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Chapter One

Biomedical Engineering

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

The practice of **biomedical engineering** has a long **history**. One of the earliest examples is a wood and leather prosthetic toe found on a 3,000-year-old Egyptian mummy. **Biomedical engineering** has evolved over the years in response to advancements in science and technology.

Before World War II the field of *bioengineering* was essentially unknown, and little communication or interaction existed between the *engineer* and the life scientist. Mechanical *engineers* have worked with the medical profession for many years in the development of artificial limbs.

Modern medical practice actually began at the turn of the twentieth century. Before1900, medicine had little to offer the average citizen since its resources were mainly physicians, their education, and their little black bags. At this time physicians were in short supply, but for different reasons than exist today. Costs were minimal, demand small, and many of the services provided by the physician also could be obtained from experienced amateurs residing in the community. The individual's dwelling was the major site for treatment and recuperation, and relatives and neighbors constituted an able and willing nursing staff. Midwives delivered babies, and those illnesses not cured by home remedies were left to run their fatal course. Only in the twentieth century didthe tremendous explosion in scientific knowledge and technology lead to the development of the American health care system with the hospital as its focal point and the specialist physician and nurse as its most visible operatives.

Cell physiology

Cell physiology is the biological study about the activities that take place in a *cell* to keep it alive. In the context of human *physiology*, the term *cell physiology* often specifically applies to the *physiology* of membrane transport, neuron transmission, and (less frequently) muscle contraction.

Bioelectric potentials are generated by a number of different biological processes, and are used by cells to govern metabolism, to conduct impulses along nerve fibers, and to regulate muscular contraction. In most organisms **bioelectric potentials** vary in strength from one to several hundred mili volts.

- Communication within neuron
  - electrical signal.
- Electric current: Movement of electrons.
- Bioelectric potential : movement of ions.

Significance

The electric potentials generated in human tissues are widely used for diagnostic purposes.

Clinicians utilizes them for the diagnosis of nerve, muscle, cardiac, brain, visual and auditory functions.

ION DISTRIBUTION

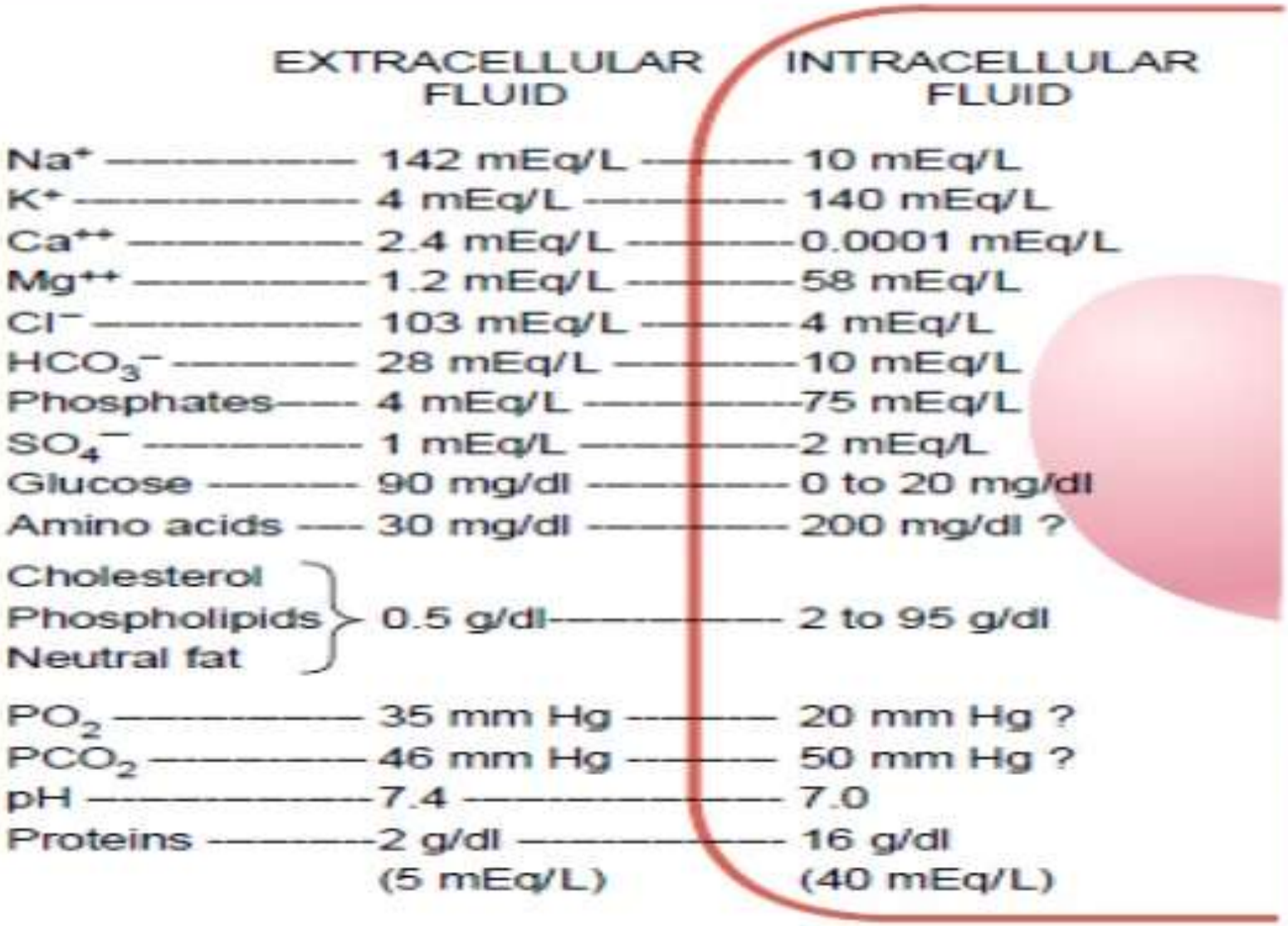
- Particles / molecules
  - electrically charged
- Anions
  - negatively charged
- Cations
  - positively charged

ION DISTRIBUTION

- Anions (-)
  - Large intracellular proteins
  - Chloride ions Cl^-
- Cations (+)
  - Sodium Na^+
  - Potassium K^+

The cell membrane separates the intracellular fluid from extracellular fluid.

Both the compartments having widely different ionic compositions.


EXTRACELLULAR FLUID
INTRACELLULAR FLUID
Na+ 142 mEq/L 10 mEq/L
K+ 4 mEq/L 140 mEq/L
Ca++ 2.4 mEq/L 0.0001 mEq/L
Mg++ 1.2 mEq/L 58 mEq/L
Cl− 103 mEq/L 4 mEq/L
HCO3− 28 mEq/L 10 mEq/L
Phosphates 4 mEq/L 75 mEq/L
SO4− 1 mEq/L 2 mEq/L
Glucose 90 mg/dl 0 to 20 mg/dl
Amino acids 30 mg/dl 200 mg/dl ?
Cholesterol
Phospholipids 0.5 g/dl 2 to 95 g/dl
Neutral fat
PO2 35 mm Hg 20 mm Hg ?
PCO2 46 mm Hg 50 mm Hg ?
pH 7.4 7.0
Proteins 2 g/dl 16 g/dl
(5 mEq/L) (40 mEq/L)

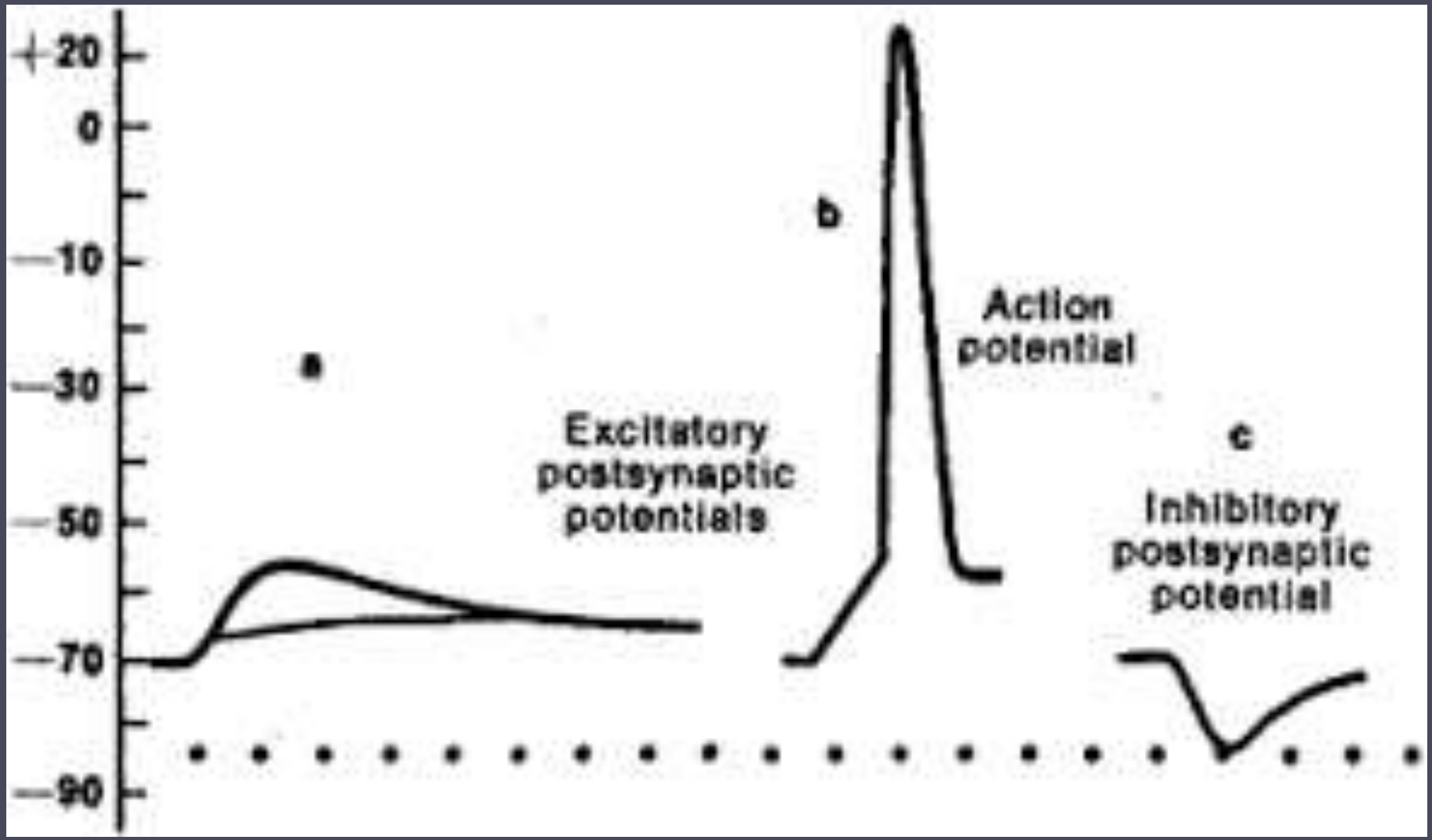
- All living cells have an electrical potential difference across their surface membranes
- All the bioelectric potentials are basically generated due to diffusion of ions across the membrane either during resting or at any moment of excitation.

Equation that describes relationship of membrane potential with ion distribution across the cell membrane is **Goldman-Hodgkin-Katz** equation.

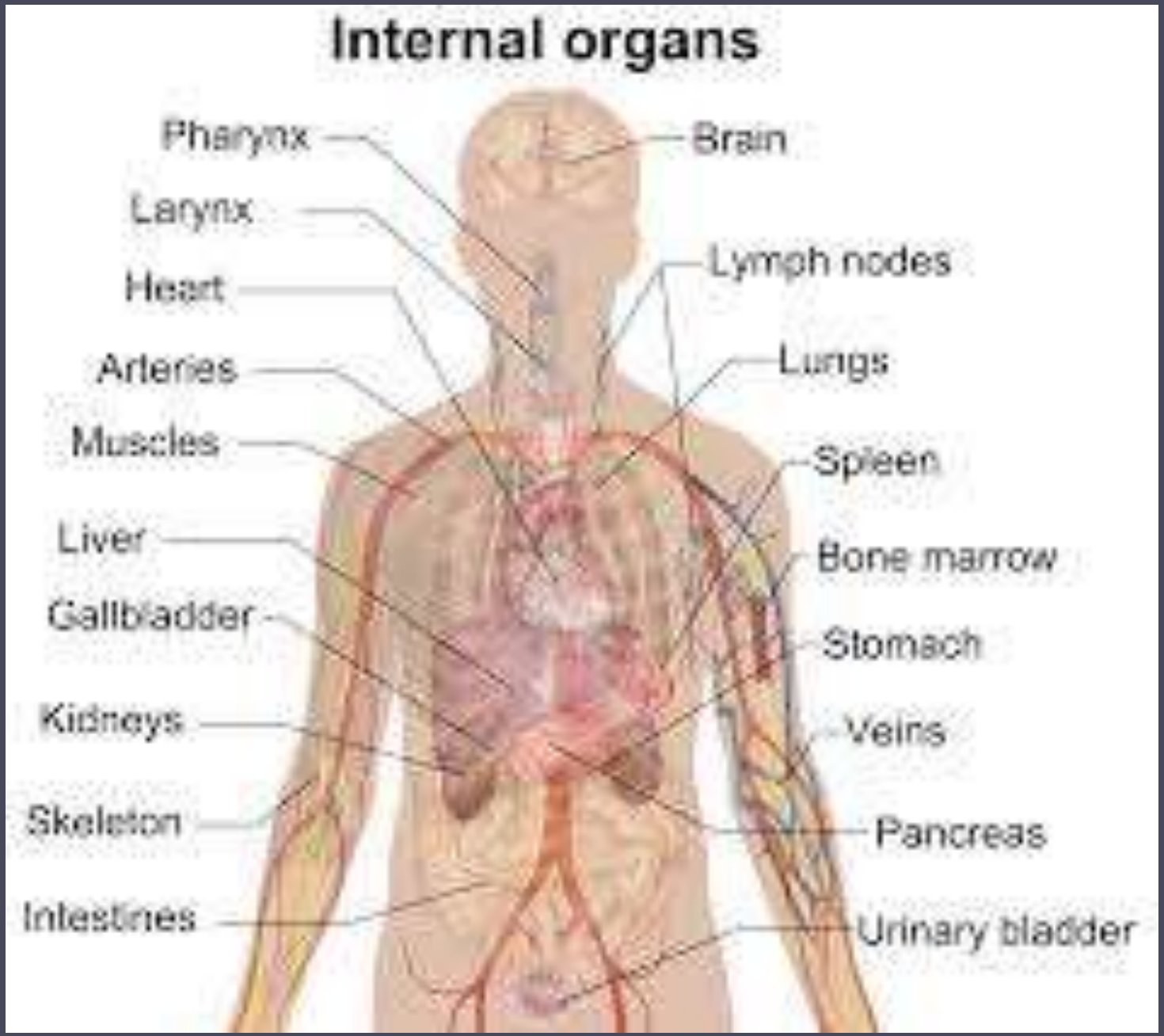
$$EMF = -61 \log \frac{C_{Na^+}{}_i P_{Na^+} + C_{K^+}{}_i P_{K^+} + C_{Cl^-}{}_o P_{Cl^-}}{C_{Na^+}{}_o P_{Na^+} + C_{K^+}{}_o P_{K^+} + C_{Cl^-}{}_i P_{Cl^-}}$$

- Neurons have an electrical potential (voltage) across the cell membrane.
- The inside of the cell is more negative than the outside at rest
  - called the Resting Membrane Potential

RESTING MEMBRANE POTENTIAL


+20
0
−10
−30
−50
−70
−90
a
Excitatory
postsynaptic
potentials
b
Action
potential
c
Inhibitory
postsynaptic
potential

Humans have five **vital organs** that are essential for survival. These are the brain, heart, kidneys, liver and lungs. The **human** brain is the **body's** control center, receiving and sending signals to other **organs** through the nervous system and through secreted hormones.


Internal organs
Pharynx
Larynx
Heart
Arteries
Muscles
Liver
Gallbladder
Kidneys
Skeleton
Intestines
Brain
Lymph nodes
Lungs
Spleen
Bone marrow
Stomach
Veins
Pancreas
Urinary bladder

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Biomedical engineering
- Background of Biomedical engineering
- Cell physiology
- Bioelectric potential
- List different major system with organs of human body
- Resting and action potential.

Questions… ?

Chapter Two

Understand the Basic Sources of Biomedical Signals and Noise.

SIGNAL AND NOISE

Signal noise, in its most basic sense, is any unwanted interference that degrades a communication signal. Signal noise can interfere with both analog and digital signals; however, the amount of noise necessary to affect a digital signal is much higher. This is because digital signals communicate using a set of discrete electrical pulses to convey digital “bits.” As can be seen in Figure 1, those electrical pulses would require a lot of noise in order to be confused with one another

Signal no

Noise Signal

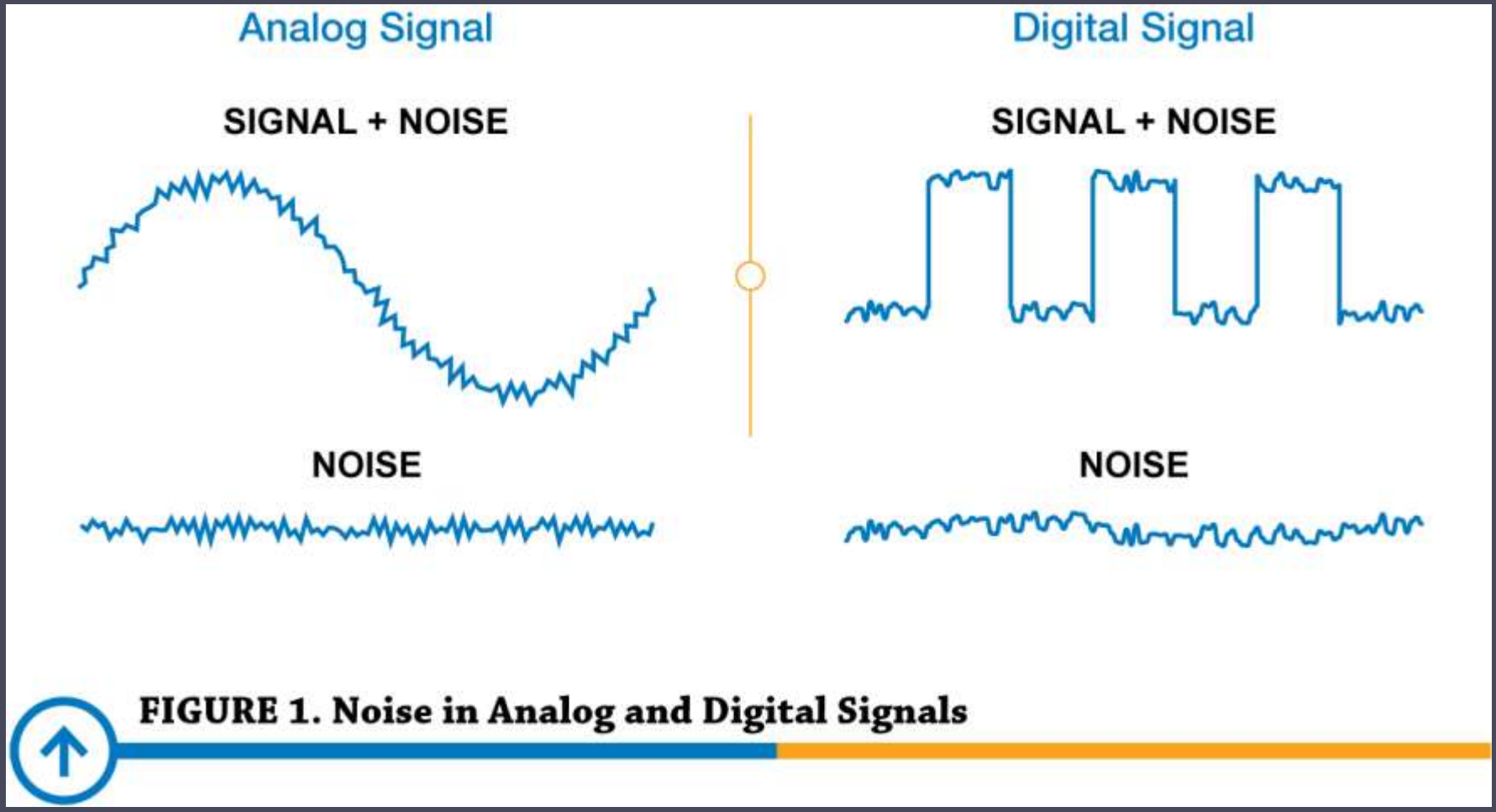


FIGURE 1. Noise in Analog and Digital Signals

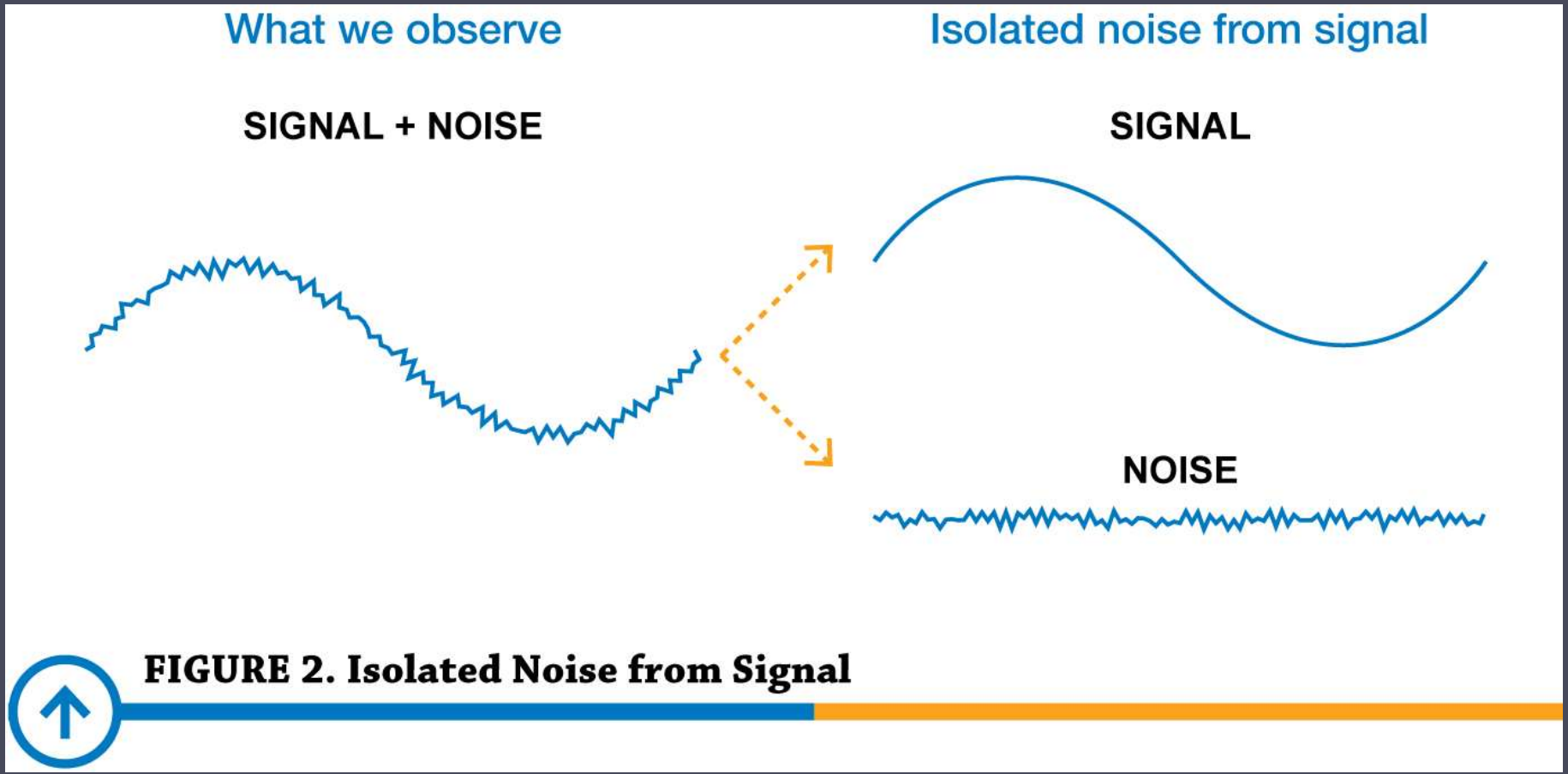
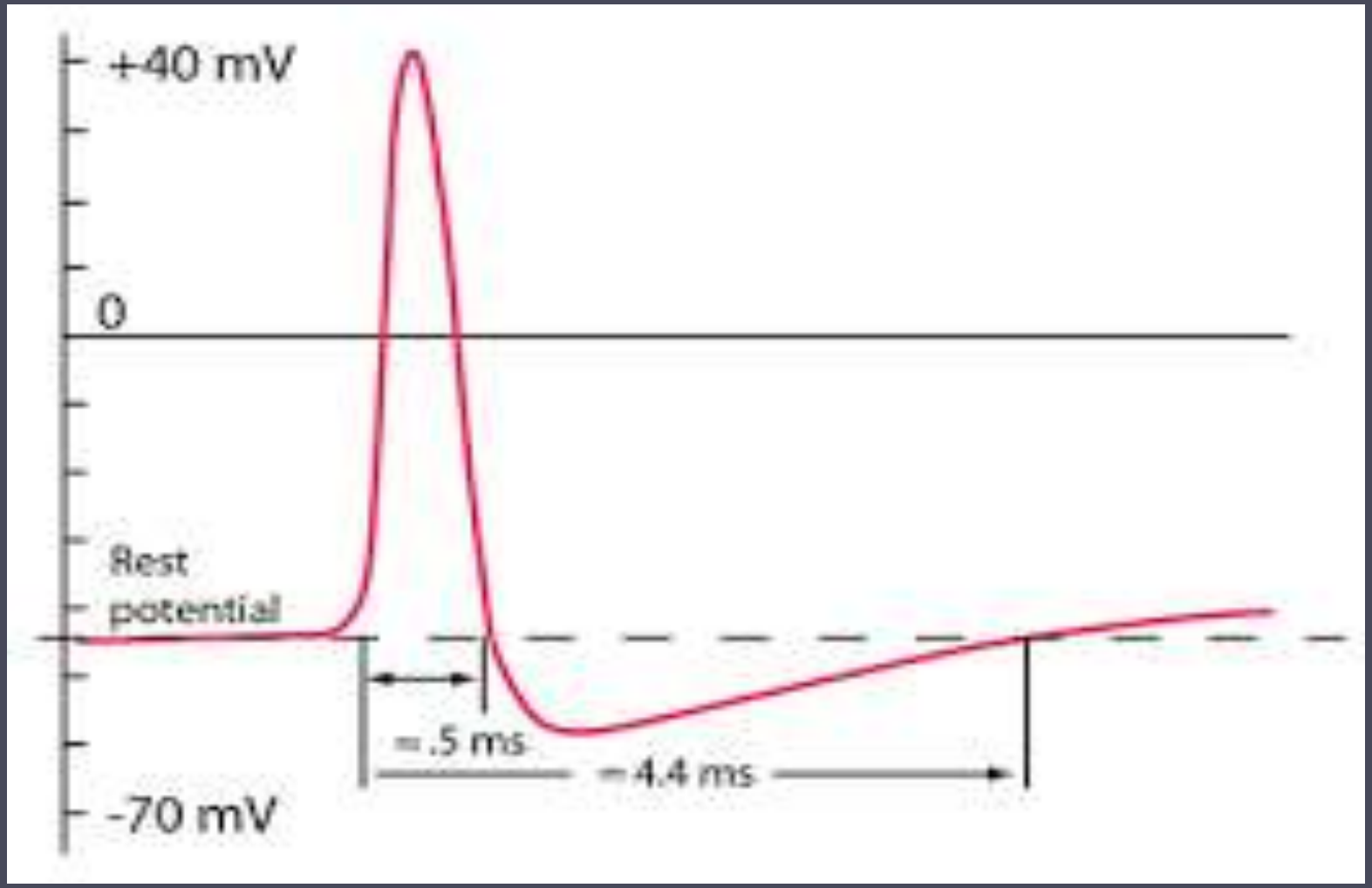


FIGURE 2. Isolated Noise from Signal


+40 mV
0
Rest
potential
=.5 ms
=4.4 ms
-70 mV

All cells in animal body tissues are electrically polarized – in other words, they maintain a voltage difference across the cell's plasma membrane, known as the membrane potential. This electrical polarization results from a complex interplay between protein structures embedded in the membrane called ion pumps and ion channels. In neurons, the types of ion channels in the membrane usually vary across different parts of the cell, giving the dendrites, axon, and cell body different electrical properties. As a result, some parts of the membrane of a neuron may be excitable (capable of generating action potentials), whereas others are not. Recent studies[*citation needed*] have shown that the most excitable part of a neuron is the part after the axon hillock (the point where the axon leaves the cell body), which is called the initial segment, but the axon and cell body are also excitable in most cases.

Each excitable patch of membrane has two important levels of membrane potential: the resting potential, which is the value the membrane potential maintains as long as nothing perturbs the cell, and a higher value called the threshold potential. At the axon hillock of a typical neuron, the resting potential is around –70 milivolts (mV) and the threshold potential is around –55 mV. Synaptic inputs to a neuron cause the membrane to depolarize or hyperpolarize; that is, they cause the membrane potential to rise or fall. Action potentials are triggered when enough depolarization accumulates to bring the membrane potential up to threshold. When an action potential is triggered, the membrane potential abruptly shoots upward and then equally abruptly shoots back downward, often ending below the resting level, where it remains for some period of time. The shape of the action potential is stereotyped; this means that the rise and fall usually have approximately the same amplitude and time course for all action potentials in a given cell. In most neurons, the entire process takes place in about a thousandth of a second. Many types of neurons emit action potentials constantly at rates of up to 10–100 per second.

Learning Outcomes….

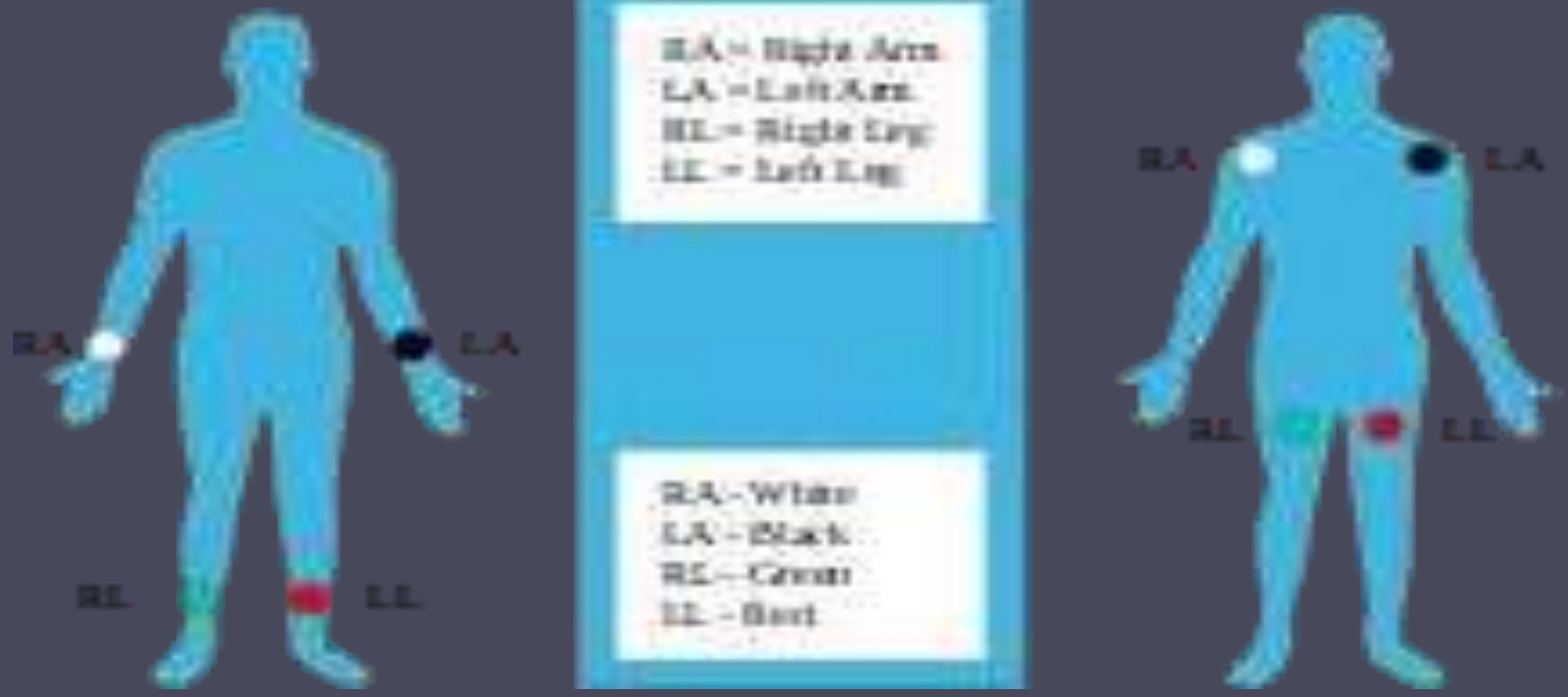
To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Bioelectric signals
- Basic concept of biomedical signals
- Cell potential waveform
- Bioelectric potential
- Signal and noise
- Interfacing analog signals to microprocessors.

Questions… ?

Chapter Three

Understand sensors and biomedical electrodes.


RA – Right Arm
LA – Left Arm
RL – Right Leg
LL – Left Leg
RA
LA
RL
LL
RA – White
LA – Black
RL – Green
LL – Red
RA
LA
RL
LL

Pulse sensors

Heart rate measurement is one of the very important parameters of the human cardiovascular system. The heart rate of a healthy adult at rest is around 72 beats per minute (bpm).

Basically, the device consists of an infrared transmitter LED and an infrared sensor photo-transistor. The transmitter-sensor pair is clipped on one of the fingers of the subject. The LED emits infrared light to the finger of the subject. The photo-transistor detects this light beam and measures the change of blood volume through the finger artery. This signal, which is in the form of pulses is then amplified and filtered suitably and is fed to a low-cost microcontroller for analysis and display.

Transducers

- Transducer
  - a device that converts primary form of energy into other different energy form only for measurement purposes.
    - Primary Energy Forms: mechanical, thermal, electromagnetic, optical, chemical, etc.
- Sensor
  - It is a wide term which covers almost everything from human eye to trigger of a pistol.
  - Senses the change in parameter(specific).

CLASSIFICATION OF TRANSDUCERS

- Active & Passive Transducers
- Analog & Digital Transducers
- Primary & secondary Transducers
- On the basis of principle used

Active vs Passive Transducers

☐Passive Transducers:

- Add energy to the measurement environment as part of the measurement process.
- Requires external power supply.
  - Strain gauge, potentiometer & etc.

☐Active Transducers :

- Do not add energy as part of the measurement process but may remove energy in their operation.
- Does not require external power supply
  - Thermocouple, photo-voltaic cell & etc.

ANALOG & DIGITAL TRANSDUCERS

ANALOG TRANSDUCER The transducers which convert the input quantity into an analog output which is a continuous function of time.

DIGITA TRANSDUCERS The transducers which convert the input quantity into digital form means in the form of pulses.

PRIMARY vs SECONDARY TRANSDUCERS

- PRIMARY TRANSDUCERS - Some transducers contain the mechanical as well as electrical device. The mechanical device converts the physical quantity to be measured into a mechanical signal. Such mechanical device are called as the primary transducers.
- SECONDARY TRANSDUCERS - The electrical device then convert this mechanical signal into a corresponding electrical signal. Such electrical device are known as secondary transducers

CLASSIFICATION ON THE BASIS OF PRINCIPLE USED

- Capacitive
- Inductive
- Resistive
- Electromagnetic
- Piezoelectric
- Photoconductive
- Photovoltaic

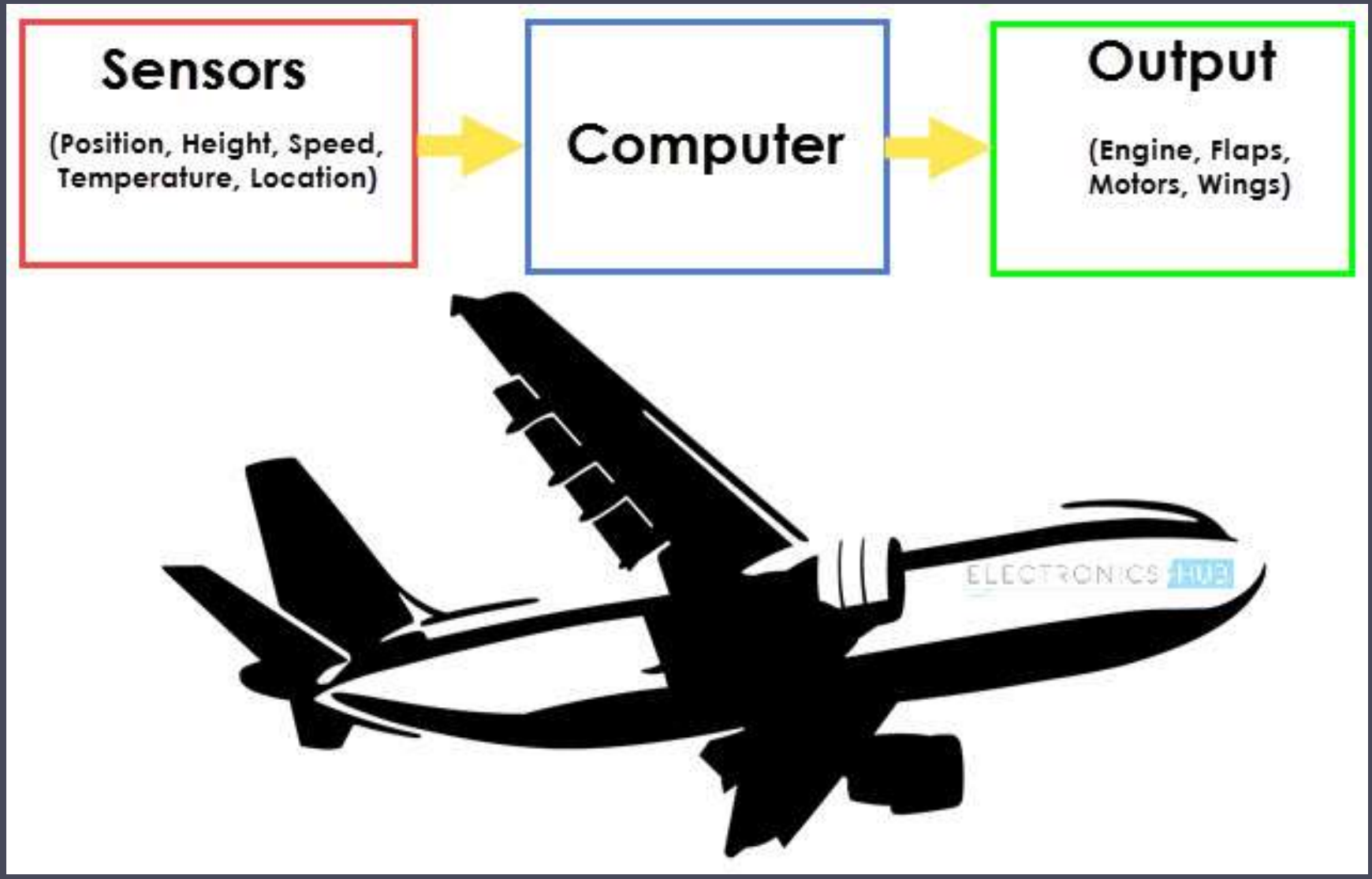
Selecting a Transducer

- What is the physical quantity to be measured?
- Which transducer principle can best be used to measure this quantity?
- What accuracy is required for this measurement?
  - Fundamental transducer parameters
  - Physical conditions
  - Environmental conditions
  - Compatibility of the associated equipment
- Reducing the total measurement error :
  - Using in-place system calibration with corrections performed in the data reduction
  - Artificially controlling the environment to minimize possible errors

Transducers for Physiological Variable Measurements

- A variable is any quantity whose value changes with time. A variable associated with the physiological processes of the body is known as a physiological variable.
- Physiological variables occur in many forms: as ionic potential, mechanical movements, hydraulic pressure ,flows and body temperature etc.
- Different transducers are used for different physiological variables.

A **sensor** is a device that detects and responds to some type of input from the physical environment. An oxygen **sensor** in a car's emission control system detects the gasoline/oxygen ratio, usually through a chemical reaction that generates a voltage.


Sensors
(Position, Height, Speed, Temperature, Location)
Computer
Output
(Engine, Flaps, Motors, Wings)
ELECTRONICS HUB

Different Types of Sensors

- Temperature Sensor.
- Proximity Sensor.
- Accelerometer.
- IR Sensor (Infrared Sensor)
- Pressure Sensor.
- Light Sensor.
- Ultrasonic Sensor.
- Smoke, Gas and Alcohol Sensor.

able break / lead breakage, broken connectors and damaged cable insulation – many of these failure causes and **sources** of **errors** in **sensors** can be traced back to mechanical failure of qualitatively inferior components

There is a tendency for the transmitters to drift over time, and be affected by ambient temperature fluctuations. An additional *source* of *error* is introduced when an A/D convertor is used to convert the analogue signal of ohms or mA from the *sensor* or transmitter into digital signals for processing by a computer.

Bio potential electrodes is a transducer that convert the body ionic current in the body into the traditional electronic current flowing in the **electrode**. **Bio potential electrode** should be able to conduct small current across the interface between the body and the electronic measuring circuit.

The current flow in the human body is due to ion flow, not electrons. A **bio potential electrode** is a transducer that senses ion distribution on the surface of tissue, and converts the ion current to electron current. The cautions are discharged into the electrolyte, and the electrons carry charge through the lead wires.

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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.

P wave: signal spread from SA node to make the atria contract. P-Q Segment: signal arrives AV node stay for a instant to allow the ventricle to be filled with blood. Q wave :After the Bundle of His the signal is divided into two branches and run through the septum. R,S wave: Left and right ventricle contraction are marked by the R,S wave. T wave: ventricle relaxing

ECG SCREEN

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Sensor and transducer
- Classification of sensors
- Source of sensor errors
- Electrode for biophysical sensing
- ECG, EEG, EMG and microelectrodes.

Questions… ?

Chapter Five

Understand recording and monitiring system

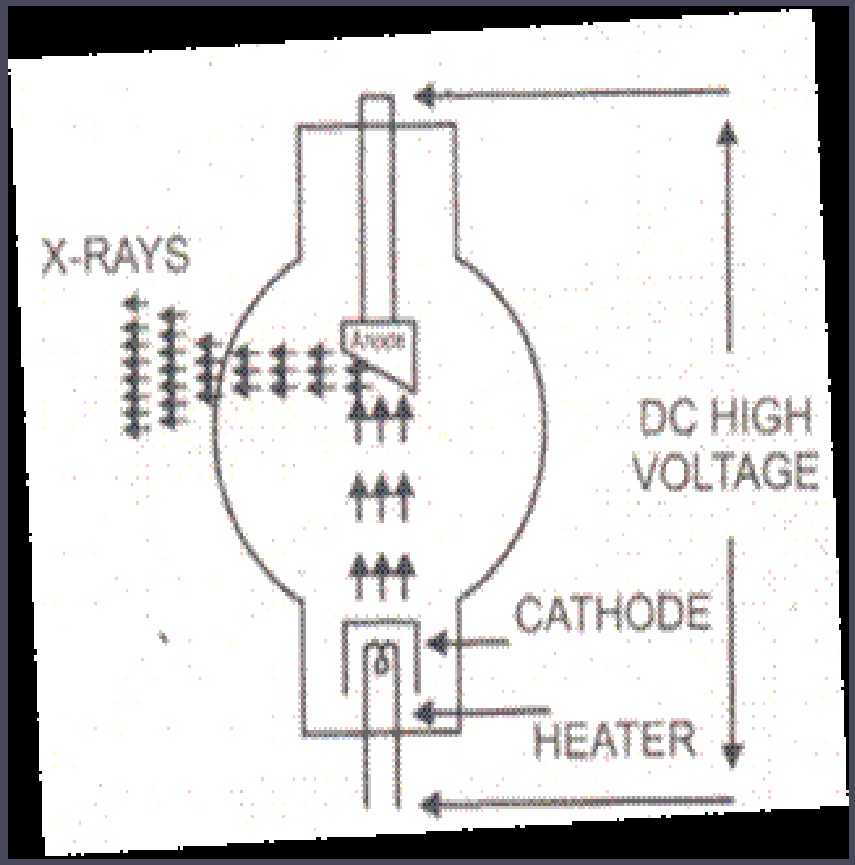
X-RAYS

- The frequency of x-rays as approximately 1020 Hz and its wave length is approximately 0.01 to 10 nanometer.

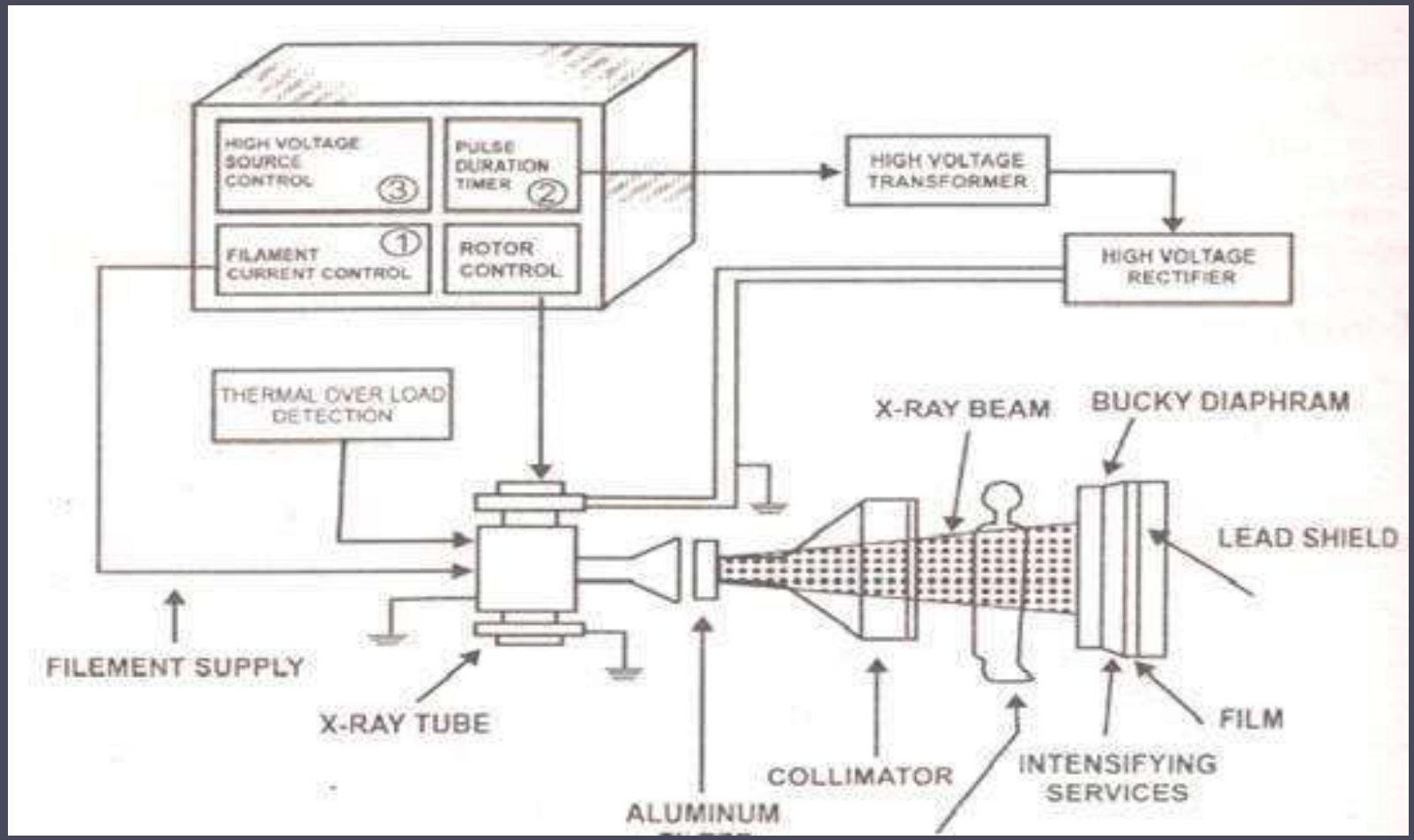
- It consist of high vacuum tube with a heater, cathode and anode, vacuum tube, a large DC voltage is used between cathode and anode of x-rays tube.

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 thought the well of the tube.



BLOCK DIAGRAM



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.

Thermal array recorder. This compact, *thermal array recorder* works with Philips modular patient monitors. It offers powerful *recording* capabilities and produces high-resolution waveforms and measurements.

Portable Thermal Array Recorder

A portable field expandable recorder which uses a high quality, durable, thermal writing linear array to produce traces on its 200mm writing width. This recorder can be expanded from 1 to 18 channels using plug-in analog voltage amplifiers or up to 72 channels of logic input. A battery protected, 8 or 14 bit resolution, 32K word per channel memory allows for data capture and storage at sampling rates.

Some additional features include: a-c/d-c power; plug-in amplifiers for voltage, temperature, strain, F/V and logic event; chart speeds up to 20mm/sec; recording parameters printed onto a chart; weighs less than 25 pounds with 9 channels; multiple triggers and grid pattern selection. A PC compatible floppy disk drive stores recorded files

Electrostatic Recording

a process in which various kinds of information represented by electric signals are placed and preserved on a dielectric medium. The process entails creating on the medium a particular distribution of electric charges, known as a charge pattern, which constitutes a “latent image” of the recorded information.

Electrostatic recording systems may be divided into two basic groups, depending on the methods used for recording and reproducing information. In systems of the first group, the recording component is either an electrode head or a cathode-ray tube with a metal-filament screen. A latent image element area is formed by the transfer of charges from the electrodes (or filaments) of the recording component to the dielectric medium across an air gap 5–20 micrometers wide. The transfer takes place as a result of an electric discharge that occurs when a voltage of 700–900 volts is applied to the electrodes.

Digital display system

Digital displays are essentially flat panel screens that rely on different technologies to present multimedia content to an audience. The most common are LCD screens which use liquid crystal cells to **display** content and **LED** screens that are based on Light Emitting Diode technology.

How Digital Displays Work

Digital displays are essentially flat panel screens that rely on different technologies to present multimedia content to an audience. The most common are LCD screens which use liquid crystal cells to display content and LED screens that are based on Light Emitting Diode technology. Digital displays on their own can’t do much. They need some type of media player hardware and software that can render content for them.

Display orientation

It’s a good idea to ask your display vendor if the backlighting is compatible with more than one mounting orientation. For example, some displays position the background LEDs in a way that feavours one orientation over the other (usually, landscape). If you plan to install displays in a vertical (portrait) orientation, make sure the display’s background lighting provides an even coverage so there are no hot-spots or shadows. Professional grade displays are designed in such a way the backlight will always be even, regardless of the screen orientation. Still, it’s important you confirm this prior to installation.

Smart displays

The latest trend in digital signage is the smart display. These displays are also called “System on Chip” or SoC because they include an entire computer on a single piece of silicon. With SoC displays, the media player hardware is embedded behind the glass, right inside the display frame. Smart displays have more in common with tablets than your run-of-the-mill “dumb” display. They are gaining in popularity because they are less expensive and easier to deploy than similar unbundled components.


LED DIGITAL BOARD

The **Central Monitoring System**, abbreviated to CMS, is a **centralized** telephone interception provisioning **system** installed by the Centre for Development of Tele matics (C-DOT), an Indian Government owned telecommunications technology development centre, and operated by Telecom Enforcement Resource and **Monitoring** (TERM) .

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Recording and monitoring instruments
- Basic electronic recording system
- Factor to be consider for signal conditioner
- Digital thermal array recorder and electrostatic recorder
- Digital display system
- Basic central monitoring system.

Questions… ?

Chapter Six

Understand the instrumentation for measuring brain function

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:

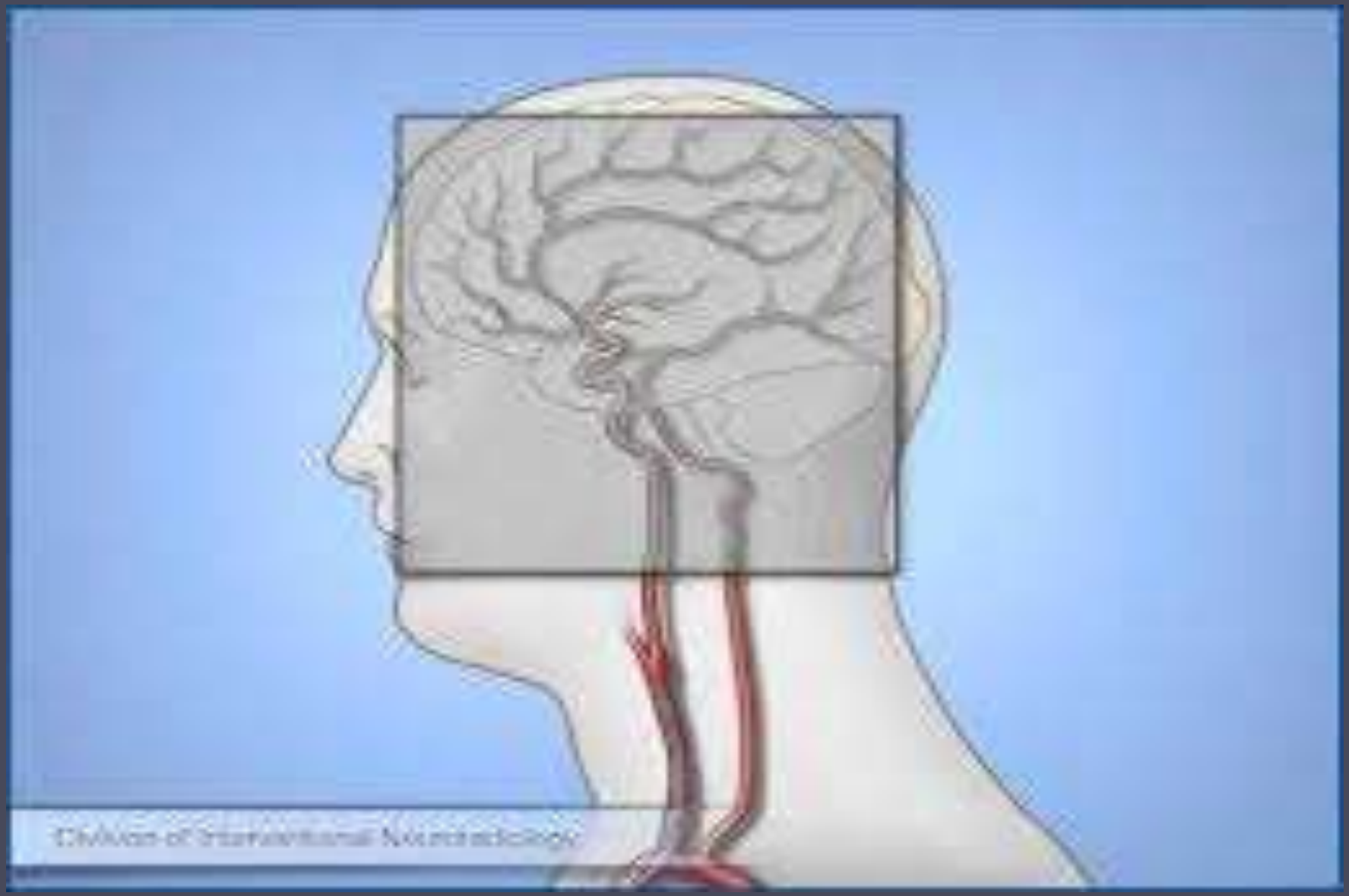
- MRI is particularly useful for the scanning and detection of abnormalities in soft tissue structures in the body
- There is no involvement of any kind of radiations in the MRI.
- MRI scan can provide information about the blood circulation throughout the body and blood vessels.

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.

Cerebral angiography is a diagnostic test that uses an X-ray. It produces a **cerebral angiogram**, or an image that can help your doctor find blockages or other abnormalities in the blood vessels of your head and neck. Blockages or abnormalities can lead to a stroke or bleeding in the **brain**.

Angiography is a minimally invasive medical test that uses x-rays and an iodine-containing contrast material to produce pictures of blood vessels in the **brain**. In **cerebral angiography**, a thin plastic tube called a catheter is inserted into an artery in the leg or arm through a small incision in the skin.



Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Anatomical and physiological parameters of brain
- Cerebral angiography
- Ultrasonic equipment
- Techniques involve in EEG

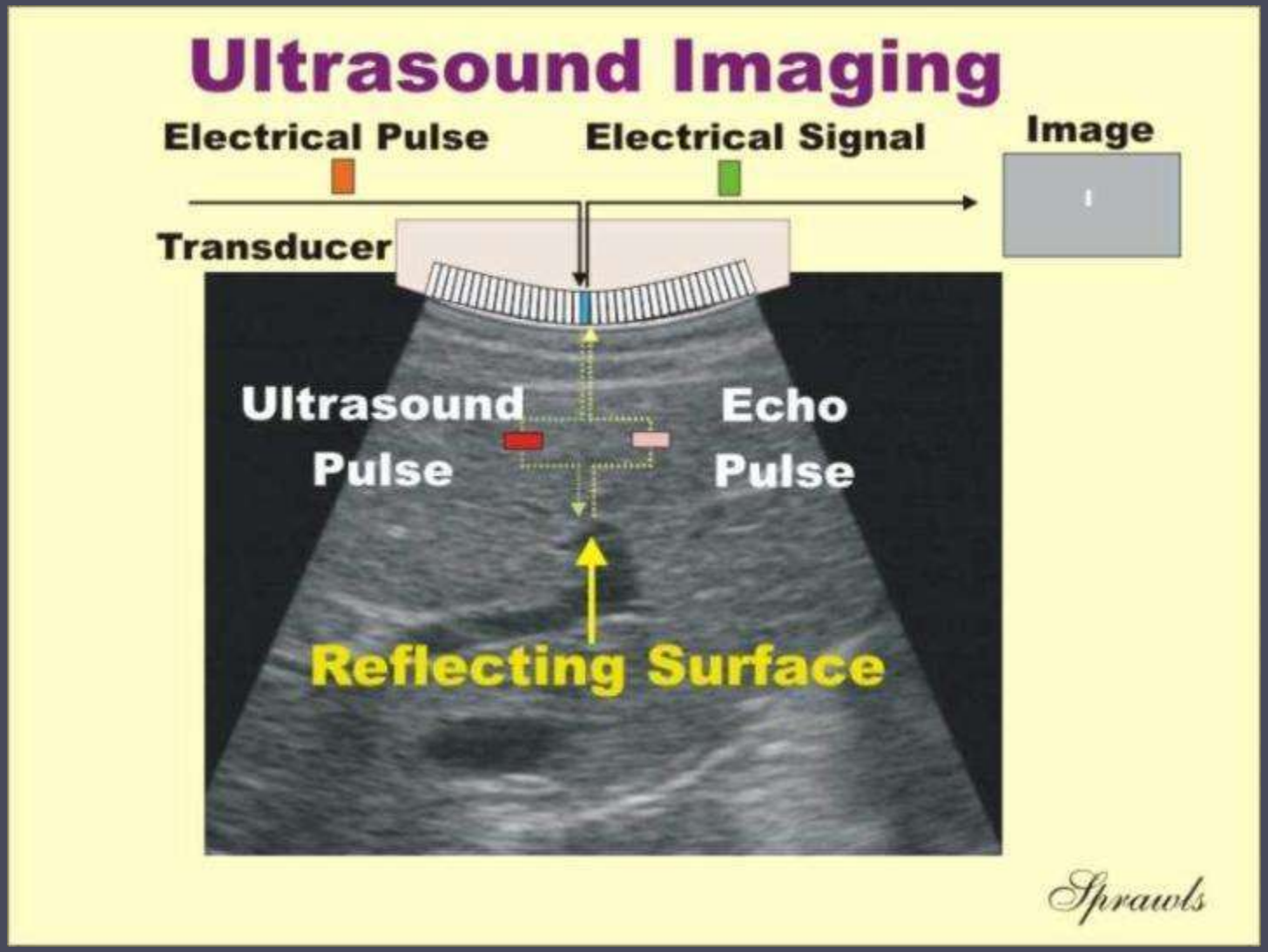
Questions… ?

Chapter Seven

Understand he concept of automated biochemical analysis system

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
Electrical Pulse
Electrical Signal
Image
Transducer
Ultrasound Pulse
Echo Pulse
Reflecting Surface
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.

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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

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Automated biochemical system
- Components of automated biochemical system
- Microprocessor based ion analyzer
- Uses of centrifuge, colorimeter, bio-chemistry analyzer and photometer.

Questions… ?

Chapter Eight

Understand Electro surgery generator

An **electrosurgical** unit (ESU) consists of a **generator** and a hand piece with one or more electrodes. The device is controlled using a switch on the hand piece or a foot switch. **Electrosurgical generators** can produce a variety of electrical waveforms. As these waveforms change, so do the corresponding tissue effects.

Phonocardiograph (PCG)

- A Phonocardiogram is a recording of the heart sounds and murmurs.
- Eliminates subjective interpretation of the heart sounds
- Enables evaluation of the heart sounds and murmurs with respect to the electric and mechanical events in the cardiac cycle.
- Evaluation of the result is based on the basis of changes in the wave shape and various timing parameters.

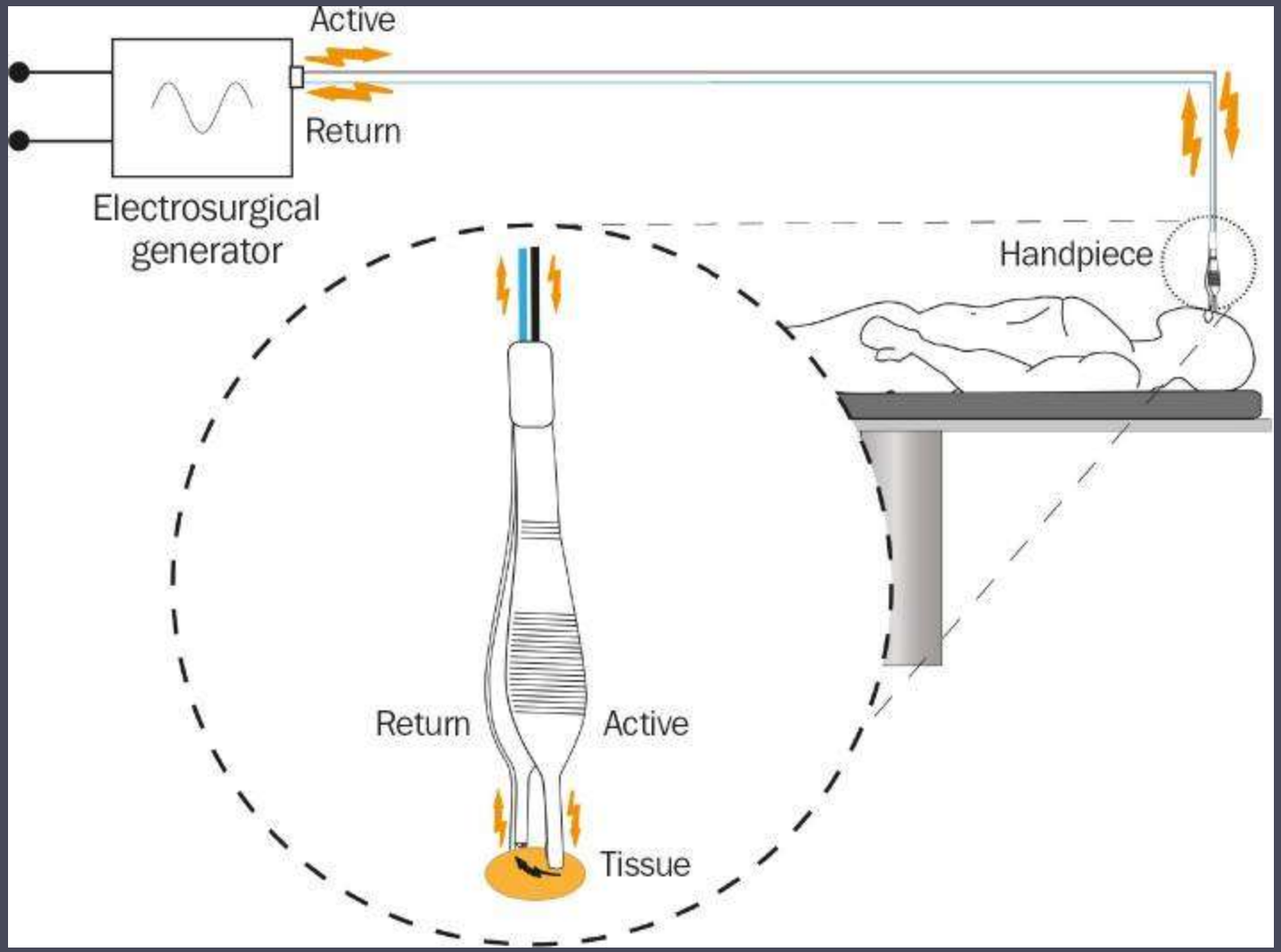

Figure 1 : Bipolor Electrosurgical Generator

In **bipolar electrosurgery** (Figure 1), both the active electrode and return electrode functions are performed at the site of surgery. The two tips of the forceps perform the active and return electrode functions. Only the tissue grasped in the forceps is included in the electrical circuit. Because the return function is performed by one tip of the forceps, no patient return electrode is needed. Bipolar electrosurgery operates regardless of the medium in which it is used, permitting coagulation in a fluid environment – a great advantage when attempting to coagulate in a wet field. As a result, bipolar electrosurgery is often referred to as 'wet field' cautery

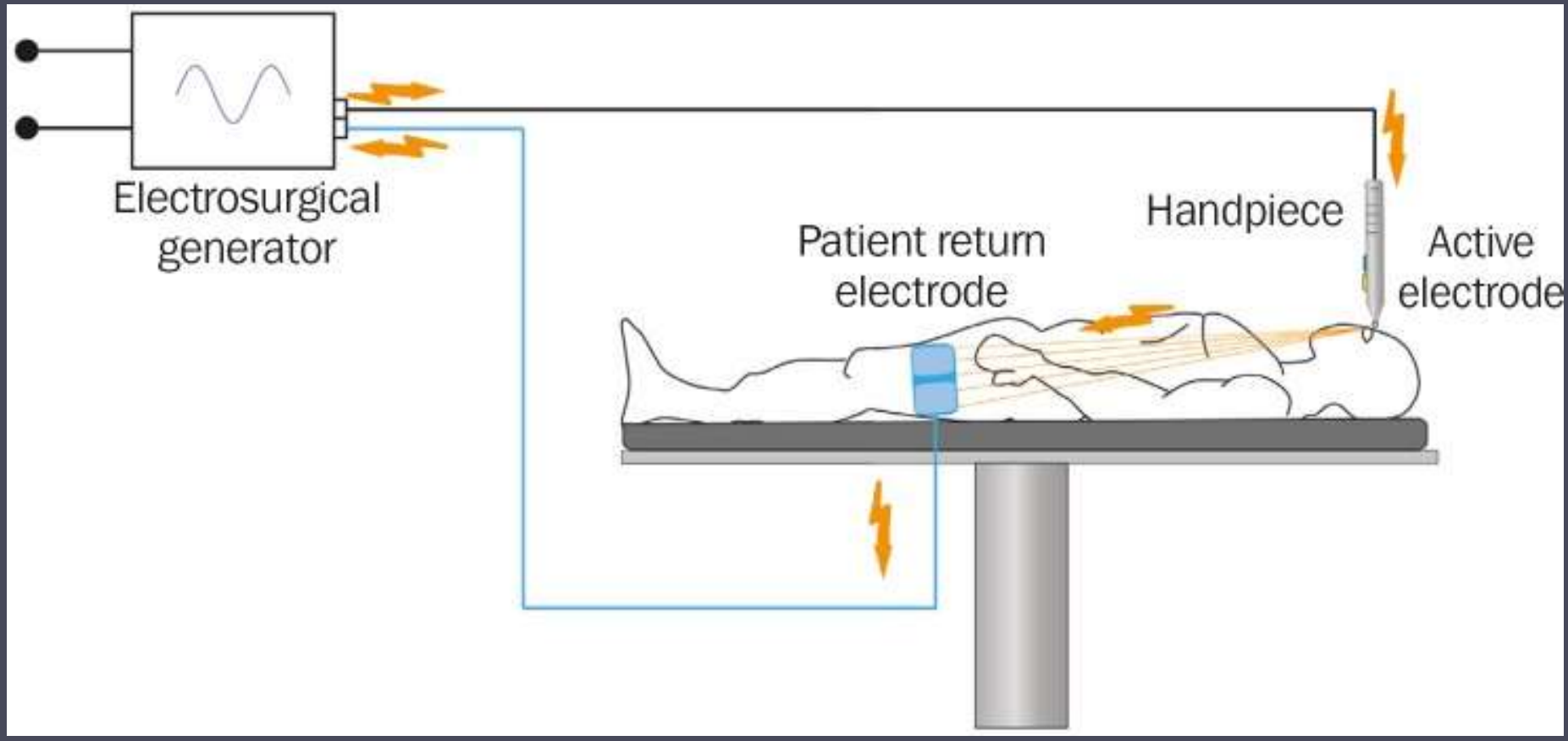

Figure 2 : Monopolor Electrosurgery Generator.

In **monopolar electrosurgery** (Figure 2), the active electrode is placed at the surgical site. The patient return electrode (also known as a ‘dispersive pad’ is placed somewhere else on the patient's body. The current passes through the patient as it completes the circuit from the active electrode to the patient return electrode. The function of the patient return electrode is to remove current from the patient safely. A return electrode burn will occur if the heat produced, over time, is not safely dissipated by the size or conductivity of the patient return electrode.

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Electro surgery
- Historical background of electro surgery
- Basic principle of electro surgery
- Types of electro surgery techniques
- Safety aspects in electro surgical units.

Questions… ?

Chapter Ten

Understand cleaning and disinfection

Cleaning removes germs, dirt, and impurities from surfaces or objects.

Disinfecting kills germs on surfaces or objects.

Sanitizing lowers the number of germs on surfaces or objects to a safe level, as judged by public health standards or requirements.

Guideline for Disinfection and Sterilization in Healthcare Facilities

Cleaning is the removal of foreign material (e.g., soil, and organic material) from objects and is normally accomplished using water with detergents or enzymatic products. Thorough cleaning is required before high-level disinfection and sterilization because inorganic and organic materials that remain on the surfaces of instruments interfere with the effectiveness of these processes. Also, if soiled materials dry or bake onto the instruments, the removal process becomes more difficult and the disinfection or sterilization process less effective or ineffective. Surgical instruments should be presoaked or rinsed to prevent drying of blood and to soften or remove blood from the instruments.

Routine General Cleaning

Routine cleaning of the environment should be undertaken at least daily. Thorough cleaning with neutral detergent and water is commonly used. If soiling (with blood and/or bodily fluids) is evident, then general cleaning should be followed with a disinfectant clean - using a chlorine releasing product/sodium hypochlorite or a chlorine dioxide solution. If using a hypochlorite solution the area should then be rinsed and dried although this is not required with some chlorine dioxide solutions.Always ensure that surfaces that are being disinfected are compatible with the product being used.

Learning Outcomes….

To provide the students with an opportunity to acquire knowledge in the area of biomedical engineering with special emphasis on:

- Cleaning and disinfection
- Sterilization
- Different types sterilization process
- Steam autoclave process.

Questions… ?

THANK YOU