



SNS COLLEGE OF TECHNOLOGY

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Department of Biomedical Engineering

Course Name: 19GET277 & BIOLOGY FOR ENGINEERS

IV Year : VII Semester

Unit V – BIOLOGY AND ITS INDUSTRIAL APPLICATION

Topic : Biomedical Instrumentation

19GET277 / BIOLOGY FOR ENGINEERS /Unit 5/N.Jayashree/AP/BME

INSTRUMENTATION

- Instrumentation is the use of measuring instruments to monitor and control a process. It is the art and science of measurement and control of process variables within a production, laboratory, or manufacturing area.

BIOMEDICAL INSTRUMENTATION

- Biomedical Instrumentation is the field of creating such instruments that help us to measure, record and transmit data to or from the body.

TYPES OF BIOMEDICAL INSTRUMENTATION SYSTEM

- Direct / Indirect
- Invasive / Noninvasive
- Contact / Remote
- Sense / Actuate
- Real-time / Static

INSTRUMENTS USED

There are many instruments used in biomedical such as:

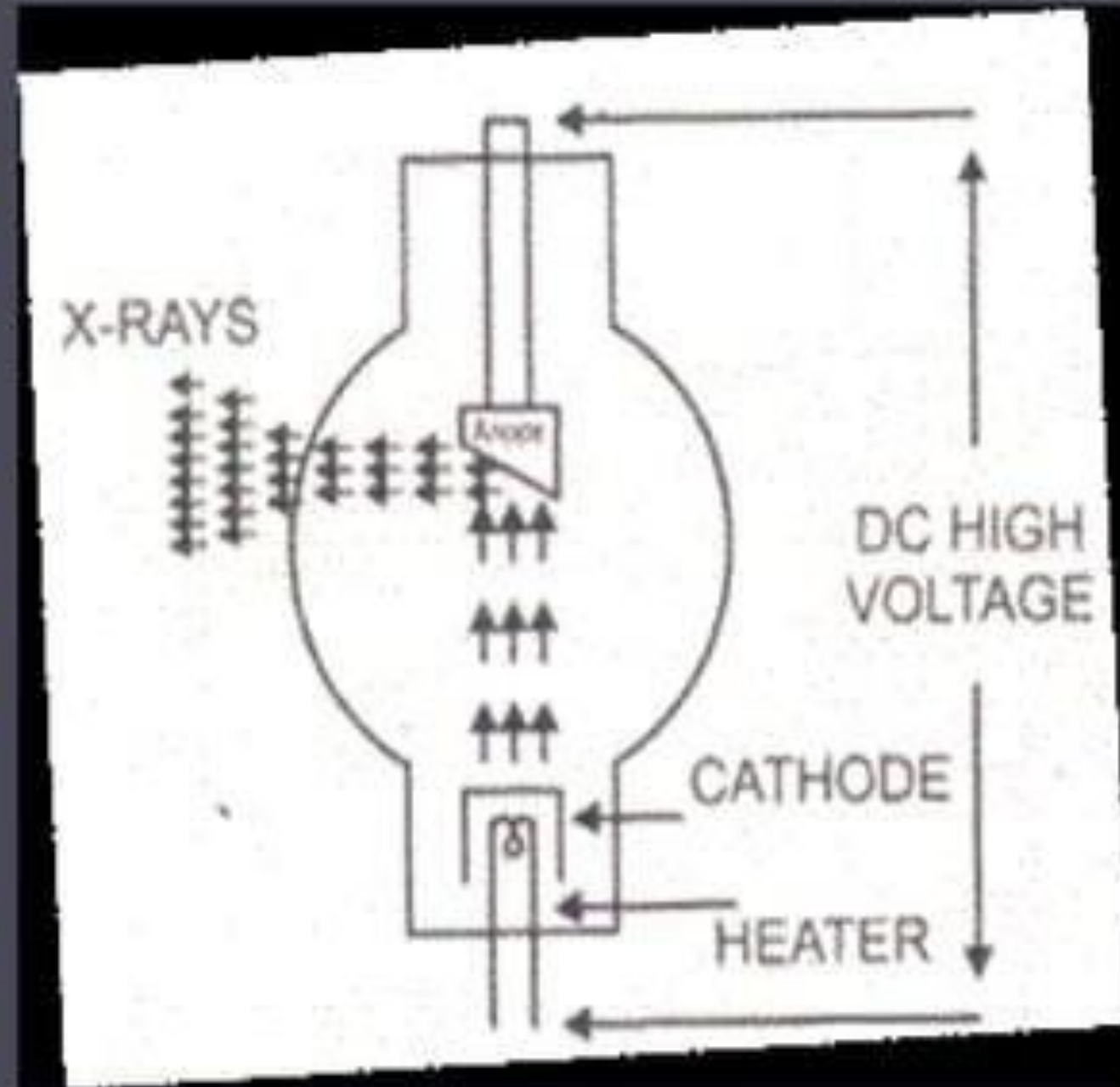
- X-Rays
- Electrocardiography (ECG)
- MRI
- Ultrasound
- CT Scan

X-RAYS

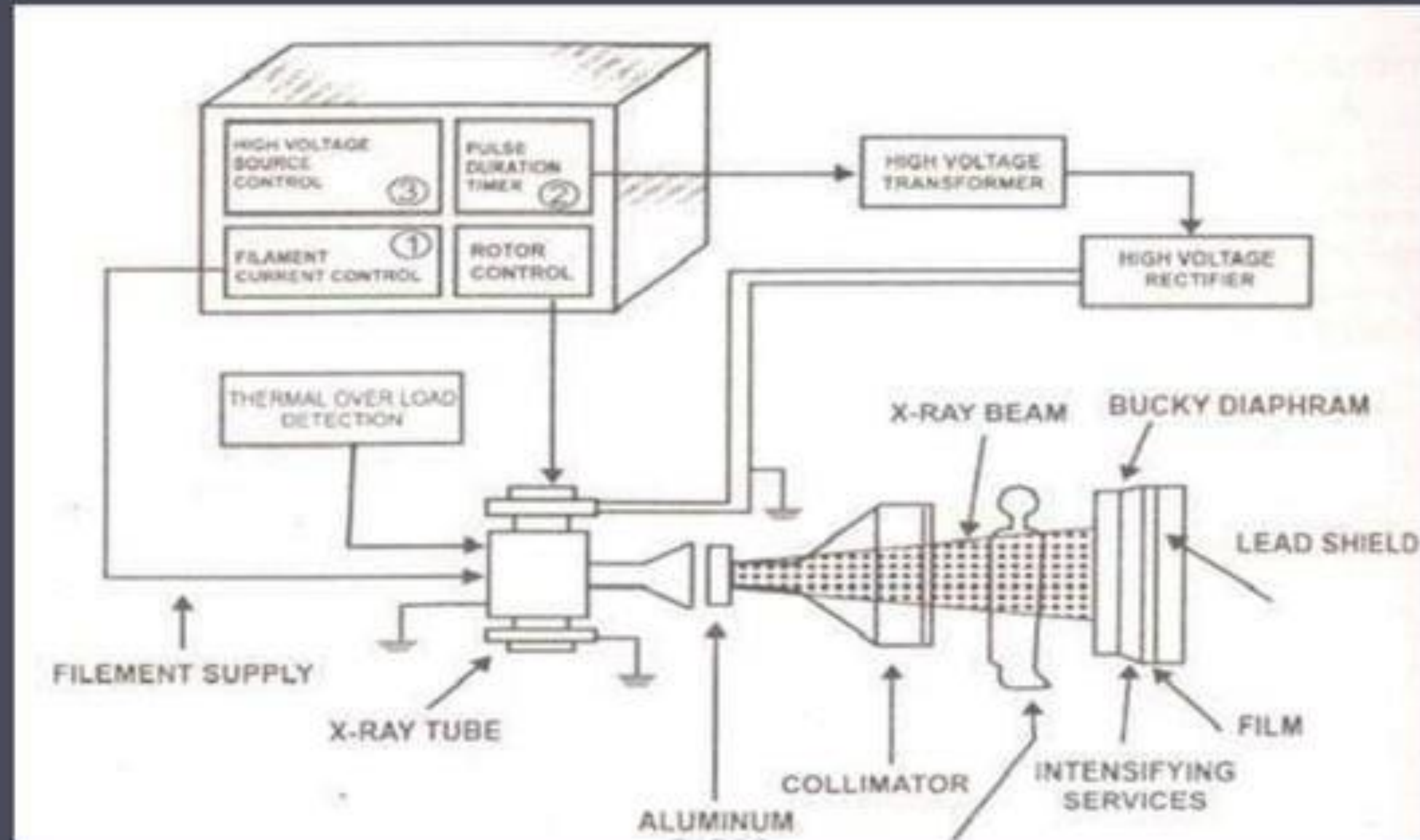
- ❑ The frequency of x-rays is approximately 10^{16} Hz and its wavelength is approximately 0.01 to 10 nanometer.
- ❑ It consists of a high vacuum tube with a heater, cathode and anode, a large DC voltage is used between cathode and anode of x-rays tube.

HOW IT PRODUCED

- When heater is on and very high anode to cathode voltage is applied the electron emits from cathode and travel toward the anode with very high Velocity.
- This beam of electron strike the metal anode such speed that new rays are made from the slanting surface of the anode.
- These rays are x-rays, seem to bounce sideways out through the well of the tube.



BLOCK DIAGRAM



ELECTROCARDIOGRAPHY

- ❑ Electrocardiography is the recording of the electrical activity of the heart.
- ❑ It picks up electrical impulses generated by the polarization and depolarization of cardiac tissue and translates into a waveform.

CONT...

- ❑ It detects and amplifies the tiny electrical changes on the skin that are caused when the heart muscle depolarizes during each heartbeat.
- ❑ At rest, each heart muscle cell has a negative charge, called the membrane potential, across its cell membrane.

ECG SCREEN



MAGNETIC RESONANCE IMAGING



- ❑ Magnetic resonance imaging (MRI) makes use of the magnetic properties of certain atomic nuclei.
- ❑ The hydrogen nuclei behave like compass needles that are partially aligned by a strong magnetic field in the scanner.
- ❑ MRI does not involve radioactivity or ionising radiation. The frequencies used (typically 40-130 MHz) are in the normal radiofrequency range, and there are no adverse health effects.

Advantages:

- ❑ MRI is particularly useful for the scanning and detection of abnormalities in soft tissue structures in the body
- ❑ There is no involvement of any kind of radiations in the MRI.
- ❑ MRI scan can provide information about the blood circulation throughout the body and blood vessels.

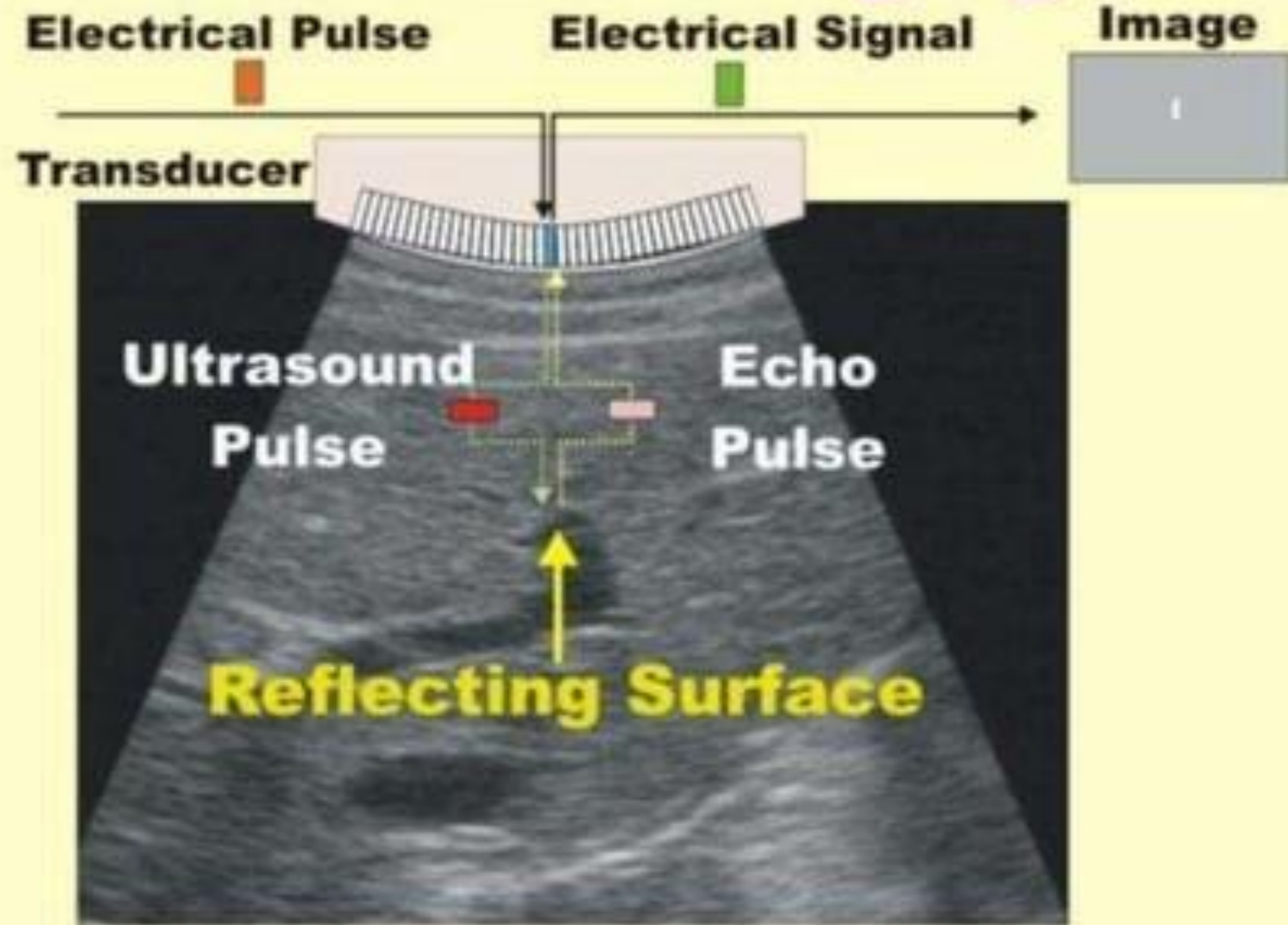
Disadvantages:

- ❑ MRI scan is done in an enclosed space, i.e. fearful of being in a closely enclosed surface, are facing problems with MRI to be done.
- ❑ MRI scans involve really loud noises while processing because they involve a really high amount of electric current supply.
- ❑ MRI scanners are usually expensive.

ULTRASOUND

- ❑ Ultrasound is an oscillating sound pressure wave with a frequency greater than the upper limit of the human hearing range.
- ❑ The frequencies of ultrasound required for medical imaging are in the range 1 - 20 MHz.
- ❑ Ultrasound can be used for medical imaging, detection, measurement and cleaning.

Ultrasound Imaging



Sprawls

ADVANTAGE

- ❑ Usually non-invasive, safe and relatively painless
- ❑ Uses no ionising radiation
- ❑ Does not usually require injection of a contrast medium (dye)

DISADVANTAGES

- ❑ Quality and interpretation of the image highly depends on the skill of the person doing the scan.
- ❑ Use of a special probe is required in some ultrasounds
- ❑ Special preparations may be required before a procedure (e.g. fasting or a full bladder)

COMPUTERIZED TOMOGRAPHY

- ❑ A 'computerized tomography' (CT) uses a computer that takes data from several X-ray images of structures inside a human's or animal's body and converts them into pictures on a monitor.

WORKING

- ❑ A CT scanner emits a series of narrow beams through the human body as it moves through an arc.
- ❑ Inside the CT scanner there is an X-ray detector which can see hundreds of different levels of density. It can see tissues inside a solid organ. This data is transmitted to a computer, which builds up a 3D cross-sectional picture of the part of the body and displays it on the screen.

ADVANTAGES

- Quick and painless
- Can help diagnose and guide treatment for a wider range of conditions than plain X-rays
- Can detect or exclude the presence of more serious problems

DISADVANTAGES

- Small increased risk of cancer in future from exposure to ionising radiation.
- Uses higher doses of radiation, so the risks (while still small) are in general greater than other imaging types



REFERENCE

Introduction to biomedical equipment
technology; *J.J. Carr*

Medical Instrumentation; *Webster*

Electronic devices; *Boylestad*

THANK YOU