BM-3252 MEDICAL PHYSICS

UNIT II

Alpha decay

- Some heavy nuclei gain stability by a different form of radioactive decay, termed alpha (α) decay.
- The a-decay occurs mostly in heavy nuclides such as uranium, radon, plutonium, and so forth. Beryllium-8 is the only lightest nuclide that decays by breaking up into two a-particles.
- The a-particles are basically helium ions with two protons and two neutrons in the nucleus and two electrons removed from the helium atom.
- Alpha decay may be described by the following equation:

$$ {}^{A}_{Z}X \rightarrow {}^{A-4}_{Z-2}Y + \underset{\text{(alpha particle)}}{{}^{4}_{2}He^{+2}} + \text{transition energy} $$

- In this mode of decay, an alpha particle (two protons and two neutrons tightly bound as a nucleus of helium ${}^{4}_{2}He$) is ejected from the unstable nucleus.
- After a-decay, the atomic number of the nucleus is reduced by 2 and the mass number by 4. The alpha particle is a relatively massive, poorly penetrating type of radiation that can be stopped by a sheet of paper.
- An example of alpha decay is

$$ {}^{226}_{88}Ra \rightarrow {}^{222}_{86}Rn + {}^{4}_{2}He $$

$$ {}^{222}_{86}Rn \rightarrow {}^{218}_{84}Po + \alpha $$

- This example depicts the decay of naturally occurring radium into the inert gas radon by emission of an alpha particle. Again after an emission of alpha particle Radon decays into

Polonium.

- The α-particles from a given radionuclide all have discrete energies corresponding to the decay of the initial nuclide to a particular energy level of the product (including, of course, its ground state).
- The energy of the α-particles is, as a rule, equal to the energy difference between the two levels and ranges from 1 to 10MeV.
- The high-energy a-particles normally originate from the short-lived radionuclides and vice versa.
- The range of the α-particles is very short in matter and is approximately 0.03 mm in body tissue.
- The α-particles can be stopped by a piece of paper, a few centimeters of air, and gloves.