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paper Radiation protection.
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Module- 4th Semester.

Q:-1:- ~~Deform~~ Differeniate between determinivtics and Stochastic effect of radiation.

→ **Deterministics effects of Radiation:**→

Deterministic radiation responses are those that exhibit increasing Severity with increasing radiation dose.
→ there is a dose threshold, and the dose-response relationship is non-linear.
→ these early effects have been studied extensively with laborlary animals and some data have been obtained from observation of humans.

P-T-O

→ After exposure to a high radiation dose, humans can experience a response within a few days to a few weeks. This immediate response is called deterministic effect.

→ They are produced by high radiation doses delivered over a short time period.

Stochastic effects of radiation :→

Stochastic effects of radiation exposure are the result of low doses delivered over a long time period.

→ If the incidence of the radiation response increases with increasing radiation dose, it is called stochastic effect of radiation.

→ Radiation exposure experienced by personnel in diagnostic imaging are low dose and low linear energy transfer. (LET)

→ The radiation exposures that we experience in diagnostic radiology are low and low of (LET). they are Chronic in nature because they are Intermittently over long time period therefore Stochastic radiation effects are of particular importance.

→ The Principal Stochastis effects are radiation - induced malignancy and genetic effects.

→ Stochastic effects of radiation exposure exhibit an increasing incidence of response - not Severity - with increasing dose.

→ No dose Threshold has been establisshed for a Stochastic response.

→ The Stochastic dose - response relation Ship is linear.

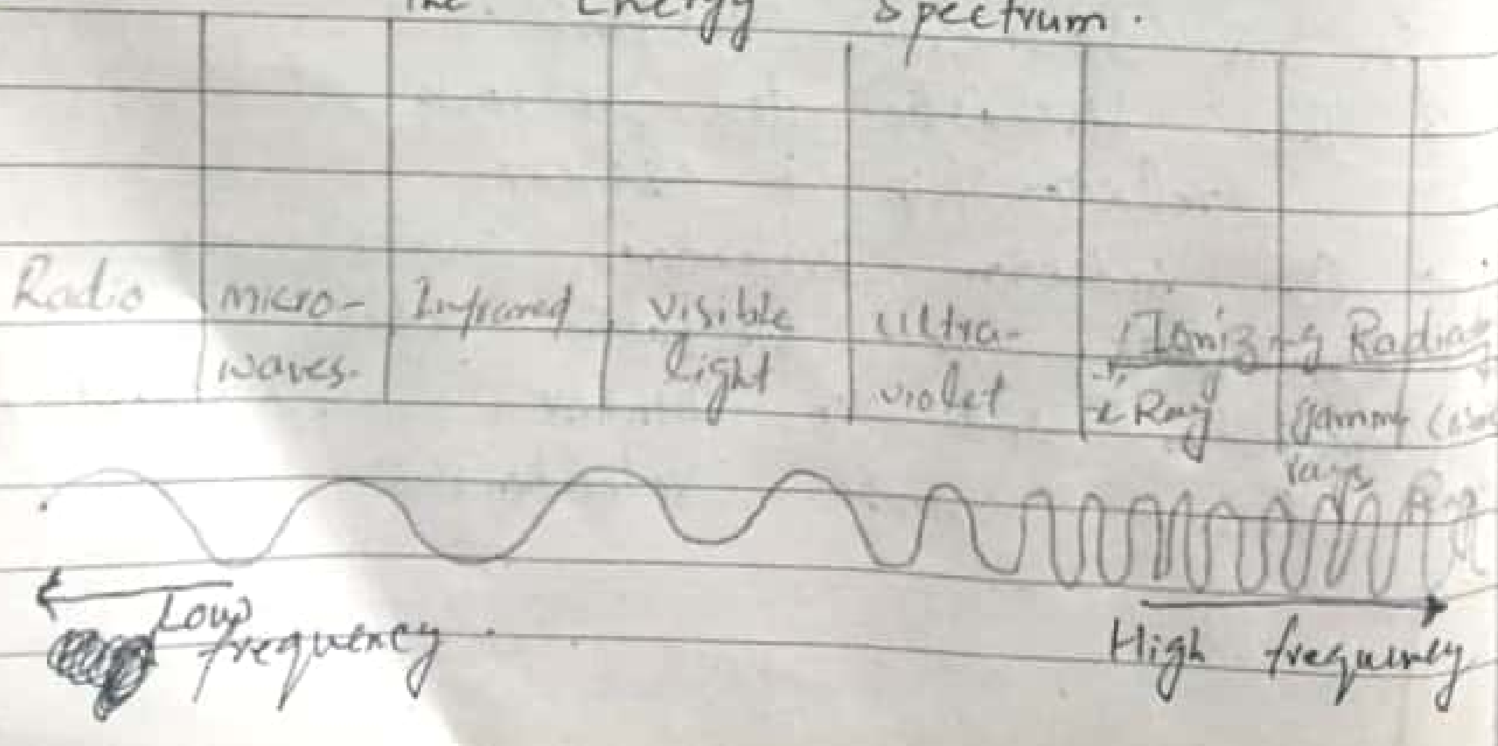
→ Our radiation protection guides are based on the Stochastic effect of radiation and on linear, nonthreshold dose - response releationship.

Q 2:- Explain briefly the following terms. Radiation, Radioactivity, non-Ionizing radiation and harmful radiation.

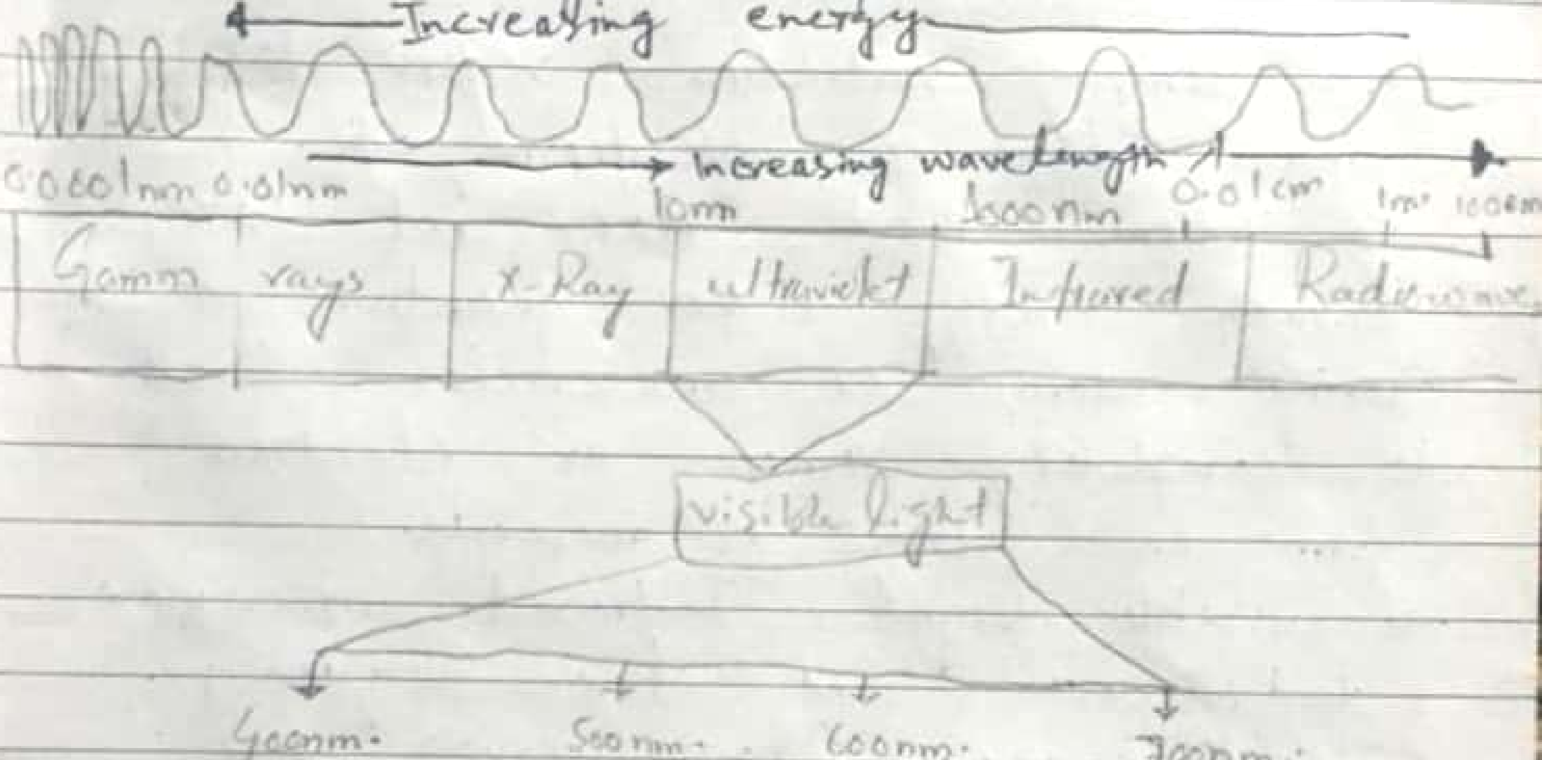
Radiation:→

Energy emitted and transfered through Space is called radiation. Radiation is the transfer of energy.

The Energy Spectrum.



Electromagnetic Spectrum.



Radio Activity :→

Radioactivity is the Spontenous emission of particles and energy in order to become stable.

Non-Ionizing Radiation :→

Non-Ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy per quantum to Ionize atom or molecules. that is to completely remove an electron from an atom or molecule.
→ visible light, Infrared, microwave radio waves, and low-frequency radio-frequency (long-wave) are all examples of non-Ionizing radiation.

Harmful Radiation :→

Gamma rays are the most harmful external Hazard. Beta particles can partially Penetrates Skin, causing 'beta burns'. Alpha particles can not pentrate intact Skin.

Gamma and x- Rays Can pass through a person & damaging cell in their path.

→ Radiation damages the cell that make up the human body
→ low levels of radiation are not dangerous, but medium level can leads to Sickness. Headaches vomiting and fever.
→ High levels can Kill you by Causing damage to your Internal organ its difficult to treat high radiation exposure.
→ Exposure to radiation over a long time can Cause Cancer.

Q-3 (a) Two basic Principles of radiation Protection.

(1) Minimize time :→

The dose to an individual is directly related to the duration of radiation of exposure.
→ If the time during which one is exposed to radiation is doubled the exposure will be double.

→ Keep the time of exposure to radiation as Short as possible.

→ During radiography, the time of exposure is kept to a minimum to reduce motion blur.
→ During fluroscopy, the time of exposure also should kept to a minimium to reduce patient radiation exposure.

(3) Maximize Distance :-

→ Maintain as large a distance as possible between the source of radiation and exposed person.
→ As the distance between the source of radiation and the person increases, radiation exposure decreases rapidly.
→ If the distance from the source exceeds five times the source diameter. It can be treated as point source.
→ Most radiation sources are point sources. The x-ray tube target, for example, is a point source of radiation.
→ The square law was used as to calculate exposure in radiographic technique.

$$\frac{\text{New exposure}}{\text{old exposure}} = \frac{\text{old distance squared}}{\text{New distance squared.}}$$

→ In radiography, the distance from radiation source to patient usually is fixed by the type of examination, and the radiologic technologist is positioned behind a protective barrier.

→ During Fluroscopy, the radiologic technologist can exersice good radiation protection procedure.
The technologist should remain as far from the patient as practicable.

Q-3 (B)

Radiation Protection devices

- Radiation protection Aprons.
- Radiation Protection Assecories.
- Radiation Protection Gloves.
- Radiation Protection Glasses.
- Radiation protection thyroids Shields.
- Radiation Protection Apron Racks.
- Radiation protection Apron Racks and Drap shields.

- Radiation protection Barrier and table shields.
- Patient Radiation protection.
- Portable radiation protection in the Field or in the imaging Suite.

Q-4 :-

Features For Radiation Protection Design.

→ ①. Protective x-Ray tube Housing :→

Every x-Ray tube must be contained within a protective housing that reduces leakages radiation during dose.

→ leakage radiation must be less than 1 mGy/hr (100m R/hr) at a distance of 1m from the protective housing.

② Control Panel.

The control panel must Indicate the condition of exposure and must positively indicate when the x-Ray tube is energised.

→ The x-Ray beam on must be positively and clearly indicated to the radiologic technologist.

3) Source-to-Image Receptor Distance Indicator:→

A Source-to-Image receptor distance (SID) indicator must be provided.

→ This can be as a tape measure attaches to the tube housing.

→ The SID Indicator must be accurate to within 2% of the indicated SID.

④ Collimation:→

light-localized, variable-aperture rectangular collimator should be provided.

→ The x-Ray beam and the light beam must coincide to within 2% of the SID.

⑤ Positive - Beam limitation :→

Automatic, localized, variable - aperature collimator were required on all but special x-Ray Imaging System manufactured in the united states between 1974 and 1994.
→ These positive - beam limiting (PBL) devices are no longer required but continue to be a part of must new radiographic Imaging System.
→ The PBL must be accurate to within 2% of the SID.

⑥ Beam Alignment :→

To proper collimation, each radiographic tube should be provided with a a mechanism to ensure proper alignment of the x-Ray beam and the Image receptor.

⑦ **Filtration :-**

All general purpose diagnostic x-Ray beam must have -

- A total filteration (Inherent plus added) of a least 2.5 mm Al when operated above 70 kvp.
- x-Ray tubes designed for mamography have 30 μm Mo or 60 μm Rh filteration.

8. **Reproducibility :-**

For any given radiographic technique, the output radiation intensity should be constant from one exposure to another.

→ The variation in x-Ray intensity should not exced 5%.

9) Linearity:→

When adjacent mA Stations are used, for example 100mA and 200 mA and exposure time is adjusted for Contant MAS, the Out put radiation intensity Should be remain Constant.

At Constant exposure radiation, Causing the mAs to increase in proportion to the Increase in mA, radiation intensity should be proportional to mAs.

→ The maximum acceptable variation in linearity is 10% from one mA station to an adjcanet mA station.

Q-5

What is GM Counter.
How it can be used as radiation protection device.

GM ~~De~~ Counter :→

Geiger-Muller (GM) counter is a gas-filled detector designed for maximium gas amplification effect.
The principle of a GM counter is
The center wire (Anode) is maintained at a high positive voltage relative to the outer cylinderical (electrode cathode).
→ The outer electrode may be a metal cylinder or a metallic film sprayed on the inside of a glass or plastic tube.
Some GM counters have a thin radiation entrance window at one end of the tube. The cylinder of the tube is sealed and filled with a special gas mixture typically argon.

when Ionization occur in Gm Counter, electron are accelerated toward the Center wire.

→ Gas amplification in Gm Counter as in a proportional Counter.

In addition to Ionizing gas molecule the accelerating electron also can Cause excitation of gas molecule through Collisions. these excited gas molecules quickly (~10^9 sec). return to the ground State. through the emission of Photon at visible or ultraviolet (wave length). if a uv photon interacts in the gas or at the cathode, Surface by Photoelectric absorption.

→ The avalanche Ionization in a Gm tube releases a large and essentially Constant quantity of electrical charge, regardless of voltage applied to the tube or the energy of Ionizing radiation event.

→ Once the avalanches has terminated in a GM Counter. an addional problem arises.
The positive Ion cloud moves towards the outer electrode. When the Ion cloud is very close to the outer electrode, electron are pulled out from it to neutrilize the positive Ions
→ Some of these electron enter higher-energy orbits of the positive Ion. When they eventually drop into the lower-energy orbits, UV radiation is emitted. This can cause the release of electrons from the outer wall and set off another avalanche.
→ Thus if non precautions are taken, a single Ionizing radiation event can cause the GM Counter to go into pulsating series of discharg

→ This problem is prevented by the introduction of quenching gas into the GM counter gas mixture.

Such GM counters are called Self-quenched. Effective quenching gases have three properties.

→ Firstly, they tend to give up electron easily.

→ Secondly, when the quenching gas molecules are neutrilized by electrons entering higher energy orbits. they deenergize themselves by dissociating into molecular fragments rather than emitting UV photon.

→ third, the quenching gas molecules are strong absorbs of UV radiation.

Use of G.M. Counter

Geiger-Muller Counters operate under even higher voltages between the anode and the cathode. usually in the 800 to 1200 volt range. Like the proportional counter, the high voltage accelerates the charges produced in intial Ionization to where they have enough energy to Ionize other electron in the gas.

→ The collection of the large numbers of Secondary Ions in the GM region is known as an avalanche and produce a large voltages plus.

→ The electric circuit of GM Counter Counts and records the number of pulses and the information is often displayed in counts per minute.

→ Geiger Counter are used for Continaminution Control in nuclear medicine laborteries.

→ As Portable Survey instrument, They are used to detect the presence radioactive ~~Contin~~ Contamination on work Surfaces and laborataries apparatus.

→ They are not particularly useful as dosimeters because they are difficult to calibrate for varying condition of radiation.

→ They have a Sensitive instruments that are capable of detecting and Indicating single Ionizing events.

→ The Geiger Counter does not have a very wide range. most instrument are limited to less than 1m Gy/hr (100 mR/hr).