Radiography and Imaging Technology

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What is Energy?

- **Definition:**
  Energy is the ability or capacity of a body to do work.
- **Explanation:**
  It can exist in different forms and can be converted from one form to another, but it cannot be created or destroyed (Law of Conservation of Energy).
- **Examples:**
- A moving car has kinetic energy.
- A stretched bow has potential energy.
- A hot object has heat energy.

Types of Energy

- **Main Types:**
- **Mechanical Energy** – includes kinetic and potential energy.
- **Thermal Energy** – due to particle motion (heat).
- **Chemical Energy** – stored in bonds of molecules.
- **Electrical Energy** – due to moving charges.
- **Nuclear Energy** – released during atomic reactions.
- **Radiant (Light) Energy** – energy carried by electromagnetic waves.
- **Mnemonic:** *"My Tiny Cat Eats Nice Rice"*
  (M – Mechanical, T – Thermal, C – Chemical, E – Electrical, N – Nuclear, R – Radiant)

Radiant Energy

- **Definition:**
  Radiant energy is the energy of electromagnetic waves that can travel through space (vacuum).
- **Sources:**
- The **Sun** is the main natural source.
- Artificial sources include bulbs, lasers, and X-ray tubes.
- **Examples:**
- Visible light
- Infrared radiation
- Ultraviolet rays

Electromagnetic (EM) Waves

- **Definition:**
  Waves that can travel through space without any medium, produced by vibrating electric and magnetic fields perpendicular to each other.
- **Key Features:**
- Transverse in nature
- Carry energy as radiant energy
- Can travel in vacuum
- **Examples:**
  Radio, Microwave, Infrared, Visible, Ultraviolet, X-rays, Gamma rays

Speed of Light

- All electromagnetic waves travel at the same speed in a vacuum.
- **Value:**
  $c = 3 \times 108$ m/s
- **Equation:**
- $c = f\lambda$
- where:
- f = frequency
- λ = wavelength
- **Note:**
  Speed decreases when light travels through materials like water or glass.

Quantization of Energy

- **Concept:**
  Energy is not continuous but comes in small packets called **quanta** (plural: quanta, singular: quantum).
- **Einstein's Contribution:**
  Each light quantum is called a **photon**, having energy:
- $E=hf$
- where
- h = Planck's constant (6.626×10^{-34} J·s)
- f = frequency of radiation
- **Meaning:**
  Higher frequency → higher energy photons.

Various Forms of Radiant Energy

- **Spectrum Range:**
- **Radio Waves** – communication
- **Microwaves** – radar, ovens
- **Infrared** – heat, night vision
- **Visible Light** – human vision
- **Ultraviolet** – sterilization
- **X-rays** – medical imaging
- **Gamma Rays** – cancer treatment
- **Mnemonic:** *"Rabbits Mate In Very Unusual X Gardens."*

Applications of Radiant Energy

- **1. Solar Energy:**
  Used in solar panels to produce electricity and heat water.
- **2. Communication:**
  Radio, TV, and mobile phones use electromagnetic waves.
- **3. Medical Imaging:**
  X-rays and gamma rays help in diagnosis and treatment.
- **4. Illumination:**
  Light bulbs and LEDs convert electrical energy into radiant light.
- **5. Industry:**
  Lasers used for cutting, welding, and scanning.

Time

- **Definition:**
  Power is the **rate at which work is done** or **energy is transferred per unit time**.
- **Formula:**
- P=W/t
- **Unit:** Watt (W) = 1 Joule per second (1 J/s)
- **Examples:**
- A 60 W bulb uses 60 joules of energy every second.
- High power → faster energy transfer.