SNS COLLEGE OF TECHNOLOGY

(AN AUTONOMOUS INSTITUTION)

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Department of Biomedical Engineering

Course Name: 23BMT204 Biomedical Instrumentation

II Year : IV Semester

Unit III – Neurological Equipment

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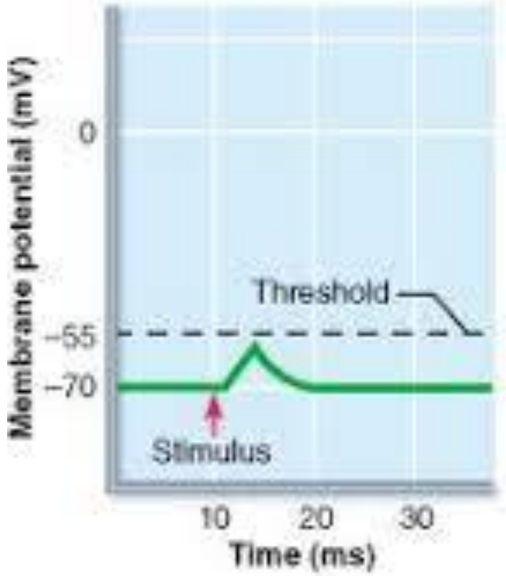
Topic : Clinical significance of EEG

Electroencephalography (EEG)

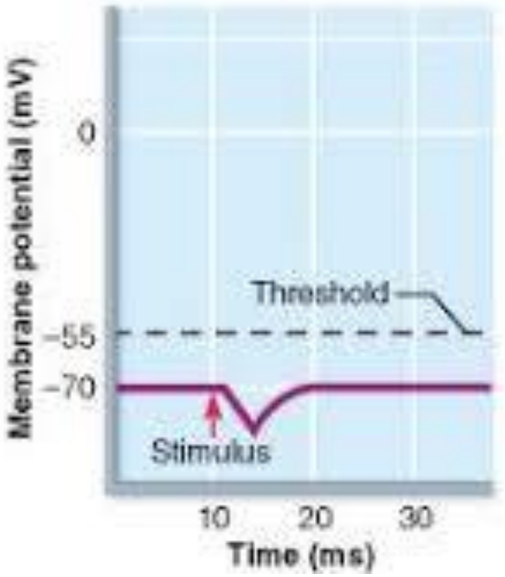
- Study of electrical activity of the brain.
- The brain waves are summation of action potential (neural depolarisation)in the brain due to the stimuli from 5 senses.
- These brain waves are picked up and recorded by means of EEG electrodes.
- Surface of the brain → 10mV
- Surface of the skull → 1 to 100μV
- 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 dendrities 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

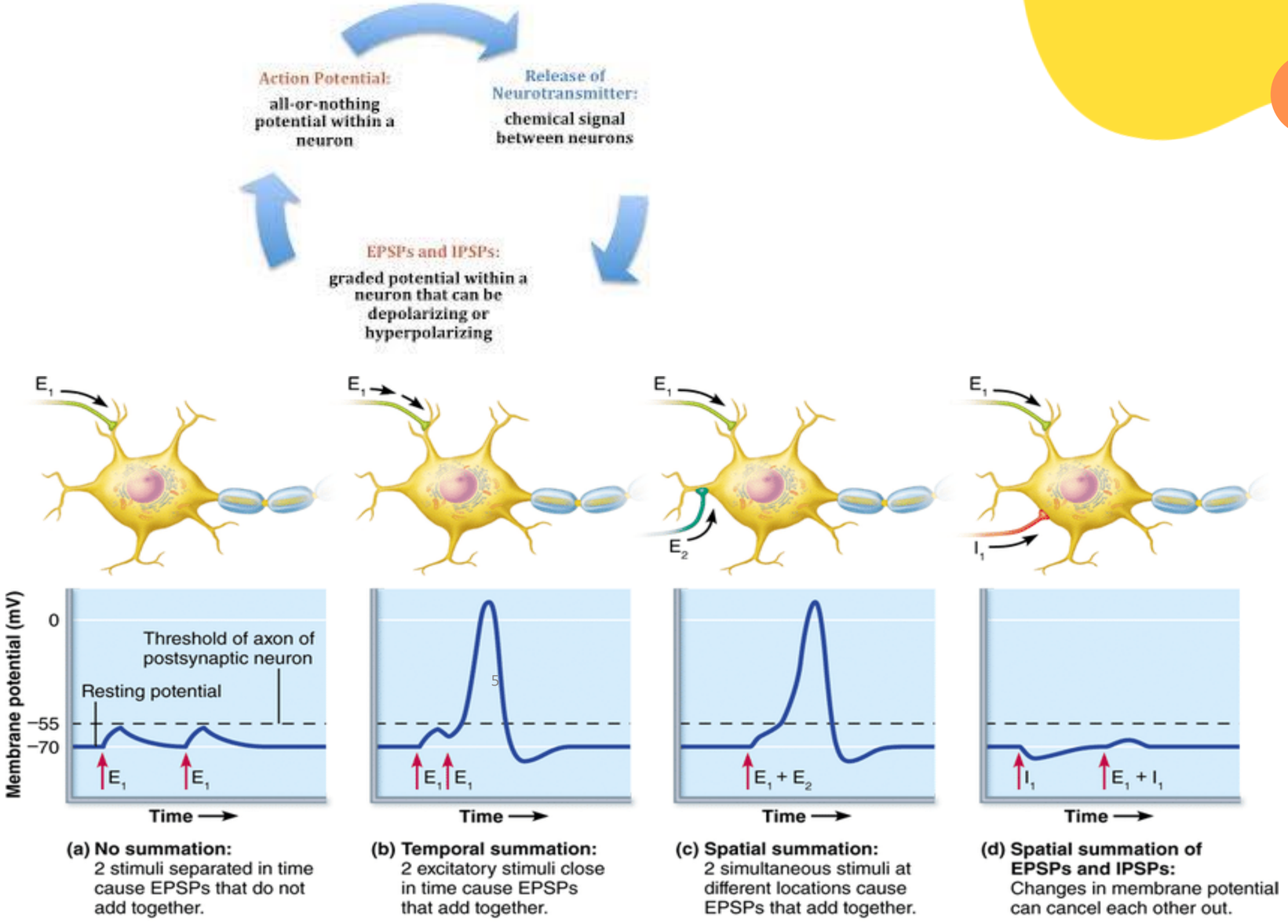


EPSP

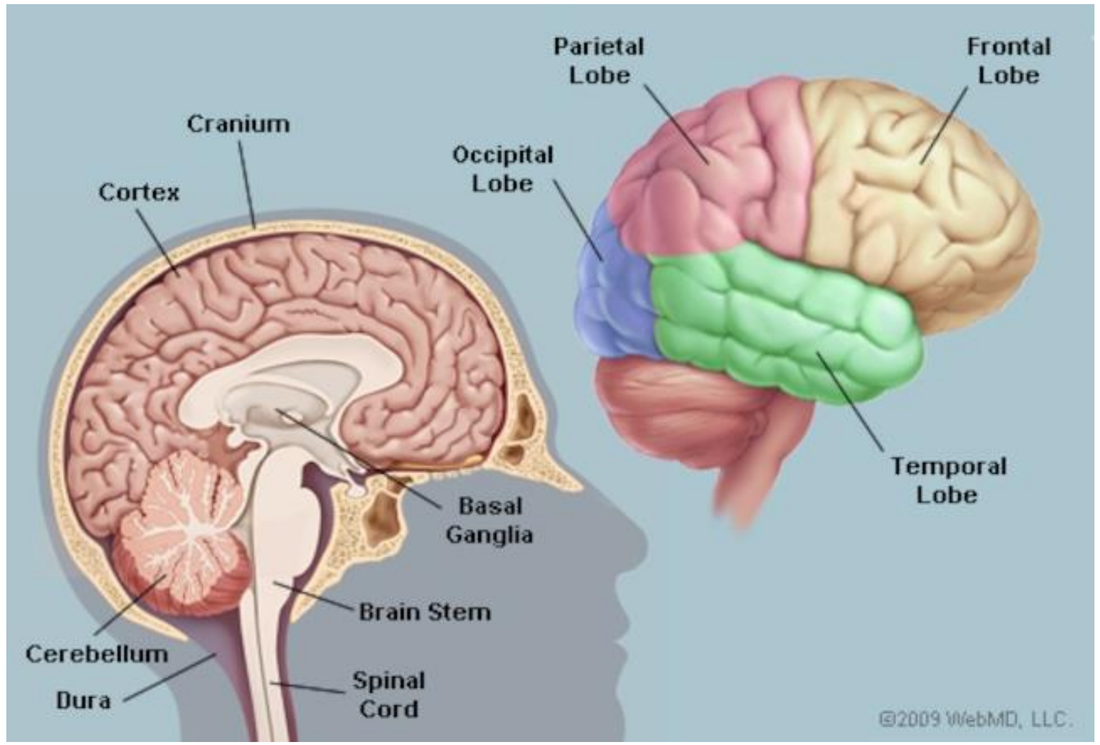


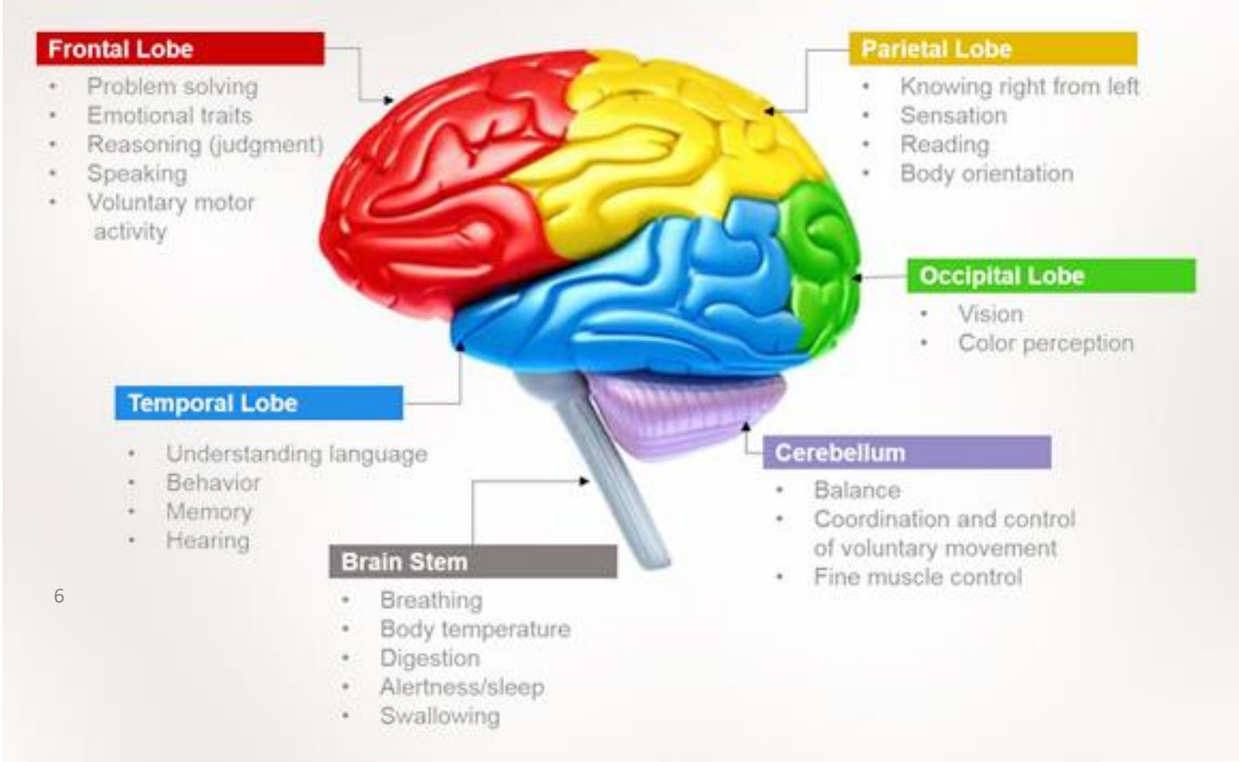
IPSP

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


Action Potential:
all-or-nothing potential within a neuron
Release of Neurotransmitter:
chemical signal between neurons
EPSPs and IPSPs:
graded potential within a neuron that can be depolarizing or hyperpolarizing
E1
E2
I1
Membrane potential (mV)
0
−55
−70
Threshold of axon of postsynaptic neuron
Resting potential
E1
E1 + E2
I1
E1 + I1
Time
(a) No summation: 2 stimuli separated in time cause EPSPs that do not add together.
(b) Temporal summation: 2 excitatory stimuli close in time cause EPSPs that add together.
(c) Spatial summation: 2 simultaneous stimuli at different locations cause EPSPs that add together.
(d) Spatial summation of EPSPs and IPSPs: Changes in membrane potential can cancel each other out.

Anatomy of brain





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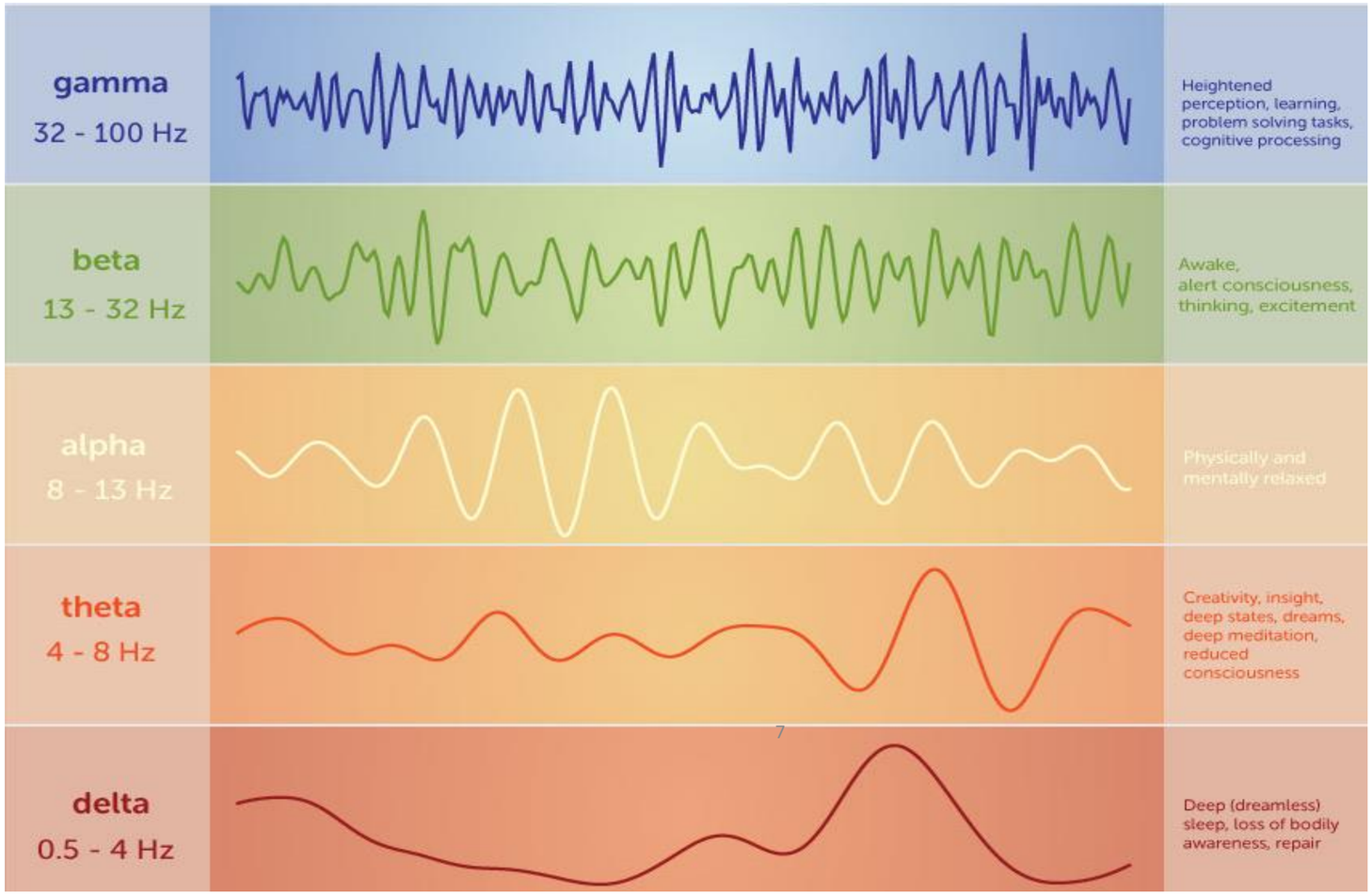


Hyper concentration and focus

Awake and alert

Relaxed focus

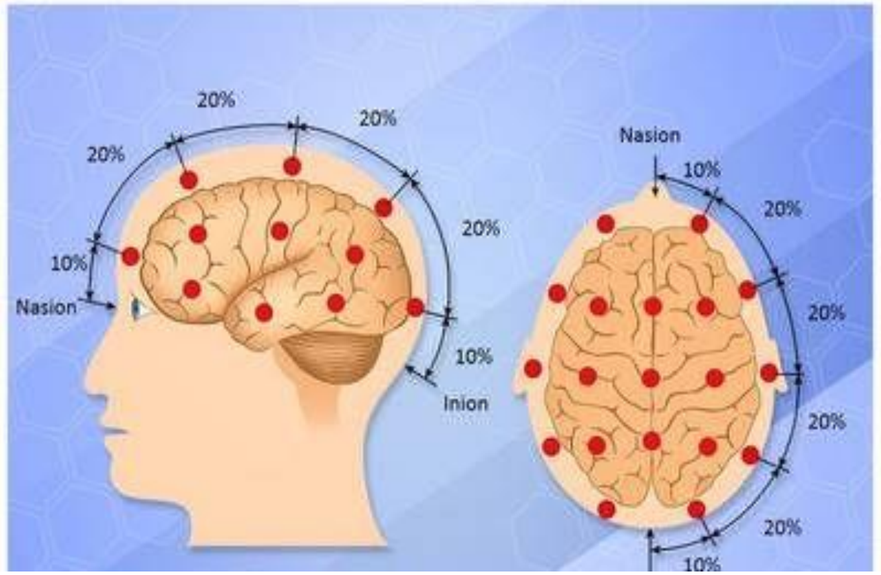
Light sleep/dream sleep,reduced consiousness

deep sleep, loss of consiousness

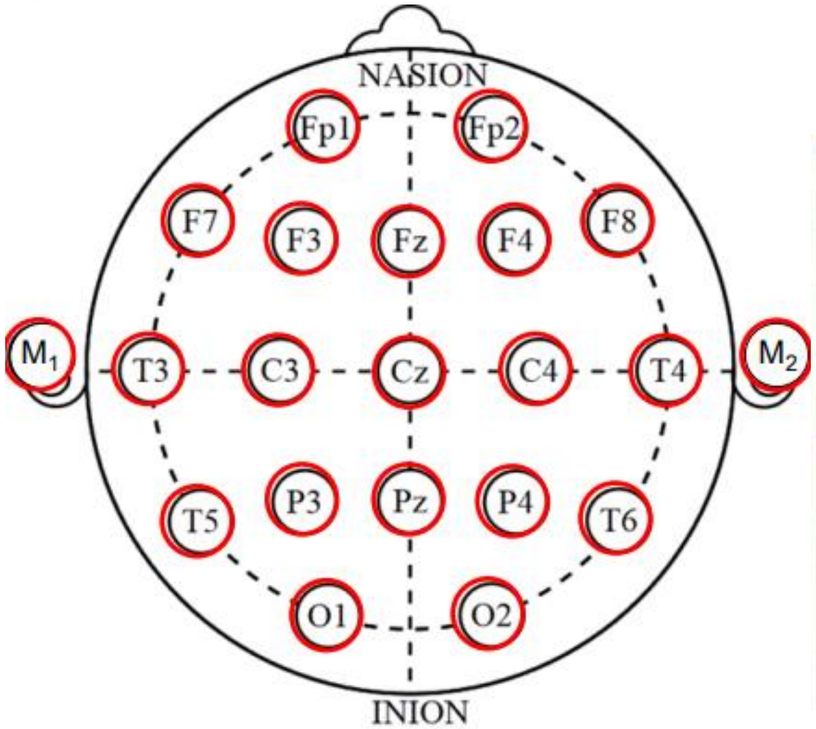
Placement of EEG Electrode

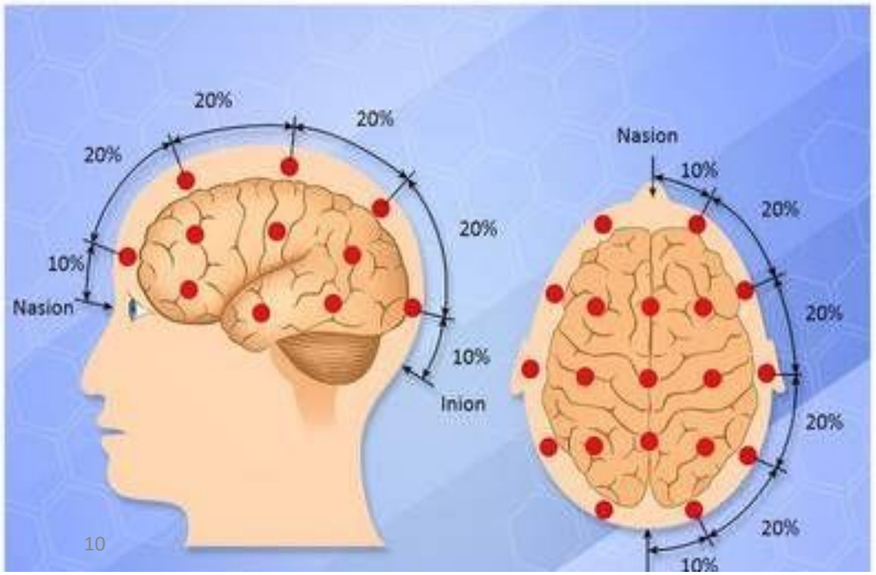
- The 10-20 system is based on the relationship between the location of an electrode and the underlying area of cerebral cortex.
- Each site has a letter and a number or another letter to identify the hemisphere location.
- The letters F, T, C, P, and O stand for Frontal, Temporal, Central, Parietal 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.

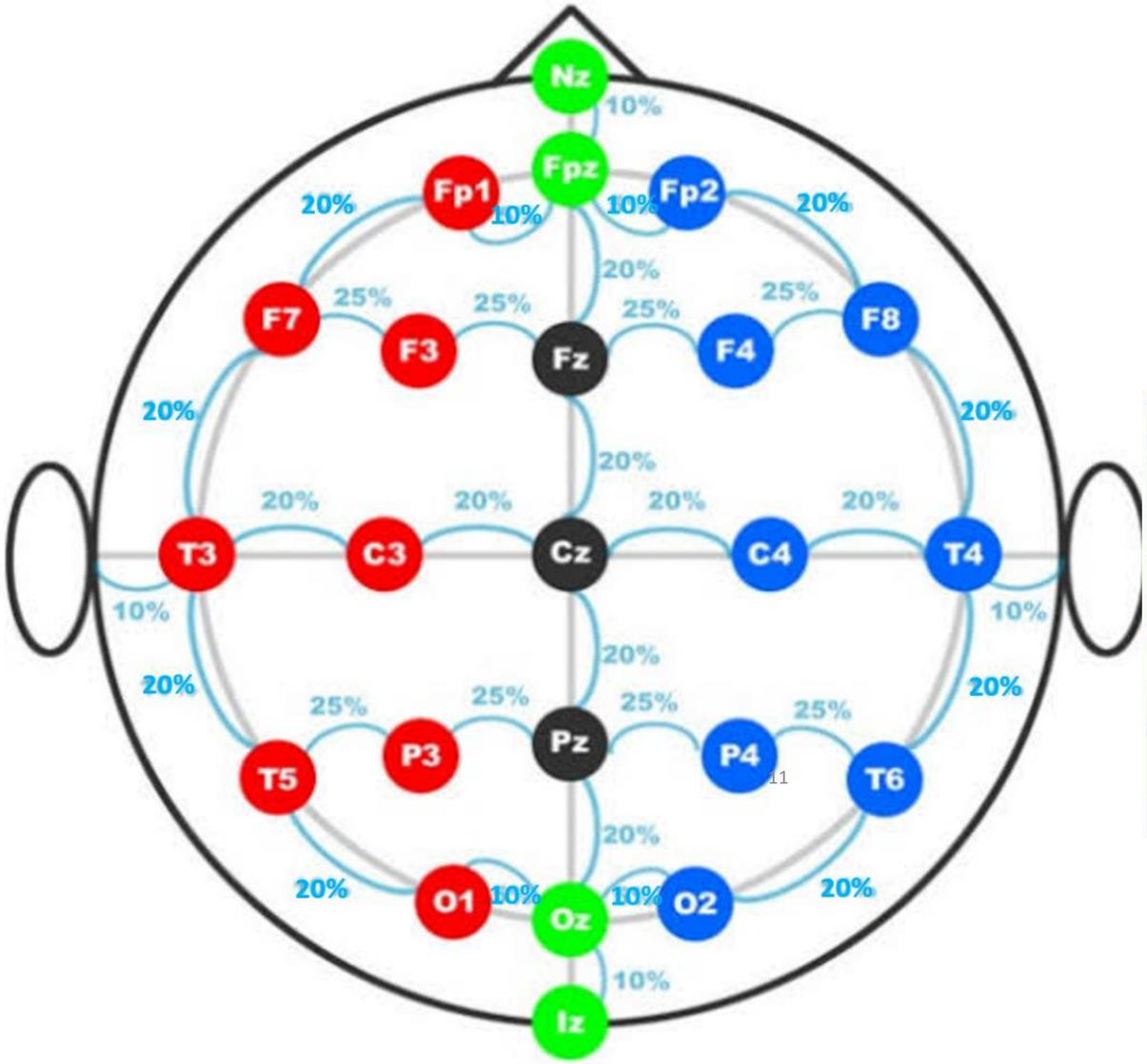
- Four Skull Landmarks:
  - Nasion
  - Inion
  - Left Pre-auricular point
  - Right Pre-auricular point

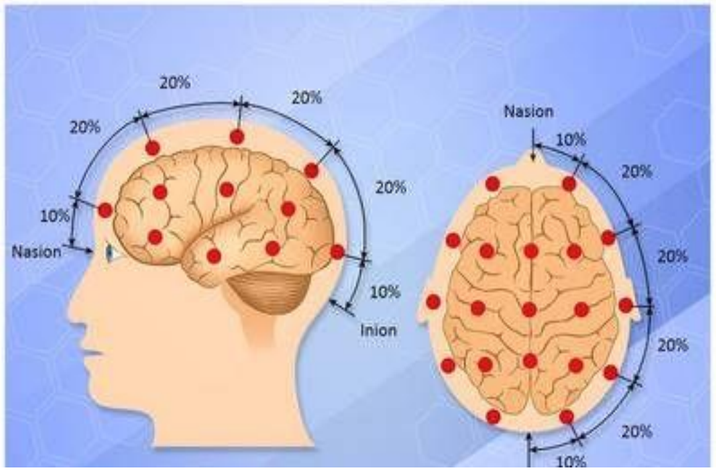


as name reflects that an electrodes are placed at distance of 10 % and 20% of total distance



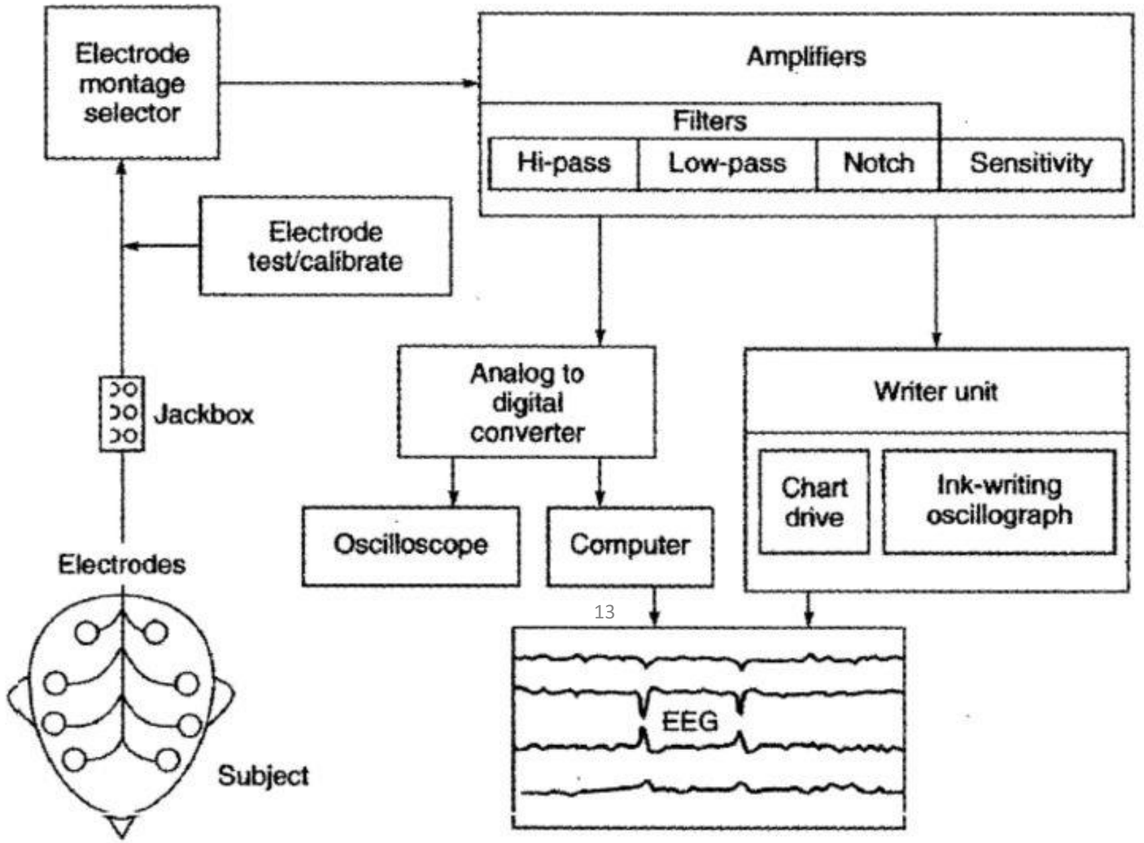



Nz
Fp1
Fpz
Fp2
F7
F3
Fz
F4
F8
T3
C3
Cz
C4
T4
T5
P3
Pz
P4
T6
O1
Oz
O2
Iz
10%
20%
25%


Nasion
Inion
10%
20%

- 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 ehich 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 perauricular points . These points areT3,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

SCHEMATIC DIAGRAM OF AN EEG MACHINE



- 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

- 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

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- Paper drive
  - Provided by synchronous motors
  - Speed of 15,30 and 60 mm/s