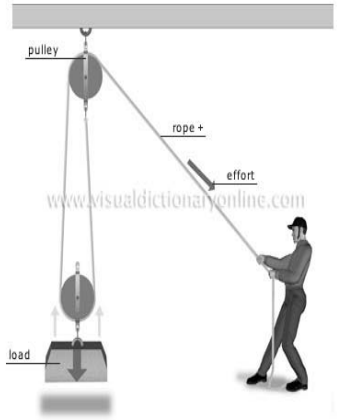


Fig: Pulley

9.I.3.2 Potters wheel: We do not know the name of the inventor. It was originally used as potter's wheel. Potters use wheel in the construction of pots and other articles made of clay with symmetry. This is possible by the use of wheel in a horizontal plane. The wheel reached the Europe and Western Asia in 4th millennium BC, and the Indus valley by 3rd millennium BC.

Fig: Potters wheel

9.I.3.3 Spoked Wheel: Spoked wheel was first used in war chariots some 3500 years back. By 1500 AD the Egyptians made the spoked wheels. Wheels were designed to fit on tracks for transport during 16th century. Then the wire wheel for bicycle came in. With the invention of automobiles, pneumatic (air filled) tyres came into existence. . The spoked wheel had been in continued use without major modification until 1870s, when wire wheels and pneumatic tires were invented.

Fig: Spoked wheel

By 1930 automobile wheels were manufactured with steel to suit the road. Today we know no industry running without wheels. When an object is moving on a surface, there exists a force opposing the relative motion of the objects and that force is called friction. The force of friction in rolling motion is less than the force of friction in sliding motion. So wheels are used in carts and other locomotives to achieve a speedy transport.

9.I.3.4: Spinning wheel: Spinning wheel is used to spin cotton and produce threads which is then used to produce clothes. The spinning wheel reduced the dependence of ancient man on animal skins for clothing.

Fig: Spinning wheel

9.I.4 Uses of Wheels:

i) Wheels are used both in transport and in working of many machines.

ii) Wheels and Axle arrangement is used as simple machine. A smaller force applied on the axle is capable of lifting a heavier weight coupled to the wheel, the ratio being ratio of diameter of the wheel and axle.

iii) A wheel with teeth cut into its outer rim is called gear. A pair of gears gives mechanical advantage (ratio of load to the effort) in the ratio of teeth of the gear wheels. When effort is supplied to the smaller gear, a heavier load can be moved by the bigger gear. When the effort is applied to the bigger wheel, the smaller wheel resolves at a higher speed.

iv) Gears are virtual elements in modern machinery. Gears are used in automobiles to change the ratio of engine speed to the speed of the running wheels. Gears can be arranged to change the direction of the motion. They can be used in the transmission of turning force of the engine's fly wheel to the rear wheels.

v) Pulleys which are smoother wheels coupled by strings or belts are important parts of machinery. They are used to apply force in a convenient direction, to lift heavy loads with smaller forces.

vi) Wheels play an important part in the production of electric power from falling water in hydroelectric stations, from steam in thermal stations, from wind in wind mills and so on.

Thus wheel is a symbol of industrialization even from ancient age and its status continue to be the same in our modern age.

9.I.5 Summary:

A wheel is a circular device, capable of rotating on its axis, facilitating movement of transportation while supporting a load (mass) or performing labor in machines. Wheel is regarded as one of the oldest and most important inventions. There are many types of wheels such as pulley, potters wheel, Spoked wheel, spinning wheel etc. Wheel has many uses. Thus wheel is a symbol of industrialization even from ancient age and its status continue to be the same in our modern age.

9.I.6 Technical Terms:

Pulley

Potters Wheel

Spoked Wheel

Spinning Wheel

Gear

Axle

9.I.7 Self Assessment Questions:

1) Write an essay on wheel.

Lesson - 9.II

COMPASS

Objective:

- To study about types, different parts and uses of compass

Structure:

9.II.1 Introduction:

A compass is a device which can determine a direction o the Earth. It is used to know the directions even when sun, moon and stars are not visible due to conditions of weather. Generally it is used for navigation. A compass may be aligned to either magnetic North or true North or occasionally to an arbitrary direction based on location of celestial bodies. Magnetic North is the direction of the North tip of the earth's magnetic field, while true North is the direction in which earth rotates. A compass working on the principle of magnetism is a modern compass. A compass working on the principle of gyrostate is a gyrocompass.

9.II.2 History:

Magnetic compass was first used in China in 400BC as a fortune telling instrument. A type of magnetite called lodestone was used as a tool in divining magic. Chinese used this magnetic iron for navigation in the beginning of the 12th century. . First compass consisted of a hollowed cut loadstone (Magnetic iron-oxide). This was floated on water on a north-south axis. Afterwards it was learnt that any magnetized iron bar could be used as a loadstone.

By the beginning of 13th century, its use spread to the Europe and beyond. Europes improved the variety and used the Mariner's compass. One of the changes they made was to set the compass in a series of brass rings (gimbals rings) attached to a base having pivot. The new design of the compass goes to Flavio Gioia of Italy (1300). His compound showed sub divisions of north, south, east and west. This helped in the sea voyages of discovery of 15th and 16th century.

9.II.3 Types of Compasses:

Many types of compasses are discovered basing on the necessity. Some of them are General compass or Magnetic compass, Gyrocompass, solar compass, Astrocompass, solid state compass, modern compass, GPS compass, Sylvan type compass etc.

9.II.3.1 General Compass or Magnetic Compass: The most common type of compass is a magnetic compass., which is used to ascertain the direction of magnetic North. The Chinese used magnetic compass in navigation. A magnetic compass is made by placing a bit of magnetized iron or steel needle in compartment with low friction. It is allowed to move about freely. In compasses the North end of the metal piece is marked with red paint. Basing on this the other directions are easily identified. When boats or ships were traveling on seas, the direction was known from magnetic compass. When a magnet needle is suspended freely or allowed to turn freely on a pivot, it sets itself in the North-South directions. The angles of other directions are found from a circular scale on the dial of the compass. Arabs used the fish shaped compasses for navigation in mid 16th century. Magnetic compass is used by architects to construct houses according to the principles of vastu from a correct knowledge of directions. A magnetic compass is used in navigation survey to detect the presence of iron bearing areas from the distinction of terrestrial magnetism of the place from other places. Magnetic compass is suitable in static condition to know the direction in new places.

A magnetic compass gives a direction close to the true north and the true south by applying a small correction called declination. A magnetic compass cannot work satisfactorily in the vicinity of iron and steel objects. Modern ships use these materials in abundance where as ancient ships use those made from wood. The magnetic compass may be suitable on wooden ships and boats but not in steel ships.

9.II.3.2 Gyrocompass: It is a special type of compass developed in the late 19th century to ascertain true North. It consists of a fast spinning wheel or ball to perform tricks. It utilizes the law of conservation of angular momentum and the spinning of the Earth's axis to points towards true North. When a disc or wheel of Gyrocompass is rotating at high speed, it exhibits a remarkable stability of the axis of rotation, along the north South

line and it is mounted on gimbals rings with three degrees of freedom. The motions of the ship do not affect the Gyrocompass. The rotation of the disc is maintained by electric motors. Gyrocompass is the suitable navigation and air travel. The gyrocompass is commonly used in large ships, and in other places where a more accurate reading of North is required.

9.II.3.3 Solar Compass: Solar compass depends on the sun or moon or stars being visible. This is the traditional way of knowing directions.

9.II.3.4 Astrocompass: It is another type of compass which can be used to found true North rather than magnetic North. Astrocompass relies on the position of the celestial bodies. It is useful at the poles, where magnetic compasses become unreliable.

9.II.3.5 Solid State Compass: They work upon a number of electronic magnetic sensors to calculate the precise direction.

9.II.3.6 Modern Compass: The modern compass has a 360 degree mica card of 6 to 9 inches in diameter. It rests on a jeweled bearing in a bowl filled with liquid of alcohol and water or light oil. The card carries either a pair of bar magnets or a single ring magnet. A pointer in this compass gives the correct direction to the user.

9.II.3.7 GPS Compass: GPS compasses are replacing many traditional compasses for personal use. They make use of satellites in a geo-synchronous orbit over the earth to discern the bearer's exact location and the direction they heading.

9.II.3.8 Sylvan Type Compass: It is a mountaineer's compass that comes with or without mirrors.

9.II.4 Parts of a Compass:

Compasses have the following parts such as

i) A free moving magnetic needle - the heart of a compass

- Rotating housing having a dial with magnetic bearings degrees printed on it
- Magnetic alignment arrow
- A printed alignment arrow to align with magnetic arrow
- Grind lines for aligning the compass on a map
- Base plate - the bottom of the compass
- A mirror for easy alignment
- Sighting notch to record the direction
- Lanyard to allow the compass to be hanged on the neck
- Rider to measure distances on a map

9.II.5 Uses of compass:

Compasses are used in navigation, aeroplanes and in knowing the directions in new places.

9.II.6 Summary:

A compass is a device which can determine a direction o the Earth. It is used to know the directions even when sun, moon and stars are not visible due to conditions of weather. Generally it is used for navigation. A compass may be aligned to either magnetic North or true North or occasionally to an arbitrary direction based on location of celestial bodies. Magnetic North is the direction of the North tip of the earth's magnetic field, while true North is the direction in which earth rotates. A compass working on the principle of magnetism is a modern compass. Many types of compasses are discovered basing on the necessity. Some of them are General compass or Magnetic compass, Gyrocompass, solar compass, Astrocompass, solid state compass, modern compass, GPS compass, Sylvan type compass etc. Compasses are used in navigation, aeroplanes and in knowing the directions in new places.

9.II.7 Technical Terms:

General Compass or Magnetic Compass

Gyro Compass

Solar Compass

Astro Compass

Solid State Compass

Modern Compass

GPS Compass

Sylvan Type Compass

9.II.8 Self Assessment Questions:

1) Write an account on compass.

Lesson - 9.III

SURVEYING

Objective:

To know about surveying methods, instruments used in surveying, defects and uses in surveying.

Structure:

9.III.1 Introduction:

The word, survey is used both in social sciences and experimental sciences. For laying high ways and rail roads, for constructing huge dams, for erecting huge structures for industries, the areas must be studied for their suitability and for proper planning. Surveying is used for this. Surveyors use elements of geometry, engineering, trigonometry, mathematics, physics and law in order to accomplish their objective.

In engineering and technology, it includes collection of data over a large area and drawing important conclusion from data. In population survey, it gives the distribution of population in various regions of the country. Making use of this data we can formulate plans for the development of nation. Opinion survey indicates the possible result of an election. Gravity survey is based on the data of acceleration due to gravity and velocity of seismic waves. Gravity survey gives

information about the mineral deposits and the proneness of the region to earthquakes. Magnetic survey based on the measurements of the terrestrial magnetism gives information about the areas of iron, cobalt and nickel.

9.III.2 Definition:

Surveying is the technique of accurately determining the terrestrial or three-dimensional space position of points and the distances and angles between them. These points are often used to establish land maps and boundaries for ownership of governmental purposes.

9.III.3 Methods of Surveying:

Four methods of surveying are used.

9.III.3.1 Traverse: This is the most common horizontal control. It consists of a series of points called stations. Each of it is located in the field by angle and distance from adjacent stations. Each station is selected for convenience and marked with a nail in the top of a wood stake. The traverse returns to the starting point forming a polygon. Because field measurements contain inaccuaries, the angles and distances between stations must be adjusted to make them mathematically correct.

9.III.3.2 Triangulation Method: It is used for most accurate horizontal controls over large areas. This is the widely used method of today's surveying . This consists of a series of adjacent triangles with sides in common. In this method, length of one side and the three angles of a triangle are measured to work out the lengths of two sides. Here first the base line is measured accurately. Then the angles are taken from the two end points.

9.III.3.3 Trilateration Method: The methods of surveying in which only lengths are measured (angles not necessary) is Trilateration method. Here the lengths of four sides and a diagonal are measured for an oblong field.

9.III.3.4 Stake Outs: In this, the existing objects are located in the field of angle, distance and elevation measurements from the points of a control survey. Measurements are recorded in field note book and taken to office for plotting and computations. The surveyor sets wooden stakes at specified locations near the proposed construction to show the builder exactly where to build in order to conform to the designer's intentions.

9.III.4 Types of Surveying:

Surveying is classified into many types according to purpose

Geodetic Survey:

It involves gathering information for maps of areas up to several hectares. It is used for large areas such as countries.

Plane Survey:

It is used to measure small areas taking them as flat surfaces.

Land / Topographic Surveys:

It involves locating and making proper boundaries and determining proper area. These are required for real estate transactions.

Archaeological Survey:

It is used to assess archaeological remnants.

House Built Survey:

It is conducted several times during the construction of a housing project to verify the specifications set on the plot plan or site plan. This usually entails a complete survey of the site to confirm that the structure, utilities and roadways proposed were built in the proper locations or not.

Bathymetric Survey:

It is a survey carried out to map the sea bed profile.

Boundary Survey:

It is a survey to establish the boundaries of a land as per the legal description.

Construction Survey:

It is the process of establishing and making the position and detailed layout of new structures such as roads or buildings for subsequent construction.

Deformation Survey:

It is a survey to determine the shape and plane of an object.

Geological Survey:

It is conducted for the purpose of recording the geologically significant features of the areas under investigation.

Hydrographic Survey:

This is conducted to map the mapping, the coastline and seabed for navigation, engineering or resources management purposes.

Mortgage Survey or Physical Survey:

It is a simple survey which determines land boundaries and building locations.

Soil Survey or Soil Mapping:

It is the process of determining the soil types and other properties of the soil covering the landscape and mapping them for others to understand and use.

Medical Surveys:

It gives an idea of the health and diseases of mankind and form the basis for measures to betaken to protect the people from dangerous diseases like small pox, malaria etc.

Technological Survey:

It gives information about the suitability of various regions in the establishment of industries and economic survey gives the prospects of the plane economically.

Instruments Used in Surveying:

Several instruments are used in surveying. They are sextant, transit, theodolite, tapes, EDM, sub tense bars, engineers level etc.

9.III.5 Defects in Surveying:

i) Most surveying involves plane surveying methods, which ignore the curves on the earth. Plumb lines are considered as parallel, which point towards the centre of the earth. They are along the radii of the earth and no two thumb lines are therefore exactly parallel.

ii) A straight line of sight is considered level, although a level line actually curves parallel to average surface of the earth. Hese do not produce much error in surveys of ordinary sites.

iii) Curvature of earth must be considered in large surveys, and a special method called geodetic survey is used for this.

9.III.6 Uses of Surveying:

i) The importance of survey is evident in knowing the areas of plots and agriculture land in transactions of buying and selling. Local surveying is the measuring of distances of angles on earth's surface in order to mark maps. Surveyors work to keep the maps up to date.

ii) Acoustic survey or Ultrasonic survey based on techniques using high frequency sound waves gives information about water, oil etc. Underground radioactivity survey gives information about the radioactive deposits of uranium and radium etc., which are used in nuclear reactors for the production of power in atom bombs, in the treatment of cancer in medicine and so on.

iii) Infrared survey using the principle of infrared photograph gives information about geothermal springs and provides an opportunity to tap this geothermal energy.

9.III.7 Summary:

Surveying is the technique of accurately determining the terrestrial or three-dimensional space position of points and the distances and angles between them. These points are often used to establish land maps and boundaries for ownership of governmental purposes. Generally four methods of surveying are used. They are Traverse method, Triangulation method, Trialteration method and stake outs. Surveying is classified into many types according to purpose. Some of them include Geodetic survey, plane survey, Archaeological survey, Boundary survey, Geological survey etc. Surveying has many uses.

9.III.8 Technical Terms:

Traverse Method

Triangulation Method

Trialteration Method

Stake Outs

Geodetic Survey

Plane Survey

Archaeological Survey

Boundary Survey

Geological Survey

9.III.9 Self Assessment Questions:

1) Write an essay on surveying.
2) Write an account on different types of surveying.

Lesson Writer

Dr. T. Srivalli

Lesson - 10.I

STEAM ENGINE

Objective:

- To gain knowledge about the principle, development and uses of steam engine

Structure:

10.I.1 Introduction:

Steam engine was the first heat engine constructed to get work from heat. Attempts were made to construct steam engine right from the third century A.D. Fuel like wood or coal was used to generate steam in vessel containing water cell. In third century A.D. Hero of Alexandria tried to rotate a globe with two nozzles at pointing ends in opposite directions through which steam is passed. The resulting reaction force produced by the escape of steam through the nozzles caused the globe to rotate rapidly.

10.I.2 Principle:

Heat energy is converted into mechanical energy using of heat engine. In all heat engines the chemical radiation that takes place when fuel is burnt, imparts a high degree of kinetic energy to countless gas molecules. Generally these molecules strike certain movable parts, such as pistons or vanes which in turn provide driving forces.

10.I.3 History:

Towards the end of the seventeenth century, the French man Davis Papin devised one type of reciprocating engine. In this engine a movable piston was free to move in a cylinder containing water heated externally. The expansion power of the steam pushed the piston outwards. When the source of heat is removed, steam condensed and the piston moved inwards due to atmospheric pressure.

The English man Thomas Neweomen improved upon Papin engine in the early parts of eighteenth century without removing the source of heat. Neweomen cooled the cylinder by sprinkling cold water on the cylinder after the outward motion of the piston due to expansion of steam. The cooling resulted in rapid condensation of steam and the piston moves inwards. The outward down motion of the piston was transmitted

to a pump used for pumping water from deep wells and mines. With the introduction of valves Corns, the admission of steam and cold water becomes easier.

Reciprocating steam engine or External combustion engine: This was a modern steam engine was developed by James Watt of Scottland. This has separate boiler and condenser from the cylinder having piston. This innovation avoided alternate heating and cooling of the cylinder reducing the wastage or loss of heat in Neweomen's engine. A double action device was invented in which steam was admitted through both ends. Speed of engine was regulated by a Governor. He developed a mechanism for changing the to and fro motion of the piston to rotary motion and this development made the use of steam engine in locomotives revolutionizing the method of transport.

The reciprocating steam engine developed by Watt is external combusting engine. This engine had a fuel chamber where it is burnt. The flames are drawn through long horizontal pipes immersed in water contained boiler. Steam is generated with economy of heat. Thus produced steam from boiled water enters the cylinder through a hole in the steam chest. Holes are closed alternatively by a sliding valve. Alternate exit of steam through holes at the opposite ends helps in moving the piston forward and backward. This movement is used for the circulation of the wheels by cranks and levers. A heavy fly wheel attached to the engine makes it to run smoothly.

10.I.4 Working of Steam Engine:

i) Water is heated in the boiler so that it vapourises. The steam is then superheated. Such a current of superheated steam is led into the expansion chamber at a high pressure through a pipe. This pressure is about 20 times the atmospheric pressure. Steam from the boiler enters a chamber called steam chest.

ii) Steam enters into the cylinder through one or two holes in the cylinder. The holes are closed alternately by a sliding valve.

iii) Steam from one hole pushes the piston forward which closes the first hole and opens the second hole. Steam from the second hole pushes the piston backward. This to and fro motion of the piston is converted into circulation of the wheels by some cranks and levers. A heavy wheel called fly wheel causes the engine to run smoothly during the change of direction of motion of the piston. Thus a steam engine moves.

iv) The steam engine played an important role in the industrial revolution.

v) The use of the steam engine was first found out by Thomas New Commen. He used a cylinder and a piston for operating the steam. James Watt of Scottland invented the modern version of reciprocating steam engine.

Making use of this, a first passenger train was run between Stockton and Darlington of North England in 1895.

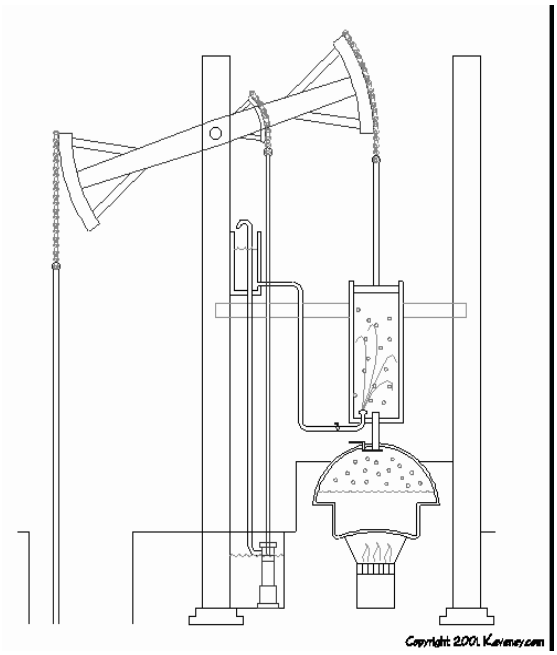


Fig. Steam engine

10.I.5 Uses of Steam Engine:

At one time the steam engine has no serious rival. It is used in several purposes.

i) It ran machines in industrial plants.

ii) It generated electricity in central power stations.

iii) It propelled ocean liners and locomotives.

iv) It operated pumps and had many other uses.

v) It played an important part in the industrial revolution.

vi) It is most important in railway transport.

vii) In olden times horse and oxen were used to pull carts. The speed of transport is very small. With the introduction of steam engine locomotive on railway track, even long distances are covered in a less, short time.

viii) The administration of a country, the trade and commerce on land, the personal and official travels of people became easier, safer, efficient and comfortable.

It is not an exaggeration to say that there is no heavy industry that was not influenced by steam engine. Due to the shortage of coal which forms the source of heat energy, diesel engines and electrical locomotives are used now to increase the efficiency and to save coal for some other purposes like generation of thermal power etc.

10.I.6 Summary:

Steam engine was the first heat engine constructed to get work from heat. Heat energy is converted into mechanical energy using of heat engine. In all heat engines the chemical radiation that takes place when fuel is burnt, imparts a high degree of kinetic energy to countless gas molecules. Generally these molecules strike certain movable parts, such as pistons or vanes which in turn provide driving forces. Making use of this, a first passenger train was run between Stockton and Darlington of North England in 1895. It is used in several purposes. It is not an exaggeration to say that there is no heavy industry that was not influenced by steam engine. Due to the shortage of coal which forms the source of heat energy, diesel engines and electrical locomotives are used now to increase the efficiency and to save coal for some other purposes like generation of thermal power etc.

10.I.7 Technical Terms:

Expansion of Steam

Condensation of Steam

Reciprocating Steam Engine

External Combusting Engine

10.I.8 Self Assessment Questions:

1) Write an account on steam engine

Lesson - 10.II

AUTOMOBILE

Objective:

- To gain knowledge about the types and uses of automobiles.

Structure:

10.II.1 Introduction:

An automobile or motor car is a wheeled motor vehicle for transporting passengers, which also carries its own engine or motor. These automobiles are designed to run primarily on roads, to have seating for one to eight people, to typically have four wheels, and to be constructed principally for the transport of people rather than goods. With it, society has become more mobile. Travel used to be arduous and dangerous is now routine. A home-remote from a person's place of work and places of entertainment distant from either of these is not a disadvantage after the development of automobiles. It is the world wise basic transport machine to travel anywhere in comfort.

10.II.2 History:

First real automobile driven by a gasoline engine appeared in 1896. Before that steam driven cars were in use. Nicolas Cugnot was the first French engineer who built the first self-propelled mechanical vehicle or automobile in1769 by adapting an existing horse-drawn vehicle. A three wheeled human peddled, steam carriage with modern features such as flywheel, brake, gear box and bearings was built in 1770 which ran at a speed of 6 mph. However, it was not developed further.

Francois Isaac of Swiss designed the first internal combustion engine in 1806, which was fueled by a mixture of hydrogen and oxygen and used it to develop the world's first vehicle. Although several others tried to develop a four wheeler, Karl Benz was acknowledged as the inventor of the modern automobile. An automobile powered by four-stroke cycle gasoline engine was built in Germany by Karl Benz in 1885. After

world war II a number of automobiles, became linger, lower and more elaborative. A number of new models with efficiency in fuel combustion are marketed by different companies now-a-days.

The large scale production of affordable automobiles was done by Ransom Olds at his factory in 1902. This concept was expanded by Henry Ford in 1914. Since 1920s, all cars have been produced to meet the market demands.

10.II.3 Fuel and Propulsion Technologies:

Most automobiles in use today are propelled by gasoline (petrol) or diesel internal combustion engines causing air pollution. Increasing costs of oil based fuels, tightening environmental laws and restrictions on green house gas emissions are propelling work on alternative power systems for automobiles. To overcome these problems hybrid vehicles and electric and hydrogen vehicles which do not release pollution into the air are being developed.

Diesel engine cars have long been popular. The main benefit of diesel engine is a 50% fuel burn efficiency compared with 27% in the best gasoline engines. Gasoline engine has the advantage over diesel in being lighter and able to work at higher rotational speeds and they are the usual choice for fitting to high performance sports cars. Exhaust gases are also cleaned up by fitting a catalytic converter into the exhaust system. With a slight redesign, gasoline powered vehicles can ran on ethanol concentrations as high as 85%. 100% ethanol is used in some parts of the world such as Brazil, but vehicles must be started on pure gasoline and switched over to ethanol once the engine is running. Most gasoline engine cars can also run on LPG with the addition of an LPG tank for fuel.

10.II.4 Transmission:

The next important part of the automobile is the system of transmission. In the transmission system a foot operated clutch links the gears (a system of toothed wheels) to the engine's crank shaft and allows the connection or disconnection of the two. Depending on the ratio of teeth in the gears, we can change the ratio of the speed of the wheels to the speed of the engine shaft. Steering gear lets the car's direction be changed. Steering wheel turns a worm gear at the bottom of the steering column. Brakes use friction to stop the automobile. Breaks may be of disc type or drum type. Brakes are controlled by the driver's brake pedal. The electrical system has a storage battery, starter, an alternator, ignition system and lighting system.

Current form of battery causes the starter to turn. The starter is a powerful electric motor that operates the engine, until it runs by itself. The battery stores the electric charge, and is kept charged by the alternative A.C. generator driven by the engine. Diesel engine needs no spark because the combustion takes place by the heat of compression. Petrol engine requires a spark plug drawing current from the battery. The car's lighting system draws its power from the electrical system. The final door system consisting of a differential device allows the two driving wheels to rotate with different speed in taking a turn. The lubricating system reduces wear, metal to metal friction and promotes cooling of the heated parts. Cooling system using water removes the excess heat of the engine. Water from the radiator is used for this purpose. The emission control system reduces the harmful chemicals that accompany combustion.

10.II.5 Different Types of Automobiles:

People are more and more dependent on trucks and buses for their needs. Trucks deliver foods and soft drinks, fuel and all types of merchandise. Farmers need trucks to carry their products to market.

Buses in cities and between cities are means of easy travel. Smaller trucks have the same kind of engines. Truck body and frame are built stronger to carry heavy loads. The extra force needed to have larger loads is obtained by extra gears in transmission. Midget automobiles, motor cycles, scooters are other small motor vehicles. They are easier to handle in traffic and provide rapid transportation most economically.

Steam engine, internal combustion engines and electric motor with battery were tried to run automobiles. Steam engine was rejected due to its heaviness and motor with batteries was rejected due to its limited range of distance. Internal combustion engines being lighter are more efficient are used in automobiles.

10.II.6 Uses of Automobiles:

The automobiles are playing important role in the personal and public transport of passengers and goods. The road journey for short distances and rail journey for long distances on land are ideal for passengers or goods on land as evident from daily experience.

10.II.7 Summary:

An automobile or motor car is a wheeled motor vehicle for transporting passengers, which also carries its own engine or motor. These automobiles are designed to run primarily on roads, to have seating for one to eight people, to typically have four wheels, and to be constructed principally for the transport of people rather than goods. First real automobile driven by a gasoline engine appeared in 1896. Before that steam driven cars were in use. Most automobiles in use today are propelled by gasoline (petrol) or diesel internal combustion engines causing air pollution. Increasing costs of oil based fuels, tightening environmental laws and restrictions on green house gas emissions are propelling work on alternative power systems for automobiles. To overcome these problems hybrid vehicles and electric and hydrogen vehicles which do not release pollution into the air are being developed. Different types of automobiles are used by people for different purposes.

10.II.8 Technical Terms:

Gasoline Engine
Self Propelled Mechanical Vehicle
Steam Engine
Internal Combustion Engines
Electric Motor

10.II.9 Self Assessment Questions:

1) Write an account on automobiles

Lesson Writer

Dr. T. Srivalli

Lesson - 11.I

SHIP

Objective:

- To gain knowledge about the modernization, classification and uses of ships.

Structure:

11.I.1 Introduction:

A ship is a large transporting vessel that flows on water. Ships may be found on lakes, seas and rivers. Ancient man constructed boats and ships to satisfy his urge to travel on water. They allow for a variety of activities such as the transport of people or goods, fishing, entertainment, public safety and warfare.

Ships and boats have developed alongside mankind. They have become an integral part of modern commercial and military systems. Fishing boats are used by millions of fishermen throughout the world. Military forces operate highly sophisticated vessels to transport and support forces ashore. Commercial vessels transport tons of cargo. These vessels were also key in history's great exploration and scientific and technological development. On one hand, ships have been used for colonization and the slave trade and on the other side, they also have served scientific, cultural and humanitarian needs. From Mesolithic canoes to today's powerful nuclear-powered aircraft carriers, ships tell the history of man.

Ships are generally distinguished from boats based on the size and the ship's ability to operate independently for extended periods. A number of large vessels are traditionally referred to as boats. Foe example submarines, river boat and ferry boat. Though large enough to carry their own boats and heavy cargoes, these vessels are designed for operation on inland or protected coastal system.

11.I.2 History:

The first known boats dates back to the Neolithic period, about 10,000 years ago. They were used mainly for hunting and fishing. The oldest dugout canoes found by archaeologists were often cut from coniferous tree logs using simple stone tools. By around 3000 BC ancient Egyptians assembled woods of plants into a ship hull. Boats and ships of ancient times were driven by rowing manually with sticks of special form or by the force of winds on tall mats. They were made of wood as wood is lighter than water. More carpentry is required to produce them. The travel in those days was full of uncertainties and dangers. Ancient people used their knowledge of astronomy (celestial navigation) in navigation to find directions. Later magnetic compass was used for finding directions on seas. In China, magnetic compass was developed and used in navigation between 1040 and 1117. The true mariner's compass, using a pivoting needle in a dry box was invented in Europe around 1300. Rudder is a very important part of the ship as it enables one to change the direction just like a steering wheel in an automobiles. Explores traveled in such ships, found new sea routes and discovered new continents like America and Australia.

11.I.3 Specialization and Modernization:

Ship designs stayed fairly unchanged until the late 19th century. The industrial revolution brought many changes in the construction of ships. The ability to construct ships from metal triggered an explosion in ship design. Ships made with steel are strong enough to withstand through conditions of the seas. Ships built for entirely new functions such as fire fighting, rescue and research also began to appear. The invention of steam engines resulted in mechanized propulsion of ships. Steam engines used in ships increased their speed many times and coal a cheap fuel is sufficient for the steam engine. Steam turbines which are big wheels with blades driven by jets of steam are the next development and this reduced the weight of the engine. Later electric motors driven by turbines were used as electrical energy is more flexible. Internal combustion engines like diesel engine running with diesel oil provided lighter engines with good efficiency. Attempts are made to use nuclear energy to drive ships to increase the speed still further.

Now-a-days gyrostatic compass based on the principle of the stability of the axis of rotation of a disc rotating with high speed is used to know the direction of travel as it is not affected by the iron and steel objects in the ship and the motion of the ship.

A system of warning called SONAR (Sound Navigation And Ranging) working on the principle of echo of high frequency sound waves is used to detect icebergs, whales, sharks or enemy submarines under water. It can be used to know the regions where fishes are abundant. A system of communication based on the principle of production, transmission and rejection of radio waves called R A D A R (Radio Detection And Ranging) is used to communicate with the outside world.

Modern ships of very big size are like floating cities with all facilities of a modern city. They provide a comfortable and safe journey over seas. Ships with good storage facilities are used in the transport of commercial goods, food grains, oil and many other items. There are ships which help in the exploration of marine resources like petroleum, minerals, corals etc. There are warships equipped with modern weapons to protect the marine borders, marine resources and fishermen from enemies. Navy plays an important role in relief operation during floods and other natural calamities.

As long ago as 2000 B.C. the Egyptians built boats from wood. Now-a-days Glass-Reinforced Plastic (GRP) is used in place of carvel, clinker constructed and ply wood made boats.

11.I.4 Classification of Ships:

Ships are difficult to classify, mainly because there are so many criteria to base classification on. One classification is based on purpose they serve. They are passenger ships, cargo ships, and special purpose ships.

11.I.4.1 Passenger Ships: They are the most luxurious. They are large and fast. They are equipped with all kinds of scientific devices to make travel comfortable. To aid in navigation, when viability is poor, the ship is equipped with radar. These are categorized as either a sailing ship or a motor ship. Sailing ships are ships which are propelled solely by means of sails. Motor ships are ships which are propelled by mechanical means to propel itself. Motor ships include ships that propel itself through the use of both sail and mechanical means. Passenger ships range in size from small river ferries to giant cruise ships.

Fig. Passenger Ship

11.I.4.2 Cargo Ships: Commercial vessels or merchant ships are the cargo ships to transport dry and liquid

cargo. They carry freight. Each is designed by special cargos. They are fast and can be loaded and unloaded speedily. Tankers are used to carry oil. Ships have been designed to carry live stock, refrigerator ships to carry perishable goods like fish and fruit, nickel-lined ships to carry corrosive material.

Fig: Cargo Ship

11.I.4.3 Special Purpose Ships: These are not used for transport but are designed to perform other specific tasks. Ex: tugboats, pilot boats, rescue boats, cable ships, research vessels, survey vessels, ice breakers etc.

Fig. Rescue Boat

There are many types of naval vessels currently and through history. Modern naval vessels can be classified into three categories. Warships, submarines and auxiliary vessels. Modern warships are generally divided into seven main categories. Aircraft carriers, cruisers, destroyers, frigates, corvettes, submarines and amphibious assault ships. Battle ships encompass as eighth category, but are not in current service with any navy in the world.

11.I.5 Summary:

A ship is a large transporting vessel that flows on water. Ships may be found on lakes, seas and rivers. Ancient man constructed boats and ships to satisfy his urge to travel on water. They allow for a variety of activities such as the transport of people or goods, fishing, entertainment, public safety and warfare. The first known boats dates back to the Neolithic period, about 10,000 years ago. They were used mainly for hunting and fishing. The oldest dugout canoes found by archaeologists were often cut from coniferous tree logs using simple stone tools. Ship designs stayed fairly unchanged until the late 19th century. The industrial revolution brought many changes in the construction of ships. The ability to construct ships from metal triggered an explosion in ship design. Modern ships of very big size are like floating cities with all facilities of a modern city. They provide a comfortable and safe journey over seas. Ships are difficult to classify, mainly because there are so many criteria to base classification on. One classification is based on purpose they serve. They are passenger ships, cargo ships, and special purpose ships.

11.I.6 Technical Terms:

Ships, Boats

Passenger Ships

Cargo Ships

Special Purpose Ships

11.I.7 Self Assessment Questions:

1) Write an account on ships

Lesson - 11.II

AEROPLANE

Objective:

- To gain knowledge about the evolution, parts, and working condition of aeroplane

Structure:

11.II.1 History:

Just as the beginning of the nineteenth century saw the achievements of the railways and steamship, so the beginning of the twentieth century witnessed the conquest of air. Air crafts are no sudden advances in man's struggle with nature, but rather the final yielding of defenses which withstood his attacks for hundreds of years. In 1852 Giffard constructed a balloon with a steam engine and propeller and succeeded in driving it at the rate of 5 to 6 miles per hour. About 1871 Otto Lilienthal commenced to study the flights of birds particularly the position and shape of their wings gliding near the surface of water and the construction of kites. When a kite is pulled against the wind, it rises upwards due to a component of the thrust of the wind on the kite. Lilienthal constructed a frame with a pair of wings, launched himself from the top of a hill and was able to glide several hundred feet in air. He altered his direction by swinging his legs.

11.II.2 Evolution of Aeroplane:

The evolution of the areoplane on scientific lines was aided by the work of S.P.Langley of Smithsonian Institution, Washington. He succeeded in constructing a steam engine when propelled his model of the aeroplane for a minute and half.

Sometimes before 1900 gliding experiments with a biplane were made in America by the brothers Wilbur and Orville Wright. In 1901 they succeeded in making flights more that 600 ft. long by increasing the surface area of the plane and reducing the air resistance by lying flat on the lower plane. In 1903 they constructed a motor and made flights lasting about a minute and they increased the time of flights to 5 minutes and 31 minutes in the subsequent two years. They made experimental researches in aero-dynamic

with a wind tunnel. They determined experimentally the best sections of wings. They invented a system of control to prevent side slipping and escaped from the dangers of all due to slide slipping. They succeeded in constructing an air craft using the scientific data collected by them and developed an engine weighing 240 lb with a horse power of 20.

11.II.3 Parts of Aeroplane:

The important parts of the aeroplane are propeller, wings, engine, streamlined body, rudder and a system of communication with ground control. The aeroplane consists of wheels enabling it to run with speed on a runway. The engine is an internal combustion engine with petrol as fuel. The propeller resembling a fan rotates at a high speed with the power provided from the engine. It pushes the air backwards and the air pushes the aeroplane forwards. After gaining sufficient speed on the ground, it raises into the air. This is possible, due to the special shape of the wings. The air moving past the wings has a higher speed over the upper surface than on the lower surface due to the special shape of the section of wing. Where the velocity is minimum pressure is minimum and vice versa according to Bernouslli's principle. So, the higher pressure of air below the wings lift the aeroplane upwards and the lifting force increases with the differences of speed of air above and below. The rudder provides a steering action. A number of instruments like altimeter, anemometer and gyrocompass enable the pilot to know the altitude, velocity and direction. The streamlined shape of the body reduces the air drag. A system of radar provides communication with ground control at the aerodromes. Parachutes are provided for emergency landing of passengers.

The piston engine with propeller is suitable up to speeds of 600 Mph and engines using the principle of jet propulsion are suitable at higher speeds due to higher efficiency. Now a days there are aeroplanes capable of traveling at speeds greater than the speed of sound. Alloys of aluminium eight times stronger than pure aluminium, and three times lighter than steel are used in the construction of aeroplanes. Attempts are made to produce alloys with better strength-weight ratio even at high temperatures. Magnesium, Znic, Zironium, Titanium are mixed with aluminium to achieve these qualities and to reduce cost.

Two types of air craft have been developed. One type lighter-than-air, is known as airship. Man's first flights in air were made with it. The other type, heavier-than-air, is known as aeroplane. They are of more recent origin than airships. These are the ones which are much more widely used now-a-days.

Fig: Aeroplane

11.II.4 Working of Aeroplane:

1) **Lifting Force:** An airplane is lifted up because of two forces. One force is developed when the air through which the plane is traveling strikes the underside of the wing. This is only a part of the total lifting force. When an airplane moves with high speed the pressure of air above the wings is less that that below it, according to Bernouilli's principle. Consequently there is a thrust upwards. This force constitutes a major portion of the lifting force.

2) **Driving Force:** The propeller produces the force which drives the airplane through the air. The propeller has curved blades so designed that as it turns it acts as a screw and pulls the plan through the air. Some propellers are built with adjustable blades during take-off, the bite of the blade is small. Thus it is possible for the engine to turn the propellers fast enough to develop sufficient force to move the plane off the runway. When the plane is air-force, the bite is increased for maximum flying efficiency. In many air planes, the propellers are adjusted automatically for most efficient operation under all flying conditions.

3) **Devices for Safety:** The pilot must know engine temperatures as well as those in other parts of the air plane. Any trouble in the engine can be traced to a high temperature. Then too the air temperature outside may be an important indication as to whether there is a possibility of the formation of ice on wings so. Gauges measuring engine-cylinder temperature, oil temperature and outside air temperature are found on the instrument panel.

4) **Air Speed Measurement:** Pilot-tube, based on Bernoulli's theorem, is attached to a wing. When air blows into the open end of the tube creates a pressure which is read in miles per hour on a dial on the instrument panel. Since winds affect the air-speed readings, the readings must be corrected to get the ground speed.

5) **Altimeter:** Altimeter measure the altitude at which a plane is flying. An aneroid barometer is used to find the height. It converts pressures into heights above mean sea level. The altitude of the land over which the airplane was flying would have to be subtracted from the height above mean sea level to get the height of the plane above the earth. Thus it was possible, when flying near mountains, to have altimeter show 10,000 ft and yet have the air plane strike a mountain top.

6) **Terrain-Clearance Indicator:** It is an instrument to indicate the pilot as to how far he is above the surface of the earth at all times. A radio signal is sent from the air plane to the earth and it is reflected from the ground back to the air plane. The time taken by the signal to go to the ground and back is automatically converted into heights above the earth and indicated by the instrument.

7) **Directional Gyroscope:** In airplanes magnetic compasses are not generally used because frequently they require connections. So a directional gyro is used. The gyroscope is the important part in it. When the wheel of the gyroscope spins at a constant high speed, its axis will point in a constant direction. At the beginning of the flight, the pilot turns on the gyro and when the wheel spins at the proper speed, he adjusts the instrument to point in the direction of his destination. When the plane gets off the course, it is indicated by a dial on the front of the gyro.

8) **Bank and Climb Indicator:** When the air plane is flying at very high altitudes and when the visibility is poor, to indicate whether is airplane is flying level and upright, a look at the indicator tells the pilot the correct position. This also consists of a gyroscope mounted so that as it spins its shaft is always in a vertical position. Regardless of the position of the airplane the shaft always remains vertical. If the airplane climbs, drives or tips to either side (banking) its exact position with respect to the earth is shown.

9) **Radio Aids to Flying:** If the antenna is turned in one particular direction our T.V. gives a good picture but in another direction it dies out. This property of antenna is used as the basis for a radio

direction finder. To find the exact location pilot tunes one radio station and gets its direction from the air plane. He then draws a line on his map from the radio station towards the air plane. He repeats it with another station. The two lines intersect at a point. That is the exact location of the air plane.

Robot controlled airplanes has been developed. They fly without any person in it. All adjustments necessary for light are made by machinery controlled by radio signals sent from a ground station or another air plane or ship.

In long distance flights a single airplane can control simultaneously the fights of a group of planes. Such is called mother plane.

11.II.5 Uses of Aeroplane:

With the development of air craft, the world appears to shrink because one can travel from one continent to another continent even over ocean with high speed in a small time. Cultural, political, scientific and commercial contacts have developed to a greater degree. Air mail, aerial survey of resources, conduct of relief operations during natural calamities, transport of passengers as well as cargo, defense and offence during wars are some of the advantages provided by the air craft.

The airplanes have become today an internal part of our transportation system and an important means of transportation. Passenger flights from one continent to another is no longer a across planes each month and mail is also flown then world. Any city in the world is only a few hours flying time from any other city. Delhi is connected to almost all the big cities in the world.

11.II.6 Summary:

Just as the beginning of the nineteenth century saw the achievements of the railways and steamship, so the beginning of the twentieth century witnessed the conquest of air. Air crafts are no sudden advances in man's struggle with nature, but rather the final yielding of defenses which withstood his attacks for hundreds of years. The evolution of the areoplane on scientific lines was aided by the work of S.P. Langley of Smithsonian Institution, Washington. The important parts of the aeroplane are propeller, wings, engine, steamlined body, rudder and a system of communication with ground control. The aeroplane consists of wheels enabling it to run with speed on a runway. For working of aeroplane the following instruments such as lifting force, driving force, devices for safety, air speed measurement, altimeter, Terrain-clearance indicator, directional gyroscope, Bank and climb indicator, radio aids to flying are necessary.

11.II.7 Technical Terms:

Propeller

Wings

Engine

Streamlined Body

Rudder

A system of communication with ground control

Lifting Force

Driving Force

Devices for Safety

Air Speed Measurement

Altimeter

Terrain-Clearance Indicator

Directional Gyroscope

Bank and Climb Indicator

Radio Aids to Flying

11.II.8 Self Assessment Questions:

1) Write an account on aeroplane.

Lesson Writer

Dr. T. Srivalli

Lesson - 12

MEANS OF COMMUNICATION

Objective:

The aim of this lesson is to make the student gain knowledge on-

- Various means of communication systems that are used now and then.

Structure:

12.1 Introduction:

Communication is the exchange of thoughts, messages, or information, as by speech, visuals, signals, writing, or behavior. The word is derived from the Latin word "communis", meaning to share. Communication is the sending and receiving of verbal or non-verbal messages between people and places. Communication can be verbal or non-verbal. Letters are the most common means of communication in the past but now we have a wide rage of communication means like telegram, telephone, telex, fax, e-mail, radio, television, newspapers, etc. In this fast life the popular means of communication is e-mail, chatting, cell phones and also satellites.

12.2 Radio:

Guglielmo Marconi (1874-1937) of Bologna, Italy, is credited with inventing radio. On December 11, 1901, Marconi surprised the world by transmitting a radio signal in Morse code over a distance of 2,137 miles (3,440 kilometers) from England to Newfoundland, Canada. In 1943, the radio patent by a vote by the United States Congress was reversed and given to Nikola Tesla. Nikola Tesla invented the fundamentals for the radio transmission before Marconi even thought of it.

Within the history of radio, many people were involved in the invention of radio technology that continues to evolve in modern wireless communication systems today. Radio development began as "wireless telegraphy", first invented by David Edward Hughes. Radio is the radiation and detection of signals sent through space as radio waves. Radio waves are a form of electromagnetic radiation having a much longer wave length than visible light. Radio was initially called "wireless telegraphy" because it performed the same function as a telegraph without using wires. The earliest users of radio were ships, which found it useful to communicate over vast stretches of ocean.

They are various methods of transmitting signals (speech, music, data etc.) on carrier frequencies. Normally in every radio we have FM and AM. FM is Frequency Modulation where the carrier frequency is modified by the signal frequency. AM is Amplitude Modulation where the carrier amplitude is modified by the signal.

12.2.1 Uses of radio:

The radio is used in many different ways.

1. It mainly used for communication purposes.
2. People use the radio for listening to music, to know weather conditions.
3. Soldiers and people also use them in wars because the people have to know what's going on.
4. They were also used in wars when there was no television.
5. They can also use them on ships and planes to know news and latest details.
6. They are used to know the various commercial products available in the market.
7. They are also useful to know the activities going on in and around the city.
8. People also use radio to listen the running commentary of cricket match or any other live match when they are not in the position to see in television.
9. Radio is used for the transmission of data in coded form.

10. Long-range radio signals enable astronauts to communicate with the earth from the moon and carry information from space probes as they travel to distant planets
11. For navigation of ships and aircraft the radio range, radio compass and radio time signals are widely used.
12. They are a very important component of many businesses such as the construction industry etc.

Radio is widely uses as it is very cheap, in fact all it would cost is the initial price of the radio sets at the shop.

12.3 Telephone:

The origins of the telephone date back to the non-electrical string telephone or "lover's telephone" that has been known for centuries, comprising two diaphragms connected by a taut string or wire. Sound waves are carried as mechanical vibrations along the string or wire from one diaphragm to the other. The classic example is the tin can telephone, a children's toy made by connecting the two ends of a string to the bottoms of two metal cans, paper cups or similar items. The essential idea of this toy was that a diaphragm can collect voice sounds from the air, as in the ear, and a string or wire can transmit such collected voice sounds for reproduction at a distance.

Alexander Graham Bell is the inventor of the first practical telephone. He was born on March 3, 1847, in Edinburgh, Scotland; Alexander Graham Bell was the son and grandson of authorities in elocution and the correction of speech. Educated to pursue a career in the same specialty, his knowledge of the nature of sound led him not only to teach the deaf, but also to invent the telephone. The first words that Graham Bell spoke on the telephone on 10 March 1876 through the instrument to his assistant, Thomas A. Watson, in the next room, which was communicated successfully were - "Watson -- come here -- I want to see you!"

12.3.1 Alexander Graham Bell - Evolution of the Telegraph into the Telephone:

The telegraph and telephone are both wire-based electrical systems, and Alexander Graham Bell's success with the telephone was the result of his attempts to improve the telegraph. Telegraph had been an established means of communication for some 30 years. Telegraph was basically limited to receiving and sending one message at a time with its dot-and-dash Morse code. At this time Graham Bell's extensive knowledge of the nature of sound and his understanding of music enabled him to conjecture the possibility of transmitting multiple messages over the same wire at the same time. His "harmonic telegraph" was based on the principle that several notes could be sent simultaneously along the same wire if the notes or signals differed in pitch.

Telephone which is the fastest means of communication. Today, we can talk to people in far-off cities or even in different countries through the STD (Subscriber Trunk Dialing) and ISD (International Subscriber Dialing). Telephone facilities are available in all cities, towns and most of the villages these days. India has made great strides in the telecommunication sector in recent years. Telephone services are better and much cheaper than before. Cellular phones are also being increasingly used.

12.4 Wireless:

Wireless telecommunications is the transfer of information between two or more points that are not physically connected. Distances can be short, such as a few meters for television remote control, or as far as thousands or even millions of kilometers for deep-space radio communications. It encompasses various types

of fixed, mobile, and portable two-way radios, cellular telephones, personal digital assistants (PDAs), and wireless networking. Other examples of wireless technology include GPS units, Garage door openers or garage doors, wireless computer mice, keyboards and Headset (audio), headphones, radio receivers, satellite television, broadcast television and cordless telephones.

Wireless operations permit services, such as long range communications, that are impossible or impractical to implement with the use of wires. The term is commonly used in the telecommunications industry to refer to telecommunications systems like radio transmitters and receivers, remote controls, computer networks, network terminals, etc., which use some form of energy to transfer information without the use of wires.

Common Wireless Equipments are:

- Telemetry control and traffic control systems
- Infrared and ultrasonic remote control devices
- Professional LMR (Land Mobile Radio) and SMR (Specialized Mobile Radio) typically used by business, industrial and Public Safety entities.
- Consumer Two way radio including FRS Family Radio Service, GMRS (General Mobile Radio Service) and Citizens band ("CB") radios.
- Consumer and professional Marine VHF radios.
- Air band and radio navigation equipment used by aviators and air traffic control
- Cellular telephones and pagers
- Global Positioning System (GPS): allows drivers of cars and trucks, captains of boats and ships, and pilots of aircraft to ascertain their location anywhere on earth.
- Cordless computer peripherals: the cordless mouse is a common example; keyboards and printers can also be linked to a computer via wireless using technology such as Wireless USB or Bluetooth
- Cordless telephone sets: these are limited-range devices, not to be confused with cell phones.
- Satellite television: Is broadcast from satellites in geostationary orbit. Typical services use direct broadcast satellite to provide multiple television channels to viewers.

12.4.1 Wireless networks:

Wireless networking is used to meet many needs. Perhaps the most common use is to connect laptop users who travel from location to location. Another common use is for mobile networks that connect via satellite. A wireless transmission method is a logical choice to network a LAN segment that must frequently change locations. The following situations justify the use of wireless technology:

- To span a distance beyond the capabilities of typical cabling,
- To provide a backup communications link in case of normal network failure,
- To link portable or temporary workstations,

- To overcome situations where normal cabling is difficult or financially impractical, or
- To remotely connect mobile users or networks.

Applications may involve point-to-point communication, point-to-multipoint communication, broadcasting, cellular networks and other wireless networks.

12.5 Camera:

A camera is a device that records images that can be stored directly, transmitted to another location, or both. These images may be still photographs or moving images such as videos or movies. The term camera comes from the word camera obscura (Latin for "dark chamber"), an early mechanism for projecting images.

Cameras may work with the light of the visible spectrum or with other portions of the electromagnetic spectrum, especially infrared. A camera generally consists of an enclosed hollow with an opening at one end for light to enter, and a recording or viewing surface for capturing the light at the other end. A majority of cameras have a lens positioned in front of the camera's opening to gather the incoming light and focus all or part of the image on the recording surface. The diameter of the aperture is often controlled by a diaphragm mechanism, but some cameras have a fixed-size aperture. Most cameras use an electronic image sensor to store photographs on Flash memory. Other cameras including the majority from the 20th century use photographic film. The still camera takes one photo each time the user presses the shutter button. A typical movie camera continuously takes 24 film frames per second as long as the user holds down the shutter button, or until the shutter button is pressed a second time

12.5.1 Uses of camera: From recording events to damaging careers, cameras have made a huge impact on society. It sums up a whole story in a single image or a video. It serves as a preserver of memories and as a communications tool. There are many uses of cameras especially digital cameras, like-

1. For keeping a record of friends and family we can take photographs. With the help of the modern digital camera this becomes easier as there is no need for film. A digital camera can be ready at any time, as long as the batteries are good. We can keep a record of all the events of the life.
2. Digital cameras are an excellent way to keep a visual inventory for insurance purposes.
3. Digital camera can create photos and graphics for Web site.
4. Digital cameras are also good for creating virtual reality tours of your home or business to present on the Web.
5. To make photo business cards.
6. To produce your own clip art images, either taking regular photographs or close-ups.
7. Digital cameras are helpful for recording textures for Web sites and presentations.
8. For recording an event or meeting.
9. Taking photos of an historic building.
10. They preserve lifelong sweet memories.

12.5.2 Types of camera: The oldest type of camera is Plate camera. This camera could be used only in one place and still photos could be taken successfully. The next type of camera is the large format camera which is a direct successor of the early plate cameras and was used for high quality photography and for technical, architectural and industrial photography. These cameras have a wide range of movements allowing very close control of focus and perspective. Later Medium-format cameras have a film size somewhere in between the large format cameras and the smaller 35mm cameras were developed. There are even compact amateur cameras available in this format. Following medium format camera, folding camera came into existence. The introduction of films enabled the existing designs much smaller and could be folded up. These designs were very compact and small models vest pocket cameras. Succeeding this model the box cameras came into use.

Box cameras were introduced as a budget level camera. As camera and lens technology developed and wide aperture lenses became more common, range-finder cameras were introduced to make focusing more precise. Then the use of more sophisticated camera called the single-lens reflex camera came into use in which the photographer sees the scene through the camera lens. Following this model Twin-lens reflex cameras were used in which a pair of nearly identical lenses, one to form the image and one as a viewfinder came into use. The advantage of this camera was that it could be easily focused using the viewing screen and that under most circumstances the view seen in the viewing screen was identical to that recorded on film. Now we have the ciné camera or movie camera which takes a rapid sequence of photographs on strips of film. In contrast to a still camera, which captures a single snapshot at a time, the ciné camera takes a series of images; each called a "frame" through the use of an intermittent mechanism. The frames are later played back in a ciné projector at a specific speed, called the "frame rate". The first ciné camera was built around 1888 and by 1890 several types were being manufactured. In the last quarter of the 20th century camcorders supplanted film motion cameras for amateurs were widely used.

12.5.3 Construction of camera: A camera has a very peculiar type of construction. A convex lens is placed in front of the dark room of a camera. A film is tightened at the back side of the convex lens. To transmit a light beam into the camera an aperture is used. The diameter of the aperture can be changed depending on the intensity of light and speed of the film. Light this is coming from the object incident upon the film and forms an inverted virtual image. The list of various types of cameras and how they are used has been discussed in the above paras. Various types of cameras and used to take various types of photos like still photos, moving object photos, objects inside the water etc.

12.6 Teleprinter:

A teleprinter is an electromechanical typewriter that can be used to communicate typed messages from one point to another point and also from a point to multi points over a variety of communication channels that range from a simple electrical connection, such as a pair of wires, to the use of radio and microwave as the transmission medium. They could also serve as a command line interface to early mainframe computers and minicomputers, sending typed data to the computer with or without printed output, and printing the response from the computer.Teleprinters are now largely obsolete, though they are still widely used in the aviation industry and variations called Telecommunications Devices for the Deaf (TDDs) are still used by the hearing impaired for typed communications over ordinary telephone lines.

12.6.1 Uses of Teleprinter:

- Leased line and radioteletype networks arranged in point-to-point and / or multipoint configurations to support data processing applications for government and industry such as integrating the accounting, billing, management, production, purchasing, sales, shipping and receiving departments within an organization to speed internal communications.
- Message switching systems was an early form of E-mail, done with electromechanical gear
- Broadcast systems such as weather information distribution and "news wires".
- "Loop" systems, where anything typed on any machine on the loop printed on all the machines. Police departments used such systems.
- Computers used teleprinters for input and output from the early days of computing.

12.6.2 Obsolescence of Teleprinters:

- Teleprinters are in obsolete due to use of the fax, personal computer, inkjet printer, broadband, and the Internet.
- In the 1980s, more sophisticated electronic devices came into existence which has replaced teleprinters.
- Home or laptop computer replaced teleprinters, as they are more sophisticated, save money, time and paper.

12.6.3 Working of Teleprinter: Teleprinter can operate in either the simplex or the duplex mode at speeds up to 75 Bauds, and is compatible with the majority of teleprinters and circuits now in service. Each character is printed as soon as it is received by type bars carried in a type basket which moves to and fro in front of the stationary paper carriage. A range of additional optional features is available to enable the machine to be used in specialized high-speed telecommunications and data processing applications. The machine has been designed to operate continuously for long periods and to function reliably with the minimum of maintenance attention. With suitable lubricants and ribbon, it will remain serviceable at temperatures within the range -25C to +50C. The Model 444 is basically a 5-unit, start-stop, two shift machines operating on International Telegraph Alphabet No 2, no provision has been made for third shift and there are no longer 6-unit machines.

12.7 RADAR:

Radar is an object-detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. The radar dish or antenna transmits radio waves or microwaves which bounce off any object in their path. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the transmitter. Radar was secretly developed by several nations before and during World War II. The term RADAR was coined in 1941 by the United States Navy which means RAdio Detection And Ranging.

12.7.1 Uses of RADAR: The modern uses of radar are highly diverse as they are used in air traffic control, radar astronomy, air-defense systems, antimissile systems; marine radars to locate landmarks and other ships; aircraft anti-collision systems; ocean surveillance systems, outer space surveillance and rendezvous systems; meteorological precipitation monitoring; altimetry and flight control systems; guided missile target locating systems; and ground-penetrating radar for geological observations. High tech radar systems are associated with digital signal processing and are capable of extracting objects from very high noise levels.

The first use of radar was done for military a purpose that is to locate air, ground and sea targets. This evolved in the civilian field into applications for aircraft, ships, and roads. In aviation, aircraft are equipped with radar devices that give warning on any obstacles in the path.

Marine radars are used to measure the bearing and distance of ships to prevent collision with other ships, to navigate and to fix their position at sea when within range of shore or other fixed references such as islands, buoys, and lightships. In port or in harbour, vessel traffic service radar systems are used to monitor and regulate ship movements in busy waters. Police forces use radar guns to monitor vehicle speeds on the roads.

Meteorologists use radar to monitor precipitation. It has become the primary tool for short-term weather forecasting and to watch for severe weather such as thunderstorms, tornadoes, winter storms, precipitation types, etc. Geologists use specialised ground-penetrating radars to map the composition of the Earth's crust.

12.7.2 Working of RADAR: A radar system has a transmitter that emits radio waves called radar signals in particular direction. When these come into contact with an object they are usually reflected or scattered in many directions. Radar signals are reflected especially well by materials of considerable electrical conductivity-especially by most metals, by seawater, by wet land, and by wetlands. Some of these make the use of radar altimeters possible. The radar signals that are reflected back towards the transmitter make radar work. The reflected radar signals captured by the receiving antenna are usually very weak; these signals can be strengthened by electronic amplifiers. More sophisticated methods of signal processing are also used in order to recover useful radar signals.

The weak absorption of radio waves by the medium through which it passes is what enables radar sets to detect objects at relatively long ranges-ranges at which other electromagnetic wavelengths, such as visible light, infrared light, and ultraviolet light, are too strongly attenuated. Such things as fog, clouds, rain, falling snow, and sleet that block visible light are usually transparent to radio waves. Certain radio frequencies that are absorbed or scattered by water vapor, raindrops, or atmospheric gases (especially oxygen) are avoided in designing radars except when detection of these is intended. Radar relies on its own transmissions rather than light from the Sun or the Moon, or from electromagnetic waves emitted by the objects themselves.

12.8 Television:

John Logie Baird gets the credit of inventing the Television. He demonstrated moving images in 1926. Baird transmitted the first televised pictures of moving objects in 1924, the first televised human face in 1925, and the first real-time moving object in 1926. But it was electronics inventor Philo Farnsworth who is credited with inventing the first completely electronic television. In 1927 Farnsworth transmitted a television image comprising 60 horizontal lines--double the resolution achieved by Baird.

Television (TV) is a telecommunication medium for transmitting and receiving moving images that can be monochrome (black-and-white) or colored, with or without accompanying sound. "Television" may also refer specifically to a television set, television programming, or television transmission.

TV was commercially available since the late 1920s. The television set has become commonplace in homes, businesses and institutions, particularly as a vehicle for advertising, a source of entertainment, and news. Since the 1970s the availability of video cassettes, laserdiscs, DVDs and now Blue-ray Discs, have resulted in the television set frequently being used for viewing recorded as well as broadcast material. In recent years Internet television has seen the rise of television available via the Internet, e.g. iPlayer and Hulu.

The broadcast television system is typically disseminated via radio transmissions on designated channels in the 54-890 MHz frequency band. Signals are now often transmitted with stereo or surround sound in many countries. Until the 2000s broadcast TV programs were generally transmitted as an analog television signal, but in 2008 USA started using digital mode.

A standard television set comprises multiple internal electronic circuits, including those for receiving and decoding broadcast signals. A visual display device which lacks a tuner is properly called a video monitor, rather than a television. A television system may use different technical standards such as digital television and high-definition television. Television systems are also used for surveillance, industrial process control, and guiding of weapons, in places where direct observation is difficult or dangerous.

12.8.1 Use of Television for Communication of Information in India:

The televisions are considered as potential vehicle for disseminating agricultural technology information. Indians had it in 1959ith the objective for assessing the value of different education TV programmers suitable for group viewing in rural and urban communities. Television was first demonstrated in India in 1965 at an industrial exhibition.

1. TV was first used in those days for transmitting programs designed for community viewing such as "responsibility of citizenships which include traffic and road sense, danger to community health etc.
2. It was then used for the community viewing experiment to school or educational television, which was launched in Oct, 23, 1961 in Delhi schools.
3. From April 1965, television general service was increased to one hour, four days a week.
4. A daily transmission of krishi Darshan Programme for better farming precautions was introduced from January 26. 1967.

TV now a days has become an important item in every house. It can be used in various ways. Children use it to play video games; adults like to update themselves with the news and ongoing events. Youth love to see various games and the house wives try to entertain themselves with programs like cooking, serials etc. An electronic device has many uses if it is rightly used and if it is misused it can not only harm the household but also the whole society.

The countries second television center came up at Bombay on October 2, 1972. It was quickly followed by Sringar, Amritsar in 1973; Calcutta, Madras and Lucknow in 1975 but from August 1, 1975 Doordarshan undertook an historic and a unique steps forward.

The country's most exciting and ambitious project was started by Doordarshan was started by the satellite instructional television experiment popularly known as SITE. In the beginning, Doordarshan formed a part of all India Radio outfit. But on April 1, 1976, Doordarshan was made an independent department of the ministry of information and Broadcasting. Unit 1982 television in India has not gone colour. From August 15, 1982 colour was introduced. Between 1980 and 1984 several new high power transmitters and low power transmitter's area and are assessable to the Annual Report of information and Broadcasting Ministry.

Doordarshan now has several channels. DD1 is the National channel available all over the country on certain fix hours. Dd2 and DD3 are also available. There are regional channels for putting out programmers in the 13 regional languages. Krishi Darshan is the oldest well established and the best known program for the rural area and farmers. The basic objective of the program is to familiarize the rural audience with the latest technical and scientific know how about the farming practices, rural development programs, to acquaint the viewers with the importance of health, family planning, sanitation, etc. Now in these days with the introduction of cable, dish and many other means of communication and entertainment TV is widely used by all communities of the society.

12.9 Satellites:

Satellite is an object which has been placed into orbit by human endeavour. Such objects are sometimes called artificial satellites to distinguish them from natural satellites such as the Moon. The world's first artificial satellite, the Sputnik 1, was launched by the Soviet Union in 1957. Since then, thousands of satellites have been launched into orbit around the Earth. Artificial satellites originate from more than 50 countries and have used the satellite launching capabilities of ten nations. A few hundred satellites are currently operational, whereas thousands of unused satellites and satellite fragments orbit the Earth as space debris. Space stations and human spacecraft in orbit are also satellites. Satellite orbits vary greatly, depending on the purpose of the satellite, and are classified in a number of ways.

12.9.1 Uses of Satellites:

Satellites are used for a large number of purposes. Common types include military and civilian Earth observation satellites, communications satellites, navigation satellites, weather satellites, and research satellites. Satellites are usually semi-independent computer-controlled systems. Satellite subsystems attend many tasks, such as power generation, thermal control, telemetry, attitude control and orbit control.

Satellites can be classified by their function since they are launched into space to do a specific job. Below are the names of nine different types and Uses of satellites:

- Atmospheric Studies satellites - Polar
- Astronomy satellites - Hubble Space Telescope
- Communications satellites - Anik E
- Navigation satellites - Navstar
- Reconaissance satellites - Kennan, Big Bird, Lacrosse
- Remote Sensing satellites - Radarsat

- Search and Rescue satellites - Cospas-Sarsat
- Space Exploration satellites - Galileo
- Weather satellites - Meteosat

12.9.2 Types of Satellites:

- Anti-Satellite weapons/"Killer Satellites" are satellites that are designed to destroy enemy warheads, satellites, other space assets.
- Astronomical satellites are satellites used for observation of distant planets, galaxies, and other outer space objects.
- Biosatellites are satellites designed to carry living organisms, generally for scientific experimentation.
- Communications satellites are satellites stationed in space for the purpose of telecommunications.
- Miniaturized satellites are satellites of unusually low weights and small sizes. They are used in many ways.
- Navigational satellites are satellites which use radio time signals transmitted to enable mobile receivers on the ground to determine their exact location.
- Reconnaissance satellites are Earth observation satellite or communications satellite deployed for military or intelligence applications. Very little is known about the full power of these satellites, as governments who operate them usually keep information secret.
- Earth observation satellites are satellites intended for non-military uses such as environmental monitoring, meteorology, map making etc.
- Tether satellites are satellites which are connected to another satellite by a thin cable called a tether.
- Weather satellites are primarily used to monitor Earth's weather and climate.[14]
- Recovery satellites are satellites that provide a recovery of reconnaissance, biological, space-production and other payloads from orbit to Earth.
- Manned spacecraft (spaceships) are large satellites able for put human into (and beyond) an orbit, being on it and recovery back to Earth. Spacecrafts, and orbital parts-space planes of reusable systems also, has a major propulsion or landing facilities, and often uses as transport to and from the orbital stations.
- Space stations are man-made orbital structures that are designed for human beings to live on in outer space. Space stations are designed for medium-term living in orbit, for periods of weeks, months, or even years.

12.10 Various communication means available in India are:

Communication is the sending and receiving of spoken or written messages between people and places. Letters are the most common means of communication. Other means of communication which are not discussed above are telegram, telex, fax, e-mail, newspapers, etc. Now we send message by electronic-mail (e-mail) and the internet to any part of the world on the computers. The internet is a worldwide computer network, by which a user can connect his computer to another computer in any part of the world. E-mail is a very inexpensive means of communication. The letter, telephone and e-mail are personal means of communication i.e. they are used as means of communication between individuals.

When we have to communicate with a big group of people, or many people at one time, we have to use means of mass communication Newspaper, radio or television, etc., are means of mass communication. A newspaper has something for everybody. It gives opinions, information and news of interest from every corner of the world. In India, newspaper and magazines are published in English and regional languages. Every means of communication is useful in its own way. Together, they help us keep in touch with our friends, relatives and the world.

12.10.1 INSAT:

INSAT is one of the latest means of communication system. A total communication revolution has begun in the whole nation through INSAT networking system connecting for the first time even remote areas and offshore islands of 150,000 route kms with the main stream. All total 133 telecommunication terminals operating in the INSAT network cover about 5000 two way speech circuits over 170 routes.

12.10.2 Use of INSAT:

1. Various' specialized communication service systems like PTI news service, facsimile transmission and emergency communication for relief operations for disaster affected areas have been successfully operated through INSAT.
2. For cyclone forecast in coastal areas, over 250 disaster warning receivers have been installed which are connected with specific Disaster Warning System (DWS) through INSAT network and are able to save thousands of people by forecasting the cyclone.
3. 100 hours of TV educational program per month covering 4000 schools and colleges has been further increased by use of INSAT system.
4. INSAT can help to impart training, developmental communications and distance education to the Open University students.
5. Now INSAT has been advantageously used for a variety of applications.
6. Communication links are now possible between industries located in major metropolitan cities and their branch offices spreading throughout the country with the operation of the Remote Area Business and Message Network (RABMN) through INSAT.
7. The National Information Centre Network (NIC NET) operating over 700 stations is able to provide reliable data communication links interconnecting district headquarters, State capitals and the Central Government through INSAT.

8. Another unique approach of INSAT operation is the Talk-Back facilities, experimentations for providing relevant educational instructions to social workers, village teachers, agricultural communities, panchayat officials and Open University students.
9. INSAT technology is helpful in multimedia services.
10. GRAMSATS program is running successfully for dissemination of language and regional and specific education even to remote areas with the introduction of mobile communication in INSAT -2C.

Hence, with the successful launch of INSAT system, the country is now fully poised to become an integral part of the global information super-highway.

12.11 Self Assessment Questions:

1. Explain the various means of communication systems in modern world.
2. What are the uses of Satellites?
3. Define RADAR.
4. How radio is used as an effective means of entertainment and communication?
5. Television is an effective mode of visual entertainment - discuss.
6. Telephone is a common mode of communication - discuss.
7. Write an essay on significance of wireless in telecommunications.
8. Give an account of working of teleprinters.
9. What is a satellite? How it helps in the field of communication?

Lesson Writer

Dr. M. Syamala

Lesson - 13.I

HYBRIDIZATION

Objective:

- To gain knowledge about the process of hybridization
- To know the advantages and disadvantages of hybridization
- To understand role of hybridization in evolution

Structure:

13.I.1 Introduction:

Genetics is the branch of science dealing with the inheritance of parental characters to off spring. The branch was identified by Gregor Mendel. He proposed his Laws of inheritance after performing experiments with a garden pea plant Pisum sativum. The primary basis for the inheritance of characters is the presence of genes over chromosomes located in the nucleus of the cells. The cells are of two types (a) Somatic cells for body construction and (b) Germ cells for reproduction. It is through these germ cells viz., eggs from female and sperm cells from male, the characters are transmitted.

Generally, fertilization occurs among the individuals of the same species. Experimentally it is proved that new species can be produced by crossing individuals having similar number of chromosomes.

13.I.2 Definition:

Hybridization is the crossing between the individuals of populations having different adoptive genes on their chromosomes (A population is one with a number of same types of individuals living in a particular area). Such organisms having different adoptive genes are called as races or sub-species. The resultants are called hybrids.

Cross between such organisms brings out aggregation of both the parents in the off spring. Hybrids produced here may not successfully live in that environment. But nature is not stationary. In the changing environment, the new hybrid may grow vigorously adopting itself and may yield high produce. Hybridization may be natural or artificial.

13.I.3 Examples:

Pennisetum typhoidium is the Sorghum plant (Sajja). It yields high but it is easily susceptible to diseases. It is not a resistant variety. Pennisetum purpureum is a grass plant with high resistance against diseases. When a cross is made between these two plants new hybrids are produced which yield more and are highly resistant against diseases.

Pennisetum typhoideum X Pennisetum purpureum

(Sajja) (Grass)

↓

High yielding hybrid

In the same way Eqqus cabalus is the horse which can run fastly. Eqqus asinus is the ass which is a good weight carrier. When these two individuals are crossed a new sterile mule (Zebra Kanchara Gadida) is produced, which is both a runner and weight carrier.

Eqqus cabalus X Eqqus asinus

↓

Eqqus Zebra

The present day domesticated plants and animals like cotton, mustard, dogs, chicks, rabbits etc., are the hybrids obtained from careful selection and artificial hybridization between wild type organisms. G.H. Shull, a geneticist presumed that the hybrids are strong resistant and highly productive. This is due to the hybrid vigour developed due to the combination of genes of two different organisms. Self fertilization yields weak non-resistant individuals. Hence marriages between the members of the same family (Menarikams) are not advised now a days.

At the same time cross fertilization leads to a healthy population with high yielding capacity. Present day food problem is faced successfully using these hybridization techniques. The new hybrids easily adapt to the changing environment as they have the genes of both the parents. For example, Zea mays (Maize) contains some useful genes of a weedy Zea mexicana to grow successfully in the environment.

13.I.4 Hybridization and Polyploidy:

Hybridization followed by chromosomal doubling may yield polyploidy plants.

i) Present day horse Eqqus cabalus is the progeny of the wild horses living in the world.

ii) The new world cotton Gossypium is a polyploidy derived by hybridization between wild variety viz., Gossypium arboretum, G. herbaceum, G. hirsutum and G. barbedense etc.

iii) Cross between cabbage Brassica oleracea and raddish Raphanus sativus yield a new plant Raphanobrassica.

iv) Cross between lion and tiger yields liger. Dot is the one produced by a cross between dog and cat. Triticale is the plant derived from a cross between wheat and a rye plant.

A number of high yielding paddy varieties of cereals, cotton, sugarcane, pulses, maize etc. are developed on the same principle of hybridization. Hence hybridization helps not only in productivity but also enhances resistance against diseases. Besides individual nature, it leads to the development and betterment of the society.

13.I.5 Drawbacks:

Hybrids generally are sterile

Genes are highly heterozygous

13.I.6 Advantages:

Besides these drawbacks, a number of advantages are there with hybridization.

i) A number of new resistant varieties of crops giving good yield are the result of the hybridization techniques.

ii) Hybridization brings superior characters like high yield, good seed, disease resistance, disease resistance etc. into a single variety.

iii) Hybridization results in the production of more vigorous and better adopted variety.

13.I.7 Disadvantages:

i) It is a technical procedure which can be adopted only by experienced plant breeder

ii) It is a tedious time consuming and expensive procedure

iii) It produces sterile hybrids in certain plants

13.I.8 Hybridization and Evolution:

Hybridization generally brings about populations which are intermediate between the two parental organisms. But it promotes the origin of new characters also by three ways.

i) Transgressive segregation where the hybrids superior than both the organisms. Ex: Nicotiana alata (Tobacco) X N. longidorffi ((Tobacco with small flowers). Hybrids with larger flowers than both the above plants.

ii) Hybridization establishes new genetic composition for the development of a new species. Mutations occurred and rejected in the parental organisms may get adopted in the new genetic background.

iii) Hybrids may stimulate the occurrence of new mutations (Mutation is a sudden change occurring in the gene. It may be useful or dangerous)). Thus the rate of mutations increases.

13.I.9 Summary:

Hybridization is the crossing between the individuals of populations having different adoptive genes on their chromosomes (A population is one with a number of same types of individuals living in a particular area). Such organisms having different adoptive genes are called as races or sub-species. The resultants are called hybrids. Hybridization may be natural or artificial. There are many examples of successful hybrids are obtained. Hybridization followed by chromosomal doubling may yield polyploidy plants. A number of high yielding paddy varieties of cereals, cotton, sugarcane, pulses, maize etc. are developed on the same principle of hybridization. Hence, hybridization helps not only in productivity but also enhances resistance against diseases. Besides individual nature, it leads to the development and betterment of the society. Hybridization generally brings about populations which are intermediate between the two parental organisms. But it promotes the origin of new characters also by three ways such as transgressive segregation, and mutations.

13.I.10 Technical Terms:

Hybridization

Cross Fertilization

Polyploidy

Hybrid Vigour

Chromosomal Doubling

Transgressive Segregation

Mutations

13.I.11 Self Assessment Questions:

1) What is meant by hybridization? Describe its role in plant breeding and animal husbandry.

Lesson - 13.II

GREEN REVOLUTION

Objective:

- To gain knowledge about green revolution

Structure:

13.II.1 Introduction:

Norman Borlog, a Mexican was the first man to raise this slogan of green revolution and is recognised to be the father of Green Revolution. He was awarded the Nobel prize for his outstanding contribution in this direction in the field of agriculture. Mexico, Philippines, Thailand and Ceylon presently Srilanka were successful in achieving their goal in agricultural outputs by implementing this programme. At present it is the symbol of high food production to meet the challenges of starvation arising from the increasing population. It has revolutionized the old and traditional operations in agriculture, and brought an era of plenty of prosperity.

13.II.2 Definition:

Green revolution is the name given to the massive effort to bring about a many fold increase in food production by using the scientific advancements, sophisticated equipment and technical assistance that is available on hand i.e., using high yielding seeds, artificial fertilizers, water and power. It became a successful one because of advancement occurred in Botany, Chemistry and Physics. Hence, one should have a brief idea on Botany, Chemistry, Mechanics and other allied Sciences.

13.II.2.1 Botany: It is that branch of science which deals with plants. It reveals the structure of plants, their nature, the productivity, the physico-chemical conditions required for their normal growth etc. Science of Ecology explains the influence of environment over crops. Through this, the nature of soil, type of plants that can be grown in that soil can be known. Genetics and plant breeding reveal the life span of various plants. Hence this brash helps in selecting types of seeds to be sown in the soil.

13.II.2.2 Chemistry: Metabolic activities occurring in plants are the chemical processes occurring systematically. Hence they are called Biochemical activities. The knowledge of Biochemistry helps in understanding the chemical nature of the plants, their growth patterns yielding capacity and nutrient value of the yield. The type of fertilizers to be used, pesticides, insecticides and their effect in regular metabolism besides killing the pests and insects of dangerous nature, soil texture etc., through which it will be possible to select best varieties available to be grown in our area.

13.II.2.3 Mechanics: Use of modern agronomical instruments depends upon the knowledge of their functioning. A number of new instruments are introduced for every step in agriculture. Spraying of fertilizers, pesticides, insecticides is done now a days through helicopters in developed countries. Through mechanics, one can learn to use mechanics and high technology efficiently.

13.II.2.4 Other Related Sciences: Knowledge about irrigation, water conservation and environmental science is also necessary for achieving better results.

Usage of hybrid varieties, proper management of water supply, spraying of insecticides and pesticides, implementing modern machines, storing the produce in granaries etc., constitute various steps in green revolution.

13.II.3 Green Revolution - A Fact in India:

India, once called the Annapurna, which was a food exporting country up to 1945, was with begging bowl seeking charity to feed its ever increasing population after independence. Perennial food storage was mainly due to the partition followed by increasing growth of population.

In such a disastrous condition, the Government thought of spending its resources to attain self-sufficiency in food during the plan concerned. Drought and floods during second Five year plan, and concentration over the development of heavy industries led to the food crisis again. The production was about 68 million tons as against the requirement of 92 million tons. India was compelled to import food grains from America to Third Five year plan under PL - 480 scheme (Food for peace programme). Then the slogan of Green Revolution was raised. Due to this new strategy, food production crossed 108 million tons in 1970. During implementation of the programme, massive efforts were made to revolutionize the process of farming. New Dwarf variety of seeds were used. They showed good response to chemical fertilizers. Improved irrigation and usage of one of the variety of rice developed by International Rice Research Institute resulted in 6 fold increase in the yield.

13.II.4 Results of Green Revolution in India:

i) By using new methods of production in rice popular varieties viz., Vijaya, Newsabarmathi, Krishna, Ratna Bala, Padma, Kawvery, pusa, Jaya etc. are produced. Besides rice, India achieved overwhelming procedure in Mexico dwarf varieties like Hirum rust resistant seeds like Moti, Shera, Pusa, Terma were developed by Indian scientists in their research labs.

ii) Besides new varieties of seeds in Jowar, Maize, Bajra, Ragi, Barley, Cotton, Sunflower, Soyabean and Coconut were also developed.

iii) To meet the needs of these new varieties, irrigation facilities were improved. Large amounts of synthetic fertilizers were produced and supplied. Pesticides were sprayed. High yielding varieties, multiple cropping programme involved a tight schedule of various farming operations, use of tractors, power operated motors increased production by the implementation of these schemes. Food production crossed 121 million tons in 1977-78.

iv) During the past 10 years the production has gone so high that now we are able to export again certain amounts of food grains besides meeting the needs of our society. Even though there were three successive droughts since these years prevailed, we never faced shortage of food grain.

13.II.5 Problems of The Green Revolution in India:

In spite of the green revolution, the agricultural productivity in India per hectare as well as per worker is very low when compared with the advanced countries. The problems faced in India are

i) Over Crowding: The important reason in agriculture is over crowding. This makes the cultivated land per cultivator very low. That is there are too many people depending on agriculture. Its production may not go down even if some of them are kept in some other jobs.

ii) Conservative Type: The Indian cultivators are illiterate and ignorant. Hence they are very conservative. They do not rise up to the occasion to consider the economic progress in cultivating the land. They do not also grow different crops.

iii) Facilities: The non-form services such as finance, marketing and storing facilities are very inadequate to the farmers.

iv) Uneconomic Holding: The average holding in India is very small. So it is uneconomic since the cultivar could not profitably use improved implements, seeds and methods of cultivation.

v) Land Tenure: The position of the tenants is unsatisfactory. The existing conditions and practices of land tenure do not provide the necessary incentive to improve cultivation and productivity.

vi) Techniques of Production: The techniques of production are outmoded. So, they are not effective. The cultivators do not systematically use farm yard manure and chemical fertilizers. Hence their use is extremely inadequate.

vii) Inadequate Facilities: The farmers are not provided, adequate irrigational facilities even after the expansion after independence. The measures of land reforms failed to achieve the objectives.

viii) Due to application of machines displacing labour, the landless labourers are hard hit. So the government is not able to have alternate employment opportunities.

In spite of the above problems, dramatic change through the implementation of Green revolution increased our food reserves and we have achieved self sufficiency.

13.II.6 Summary:

Norman Borlog, a Mexican was the first man to raise this slogan of green revolution and he is recognised to be the father of Green Revolution. He was awarded the Nobel prize for his outstanding contribution in this direction in the field of agriculture. Green revolution is the name given to the massive effort to bring about many fold increase in food production by using the scientific advancements, sophisticated equipment and technical assistance that is available on hand i.e., using high yielding seeds, artificial fertilizers, water and power. It became a successful one because of advance researches which have occurred in Botany, Chemistry and Physics. By using green revolution in India many high yielding varieties are developed. In spite of the green revolution, the agricultural productivity in India per hectare as well as per worker is very low when compared with the advanced countries due to some problems such as overcrowding, uneconomic holding, inadequate facilities etc. In spite of the above problems, dramatic change through the implementation of Green revolution increased our food reserves and we have achieved self sufficiency.

13.II.7 Technical Terms:

High Yielding Varieties

Multiple Cropping Programme

Artificial Fertilizers

Botany

Chemistry

Mechanics

Over Crowding

Uneconomic Holding

Inadequate Facilities

13.II.8 Self Assessment Questions:

1) Give an account on green revolution.

Lesson - 13.III

ARTIFICIAL INSEMINATION

Objective:

- To gain knowledge about the process of artificial insemination
- To study different steps involved in successful implementation of artificial insemination.
- To know about the uses of artificial insemination

Structure:

13.III.1 Introduction:

Man is a social being. He is living in an advanced society where he is able to implement the advanced and recent outputs of scientific investigation in the way he is benefited. Cross fertilization among plants and animals yield better variety of productive variety of organisms. But in this if one good variety is present in one place and another is present in some other place, he is bound to take either of it for yielding good varieties. He could successfully tide over this problem when the phenomenon of artificial insemination was made possible.

13.III.2 Definition:

Artificial insemination is the process in which sperm cells or semen collected from one individual is artificially injected into the vagina of the female. The potential germ cells of the semen could fertilize the eggs and could yield the same good productive variety as obtained in hybridization.

13.III.3 History:

Something about artificial insemination is known in the early days of this century, but it is well studied and practically implemented in large scale only after 1950's. In this process, semen from male organisms is collected and stored in deep freezers. Potential germ cells of the semen lie in hybernative or restive stage, but they never die. Whenever the semen is to be utilized, it is taken into an instrument called 'Insemination gun' and then injected into the vagina of the female individual. The phenomenon has got world wide importance by which high yielding chicken, cattle etc. are obtained.

13.III.4 Steps for Successful Implementation of Artificial Insemination:

Artificial insemination is a laborious process and one must be careful in manipulating the process.

i) Collection of semen: An artificial vagina is used to make males ejaculate the semen. Such ejaculated semen is temporarily kept in this artificial vagina.

ii) Nature of semen: One must know about the nature and characteristic features of semen collected using various modern instruments. Then diluters are added to the semen before it is kept in deep freezers. The diluters help in storing the sperm cells without decay or degeneration.

iii) Storage: The third step is storage. The sperm cells thus collected are kept in sterilized bottles, added with diluter and placed in deep freezers. To store the semen for longer times in cold conditions, liquid nitrogen is being used as storing liquid at 196oC. At this temperature they are carried to different places in hygienic conditions only.

iv) Insemination: Before the stored semen is actually introduced into the vagina of female, one must see whether the female is in heat or not. When it is confirmed that the female is in heat, insemination is done with the help of a well sterilized insemination gun. The sperm cells thus entered vagina develop into embryos.

The making use of this phenomenon can easily be crossed to get fertile semen from selected variety of various individuals.

13.III.5 Uses of Artificial Insemination:

i) Artificial insemination has a great value. It prevents the spreading of diseases through male by implementing these in controlled conditions and under supervision of a specialist.

ii) Selection of both the sexes is possible. Semen from these organisms can only be collected and artificially inseminated. This yields healthy productive variety.

iii) Even if a single male is selected as a good variety, 3000-5000 doses of semen can be collected from the selected one in a year. Thus about 5000 selected females distributed all over the world can be inseminated. This yields best variety of offspring in a short span.

iv) Using artificial insemination, hybridization is made possible between races, species of individuals to get hybrid varieties.

v) It is possible to store the semen over years when a good male is selected. Even if the male dies, its semen collected early can be utilized in future.

vi) At present semen from selected Ongole bull is being collected by different countries to be used in artificial insemination.

13.III.6 Artificial Insemination in Human Beings:

The same process is extended even to human beings now a days. When the man is potent but could not participate in sexual intercourse, his semen is collected by masturbation, and then injected into his wife's vagina. Thus she can be made pregnant when the inseminated sperm cells fertilize the eggs. This is called A.I.H. (Artificial Insemination from Husband). When the man is impotent and still wants to become father, semen from donors is collected and artificially inseminated. This is called A.I.D. (Artificial Insemination from Donor). When both man and woman are unable to get the children for various reasons due to the closure of fallopian tubes, irregular menstruation, fatty body, blockage of sperm ducts etc. semen from husband and egg from the wife are collected into a test tube where the fertilization occurs. Then the fertilized ovum is again introduced and carefully implanted in the uterus of females where it develops into adult. This is what is called 'Test Tube Baby'. This was successfully done by two doctors namely Edwards and Steptoe.

Now a days sperm banks are coming up in Western countries where sperm from donors is accepted collected and stored to be supplied to those who need it.

13.III.7 Summary:

Artificial insemination is the process in which sperm cells or semen collected from one individual is artificially injected into the vagina of the female. The potential germ cells of the semen could fertilize the eggs and could yield the same good productive variety as obtained in hybridization. Something about artificial insemination is known in the early days of this century, but it is well studied and practically implemented in huge scale only after 1950's. Steps for successful implementation of artificial insemination include collection of semen, understanding nature of semen, storage and insemination. Artificial insemination is having many uses. Now a days sperm banks are coming up in Western countries where sperm from donors is accepted collected and stored to be supplied to those who need it.

13.III.8 Technical Terms:

Insemination

Artificial Insemination from Husband

Artificial Insemination from Donor

Test Tube Baby

Sperm Banks

13.III.9 Self Assessment Questions:

1) Describe the artificial insemination. Discuss its uses.

Lesson Writer
Dr. T. Srivalli

Lesson - 14.I

FERTILIZERS

Objective:

- To gain knowledge about different fertilizers used to crop plants.
- To know about the typeas of fertilizers and their uses.

Structure:

14.I.1 Introduction:

Food is the source of energy. This food is obtained by animals either from plant or animal sources. Plants synthesize food material making use of solar energy from sun, carbon di oxide from atmosphere, water and minerals from soil they grow. Continuous usage of land for cropping decreases the amounts of minerals in the soil. Such soils become sterile if the minerals are not substituted. Fertilizers can substitute such loss. Usage of these fertilizers in regular fashion increases the productivity of the soil. Thus, the sterile lands can be made fertile by supplying the deficient elements artificially in the form of fertilizers.

14.I.2 Definition:

Fertilizers are food materials for the plants to grow, to synthesize food materials and to reproduce. They substitute the soil minerals that are used up. They increase the productivity of the soil. They may be in the form of solid, semisolid slurry, pure liquid or gas. Plants absorb these fertilizers through their root

system. They are in the form of soluble major elements viz., Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulphur and mineral elements viz., Manganese, Copper, Boron, Molybdenum, and Chlorine etc.

14.I.3 Important Elements in The Fertilizers:

For the proper growth of the plant mineral nutrients are required. These minerals are two types macronutrients and micronutrients. Macronutrients are required in large quantities and mineral nutrients are required in small quantities. If any of the mineral is deficient, the crops show deficiency symptoms. In order to the plant properly, minerals should be given directly to the plants in the form of fertilizers. Nitrogen, Phosphorus and Potassium are the three important ingredients of the fertilizers. They are available as Ammonia, Nitrates, Potash, Phosphates in the marked under different commercial names.

14.I.4 Types of Fertilizers:

There are three types of fertilizers available. They are Live fertilizers, Natural Manures and Commercial or synthetic fertilizers. In addition to these mixed fertilizers and biological fertilizers are also used.

14.I.4.1 Live Fertilizers: Blue green algae like Nostoc and Anabaena, Bacteria like Rhizobium, Azetobacter and Clostridium are generally called nitrogen fixing organisms. They fix the atmospheric nitrogen in the form of nitrates and make it available to plants. Thus their presence increases the fertility of the soil. Cereals and pulses belonging to the family Leguminosae possesses root nodules which in turn which in turn possesses their nitrogen fixing bacteria. Thus these crops are recommended as alternative crops in agriculture. They yield good productivity and also increase the available nitrogen in the form of nitrates. Now a days, these algae cells are supplied to the farmers in the form of live fertilizers.

14.I.4.2 Natural Manures: These are synthesized and made available to the crops by nature. Manures are mainly composed of organic minerals. They are available in the form of animal dung, bird guano and rotted plant and animal bodies as compost. They improve the texture of the soil and replace the used up chemicals. Bacterial decomposition of plant and animal tissues release more amounts of nitrogen in the form of nitrates. Cattle dung, poultry droppings, stored in artificial ponds are acted upon by bacteria to release nitrogen. The plant and animal wastes are recycled in this way. Organic fertilizers provide small amounts of growth elements and serve as conditions for the soil.

14.I.4.3 Commercial or Synthetic Fertilizers: These are the fertilizers with inorganic components. Nitrogen, Phosphorus and Potassium are the three important inorganic elements on which plants largely depend upon. They are the primary elements. They are supplied artificially by these commercial fertilizers.

Growing plants can absorb fertilizers in mixed state only. Some specially designed fertilizers dissolve slowly in the soil, thus provide continuous supply of the elements to the plants. UAN solutions are also sprayed directly over the plants by farmers. They enter the plant system through stomata.

Nitrogen Fertilizers: Yields of the crops are governed by nitrogen. Rotation of main crops with leguminous plants like cicer, clover, alfalfa provide sufficient amounts of fixed nitrates. As already studied, farmers are supplied with algal fertilizers which provide nitrates directly. Ammonium sulphate, Ammonium trinitrate and anhydrous ammonia are the nitrogen fertilizers.

Phosphate Fertilizers: Phosphorus is the second important element for farming. This is supplied in the form of bone powder devoid of important chemicals. Superphosphate and triple super phosphate are manufactured by treating rock phosphate with sulphuric acid and phosphoric acid respectively. Extensive root system and early ripening depend upon phosphates.

14.I.4.4 Mixed Fertilizers: The composition of the fertilizer mixtures is identified by N, P, K code, where N is element nitrogen, P is the anhydride of Phosphoric acid (P2O2), K is the oxide of Potassium (K2O). Thus formula 17-17-17 means all the three components viz., nitrogen, phosphorus and potassium are in equal per cent by weight to give a product of 51 fertilizer units. None of the N-P-K formulas totals 1000 nutrients. Free water, water content of the hydrated compounds, traces of sodium, silica, chloride, sulphate etc. impurities and other inert materials called ballast can be traced from the analysis of fertilizer. Aqueous solutions of urea, ammonia and ammonium nitrate (UAN) are also used in the preparation of NPK fertilizers by mixing them with super phosphates and triple super phosphates. N, P, K fertilizer solutions of suspensions are the siurris of fine crystals in saturated solutions. They can spread uniformly over the fields and give better dispersion.

14.I.4.5 Biological Fertilizers: The nitrogen fixing bacteria, blue green algae which can fix atmospheric nitrogen are also used as fertilizers.

Fertilizers may be directly sprinkled over the land or sprayed on the form of solutions over foliage. Some plants need at different times. Hence timely usage of them gives good yield.

14.I.5 Useful Effects of Fertilizers:

i) Fertilizers make sterile soil fertile

ii) Usage of these fertilizers in regular fashion increases the productivity of the soil.

Besides useful effects, fertilizers if used without supervision and care, may find their ways to rivers, lakes where they cause damage to the water system by stimulating the growth of certain tiny plants. They are expensive and their manufacture consumes much of fuels, coal and oil. Hence proper management of the fertilizers gives not only good yield but also enriches the soils for blossom growth of plants.

14.I.6 Summary:

Fertilizers are food materials for the plants to grow, to synthesize food materials and to reproduce. They substitute the soil minerals that are used up. They increase the productivity of the soil. They may be in the form of solid, semisolid slurry, pure liquid or gas. Plants absorb these fertilizers through their root system. They are in the form of soluble major elements viz., Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulphur and mineral elements viz., Manganese, Copper, Boron, Molybdenum, and Chlorine etc. Nitrogen, Phosphorus and Potassium are the three important ingredients of the fertilizers. They are available as Ammonia, Nitrates, Potash, Phosphates in the marked under different commercial names. : There are three types of fertilizers available. Live fertilizers, Natural Manures and Commercial or synthetic

fertilizers. In addition to these mixed fertilizers and biological fertilizers are also used. Fertilizers may be directly sprinkled over the land or sprayed on the form of solutions over foliage. Some plants need at different times. Timely usage of them gives good yield.

14.I.7 Technical Terms:

Major Elements

Mineral Elements

Ammonia

Nitrates

Potash

Phosphates

Live Fertilizers

Natural Manures

Commercial or Synthetic Fertilizers

Mixed Fertilizers

14.I.8 Self Assessment Questions:

1) Give an account on fertilizers.

Lesson - 14.II

FERTILIZERS

Objective: The aim of the lesson is to gain knowledge on:

- The insecticides and different insecticides used to protect crops from insects

Structure:

14.II.1 Introduction:

India is a vast country with a large population of 850,000,000 approximately. Till 1945, our country never faced problem of food shortage. Partition followed by increasing population posed great threat to the survival of man himself and acute shortage of food was faced after independence till 1975. By diverging our resources and whole hearted implementation of green revolution, we could increase the food productivity and the standard of living. More new varieties of crops have been discovered and grown. With the increase in the number of crops insect pests have also increased which are destroying the flowers, stems, fruits and at times the whole crop itself. Locusts, beetles, stem borers, leaf folders, termites etc., are the common insects, which are seen in the fields. Number of mosquitoes and flies like anopheles (malaria), culex (elephantiasis), Aldex (yellow fever), psetpse fly (sleeping sickness), sand flies, fruit flies, mango flies transmit diseases and germs from one man to other. To keep the crop away from these insects and to save the man from dreadful diseases, inventions resulted in the production of insecticides or insect killers.

14.II.2 Definition:

Insecticides are the chemical substances used to kill insects and other related organisms which destroy plants and cause damage to the society. Insecticides may be organic or inorganic in nature.

14.II.3 Classification of Insecticides:

Insecticides are classified into two basing on the type of action.

1. Classification based on function
2. Classification based on the nature of the chemical compound.

14.II.3.1 Classification Based on Function: Basing on function the insecticides are classified into 9 types. They may cause stomach poisons, contact poisons, residual poisons, systemic poisons, fumigates, repellents, attractants, insect growth regulators and pheromones. Many of these act in more than one way.

i) **Stomach Poisons:** These are sprayed over plants as they can easily enter the insects through leaves which are chewed by them. When insects eat these plant parts these insecticides will enter into the insect stomach and work as poison.

ii) **Contact Poisons:** These are used directly on the insects piercing the tissues and sucking plant or animal fluids as their food.

iii) **Residual Poisons:** These are sprayed on the aerial plant parts so that insects touching them will pickup large doses of the poison which kill them.

iv) **Systemic Poisons:** These insecticides are sprayed on plants and animals. These organisms absorb this insecticide, and the poisons enter the body system of plants and animals and are carried to different body parts. When insects feed on them, they get heavy lethal doses of the poison and killed.

v) **Fumigates:** These are sprayed as gases or solutions which can evaporate to gaseous state and enter the respiratory system. Ex: Carbon tetrachloride, ethylene dibromide, sulphur dioxide. They are used in food processing units, ware houses, granaries, libraries, ship holds, store rooms. They are applied on stocked bags, stored foods in polythene sheets, trees in order to control scale insects, to destroy weeds, soil infesting insects and nematodes.

vi) **Repellents:** These are applied on the body of the host. Ex: Odomas cream, vaporizers etc., which prevent the insects from reaching their host.

vii) **Attractants:** These will attract the insects. Ex: Bagion bait etc., induce the insects because of their taste to come to specific locations in relations to food sources.

viii) **Growth Regulators:** These disrupt normal growth or development such as control of metamorphosis by juvenile hormones regulation of molting, deposition of chitin in the body wall etc.

ix) **Pheromones:** These substances are produced by female insect to attract male insects.

These substances are highly specific. They can attract the insects and kill them.

14.II.3.2 Classification Based on Nature of Chemical Compound: Basing on the chemical nature the insecticides are divided into two kinds. They are inorganic insecticides and organic insecticides.

i) **Inorganic Insecticides:** Inorganic insecticides like lead acetate, calcium arsenate, copper aceto arsenate, DDT, lindane, aldrin, endosulfan are used as insecticides. Among them lead acetate is more safe.

ii) **Organic Insecticides:** DDT (Dichloro Diphenyl Trichloro Ethane) and lindane are largely used to control the insects till 1968. They were banned in USA and other Western countries as they were found to be long standing in the soils causing harm to any biological system. Resistant strains of insects have developed by their indiscriminate use. So, they are slowly replaced by organic insecticides such as TDE, 2,2 bis (P-chlorophenyl) 1,1-dichloro ethane and Methoxy chlore (trichloro ethane). TDE will control many types of larval forms and methoxy chlore controls house flies.

Development and usage of organo phosphorus insecticides began from 1950. As they are proved to be less toxic to non target organisms like fishes and man organo chlorines are used in place of them. These were well received by public.

14.II.4 Other types of Insecticides:

In addition, to these other types of insecticides such as synthetic carbonate insecticides such as Dimethane, Isolon and insecticides extracted from plants such as Nicotine, Rotenon, Pyrethrins etc., are also used. Nicotine is extracted from Tobacco plant and works as a contact insecticide. Rorenon is an alkaloid extracted from roots of Derris elliptica. Pyrethrin is extracted from the flowers of Chrysanthemum coocirium and it kills house flies.

14.II.5 Available Insect Formulations:

Insecticides are used in the form of dust or emulsions or granular form.

i) **Dust:** They are in the form of powder and are less poisonous.

ii) **Emulsion:** These insecticides will be dissolved in emulsifiers and kept in liquid form. During usage they are diluted with water.

iii) **Granular Form:** The insecticides are available in the form of granules which are used to control the insects attacking the plants.

14.II.6 Application of Insecticides:

Insecticides act on insects and kill them when used in proper times and in proper quantities. Their application should be correlated with the occurrence of insect pests. Insecticides should only be used only when their economic damage is heavy. Indiscriminate use of these insecticides causes environmental pollution.

14.II.7 Uses of Insecticides:

i) By proper application of insecticides on the crop plants, the diseases on the crop can be controlled and helpful in green revolution.

ii) By the use of these insecticides household insects can be controlled and spreading of the diseases can be controlled.

14.II.8 Harmful Effects of Insecticides:

i) Continuous use of insecticides led to the development of resistant varieties.

ii) Through fields, they enter water systems along with rain water. They enter the plant system through stomata or root system. Through water and plants, they may finally reach man who used them to kill insects.

iii) Organophosphates can cause serious diseases such as pulmonary (lung) disorders, dermatitis, irritation, vomiting, diarrhea, kidney failure, cardiac disorders etc.

iv) Large scale use finally leads to the death of the human beings. In smaller quantities when present in water, lead to the mass mortality of fish, crustacean organisms and other individuals which form the food for higher organisms.

v) In this way the insecticides, besides killing the target organisms have dreadful effect on non-target organisms like fish, crustaceans and man as well causing environmental pollution.

14.II.9 Summary:

Insect pests destroy the flowers, stems, fruits and at times the whole crop itself. Locusts, beetles, stem borers, leaf folders, termites etc., are the common insects which are seen in the fields. Number of mosquitoes and flies like anopheles (malaria), culex (elephantiasis), Aldex (yellow fever), psetpse fly (sleeping sickness), sand flies, fruit flies, mango flies transmit diseases causing germs from one man to other. Insecticides are the chemical substances used to kill insects and other related organisms which destroy plants and cause damage to the society. Insecticides may be organic or inorganic in nature. Basing on their action insecticides are classified into two types. They are classification based on function and classification based on nature of chemical compound. Basing on function the insecticides are classified into 9 types. They may cause stomach poisons, contact poisons, residual poisons, systemic poisons, fumigates, repellents, attractants, insect growth regulators and pheromones. Basing on the chemical nature the insecticides are divided into two kinds. They are inorganic insecticides and organic insecticides. In addition to these other types of insecticides such as synthetic carbonate insecticides such as Dimethane, Isolon and insecticides extracted from plants such as Nicotine, Rotenon, Pyrethrins etc., are also used. Insecticides are used in the form of dust or emulsions or granular form. Insecticides should only be used only when their economic damage is heavy. Indiscriminate use of these insecticides causes environmental pollution. By proper application of insecticides crop plants can be protected from insects and also house hold flies can be destroyed. But indiscriminate use of insecticides is avoided as they cause development of resistant insect pests.

14.II.10 Technical Terms:

Organic Insecticides

Inorganic Insecticides

Stomach Poisons

Contact Poisons

Residual Poisons

Systemic Poisons

Fumigates

Repellents

Attractants

Insect Growth Regulators

Pheromones

Synthetic Carbonate Insecticides

Dimethane

Isolon

Nicotine

Rotenon

Pyrethrins

14.II.11 Self Assessment Questions:

1) Write an essay on insecticides.

2) Describe the role of insecticides in the plant protection.

Lesson - 14.III

PESTICIDES

Objective: To aim of the lesson is to gain knowledge on:

- The different types of pesticides
- To understand method of using of pesticides
- To know useful and harmful effects of pesticides

Structure:

14.III.1 Introduction:

Successful implementation of the programme of green revolution achieved enormous increase in the food produce. But the extensive use of fertilizers, growth of variety of plants also brought a number of pests into existence. Scientists research paved the way for the production of pesticides.

Pests are the creatures that attack and destroy food, clothes, furniture and buildings, farm animals etc. Many of them spread diseases. They cause damage to the food producing plants and the produced food. The pests may attack one or different kinds of plants.

14.III.2 Definition:

Pesticides are substances which are used to control different diseases in plants, animals and human beings. By knowing the life cycles of pests, one can select the pesticide to be used.

14.III.3 Control of Pests:

Pests can be controlled in three ways. Indirect, Biological and Direct control methods.

i) **Indirect Control:** This is done by rotating crops, destroying weeds near crops and by changing the time of sowing a crop.

ii) **Biological Control:** Predator organisms that depend upon pests for their food can be used to destroy the pests.

iii) **Direct Control:** This is done by using pesticides.

14.III.4 Types of Pesticides:

Various chemicals have been used to control the pests since more than 100 years. In the beginning, inorganic chemicals were used to kill them. Then organochlorides were extensively used. Among them DDT, lindane, aldrine, hexachloro cyclohexane are used both in western countries and in our country. Later, the western countries banned the use of DDT, while India is still using it. It is the potential chemical which stays for long times in the soil and environment, without being changed and it has profound effect on non-target organisms. Hence, its production is banned. From 1950 onwards organo phosphates made their way into the fields. Parathion and Malathion replaced partly DDT.

Carbonates have been used in recent past. Substituted urea, substituted phenols and nitro compounds entered as insecticides, fungicides, fumigates, herbicides, defoliates, desiccants, rodenticides etc. Pesticides obtained from plants like cryolide, micotene, rotenone and pyrethrums were also used to control the pests.

14.III.5 Method of Using Pesticides:

i) Pesticides are used as smoke or mist, which can reach almost all parts of the plants, thus killing the pest present in any part. Powerful chemicals are mixed with food materials to be fed to the pests. Thus, poisoned bran pellets kill slugs and snails, rats, mice and squirrels.

ii) Most of them are added to the water, oils or some other dried materials. Then they are made into pellets and used as food for pests. Some are made into solid stripes to be hung in houses. They give off vapor which kills house flies, wasps, green flies etc.

iii) Mechanical sprayers are used to spray the pesticides. They may be handy or carried on tractors. In larger alternate, helicopters are used to spray the pesticides. Pesticides are pumped in the soil layers through special machines. Building and store rooms can be protected from beetles and moths by treating them with clouds of pesticides. Pesticides are mixed with soil in the basements.

14.III.6 Harmful Effects of Pesticides:

Pesticides are very dangerous. One should wear masks to be protected from these pesticides. Care should be taken to see that the pesticides are sprayed only in the area that is meant for. Some pesticides like DDT and other organ chlorines remain for longer times in the soil without being degraded. To save from the dangers of these pesticides, safer pesticides such as pyrethroids are developed from plant extracts.

14.III.7 Uses of Pesticides:

By using pesticides, crops can be protected from different pests. Pesticides helped man against the spread of dreadful diseases like plague, malaria, elephantiasis, typhoid, cholera etc. In this way, pesticides are used to kill and take out the pests on crop lands to increase the productivity.

14.III.8 Pesticides as Pollutants of Environment and Their Adverse Effects:

i) Prolonged exposure of a species to a pesticide lad to the development of resistant varieties. Resistant variety of Anopheles now prevailing in our country is a resistant variety of DDT.

ii) Pesticides have lethal effects on non-target organisms also. When they are sprayed, organisms other than pests are also affected. Pests, because of their predators are take-out, change to major pests, spider mites, cotton leaf perforates once classified as minor pests have become major pests.

iii) Uncontrolled usage of pesticides reaches into water system. They slowly concentrate in the livers and fatty tissues of non-target organisms like fish, crustaceans and other aquatic organisms. When these are eaten by man as food, they enter the human being and cause drastic effects.

iv) Mass mortality of fishes happening at times is due to indiscriminate use, careless handling, and discharge of untreated effluents into the natural waters.

v) Pesticides cause pulmonary disorders, dermatitis, allergy, vomiting, cardiac failure and cancerous conditions.

vi) Birds, lizards, which prey upon pests are killed when the pesticides are heavily used.

Thus pesticides on one side help in controlling the pest and on the other side they cause severe effects on the non-target organisms.

14.III.9 Summary:

Pests are the creatures that attack and destroy food, clothes, furniture and buildings, farm animals etc. Many of them spread diseases. They cause damage to the food producing plants and produced food. The pests may attack one or different kinds of plants. Pesticides are substances which are used to control different diseases in plants, animals and human beings. By knowing the life cycles of pests, one can select the pesticide to be used. Pests can be controlled in three ways. Indirect, Biological and Direct control methods. Pesticides obtained from plants like cryolide, micotene, rotenone and pyrethrums were also used to control the pests. Pesticides are very dangerous. One should wear masks to be protected from these pesticides. Care should be taken to see that the pesticides are sprayed only in the area that is meant for. By using pesticides, crops can be protected from different pests. Pesticides helped man against the spread of dreadful diseases like plague, malaria, elephantiasis, typhoid, cholera etc.

14.III.10 Technical Terms:

Indirect Control

Biological Control

Direct Control

Cryolide

Micotene

Rotenone

Pyrethrums

14.III.11 Self Assessment Questions:

1) Write an essay on pesticides.

2) What is pesticide? Describe the function of different pesticides.

Lesson Writer

Dr. T. Srivalli

Lesson - 15

SOCIAL WELL BEING

Man has three basic needs - food, clothing and shelter. The ancient man covered his body with bark to protect himself from sun and rain. The new stone age man came to know of cotton and clothing, while the modern man can prepare fibres artificially to suit his needs. Nylon, Terlene, Orlon etc. are the man made fibres i.e., synthetic fibres. Nylon is extensively used in making hosiery, goods, fishing nets, brushes etc.

After sun set the living houses and working places are to be illuminated artificially. The ancient man used animal fat or wax or oil to glow the lamp where as the modern man uses electricity for his lamp. Modern society owes much to Thomas Alva Edison, who invented the electric bulb. Now, we have Sodium and Mercury vapour lamps and Fluorescent tubes for better illumination.

Paper and printing play an important role in the modern society as means of transmission of thought in the form of books, news papers, magazines etc. We cannot imagine the present day society without them. Printing technology has gone through radical changes. The letter press is replaced by offset, facsimile, printing methods.

At low temperatures bacteria cannot survive and so foods, drinks and medicines stored in a refrigerator would not be spoiled. As such refrigerator is a boon to the society.

Cinema provides entertainment to the common man, with music and dance. Films on health and hygiene, duties and rights of a citizen, family planning and social welfare impart education to the common man. Documentation on social evils like dowry system, untouchability, corruption, misappropriation of public funds etc. can keep the people away from those evils.

Thus, synthetic fibres, electric lamp, paper, paper printing, refrigeration, cinema are some of the inventions, which provide welfare to the society.

Lesson - 15.I

SYNTHETIC FIBRES

Objective:

- To gain knowledge about manufacture and types of synthetic fibres

Structure:

15.I.1 Introduction:

Man has three basic needs - food, clothing and shelter. The ancient man covered his body with bark to protect himself from sun and rain. The new stone age man came to know of cotton and clothing, while the modern man can prepare fibres artificially to suit his needs. Nylon, Terlene, Orlon etc. are the man made fibres i.e., synthetic fibres. Nylon is extensively used in making hosiery, goods, fishing nets, brushes etc.

15.I.2 Definition:

The fibres created by man using chemical substances are called synthetic fibres or man made fibres. They are often superior to naturally occurring materials. This is one of the outstanding achievements of the modern civilization. Some of the synthetic fibres are Terelene, Viscose rayon, Acetate, Nylon, Orlon, Polyesters, Vinyl and so on. These materials are found in the market under various brand names.

The word fibre is now used for synthetic products of semi synthetic or true synthetic nature. The semi synthetics are formed when natural polymeric materials (Ex. Cellulose or certain proteins) are brought into disposed state and then spun into filaments. Viscose rayon is made in this way. True synthetics are formed by pressing the liquid through perforated cylinders. Then continuous filament of infinite lenghs are formed. Ex. Nylon, Orlon etc. These filaments are dyed and mixed with natural fibres like wool or cotton. These new filaments are woven into cloth.

15.I.3 History:

People tried to make artificial silk fibres in 17th century. In 1888, Joseph Swan invented a way to make nitrocellose fibres for electric lamps. After 10 years of the display of artificial silk at the paris exhibition in 1889, two methods namely Cuprammonium and the Viscose processes were employed to make synthetic Rayon. Their manufacture depended upon polymer chemistry. Later, nylon was discovered by W, H. Carothers in 1934 to be used for hosiery and as material for parachutes in world war II.

15.I.4 Manufacture of Synthetic Fibres:

The manufacture of synthetic fiber requires a raw material having requisite long thread like molecules. Organic complex chemicals such as polyamides, polyesters, polyvinyls, polyolefans and polyethanes are used. They are synthesized by polymerization. A polymer consisting of carbon atoms linked in long chains undergo complex chemical reactions. The molecular structure is reorganized to result in another type of polymer.

Fibers made by chemical processes are of two kinds:

1) **Regenerated Synthetic Fiber:** It is produced by modifying natural materials that have been chemically processed in some way such as cellulose. Ex: Rayon is made by processing the cellulose in wood pulp.

2) **True Synthetic Fibres:** It is made entirely from chemicals Ex. Nylon, Polyester etc. Nylon was the original true synthetic fiber made from chemicals obtained from petroleum (crude oil).

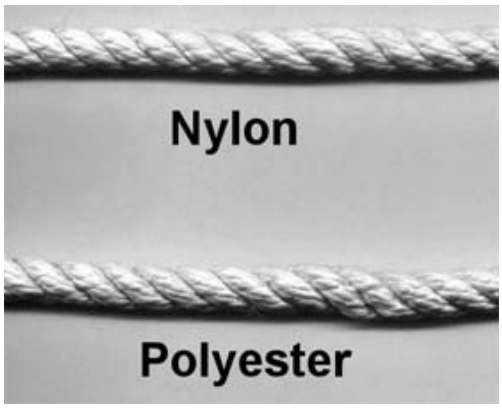
15.I.5 Types of Synthetic Fibres:

There are many types of synthetic fibres such as Polyamide fibres (Nylon), Acetate and triacetate fibres, Polyester fibres, Polyolefine fibres, Polyolefine fibres, inorganic fibres etc.

A) **Polyamide Fibres:** Polyamide fibres contains recurring amide groups in the main polymer chains. Synthetic polyamide fibres form 'Nylon', a major textile fibre. The term nylon coined by Du Point was defined as a genetic term for any long chain of synthetic polyamide (produced by the interaction of a diamine and dibasic acid).

Nylon 6, 6: It is a fibre spun from polyhexamethylene adipamide formed by the condensation of hexamethylene diamine and adipose acid. Both these substances in turn can be prepared from natural gas or petroleum. When these substances are mixed thick, molten nylon is produced. This is forced through tiny holes of a spinner. Each of the substances used in preparing Nylon have six carbon atoms. Hence, it is called Nylon 6, 6. It offers a range of properties that make it one of the most successful of all synthetic fibres. The outstanding mechanical properties of nylon 6, 6 include high strength to weight ratio, high breaking elongation, and excellent recovery from deformation, high abrasion resistance and high flexibility resistance. The fabric remains strong and stable when wet.

Nylon 1, 1: It resembles nylon 6, 6 in many important properties but care must be taken while ironing. This is more stiff and useful in making brush bristles, automobiles try cords excellent insulation.



B) **Acetate and Triacetate Fibres:** They are made from cellulose obtained from wood pulp. To get acetate fibres, the polymer is dissolved in a solvent acetone. For triacetate fibres, the solvent is methylene chloride. The process of making these fibres is known as dry spinning. These fibres used in clothing, knit wear, trouser lining and bedding.

C) **Polyester Fibres:** Polyester fibres are polymers made by condensation reaction taking place between small molecules. They are normally made from esters on ethylene glycol, terephthalic acid and oil refining by-products and by means of melt spinning. The raw materials are converted to poly ethylene terephthalate before being spun. They are used in dress making, suits, bed sheets etc.

D) **Polyvinyl Derivatives:** During the period 1955-60, polyacrilonitrile fibre factories were established in Germany, Japan, Italy, Belgium, Canada, France and Netherlands. These fibres are known by the generic name acrylic. The tenacities nof acrylic fibres are generally between those of standard rayon and nylon. Acrylics are sufficiently strong for normal apparel application but rarely considerede for those high strength application in which nylon and polyester fibres serve. These fibres tend to be heat sensitive at high temperature, and they decompose. Hence they are wet spun. These fibres are used for sweaters, socks and knitwear because they are soft.

Polyvinyl Chloride Fibres (PVC), Polytetra Fluoroethylene fibres (PTFE), are also the derivatives of polyvinyl compounds.

E) **Polyolefine Fibres:** Polyethylene fibres have great industrial uses such as for filtration fibres protective clothing, ropes and cordage. These fibres have applications similar to those of poltethylene, but offers higher strength, increased toughness, creep resistance and a higher melting point. Also, it is water resistant and chemically inert.

F) **Inorganic Fibers:** These are produced from glass ammonium silicates, metallics and have special industrial applications. Glass fibres are used where resistance to spread of flame is necessary. Aluminium silicate are used in high temperature applications, filters, packing, baskets etc.

Modern fibers that are made from older artificial materials include glass fiber and metallic fiber. Glass fiber is used for industrial, automotive and home insulation (Fiberglass); for reinforcement of composite and plastics; specialty papers in battery separators and filtration. Metallic fiber is used for adding metallic

properties to clothing for the purpose of fashion; elimination and prevention of static charge build-up; conducting electricity to transmit information; conduction of heat.

15.I.6 Uses of Synthetic Fibres:

- Nylon is having extensive use in making hosiery goods such as socks, stockings, underwear shirts etc.
- Nylon is also used in making fishing nets, nets brusher, window screens, tubing etc.
- Nylon fibres are also used to make plastic toys, television cabinets etc.
- Acetate fibres used in clothing, knit wear, trouser lining and bedding.
- Polyester fibres are used in dress making, suits, bed sheets etc.
- Polyvinyl fibres are used for sweaters, socks and knitwear because they are soft.
- Polyethylene fibres have great industrial uses as for filtration fibres protective clothing, ropes and cordage.
- Inorganic fibres are used in filters, packing, baskets etc.

15.I.7 Summary:

Man has three basic needs - food, clothing and shelter. The ancient man covered his body with bark to protect himself from sun and rain. The new stone age man came to know of cotton and clothing, while the modern man can prepare fibres artificially to suit his needs. The fibres created by man using chemical substances are called synthetic fibres or man made fibres. They are often superior to naturally occurring materials. The manufacture of synthetic fiber requires a raw material having requisite long thread like molecules. Organic complex chemicals such as polyamides, polyesters, polyvinyls, polyolefans and polyethanes are used. They are synthesized by polymerization.

15.I.8 Technical Terms:

Synthetic Fibres

Polyamide Fibres (Nylon)

Acetate and Triacetate Fibres

Polyester Fibres

Polyolefine Fibres

Inorganic Fibres

15.I.9 Self Assessment Questions:

1) What are synthetic fibres? Give an account of these synthetic fibres.
2) What are different types of synthetic fibres and write an account on uses of these fibers?

Lesson - 15.II

ELECTRIC BULB

Objective:

- To gain knowledge about invention, types and uses of electric bulb.

Structure:

15.II.1 Introduction:

After sun set the living houses and working places are to be illuminated artificially. Good lighting makes it safe for people to travel on the road safely. Lighting is necessary at homes to work during nights. The ancient man used animal fat or wax or oil to glow the lamp where as the modern man uses electricity for his lamp. Now, we have Sodium and Mercury vapour lamps and Fluorescent tubes for better illumination.

15.II.2 Definition:

An electric lamp is a device for converting electrical energy into illumination. This electric lamp was first invented by Thomas Edison in 1883.

15.II.3 History:

Before discovering fire, man had only heat and light from the sun. He was quite helpless at the time. After thousands of years, he discovered fire and he began to notice that some materials burned better than others. As time passed on, man began to select things which provided better light. Pine knots were used as torches. Animal fats were placed in shallow stone dishes and mass and other material was used as sticks. These were the first oil lamps. First candles were made by melting animal fats. The Japanese and Chinese obtained oil for their lamps from various nuts.

Petroleum was discovered in 1859. By heating petroleum in a closed vessel, a thin colourless product known as kerosene is obtained. This oil is called coal oil, which is most commonly used for lamps. After a few years, accidentally a valve was made by the American inventor in1883.

15.II.4 Principle:

When electric current is sent into any thin wire, which has high resistance to the passage of electric current, which glows red hot or white hot and became incandescent. These are used in photography. The incoming electrons crowding past the atoms of which the wire is made give up a large amount of energy in the form of heat or light, and some cause electrons to fly out of the orbits of the atoms. The process in which atoms are said to emit the electrons is called electron emission. The filament emitting the electrons is called emitter.

15.II.5 Discovery:

Edison discovered that there were certain bodies, through which electric power flowed more easily. They are called good conductors, and the other bodies that resist the flow of current are called bad conductors. When the electricity travels through these bad conductors, it would resist the current so that the bad conductor glowed until it became white hot. Edison conducted the experiment with carbon. But carbon burnt soon itself when it was in contact with the oxygen in the air. Then he carried out the experiment inside a glass bulb from which he had removed all the air. Then the light of the glowing filament lasted much longer and the first electric bulb was born. Thomas Edison and Joseph Swan invented a lamp suitable to home in 1870. Now the carbon was replaced by fine coiled Tungsten wire because of the high melting point (61.450F or 33.820C), low evaporation and low electrical consumption.

15.II.6 Types of Electric Bulbs:

There are many types of electric lamps such as Incandescent bulbs, Fluorescent lamps, Halogen lamps, Carbon arc lamps etc.

15.II.6.1 Incandescent Bulb: The type of electric bulbs discovered by Edison are known as incandescent bulbs because they glow when they become white hot due to the passage of electric current through the filament. The efficiency of these bulbs is low as most of the electric energy supplies is converted into light energy.

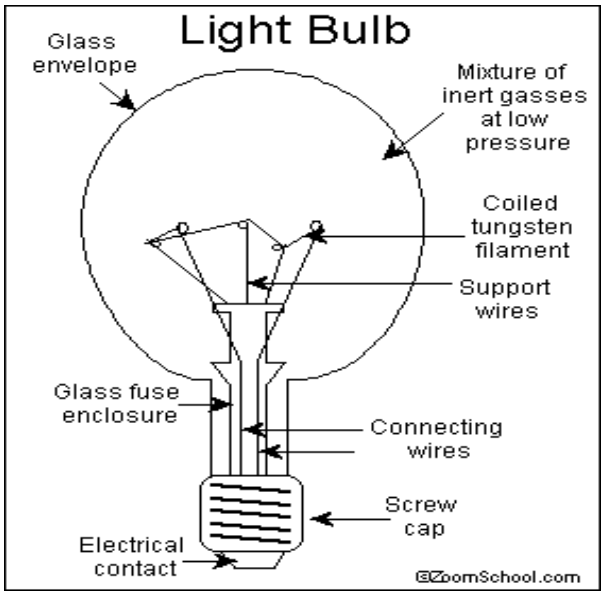


Fig: Incandescent Bulb

15.II.6.2 Fluorescent Lamp: Further improvement was inserting the inert gas mixture of Argon and Nitrogen and a small drop of mercury into the bulb whose inner surface is coated with phosphorescent powder. This is known as Fluoresent lamp. For the fluorescent lamp to glow electric source, a choke and a starter are needed. When the switch is closed, current flows through the filaments, electrons are produced and the electric discharge takes place in the tube. Mercury evaporates and ultra violet light is emitted. The UV light falls on the phosphor powder and produces waves of longer wave lengths. The colour of the light depends upon the nature of the phosphorescent powder. These are used in houses.

15.II.6.3 Halogen Lamp: Halogen lamps are usually much smaller than the standard incandescent bulbs and most have a bulb of fused silica (quartz), but sometimes alumino-silicate glass. Fluorescent lamps have much higher efficicacy than filament lamps. The compact fluorescent lamp (CFL) was commercialized in the early 1980s. Typical average life time ratings for linear fluorescent tubes are 10,000 - 20,000 hours, compared to 750 hours (110 V) and 1000 hours (240 V) for filament lamps.

Fig: Fluorescent Lamp

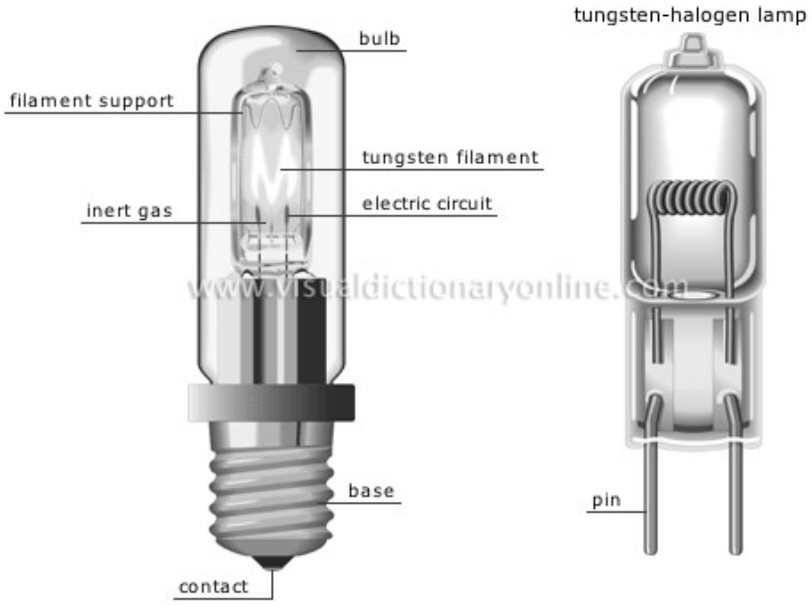


Fig: Halogen Lamp

15.II.7 Uses of Electric Bulbs:

- Fluorescent tubes, vapour lamps etc. are expensive but have longer life. They are widely used in stores, offices and street lighting.
- The brightest light is emitted by mercury vapour lamps. They are economical to use as their life span and glowing capacity are high. In cities, best lightings is provided by sodium vapour lamps.

They give 6 to 8 times more light than ordinary light for every Watt of electricity. Their light looks more natural.

- Sodium and Mercury vapour lamps are used for street lights.
- Carbon arc lamps are used in cine projectors, electric furnaces, arc weldings etc.

Thus electric lamps help a lot in homes, in streets besides their utility in industries. They are needed by society for their daily life to be continued smoothly and safely.

15.II.8 Summary:

After sun set the living houses and working places are to be illuminated artificially. Good lighting makes it safe for people to travel on the road safely. Lighting is necessary at homes to work during nights. The ancient man used animal fat or wax or oil to glow the lamp where as the modern man uses electricity for his lamp. Now we have Sodium and Mercury vapour lamps and Fluorescent tubes for better illumination. An electric lamp is a device for converting electrical energy into illumination. This electric lamp was first invented by Thomas Edison in 1883. There are many types of electric lamps such as Incandescent bulbs, Fluorescent lamps, Halogen lamps, Carbon arc lamps etc. Electric lamps help a lot in homes, in streets besides their utility in industries. They are needed by society for their daily life to be continued smoothly and safely.

15.II.9 Technical Terms:

Electric Lamp

Incandescent Bulbs

Fluorescent Lamps

Halogen Lamps

Mercury Vapour Lamp

15.II.10 Self Assessment Questions:

1) Give an account on different electric lamps?
2) What is an electric lamp? What are the uses of electric lamp?

Lesson - 15.III

PAPER

Objective:

- To gain knowledge about paper, manufacturing, types and uses of paper

Structure:

15.III.1 Introduction:

Paper is a thin sheeted versatile material mainly used for writing, printing, cleaning, photography, insulating, packing etc. It is also used in a number of industrial and construction processes and occasionally as a food ingredient, particularly in Asian cultures. It is produced by pressing and drying the moist fibers into flexible sheets. Mostly the cellular pulp derived from wood, rags or grasses is used.

15.III.2 History:

The word 'paper' is derived from the reed plant papyrus, which grows abundantly along the Nile River in Egypt. The earliest recorded forms of paper were in use in Egypt in 3500 BC, made from papyrus plant. Papyrus was the most widely used writing material in ancient times, and many papyrus records till survive. True paper is believed to have originated in China in approximately 2nd century AD, although there is some evidence for being used before this date. The use of paper spread from China through the Islamic world to Europe where its production commenced in the early 12th century. Mechanical production of paper in the early 19th century caused significant cultural changes worldwide, allowing for relatively cheap exchange of information in the form of letters, newspapers and books for the first time.

15.III.3 Manufacturing of Paper:

It is considered to be one of the four great inventions of Ancient China, since the first paper making process was developed in China during the early 2nd century. Tsa Lun of China is regarded to have invented the modern method of paper making from rags and other fibers in 105 AD. Archaeologically, true paper without writing has been excavated in China. This was primarily used for purposes of wrapping or padding protection for delicate bronze mirrors and for safety transport of poisonous medicine. Although paper used for writing became widespread by the 3rd century, paper continued to be used for wrapping and other purposes. Toilet paper was used in China by at least the 6th century AD.

15.III.4 Steps Involved in Paper Manufacturing:

Various steps involved in paper making are chemical pulping, mechanical pulping to break down the chemical structure of lignin, bleaching to produce white paper, pressing and drying using air and heat, finishing through sizing by adding additives.

1. **Pulping:** Suspension of cellulosic fibre is prepared by beating it in water so that the fibres are separated and saturated with water or by mechanical device for producing news print or by chemical method for writing paper. This is cooked with substances like Sodium hydroxide, Sodium Sulphate, Sodium Monosulphate.

   Paper recycling processes use either chemical or mechanical pulp. There are 3 main classifications of recycled fiber viz., mill broke or internal mill waste, pre consumer waste and post consumer waste. Recycled paper can be made from 100% recycled materials or blended with virgin pulp. Recycled papers are not as strong as bright as papers made from virgin pulp. Strength of the paper is increased by adding different alkalis. This process is called crafting.

2. The paper stock is filtered on a woven screen to form a matte sheet of fibre.
3. The wet sheet is pressed and compacted to squeeze out a larger portion of water.
4. The remaining water is removed by evaporation.
5. Depending upon the requirements, the dry paper is further compressed, coated and impregnated.

The first paper mills were built in Baghdad from 794 AD, which helped transform paper making from an art into a major industry. The first paper mill in Europe used hemp and linen rags as a source of fiber. Now a days, steam driven paper making machines are used to produce paper in bulk quantities. wrapping or padding protection for delicate bronze mirrors and for safety transport of poisonous medicine.

15.III.5 Grades and Types of Paper:

The difference among various grades and types of paper are determined by

- Type of the paper pulp
- Degree of beating or refining the stock
- The addition of various materials to the stock
- Formation conditions of the sheet including basic weight or substance per unit and
- The physical and chemical treatment applied to the paper after its formation.

15.III.6 Types, Thickness and Weight of Paper:

The thickness of paper is often measured by the caliper (GSM), which is typically given in thousandths of an inch. Thickness of paper may vary between 0.07 mm to 0.18 mm. Paper if often characterized by weight of a ream of 500 sheets of varying 'basic sizes', before the paper is cut into the size and sold to customers. The sizing system in Europe is based on common width to height ratios for different paper sizes. The largest standard size paper is A0. Two sheets of A1 placed upright side by side fit exactly into one sheet of A0 laid on its side. Similarly 2 sheets of A2 fit into one sheet of A1 and so forth. Common sizes used in the office and the home are A4 and A3 (A3 is the size of 2 A2 sheets).

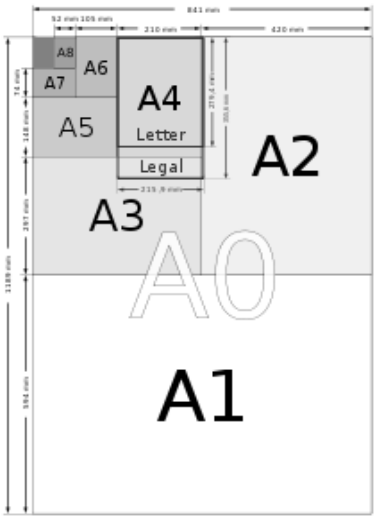


Fig: Paper Sizes

15.III.7 Uses of Paper:

Paper is used to sew bags for packing of tea, envelops, carry bags, paper plates to be used in place of plastic.

It is also used in a number of industrial and construction processes

15.III.8 Summary:

Paper is a thin sheeted versatile material mainly used for writing, printing, cleaning, photography, insulating, packing etc. It is also used in a number of industrial and construction processes. The word paper is derived from the reed plant papyrus, which grows abundantly along the Nile River in Egypt. Manufacturing of paper: It is considered to be one of the four great inventions of Ancient China. Various steps involved in paper making are chemical pulping, mechanical pulping to break down the chemical structure of lignin, bleaching to produce white paper, pressing and drying using air and heat, finishing through sizing by adding additives. The thickness of paper is often measured by the caliper (GSM), which is typically given in thousandths of an inch. Paper is used to sew bags for packing of tea, envelops, carry bags, paper plates to be used in place of plastic. It is also used in a number of industrial and construction processes

15.III.9 Technical Terms:

Pulping

Chemical Pulping

Mechanical Pulping,

15.III.10 Self Assessment Questions:

1) Write a brief account on manufacture of paper.
2) What is the importance of paper? What are the raw materials required in its manufacture?

Lesson Writer

Dr. T. Srivalli

Lesson - 16.I

PRINTING PRESS

Objective:

- To know about the printing, types of printing and printing revolution

Structure:

16.I.1 Introduction:

Printing has a great deal in the transformation of economic, social and ideological relations of civilization. The major role of printed book is spreading of literacy and general knowledge. First books to be printed were religious and scientific in nature. We are surrounded by things that have been printed like stamps, drawings, pictures, decorations, currency books, magazines, maps, directories, news papers etc. We depend on all things for information in every day life.

16.I.2 Definition:

Printing is defined as a process where the compound letters or designs (blocks) are pressed on a paper using certain quantity of colouring agent to form an illustration. This application of colour is done under pressure.

16.I.3 History:

In the 2nd century Chinese discovered printing. The process was laborious. In 11th century Pi Sheng (1041 - 48) an alchemist invented the movable type. In 12th century the

production of paper which was only known to Chinese, entered Central Asia, and was distributed as a commodity in the Arab world. Though Chinese invented the movable type, the credit goes to Gutenberg (1454) for inventing movable printing press. The Europeans could utilize the methodology because their alphabet had only 26 letters.

16.I.4 Types of Printing:

There are several kinds of printing. Some of them are

16.I.4.1 Xylography: The art of printing from wood carving was called xylography, which was developed in 14th century. This process was extended to make religious pictures. Later metallographic printing was developed.

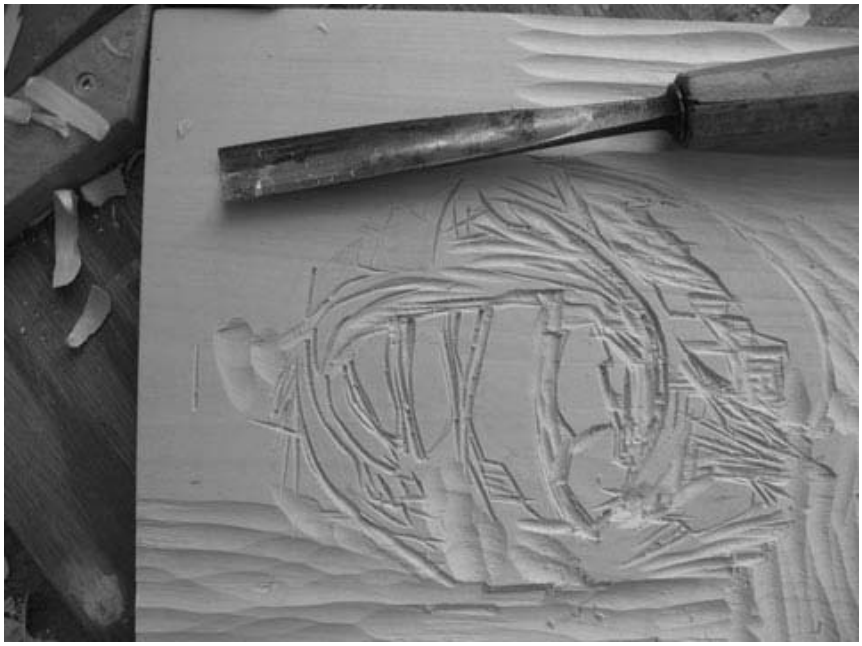


Fig: Xylography

16.I.4.2 Lithography: Lithography is based on the principle that water and grease do not mix. It was first shown in 1796 by Senefelder. He showed that his design draw on a stone with calcium carbonate base and having homogeneous surface with greasy ink wetted with water and then brushed with ink, retains ink only on the design. This could be reproduced on a paper pressed on it. Later it was improved by using slab of porous stone. The material is drown by hand from right to left with greasy crayons. Then these slabs are pressed against paper. Thus the material on the slab is transformed to the paper. Later stone was replaced by zinc plates and rotary presses were developed.

Fig: Lithography

16.I.4.3 Typography: In this method letters made up by lead metal are used. Johannes Gutenberg is credited with the simultaneous discovery of printing press and association of dye, matrix and lead for the production of durable type surfaces in large numbers in which each letter is strictly identified. The typographer's work consists of four steps

- Arranging type pieces taking each letter by letter from a type-case
- Composing them as lines by 'wooden sticks'
- Spacing the lines by blank pieces of lead
- Distributing the letters back to type case after printing.

Gutenberg's Press (1450 A.D.) is a simple adoption of binding press in which fixed lower surface (bed), movable upper surface, moved vertically by a small bar on a screw. The composed type is fixed and inked, covered with paper and the whole is pressed in the vice formed by the two surfaces. Gutenberg produced a 42 lines Bible for the first time. Then his shop produced the first dated book.

16.I.4.4 Stereotype or Stereography: Increasing demand for printed matter stimulated the search for greater speed. Stereograph consists of making an impression of whole text blocks of type in clay and makes lead moulds of the whole. This made printing of the same text several presses at the same time economical.

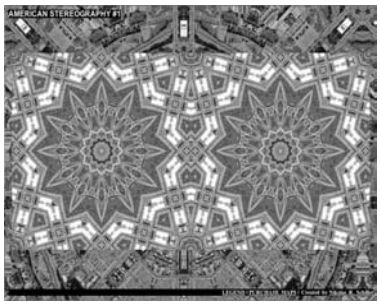


Fig. Stereography

16.I.4.5 Off-set Printing: In 1904, Ira W. Rubbel discovered that an image transferred from the plate cylinder of his rotary to the rubber blanket of impression cylinder; during paper feed stoppage could itself be used for printing with superior result. Rubbel and associates constructed a three cylinder press, i.e., the first offset press. This method is extensively used for commercial and advertising. Several books are also printed by this method.

Koening mechanical press was developed in early 19th century. It consists of cylinders bearing the sheet of paper, pressing it against type-form placed on a flat bed that moved to and fro. The rotation of the cylinder was linked to the forward movement but was designated when the bed moved back to go under ink rollers. Attempts to mechanize composition began in mid 19th century. In 1822 William Church took at patent for type setting machine with a key board, each key releasing a piece of type or the corresponding letter, which was then adjusted by hand.

Web-fed Rotary Printing: The largr circulation dailies require high production speeds. In this method each printing cylinder usually carries 4 to 8 plates and thus can print 4 to 8 pages at a time.

Teletype Setters: As in a type machine by pressing the keys, appropriate letters are printed on the paper. By this method composing can be done fastly.

Otto Mergen Thaler invented the first automatic type setting machine in 1884. here the operator uses key board for type setting. This is the linotype one. In 1887 Tolbert invented a Monotype press having two units. The first unit is operated on keyboard which sends a punched paper to the second unit. This decodes the punched paper and sets up the lines. In 1905 Ludion machine is used for large size type. It combines with hand and machine setting.

16.I.5 Printing Revolution:

Automatism of composition speeded up the printing process considerably. The perfection of teletype setter, remote control equipment in 1929 could compose 20,000 characters per hour. Recent development of photo type setting and other techniques has enormously decreased the time factor involved. Microcomputers and word processors have changed the entire mode of printing. Type writers hooked to telephone lines can print a text thousands of miles away on a Teletext machine. Facsimile machines, visual, data units, electric scanning of colour pictures and prepress method are the recent advances in printing.

16.I.6 Summary:

Printing has a great deal in the transformation of economic, social and ideological relations of civilization. The major role of printed book is spreading of literacy and general knowledge. Printing is defined as a process where the compound letters or designs (blocks) are pressed on a paper using certain quantity of colouring agent to form an illustration. This application of colour is done under pressure. There are several kinds of printing such as Xylography, Lithography, Typography, Stereography and Offset printing. Microcomputers and word processors have changed the entire mode of printing. Type writers hooked to telephone lines can print a text thousands of miles away on a Teletext machine. Facsimile machines, visual, data units, electric scanning of colour pictures and prepress method are the recent advances in printing.

16.I.7 Technical Terms:

Xylography

Lithography

Typography

Stereography

Offset Printing

Gutenberg's Press

Koening Mechanical Press

Printing Revolution

16.I.8 Self Assessment Questions:

1) Give an account on printing.

2) What are different types of printing?

Lesson - 16.II

REFRIGERATION

Objective:

- To study about refrigeration process, methods of refrigeration, and uses of refrigeration

Structure:

16.II.1 Introduction:

In ancient time snow and ice were the natural things used to refrigerate things. Even at that time another way to produce cold was the process of dissolving certain salts to eater like soft paper and Ammonium Nitrate which removes heat from water. Still another process of refrigeration is 'evaporation', the process of change of liquid vapour to a vapour.

16.II.2 Definition:

Refrigeration is the process of removing heat from an enclosed space, or from a substance, and moving it to a place where it is unobjectionable. The primary purpose of refrigeration is lowering the temperature of the enclosed space or substance and then maintaining that lowered temperature. The term cooling refers generally to any natural or artificial process by which heat is dissipated. The process of artificially producing extreme cold temperatures is referred as cryogenics.

16.II.3 History:

If you put a little water or alcohol on your hand you feel cool because the liquid takes heat from the hand and evaporates. This was the principle of evaporation that led to the construction of our modern refrigerators. The first known method of artificial refrigeration was demonstrated by Willium Cullen at the University of Clasgow in Scotland in 1756. In 1823 Michael Faraday was the person who learned how to change the ammonia vapour to a liquid by compressing or squeezing it and then removing heat from it. When the pressure is removed and this liquid is allowed to evaporate again it takes up heat and produces cold. Jacob Perkins obtained the first patient for a vapour compression refrigeration system in 1834. In 1842, Jojn Gorrie designed the first system for refrigerating water to produce ice. Commercial refrigeration commenced from 1856 by Alexander Twining. Domestic mechanical refrigerators became available in around 1911.

Refrigeration is currently used for air-conducting of private homes, public buildings, foodstuffs in homes, restaurants and large storage warehouses. Dairy products need continuous refrigeration. It also helps keep fruits and vegetables edible longer.

16.II.4 Methods of Refrigeration:

There are two methods of refrigeration Non-cyclic and cyclic.

16.II.4.1 Non-cyclic Refrigeration: This is done by melting ice or by subliming dry ice (solid carbondioxide). It is used for small scale refrigeration required in laboratories, workshops or in portable coolers.

16.II.4.2 Cyclic Refrigeration: Here heat is removed from a low temperature space or souece and rejected to a high temperature sink with the help of external work, and its inverse, the thermodynamic power cycle. A refrigeration cycle describes the changes that take place in the refrigerant as it alternately absorbs and rejects heat as it circulates through a refrigerant. Insulation is used to reduce the work and energy required to achieve and maintain a lower temperature in the cooled space. The most common types of refrigeration systems use the reverse-Rankine vapour compression refrigeration cycle. Cyclic refrigeration can be classified as Vapour cycle and Gas cycle.

Vapour cycle refrigeration: It can further be classified as vapour compression refrigeration and vapour absorption refrigeration. Vapour compression cycle is used in

In the vapour compression type, the vapour is compressed using an electric motor. In the vapour absorption type, the low pressure vapour is dissolved in a dilute solution of refrigerant liquid at room temperature and the concentrated solution is heated to expek the vapour and high pressure. The vapour compression machines are most efficient and can easily be operated. These are used in household purposes as well as in many commercial and industrial refrigeration systems.

16.II.5 Process of Refrigeration:

The part of the container in which the material is kept for cooling is called refrigeration chamber. The walls and door of the refrigeration chamber are well insulated against the passage of heat through them. This whole machine is called Refrigerator. The refrigerator consists of an evaporator, compressor and a condenser. The former one is inside the chamber and the other two

are located outside. All the three are connected by pipes to form circuit. This circuit is filled with a liquid called 'refrigerant' which will vapourize easily to a liquid under low pressure. The vaporized refrigerant can be returned to a liquid by compressing it at ordinary temperatures. Examples of refrigerants are Ammonia, carbondioxide, Sulphur dioxide, Methyl Chloride. The main process involved in the refrigeration are vapour compression, absorption of heat, release of steam thus cooling the air, warming of air, because of taking heat from the food kept in refrigeration chamber. So in the refrigeration cycle the refrigerant is first compressed and cooled and then the expanding refrigerant absorbs heat from its surroundings to provide refrigeration. This cycle is repeated after the refrigerant absorbs heat. Compression raises the temperature of the refrigerant above that of the natural surroundings, so that it can give up its heat in a heat exchange to heat sink like air or water. Expansion lowers the refrigerant temperature below the temperature that is to be produced inside the cold temperatures. The cycle of evaporation and condensation of the refrigerant goes on as long as the compressor is running. Inside the refrigeration chamber there is a thermostat. When the chamber has been cooled to the desired temperature, the thermostat shuts off the compressor motor. When warm things are placed in the refrigerator or when the door is opened, the refrigeration chamber becomes too warm, then the thermostat turns the compressor on.

Newer refrigerators may include automatic defrosting, a power failure warning, chilled water and ice available from an indoor station cabinet rollers, adjustable shelves and trays, a status indicator, an indoor ice candy, a cooling zone in the refrigerator door shelves. Later advances include automatic ice units and self compartmentalized freezing units.

Domestic refrigerators and freezers for food storage are made in a range of sizes starting from 4 Liters to 600 Liters. Most common type is the compressor refrigerators, oil gas and duel power gas/electricity units, solar refrigerators and thermal mass refrigerators. Refrigeration units for commercial and industrial application can be made any size, shape or style to fit customer needs. The refrigerators became most important requirement in every house.

Fig: Domestic refrigerators

16.II.6 Uses:

- Refrigerators are mainly used to cool the substances and to prevent putrification.
- They are used in Medical shops to keep life saving drugs, polio vaccines, antibiotics etc.
- They are used in cool drink shops, bars etc. for keeping the liquids cool for their commercial purpose.
- The same principle is used in Air conducting. Air conditioning is widely applied in theatres, operation theaters etc.

16.II.7 Summary:

In ancient time snow and ice were the natural things used to refrigerate things. Even at that time another way to produce cold was the process of dissolving certain salts to eater like soft paper and Ammonium Nitrate which removes heat from water. Refrigeration is the process of removing heat from an enclosed space, or from a substance, and moving it to a place where it is unobjectionable. The primary purpose of refrigeration is lowering the temperature of the enclosed space or substance and then maintaining that lowered temperature. There are two methods of refrigeration Non-cyclic and cyclic. Non-cyclic refrigeration is done by melting ice or by subliming dry ice (solid carbondioxide). It is used for small scale refrigeration required in laboratories, workshops or in portable coolers. In cyclic refrigeration heat is removed from a low temperature space or souece and rejected to a high temperature sink with the help of external work, and its inverse, the thermodynamic power cycle. Cyclic refrigeration can be classified as Vapour cycle and Gas cycle. The refrigerator consists of an evaporator, compressor and a condenser. The cycle of evaporation and condensation of the refrigerant goes on as long as the compressor is running which keeps the inside things cold. Refrigerators are used for many purposes in our daily life.

16.II.8 Technical Terms:

Refrigeration

Cyclic Refrigeration

Non-cyclic Refrigeration

Vapour Cyclic Refrigeration

Gas Cycle Refrigeration

Evaporation

Condensation

Compressor

Refrigerant

16.II.9 Self Assessment Questions:

1) Write an account on refrigeration.

Lesson - 16.III

CINEMA

Objective:

- To know about cinema

Structure:

16.III.1 Introduction:

Cinema has significant place in modern society. It provides entertainment to the common man, with music and dance. It is an instrument of social change. Films on National integration, adult education, health and hygiene, duties and rights of a citizen, family planning and social welfare etc. can impart education to the common man. Documentation on social evils like dowry system, untouchability, corruption, misappropriation of public funds etc. can keep the people away from those evils. The origin of the name 'film' comes from the fact that photographic film has historically been the primary medium for recording and displaying motion pictures.

16.III.2 History:

Mechanism for producing artificially created, two dimensional images in motion were demonstrated as early as the 1860s, with devices such as zoetrope and the praxinoscope. These machines were outgrowths of simple optical devices and would display sequences of still pictures at sufficient speed for the images of pictures to appear to be moving, a phenomenon called persistence of vision. With the development of celluloid film for still photography, it became possible

to directly capture objects in motion in real time. By the 1880s, the development of the motion pictures cinema allowed the individual component images to be captured and stored on a single reel. This led quickly to the development of motion picture projector to shine light through the processed and printed film and magnify these 'moving picture shows' onto a screen for an entire audience. The first movie was invented by 'Louis' and 'jean Lumiere' in 1895.

The earliest cinemas were silent. The actions are generally being explained by the captions. When a cinema was shown the audience read what the actors were saying as printed words were projected on the screen. Now cinemas carry sound system also.

16.III.3 Mechanism of Cinema Making:

There are several stages in cinema making such as sound recording, sound production, and projection. In addition to these now a days animation is widely used in cinemas.

16.III.4 Sound Recording:

The audio sound is recorded while the film was being made. In the electronic process, where a film is being made, a microphone picks up the artist's voices and other sounds of the scene, while the scene is photographed by the camera simultaneously. The microphone changes the sound into electric current of varying strength. The amplified current is passed through a metal ribbon in the form of a loop. As the metal ribbon is placed in the magnetic field, this current goes to two electromagnets that open and close a slit present in between the bits of two flat pieces of metal. Depending on the strength of current received from microphone, the above slit either widens or becomes narrow. Here the ribbon works as optical shutter. The light after passing through this slit strikes the side of the film along with the light entering the camera lens. It forms a dark and light stripe all along the side. This is called 'sound track'.

16.III.5 Sound Production:

The sound from the sound-track or the film is reproduced using a special photo electric cell which has a metal plate coated with another metal that emits electrons and loud speaker. The light from a powerful source illuminates the film and as such the emergent light has variable intensity. It is made to fall on a photo electric cell which converts the incident light into electric current. That current is amplified and fed to the loud speaker which converts electrical energy into sound energy.

Thus both sound and light signals are recorded on the film of width 35mm or 70 mm in the cine studios and reproduced in cine theaters. For documentaries 16 mm film and 16 mm film projector are used.

16.III.6 Projection:

The cinema means recording of sound and light on film and reproducing it. The movie camera takes a series of still pictures on the film with the help of a shutter which opens and closes up a number of times (generally 24 times) in one second. The film moves in jerks so that the film is exposed to light from the object when the shutter is open.

The projector projects the pictures on the screen at the speed equal to that of recording light from a source of light like a carbon or halogen lamp illuminates the film. This produces an

illumination of a moving picture. This is because of the property of human eye known as persistence of vision. If an image of an object is formed on the retina of the human eye, it persists for 1/16th of second. So if still pictures are shown in succession at the rate of 16 pictures or more (generally 24 pictures) an illusion of continuous movement of pictures is obtained. At this speed, one can witness the cinema.

16.III.7 Animation:

Animation is the technique in which each frame of a film is produced individually, whether generated as a computer graphic, or photographing a drawn image, or by repeatedly making small changes and then photographing the result with special animation cameras. When it is initially produced, a feature film is often shown to audience in a movie theatre or cinema hall.

Film production cycle is comprised of 5 main stages. Development, Pre-production, Production, Post-production and distribution. Film stock consists of transparent celluloid, acetate or polyester base coated with an emulsion containing light sensitive chemicals. Cellulose nitrate was the first type of film base used to record motion pictures, but due to its flammability it was replaced by safer materials. Most commercial films are shot as 35 mm prints. Most films were shot between 16 and 25 fps and projected from 18 fps on up.

16.III.8 Impact of Cinema on The Society:

- Cinema is a powerful and effective means of communication. Because of its audio-visual character, it has a great mass appeal. It can be used for entertainment, mass awakening and can help in enlisting public co-operation in the task of the nation building.
- Rigidity of the caste system, untouchability. dowry system etc. are the social evils hindering the progress of the society. Through cinema, people can be educated about the eradication of these evils.
- Movies can be used for promoting national integration prohibition, intercaste marriages, family planning programmes, eradication of illiteracy, drug effects, importance of vaccination to children etc. These themes help in the transformation of our society. Besides the above, a number of social reforms can also be introduced and implemented through cinema.
- Cinema helps a lot in expanding education. Illiterate and uneducated people can be educated with the resources, advancements in science and technology, national movements, achievements of the country and other activities like warfare, nuclear bombs etc. Feature films produced for the sake of children help a lot in imparting good education.
- Cinema influences the thinking of the people. It bring out changes in the fashions and create direct impact on our social life. By skillful adoption of good moral, social and conductive themes and by introduction of popular sentiments, films can arouse national consciousness and can utilize the energies of youth in social restriction and nation building activities.

- Cinemas are powerful means of publicity and advertisement. Thus commercial people utilize this medium to sell their products.

16.III.9 Disadvantages:

Besides advantages, cinema has disadvantages also. Films of obscene, unnatural, moral degradation cause immense harm to the society. Immoral, filthy and crime pictures catch the imagination of youth. They have great role in driving the youth to evil acts. Present day films of such nature are causing a number of unhappy situations in the society. Such films should be banned from projection.

"A good film is valuable than education and a bad film is more dangerous than poison".

While motion picture films have been around for more than a century, film is still a relative newcomer in the pantheon of fine arts. The appearance of televisions, VCRs, DVD players etc. could not affect the cinema industry.

16.III.10 Summary:

Cinema has significant place in modern society. It provides entertainment to the common man, with music and dance. It is an instrument of social change. Films on National integration, adult education, health and hygiene, duties and rights of a citizen, family planning and social welfare etc. can impart education to the common man. Documentation on social evils like dowry system, untouchability, corruption, misappropriation of public funds etc. can keep the people away from those evils. The earliest cinemas were silent. The actions are generally being explained by the captions. When a cinema was shown the audience read what the actors were saying as printed words were projected on the screen. Now cinemas carry sound system also. There are several stages in cinema making such as sound recording, sound production, and projection. In addition to these now a days animation is widely used in cinemas. Cinemas have both positive and negative impact on the society.

16.III.11 Technical Terms:

Sound Recording

Sound Production

Projection

Animation

16.III.12 Self Assessment Questions:

1) Write an account on the importance of cinema in modern society.

2) Write an account on mechanism of cinema making.

Lesson Writer
Dr. T. Srivalli

Lesson - 17

SOURCES OF ENERGY

Objective:

The aim of the lesson is to make the student gain knowledge regarding-

- Various types of conventional and non- conventional sources of energy.
- To know about gunpowder, glass and metallurgy of metals.

Structure:

17.1 Introduction:

Sources of energy are a form of natural resources. Natural resources are naturally occurring substances that are considered valuable in their relatively unmodified natural form. A natural resource's value rests in the amount of the material available and the demand for it. A commodity is generally considered a natural resource when the primary activities associated with it are extraction and purification, as opposed to creation. The term was introduced by E.F. Schumacher in his 1970s book Small is Beautiful.

Natural resources are mostly classified into renewable and non-renewable resources. Renewable resources are those which can restock (renew) themselves if they are not over-exploited but used sustainably. Resources like solar, wind biomass, biogas, geothermal, tidal are considered to be renewable sources or non-conventional sources of energy. Non- renewable resources are those which cannot be renewed. Resources like coal, atomic energy, wood, natural gas etc., are considered as non- renewable or conventional forms of energy. Resources can also be classified on the basis of their origin as biotic and abiotic. Biotic resources are derived from living organisms. Abiotic resources are derived from the non-living world.

17.2 Gunpowder:

Gunpowder, also known as black powder, was the first chemical explosive and the only one known until the mid 1800s. It is a mixture of sulfur, charcoal, and potassium nitrate with the sulfur and charcoal acting as fuels, while the saltpeter works as an oxidizer. Because of its burning properties and the amount of heat and gas volume that it generates, gunpowder has been widely used as a propellant in firearms and as a pyrotechnic composition in fireworks.

Gunpowder was discovered in the 9th century in China. This discovery led to the invention of fireworks and the earliest gunpowder weapons in China. In the centuries following the Chinese discovery, gunpowder weapons began appearing in the Arab world, Europe, and India. Gunpowder is classified as a low explosive because of its relatively slow decomposition rate and consequently low brisance. Ignition of the powder packed behind a bullet must generate enough pressure to force it from the muzzle at high speed, but not enough to rupture the gun barrel. Gunpowder was widely used to fill artillery shells and in mining and civil engineering to blast rock roughly until the 2nd half of the 19th century. Gunpowder is no longer used in modern explosive military warheads due to its cost.

17.2.1 Use of gun power in India: In the year 1780 the British began to annex the territories of the Sultanate of Mysore, during the Second Anglo-Mysore War. The British battalion was defeated during the Battle of Guntur, by the forces of Hyder Ali, who effectively utilized Mysorean rockets and Rocket artillery against the closely massed British forces.

It was written in the Tarikh-i Firishta (1606-1607) that Nasir ud din Mahmud the ruler of the Delhi Sultanate presented the envoy of the Mongol ruler Hulegu Khan with a dazzling pyrotechnics display upon his arrival in Delhi in 1258 AD. Nasir ud din Mahmud tried to express his strength as a ruler and tried to ward off any Mongol attempt similar to the Siege of Baghdad (1258). Firearms known as top-o-tufak also existed in many Muslim kingdoms in India by as early as 1366 AD. From then on the employment of gunpowder warfare in India was prevalent, with events such as the "Siege of Belgaum" in 1473 by Sultan Muhammad Shah Bahmani.

The shipwrecked Ottoman Admiral Seydi Ali Reis is known to have introduced the earliest type of Matchlock which were utilized against the Portuguese during the Siege of Diu (1531). And ever since a diverse variety of firearms; large guns in particular, became visible in Tanjore, Dacca, Bijapur and Murshidabad. The Mughals then began to utilize Bamboo rocket and Sappers were special units that laid gunpowder under heavy stone fortifications. The Mughal Emperor Shah Jahan is known to have introduced much more advanced Matchlocks, their designs were a combination of Ottoman and Mughal designs. Hyder Ali and his son Tipu Sultan were the first to introduce modern Cannons and Muskets, their army was also the first in India to have official uniforms.

17.2.2 Composition of gun powder: Gunpowder formulations from the new smokeless powders and semi-smokeless powders. Semi-smokeless powders featured bulk volume properties that approximated black powder, but had significantly reduced amounts of smoke and combustion products. One difference between them is that the older black powder burns at nearly the same rate in the open as when contained, while in smokeless powders the burn rate accelerates more rapidly within a closed chamber, making for a sharper rise in pressure which could rupture older weapons designed for black powder. Black powder is a granular mixture of -

- A nitrate, typically potassium nitrate which supplies oxygen for the reaction.
- Charcoal, which provides carbon and other fuel for the reaction, simplified as carbon.
- Sulfur which, while also serving as a fuel, lowers the temperature required to ignite the mixture, thereby increasing the rate of combustion.

Potassium nitrate is the most important ingredient in terms of both bulk and function because the combustion process releases oxygen from the potassium nitrate, promoting the rapid burning of the other ingredients. Charcoal does not consist of pure carbon; rather, it consists of partially pyrolyzed cellulose, in which the wood is not completely decomposed. Carbon differs from charcoal. Whereas charcoal's auto ignition temperature is relatively low, carbon's is much greater. Thus, a black powder composition containing pure carbon would burn similarly to a match head, at best.

The current standard composition for the black powders that are manufactured by pyrotechnicians was adopted in 1780. Proportions by weight are 75% potassium nitrate (known as saltpeter or saltpetre), 15% softwood charcoal, and 10% sulfur. These ratios have varied over the centuries and by country, and can be altered somewhat depending on the purpose of the powder. For instance, power grades of black powder, unsuitable for use in firearms but adequate for blasting rock in quarrying operations, is called blasting powder rather than gunpowder with standard proportions of 70% nitrate, 14% charcoal, and 16% sulfur; blasting powder may be made with the cheaper sodium nitrate substituted for potassium nitrate and proportions may be as low as 40% nitrate, 30% charcoal, and 30% sulfur.

17.3 Glass:

Glass is an inorganic solid material that is usually clear or translucent with different colors. It is hard, brittle, and stands up to the effects of wind, rain or sun. Glass has been used for various kinds of bottles and utensils, mirrors, windows and more. It is thought to have been first created around 3000 BC, during the Bronze Age. The history of creating glass can be traced back to 3500 BCE in Mesopotamia. The term glass developed in the late Roman Empire.

17.3.1 Manufacturing of Glass: Glass is a hard material normally fragile and transparent common in our daily life. It is composed mainly of sand (silicates, SiO2) and an alkali. These materials at high temperature fuse together; then they are cooled rapidly forming a rigid structure, however not having enough time to form a crystalline regular structure. Depending on the final use and application the composition of the glass and cooling rate will vary to achieve the adequate properties for the specific application. The common ingredients to manufacture glass are:

Sand (SiO2 silica) in its pure form it exists as a polymer, Soda ash (sodium carbonate Na2CO3), Limestone (calcium carbonate or CaCo3) or dolomite (MgCO3) also known as lime, calcium carbonate is found naturally as limestone, marble, or chalk.

The soda makes the glass water-soluble, soft and not very durable. Therefore lime is added increasing the hardness and chemical durability and providing insolubility of the materials. Other materials and oxides can be added to increase properties (tinting, durability, etc.), produce different effects, colors, etc.

17.3.2 Main properties of glass:

The main characteristics of glass are:

- Solid and hard material
- Disordered and amorphous structure
- Fragile and easily breakable into sharp pieces
- Transparent to visible light
- Inert and biologically inactive material.
- Glass is 100% recyclable and one of the safest packaging materials due to its composition and properties

17.3.3 Types of glass and their uses: Glass is used for architecture application, illumination, electrical transmission, instruments for scientific research, optical instruments, domestic tools and even textiles. Glass does not deteriorate, corrode, stain or fade and therefore is one of the safest packaging materials. These properties can be modified and changed by adding other compounds or heat treatment. The main types of glass are described below:

1. **Commercial glass or Soda-lime glass:** This is the most common commercial glass and less expensive. It has light transmission appropriate to be use in flat glass in windows. It has a smooth and nonporous surface that allows glass bottles and packaging glass to be easily cleaned. The disadvantages of soda-lime glass is that is not resistant to high temperatures and sudden thermal changes. Some of the use of soda-lime glass is primarily used for bottles, jars, everyday drinking glasses, and window glass.
2. **Lead glass:** Glass with high lead oxide contents may be used as radiation shielding glass because lead absorb gamma rays and other forms of harmful radiation, for example, for nuclear industry.
3. **Borosilicate glass:** Boron gives greater resistance to thermal changes and chemical corrosion. It is suitable for industrial chemical process plants, in laboratories, in the pharmaceutical industry,

in bulbs for high-powered lamps, etc. Borosilicate glass is also used in the home for cooking plates and other heat-resistant products. It is used for domestic kitchens and chemistry laboratories, because it has greater resistance to thermal shock.

4. **Recently developed forms of glass include**- Safety glass, constructed of two pieces of plate glass join by a plastic to prevent the glass from scattering when broken. Fiberglass made from molten glass formed into continuous filaments that is used for fabrics or electrical insulation. Foam glass made by trapping gas bubbles in glass to produce a spongy material for insulating purposes.

5. **Mosaic glass:** Modern glass originated in Alexandria during the Ptolemaic period, artisans created "mosaic glass" in which slices of colored glass were used to create decorative patterns.

6. **Glassblowing:** Glassblowing was invented during the 1st century BC by the glassmakers of Syria.

7. **Lead Crystal Glass:** During the 15th century in Venice, the first clear glass called cristallo was invented and then heavily exported.

8. **Sheet Glass:** On March 25, 1902, Irving W Colburn patented the sheet glass drawing machine.

9. **Glass jars and Bottles:** On August 2, 1904, a patent for a "glass shaping machine" was patented by Michael Owen. As a result of this invention a large quantities of bottles, jars, were produced.

17.4 Metallurgy:

It is a branch of science which deals with the extraction of metals and alloys from their ores. Metallurgy is the art of working metals, comprehending the whole process of separating them from other matters in the ore, smelting, refining, and parting them; sometimes, in a narrower sense, only the process of extracting metals from their ores. Metallurgy is a domain of materials science that studies the physical and chemical behavior of metallic elements, their inter metallic compounds, and their mixtures, which are called alloys. It is also the technology of metals: the way in which science is applied to their practical use. Metallurgy is distinguished from the craft of metalworking. The first evidence of human metallurgy dates from the 5th and 6th millennium BC.

17.4.1 Stages of metallurgy: Metallurgy involves mainly two steps namely production of impure metal and refining. There are three stages in the annealing process, first is the recovery phase, which results in softening of the metal through removal of crystal. The second phase is recrystallization, where new strain-free grains nucleate and grow to replace those deformed by internal stresses. Refining of metals means purification of metals. Depending upon the nature of the metal and the nature of the impurities, present different methods are applied for the refining of metals. Some of the commonly used methods are:

1. **Distillation:** Volatile meals like zinc and mercury are purified by this method. The non-volatile impurities are left behind in the retort.

2. **Liquation:** The method is used for easily fusible like bismuth, tin and lead. The crude metal is placed on the sloping hearth of a furnace and heated gently when the metal melts and flows down, leaving behind the infusible impurities which remain sticking to the floor of the hearth.

3. **Poling:** Some impurities have greater affinity for oxygen than for the metal. When the molten metal is stirred with green wood poles, the impurities come to the surface, get oxidised and form a scum which can be removed. Wood gases (hydrocarbons from wood) reduce any oxide of the metal back to the metal. Copper and tin are purified by this process.

4. **Filtration:** Filtration is a mechanical method to separate solids from liquids or gases.

5. **Centrifugation:** Centrifugation is a process in which light particles are revolved over high speed with the help of electric motor so that the fine particles which do not settle at bottom would settle down.

6. **Evopration:** Evaporation is used to remove volatile liquids from non-volatile solutes which cannot be done through filtration due to the small size of the substances.

7. **Crystallization:** Crystallization separates a product from a liquid

8. **Smelting:** Smelting is used to produce metals from raw ore, and involves adding chemicals to the ore and heating it up to the melting point of the metal.

9. **Refining:** Refining is used primarily in the petroleum industry, whereby crude oil is heated and separated into stages according to the condensation points of the various elements.

10. **Distillation:** It is widely used in petroleum refining and in purification of ethanol separates volatile liquids on the basis of their relative volatilities.

11. **Fractionation:** It refers to a purification strategy in which some relatively inefficient purification method is repeatedly applied to isolate the desired substance in progressively greater purity.

12. **Electrolysis:** It refers to the breakdown of substances using an electric current. This removes impurities in a substance.

13. **Sublimation:** It is the process of changing of any substance from a solid to a gas without passing through liquid phase.

17.5 Conventional Sources of Energy:

The sources of conventional energy which have been in use for a long time are coal, petroleum, natural gas, nuclear power, water power and wood. They are exhaust able except water. They cause pollution when used, as they emit smoke and ash. They are very expensive to be maintained, stored and transmitted as they are carried over long distance through transmission grid and lines.

17.5.1 Wood: Wood comes from the trees and is used as a fuel in various areas. The burning of wood is currently the largest use of energy. Wood fuel can be used for cooking and heating, and also in steam engines and steam turbines that generate electricity. Wood fuel is available in various forms like firewood, charcoal, chips, sheets, pellets, and sawdust. The particular form used depends on the industry by-products. Carbon emissions would increase by using gas powered saws and splitters in the production of firewood, but when wood heat replaces carbon-producing fuels such as propane, heating oil or electricity from a coal-burning plant, then wood burning has a positive impact on the carbon footprint.

Wood may be used indoors in a furnace, stove, or fireplace. Wood also may be burned outdoors in a campfire, or bonfire. Wood is the most easily available form of fuel, requiring no tools in the case

of picking up dead wood, or little tools, although as in any industry, specialized tools, such as skidders and hydraulic wood splitters, have evolved to mechanize production. The discovery of how to make fire for the purpose of burning wood is regarded as one of early man's invention.

17.5.2 Coal: Coal is one of the important types of conventional or non-renewable from of energy. It is also called as "black diamond". Coal is the most abundant fossil fuel in the world with an estimated reserve of one trillion metric tons. Most of the world's coal reserves exist in Eastern Europe and Asia, but the United States also has considerable reserves. Coal formed slowly over millions of years from the buried remains of ancient swamp plants. During the formation of coal, carbonaceous matter was first compressed into a spongy material called "peat," which is about 90% water. As the peat became more deeply buried, the increased pressure and temperature turned it into coal.

Different types of coal resulted from differences in the pressure and temperature that is inside the earth's crust. The softest coal which has the lowest energy output is called lignite. Anthracite is the hardest coal and gives greatest energy when burned. Bituminous coal is another type of coal which has the highest sulfur content of all the coal types. When the coal is burned, the pollutant sulfur dioxide is released into the atmosphere. Coal mining creates several environmental problems. We have large quantum of coal in Andhra Pradesh, Madhya Pradesh, Assam, Tamil Nadu, Orissa, Bihar and West Bengal.

Coal is most cheaply mined using strip mining techniques. Currently, the world is consuming coal at a rate of about 5 billion metric tons per year. The main use of coal is for power generation, heating and cooking, to melt ores, to drive engines etc.

The burning of coal results in significant atmospheric pollution. The sulfur contained in coal forms sulfur dioxide when burned. Harmful nitrogen oxides, heavy metals, and carbon dioxide are also released into the air during coal burning. The harmful emissions can be reduced by installing scrubbers and electrostatic precipitators in the smokestacks of power plants. The toxic ash remaining after coal burning is also an environmental concern and is usually disposed into landfills.

17.5.3 Crude Oil: Crude oil or liquid petroleum is a fossil fuel that is refined into many different energy products like - gasoline, diesel fuel, jet fuel, heating oil. Oil forms in the underground in rock such as shale, which is rich in organic materials. After the oil forms, it migrates upward into porous reservoir rock such as sandstone or limestone, where it can become trapped by an overlying impermeable cap rock. Wells are drilled into these oil reservoirs to remove the gas and oil.

In 1889, the presence of oil in India was discovered in Digboi in Assam. First crude oil refinery in India was set up in Digboi in1901. In 1958 and 1974, crude oil was found at Cambay onshore basin and Bombay offshore basin. The major oil reserves of the country are situated at

- Mumbai high (Mumbai)
- Upper Assam (Assam)
- Cambay (Gujarat)
- Krishna-Godavari basin (Andhara Pradesh)
- Cauvery basin (Tamil Nadu)

- Nagaland
- Arunachal Pradesh

The largest crude oil producing oilfield is the Mumbai high field that produces around 260000 barrels per day.

Uses of Crude Oil

- There are many products that are derived from crude oil.
- Crude oil is used to make a variety of fuels including gasoline, diesel fuel, jet fuel, bunker fuel and kerosene.
- Crude oil is also used to make fertilizers and pesticides.
- Crude oil is used to make other products such as plastics and waxes.
- It is also used to make tar, sulfuric acid, asphalt, petroleum coke and paraffin wax.
- Crude oil is also a main ingredient in the production of synthetic rubbers.
- Crude oil is used in the production of cosmetics and perfumes.
- Crude oil is also used to produce a number of industrial solvents that are used to clean machinery.
- It is also used in liquid fuels such as butane and propane which are used in home grills.

17.5.4 Electricity: Electricity is a form of energy. Electricity is the flow of electrons. All matter is made up of atoms, and an atom has a center, called a nucleus. The nucleus contains positively charged particles called protons and uncharged particles called neutrons. The nucleus of an atom is surrounded by negatively charged particles called electrons. The negative charge of an electron is equal to the positive charge of a proton, and the number of electrons in an atom is usually equal to the number of protons. When the balancing force between protons and electrons is upset by an outside force, an atom may gain or lose an electron. When electrons are "lost" from an atom, the free movement of these electrons constitutes an electric current.

Electricity is a basic part of nature and it is one of our most widely used forms of energy. We get electricity, which is a secondary energy source, from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources. Many cities and towns were built alongside waterfalls that turned water wheels to perform work. Before electricity generation began slightly over 100 years ago, households used kerosene lamps, food was cooled in iceboxes, and rooms were warmed by wood-burning or coal-burning stoves.

An electric utility power station uses a turbine, engine, water wheel, or other similar machine to drive an electric generator or a device that converts mechanical or chemical energy to electricity. Steam turbines, internal-combustion engines, gas combustion turbines, water turbines, and wind turbines are the most common methods to generate electricity. Electricity can be generated from coal, water, petrol, natural gas, atomic energy and even by using some of the non-conventional sources of energy.

17.5.5 Nuclear Power: Nuclear energy originates from the splitting of uranium atoms in a process called fission. At the power plant, the fission process is used to generate heat for producing steam, which is used by a turbine to generate electricity. Energy created via nuclear reaction is called nuclear energy. There are two main types of nuclear reactions - fission and fusion. Fission releases nuclear energy when a single heavy nucleus splits into two smaller ones, while fusion is a process, in which two single nuclei join together to form another heavier nucleus. Nuclear energy could be natural or man-made. Nuclear reactors in power plants use fission as a main process for generating nuclear energy. Fusion is the more powerful and efficient process, but it's hardly used for peaceful purposes here on the Earth. Although many scientists are working to create fusion reactors, which will provide more energy with fewer disadvantages, there is still no safe technology for this. The following is the list of power station in India-

1. Kaiga in Karnataka
2. Kakrapar in Gujarat
3. Kalpakkam in Tamilnadu
4. Narora in Uttar Pradesh
5. Rawatbhata in Rajasthan
6. Tarapur in Maharashtra

17.6 Non-Conventional Sources of Energy:

The resources which can be used again and again and which are in the process of development are the non-conventional sources of energy. It includes solar, wind, tidal, biogas, and biomass, geothermal. They are inexhaustible. They are generally pollution free. Less expensive due to local sue and easy to maintain. The non-conventional or renewable energy sources can be used in various ways like -

- Power generation. Renewable energy provides 19% of electricity generation worldwide. Heating. Solar hot water makes is an important contribution to renewable heat in many countries.
- The use of biomass for heating continues to grow as well. In Sweden, national use of biomass energy has surpassed that of oil. Direct geothermal for heating is also growing rapidly.[18]
- Biofuels have contributed to a significant decline in oil consumption since 2006.

17.6.1 Wind power: It is a form of energy in which turbines convert the kinetic energy of wind into mechanical or electrical energy that can be used for power. Historically, wind energy is used in the form of windmills for grinding grain and pumping water. Modern commercial wind turbines produce electricity by using rotational energy to drive a generator

Wind is used to run wind turbines. Wind turbines can convert the energy in the wind into mechanical power that can be used for a variety of activities like pumping water. Wind turbines can also use generators to convert wind energy into electricity. Modern wind turbines range from around 600 kW to 5 MW of rated power. Areas where winds are stronger and more constant, such as offshore and high altitude sites wind farms get established. Globally, the long-term technical potential of wind energy is believed to be five times total current global energy production, or 40 times current electricity demand. The various uses of wind energy are -

1. For generation of electricity
2. Running vehicles
3. Wind power for the sale boats
4. Wind energy for the water pumping
5. Wind energy is used in agriculture for winnowing
6. Wind energy for power games
7. Wind energy for grinding etc.

India ranks fifth in the world in wind energy with installed capacity of 10,891 MW (as on Oct 31, 2009). In December 2009, India's Ministry of New and Renewable Energy said it is offering new incentives for grid-connected renewable wind power generation. Wind electricity producers will 14 now receive a generation-based incentive of 0.50 rupees ($0.01) per unit of electricity fed into the grid.

Energy extracted from the wind is in the form of rotary, translational or oscillatory mechanical motion, which can be used to pump fluids or can be converted to electricity, heat or fuel. Wind derived energy can be converted to other forms of energy or can be stores through the use of compressed fluids, pumped hydro systems, water saver systems, batteries, hydrogen, fly wheel, hot water, etc. Wind energy is one of the most flexible and tractable of all energy sources, as the mechanical energy derived directly from the wind and can be readily and efficiently be converted to other forms of energy. Applications of powerful turbines up to 50 kW are for operating irrigation pumps, navigational signals, remote communications, relay and weather stations, offshore oil drilling platforms. Aerogenerators in the intermediate power range roughly 100 - 250 kW can supply electricity to Small Island, farm cooperatives, small industry etc. The large WEC generators with few 1000 kWs are used for electric utility systems.

17.6.2 Hydropower: Hydro power means the power in the water. This type of energy has used from a long time. Energy in water can be harnessed and used. Since water is about 800 times denser than air, even a slow flowing stream of water, or moderate sea swell, can yield considerable amounts of energy. There are many forms of water energy:

- Hydroelectric energy is a term usually reserved for large-scale hydroelectric dams.
- Micro hydro systems are hydroelectric power installations that typically produce up to 100 kW of power.
- Run-of-the-river hydroelectricity systems derive kinetic energy from rivers and oceans without using a dam.

Advantages to hydroelectric power:

- Fuel is not burned so there is minimal pollution.
- Water to run the power plant is provided free by nature.
- Hydropower plays a major role in reducing greenhouse gas emissions.

- Relatively low operations and maintenance costs.
- The technology is reliable and proven over time.
- It is a renewable source of energy.

17.6.3 Solar energy: Solar energy is the energy derived from the sun through the form of solar radiation. Solar powered electrical generation relies on photovoltaic and heat engines. A partial list of other solar applications includes space heating and cooling through solar architecture, day lighting, solar hot water, solar cooking, and high temperature process heat for industrial purposes.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

India promises to become one of the world's largest photovoltaic solar energy markets. The country has the best solar resources in the world with 260-300 clear sunny days per year; on the other hand, it is confronted with continuous electricity shortages. Millions of Indian households have already been helped with solar light solutions. But with a population of 1.17 billion people, around 100,000 villages and 450 million people still do not have electricity. Recently the Government of India announced The National Solar Mission targeting 20,000 megawatts of cumulative installed solar power by 2020. India is the world's sixth largest energy consumer with an installed power capacity of 150, 323, MW. However India's demand/supply gap is 12% on average and the progressive states see a gap in access of 15%. India has huge solar potential because of its location between the Tropic of Cancer and the Equator, India has an average annual temperature that ranges from 25°C - 27.5 °C. India has an expanding solar energy sector: 9 solar cell manufactures, 22 PV module manufactures, and 50 PV systems manufacturers.

Solar energy can be converted to electricity in two ways - Solar photovoltaic, Solar Thermal Power. Solar Thermal Collectors - Solar Cookers, Solar Water Heater, Solar Dryers, Solar Stills, Solar Ponds, Solar Water Pumps, Solar Furnaces, flat plate etc.

Solar Photovoltaic Cells - streetlights, domestic lights, industrial use, use in satellites, etc. The most popular solar application in India is solar thermal.

Uses of solar energy

- For cooking food through - solar cookers for domestic and community purpose.
- For heating water through - solar water heater for hotels, domestic and hospital use.
- For Space Satellites through - solar cells.
- Solar cells used in calculators and watches etc.
- Electricity
- Industrial use - Solar water heater for hot water and Solar furnace.

- Agricultural purpose - Solar water pumps.
- For drinking water solar energy can be used as solar water pumps, solar stills.
- It can also be used the hospitals for sterilization.

Solar energy was used in leather industry, paper industry, drying clothes, drying pickles, and dis-infective effects are in sun's rays. Solar energy can be used in various forms, and it was used in various forms even in the olden days. Like it could be used in the form of heat, light, electrical, magnetic, chemical, etc. The traditional use of solar energy was in a crude manner and it did not have any commercial tangents. In olden days solar energy was used mainly in a passive form. That is to say solar energy was used in extraction of salt, or drying clothes etc. Salt is made in Orissa, West Bengal and in Gujarat. Solar evaporation is applicable for drying of grapes to produce "kismis". This method is common both in India as well as in Middle East. Other dry fruits are also produced in this method even now.

17.6.4 Biomass: Biomass includes solid biomass (organic, non-fossil material of biological origins), biogas (principally methane and carbon dioxide produced by anaerobic digestion of biomass and combusted to produce heat and/or power), liquid biofuels (bio-based liquid fuel from biomass transformation, mainly used in transportation applications), and municipal waste (wastes produced by the residential, commercial and public services sectors and incinerated in specific installations to produce heat and/or power). The most successful forms of biomass are sugar cane bagasse in agriculture, pulp and paper residues in forestry and manure in livestock residues. It is argued that biomass can directly substitute fossil fuels, as more effective in decreasing atmospheric CO2 than carbon sequestration in trees. India is very rich in biomass. It has a potential of 19,500 MW (3,500 MW from bagasse-based cogeneration and 16,000 MW from surplus biomass). Currently, India has 537 MW commissioned and 536 MW under construction. Following is a list of some States with most potential for biomass production:

- Andhra Pradesh (200 MW)
- Bihar (200 MW)
- Gujarat (200 MW)
- Karnataka (300 MW)
- Maharashtra (1,000 MW)
- Punjab (150 MW)
- Tamil Nadu (350 MW)
- Uttar Pradesh (1,000 MW)

17.6.5 Geothermal energy: Geothermal energy is thermal energy generated and stored in the Earth. Thermal energy is the energy that determines the temperature of matter. Earth's geothermal energy originates from the original formation of the planet (20%) and from radioactive decay of minerals (80%). The geothermal gradient, which is the difference in temperature between the core of the planet and its surface, drives a continuous conduction of thermal energy in the form of heat from the core to the surface. The heat that is used for geothermal energy can be stored deep within the Earth,

all the way down to Earth's core - 4,000 miles down. At the core, temperatures may reach over 9,000 degrees Fahrenheit. From hot springs, geothermal energy has been used for bathing since Paleolithic times and for space heating since ancient Roman times, but it is now better known for electricity generation.

There are three main applications of the steam and hot water from the wet geothermal reservoirs namely-

(a) Generation of electric power

(b) Industrial process heat

(c) Space heating for various kinds of buildings.

The following list is the indicative of the industries that would benefit from low great heat between 200 - 2500C. Desalination, chemical industries, textile industries, dye industries, paper industries, plastic industries, manufacturing industries, rayon industries, mushroom culture, crop drying etc.

17.7 Self Assessment Question:

1. What are natural resources? What are the various types of natural resources?
2. Write a note on coal and its uses.
3. What are the renewable sources of energy?
4. Explain the non-conventional sources of energy and their use.
5. Explain the composition of gunpowder
6. Write an essay on glass.
7. Explain the concept of metallurgy.
8. Solar energy is an up growing source of energy - Discuss.

Lesson Writer

Dr. M. Syamala

Lesson - 18

CLOCK AND COMPUTER

Objective:

The aim of this lesson is to make the student gain knowledge on -

- The making and uses of clock and its historical development.
- Computer - it s development and uses.

Structure:

18.1 Introduction:

Clock is a device which shows time and in this chapter the various types and the historical development of clock is explained. Computer which has become a part of this fast moving world is a very important device. This lesson explains as how the computer was first invented and how it has developed into the modern system that we use in today's life. The various parts of the computer as also explained for the information of the student.

18.2 Clock:

A clock is an instrument used to show time. The word clock is derived from the Celtic words clagan and clocca meaning "bell". Clock is traditionally been known as a timepiece. In general usage today a "clock" refers to any device for displaying the time. Watches and other timepieces that can be carried on one's person are often distinguished from clocks. The clock is one of the oldest human inventions. The study of timekeeping is known as horology.

There are various ways in which time was measured in the olden days. It is known that more than 7000 years ago, the Hindus (Aryan Civilization) used to gaze at the sky and measure the time by looking at the position of stars and the Sun. This let them understand time and they used it in various activities connected with religion, astronomy, and astrology. The Egyptians were known to have used the water clock. This device

could measure time based on a constant flow of water that moved through a port. They were also the first people to have made a calendar consisting of 365 days. The Persians and Sumerians made the hourglass, where time was measured by the amount of sand transferred from one chamber of the device to the other. Europeans were the first to make a mechanical clock similar to the ones we use today.

18.2.1 The History of Clocks:

The history of clocks dates back over many centuries. The actually date for the first clock is disputed among historians, but it is believed that the word 'clock' was first used in 14th century (around 400 year ago). The word clock is derived from the Latin 'clocca' meaning bell.

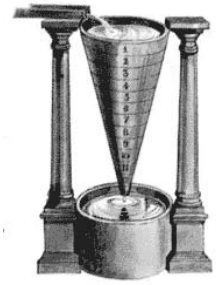
The various types of clocks used to measure time are listed below -

The Sun:

The first methods for telling the time relied on the movement of the sun across the sky. When the sun was directly overhead it was the middle of the day, or 'noon' and when it was on the horizon, it was early morning or early evening, depending if it was in the east or the west. However, this method was not very accurate, but still man had been using this method even today.

The Sundial:

This method of using the sun to tell the time was later adapted into one of the oldest forms of clock, the sundial. By using a vertical pole on a horizontal surface, the pasting of daylight hours could be easily tracked. The first sundials were thought to have been used at around 3,500 BC (about 5,500 years ago) and this form of telling time is still used today.



The Water Clock:

Around 1400 BC (around 3,400 years ago), the Egyptians invented the water clock. These water clocks were made from two containers of water, one higher than the other. The water then travelled from the higher container to the lower container through a connecting tube. The containers had markings on them to show the level of the water and these marks told the time.

Time Zones:

Clocks became so popular that in 1884 the first time zones were drawn up. As the Earth turns, each part of the world experiences 'local time' differently. In 1884, delegates from 25 different countries met and agreed to divide the world into zones. Greenwich was chosen to be the central point, and the world was thus divided into 24 zones, each 15 degrees apart (24 x 15 = 360 degrees or a full circle).

Pendulum Clock:

In 1577, Jost Burgi invented the minute hand to have a more accurate time. Later as there was some problems with this clock, Christian Huygens invented the pendulum clock. He first came up with this new item in 1656 and by the 1600's the clock also had a successful minute hand. The idea of the pendulum clock was simple and is still very popular today. However, pendulum clocks also had problems, the major problem was they would stop running after a while and had to be restarted. This problem was solved around 1840 when an external battery was fitted and by around 1906 the batteries could be fixed inside the clocks.

The Quartz Crystal Clocks:

In the 1920's the first Quartz clocks were invented. These work by applying a certain voltage and pressure inside the clock. This will vibrate or oscillate the Quartz at a constant rate. These clocks are very cheap and accurate.

These are the clocks that are used every day in our houses, offices and schools and in many cases on our wrists. In most cases, digital displays have replaced the hands of the clocks, so that the time is displayed numerically. Features of these timepieces include stopwatches, timers, alarms, and multiple time zones. There are other types of clocks, such as atomic clocks. They are currently the most accurate clocks.

Digital clock:

Digital clocks display a numeric representation of time. They should have battery backup for their running. Two numeric display formats are commonly used on digital clocks. The 24-hour notation with hours ranging 00-23; the 12-hour notation with AM/PM indicator, with hours indicated as 12AM, followed by 1AM-11AM, followed by 12PM, followed by 1PM-11PM.

18.3 Computers:

A computer is a programmable machine. The two principal characteristics of a computer are- It responds to a specific set of instructions in a well-defined manner. It can execute a prerecorded list of instructions. Modern computers are electronic and digital. The actual machinery -- wires, transistors, and circuits -- is called hardware; the instructions and data are called software.

All computers need the following hardware components:

1. **Memory:** Enables a computer to store, at least temporarily, data and programs.
2. **Mass storage device:** Allows a computer to permanently retain large amounts of data. Common mass storage devices include disk drives and tape drives.
3. **Input device:** Usually a keyboard and mouse, the input device is the conduit through which data and instructions enter a computer.

4. **Output device:** A display screen, printer, or other device that lets you see what the computer has accomplished.

5. **Central processing unit (CPU):** The heart of the computer, this is the component that actually executes instructions.

18.3.1 Computer Classification:

Computers can be generally classified by size and power as follows-

1. **Personal computer:** It is a small, single user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data.

2. **Workstation:** It is a powerful, single user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor.

3. **Minicomputer:** It is a multi-user computer capable of supporting from 10 to hundreds of users simultaneously.

4. **Mainframe:** It is a powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously.

5. **Supercomputer:** It is an extremely fast computer that can perform hundreds of millions of instructions per second.

18.3.2 Based on the Development of the Computers:

The computers are divided into -

1. **First Generation (1940-1956) Vacuum Tubes** - The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. Input was based on punched cards and paper tape, and output was displayed on printouts. The UNIVAC and ENIAC computers are examples of first-generation computing devices. The first computers of this generation were developed for the atomic energy industry.

2. **Second Generation (1956-1963) Transistors** - Transistors replaced vacuum tubes and ushered in the second generation of computers. The transistor was invented in 1947 but was not in use till late 1950s. The transistor was far superior to the vacuum tube, as it was smaller, faster, cheaper, more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output. Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN.

3. **Third Generation (1964-1971) Integrated Circuits** - The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and

efficiency of computers. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

4. **Fourth Generation (1971-Present) Microprocessors -** The microprocessor brought the fourth generation of computers. The Intel 4004 chip, developed in 1971, located all the components of the computer-from the central processing unit and memory to input/output controls-on a single chip. In 1981 IBM introduced its first computer for the home user, and in 1984 Apple introduced the Macintosh. Microprocessors also moved out of the realm of desktop computers and into many areas of life as more and more everyday products began to use microprocessors. As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUIs, the mouse and handheld devices.

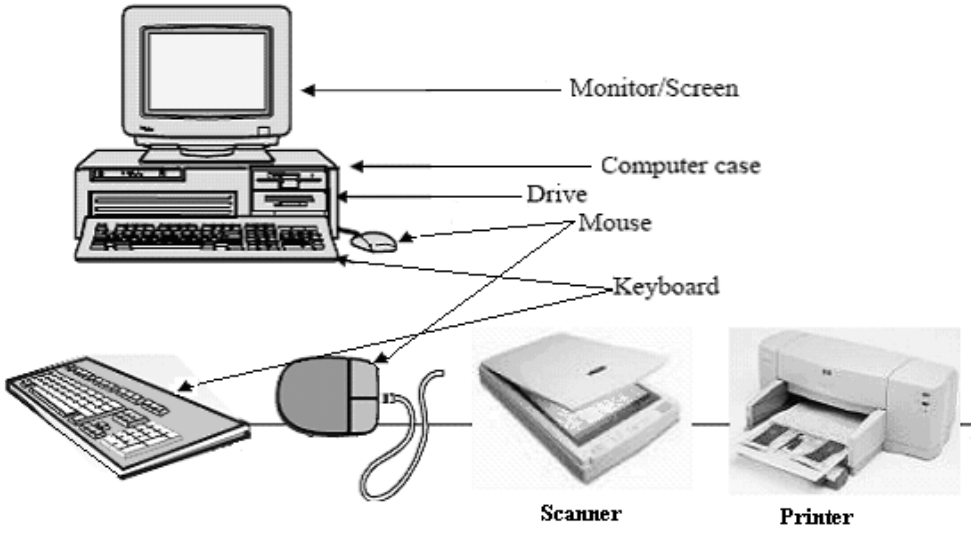
5. **Fifth Generation (Present and Beyond) Artificial Intelligence -** Fifth generation computing devices, based on artificial intelligence, are in development, though there are some applications, such as voice recognition, that are being used today. The use of parallel processing and superconductors is helping to make artificial intelligence a reality. Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come. The goal of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization.

18.3.3 Devices of a computer:

Input Devices:

1. **Keyboard:** The computer keyboard is used to enter text information into the computer, as when you type the contents of a report. Keyboard has around 104 keys for typing various data and instructions. The keyboard can also be used to type commands directing the computer to perform certain actions. In the keyboard we have 26 alphabet keys, numerical keys, a bank of editing keys used in text editing operations and a row of function keys along the top, there are 12 functional keys.

2. **Pointing Devices:** The graphical user interfaces (GUIs) in use today require some kind of device for positioning the on-screen cursor. Typical pointing devices are: mouse, trackball, touch pad, track point, graphics tablet, joystick, and touch screen. Pointing devices, such as a mouse, connected to the PC via a serial ports (old), PS/2 mouse port, USB port.



3. **Mouse:** In older mice, a ball in the bottom of the mouse rolls on the surface as you move the mouse, and internal rollers sense the ball movement and transmit the information to the computer via the cord of the mouse. The newer optical mouse uses a light and a small optical sensor to detect the motion of the mouse by tracking a tiny image of the desk surface. Optical mice avoid the problem of a dirty mouse ball, which causes regular mice to roll unsmooth if the mouse ball and internal rollers are not cleaned frequently. A cordless or wireless mouse communicates with the computer via radio waves so that a cord is not needed

4. **Joysticks:** Joysticks and other game controllers can also be connected to a computer as pointing devices. They are generally used for playing games, and not for controlling the on-screen cursor in productivity software.

5. **Touch screen:** Some computers, especially small hand-held PDAs, have touch sensitive display screens. The user can make choices and press button images on the screen.

6. **Scanners:** A scanner is a device that images a printed page or graphic by digitizing it, producing an image made of tiny pixels of different brightness and color values which are represented numerically and sent to the computer. Scanners scan graphics, but they can also scan pages of text which are then run through OCR (Optical Character Recognition) software that identifies the individual letter shapes and creates a text file of the page's contents.

7. **Microphone:** A microphone can be attached to a computer to record sound usually through a sound card input or circuitry built into the motherboard. The sound is digitized-turned into numbers that represent the original analog sound waves-and stored in the computer to later processing and playback.

8. **MIDI Devices:** MIDI (Musical Instrument Digital Interface) is a system designed to transmit information between electronic musical instruments. A MIDI musical keyboard can be attached to a computer and allow a performer to play music that is captured by the computer system as a sequence of notes with the associated timing.

Output Devices:

1. **Monitor:** Monitor screen size is measured diagonally across the screen, in inches. Not all of the screen area may be usable for image display, so the viewable area is also specified. Most monitors can display several resolutions below its maximum setting. A flat panel display usually uses an LCD (Liquid Crystal Display) screen to display output from the computer. The LCD consists of several thin layers that polarize the light passing through them. LCDs are most commonly used in computers, especially laptops.

2. **Printer:** For hardcopy (printed) output, some kind of printer attached to the computer or available over a network. The most common type of printer for home systems is the color ink jet printer. Ink jet printers are inexpensive, but the cost of consumables (ink cartridges and special paper) makes them costly to operate in the long run for many purposes. A laser printer produces good quality images by the same technology that photocopiers use. Most laser printers are monochrome (one color only, usually black), but more expensive laser printers with multiple color toner cartridges can produce color output. Laser printers are faster than ink jet printers.

3. **Sound Output:** Computers also produce sound output, ranging from simple beeps alerting the user, to impressive game sound effects, to concert quality music. The circuitry to produce sound may be included on the motherboard, but high quality audio output from a PC usually requires a sound card in one of the expansion slots, connected to a set of good quality external speakers or headphones.

18.3.4 Internet:

The Internet, sometimes called "the Net," is a worldwide system of computer networks - a network of networks in which users at any one computer can, if they have permission, get information from any other computer. The internet is computer based global information system. It is composed of many interconnected computer networks. Each network may link thousands of computers enabling them to share information. The internet has brought a transformation in many aspects of life. It is one of the biggest contributors in making the world into a global village. Use of internet has grown tremendously since it was introduced. It is mostly because of its flexibility. Nowadays one can access the internet easily. The internet has developed to give many benefits to mankind. Student can now have access to libraries around the world.

The internet is a worldwide system of computer networks which was conceived in 1969 by The Advance Research Project Agency (ARPA) of the U.S. government. It was created with the aim of creating a network that allows researchers at one university; communicate with their counterparts at other universities. The internet which literally means 'network of networks' is use for-

1. **Information:** The internet provide its users with messages ranging from job vacancies to current affairs and many more.

2. **Entertainment:** It has interesting games, movies etc., that are stored to entertain its users worldwide.

3. **Socialization:** The internet aid helps in social interaction between relatives, friend's e.etc.

4. **Education:** It develop the academic skills of learners through the educational books, tapes etc.

5. **Advertisement:** The internet aid business activities because most business enterprises and buyers can pay for goods purchased.

18.4 Self Assessment Questions:

1. Write an essay on Clock.
2. What are the uses of computers? What are the inputs -output devices of computers?
3. How is internet useful in the modern world?
4. Computers have become part of the modern life -discuss.
5. Explain the historical development of clock.

Lesson Writer

Dr. M. Syamala

Lesson - 19

RELATIONS BETWEEN SCIENCE AND SOCIETY

Man is a social animal. He lives in the society. He grows in the society and he dies in the society. As one, he cannot achieve anything. In a group, he can do miracles. He has to depend upon others and scientific knowledge is beneficial to humans. Our forefathers have not enjoyed the benefits of the scientific investigations. Their life was traditional and yield was less. Though they depend upon other persons of the society for many things, they could not advance much because of lack in scientific thinking and knowledge.

Now it is the age of science. Man made great advancements towards the civilization with the help of the science. Without scientific knowledge, one cannot advance further. One cannot live successfully in this ever changing society without depending upon scientific investigations. Even a lay man is able to understand the scientific advancements and even a poor is adopting to the new technologies coming in. Science has made man's life a comfortable one. It has solved the problems of time and distance. It has made the life easier and worth living.

Scientific revolution has changed the man's environment. It has done great service to the society.

1) Invention of automobile, steam engines, aeroplanes, train ways, cars, buses, ropeways etc. has been helping man to travel thousands of kilometers in few hours. Though cars are limited to the upper strata of society, present day mopeds, buses, railways are providing cheapest transport system. Large ships carry the passengers as well as cargo across seas and oceans. He need not waste time on the distances to be traveled when he feels that it is to be attended urgrntly. By using supersonic aeroplane one can have his breakfast at one place and lunch at another place.

2) Better means of communication system available today are the Telegraph, Telephone, Wireless, Teleprinters etc. He is able to send the messages of urgency to any place within minutes. Launching of satellites improved the communication system. Utilizing no delay service, one can talk with his friends or relatives living far off countries with in on time. Printing technology improved the thinking power. Invention of Radio, Television, made man to learn about several things by sitting at home. He is able to witness the advancements made through T.V. He is able to know the availability of various articles for his daily need through advertisements. He is able to become master of many through these two effective communication systems.

3) Home life is made comfortable and easily manageable. Various electrical appliances like Refrigerator, Air coolers, Air Conditioners, Fans, electric bulbs, Irons, Stoves, Water heaters, Washing Machines, Grinders etc. help a lot in meeting the daily needs like gringing, heating, washing, freezing, lighting etc.

4) Cinema, T.V. are the systems of recreation for the tired body. Besides their recreation, they are used as a means of educational aids to change the illiterates to literates. Open Universities and other institutions of learning are using these audio visual aids to uplift the society.

5) Invention of wonderful drugs, vaccines and life saving drugs improved the living conditions. He is able to fight against several diseases of dreadful nature with the available drugs.

6) Atomic power in industries, modern aids and new varieties of seeds in agriculture increased the productivity. Conservation of water resources, proper planned utilization of natural oils etc. are made possible through scientific investigations.

7) Researches have increased modern weapons in to the defense field. Invention of atomic and nuclear bombs guided and unguided missiles improved the society from getting security and increased the defense preparedness.

8) Introduction of Robots in the industries could not only solve the labour problem but also solve the handling of many complicated events.

9) Invention of Rockets, Jets and Supersonic planes made him possible to land on moon and other heavenly bodies.

10) Availability of natural resources, mineral deposits, fuel concentrations were known through the satellites. He is able to know and forecast the weather conditions and thus saving the society from natural calamities quite in advance. Invention of computers conquered the man's mind in calculating the problems of varied nature within no time. Making use of all these inventions and scientific technologies, man is able to save his time, energy to the maximum extent possible.

Besides providing all the amenities to man for his comfortable living, science has adverse effects also on the society. When science is abused, the society will be at loss. This brings negative results.

1) Electric shocks, short circuits lead to the dangerous situation and finally death of the individual itself. Unproper management of of electric goods cause this situation.

2) Scientific knowledge provides intelligence but his broad thinkingness never improved against individuals in particular and nation in general. This has led to the development of misunderstanding and narrow behaviour. Everyone will have a weak spot which when disturbed lead to adverse effects.

Atomic bombs over Hiroshima, Nagasaki drove Japan to ashes. Whole life is destroyed. Their power is so great than even now the disastrous effects are left upon. The power of the nuclear bombs is such that if a world war breaks out, the whole human race may be wiped out. Nuclear bombs are necessary for peace purposes but should not be used for the destruction of the society. The intention of these weapons is a great disservices in science to mankind.

Use of pesticides and insecticides which are the invention of scientific researches definitely increased productivity. But mismanagement, free availability is taking so many lives in the form of suicides. Recent Bhopal tragedy in which the leakage of Methyl Iso Cyanide (MIC) has happened took thousands of lives and disabled several people. Its effect is even felt through generations. Such a loss cannot be compared either with scientific knowledge acquired or with huge amounts of money. When such a great loss occurs through atomic bombs, one can conclude that science is curse to the society rather than a boon.

Lesson - 19.I

CAPITALISM

Objective:

- To study about capitalism
- To understand features of capitalism
- To know about role of capitalism in promoting communication

Structure:

19.I.1 Introduction:

To understand the word capitalism, one should remember that capitalism is the exact opposite of communism. The communism is to some extent prevailing in USSR. Capitalism is an economic system under which the means of production like land, factories and mines are the properties of private individuals and firms. The private owners or the associations of the means of production use them with the object of making profit for themselves i.e., 'benefit' or 'profit' is the sole guiding factor.

19.I.2 Definition:

The term capitalism denotes different meanings to different sections of society. Capitalism is a philosophy, a doctrine, an economic system and above all a way of life. The roots of capitalism are well laid in western societies. American and British societies are the best examples which are symbolic of capitalist economics.

In Capitalism, every producer produces goods for sale. He cares little for service and is interested in profits. The golden rule of capitalism is 'where there is risk, there is control'. This implies that control lies in the hands of those who bear the risk.

19.I.3 Features of Capitalism:

The following are the main features or characteristics of capitalism

- Private property: everybody is free to hold both movable and immovable properties i.e., every man is free to own land, buildings, factories, jewellery, cars and other economic goods. The owner of the property has the right to dispose or sell, mortgage and transfer his property. His property is inherited by his heirs. In this context, it should be remembered in socialism or communism, the individuals have a limited property right. The human spirit is that when a man begins to feed that is 'his', he begins to feel to improve his asset and works hard and owns the responsibility.
- Freedom of enterprises: This is the second important characteristic feature of capitalism. The people have the right to establish any enterprise, firm or industry, to enter into any contracts or agreements with others.
- Freedom of choice: It is remarked that consumer enjoys the supreme rank and is described as the sovereign or a king in selecting the goods according to his choice from the goods produced by the concerns.
- Fixed capital: Machines and factories come under fixed capital. They are used for the sake of producing the profitable goods Hence capitalism without machines and factories is unimaginable.
- Production in large quantities: Production is made in large quantities so that the goods are produced at low cost. Production is always made for sale. Hence it is true that markets hold the key role in the capitalism.
- Accumulation of wealth: Wealth that is hereditary is multiplied and further acquired. A capitalist unlike the Feudal lords, kings and princes or land lords never spends his money for luxuries unless it accumulates his wealth further.

In capitalism the Government lays a nominal and little role. It does not attempt to curtail the economic liberties of the individual. Capitalism reflects the class division of the society. It is universally true that a capitalistic society is always divided in to two classes capitalist and proletariat.

19.I.4 Merits:

Proper utilization of resources, promotion of communications, greater efficiency of the entrepreneur, increase in the standard of living, decentralization of production are the merits.

19.I.5 Demerits:

Frequent occurrence of economic depression and inflation, unplanned utilization of resources, exploitation of laborers, class-struggle, existence of monopolies etc.

19.I.6 Role of Capitalism in Promoting Communications:

The chief characteristics of capitalism are the private ownership of the means of production, private enterprise and private profit. As Fox puts it, "The social production is appropriated by the individual capitalist". Although production is a social act, exchange and appropriation continue to be individual acts. The tragedy of our times is that in the midst of plenty, there is want and privation. Over production is coupled with under consumption.

Various stages in the development of capitalism: Industrial revolution and capitalism are born during the 18th century. In Europe and North America money lending marks the first stages of capitalism which is described as the Fiscal or Monetary Capitalism.

Several sea routes were discovered to the continents of America, Africa and Asia from Europe, thus giving scope for foreign trade. This stage is described as the Mercantile Capitalism. Capitalism has reached almost peak level by the rapid industrialization in Europe. Productivity is based on machines (Industrial Revolution) Huge investments in industries, large scale production required the expansion of market. This necessitates the development of communications. This final stage is described as Industrial Capitalism.

Capitalism in promoting Communications: It is true that transaction of modern business is the blood stream of capitalism. It could scarcely go on without a prompt and elaborate system of communication. The capitalists, the business man or a trader depends upon the mail. Telephone, telegraph and the wireless for sending and receiving information related to business affairs.

All the local, state and national communities are joined through communication system which strengthens the unity and prosperity of the nation. Communication made further progress with the invention of written language and printing press. Until the invention of Telegraph in 1844 by Samuel Morse and the Telephone in 1833 by Alexander Graham Bell, the most rapid means of communication was the postal service. Radio and the Television are the most important effective communication systems. Today the T.V. has become extremely effective in presenting the events of trade, business, commerce and industry.

As a result of the deep interest shown by the industrialists and capitalists various mechanical devices of different types, shapes and signs are invented and spread. They are making the oral communication easy and clear in industrial and business concerns. Staff location system, speaking types, telephone etc. are examples for such mechanical devices. Various telephone systems like direct exchange line, PBX system, PABX system, Intercom system, Radio, Telephone etc. are also well spread. Several Electronic devices to convey written communication such as Teleprinter, Telewriter, Telefax,, Telegraph, CCIV are also used.

Need for capitalists to promote communications: We have learnt that profit making is the soul concern of the capitalist/industrialist. It is true that there is an ever increasing competition in market for the goods producer. An industrialist or businessman or capitalist ought to know the prevailing conditions of prices as quickly and fastly as he can. He has to expand his business both internally and externally. This is the exact cause behind the capitalist/capitalism in promoting the communications. Besides, a capitalist has the following far reaching advantages through sound communication system.

19.I.7 Advantages of Capitalist:

- He can learn the economic conditions prevailing in his country and abroad.
- He can quickly learn about the market conditions and accordingly keeps the entire product in process or in motion
- He learns the price situation in the market and can accordingly fix prices to his products.
- He can gain the knowledge about the areas of expansion of his business and industry.
- He can build up a good report with the personnel working under him.
- He can analyze the working and living conditions of the workers working under him and can keep good harmony with them. It thus helps him in maintaining employee-employer relations which consequently prevent tensions in his concern.
- Above all it helps the owner of the industry to ensure the exploitation of the resources viz., ma, materials and money under his disposal and reach.

Efficiency and economy are the watch dogs of capitalism. The two objectives are well ensured as the resources in capitalist economy are well exploited. Both human and material resources are fully used by the capitalist. As the capitalist's main target is to drive his firms or trade towards gaining maximum profits, he cannot have the slightest slip in making use of the resources. A capitalist employs the maximum number of workers in his firm so as to make the production of his product quicker and cheaper. Similarly he invests all his capital towards the use of machinery, raw material and advanced technology without which his products cannot competitively withstand in the market. Thus men, materials and money are exploited to the fullest extent by the capitalist in a capitalist society.

19.I.8 Summary:

The term capitalism denotes different meanings to different sections of society. Capitalism is a philosophy, a doctrine, an economic system and above all a way of life. The roots of capitalism are well laid in western societies. American and British societies are the best examples which are symbolic of capitalist economics. Private property, freedom of enterprises, fixed capital. Production in large quantities, and accumulation of wealth are the main characteristics of capitalism. Proper utilization of resources, promotion of communications, greater efficiency of the entrepreneur, increase in the standard of living, decentralization of production are the merits of capitalism. Frequent occurrence of economic depression and inflation, unplanned utilization of resources, exploitation of laborers, class-struggle, existence of monopolies etc are the demerits of capitalism. Various stages in the development of capitalism include Fiscal or Monetary Capitalism, Mercantile capitalism and Industrial capitalism. Modern communication systems plays an important role in promoting capitalism.

19.I.9 Technical Terms:

Fiscal or Monetary Capitalism

Mercantile Capitalism

Industrial Capitalism

Proper Utilization of Resources

Promotion of Communications

Greater Efficiency of The Entrepreneur

Increase in The Standard of Living

Decentralization of Production

19.I.10 Self Assessment Questions:

1) Define capitalism and explain its part in developing the means of communication.
2) What is meant by capitalism and awhat are the advantages of a capitalist?

Lesson - 19.II

WARFARE - GUNPOWDER

Objective:

- To study about gunpowder, its utilization in warfare

Structure:

19.II.1 Introduction:

Since the evolution of man, he learnt to hunt animals either for food or for protecting himself from wild animals. Early man used bow and arrows for hunting. Man turns to be a social animal and lived in a society. Civilization slowly crepted in to the society when conflicts and misunderstandings developed in between the individuals, societies, states and nations. Group wars started to save their societies. They slowly turned to the world wars with the involvement of nuclear weapons. Scientific advancements in various fields provided us various ways of comfortable living. Their inventions in the field of defense made itself with all types of modern armaments like missiles, atom bombs, cannon, submarines, guns, machine guns, battle ships, fighters etc.

19.II.2 Gun Powder:

As time passed, gun powder was invented. It is one of the earliest explosives known. It was used for the first time in 673 A.D. as Greek fire. History reveals that it was used in wars by the people of China and Arabs. Gunpowder is the mixture of Potassium Nitrate (75%), Charcoal powder (15%)and Sulphur (10%). The percentage composition varies depending on its use. Since it is black in colour it is also called black powder. It does not give much noise in explosion. The guns and canons used in the earlier warfare came into existence by the use of gunpowder. It gave high temperatures when exploded. As traced, gun powder was the only explosive used up to 1886. Some of the good explosive substances are TNT, Picric acid, Nitroglycerine, Dynamite etc.

19.II.3 Dynamites:

The invention of dynamite by Nobel was used in warfare in their earlier days. Nitroglycerine was the explosive used. They were later replaced by TNT (Tri Nitro Tolune) in 1863. This replaced the gun powder and dynamites used till then for peace purposes. Hand grenades which were prominent in 1400 A.D. came to light again after the invention of TNT. The war strategy till then suffered a lot with regard to the communications and transport which play an important role in warfare.

Fig: Dynamite

19.II.4 Bombs:

In succession the bombs came in to existence after many scientific experiments. Enrico Fermi's atomic chain reaction made the invention of atom bomb and its first usage by Americans over Hiroshima and Nagasaki of Japan which smashed the whole population to ashes. The principle involved is the nuclear fission and the energy produced is so large that it produced heavy loss to the population and its natural resources. Here the energy is produced on the principle of atomic fission. Uranium and Plutonium are the two radio active substances which are tested for and used in atom bombs. Invention of atomic fissions is really a boon when the great amounts of power released during its explosion is used for running industries and other industrial uses. But such an inhuman act of dropping the atom bombs was really felt by every human being. India also entered the list of countries with atomic power after its first atomic explosion test conducted on 18th May 1974 in Rajasthan. But then the Prime Minister clearly emphasized that the atomic power should be used for peaceful purposes only.

Further inventions resulted in the production of Hydrogen bombs in 1951 in which the principle is fission reaction. Though it is not yet used by any country, every country has got such Hydrogen bombs in their armaments.

The invention of automobile in 1876 made the availability of transport facilities in warfare, jeeps, trucks and other heavy vehicles are the means for transports in defense. Man could save time and energy by using these transport facilities to the full extent. This is followed by the invention of aeroplane on the principle of the light in kite.

Thus the whole tragedy resulted when the three new inventions namely the atomic bomb, aeroplane and automobiles were used in the world war II over Japanese two big towns Hiroshima and Nagasaki.

19.II.5 Missiles:

Now the guided and unguided missiles have taken prime role in warfare. They are the final achievements made till now in this field. Intercontinental Ballistic Missiles (ICBM) are the most powerful guided missiles which can attack their present target present 1000s of kilometers away. They can be used to destroy the whole continents. They travel enormous distance through atmosphere and finally hit the target.

Besides applying the above war strategy in which the bombs, missiles are used, biological killers are being used in warfare. Poisons of snakes, scorpions, sting bees are used to threaten and kill the enemy. Mustard gas shells have a great role in warfare as the mustard gas is a poisonous gas.

With all these further inventions made in the war field bettered the country's defense section powerful and effective. Manufacture of all these weapons are necessary to face the trouble when war breaks up. If world war III comes, what happens to the humanity and its society can be estimated. Hence there should be proper understanding, frequent peace talks and friendly relations would improve the situation and fulfill the statement 'live and let the others live'

19.II.6 Summary:

Since the evolution of man, he learnt to hunt animals either for food or for protecting himself from wild animals. Early man used bow and arrows for hunting. Man turns to be a social animal and lived in a society. Scientific advancements in various fields provided us various ways of comfortable living. Their inventions in the field of defense made itself with all types of modern armaments like missiles, atom bombs, cannon, submarines, guns, machine guns, battle ships, fighters etc. As time passed, gun powder was invented. It is one of the earliest explosives known. Gunpowder is the mixture of Potassium Nitrate (75%), Charcoal powder (15%)and Sulphur (10%). It gave high temperatures when exploded. In the course of time dynamites, bombs and missiles are invented.

19.II.7 Technical Terms:

Gunpowder
Dynamite
Bombs
Missiles
Atom Bombs
Cannon
Submarines
Guns
Machine Guns
Battle Ships
Fighters
Warfare

19.II.8 Self Assessment Questions:

1) Write an account on gun powder.

Lesson - 19.III

WARFARE - BOMB

Objective:

- To understand use of bombs in warfare

Structure:

19.III.1 Introduction:

Bomb is one of the many weapons from human efforts to terrorize and destroy enemies. The grenade is based on throwing stones at any object. After many years, the invention of gun powder towers all other explosives. It is a mixture of Potassium Nitrate, Charcoal and Sulphur. But the Chinese and Arabs are the best claims to its earliest use. Greek fire was the first used in 673 A.D. Greeks had a substance which blazed on contact with water. Gun powder was the only explosive until 1866, when the dynamite was invented by Alfred Nobel. Dynamite is a form of Nitroglycerine which was safe to handle. Its power is twice as powerful as gun powder. TNT invented in1863 came in to general use much later when detonators were developed. These detonators are relatively safe explosives. After the invention of TNT, hand grenade once used in 1400's have taken again an important role in world war I.

19.III.2 Atom Bomb:

Atom Bomb is one of the most dreadful weapons in the modern warfare. The invention of atomic bomb was the final result of years of research. It was invented by an Italian Scientist Enrico Fermi in 1942. In 1945 the first atomic bomb was test fired in New Mexico. The second bomb by name 'Little boy' was dropped on the Japanese city Hiroshima. It is the uranium bomb. The third bomb by name 'fat man' was dropped on Nagasaki, 3 days after the second bomb. It is the plutonium bomb. The bad effects of these atomic explosions are visible even today on the people of these places and society.

Atomic bomb derives its energy from nuclear reactions involving the splitting of heavy atoms into atoms. The principle involved in the explosion of atom bomb is nuclear fission. This is a chain reaction. Splitting of heavy atomic nuclei by using slow neutrons into two comparable sized nuclei is called nuclei is called nuclear fission. Radio active Uranium or Plutonium (U235,

P289) was used as the fission material in atom bombs. Further improvement is the invention of fusion bombs. They get their energy largely from the fusion reactions Hydrogen (Hydrogen bomb) or fusion of light nuclei in to heavy nuclei. Fusion bomb derives its energy in comparable amounts from fission and fusion. The atomic bomb is more properly called a nuclear bomb. The atomic bombs (fission bomb) produced an energy equal to 20,000 tons of TNT. The Hydrogen bombs have been denoted with an energy equal to 65 mega tons of TNT.

19.III.3 Hydrogen Bomb:

The fusion bombs (Hydrogen bombs) were denoted by U.S. in 1951. The principle involved in the explosion of hydrogen bomb is nuclear fusion. In a fusion reaction, the collisions of two energy rich nuclei results in a mutual rearrangement of their protons and neutrons to produce two or more reaction products, along with the release of energy. The light nuclei such as Hydrogen or isotopes of hydrogen are fused into stable helium nuclei at about 10 million degrees centigrade. Once this temperature was achieved, the energy released in the initial reactions maintain this temperature. The chain proceeds either until the supply of fissionable material is exhausted or until sufficient expansion has taken place. This whole energy is communicated by mechanical shock and radiation transport to the surrounding water, earth and air ionizing it out to a distance called fireball radius (135 m in 1 second). This mechanical shock, transferred to air in the form of heat radiation may continue for a long time. The fusion reaction is accompanied with the liberation of much energy than in fusion reaction. Hence Hydrogen bomb is thousand times more destructive than that of atom bomb.

19.III.4 Summary:

Bomb is one of the many weapons from human efforts to terrorize and destroy enemies. The grenade is based on throwing stones at any object. After many years, the invention of gun powder towers all other explosives. It is a mixture of Potassium Nitrate, Charcoal and Sulphur. Atom bomb is one of the most dreadful weapons in the modern warfare. It is based on the principle of nuclear fission. This is a chain reaction. Splitting of heavy atomic nuclei by using slow neutrons into two comparable sized nuclei is called nuclei is called nuclear fission. Hydrogen bomb is based on the principle of nuclear fusion. Hydrogen bomb is thousand times more destructive than that of atom bomb.

19.III.5 Technical Terms:

19.III.6 Self Assessment Questions:

1) Write an account on atom bomb

2) What is Hydrogen bomb? What is the principle involved in the hydrogen bomb?

Lesson - 19.IV

WARFARE - MISSILES

Objective:

- To understand the utilization of missiles in modern warfare

Structure:

19.IV.1 Definition:

Missile is a weapon that is self propelled after leaving the launching device. This is used with the intent of striking some distant object. The term missile excludes projectiles fired from guns as well as free falling bombs.

19.IV.2 History:

During World war II man invented many new weapons. Under the supervision of German Scientists, the first missile atom bomb called V - 1 which exploded even before reaching the target. It was a small jet propelled, unmanned aeroplane carrying a war head and its controls were present before launching to take it to its target. Under the guidance of German Scientist Wernher von Brown, a team made a rocket called V2 which also carried warheads. Though they had a limited accuracy, they did a great deal of damage before their launching sites were captured. From the experience of V2 rockets, missiles were developed. They had greater accuracy in hitting the target.

19.IV.3 Types of Missiles:

There are two types of missiles. They are guided missiles and unguided missiles. All missiles must be directed in same way. Those which have no further control after leaving the launching device are greatly classified as unguided missiles. These are ground launched and air launched free flying rockets which have taken an important role in world war.

The growth of instrumentation, electronics and automatic control has led to the development of guided missiles. Some targets contrast with their surroundings by emitting or

reflecting radiation. The direction and distance of targets can frequently be sensed up radiation receiving instruments. These were located either in the missile continuously towards the target. The credit of invention of these guided missiles goes to the American and Russian engineers.

All the guided and unguided missiles can be classified in to 4 groups.

1. Surface to air missiles are launched from ground or ships at aircraft or from other missiles.
2. Air to surface missiles are launched from air craft towards ground targets.
3. Surface to surface missiles have surface targets.
4. Air to air missiles are used in aerial combat.

All these missiles can be guided in different ways. Some are steered by radio from the launching site. Some follow a radar beam which is directed at the target. Some are present like the original V2. The homing missiles are guided to their targets either by heat radiation from them or by sound. A few locate the target by radar and then lock on the beam.

Missiles are also classified according to fight profile. They are two types. They are acrodynamic missiles or crusie missiles and ballistic missiles. Cruise missiles usually have wings or charge, fins to give lift and manqeurability, where as ballistic missile has no wings. It must be aimed sufficiently high to permit it to fall freely under the influence of gravity until it reaches the target. The ballistic type of design is more commonly chosen for military applications. The shape of the front part of the missile (reentry body) may be conical or blunt. The blunt shape transfers most of the kinetic energy in the surrounding atmosphere. Blunt bodies slow down greatly before striking the ground. They also have large radar reflectively. These are undesirable. As a consequence, missiles with sharper cones are developed. It conserves the energy of the missile, thus providing greater range.

The characteristics of the ballistic missile fit the requirements of a military weapon. It destroys a target located at distances ranging from hundreds to thousands of kilometers on earth. The most widely known ballistic missiles are Intercontinental ballistic missile (ICBM) and Submarine launched ballistic missiles (SLBM).

19.IV.4 ICBM:

These Intercontinental ballistic missiles are lodged missies with conical end. These are the largest and most destructive missiles. These are largely used to destroy the targets located in different continents. They carry nuclear warheads which can be as huge as tons or more megatons. (A megaton is a measure of explosive force) The bombs dropped on Hiroshima and Nagasaki were one megaton. ICBMs travel up through the atmosphere in to the space before returning to earth. Their targets are many thousands of miles away. Some of ICBMs carry several war heads, each capable of reaching a separate target. Early form of ICBMs used liquid fuel. The development of solid fuel led the military scientists to invent smaller missiles.

These weapons can travel enormous distances (5000 to 10,000 miles). As it follows a path similar to shell from a sun, it is called a ballistic missile. It can move at a speed of 10,000 mph and can rise up to a height of 600 miles.

Principle:

It is a three stage rocket fitted with German V2 engines. Steam generated from a combination of Hydrogen peroxide and Potassium Permanganate turns turbines which force the oxygen and kerosene into the rocket chamber. The heat generated creates the blasts that propel the missiles through the air stage by stage. Finally the warhead breaks through hundreds of miles above the earth. With this great speed and enormous momentum, it can hit the target on its predetermined course.

19.IV.5 Summary:

Missile is a weapon that is self propelled after leaving the launching device. This is used with the intent of striking some distant object. The term missile excludes projectiles fired from guns as well as free falling bombs. There are two types of missiles. They are guided missiles and unguided missiles. All the guided and unguided missiles can be classified in to 4 groups. Basing on the fight profile the missiles are further classified into acrodynamic missiles or crusie missiles and ballistic missiles. The most widely known ballistic missiles are Intercontinental ballistic missile (ICBM) and Submarine launched ballistic missiles (SLBM).

19.IV.6 Technical Terms:

Guided Missiles

Unguided Missiles

Acrodynamic Missiles or Crusie Missiles

Ballistic Missiles

Intercontinental Ballistic Missile

Submarine Launched Ballistic Missiles

19.IV.7 Self Assessment Questions:

1) Write an account on missiles used in warfare.

Lesson Writer

Dr. T. Srivalli

Lesson - 20

SOCIETY - GOALS & WELFARE

Objective:

The aim of the lesson is to make the student gain knowledge on -

- The concept of society and what are its goals.
- The main activities that a society takes up for the welfare of the people.

Structure:

20.1 Introduction:

The term "society" came from the Latin word societas, which means bond or interaction among parties that are friendly, or at least civil. Adam Smith, father of Economics wrote that a society "may subsist among different men, as among different merchants, from a sense of its utility without any mutual love or affection, if only they refrain from doing injury to each other." Society is used in the sense of an association; a society is a body of individuals outlined by the bounds of functional interdependence, possibly comprising characteristics such as national or cultural identity, social solidarity, language, or hierarchical organization. In the modern world society has various goals, freedom and the activities of society are mainly welfare oriented.

20.2 Social Processes:

Human beings are by nature social animal. As a social animal he meets with other human beings, interacts with them and establishes social relationship. Thus, when individuals and groups meet and establish social relationships they interact with each other. Such interaction is known as social interaction. The social processes are the fundamental in which people interact and establish social relationships.

Social processes can be defined as - "The term Social process refers to the repetitive form of behavior which is commonly found in social Life". (Horton and Hunt). Thus, Social Process consists of sequence of events, repetition of events, relationships between the events, continuity of events and special result.

20.2.1 Social Processes Categories:

The social processes can be categorized in the following subheads.

1. **Attrition:** The reduction in a work or labor force due to retirement, dropping out of the labour force, job change, and emigration.
2. **Education and Training:** The processes of developing new skills and knowledge in the individual.
3. **Experiencing:** Apprehension or participation of an object, thought, emotion, or event through the senses or the mind.
4. **Motivational Development or Loss:** Decreasing or increasing of the desire to perform an activity.
5. **Recruitment and Immigration:** Expansion of the labor force through active pursuit or influx of new members.
6. **Social Conflict :** Destruction or alteration of endowments by riots, war, terrorism, or other large-scale social conflicts

20.3 Social Changes:

Social change refers to an alteration in the social order of a society. It may refer to the notion of social progress or sociocultural evolution, the philosophical idea that society moves forward by dialectical or evolutionary means. It may refer to a paradigmatic change in the socio-economic structure, for instance a shift away from feudalism and towards capitalism. Accordingly it may also refer to social revolution, such as the Socialist revolution presented in Marxism, or to other social movements, such as Women's suffrage or the Civil rights movement. Social change may be driven by cultural, religious, economic, scientific or technological forces. Social change may include changes in nature, social institutions, social behaviours, or social relations.

20.3.1 Some major current social changes:

One of the most obvious changes currently occurring is the change in population distribution. In the recent decades, developing countries became a larger proportion of world population, increasing from 68% in 1950 to 82% in 2010, while population of the developed countries has declined from 32% of total world population in 1950 to 18% in 2010. China and India continue to be the largest countries, followed by the US as a distant third. However, population growth throughout the world is slowing. Population growth among developed countries has been slowing since the 1950s, and is now at 0.3% annual growth. Population growth among the less developed countries excluding the least developed has also been slowing, since 1960, and is now at 1.3% annual growth. Population growth among the least developed countries has not really slowed, and is the highest at 2.7% annual growth.

20.4 Characteristics of Society:

A society is mainly defined as a collection of individuals. It consists of individuals belonging to male and female and different age groups. The important characteristics or elements of society-

(1) A system of social relationships:

Society refers to social relationship. The meaning of social relationship shall be clearer if we distinguish it from physical relationship. The relation between pen and ink, table and chair, pen and

paper etc. are known as physical relations. In these relations there is no reciprocal awareness. Social relations, on the other hand, those which exist between mother and child, brother and sister, teacher and student, husband and wife etc. are determined by reciprocal awareness or interaction. Without reciprocity there is no social relationship, no society. Thus society is a network of social relationship.

(2) Inter-dependence:

In a society all members depend upon each other. For example, family, the first society in which we all are closely and deeply associated is based on the biological inter-dependence. Similarly, in a family some members earn and all depend upon them. The children depend upon their parents in childhood age and parents depend upon their grown-up children in their old age. Both male and female members in the family cannot survive without the inter-dependence upon each other in every sphere. Thus inter-dependency is most significant element of society. At the higher level, one nation depends upon the other in the economic, social, political, cultural fields.

(3) Likeness:

MacIver says that society means likeness. It exists among like beings, like-bodies and like-minded people. It is likeness which provides for understanding each by the other. This understanding is based on friendship, intimacy, association, institution and any such other types of relationships. Similarities are found among the people of society in customs, traditions, folkways, mores, norms, values, beliefs, attitudes, needs, objectives etc. So likeness or similarity is an essential element of society.

(4) Differences:

Though there is likeness in the society yet it is characterized by difference also. In every society, there are people who differ from one another in a number of ways. For example, family rests upon the biological difference between the sexes. Some are males and others are females. Similarly people differ from one another in respect of their ability, talent, capacity, interest, tendency etc. Human beings also differ from one another irrespective of rights and duties, thoughts and ideals, professions and economic activities. So society involves both likeness and differences. Difference is also very essential for society.

(5) Comprehensive culture:

Every society has its own distinctive culture; culture refers to the art, knowledge, beliefs, morals, law, value, custom, tradition, literature, science, philosophy etc. acquired by man as a member of society. Society preserves our culture and also transmits it to our future generations. Thus society is the store and centre of human culture.

(6) Co-operation and conflict:

MacIver says, "Society is co operation crossed by conflict." Both co-operation and conflict are the essential elements of society. Co-operation plays a vital role in every aspect of our social life. Society cannot exist without co-operation. People cannot lead a happy and comfortable life unless they co operate with each other. Family rests on co-operation. The members of the family co-operate with each other to live happily and peacefully. Not only co-operation but also conflict is essential for society. Society needs struggles to solve social as well as personal problems. Society also requires conflicts for its formation and growth, harmony and disharmony, association and dissociation as well. Conflict is a universal process through which all things have come to existence.

(7) Society is abstract:

Society is an organization which consists of social relation, customs, laws, mores, norms, values and so on. These are abstract and intangible. People only feel and realize these relations. Thus society is same thing which cannot be seen or touched. It can only be felt and experienced by its members. Society does not include any concrete form and therefore, society is abstract.

(8) A common geographical area:

A particular society has been demarcated by the other with natural or artificial boundaries. The natural boundaries such as the rivers, mountain ranges or forests, canals etc. The artificial boundaries are there demarcated by political settlements. The people of the area share the resources in common and participate to reach the common goals of population. The people develop unity, we feeling, integrity oneness and collection consciousness.

(9) Variety of interactions:

The society is full of interactions and the different social processes and going on in the society. The people come face to face and interact among themselves. People share certain interests, attitudes, aptitudes, traditions, customs, values, objectives and mores. The people of the society depend upon each other for their survival. The division of labour among the individuals exists and the functions assigned to them are performed. This develops functional inter relationship among the members of the society.

(10) Feeling of Solidarity:

Since individuals of the society occupy a common territory, common customs and traditions common values, common history common cultures, self contained interdependence on each other obviously causes oneness and we feeling and develops feeling of solidarity among themselves. Though occasionally interact with other societies, they never lore their identity and remains united as long as their society survives.

(11) Total culture:

Each society has its own culture and the individual relationships are organized and structured by the culture. Because of commonness in the culture content, traditional of the society unite together. The society will be differentiated by the other society because of its unique culture. Culture is present in human society and the same is absent in animal society.

20.5 Modern society:

Modern society is one which is mainly concern with the social welfare and well being of the people. The well-being of the entire society is the aim of the modern society. Social welfare is not similar to standard of living but is more concerned with the quality of life that includes factors such as the quality of the environment, level of crime, extent of drug abuse, availability of essential social services, as well as religious and spiritual aspects of life.

Social welfare is as old as humanity itself. Helping the needy and the persons in distress has been in existence practically in all the civilized communities form times immemorial. The meaning and scope of social welfare vary from country to country reflecting the historical development and evolution of administrative

organization and structure, etc. Social welfare signifies the attempts made by govt. and voluntary organizations to help families and individuals by maintaining incomes at an acceptable level, by providing medical care and public health services, by furthering adequate housing and community development, by providing services to facilitate social adjustment and by furnishing facilities designed to protect those who might be subject to exploitation and to care for those groups considered to be the responsibility of the community.

The main objectives of the social welfare is to help the needy persons to maintain the minimum standard of life by providing various services such as voluntary training to strengthen their abilities to be self dependent in the near future.

20.6 Directive Principles in India:

The Directive Principles of State Policy are guidelines to the central and state governments of India, to be kept in mind while framing laws and policies. These provisions, contained in Part IV of the Constitution of India, are not enforceable by any court, but the principles laid down therein are considered fundamental in the governance of the country, making it the duty of the State to apply these principles in making laws to establish a just society in the country. The principles have been inspired by the Directive Principles given in the Constitution of Ireland and also by the principles of Gandhism; and relate to social justice, economic welfare, foreign policy, legal and administrative matters.

Directive Principles are classified under the following categories: Gandhian, economic and socialistic, political and administrative, justice and legal, environmental, protection of monuments and peace and security.

20.7 Social Welfare:

Social welfare means the well-being of the entire society. Social welfare is not the same as standard of living but is more concerned with the quality of life that includes factors such as the quality of the environment (air, soil, water), level of crime, extent of drug abuse, availability of essential social services, as well as religious and spiritual aspects of life. Social welfare is about how people, communities and institutions in a society take action to provide certain minimum standards and certain opportunities. It is generally about helping people facing contingencies. Social welfare organized provision of educational, cultural, medical, and financial assistance to the needy. Modern social welfare measures may include any of the following: the care of destitute adults; the treatment of the mentally ill; the rehabilitation of criminals; the care of destitute, neglected, and delinquent children; the care and relief of the sick or handicapped; the care and relief of needy families; and supervisory, educational, and constructive activity, especially for the young.

The list of Social welfare programs in India are listed below :

1. 20 point programme
2. Animal welfare programme
3. Backward classes schemes
4. Child development schemes
5. Labour and employment schemes
6. Minorities Scheme
7. Rural Schemes

8. Social Schemes
9. Tribal Schemes
10. Urban Schemes
11. Voluntary Schemes
12. Women Schemes

20.8 Self Assessment Questions:

1. Define Society.
2. What is social welfare?
3. What are the aims of social processes?
4. Write an essay on social changes.
5. Define directive Principles.

Lesson Writer

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Lesson - 21

SOCIAL FREEDOM JUSTICE & SECURITY

Objective:

The aim of the lesson is to make the student gain knowledge regarding -

- Concept of social freedom or liberty.
- How liberty plays a vital role in the human society.
- Need for social justice and security for a healthy society.

Structure:

21.1 Introduction:

This chapter deals with concepts like social freedom, security and justices. Every society need and desires to have these three concepts for the development and progress of the people. Many a times the concept of social freedom is used with the same meaning as liberty. So it would not be wrong to say that every citizen of the country has the right of liberty in the field of social, economic, political etc. The same is discussed in this lesson. To have a free and happy life the people in the society should be give liberty of all kinds. In a democratic country like India which is second populous country of the world requires to educate the people in these concepts of social freedom, justice and security. Every human being wants to have a secured life and to protect this, the government gives social security. Social Justice is the right of every one and it is one of the important concept in our Fundamental rights as well as in our Indian constitution.

21.2 Social Freedom:

Social freedom and liberty would mean one and the same. The word liberty has been derived from a Latin word liber which means "individual independence". Liberty is the ability of individuals to have control over their own actions. Social liberty is the individual independence. Social liberty is the freedom of the individuals to develop themselves economically, socially, politically etc. Social liberty is the rejection of the concentration centralized bureaucracies.

Social liberty is in political, social, and economic environment which allows a person to choose to remain free of restraint by the society, except in cases in which an individual's claim of freedom interferes with another individual's right to be free from aggressive harm. An economic system of social liberty regards free-market capitalism and democratic, communalistic socialism.

There are different conceptions of liberty, which tell the relationship of individuals to society in different ways. Understanding liberty involves how we imagine the roles and responsibilities of the individual in society in relationship to conceptions of free will and determinism, which involves the larger domain of metaphysics. Social liberty is a more generally broader based freedom, like the right to assemble. Individual liberty is a more detailed and defined freedom, like the right to free speech. There are various concepts or types of liberty. These are explained below -

1. Natural Liberty:

It is the liberty which people enjoyed in the imaginary 'state of nature' when civil society did not exist. It is generally identified with unlimited and unrestricted freedom. Rousseau was the chief exponent of the concept of natural liberty. In his opinion, man lost natural liberty with the emergence of the state or civil society. But such a concept of liberty is illusory. It is license, not liberty.

Liberty, as a political concept, is based on a system of rights. It is the state which guarantees rights. It is, therefore, impossible to conceive of any liberty in the 'state of nature'. This is a misconception of liberty. The concept of natural liberty is a contradiction in terms because law or authority is the essential condition of liberty but the same was conspicuous by its absence in the 'state of nature'. In the 'state of nature' liberty was enjoyed only by the strong. Might was right. In a civil society, on the other hand, liberty is the common possession of all.

2. Civil Liberty:

It is the freedom which is enjoyed by the people in civil society. It is the civil rights guaranteed by the state. Civil rights consist in the right to life, liberty, property, speech, press, association, education etc. The more the civil rights, the greater is the civil liberty. It has both positive and negative aspects. In the negative sense, it means freedom or the immunity of an individual from interference on the part of others. In the positive sense, it implies the right to free action, the opportunity of self expansion and self expression.

3. Political Liberty:

Political liberty implies rights to determine government and share in authority of the state. It is essentially associated with democracy. Without political liberty, neither, state can be democratic nor can the individual enjoy full civil liberties.

The political liberty reflects in the following points:

(a) The Right to Vote

(b) Right to be elected

(c) Periodical Election

(d) The Right to Criticize the Government

4. Economic Liberty:

It means reasonable material security. Civil and political liberties become meaningless in the absence of economic liberty. Economic liberty docs not imply free competition in the economic sphere. It lies in the absence of gross inequalities of wealth that may enable some to obtain an unfair control over the lives and happiness of others by the mere fact of their economic superiority. It implies a socialist or socialistic system of economy. Therefore, economic liberty means right to work, right to

a decent wage, right to leisure and right to social insurances like old age, sickness, disablement and unemployment insurances.

5. National Liberty:

It implies that every nation has a birth right to be free from political domination of others. It is synonymous with national independence or Swarajya. It is based on the principle of self determination. Every nation has a right to regulate its national life according to its own will. Freedom is the necessary condition of devel-opment of every nation. No cultural social, economic or political development is possible so long as one nation is ruled by another. It is only when freedom is achieved by all nations of the world that a real international community can grow and possibilities of permanent peace can arise.

21.3 Safeguarding Social Freedom Or Liberty:

The following methods have been suggested as essential safeguards of rights and liberty:

1. Constitutional Guarantee of Rights:

Fundamental rights of the people in every state are guaranteed by the constitution which ensures to citizens the enjoyment of their rights free from any interference.

2. Independence of the Judiciary:

The rights of the people can be safe only in the hands of an impartial and independent judiciary. The judges must not be subservient to the executive or the legislature.

3. Eternal Vigilance:

According to Laski, "Eternal vigilance is the price of liberty." The citizens should be conscious and jealous guardians of their rights. Any encroachment on their rights must be protested against and if necessary, even resisted.

4. Rule of Law:

Rule of law implies equality of everybody, rich or poor, high or low, before the law. No person can be detained arbitrarily by the government without a proper trial in a duly established court of law.

5. Separation of Powers:

In the interests of individual liberty, three powers of government namely executive, legislative or judicial powers should be vested in three separate and distinct organs each independent of the other.

6. Democracy:

Democracy is considered to be the only form of government in which people can have the opportunity to protect their rights. In democracy political powers lie in the hands of the people. They can make or unmake a government.

7. Absence of Special Privileges:

Liberty is the equal possession of all and it can be effectively enjoyed by the general masses. It is only when equal opportunities are made open to all that a man can be really free. In a society where

class privileges and social and economic differences exist, there can be hardly any freedom for those placed in a position of inferiority.

8. Decentralization of Power:

Democracy does not mean only a parliament or the constitution. Democracy is not only a form of government it is a way of life. The people should take part in affairs of state at every level.

21.4 Social Security:

Social security is the comprehensive federal program of benefits providing workers and their dependents with retirement income, disability income, and other payments. The Social security tax is used to pay for the program.

Social Security is a government program that provides economic assistance to persons faced with unemployment, disability, or agedness, financed by assessment of employers and employees. It is the economic assistance provided by government. Government provides economic, and sometimes social, welfare of the aged, unemployed, etc., especially through pensions and other monetary assistance

Matters relating to Social Security are listed in the Directive Principles of State Policy and the subjects in the Concurrent List. The following social security issues are mentioned in the Concurrent List III in the Seventh Schedule of the Constitution of India-

Item No. 23: Social Security and insurance, employment and unemployment.

Item No. 24: Welfare of Labour including conditions of work, provident funds, employers' liability, workmen's compensation, invalidity and old age pension and maternity benefits.

Part IV Directive Principles of State Policy

Article 41 Right to work, to education and to public assistance in certain cases

The State shall, within the limits of its economic capacity and development, make effective provision for securing the right to work, to education and to public assistance in cases of unemployment, old age, sickness and disablement, and in other cases of undeserved want. Article 42 gives the Provision for just and humane conditions of work and maternity relief. The State shall make provision for securing just and humane conditions of work and for maternity relief.

21.5 Social Justice:

The term "social justice" implies several sound and eminently desirable concepts enunciated for the good of society in general, and of course it covers fair play for every section, especially the weaker groups in the population.

The Constitution, which is the fundamental law of the land. The preamble itself says: "We, the people of India, having solemnly resolved to constitute India into a sovereign, socialist and democratic Republic and to secure to all its citizens-Justice, social, economic and political...." Clearly, social justice in all its forms and to all citizens was regarded as fundamental to the set-up which our founding fathers prescribed for the country; it is mentioned on top of the other equally sound concepts, and yet this very concept is being violated by countless people with amazing impunity, without fear.

There are distinct classes in society which stick to their privileges and refuse to share their riches and assets with others, even while crores of people live in misery and perpetually groan under the burden of unfair practices, unjust policies and gross inequalities.

The State, according to Article 15(1) of the Constitution, "shall not discriminate against any citizen on grounds only of religion, race, caste, sex, and place of birth or any of them." The State, officially, indeed does not differentiate between man and man on any of these grounds, but at the same time the government and the administrative machinery have proved incapable of enforcing this provision.

Chapter III of the Constitution, entitled "Fundamental Rights", enumerates a series of rights which all Indian citizens are supposed to enjoy, and yet the number of people who are able to enjoy these rights in practice is much less than those who are denied their exercise. Their life continues to be one long, tragic and heart-breaking story of deprivation and sufferings through official and public apathy. Their poverty is a permanent handicap which prevents them from seeking redress from the courts, for grave wrongs done to them month after month by men in privileged positions, and also those who are protected by the men in power; ministers and legislators, in effect their patrons. In other words, they are all partners in the guilt and deserve to be hauled up for violating the Constitution and many other social reform laws passed by the Parliament.

One of the common forms of social injustice found in many countries is corruption. Corruption itself is a form of exploitation, because people holding key positions extort money in the shape of bribes, gifts and services, even for rendering simple services which are their duty. This process makes total nonsense of "equality of opportunity" guaranteed under the Constitution. Only those who have money can give bribes and grease the palms of greedy people. The rest have to suffer through the bureaucratic ways, especially red tape, which in itself involves injustices to the countless people.

In the modern world there is lack of discipline, and there are hardly any morals. The absences of these vital traits of character signify the absence of social and economic justice. Now in any society we do not find any sign of justice or fair play in any sphere of activity. It is injustice and corruption on all over. Justice is becoming scarcer with every passing year. The coming years hold little promise of restoring social injustice in the country.

21.6 Self Assessment Questions:

1. What is social freedom?
2. Explain various types of social freedom.
3. What is social security
4. What is the value of social justice in the modern society?

Lesson Writer

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