

Advance Physics

X-Rays

X-rays were discovered by German physicist Wilhelm Roentgen, in 1895. They have the ability to penetrate matter. They are a kind of diagnostic tool and provide us the images of dense parts of the body.

Eg. : Bones

X-rays are aimed to pass through the body parts of patient to be examined. The X-rays after reflection from the body part, fall on the film containing X-ray sensitive emulsion. An image, called radiograph, which is a shadow of the dense parts of the body is obtained.

CT Scan

Simple radiography images are difficult to interpret because in them a number of internal structures are superimposed (one on the top of the other). A technique known as computed tomography scan was developed in 1972. This technique makes it possible to image the internal structures distinct from each other, in a manner they would be seen in a thin section of the body. For this invention, Godfrey Hounsfield, a physicist, was awarded the Nobel Prize in 1978.

During examination, X-ray beam moves 360° around and passes through a thin section of the body of the patient. The rays coming out of the body are recorded by sensitive detectors. This process is repeated until the same body section has been examined from all angles. Computer analyses the data and reconstructs the images of the internal organs in this section of the body. Many slices can be 'stacked' (one on the other) on video screen to form a three dimensional (3D) view of a patient's internal organs.

Doctors get a complete series of pictures showing slices through the body at slightly different planes. This helps them to pinpoint small defects.

Uses of CT scan: It is used for the detection of disorder of brain etc.

Sonography

Sonography is based on ultrasound (waves of frequency above 20 kHz). Ultrasound of frequency between 1 MHz to 15 MHz is beamed into the human body and the returning echoes are detected. The ultrasound waves pass through a homogeneous tissue unimpeded (not obstructed). But when they meet another tissue or organ, a partial reflection takes place, the coefficient of reflection depends upon the difference in densities of the two tissues/organs.

For clinical examination, a sonographer places a scan head transducer in contact with the area to be scanned. A layer of aqueous gel is applied between the skin and scan head to ensure that the sound has an air-free path to the object of interest.

Eg. : A foetus (area to be examined)

A precise sequence of ultrasound waves penetrate the body, strike the organs within and reflect back to the surface, where the transducer functions as a receiver. The echoes are processed by a computer into a video image.

NOTE: Sonography is safer, comfortable and inexpensive than radiography.

Uses of sonography:

- (i) It is used to assess foetal growth and to pick up a wide range of abnormalities such as spina bifida and conditions liable to cause difficulty in labour.
- (ii) It is also used to image the adult body
- (iii) It provides us pictures of blood flow through the beating heart, based on a phenomenon known as Doppler effect.

Laser

Laser stands for light amplification by stimulated emission of radiation. The laser shoots the photons in forward direction in a very high concentration with pure and uniform wavelength, whereas normal light source shoots out stray random photons in all directions. Laser beams have high intensity and strength, which is used for variety of purposes. The working of a laser is based on stimulated emission of radiation and population inversion.

(a) Characteristics of laser:

- (i) Laser uses an active material which converts energy into light energy.
- (ii) Laser has a pumping source to provide power or energy.
- (iii) Laser directs the beam of light to be amplified through the active material.
- (iv) Laser uses a feedback mechanism to provide continuous operations.
- (v) Laser directs the beam of light into a narrow powerful cone of divergence.
- (vi) Laser uses an output coupler to transmit power out of the laser.
- (vii) The radiations of every laser are extremely intense and directional

(b) Uses of laser:

- (i) **Surgery:** Laser beams are used in all delicate operations.
- (ii) **Engineering:** Tiny welds are made with precision using powerful laser beams.
- (iii) **Communication:** Laser beams can carry telephone calls and other signals over long distances.
- (iv) **Industry:** Laser beams are used to drill holes in diamonds and hard steel. They can melt and vaporize metals, when focussed by a lens.

(v) **Weather forecasting:** A laser based type of radar called Lidar is used for weather forecasting.

(vi) **Military:** Laser beams are being developed to serve as a powerful war weapon. Nuclear physicists are using laser beams in nuclear fusion.

(vii) **Holography:** Laser beams are used in holography, a form of three dimensional photography without lenses.

(viii) **Computers:** computer engineers are attempting to transmit an entire memory bank from one computer to another using laser beams.

Photocopy Machine

Photocopying is a process which makes paper copies of documents and other visual images quickly and cheaply. Most current photocopiers use a technology called Xerography, a dry process using heat.

Xerographic office photocopying was introduced by Xerox in the 1960s and over the following 20 years it gradually replaced copies made by verifax, photostatic prints, carbon paper, mimeograph machines and other duplicating machines.

❖ **NOTE:** There have been many predictions that photocopiers will eventually become moot, as information workers continue to increase their digital document creation and distribution and rely less on distributing actual pieces of paper. However, photocopiers are undeniably more convenient than computers for the very common task of creating a copy of a humble piece of paper.

Uses of photocopying: photocopying is widely used in business, education and government systems.

EXERCISE

1. X-rays were discovered by:
 (A) Einstein (B) Rutherford
 (C) Wilhelm (D) Newton

2. CT scan uses.....for its operations.
 (A) S-rays (B) IR rays
 (C) UV rays (D) None of these
3. Sonography is based on :
 (A) Infrasonic (B) Ultrasound
 (C) Both (A) and (B) (D) None of these
4. Photocopy machine :
 (A) Produces visual images
 (B) Uses a technology called Xerography
 (C) Produces real images
 (D) Both (A) and (B)
5. Laser stands for :
 (A) Light amplification by stimulated emission of radiation.
 (B) Light amplification by spontaneous emission of radiation.
 (C) Light amplification by successive emission of rays.
 (D) None of these
6. For the invention of CT scan. Godfrey Hounsfield was awarded the Nobel prize in.
 (A) 1975 (B) 1976
 (C) 1978 (D) 1980
7. The working of laser is based on :
 (A) Stimulated emission of radiation
 (B) Stimulated absorption of radiation
 (C) Both (A) and (B)
 (D) None of these
8. Xerography was introduced by Xerox in:
 (A) 1950 (B) 1960
 (C) 1965 (D) 1955

ANSWER – KEY

ADVANCE PHYSICS

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Ans.	C	A	B	D	A	C	A	B