



# **SNS COLLEGE OF TECHNOLOGY**

## **(AN AUTONOMOUS INSTITUTION)**

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## **Department of Biomedical Engineering**

**Course Name: 19BMB203 Medical Instrumentation**

**II Year : IV Semester**

**Unit III – Neurological Equipment**

**Topic : Clinical significance of EEG**

19BMB203/Medical Instrumentation/Unit 3 /Mrs.J.Jareena /AP/BME



# Electroencephalography (EEG)



- Study of electrical activity of the brain.
- The brain waves are summation of action potential (neural depolarisation) in the brain due to the stimuli from 5 senses.
- These brain waves are picked up and recorded by means of EEG electrodes.
- Surface of the brain  $\rightarrow$  10mV
- Surface of the skull  $\rightarrow$  1 to 100 $\mu$ V
- These potential are vary with respect to position of the electrodes on the skull.

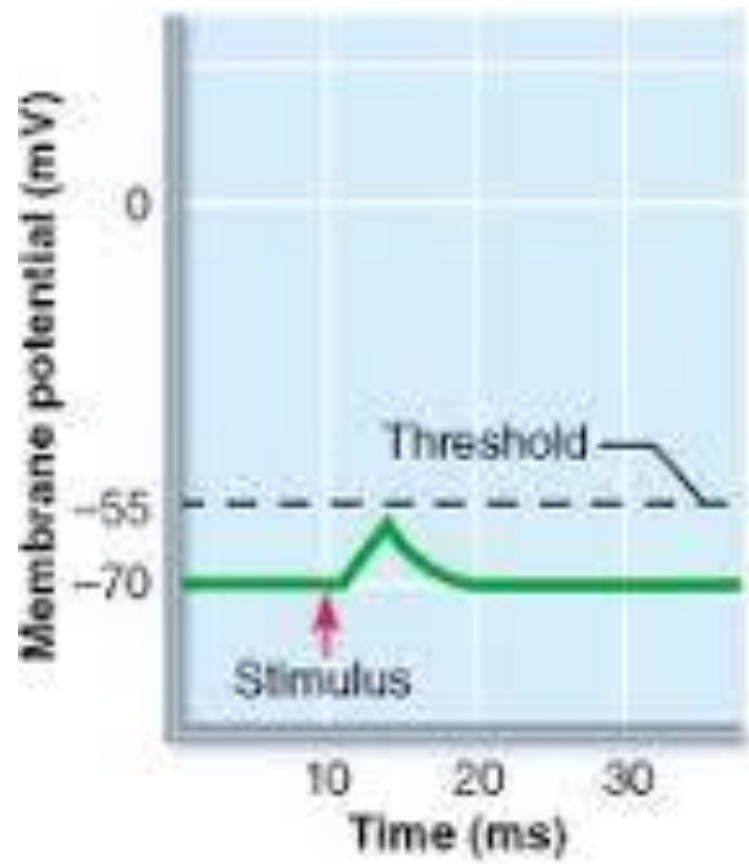


# Origin of EEG

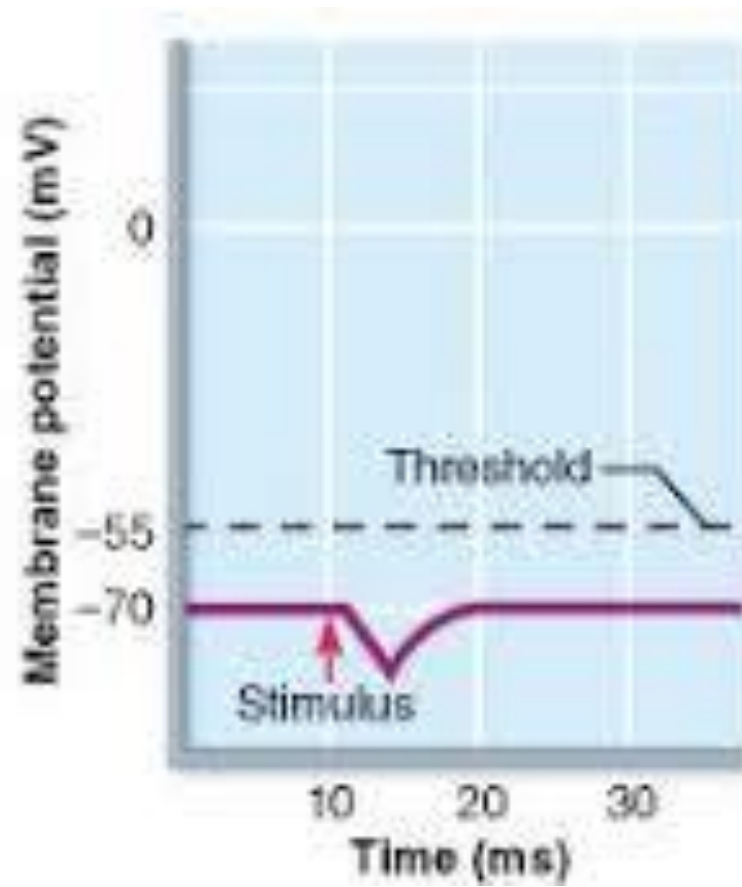


- Electric pattern are obtained as a result of graded potential on the dendrites of neuron in the cerebral cortex and other parts of the brain.
- **Graded potential** → variation around average value of resting potential.
- Electric charges are transferred from one neuron to another through post synaptic transmission.
- Summation of these dentrities potential produce EEG Waveforms.
- Graded potential is in two form → inhibitory post synaptic potential and excited post synaptic potential

Vision Title 3



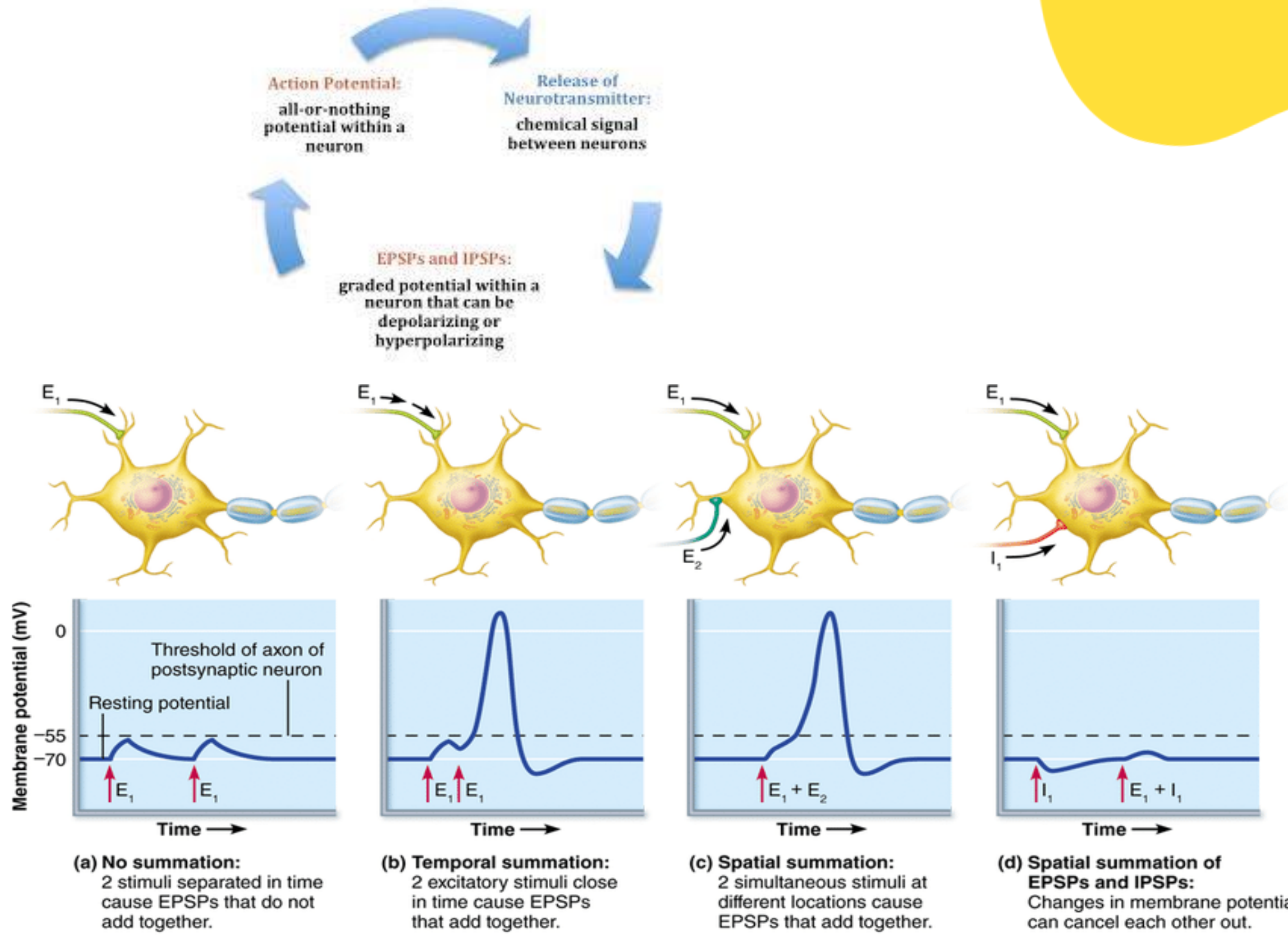
**EPSP**



**IPSP**

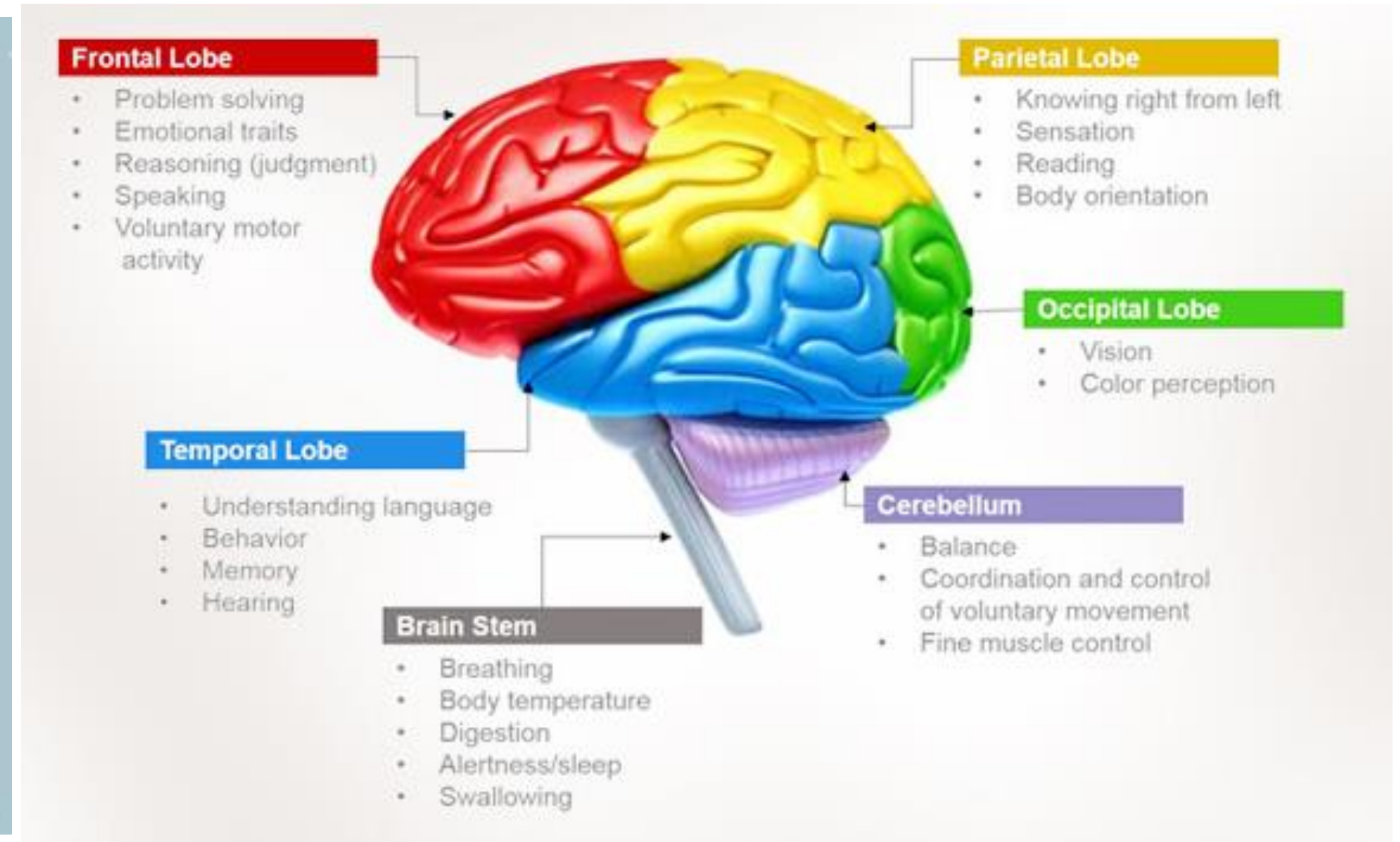
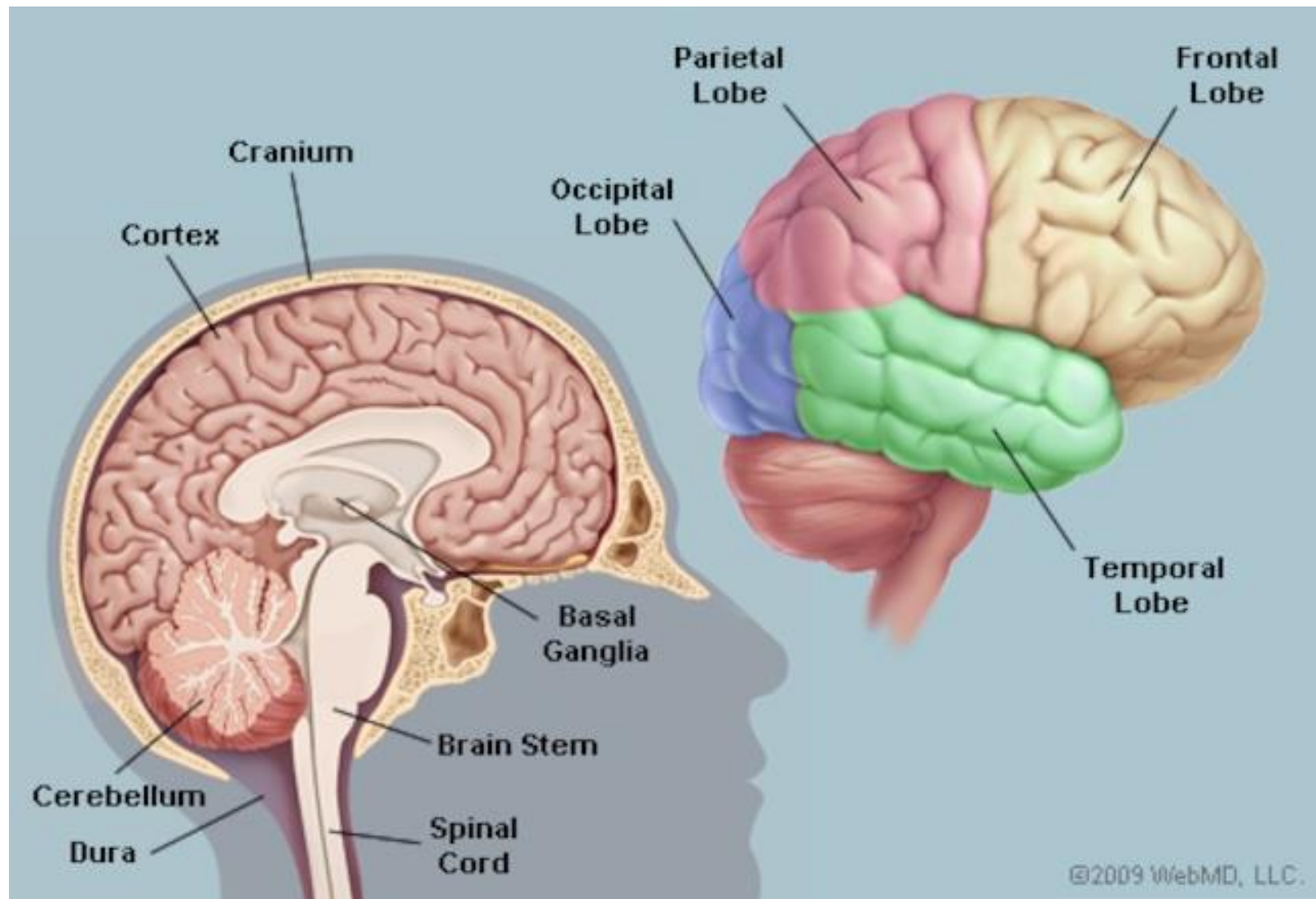
- **EPSP** – membrane potential increased in positive direction , moves closer to threshold
- **IPSP**- membrane potential decreased in negative direction, moves away for thershold

Vision Title 3





# Anatomy of brain





<b>gamma</b> 32 - 100 Hz		Heightened perception, learning, problem solving tasks, cognitive processing
<b>beta</b> 13 - 32 Hz		Awake, alert consciousness, thinking, excitement
<b>alpha</b> 8 - 13 Hz		Physically and mentally relaxed
<b>theta</b> 4 - 8 Hz		Creativity, insight, deep states, dreams, deep meditation, reduced consciousness
<b>delta</b> 0.5 - 4 Hz		Deep (dreamless) sleep, loss of bodily awareness, repair

Hyper concentration and focus

Awake and alert

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Relaxed focus

Light sleep/dream sleep, reduced consciousness

deep sleep, loss of consciousness



# Placement of EEG Electrode

- The 10-20 system is based on the relationship between the location of an electrode and the underlying area of cerebral cortex.
- Each site has a letter and a number or another letter to identify the hemisphere location.
- The letters F, T, C, P, and O stand for Frontal, Temporal, Central, Parietal and Occipital.
- Even numbers (2,4,6,8) refer to the right hemisphere
- Odd numbers (1,3,5,7) refer to the left hemisphere.
- The z refers to an electrode placed on the midline.

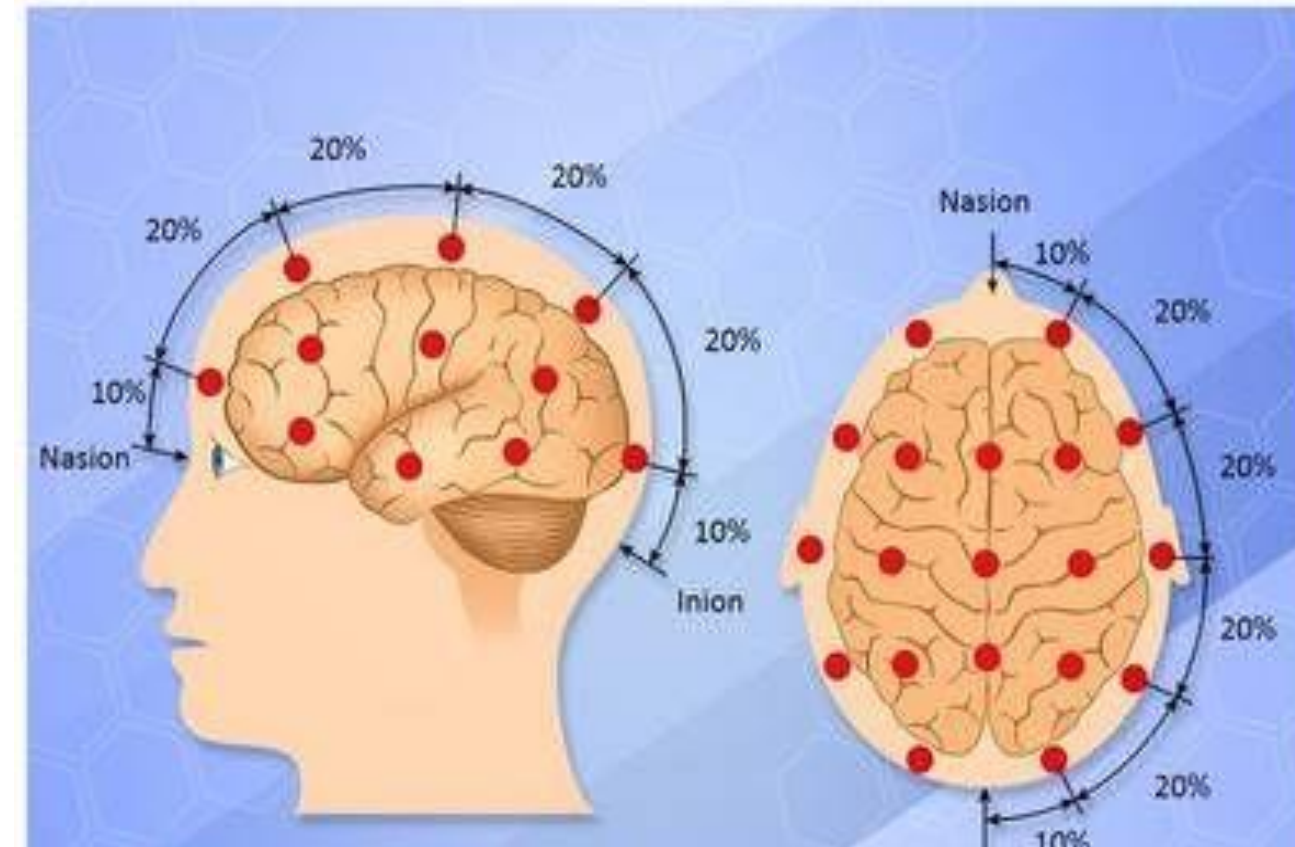
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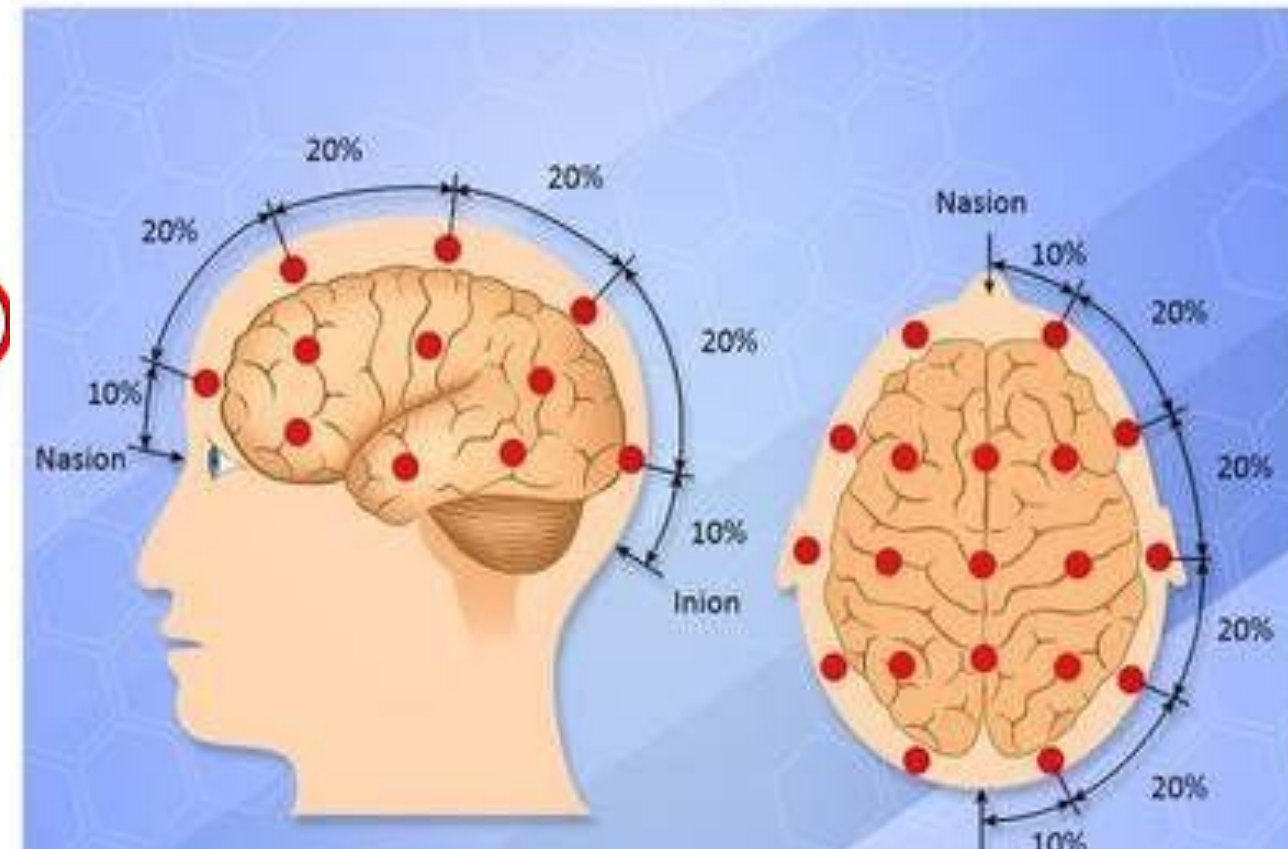
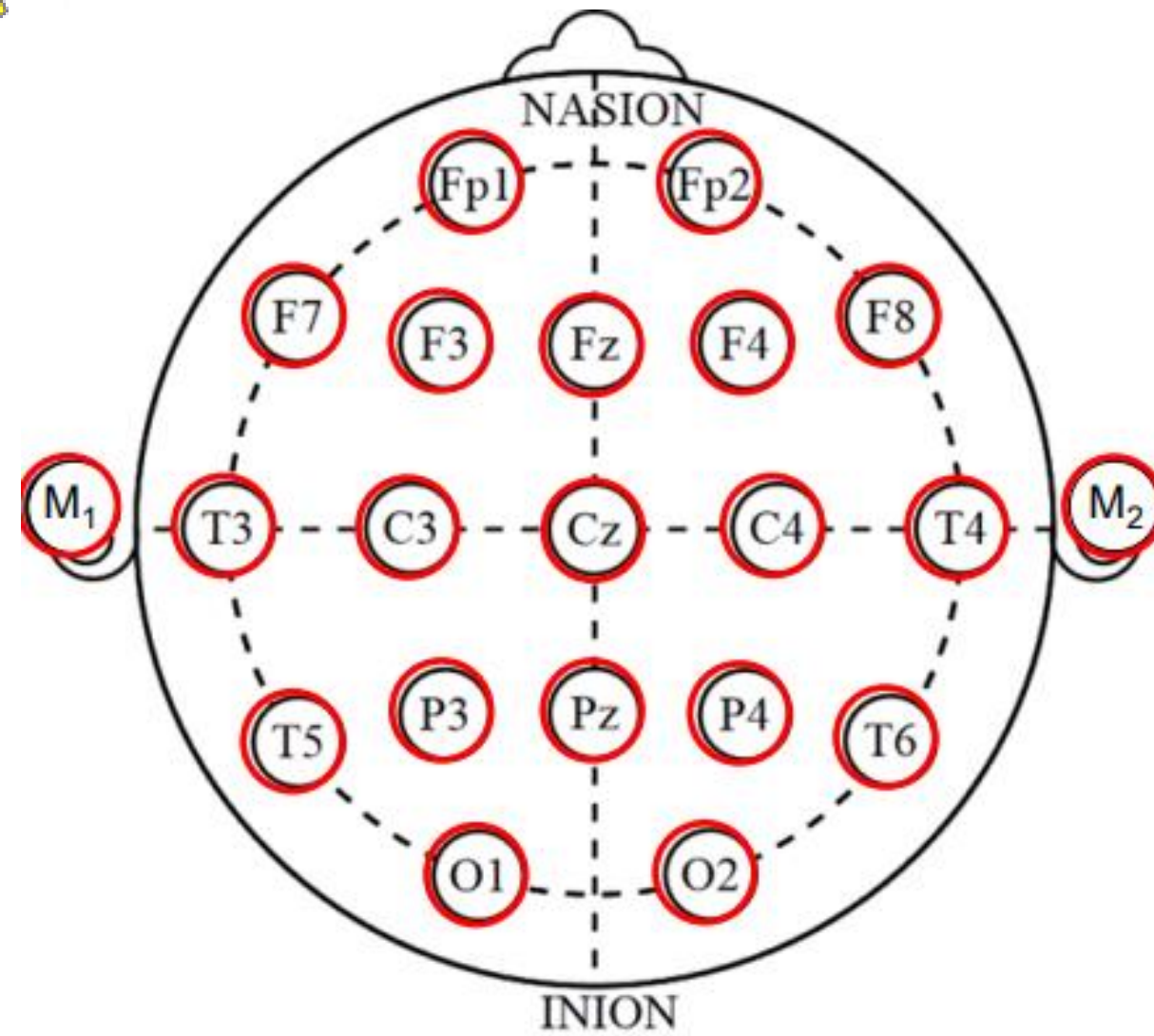
## ● Four Skull Landmarks:

- Nasion
- Inion
- Left Pre-auricular point
- Right Pre-auricular point

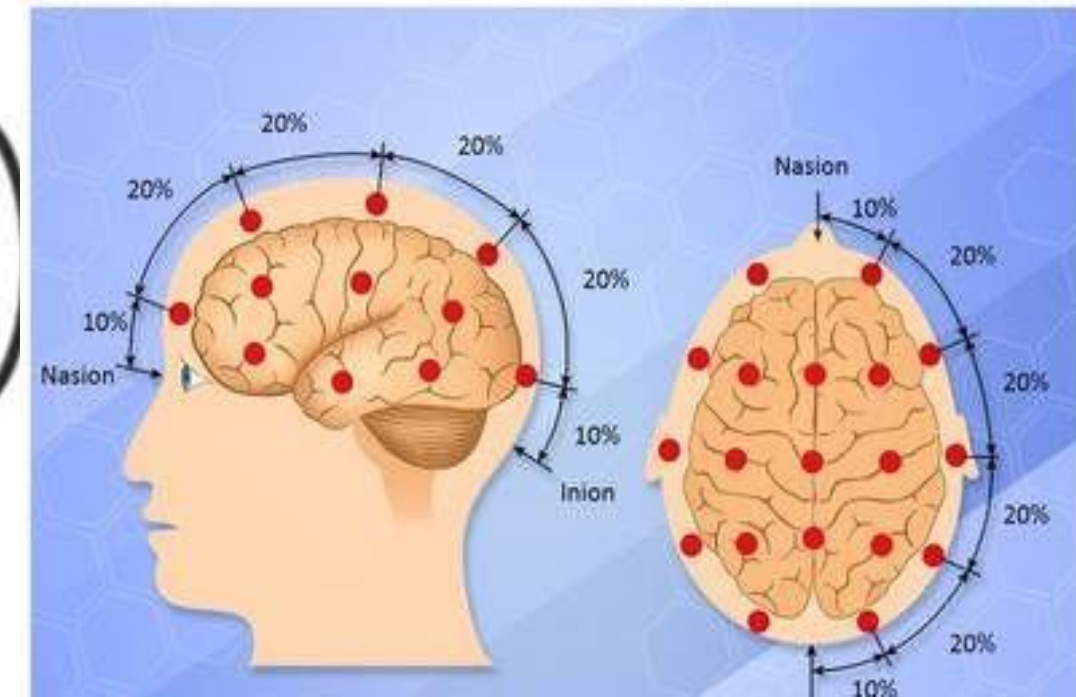
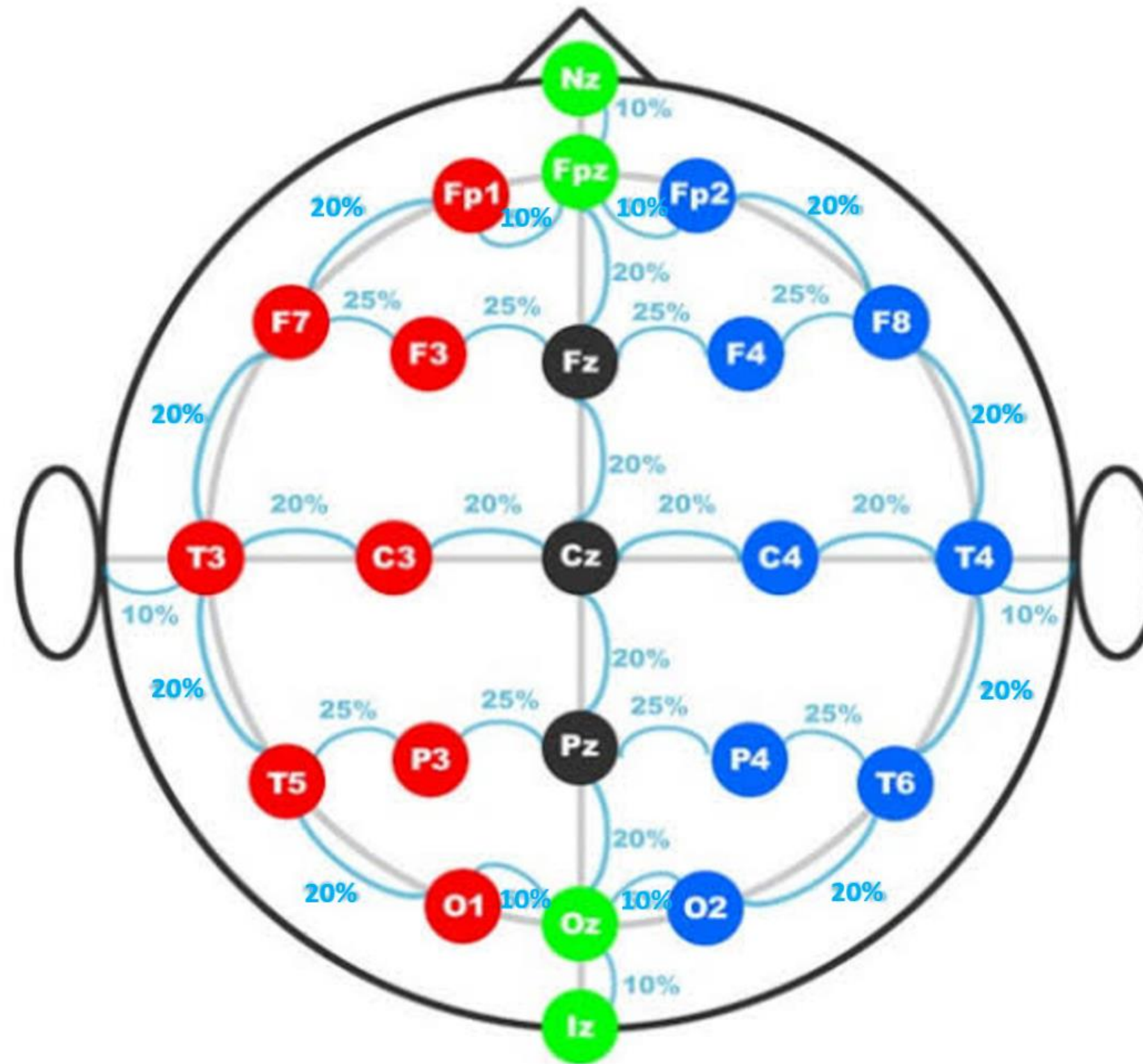




as name reflects that an electrodes are placed at distance of 10 % and 20% of total distance



ision Title 3





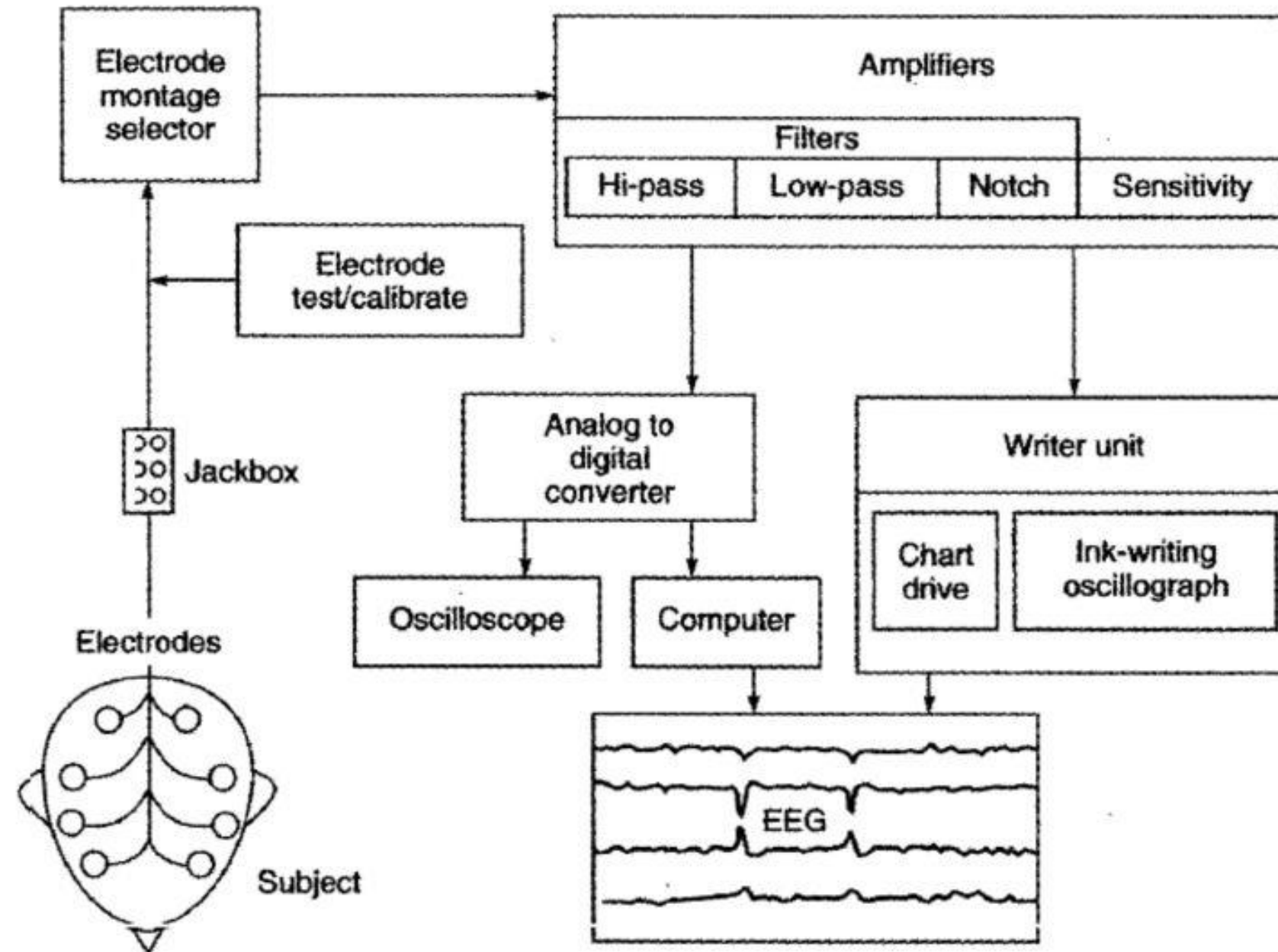
- Draw a line on the skull from the nasion to the inion
- Draw a similar line from left preauricular point to the right preauricular point.
- Mark intersection of these two lines as Cz which is the mid point of the distance between nasion and inion.
- Mark points at 10,20,20,20,20&10% of the total distance between nasion –inion . These points are Fpz,Fz,Cz,Pz, & Oz.
- Mark points at 10,20,20,20,20&10% of the total distance between preauricular points . These points are T3,C3,Cz,C4&T4
- Measure the distance between Fpz and Oz along the great circle passing through T3 and mark the points at 10, 20,20,20,20,10% of this distance. These points are Fp1,F7,T3,T5 and O1.
- Repeat this on the right side Fp2,F8,T4,T6,& O2.
- Measure the distance between Fp1 and O1 along the great circle passing through C3 and mark the points at 25% intervals.. These points are F3,C3 & P3
- Repeat this procedure on the right side and mark F4,C4, & P4
- Check that F7,F3,Fz,F4 & F8 are equidistant along transverse circle passing through F7,Fz,F8 and Check that T5,P3,PZ,P4 &T6are equidistant along transverse circle passing through T7,Pz,T6

Vision Tit 2

Vision Title 3



# SCHEMATIC DIAGRAM OF AN EEG MACHINE



n Title 3



- Montage selector
  - Pattern connection between electrode and recording channels
  - Selecting a particular channel
  - Different channel conveys different information
  - Montage selector is a large frame from which consist of different switches so as to allow the user to select the desired electrode pair.
- Preamplifier
  - High gain and low noise characteristics
  - Very high common mode rejection
- Sensitivity control
  - Sensitivity of EEG = gain of amplifier \* sensitivity of the writer
  - Two types of gain control
    - Continuous /variable- equalize the sensitivity of all channels
    - Step/discrete – increase/reduce the sensitivity by known amounts

Vision Tit 2

Vision Title 3



- Filter
  - Artefacts (low frequency) removed – low pass filter
  - Upper cut off frequency controlled by high pass filter
  - Main frequency interference eliminated – Notch filter
- Writing unit
  - Ink type direct writing mechanism
  - The best type of pen motors used in EEG machine have frequency response of about 90Hz
  - The ink jet recording system gives a response upto 1000 Hz
- Paper drive
  - Provided by synchronous motors
  - Speed of 15,30 and 60 mm/s

Vision Title 3