

The background features abstract, overlapping geometric shapes in various shades of green, ranging from light lime to dark forest green. These shapes are primarily located on the left and right sides of the frame, creating a modern, dynamic feel. The central area is white, providing a clean space for the text.

# MODULE 5

# MEDICAL IMAGING SYSTEMS

X-RAY IMAGING

- ▶ A German Physicist, Conrad Roentgen discovered X-ray radiation in 1895.
- ▶ It is found that X-Ray can be used for diagnostic and therapeutic purposes. The branch of study on the medical applications of X-ray is called Radiology. X-ray instrument is the very first instrument widely used in medical field.
- ▶ One of the important characteristics of X-Ray radiation is that it ionizes the gas through which it travels. This property differentiate the X-ray from other non-ionizing radiations such as radio waves, light and infrared radiations. The property of these radiations to penetrate the objects that are opaque to visible light is used in medical diagnosis and treatment like cancer.
- ▶ The medical field in which the radiation source is used for treatment, is called radiation therapy.
- ▶ X rays are electromagnetic waves have the wavelength range from  $10^{-6}$  cm to  $10^{-10}$  cm.
- ▶ X rays have energies in the range 100eV to 200keV

## Generation of X-rays in X-ray tubes

- ▶ An X-ray generator is a device used to generate X-Rays. An X-ray imaging system consists of an X-ray source or Generator (X-Ray Tube) and an image detection system.
- ▶ The X-ray tube (high vacuum diode) operates by emitting electrons from a heated cathode tungsten filament towards a rotating high voltage anode disc. The point where the electron (beam) strikes the target is called Focal spot.
- ▶ At the focal spot X-ray photons are directed in all directions. X-rays arise from the target disc at right angles and are focused by a collimator. For more viewing contrast we use photomultipliers. The images are received and viewed on a photographic plate. Here light and dark areas on the film represent high and low tissue penetration.
- ▶ X-ray machines work by applying controlled voltage and current to the X-ray tube. So the beam intensity of X-rays can be controlled by controlling voltage or current.
- ▶ The beam is projected on the object. Some of the beams will pass through the object and some are observed.

- ▶ The resulting pattern of radiation is detected in a photographic films
- ▶ In a x ray tube , the rotating anode is used to overcome the overheat problems, also anode is made of tungsten alloy which helps in avoiding over heat.

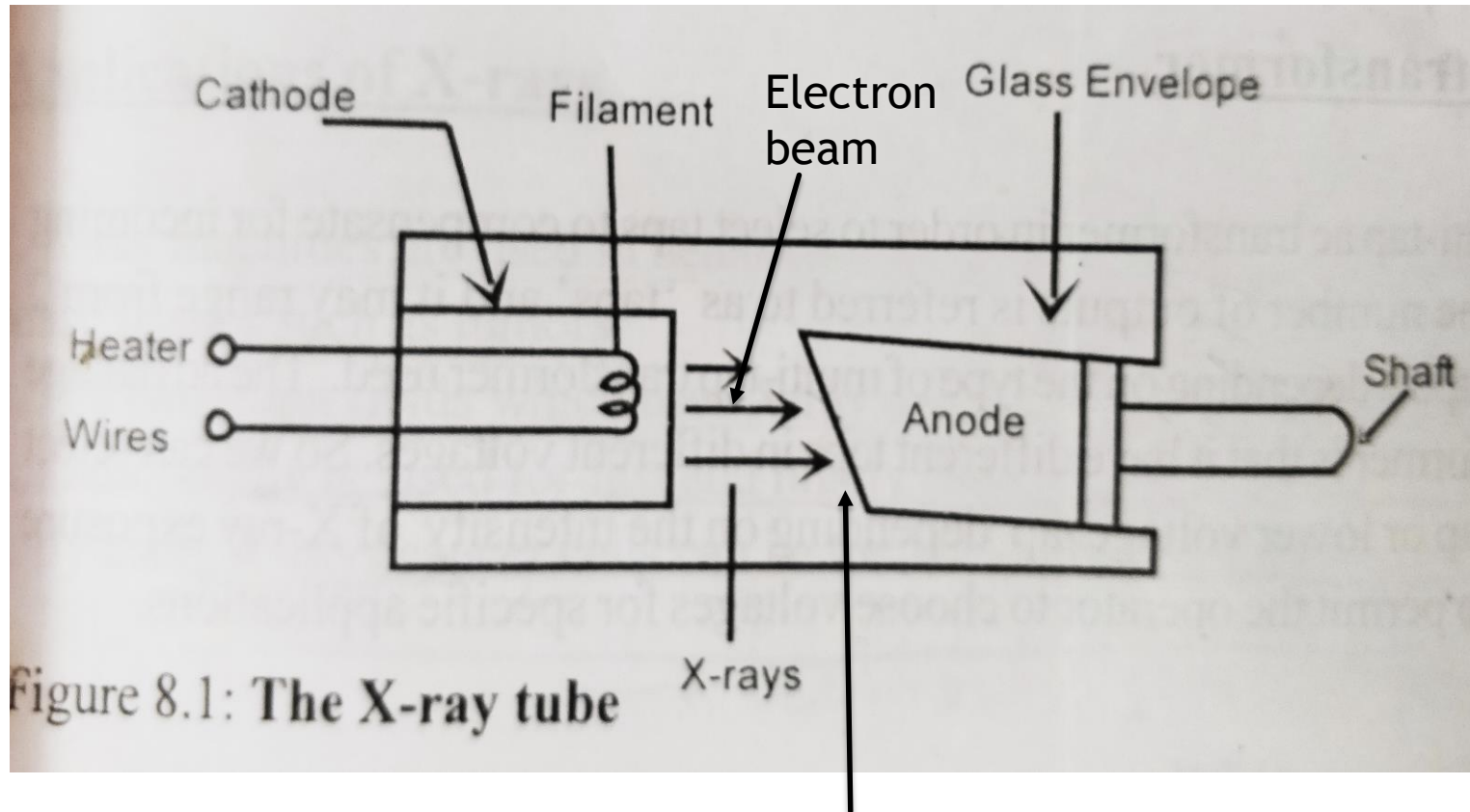


Figure 8.1: The X-ray tube

FOCAL SPOT

# BLOCK DIAGRAM OF X RAY MACHINE

## 8.3 BLOCK DIAGRAM REPRESENTATION OF X-RAY MACHINE

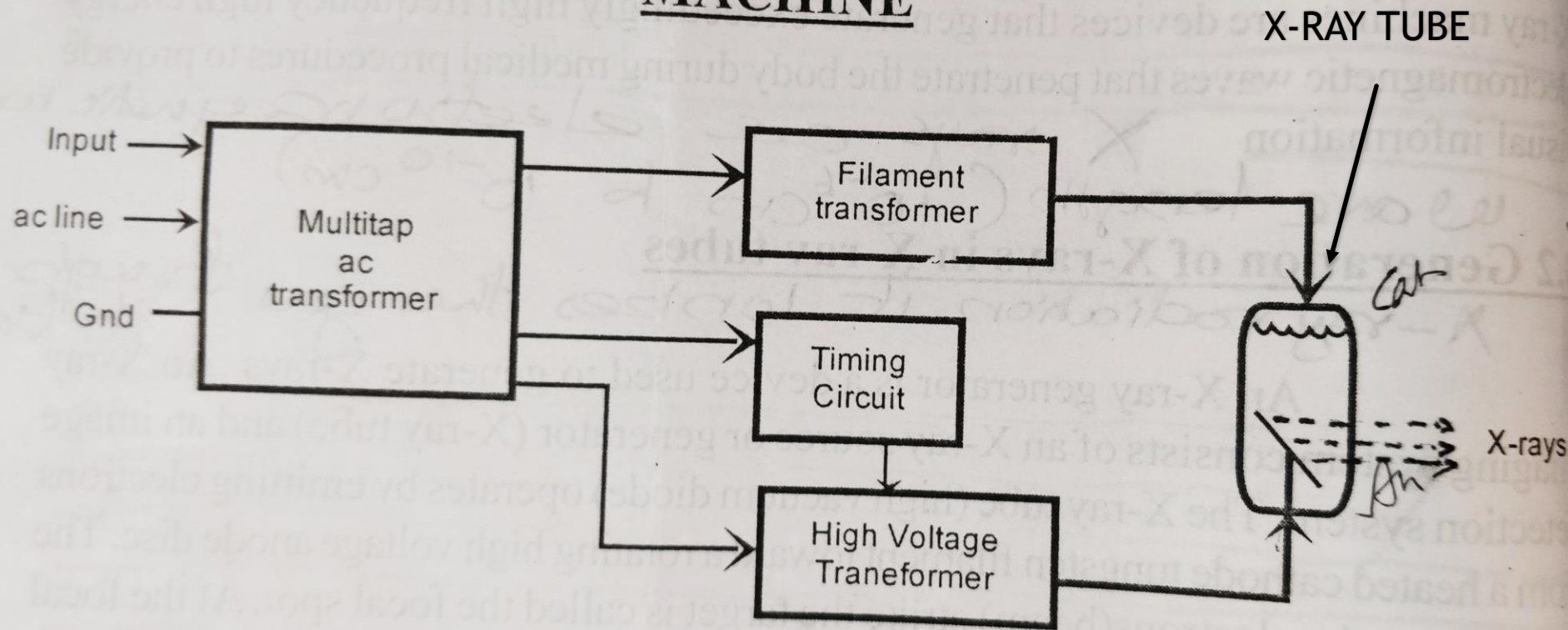


Figure 8.2 : Block diagram of X-ray machine

## 1. MULTI-TAP AC TRANSFORMER

We use a multi-tap ac transformer in order to select taps to compensate for incoming line variations. The number of outputs is referred to as “taps” and it may range from 2 outputs depending on the type of multi-transformer used.

The advantage of multi-tap transformer is that it have different taps in different voltages. So we can select a higher voltage tap or lower voltage tap depending on the intensity of X-ray exposer needed. These also permit the operator to choose voltages for specific applications.

## 2. X-RAY TUBE FILAMENT TRANSFORMER

This transformer transforms the ac line to supply power for heating the cathode filament. This power can be selected by taps to change the filament heat which in turn change the X-ray tube current and total energy delivered to the patient.

## 3. X-RAY TUBE HIGH VOLTAGE TRANSFORMER AND BRIDGE RECTIFIER

This block transforms the ac line to supply the high dc voltage for accelerating the electrons from cathode to anode. The high dc voltage is selected by taps.

## 4. TIMING CIRCUIT

Timing circuit is used to control the turn-on, turn-off and length of X-ray exposure delivered to the patient. It consists of an electronic counter that applies high voltage to the X-ray tube anode for short periods of time

# ADVANTAGES & APPLICATIONS

## Advantages of X-rays

1. X-ray can be used to produce an image of any body parts.
2. It is also available as a portable unit which can be used in hospitals widely and X-rays can be taken anywhere even in bedside .
3. It is less costly when compared to other imaging models like MRI scan.
4. It can produce fast results.
5. It is a comparatively easy technique.

## Applications of X-rays

1. X-ray machines are used in healthcare for visualizing bone structures and other dense tissues such as tumors.
2. The two main fields which uses X-ray machines are radiography and dentistry.
3. Radiography is used for fast and highly penetrating images.
4. By using X-rays cancer cells can be treated in radiotherapy.