Radio Isotopes it's applications

Chapter l:-

- Introduction - Isotopes
- Radio isotopes source
- Absorbing Doscand Units of Radiation
- Type of Radiation:-
    - A - Charged Nuclear Particles
    - B - Electromagnetic Radiation
    - C - Neutron
    - D - Characterization of neutron
- Type of Decay:-
    - A - Decay
    - B - ß- Decay
    - C - Proton Decay
    - D - Neutron Decay
    - E - Positron Decay
- Pair Production
- Absorption of Gamma Rays
- Definitions:-
    1. Masses
    2. Charges
    3. Dimensions
    4. Density of nucleues
    5. Forces
- Cross section

Chapter 2:-

- Radioactivity
- Natural Radioactivity
    1. The Radioactive Decay law
    2. Radioactive of sample
    3. Half life time and mean life time (t 1/2, T)
- Artificially produced Radionuclides
- Units of Radioactivity

Chapter 3:-

- Nuclear - Particles reactions with matter:-
  1.charged particles :- (1. Range of charged particles 2. Specific ionization and stopping power).
  2. Electrons (determination electron range from absorption curve).
  3. Law of absorption
  4. - ray (absorption - ray from matter)
- Decay X and (3 with – ray
- Stopping of neutrons (Fast neutrons, slow neutrons).

Chapter 4:- Nuclear detectors

- Motion of electrons and Ions In gas
- Gas- Filled counters
- Ionization chamber
- Ionization chamber for neutrons
- Proportional counters
- Geiger - Mueller counter
- Scintillation counter and applications
- The solid - state counters

Chapter 5:-

- Principles of radiation and detection
- Principles Rules to uses Radio isotopes in industry
- Principles of Radiotracer Technique
- Fluid properties
- Flaw Rate Measurement
  1. Peak-to-Peak Method
  2. Dilution Method
  3. Total-count Method
  4. on – the - spot activation Method
  5. Activation analysis Method
- Flow pattern study
- Leakage Investigation
- Process characteristics
  1. Homogeneous Mixing
  2. Residence Time

*** Basic Nuclear properties**:

Nuclei have certain time-independent properties such as mass, size, charge, intrinsic angular momentum (often called nuclear spin), and certain time- dependent properties such as radioactive decay and nuclear reaction. The nuclei also have excited states, whose energy is usually treated under the first class of properties, but whose decay is one of the types of radio active decay.

*** Nuclear mass**:

Early chemical methods of mass comparison had already brought out the following approximate relation:

$$\mathbf{M \approx integer \times M_H}$$

Where:

M = mass of aspecific atom.

$\mathbf{M_H}$= mass of a hydrogen atom.

The integer is now called mass number and will be denoted by the symbol **A**. It was shown by x- ray scattering that the number **Z** of atomic electrons, and hence the number of positive nuclear charges, was not equal to the mass number **A**. This made the first hypothesis of nuclear structure, that nuclei consists of **A** proton and **A-Z** bound electrons. As mentioned above though, the discovery of neutron led to suggest that protons and neutrons are the fundamental constituents of all nuclei.

With the neutron-proton hypothesis we expect the mass of an atom to be:

$$\mathbf{M \approx Z\ M_H + N\ M_n}$$

Where:

Z= number of protons in nucleus (atomic number).

N= number of neutrons in nucleus (neutron number).

$\mathbf{M_n}$= mass of a neutron.

The discovery by Thomson of atomic species with identical chemical properties but different masses (called isotopes).

*** Important terms**:

The important terms are given below:

- Nuclide: A specific nuclear species, with a given proton number **Z** and neutron number **N**.
- Isotopes: Nuclides of same **Z** and different **N**.
- Isotones: Nuclides of same **N** and different **Z**.
- Isobars: Nuclides of same mass number **A** (**A= Z+N**).
- Isomer: Nuclide in an excited state with a measurable half- life.
- Nucleon: Neutron or proton.
- Mesons: Particles of mass between the electron mass ($\mathbf{m_o}$) and the proton mass ($\mathbf{M_H}$).
- Positron: Positively charged electron mass ($\mathbf{m_o}$).
- Photon: Quantum of electromagnetic radiation, commonly apparent as light, x-ray, or gamma ray.

Reference:

1- Elements of Nuclear Physics by (Walter E.Meyerhof).

2- Nuclear Physics by (Iruing Kaplan).

3- Radio Isotope Measurement Applications in Engineering by (Robin P. Gardner & Ralphl. Ely.Jr.).

4- Nuclear Physics by (Yu. M.shirokov & N.P. Yudin).