

EM Spectrum

All electromagnetic waves are transverse waves that travel with the same speed in vacuum. This speed is the speed of light with value $3 \times 10^8 \text{ ms}^{-1}$

- Transfer energy from one place to another
- Transverse waves
- Can travel through vacuum at speed of light
- Show wave properties like reflection and refraction.
- Obey wave equation $v=f(\text{wavelength})$

Spectrum of waves

In order of wavelength,

Gamma Rays < X-rays < UV Waves < visible light < infrared < microwaves < radio waves

Applications

Radio waves

- Longest wavelength
- Used in radio and television communication to transmit sound and pictures.
- Produced by oscillating electric currents in a transmitting aerial → picked up by another aerial at the receiving end.
- Various wavelengths are
 - LW (long wave)
 - MW (medium wave)
 - SW (short wave)
 - VHF (FM communication)
 - UHF (terrestrial television communication)

Microwaves

- Radio waves with short wavelengths (few cm)
- Produced by special electronic devices such as the klystron tube.
- Used for satellite communication
- Satellite television and mobile phone networks use microwaves.
- Also used for microwave ovens as it heats up the water molecules inside food.

Infra-red Radiation

- Waves just beyond red end of the spectrum.
- All objects emit IR radiation
- As an object gets hotter, the IR wavelength emitted becomes shorter.
- At relatively low temperatures, all radiation is IR
- Used to measure temperatures (thermogram)
- IR enables doctors to diagnose cancerous growths and blocked blood circulation.
- Used for remote control for various electrical appliances.
- Also used in intruder alarms.
 - PIR motion detectors detect IR energy emitted by an intruder's body heat.

Visible Light

- Most familiar form of EM waves are visible light.
- Laser light used for medicine, engineering and telecommunication.
- Laser used to weld metals together, cut through hard materials like steel or hundreds of layers of cloth to the same pattern simultaneously.

UV Radiation

- Beyond the violet end of the visible spectrum.
- Main source is sunlight
- Gives rise to suntans.
- Also applied in sun-lamps which shine UV radiation onto a person lying on a sunbed, for the purpose of tanning the skin.
- UV stimulates our body to produce Vitamin D – needed for healthy bones
- Can cause skin cancer and damage the retina.
- Ozone absorbs a substantial amount of UV from the sun.
- UV kills bacteria and viruses.
- Sterilize hospital operating rooms and surgical equipment
- Some chemicals fluoresce when ultra-violet radiation falls on them
- Checking genuine notes
- Fluorescent light

X-Rays

- Doctors and dentists can examine the condition of a person's bones, the roots of his teeth or the state of other inner parts of the body using X-rays
- X-rays can damage or destroy living tissues and organisms.
- Used to examine flaws and cracks of metal parts
- Analysis of crystal structures in scientific research.
- Have ionizing power and are able to ionize atoms in cells, causing damage to life.

Gamma Rays

- Emitted by radioactive nuclei (e.g. Cobalt-60)

- Penetrate very deeply and cause serious damage when absorbed by living tissues
- Have HIGH IONIZING POWER
- X-rays and Gamma very similar, but produced differently.