**UNIT 5 – POLLUTION**

**NUCLEAR HAZARDS AND HUMAN HEALTH RISKS**

Radiations are the waves of energy that travels and spread all around in our environment. These radiations are useful as well harmful for us.

Examples include visible light, radio waves, microwaves, infrared and ultraviolet lights, X-rays, and gamma-rays, etc.

The differences between these various types of radiation consist in some physical properties such as energy, frequency, and wavelength.

Radiation pollution refers to the increase in the natural radiation levels in our surroundings due to human activities. It is said that in today’s world about 20% of radiation we are exposed to is due to human activities.

The human activities that may release radiation involve activities with radioactive materials such as

 mining,

 handling and processing of radioactive materials,

 handling and storage of radioactive waste,

 use of radioactive reactions to generate energy (nuclear power plants),

 use of radiation in medicine (e.g. X-Rays) and research.

Microwaves, cell phones, radio transmitters, wireless devices, computers, and other common commodities of today’s life are also the sources of various types of radiations.

Radioactive radiations are however believed to be the most harmful radiations. Radioactive substances are present in nature. They undergo natural radioactive decay in which unstable isotopes spontaneously give out fast moving particles, high energy radiations or both, at a fixed rate until a new stable isotope is formed. The isotopes release energy either in the form of gamma rays (high energy electromagnetic radiation) or ionization particles i.e. alpha particles and beta particles.

The alpha particles are fast moving positively charged particles whereas beta particles are high speed negatively charged electrons. These ionization radiations have variable penetration power. Alpha particles can be interrupted by a sheet of paper while beta particles can be blocked by a piece of wood or a few millimeters of aluminium sheet. The gamma rays can pass through paper and wood but can be stopped by concrete wall, lead slabs or water.

**Sources of Radioactivity**

Various sources of radioactivity can be grouped into two broad categories

1. Natural sources: Sources of natural radioactivity include cosmic rays from outer space, radioactive radon-222, soil, rocks, air, water and food, which contain one or more radioactive substances.

ii Anthropogenic sources: These sources are nuclear power plants, nuclear accidents, X-rays, diagnostic kits, test laboratories etc. where radioactive substances are used.

**Effects of Radiations**

 Genetic damage is caused by radiations, which induce mutations in the DNA, thereby affecting genes and chromosomes. The damage is often seen in the offsprings and may be transmitted up to several generations.

 Somatic damage includes burns, miscarriages, eye cataract and cancer of bone, thyroid, breast, lungs and skin. Many scientists are of the view that due to body’s ability to repair some of the damages, the adverse effects of radiations are observed beyond a threshold level. However, the other group believes that even a small dose of radiations over a period of time may cause adverse effects.They believe that the permissible limits of ionising radiations should be further reduced.

 Damage caused by different types of radiations depends on the penetration power and the presence of the source inside or outside the body.

 Alpha particles lack penetration power but they have more energy than beta. They will be, therefore, dangerous when they enter the body by inhalation or through food.

 Alpha particles cannot penetrate the skin to reach internal organs whereas beta particles can damage the internal organs.

 Greater threat is posed by radioisotopes with intermediate half-lives as they have long time to find entry inside the human body.

 Radioisotopes enter the environment during mining of uranium. The radio activity in the earth’s crust enters the crops grown there and ultimately reaches in human beings.

 Radionuclides enter the water bodies or the groundwater coming in contact with the contaminate soil or rock.

 Eg. Radioactive Iodine (I131) accumulates in thyroid gland and causes cancer. Similarly, strontium-90 accumulates in the bones and causes leuke mia or cancer of bone marrow.

**Control of Radiation/Nuclear Pollution**

a. Siting of nuclear power plants should be carefully done after studying long term and short term effects.

b. Proper disposal of wastes from laboratory involving the use of radioisotopes should be done.

c. Workers in nuclear plants should be provided with nuclear gadgets and safety measures against accidents.

d. Leakage of radioactive elements from nuclear reactors, laboratories, trans port, careless handling and use of radioactive fuels should be checked.

e. Level of radiation pollution should be monitored regularly in risk areas.

f. Disposal of radioactive wastes should be done with special attention.

**Case Study**

The Chernobyl disaster was a catastrophic nuclear accident that occurred on 26th of April, 1986 at the Chernobyl Nuclear Power Plant in Ukraine (then USSR), which was under the direct jurisdiction of the central authorities of the Soviet Union.

An explosion and fire released large quantities of radioactive particles into the atmosphere, which spread over much of the western USSR and Europe. The reactor which had been working continuously for 2 years was shut down on April 25, 1986 for intermediate repairs.

Due to faulty operations of shutting down the plant, explosion occurred in the reactor at 01.23 hrs on April 26, 1986. Three seconds later another explosion occurred. The explosion was so severe that the 1000 tonne steel concrete lid of the reactor 4 blew off. Fire started at the reactor due to combustion of graphite rods. The Chernobyl disaster was the worst nuclear power plant accident in history in terms of cost and casualties. Fuel and radioactive debris spewed out in a volcanic cloud of molten mass of the core and gases. The debris and gases drifted over most of the northern hemisphere. Poland, Denmark, Sweden and Norway were affected. During the accident itself, 31 people died, 239 people were hospitalized and long-term effects such as cancers are still being investigated. It was feared that some of the 5,76,000 people exposed to the radiations would suffer from cancer.