

# 10 SCIENCE AND TECHNOLOGY

In this chapter you will learn:

- Role of Science and Technology in the Development of the Country
- Lasers
- Fibre Optics
- Satellites and Radar
- Radioactivity
- X – rays
- Ultrasound
- E.C.G, E.E.G, MRI, C.T. Scan, Angeography
- Important Industries of Pakistan

## 10.1 Role of Science and Technology

We had extremely limited resources in the beginning when Pakistan came into being. Most of the things of daily usage had been imported from other countries. In the field of science and technology we were lagging so much that even a bicycle or a fan was not manufactured. By the grace of God, motor cycles, cars, tractors and even ships are now made in Pakistan.

No doubt, it is the age of science and technology. Without the progress in this department, no country can keep the stability of real independence. It always depends on others for its necessities.

In the medical sector we have made higher achievements. In modern diagnosis, Ultrasound, CT scan, ECG, MRI and in modern ways of treatment surgery of vital parts of the body angiography, angioplasty etc. are becoming common. There is also advancement in laser treatment whereas radiotherapy is also onto the road of success.

Agricultural development is quite evident. In the past, when cultivation was done by ploughs. But now almost everyone is cultivating by tractors and modern equipments. Efforts made by agriculture department are appreciable for providing good seeds for good production. Now many universities are linked with this department.

Evident Progress is attained in industries such as sugar, cement, glass and ceramics. Sports items, surgery tools and hand made carpets, made in Pakistan, are very popular in the world. The use of optical fibre for the improvement of communication system, has placed us among the developed countries. In engineering department besides heavy machinery, the role of cottage industry is exemplary.

After achieving the enrichment of uranium, Pakistan made a nuclear test and proved to the world that it has full capability of its defence. Pakistan is not lagging behind its opponent in manufacturing long range missiles, tanks and ships also.

## 10.2 Lasers

Laser is an abbreviation of the light amplification by stimulated emission of radiation. Laser is an intense beam of light in which all the waves have the same wavelength and all are in phase. Such a beam of light is called monochromatic. Laser beam travels in one direction, whereas ordinary light spreads out. That is why the ordinary light covers a large distant area while the laser does not spread. Due to this characteristic of laser, different figures can be displayed in space. Because laser is an amplified light i.e., it intensifies the light. To raise the intensity of light, it is amplified again and again. For this purpose two plane mirrors are used.

### Tidbits

The first laser ever used is ruby crystal which is excited by a powerful flash of light.

Usually crystals e.g., ruby, glass or semi-conductors are used to make lasers. Beside these, some gases are also used for this purpose.

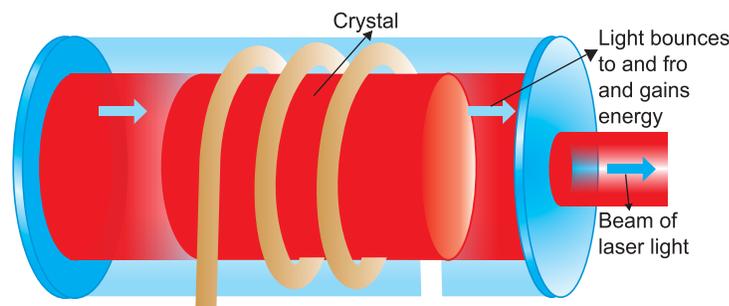


Fig. 10.1: Apparatus used in laser

### Applications of Laser

Now-a-days, use of laser has become very common. A few of the applications are given below:

## Surgery

Lasers are employed as light scalpel, that is surgical cutting and coagulation tool. When a laser beam is focussed onto a tissue, it cuts down after being too much hot. Thus only that area is cut on which it is focussed. Laser does not harm the surrounding portion. By laser surgery the blood coagolatics in capillaries so it protects from bleeding. Laser surgery is of special importance in liver operation.

## Ophthalmology

Argon lasers are presently used for operating cataract and glaucoma.

## Dermatology

Laser radiations are used for many skin diseases and removal of stains and pigments in the skin.

## Dentistry

Laser presents promising application in clinical dentistry in which by means of photocoagulation nerves a special painted material is fused into teeth cavities.

Laser surgery is also used for the following diseases:

- 1- Laser surgery has been used to treat cancer.
- 2- Lasers are used to crush gallstones and kidney stones without any surgery, the process is called lithotropsy.
- 3- Lasers are used to mend retina of human eye.
- 4- Lasers are used to reshape cornea to improve poor vision.
- 5- By laser, holes can be drilled in the hardest material e.g., steel, diamond, also in glass or metals precise patterns are made by cutting very carefully.
- 6- Laser is used to produce three-dimensional images called holograms. This process is called holography.
- 7- Military purposes are also fulfilled by laser technology e.g., by laser guided missiles and bombs, aircrafts and tanks can be hit accurately.
- 8- Use of lasers and optical fibres have revolutionized the communication system.
- 9- In super markets, record of prices of items is stored in computer. To sell an item it is scanned by laser and every detail appears on screen.

## 10.3 Fibre Optics

### Principle of Fibre Optics

When a ray of light passes from a denser to a rarer medium it bends away from the normal to the interface. Now if we go on increasing the angle of incidence then at a particular angle of incidence, the angle of refraction will become  $90^\circ$  (Fig.10.2). When the angle of incidence is made greater than  $\theta_c$ , the ray does not refract but reflects into the same medium. It is called the total internal reflection.

Light through optical fibre also passes due to the total internal reflection. Optical fibres are fine strands of glass. The fibres have a core of pure glass, which is surrounded by a different kind of glass. These days in telecommunication optical fibres are replacing metal cables for transmitting telephone calls in a better way. In this way each caller's voice is changed into a light signal.

### Uses

Optical fibre enables doctors to look inside the human body. As optical fibres are very thin so it can be easily passed into the body to get the required picture. In eye surgery light is obtained from fibre optic light guide. Optical fibre can transmit thousands of telephone calls. T.V. programmes can be transmitted by one or two flexible and thin hair-like optical fibres.

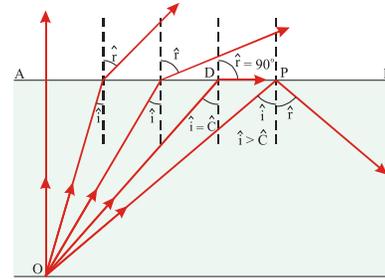


Fig. 10.2. Total internal reflection

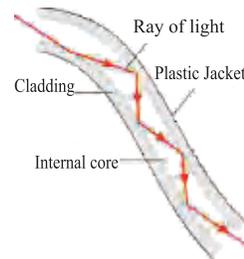


Fig: 10.3. Optical fibre

## 10.4 Satellites and Radars

### Satellites

T.V. displays slides about the address of any celebrity or about different matches, world Olympics, Taraviih in Ramazan-ul-Mubarak and sacred occasions of Haj, before the commencement of programme. All these programmes are relayed through artificial satellite.

There are some communication satellites which relay the telephonic conversation and send the T.V. programmes all over the world. These revolve in particular orbits, which are called geo-stationary orbits.

Electrical power for the satellites is provided from panels of solar cells. These panels convert solar energy to electricity. The spacecraft travelling far away from the Sun carry small nuclear reactors with them to generate the required power.

## Radar

The word radar is derived from radio detection and ranging. Radar is a reliable instrument for sending and receiving electromagnetic waves, which are usually in the form of radio waves or microwaves. Electromagnetic waves travel with speed of light. Its characteristics depend on the wavelength. Radar remote detection system is used to locate and identify objects.

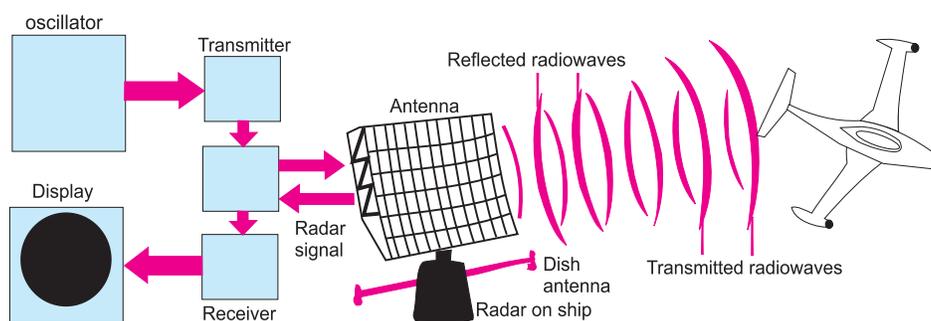


Fig. 10.4

Radar transmits, short pulses of high frequency radio waves by means of a revolving aerial. When pulses strike an object, these are reflected, which are received by radar antenna. A trace or shape of that object appears on a screen (Fig. 10.4). Radar can determine a number of properties of distant objects such as its distance, speed and direction of motion.

Radar controls air traffic both civilian and military. Large network of ground based radar system helps air traffic controllers to keep track of aircraft to prevent mid-air collisions. Commercial and military ships also use radar to make ships alert of obstacles especially in bad weather and dim light. Military forces around the world take the help of radar to detect aircraft, missiles, troops movement and ships at sea. In this scientific age radar is used to know about weather and to forecast for rain or storm. Some spacecrafts also carry radar for mapping the surface of planets covered by thick clouds.

## 10.5 Radioactivity

The elements having atomic number greater than 82, continuously go on emitting radiations. These elements are called radioactive elements. The phenomenon of emission of radiation from these elements is called radioactivity. These radiations are of three types  $\alpha$ ,  $\beta$  and  $\gamma$ .

In 1896, Henry Becquerel by chance discovered radioactivity. He observed that uranium salt makes the photographic plate foggy. The process continued despite of uranium was covered by black sheet.

### Alpha Radiation

Alpha radiations comprise of fast moving helium nuclei, mass of helium is 4 and charge is +2. These carry positive charge. Compared to  $\beta$  and  $\gamma$ -rays the range and penetrating power of  $\alpha$ -radiation is small.

### Beta Radiation

Beta particles are fast moving electrons. Its mass number is zero and charge number is 1. Its penetrating power is greater than that of  $\alpha$ -particles.

### Gamma Radiation

Gamma rays are high energy carrying electromagnetic radiations.  $\gamma$ -rays are identical with X-rays but gamma rays are of short wavelength, and have high energy. Their range and penetrating power are also greater.  $\gamma$ -rays are ejected from the nucleus. These are not affected by electric or magnetic fields.

### Isotopes

Isotopes are the nuclei of the same atomic number and different mass number and have the same chemical properties, e.g., chlorine 35 and chlorine 37 are the two isotopes of chlorine.

### Radioisotopes and Their Uses

The isotopes which possess radioactive nature are called radioisotopes. There are many advantages of isotopes in some fields e.g., industry, scientific research and medicine.

- (1) In industries radioisotopes are used as tracers. These are used to check the flow of liquid in chemical plants.
- (2) The ability of a substance to absorb  $\gamma$ -rays has been adapted to keep automatic control on the thickness of paper, plastic and metal sheets as it is passed through the production plant.
- (3) Besides this radioisotopes detect the crack or leakage in the underground pipe.
- (4) Radioisotopes are being used in scientific research to study the chemical reactions on a wide scale. Phosphorus 32 and sulphur 35 are employed on living system to trace the metabolic path.
- (5)  $\gamma$ -rays are used to detect the flaws and cracks of metal parts.

- (6)  $\gamma$ -ray are employed to preserve food for a long period. If  $\gamma$ -rays are passed through food stuff, bacteria in it get killed. Food without bacteria does not go bad for a long time specially when it is stored in air tight containers. But if there occurs any change in the food it is dangerous to take such food. The treatment for this purpose needs intensive care.

### Protection and Precautions against the Radiation

The cells of the body undergo dangerous physical and chemical changes as a result of exposure to radiation.

1. The extent of the damage depends on nature of radiations, parts of the body exposed to radiation and duration or dose of radiation.
2. Radioactive sources should be stored carefully. It should be tagged “R” for radioactive materials.
3. Laboratory walls, floor, benches should be hard gloss painted.
4. Lab should be capable to be washed thoroughly so that any crack on the bench, the floor-wall joins should be free of radiations.
5. Clothings for the lab and out door should be kept separate.
6. Use the gloves according to situation.



Symbol of radioactivity

## 10.6 X-rays

X-rays is one of the monumental discoveries of mankind, which was discovered accidentally. When high energy electrons impinge on metal surface, very powerful radiations are emitted. These radiations are called X-rays (Fig.10.5). X-rays are those high energy photons, which are liberated from the metal due to collision of fast moving electrons. Materials which contain only light atoms do not absorb much X-rays. For example, they pass easily through most living things, but not through bones, which contain heavier atoms. This means that X-rays can be used to find defects in the bones and teeth inside the body without surgery.

### Properties of X-rays

- (i) These rays are not deflected by an electric or a magnetic field.

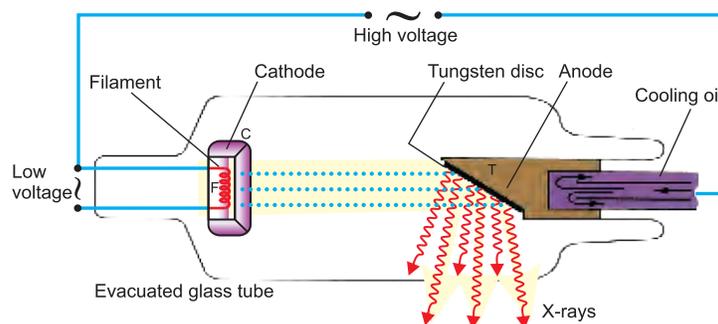


Fig. 10.5

- (ii) These are highly penetrating rays. Their penetrating power depends on the density of the objects with which they strike. Higher the density, lesser is the penetration.
- (iii) Compared to light, these are short wavelength electromagnetic waves. Their frequency is greater.
- (iv) These affect the photographic plate more than the light rays.

### Uses of X-rays

- (i) X-ray technology lets the doctors to see the depth of human tissues, to examine broken bones, cavities and to trace the swallowed objects.
- (ii) By latest experiments on X-rays, physicians have become expert in locating the diseases in soft tissues e.g., lungs, blood vessels and intestines.
- (iii) In the industrial world, even a minute flaw in heavy metallic equipments is detected by X-ray scanner, in twinkling of an eye.
- (iv) X-ray scanners are used as standard equipment for airport security.

### PRECAUTION

As X-rays can be harmful for the cells of human body, therefore, these should be applied very carefully and used if necessary.

## 10.7 Ultrasound

Ultrasound is the sound that cannot be heard because its frequency is much greater than the frequency which a normal ear can hear.

**Sounds having frequency greater than 20 kHz are said to be ultrasound or ultrasonics**

Usually two-dimensional images are obtained by ultrasound whereas the objects are three dimensional.

Recently such developments have been made in ultrasound machines that two dimensional images obtained are changed into three dimensional images by special computer software.

When the moving object reflects ultrasound then a change occurs in its reflected frequency. When probe moves near to the body, the frequency rises and when probe is away frequency decreases. How much the frequency is changed, depends upon fast or slow movement of the body.

Ultrasound of any body can be done much faster than X-rays. Without using radiation the structure of the body can be observed. Because, with the help of ultrasound the structure of internal organs of the body or any defect in them can be judged without doing any surgery, therefore, the importance of ultrasound is increasing in medical diagnosis section.

### Uses of Ultrasound

- (i) Speed of blood flow through kidneys can be determined.
- (ii) In kidneys, pancreas, gallbladder, the presence of stone can be located.
- (iii) In jaundice, condition of liver and arteries can be observed.
- (iv) Internal heart structure and irregularities in blood circulation system can be studied.
- (v) Tumor in the body or cancer in any organ can be detected.
- (vi) Any sort of obstrectries can be located.
- (vii) Ultrasound is helpful in some medical processes, e.g.
  - To break kidney stone by ultrasound.
  - Use in biopsy.
  - Extraction of extra water from lungs and abdomen in different diseases.

#### Tidbits

If dirty object is dipped in water and ultrasound is switched on, the dirt separates from the object due to vibration.

Besides this, sonar systems fitted on ships and submarines use ultrasounds, to find the hidden secrets under water.

## 10.8 E.C.G. (Electrocardiogram)

Electrocardiogram is the test that measures the electrical activity of the heart. The heart beats in a peculiar way so that blood may be pumped through the whole body. In an E.C.G. test, the electrical impulses, which are produced due to heart beating, get recorded and usually appear on a strip of paper, which is known as an electrocardiogram. Because any heart disease affects the heartbeat, so it records any problem in the regularity of heartbeat. If one feels

difficulty in breathing (dyspnoea), chest pain (angina), feeble or fast (palpitation) heart beat becomes abnormal, then it is better to have an E.C.G. in that state.

E.C.G. not only helps to discover the heart disease but also informs how well the patient is responding to the treatment. If E.C.G. recording taken at rest is normal but the patient is feeling suffocation or pressure on chest, then E.C.G. recording may be made when the patient is exercising, this may reveal the problem. From E.C.G. proof of problem in coronary artery can be had. It can be used to assess that the patient is under heart attack or evidence of previous heart attack.

#### BE CAREFUL

While exercising if the patient complains chest pain or any change in E.C.G. is observed or blood pressure drops, the test may be discontinued.

## 10.9 E.E.G. (Electroencephalography)

Recording of electrical activity of brain called brain waves from outer surface of head is said to be E.E.G. To get E.E.G. sixteen electrodes are set on different places for about 10-30 minutes and informations are collected about brain waves.

### Uses

1. To diagnose the different types of epilepsy and to enquire about the beginning of this disease into the brain.
2. To diagnose different brain diseases e.g., dementia, encephalitis and hypoglycemia.
3. To know the effect on brain (Hepatic Encephalopathy) due to liver problem.
4. To collect informations about brain death and coma condition.

## 10.10 MRI (Magnetic Resonance Imaging)

MRI is the special medical diagnostic technique that creates images of the body using the principles of nuclear magnetic resonance. This generates thin section images of any part of the body including the heart arteries and veins from any angle and direction without surgical application and in a relatively short period of time. These informations may allow early diagnosis of many diseases.

These days in medical departments MRI is specially preferred for diagnosing central nervous system. MRI scanner is better than x-ray because it can distinguish both, normal and

diseased state of a soft tissue. Provides informations about the existence of cancer in brain, hemorrhage, obstruction in brain artery etc.

## 10.11 C.T. Scan (Computerized Tomograph Scan)

C.T. Scan is a special type of X-ray, which is obtained by sending several beams of X-rays at different angles through the body instead of passing a single X-ray beam. The machine used for this purpose is called C.T. scanner. C.T. scanning technique was discovered by a British scientist Sir Geoferry Hounsfield, for which he got the Nobel award. Scanner looks like a doughnut.

For scanning, patient is laid in such a way that the body part to be examined is placed in the round tunnel or opening of the scanner. The bed is then moved slowly backward and forward to allow the scanner to take pictures of the body, without touching it.

Duration of test depends on the number of pictures and angles selected for pictures. Scanning does not hurt, but some people find it uncomfortable to lie in the tunnel, as there is little room inside the tunnel. In the same way some people get nervous because of the whirling noise of the machine, while working.

### Uses

1. To detect the blockage in intestines
2. To study about the structure of abdominal organs and condition of aorta.
3. To get knowledge for the lungs cancer and its spreading, effects on lungs due to cancer or different diseases of lungs.
4. To know about brain diseases e.g., brain cancer, brain constriction or haemorrhage, coagulation of blood due to head injury.

### Do You Know?

As more X-rays are involved in C.T. Scan than an ordinary X-ray so the doctors recommend C.T. Scan in a sound medical reason.

## 10.12 Angeography

Angeography is a way to produce inside pictures of arteries. When arteries are blocked or suffer any loss or any irregularity developed in them, then chest pain, heart attack, stroke or any other problem may occur. Angeography helps the physician to determine the source of problem and the extent of damage to the arteries segments. By angeography blockage or constriction in heart arteries are known, by which choice of treatment procedure becomes easy e.g., replacement of valve, by-pass operation or to lay a pace maker.

## 10.13 Important Industries of Pakistan

### 1. Sugar Industry

Sugar industry is one of the vital industries. Sugar is naturally present in most of the green plants and fruits. It is formed through a natural process called photosynthesis. Two main sources of sugar are sugarcane and sugarbeet.

#### Preparation of Sugar from Sugarcane

Sugar is mostly made by sugarcane. Sugar is stored in the stalks of sugarcane. Sugarcane contains sucrose, glucose, fructose, water, fibres and some other materials. From ingredients of sugarcane, sucrose is extracted in white crystals. This is called sugar.

Sugar mills are located near fields, because sugarcanes start losing its weight slowly, after it is harvested, therefore it is crushed quickly. Moreover sugarcanes require a large space, so it is difficult and expensive to carry them. Sugarbeet is second major source of commercial sugar in the world. This grows in cold climate. Sugar is stored in the roots of beets.

Sugar is manufactured through the following processes.

#### (i) Extraction of Juice

Sugarcane is cut into small pieces, the rind and nodes of the canes are separated. Then cane is crushed by crusher and juice is extracted leaving the bagasse.

#### (ii) Purification of Juice

Juice is passed through strainers to remove straws and the bagasse. Then impurities are removed from juice so that strained, purified juice is obtained.

#### (iii) Evaporation of Juice

Purified juice that contains sucrose, water and certain impurities is sent to evaporator for the removal of surplus water. The obtained syrup is changed into concentrated syrup for raw sugar. Then from concentrated syrup, white sugar is obtained. In evaporation process the juice is heated from 100°C to 110°C.

#### (iv) Crystallization

Concentrated syrup is boiled in sugar boiling plant where crystallization is carried out to the desired size of grains.

#### (v) Centrifugation

In this process, sugar crystals are separated from molasses and washed with steam if necessary.

#### (vi) Drying and Bagging

Drying sugar with hot air in dryers is then bagged for marketing.

Following by-products are obtained during manufacturing sugar:

**(a) Bagasse**

This is used as fuel in sugar mills. The surplus is being used in manufacturing of paper, chipboard and boards.

**(b) Molasses**

Most of the available molasses is exported. A small percentage is used for production of alcohol and cattle feeds.

## **2. Steel Industry**

According to the need, iron is melted, and hot air is passed to make it free of impurities. Ore is an important source of iron. By mixing oxygen in it, a compound is made. Ore is mixed with carbon and limestone and on heating it is changed into pig iron. Adding scrap iron and limestone into pig iron, it is sent back to the furnace to get pure iron. Iron is mixed with carbon or sometimes with other elements to produce extra hardness according to necessity. It is called steel. Ordinary steel contains carbon upto 1.7%. It is used for building plazas, factories, ships, aeroplanes and car bodies. To save from rust these may be coated with paint or plastic or with protective layer of zinc. Stainless steel is a mixture of chromium, nickel, molybdenum, which is used to make surgery tools and home appliances and every type of light and heavy machinery.

Pakistan steel mill is providing raw material for engineering and construction industries. And those lower level industries, which depend upon Pakistan steel mills products, are fed by it. As Pakistan has iron resources, so steel mill prepares millions of tonnes of steel. Though Pakistan's steel products are very popular but surgery tools are at the top of this list. Gujranwala and Sialkot are famous for these products all over the world.

## **3. Pharmaceutical Industry**

Pharmaceuticals are medical products, which are prescribed by doctors for different diseases. The place where these products are prepared is called pharmacy. Pharmacy simply is the preparation of medicines. The industry linked with the preparation of medicine is called as pharmaceutical industry. Earlier we were dependent mostly on imported medicines. But gradually attention was given to pharmaceutical industry. Now we prepare most of the medicine in our country. Pharmaceutical industry is based on pharmaceutical chemistry which is of course a branch of chemistry in which preparation of new compounds, its testing and its effects on the human health are examined.

## **4. Synthetic Fibre Industry**

There are two types of fibres:

- (i) Natural Fibre**
- (ii) Artificial Fibre**

**(i) Natural Fibre**

Natural fibre is obtained by natural resources e.g., cotton, jute, wool, silk, etc.

**(ii) Artificial Fibre**

Artificial fibre, is that fibre which is prepared by the man himself using different raw materials e.g., polyester, nylon, rayon, acetates, viscose, acrylic etc. These are obtained from petroleum, and are prepared by different methods. Steel fibre, carbon fibre, Teflon fibre are also fibres. The formation of synthetic fibres includes the process like polymerization, spinning stretching, cutting and reeling.

**5. Cotton Textile Industry**

Textile is the major sector of Pakistan industry. Textile industry is mostly located in Karachi, Lahore, Multan, Faisalabad and Gujranwala. Textile industry comprises of the following sections:

- (i) Spinning
- (ii) Weaving and fabric formation
- (iii) Garments manufacturing

**(i) Spinning**

Cotton bales are sent to the textile mills where cotton fibres are changed into yarn.

**(ii) Weaving and fabric formation**

Fabric is made from yarn. Two methods are employed for it.

**Weaving:** Here the fabric is made on looms.

**Knitting:** In this process fabric is knitted on machines.

First of all, fabric is cleaned, impurities are removed from it and then fabric is dyed or printed.

**(iii) Garments Manufacturing**

Garments from different fabrics are stitched to make it ready. Here cutting, stitching and pressing departments are involved.

At the time of independence of Pakistan, textile industry had no base as was the case with almost all industries. Hence Pakistan was entirely dependent upon imported yarn as the hand-made looms were insufficient to meet the country demand. But now, major contributions towards the foreign exchange earned by Pakistan comes from textile industry.

**6. Leather Industry**

Leather is usually obtained from the hides (skins) of different animals like horses, buffalos, sheep, camels etc. Apart from this, leather is also prepared from different chemicals. It is called artificial leather.

Skins or hides are passed through different processes, which is called tannery (Fig.10.6). Finished leather from tannery is used for different purposes e.g., leather garments purses, jackets, attaché cases etc. Leather garments are mostly made in Kasur, Gujranwala, Faisalabad, and Sialkot and are popular in many foreign countries.



Fig. 10.6

### IMPORTANT POINTS

- Laser is the abbreviation of light amplification by stimulated emission of radiation. It is a device to produce an intense beam of light in which all waves have the same wavelength and all waves are in phase.
- Optical fibres are fine strands of glass. Light passes through optical fibre due to total internal reflection.
- Spacecraft is said to be an artificial satellite, which is launched in a particular orbit around the planet.
- The satellites in geo-stationary orbit to relay T.V. programmes and messages are called communication satellites.
- Radar is a reliable instrument for sending and receiving electromagnetic waves or micro-waves.
- Elements having atomic number greater than 82 continuously go on emitting radiations. These elements are called radioactive elements. The phenomenon of emission of radiation from these is called radioactivity.
- The isotopes which emit radiations are called radioisotopes.
- X-rays are high energy electromagnetic waves which pass through paper, wood, flesh etc.
- The sounds having frequency greater than 20 kHz are called ultrasound or ultrasonic.
- Electrocardiogram is a test that measures the electrical activity of heart.
- Electrical activity of brain recorded from outer surface of head, is said to be E.E.G.
- MRI is a special type of medical diagnostic technique, which makes images on the principle of nuclear magnetic resonance.
- C.T. scan is a special type of X-ray, which is obtained by sending several beams of X-rays at different angles through the body instead of single X-ray beam.
- Angiography is a way to produce X-ray picture from inside the arteries.
- In Pakistan sugar is manufactured by sugarcane and beet.

- The industry linked with medicines is said to be pharmaceutical.
- Artificial fibres like polyester, nylon, rayon, acrylic, etc. are obtained from petroleum.
- In textile industries, yarn and fabric is prepared.
- Leather industries prepare leather and leather articles from skins or hides.

## GLOSSARY

<b>Leaser :</b>	Form of light having all waves of the same wavelength and inphase as well.
<b>Fibre Optics:</b>	Communication in the form of light signals.
<b>Satellite:</b>	Spacecraft revolving round a planet.
<b>Radar:</b>	A device to detect aeroplanes etc. by means of electromagnetic waves.
<b>Radioactivity:</b>	Emission of radiation from nucleus of an atom.
<b>Isotopes:</b>	Nuclei of the same atomic number and different mass number.
<b>X-ray:</b>	High energy electromagnetic waves which pass through paper, wood, flesh, etc.
<b>Ultrasound:</b>	Sound waves of frequency greater than 20 kHz.
<b>E.C.G:</b>	Electrocardiogram , which is the electrical activity test of heart.
<b>E.E.G:</b>	X-ray of brain condition.
<b>MRI:</b>	Magnetic resonance imaging test.
<b>Angeography:</b>	A way of taking pictures from inside the arteries.
<b>C.T. Scan:</b>	A special type of x-ray at different angles through the body.
<b>Sugar Industry:</b>	Mills producing sugar from sugarcane and beets.
<b>Steel Industry:</b>	Mills manufacturing steel from raw iron.
<b>Pharmaceutical Industry:</b>	Factories of medicines.
<b>Synthetic Fibre Industry:</b>	Industries preparing artificial fibre.
<b>Cotton Textile Industry:</b>	Mills to prepare yarn and fabric from cotton.
<b>Leather Industry:</b>	Factories preparing leather and its articles from skins or hides.

**QUESTIONS**

- Q 1.** Mark(✓) against the right and (×) against the wrong statement.
- (i) There is no difference in laser light and ordinary light.
  - (ii) Hearing aid is called radar.
  - (iii) X-rays can pass through flesh.
  - (iv) Rays emitted from radioactive sources are harmless.
  - (v) Ultrasound are the sound waves of frequency greater than 20 kHz.
- Q 2.** For every statement given below, four answers are given. Select the correct answer.
- (i) Emission of radiations from nucleus is said to be
    - (a) chemical reaction
    - (b) atomic reaction
    - (c) radioactivity
    - (d) nuclear fission
  - (ii) Frequency of ultrasound is:
    - (a) less than 20 Hz
    - (b) 20 Hz
    - (c) 20kHz
    - (d) more than 20 kHz
  - (iii) Radioactivity occurs naturally from all the elements with atomic number greater than
    - (a) 62
    - (b) 70
    - (c) 80
    - (d) 82
  - (iv) The principle of light on which the fibre optics work is
    - (a) reflection
    - (b) refraction
    - (c) total internal reflection
    - (d) dispersion
- Q.3.** Fill in the blanks.
- (i) Alpha particles are deflected towards \_\_\_\_\_ plate.
  - (ii) The \_\_\_\_\_ rays are not affected by any field.
  - (iii) Optical fibres are fine \_\_\_\_\_ of glass.
  - (iv) The \_\_\_\_\_ of all waves of laser is the same.
  - (v) E.C.G. evaluates the \_\_\_\_\_ activity of heart.
- Q.4.** Give brief answers.
- (i) Which objects are used for laser?

- (ii) From where do the satellites get electrical power?
  - (iii) What are called the elements, which emit radiation?
  - (iv) Differentiate between E.C.G. and E.E.G.
  - (v) How steel is made harder?
- Q. 5. What is laser? Describe few important uses of it.
- Q. 6. Define optical fibre. Describe its construction, principle and working.
- Q. 7. What do you mean by radar system? How does it work? Write some of its uses.
- Q. 8. Discuss in detail the satellite and its types and highlight its uses.
- Q. 9. What is radioactivity? How many are the types of radiations? Describe their characteristics.
- Q. 10. What are radioisotopes? Write down some of their uses.
- Q. 11. How are X-rays obtained? Write their properties and uses.
- Q. 12. What is the difference between X-rays and C.T. scan? Which method is better for treatment?
- Q. 13. Highlight the importance and uses of steel mill.
- Q. 14. Write a note on pharmaceutical industry.
- Q. 15. What are synthetic fibres?
- Q. 16. What do you know about important sections of textile industry?
- Q. 17. Write a note on leather industry.
- Q. 18. Describe sugar processing in detail.