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Q1: ANS

Deterministic Effects:

- Deterministic effects describe cause and effect relationship between ionization radiation and certain side-effects.
- Deterministic effects are also called Non-Stochastic effect.
- It depends on
 - Dose
 - Dose rate
 - Dose Fraction
 - Irradiated volume
 - Type of radiation (Linear energy Transfer "LTE")
- Deterministic effect includes Acute and Chronic Radiation Sickness.
- Severity may be proportional to the dose of received.
- It have a Threshold level of Radiation dose.
- Deterministic effects causes, hair loss, cataract, skin injury etc.

Stochastic Effects:

- When a person received a high dose of radiation then stochastic effects occurs.
- It has no Threshold level of radiation dose.
- The probability of the effects is proportional to the dose
- Stochastic effects causes, Cancer, Leukemia, Hereditary effect etc.

Q2: ANS

Radiation:

- Radiation is the emission or transmission of energy in the form of waves or particles through space or through material medium.
- Types of Radiation:
 - X-rays
 - Microwaves
 - Infrared
 - Thermal radiation
 - Blackbody radiation

Radioactivity:

- Radioactivity is a process of undergoing the transformation of an unstable nucleus by the spontaneous emission of radiation, generally Alpha or Beta particles, often accompanied by gamma rays from the nucleus of unstable Radionuclide.
- Often used to express the rate at which radioactive material emits radiation.
- It is measured in unit of Becquerel's in SI unit system.

Ionizing Radiation:

- Its type of radiation that is able to disrupt atoms and molecules on which they pass through, giving rise to ions and free radicals.

Sources:

- X-rays, Alpha, Beta, Gamma radiation, cosmic rays from the sun and space.

Non-ionizing radiation:

- It include all kind electromagnetic radiation with frequencies $<10^{15}$ HZ and
- Wavelength $\lambda=10^{-8} - 10^4$ m.

For example:

- Ultraviolet radiation, Infrared radiation, and Microwaves.

Harmful Radiation:

- Some types of radiation are ionizing radiation include both Electromagnetic sources such as x-rays and gamma rays, and particles such as Alpha and Beta Particles, naturally occurs radon gas. Ionization radiation can cause burns, radiation sickness.
- Some of non-ionizing radiation can also be harmful, example, using sunbed for too long will expose the body to ultraviolet radiation which cause premature ageing, cataracts and skin cancers.

Q3: ANS

PART A:

Two Principles of Radiation:

- 1. Justification**
- 2. ALARA Principle**

Justification:

- Before examination the technologists must review the possible risk and benefits, so the principles must be justified.

ALARA Principle:

- ALARA means as Low as Reasonably Achievable.
- The magnitude of individual dose, the number of people exposed and the likelihood of repeatedly exposures from a justified must be kept ALARA.
- ALARA states that
 - Less time spent.
 - Near source.
 - Less radiation received.

PART B:

Radiation Protection Devices:

- One-piece full Apron.
- Skirt and Vest.
- Gonad Shield.
- Thyroid Shield.
- Gloves.

Q5: ANS

GM Counter: (Geiger-Muller)

- GM counter is a device used for the detection and measurement of all types of radiation. Alpha, Beta, and Gamma Radiations.
- GM counter was discovered in 1928.
- It consist of Geiger-Muller tube, the sensing element which detect the radiation and processing electronics which displays the result.

Principles of GM Counter:

- Gas molecules get ionized when energetic charged particles propagated through a gas.
- The electron produced by ionization, if accelerated by high potential can cause further ionization of gas molecules thereby generating a large number of more electrons.
- The GM tube filled with some inert gas at pressure of 10cm of HG.
- GM tube is enclosed in a partially evacuated glass tube.
- When an energetic charged particles enters GM tube through windows, the gas molecules which interact with the charged particle get ionized.
- The generated electrons get accelerated toward the central anode, and +ve ions toward cathode tube.
- The accelerated electrons cause ionization of more gas molecules generating large numbers of electrons within a very short interval of time.
- If N particles enters the tube per second and the counter shows (n) particles per second, the dead time can be, $T = \frac{1}{n} + \frac{1}{N}$ OR $T = \frac{N-n}{nN}$

Q4: ANS

Facility Design Features:

- Specific design features for maintaining personal exposure as low as reasonably achieved ALARA is discussing.

Plant Design Feature for ALARA:

- The equipment and plant design features Employs to maintain radiation exposures.
- Equipments and Component for ALARA:

Reactor Vessel:

- Include an integrated head package which combines the head lifting rig, control and gray rod drive mechanism.

Reactor Coolant Pumps:

- The canned high-inertia reactor coolant pumps are designed to require infrequent maintenance and inspection.

Reactor Vessel Insulation:

- Insulation in the area of the reactor vessel nozzle weld is fabricated in sections with a thin inflective metallic sheet covering and quick disconnect clasps to facilitate the removal of insulation.

Steam Generators:

- It is design to facilitate maintenance inspection in reduced radiation field.