



Biological Radiation Hazards

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قسم تقنيات الاشعة والسونار

3 Stage

المرحلة 3

محاضرة رقم 1

الجانب النظري

Lecture No. 1

Theoretical

تدريسي المادة : م.م خيرات رحيم لهمود

(INTRODUCTION)

- Radiation Is Energy That Travels In The Form Of Waves Or Energetic Particles. It's A Fundamental Aspect Of The Universe, Originating From Various Sources Both Natural And Artificial. While Often Associated With Danger, Understanding Radiation Is Crucial Because It Plays A Significant Role In Many Aspects Of Our Lives, From Medical Diagnostics To Generating Electricity. The Key Lies In Managing Exposure To Mitigate Potential Biological Hazard

What is Ionizing Radiation?

- Ionizing radiation is a form of energy that has enough power to remove electrons from atoms, causing them to become ionized. This ionization can lead to biological damage.
- **Examples:** Gamma rays, X-rays, Alpha particles, Beta particles, Neutrons.

Sources of Radiation

Radiation is ubiquitous, with both natural and artificial sources.

•Natural Sources:

- **Cosmic Radiation:** From outer space.
- **Terrestrial Radiation:** From rocks and soil (e.g., Radon gas).
- **Internal Radiation:** From naturally occurring radioactive elements in food, water, and air.

•Artificial Sources:

- **Medical Uses:** X-rays, radiation therapy.
- **Nuclear Reactors:** Power generation, research.
- **Industrial Applications:** Gauges, sterilization.
- **Nuclear Weapons:** (Significant hazard).

Types of Radiation Exposure

Living organisms can be exposed to radiation in various ways.

- **External Exposure:** When radiation originates from a source outside the body and penetrates it (e.g., X-rays).
- **Internal Exposure:** When radioactive materials enter the body through breathing, ingestion, or wounds.

Biological Effects of Radiation at the Cellular Level

When radiation strikes living cells, it can cause various types of damage.

- **Ionization of Biomolecules:** Especially water (a major cell component), leading to highly reactive free radicals.
- **DNA Damage:** Breaks in strands, alterations of nitrogenous bases.
- **Damage to Proteins and Enzymes:** Affecting vital cellular functions.
- **Cell Death:** If damage is severe and irreparable.
- **Genetic Changes (Mutations):** If DNA repair occurs incorrectly.

Deterministic Effects

These effects occur when a certain threshold dose of radiation is exceeded, and their severity increases with the dose. They have a dose threshold.

- **Radiation Skin Burns:** Redness, blistering, hair loss.
- **Acute Radiation Syndrome (ARS):** Nausea, vomiting, diarrhea, bone marrow suppression, bleeding, infection (at very high doses).
- **Cataracts:** Damage to the eye lens.
- **Temporary or Permanent Sterility:** Damage to reproductive cells.

Factors Influencing Radiation Damage

The response of living organisms to radiation varies based on several factors.

- **Radiation Dose:** Higher dose, greater damage.
- **Dose Rate:** Doses distributed over a long period are less harmful than large doses in a short time.
- **Type of Radiation:** Some types (e.g., alpha particles) are more biologically damaging.
- **Tissue Type:** Some tissues (e.g., bone marrow, reproductive cells) are more radiation-sensitive.
- **Age:** Fetuses and children are more sensitive to radiation.
- **General Health Status:** Healthier individuals may recover better.

Principles of Radiation Protection

Protection relies on three fundamental principles to minimize exposure.

- **Distance:** Increasing the distance between an individual and the radiation source significantly reduces exposure (Inverse Square Law).
- **Time:** Minimizing the time an individual spends near a radiation source.
- **Shielding:** Using radiation-absorbing materials (e.g., lead, concrete, water) between the source and the individual.

Radiation Safety Procedures in Facilities

Strict procedures must be implemented to ensure the safety of workers and the public.

- **Continuous Monitoring:** Using radiation measurement devices (e.g., personal dosimeters).
- **Controlled Areas:** Defining specific areas for working with radiation.
- **Good Ventilation:** Especially in places where radon gas or volatile radioactive materials might be present.
- **Continuous Training:** For radiation workers.
- **Radioactive Waste Management:** Safe and proper disposal.

In Case of a Radiation Accident

Important steps to take to protect individuals.

- **Immediate Evacuation:** Move away from the radiation source.
- **Removal of Contaminated Clothing:** Place in sealed bags.
- **Thorough Washing:** Of the skin with soap and water.
- **Seek Emergency Medical Help:** Inform doctors about radiation exposure.
- **Potassium Iodide Tablets:** In cases of exposure to radioactive iodine to protect the thyroid gland (under medical supervision).

QUIZ

Q1/What Is The Difference Between Ionizing And Non-ionizing Radiation?

Q2/What Are The Three Fundamental Principles Of Radiation Protection? Explain One Of Them.

Q3/Name Three Factors That Influence The Biological Response Of Living Organisms To Radiation.

Q4/ What is a Deterministic Effect of radiation, and provide two examples

Q5/List three natural and three artificial sources of radiation mentioned in the lecture.

Any questions?

*Thank
You*