



# NSCET E-LEARNING PRESENTATION

**LISTEN ... LEARN... LEAD...**



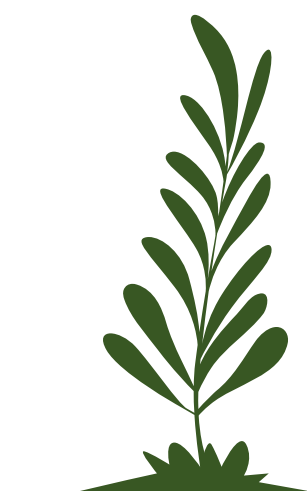


# Electrical and Electronics engineering



**III YEAR/ V<sup>th</sup> Semester**

OMD551 Basics of Biomedical Instrumentation



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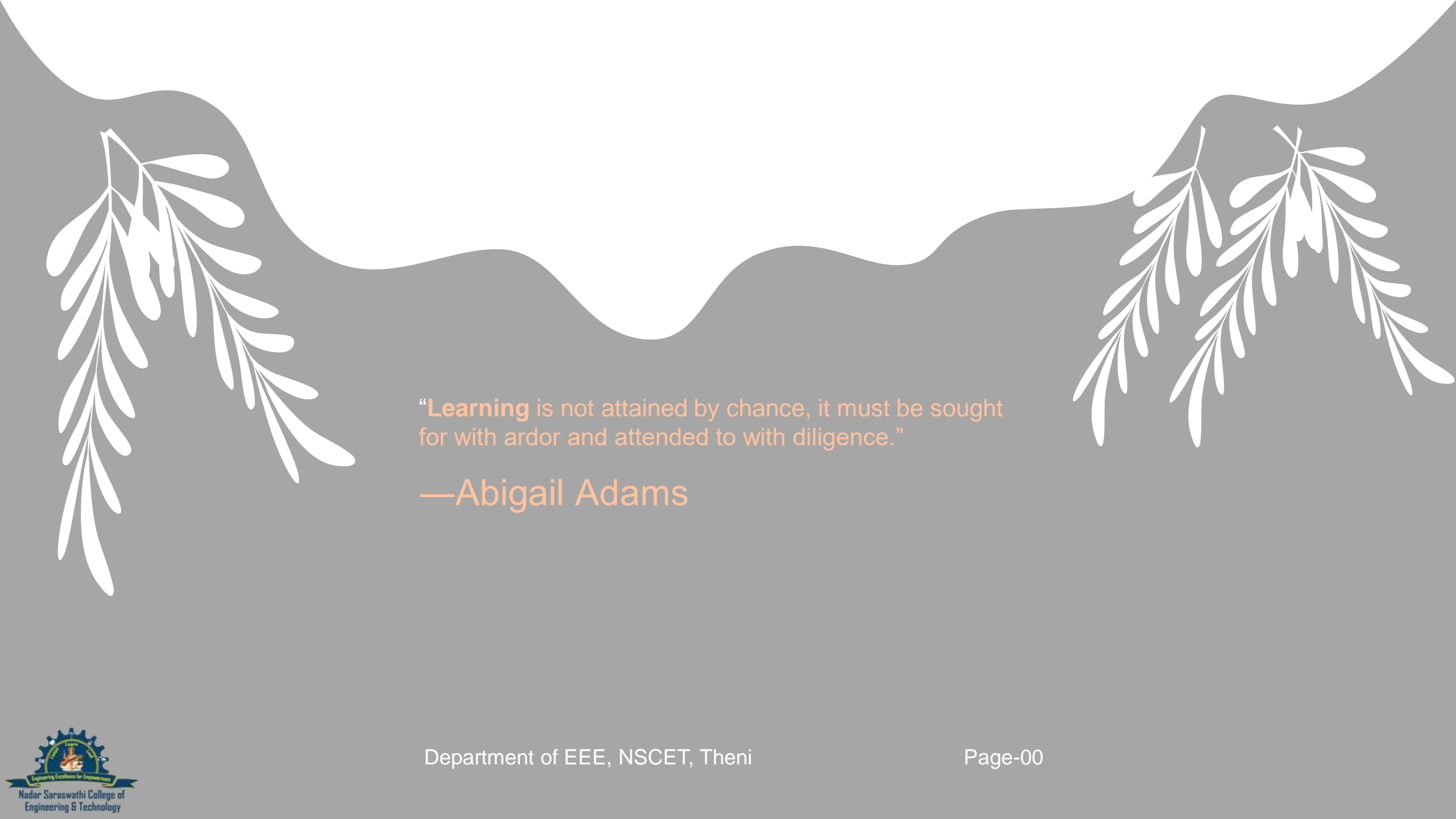




# TOPIC NAME

UNIT 01 –OMD551 Basics of Biomedical  
Instrumentation





“**Learning** is not attained by chance, it must be sought for with ardor and attended to with diligence.”

—Abigail Adams

# BIOPOTENTIAL GENERATION AND ELECTRODES TYPES

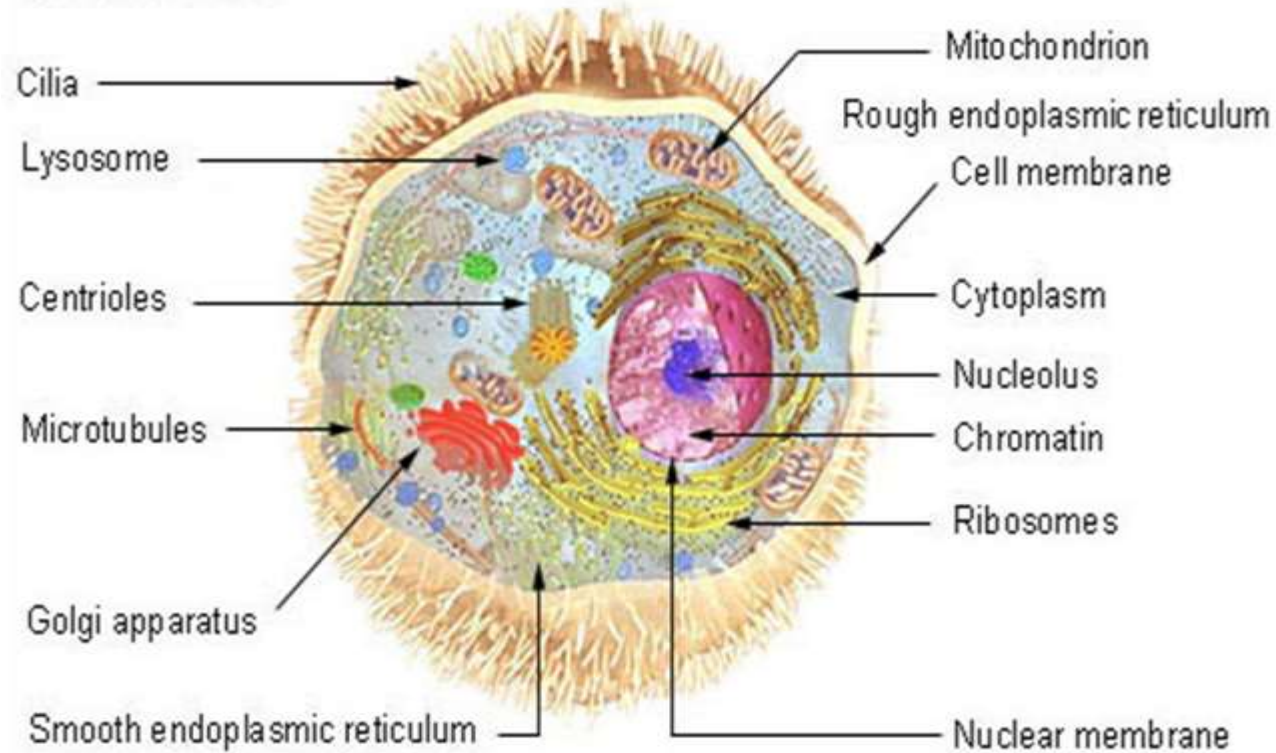
- Origin of bio potential and its propagation
- Types of electrodes-surface, needle and micro electrodes  
and their equivalent circuits
- Recording problems - measurement with two electrodes

# INTRODUCTION

- Biomedical signals : The signals which are used for extracting information from a biological system or human body.
- Bio potential is generated by a tissue of a body
- During contraction of muscle tissues, brain activity ,heartbeat etc. The bio potential is generated
- Certain parts of the human body generate their own electrical signals which convey the useful information about the function performed by the part

# CELLS AND THEIR STRUCTURES

## Cell Structure



# TYPES OF ELECTRODES

## **Polarised electrode**

Produces a constant potential and hence are used when accurate measurements are required electrodes should be made of noble metals

## **Non polarised electrode**

Accurate measurements of bio potential ,the silver-silver chloride electrode is most often used

## **Half cell-potential**

The voltage developed at an electrode-electrolyte interface is designated as the half cell potential



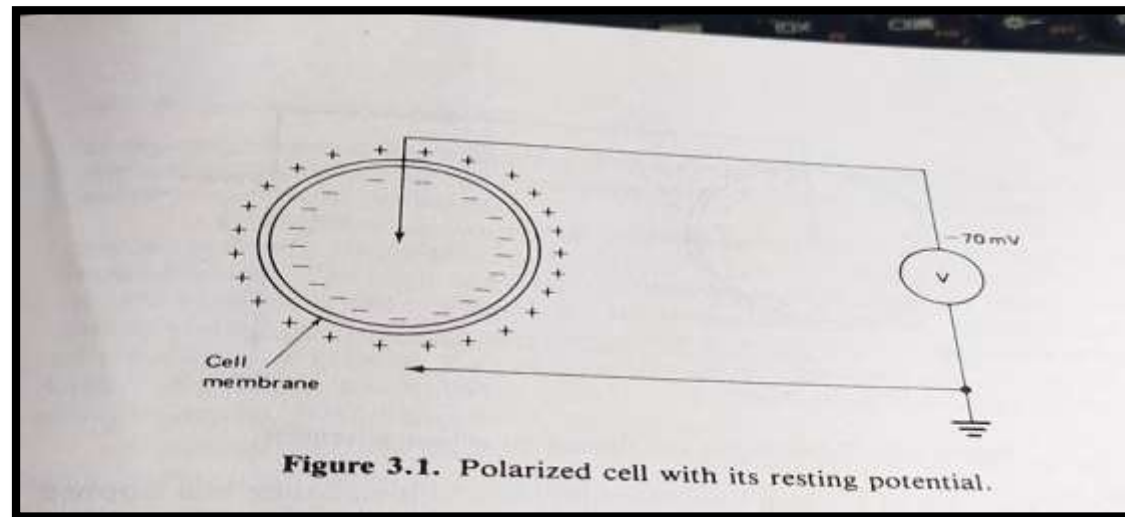
# Types of bio potential states

Bio potential state can be classified into 2 types those are

- Resting potential state
- Action potential state

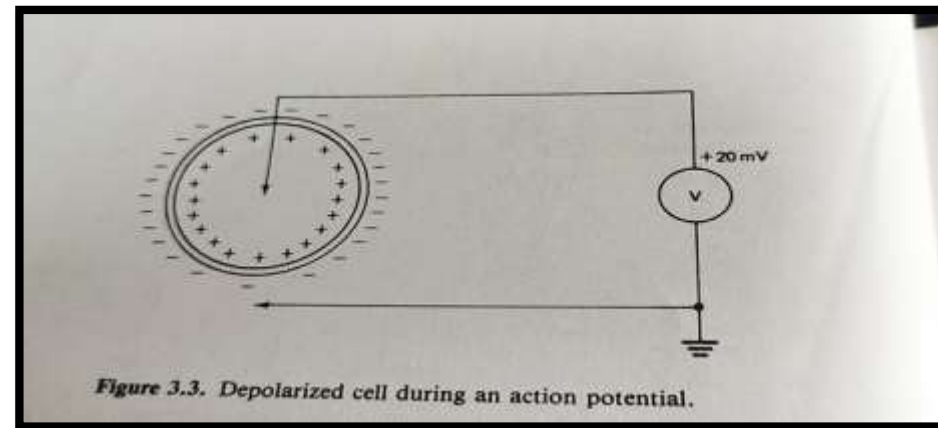
# RESTING POTENTIAL

Resting potential is defined as the electrical potential of an excitable cell selective to its surroundings when not stimulated or involved in passage of an impulse it ranges from -60v to -100mv



# ACTION POTENTIAL

- It is defined as change in electrical potential associated with the passage of an impulse along the membrane of a cell



# PROPAGATION OF ACTION POTENTIAL

- When the cell is excited & generate action potential ionic currents begin to flow  
this process excites the neighboring cells or adjacent areas of the same cell
- In nerve cell with long fiber action potential is generated over a small segment and  
its propagated in both the directions

# PROPAGATION OF ACTION POTENTIAL

- All or nothing
- Net height
- Absolute refractory period
- Relative refractory period
- Propagation of action potential

# TYPES OF MICRO ELECTRODE

There are two types micro electrodes are there those are

- Metallic
- Non metallic

# ELECTRODE –ELECTROLYTE INTERFACE

- The passage of electric current from the body to an electrode can be understood by examining the **electrode –electrolyte interface**
- **Electrolyte** : it represents the body fluid containing ions
- The net current that crosses the interface ,passing the electrode to electrolyte ,consist of
  - 1)electrons moving in a direction opposite to that of the current in the electrode
  - 2)cations (denoted by  $c^+$ ) moving in the same directions as the current
  - 3)anions (denoted by  $A^-$ ) moving in the direction opposite to that of the current in the electrolyte

## **Perfectly polarized electrode**

The electrodes in which no net transfer of charge occurs across the metal electrolyte interface

## **Perfectly non- polarized electrode**

The electrodes in which infinite exchange of charge occurs across the metal electrolyte interface



## **Artifacts**

The non polarized electrode will create a variable noise termed as artifacts

## **Over potential**

The difference between the observed half cell potential and the equilibrium zero current cell potential is known as over potential

## **Ohmic over potential**

It is direct result of the resistance of the electrolyte

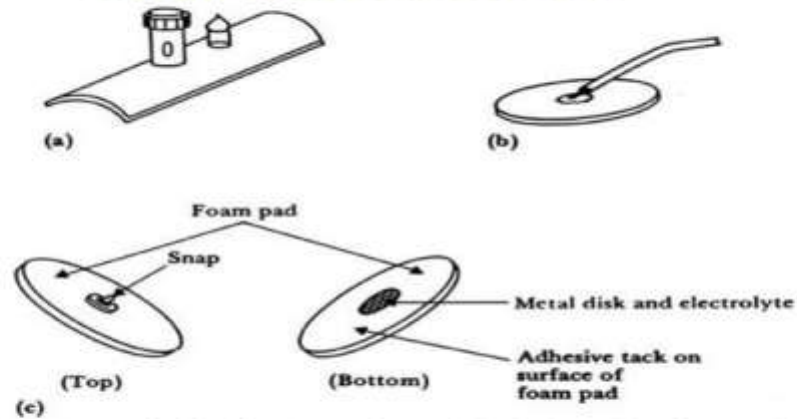
# SURFACE ELECTRODE

- Smaller area surface electrode
- Larger area surface electrode

# METAL PLATE ELECTRODE

- One of the most frequently used forms of bio potential sensing electrodes is the metal plate electrode
- It consist of a metallic conductor in contact with the skin
- An electrolyte soaked pad or gel is used to establish and maintain the contact

## Body-Surface Recording Electrode Metal-Plate Electrodes



**Body-surface biopotential electrodes** (a) Metal-plate electrode used for application to limbs. (b) Metal-disk electrode applied with surgical tape. (c) Disposable foam-pad electrodes, often used with electrocardiograph monitoring apparatus.

# SUCTION ELECTRODE

- It is the modification of metal plate electrode that does not requires straps or adhesives for holding in it in place is called as suction electrode
- This electrode is used only for short periods of time
- The suction and the pressure of the contact surface against the skin can cause irritation this electrode is quite large
- In contacting surface area is small this electrode trends to have higher source impedance than relatively large surface area metal plate electrodes used for ECG limb electrodes

# FLOATING ELECTRODES

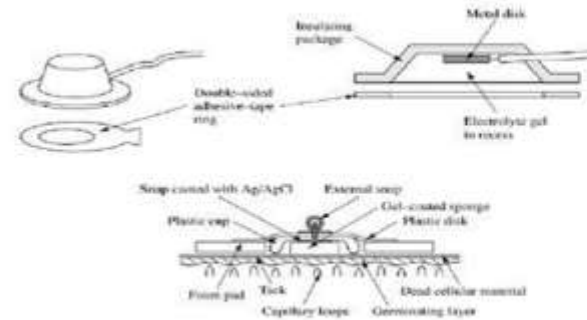
- One source of motion artefact in bio potential electrodes is the disturbance of the double layer of charge at the electrode-electrolyte interface
- The use of non-polarized electrodes like ag/agcl electrode can diminish thin artifact floating electrodes are often suitable techniques to do
- The element is surrounded by electrolyte gel in the cavity the gel does not move with respect to the double layer charge

# ELECTRODE STANDARDS

- During defibrillation large currents may flow through the electrodes greatly change the electrode overpotential & difficult to determine whether defibrillation whether defibrillation has been successful
- Generally Ag/AgCl electrodes are satisfactory whereas polarizable electrodes are not
- Noise is less than 150uv
- 10HZ impedance is less than 2 k $\Omega$
- Bias current tolerance to be 200A

## Floating electrode:

- Metal does not contact the subject directly but via electrolytic bridge
- Also called as liquid junction electrode
- Movement artifact is eliminated





## **Micro electrodes:** Intra cellular electrodes

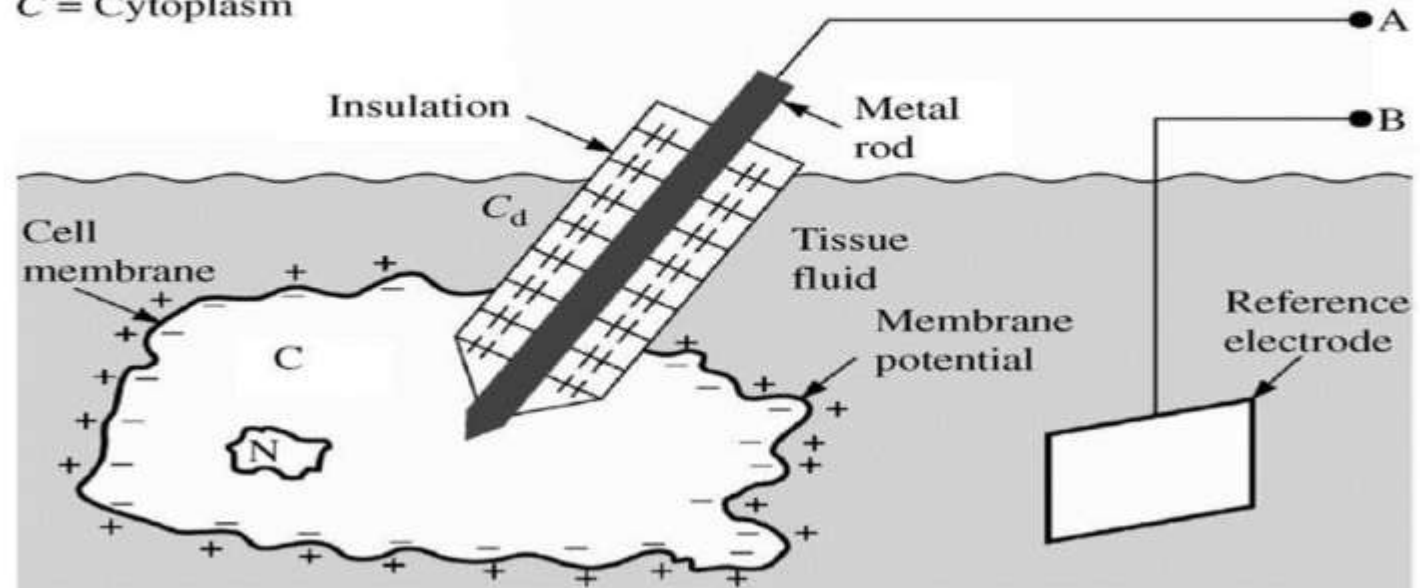
- Used to measure the potential near or within cell
- Features:
  - Smaller dimension (0.5 to 5 microns)
- Types:
  - »Metallic
  - »Non metallic (Micropipet)

## Metal microelectrode:

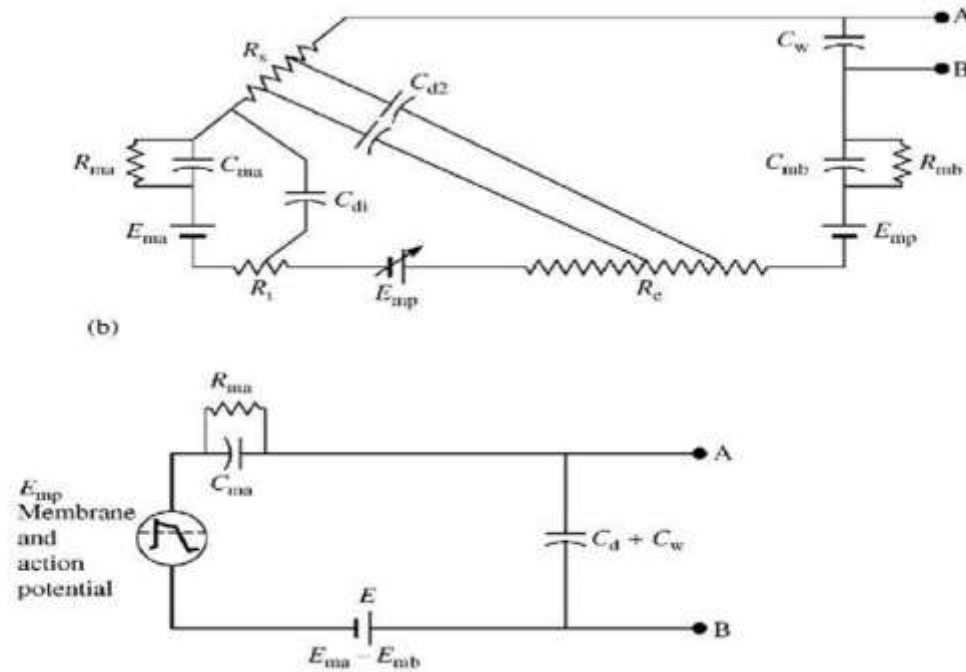
- Formed by electrolytically etching the tip of **fine Tungsten or stainless steel**
- **Electropointing**
- Coated with insulating material
- Chloriding the tip : reduce the impedance

# Metal electrode:

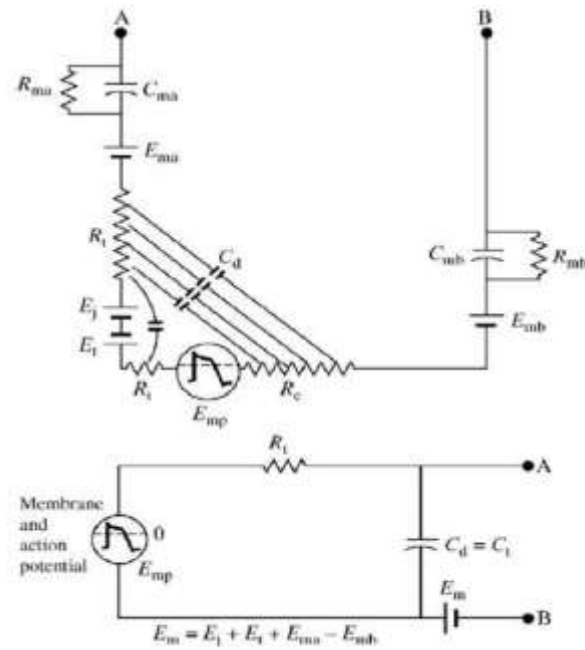
$N$  = Nucleus  
 $C$  = Cytoplasm



## Metal electrode – electrical equivalent:



## Micropipet – electrical equivalent:



# RECORDING PROBLEMS

- Electrode-electrolyte noise
- Noise at the electrolyte
- skin interface
- Motion artifact
- Electric and magnetic field interference
- Thermal noise
- Amplifier noise
- Noise from additional bioelectric events
- Other noise sources