UNIT IV

RADIATION DOSE AND ITS EFFECTS

4.1 DOSE AND EXPOSURE MEASUREMENT

- The unit of exposure is roentgen (R) which was defined as 'That quantity of radiation which will release an electrical charge of 2.58×10^{-4} coulombs in one kilogram of dry air'.
- E x posure refers to the amount of ionization produced in air, and is not directly related to the energy absorbed in other materials, such as tissue.
- The Roentgen is an old unit. The new unit has no name but is simply the value in Coulombs per kilogram (C kg^{-1}),

  1 roentgen (R) = 2.58×10^{-4} C kg^{-1} dry air.
- Radiation dose is measured in two ways: 'absorbed dose'& 'dose equivalent'

Absorbed dose

- The absorbed dose is measured in terms of the energy absorbed per unit mass of tissue. Energy is measured in joules and mass in kilograms. The unit of dose is the 'gray' (Gy)

  1 Gy = 1J kg^{-1} of tissue. There is an old unit of dose which is still sometimes used, the rad,

  1 rad = 0.01 Gy = 0.01 J kg^{-1} of tissue.
- If 1000 particles are completely absorbed in 1 kg of tissue, then the energy absorbed will be 1000 times the energy of each particle.

Dose equivalent

- The unit of dose equivalent is that dose which gives the same risk of damage or detriment to health whatever the type of radiation. This unit is called the sievert (Sv):
- 1 Sv = 1 J kg^{-1} tissue × constant.
- There is an old unit of dose equivalent which is still used, the rem,
- 1 rem = 0.01 Sv = 0.01 J kg^{-1} tissue × constant.
- The dose equivalent in sieverts is obtained by multiplying the dose in grays by a constant:
- dose equivalent (Sv) = absorbed dose (Gy) × constant.
- The constant, called the 'radiation weighting factor', depends upon the type of radiation. For x- and γ -rays the constant is 1, for neutrons it is 10 and for α-particles it is 20.

2.Whole-body dose

The maximum permitted doses of 20 mSv (2 rem) for radiation workers and 1 mSv (0.1 rem) for the general public have already been explained.

Dose and its maximul level

Exposure to 5 mSv (0.5 rem) whole-body radiation Smoking 75 cigarettes

Travelling 2500 miles by motor car

Travelling 12 500 miles by air Rock climbing for 75 min Canoeing for 5 h

Working in a typical factory for a year Being a man aged 60 for 16 h

Being a man aged 30 for 20 days

3.Organ dose

If you swallow a radioactive isotope then there may be a hazard to a particular part of your body, and therefore maximum permitted doses are specified for particular organs.

The organ within which an isotope is absorbed, and also the rate at which it is excreted by the body, depend upon the chemical form of the isotope.

It is possible to calculate the dose equivalent absorbed by a particular organ when a particular radioactive compound is ingested. On the basis of this result a maximum permitted body burden can be defined which will give rise to an equivalent dose below the annual maximum permitted dose. This maximum permitted quantity will be different for every radioactive compound.