Electromagnetic waves (Electromagnetic Spectrum)

What are the properties of Electromagnetic waves?

Ans) ① All E.M.W are transverse waves

② All E.M.W can travel in vacuum

③ All the speed of all E.M.W in air or vacuum is the same as the speed of light i.e. $3 \times 10^8 m/s$.

④ All E.M.W transfer energy

⑤ All E.M.W undergo reflection, refraction and diffraction.

Note: Based on the frequency and wavelength, all E.M.W can be displayed on a chart which is known as an electromagnetic spectrum. This display is shown in Fig. 2

Electromagnetic Spectrum Fig:1

Gamma Rays (γ)	X-Rays	Ultra violet (U.V)	Visible Light VIBGYOR	Infra Red (I.R)	Micro wave	Radio wave

highest frequency → frequency decreases → lowest frequency
shortest wavelength → wavelength increases → largest wavelength

Use and side Effect of E.M.W

a) Radio Waves :-
1. Used in Radio Communication
2. Used in Television Communication
3. Used in Astronomy

b) Micro Waves :-
1. For household purposes, it is used in the microwave oven to cook food.
2. Used in mobile communication.
3. Used in bluetooth to transfer data
4. Used in satellite communication

Q) Explain how satellite communication works.

Ans) ① The transmitter (T) on the Earth's surface sends out microwave signals towards the satellite.

② The satellite receives the signals and amplifies them.

③ The satellite then sends the signal back towards the receiver (R). And this is how information can be transferred from one point to another on the Earths surface.

Q) Infra-Red:-

① For household purposes, it is used in electrical appliances eg. electric grills.
② Used in night vision goggles
③ Used in optical fibres for internet communication
④ Used in intruder alarms.
⑤ Used in remote controls to operate televisions

Note:- If the intensity of the infra-red is very high, it is known to cause burning of soft tissues or muscles.

Q) Explain how an intruder alarm works.

Ans) The infra-red sensor detects heat signature from the human body during night time and the alarm gets triggered if the heat signature rises.

Q) Explain the working of a T.V. Remote.

Ans) Infra-Red signals are produced by the emitter inside the remote control. The T.V. sensor/ receiver receives these signals and carries out the desired function

d) Visible Light:-

→ Used in cameras for photography

e) Ultra-Violet:

① Skin tan.

② Used to sterilise water

③ Used to process food material

④ Used to identify fake currency notes

⑤ Used to scan fingerprints

Note:- Excessive exposure to U.V. Light leads to skin cancer.

f) X-Rays:-

① In the field of medicine, X-Rays are used to kill cancerous cells and they are used to locate fractures in bones.

② In the field of engineering, X-Rays are used to detect cracks in metals.

Note: High exposure to X-Rays can cause genetic mutation or cancer.

Q) Explain how X-Rays are used to locate fractures in bones or to locate cracks in metals

Ans) ① The X-Ray detector, also called the X-Ray film or photographic film is originally white.

② When exposed to X-Rays, the film turns black.

③ If there is a fracture in a bone, the bone will absorb the X-Rays which results in a white image but the fracture lets the X-Rays pass through, resulting in a black image.

④ This contrast between black and white allows the radiologist to detect the location and the intensity of the fracture.

g) Gamma Rays (γ) :-

① Gamma Rays have the same uses (except for detecting fractures) and the same side effects as X-Rays

② It is also used in sterilising surgical instruments (medical use)

Current & Diffraction