CHANDIGARH UNIVERSITY

Discover. Learn. Empower.

INSTITUTE-UNIVERSITY INSTITUTE OF ENGINEERING

ACADEMIC UNIT-II

Computer Science Engineering

Subject Name-Biology For Engineers

Subject Code- 20SZT148

CNS AND ACTION POTENTIAL

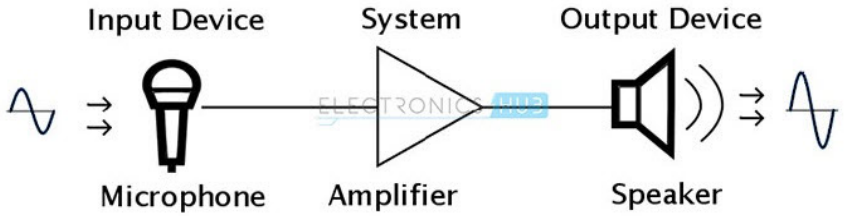
CNS AND ACTION POTENTIAL

Course Outcome

CO Number	Title	Level
CO1	It gives an idea about the about the basic cell biology.	**Understanding**
CO2	It deals with the idea of uses of biology in engineering.	**Understanding**
CO3	It provide knowledge about the uses of softwares in biology field.	**Remembering**

WHAT ARE TRANSDUCERS?

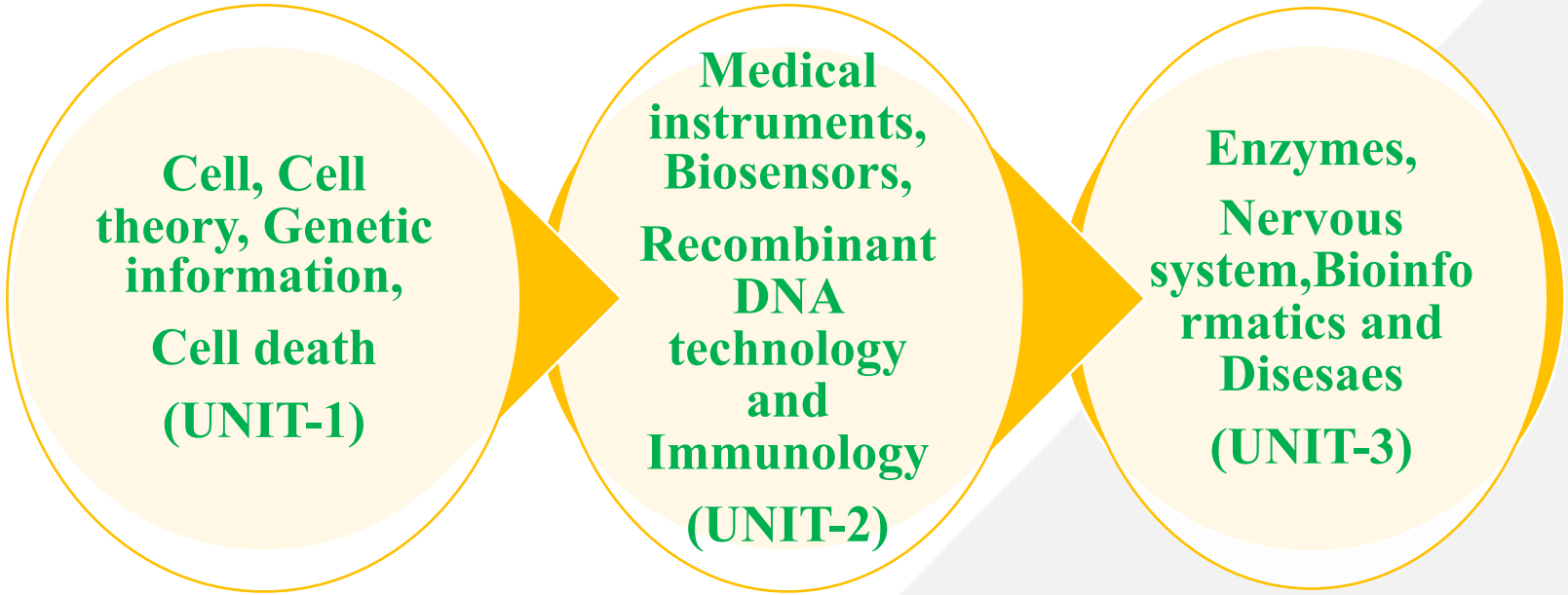
Different Types, Characteristics, Classification and Applications



Will be covered in this lecture

https://www.electronicshub.org/types-of-transducers/

BIOLOGY FOR ENGINEERS



CELLULAR ELEMENTS IN THE CNS

- The word glia is Greek for glue.
- Theses cells are recognized for their role in communication within the CNS in partnership with neurons.
- Unlike neurons, glial cells continue to undergo cell division in adulthood and their ability to proliferate is particularly noticeable after brain injury (eg, stroke).

CELLULAR ELEMENTS IN THE CNS

- two major types of glial cells in the vertebrate nervous system:
- microglia and macroglia
- Microglia are scavenger cells that resemble tissue macrophages and remove debris resulting from injury, infection, and disease.

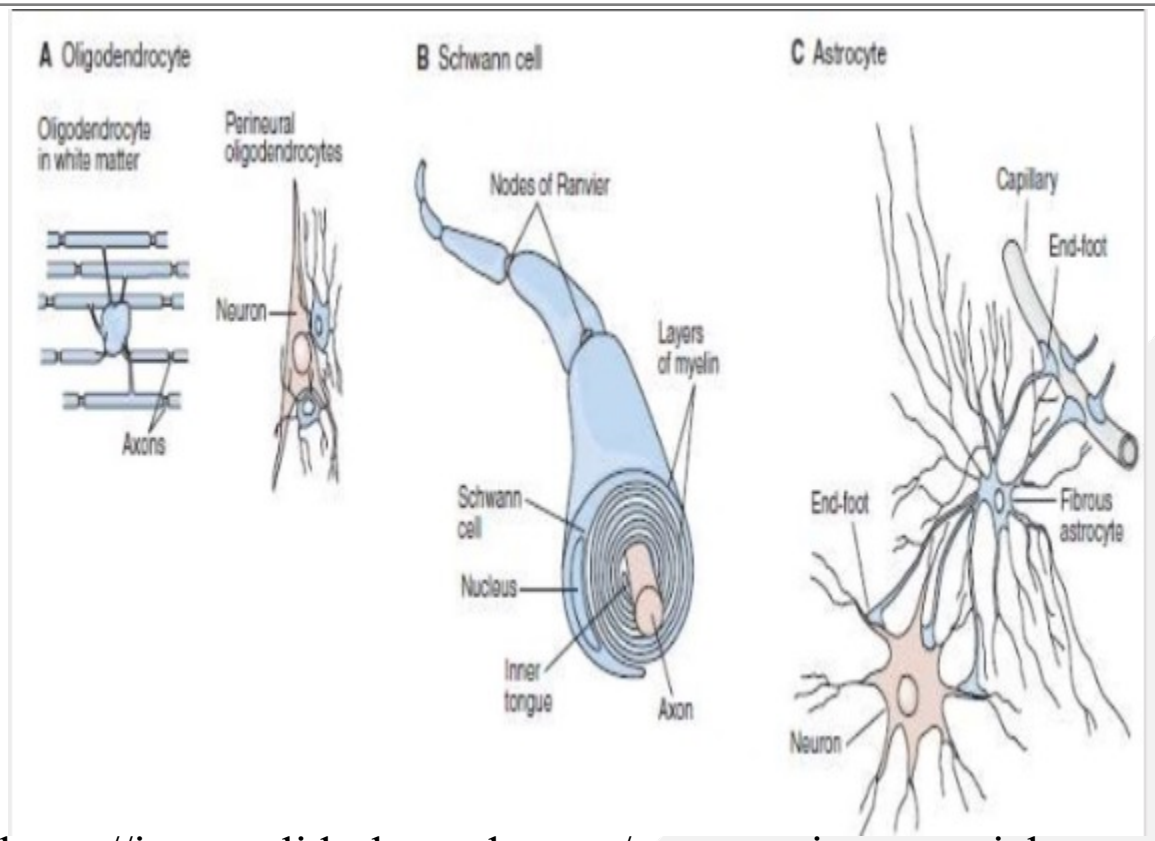
CELLULAR ELEMENTS IN THE CNS

- Three types of macroglia:
  - oligodendrocytes,
  - Schwann cells,
  - astrocytes .
- Oligodendrocytes and Schwann cells are involved in myelin formation around axons in the CNS and peripheral nervous system, respectively.

CELLULAR ELEMENTS IN THE CNS

- Astrocytes, which are found throughout the brain, are of two subtypes.
- Fibrous astrocytes, which contain many intermediate filaments, are found primarily in white matter.
- Protoplasmic astrocytes are found in gray matter and have a granular cytoplasm.
- Both types send processes to blood vessels, where they induce capillaries to form the tight junctions making up the blood–brain barrier

CELLULAR ELEMENTS IN THE CNS



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-7-638.jpg?cb=1502001532

EXCITATION & CONDUCTION

- Nerve cells respond to electrical, chemical, or mechanical stimuli.

- Two types of physicochemical disturbances are produced:

- local, nonpropagated potentials called, depending on their location, synaptic, generator, or electrotonic potentials;

Propagated potentials, the action potentials (or nerve impulses).

RESTING MEMBRANE POTENTIAL

• Resting Membrane Potential (RMP) is the voltage (charge) difference across the cell membrane when the cell is at rest.

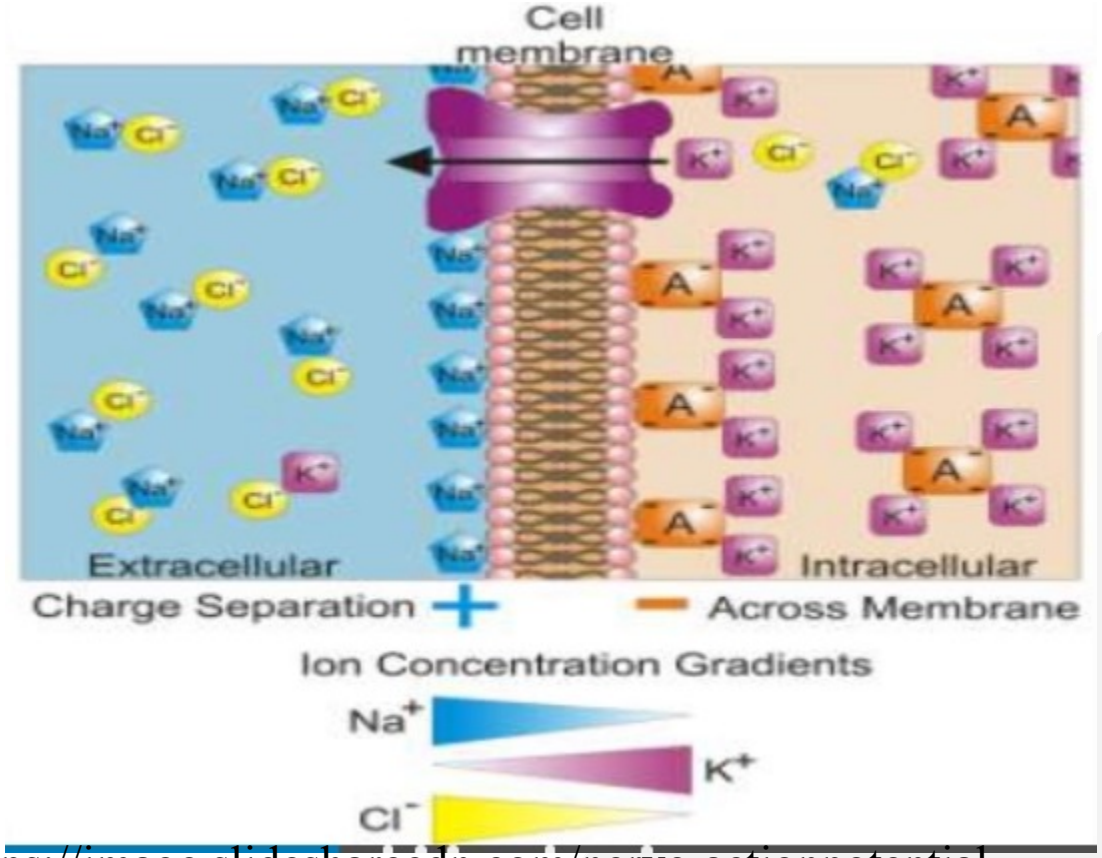
• In neurons, the resting membrane potential is usually about –70 mV, which is close to the equilibrium potential for K+.

• Because there are more open K+ channels than Na + channels at rest, the membrane permeability to K+ is greater.

RESTING MEMBRANE POTENTIAL

- The resting membrane potential represents an equilibrium situation at which the driving force for the membrane-permeant ions down their concentration gradients across the membrane is equal and opposite to the driving force for these ions down their electrical gradients.

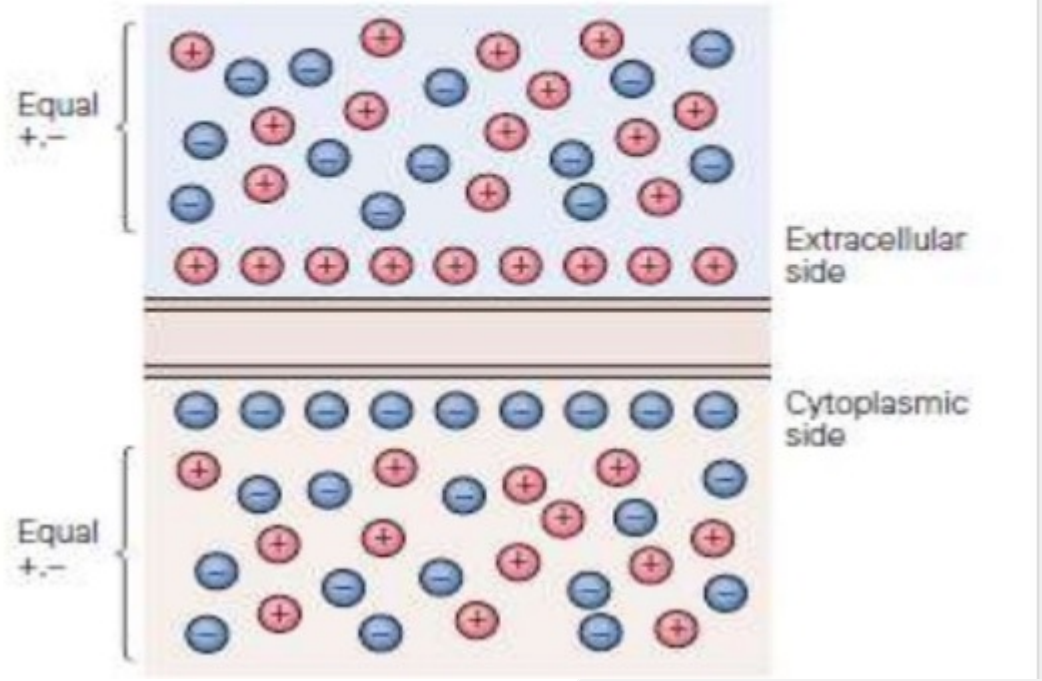
RESTING MEMBRANE POTENTIAL



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-11-638.jpg?cb=1502001532

RESTING MEMBRANE POTENTIAL

A membrane potential results from separation of positive and negative charges across the cell membrane.



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-11-638.jpg?cb=1502001532

ACTION POTENTIAL

- A momentary change in electrical potential associated with the passage of an impulse along the membrane of a muscle cell or nerve cell.
- An Action potential is the neurons way of transporting electrical signals from one cell to the next.

ACTION POTENTIAL

- Action potentials are the primary electrical responses of neurons and other excitable tissues, and they are the main form of communication within the nervous system.
- They are due to changes in the conduction of ions across the cell membrane.

- The electrical events in neurons are rapid, being measured in milli seconds(ms); and the potential changes are small,being measured in milli volts(mV).

ACTION POTENTIAL

How an action potential is generated?

• A neuron that emits an action potential is often said to "fire".

• Action potentials are generated by special types of voltage-gated ion channels embedded in a cell's plasma membrane.

• The rapid influx of sodium ions causes the polarity of the plasma membrane to reverse, and the ion channels then rapidly inactivate.

• Thus, the sodium channel activation moves in a wave-like fashion

ACTION POTENTIAL

How an action potential is propagated?

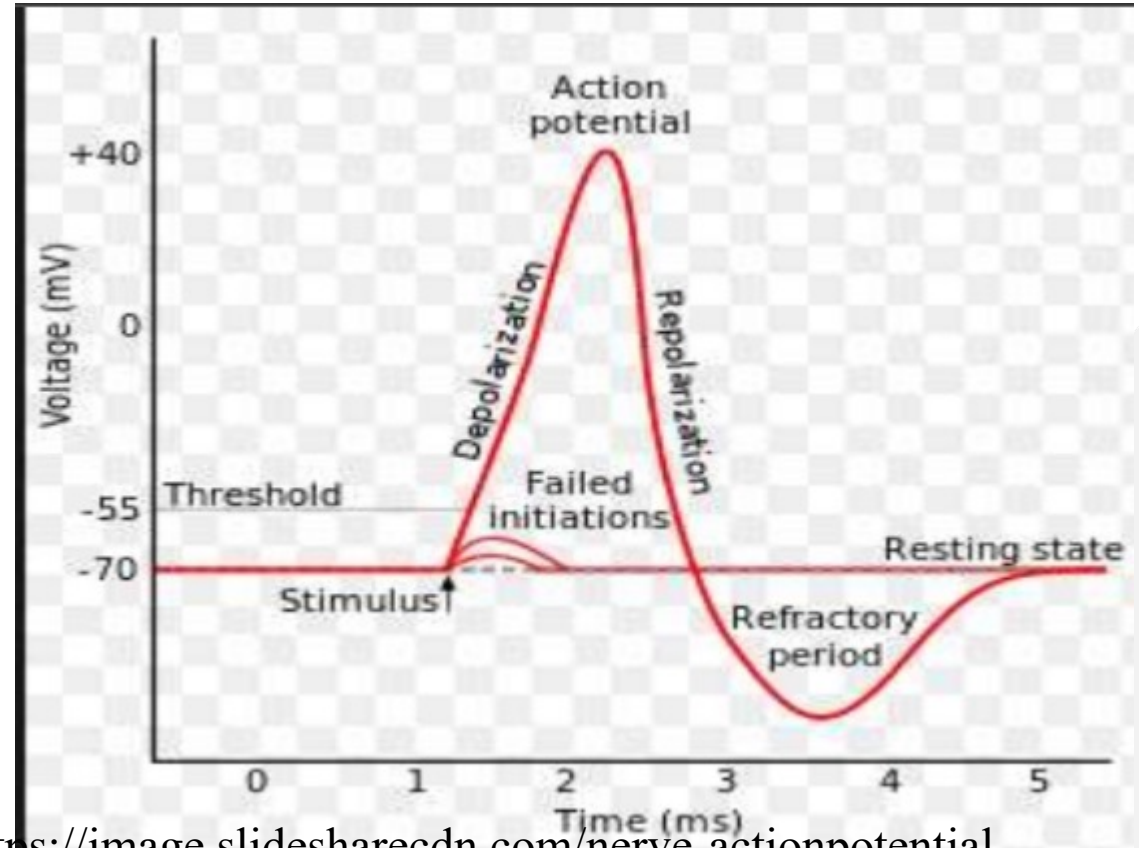
- The action potential is propagated down the length of the neuron, from its input source at the dendrites, to the cell body, and then down the axon to the synaptic terminals

ACTION POTENTIAL

How does a stimulus trigger an action potential?

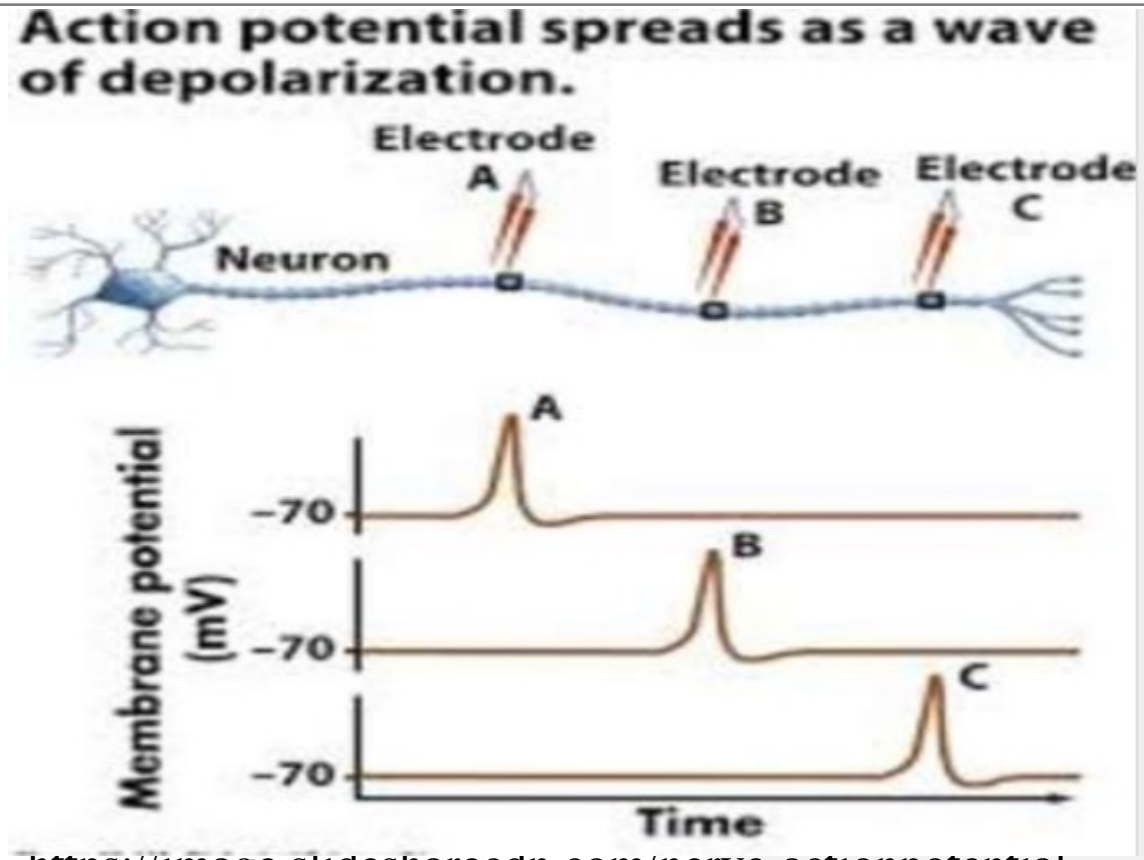
• The stimulus triggers an action potential in the cell membrane of the nerve cell, and that action potential provides the stimulus for a neighboring segment of the cell membrane.

ACTION POTENTIAL



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-18-638.jpg?cb=1502001532

ACTION POTENTIAL



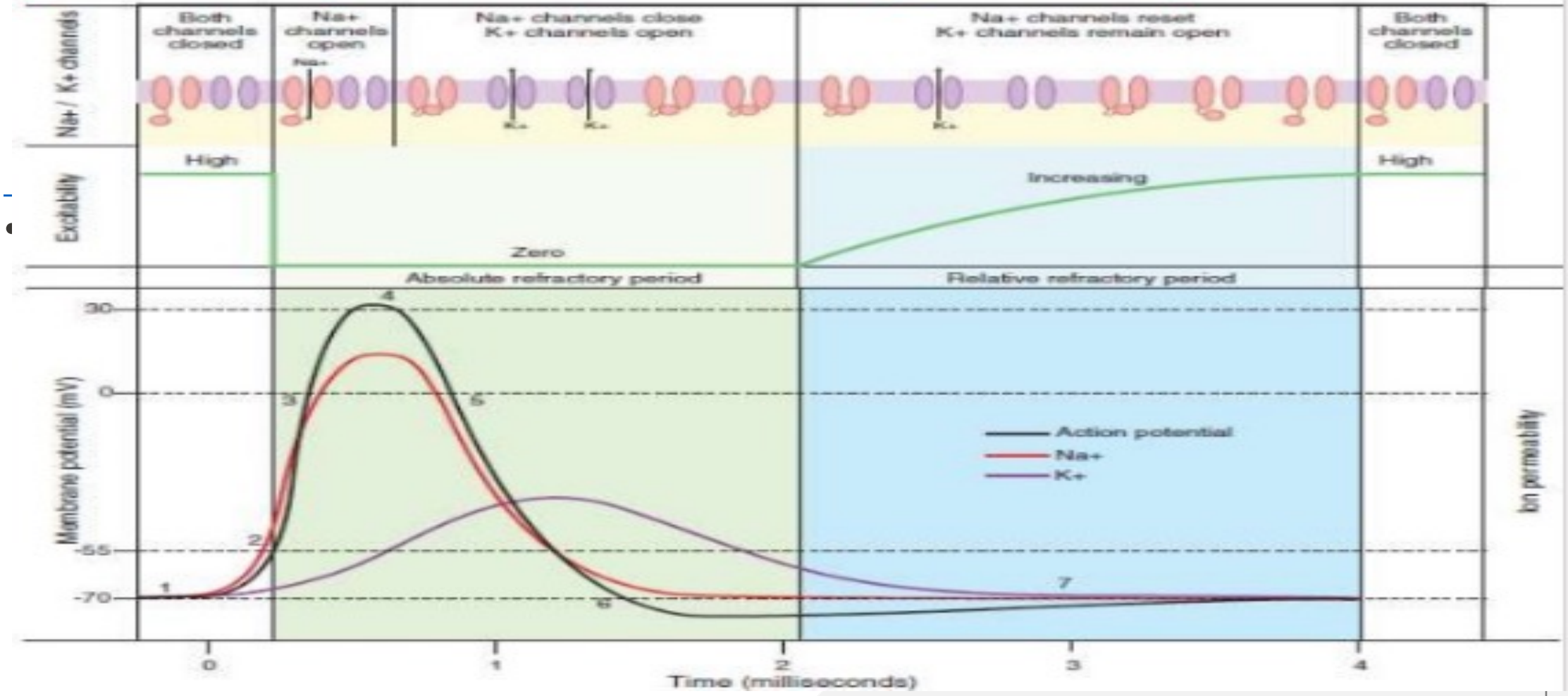
https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-18-638.jpg?cb=1502001532

IONIC FLUXES DURING THE ACTION POTENTIAL

- The conductance of an ion is the reciprocal of its electrical resistance in the membrane and is a measure of the membrane permeability to that ion.

- In response to a depolarizing stimulus, some of the voltage-gated Na+ channels open and Na + enters the cell and the membrane is brought to its threshold potential and the voltage-gated Na+ channels overwhelm the K + and other channels.

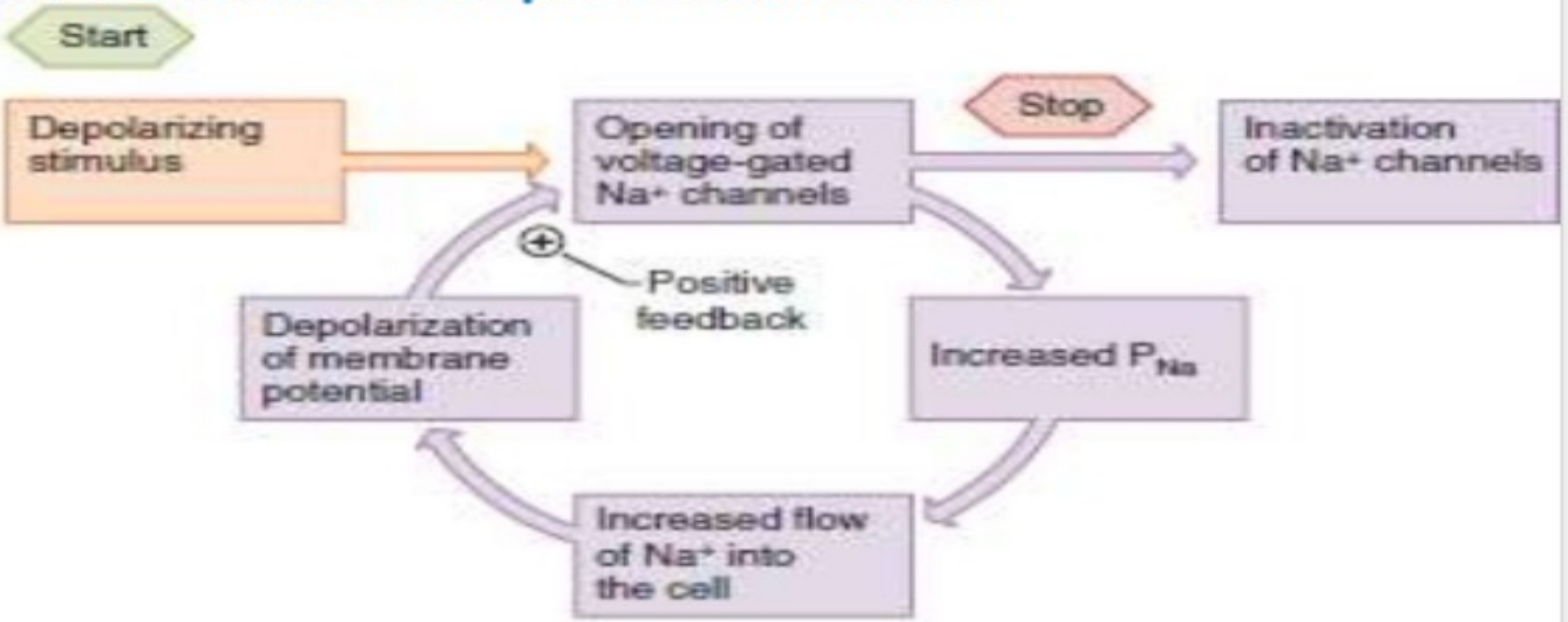
Changes in membrane potential and relative membrane permeability to Na + and K + during an action potential.



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-21-638.jpg?cb=1502001532

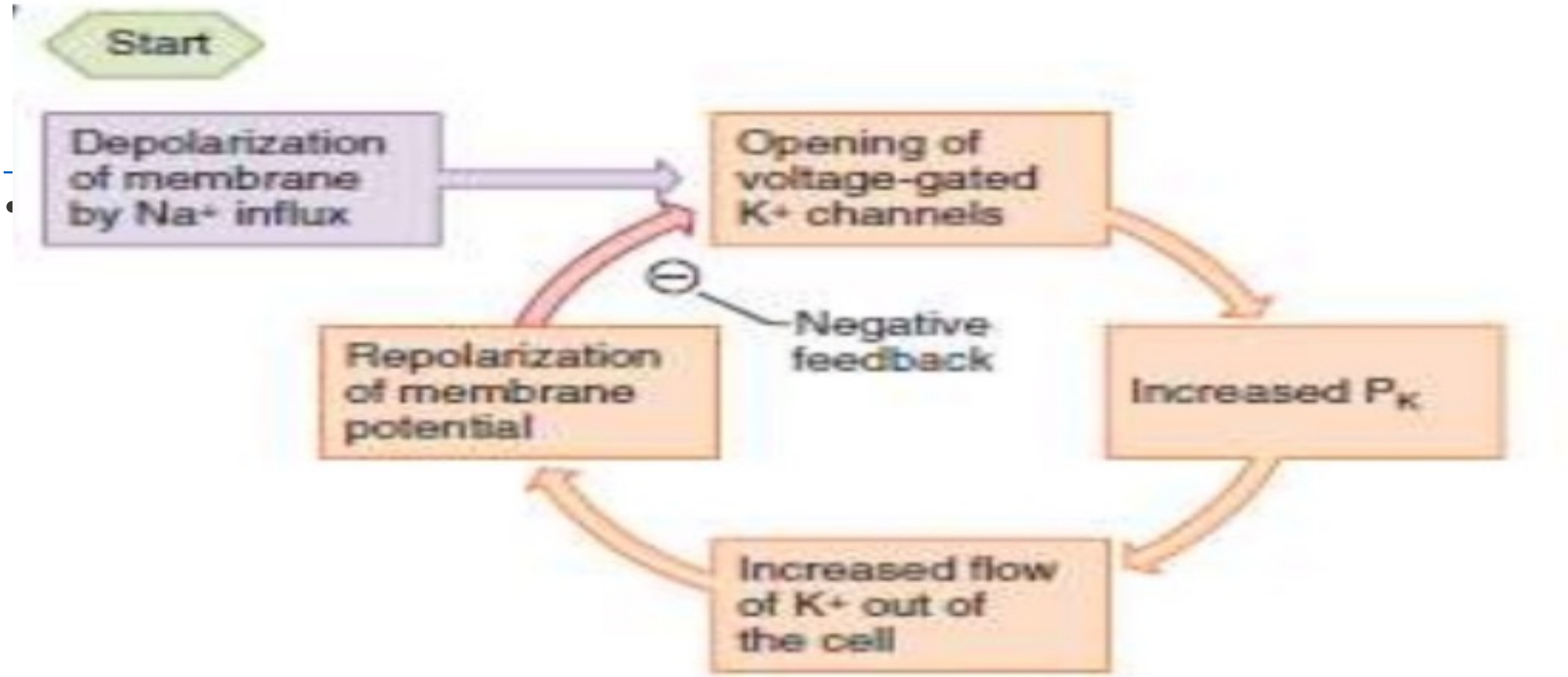
Feedback control in voltage-gated ion channels in the membrane.

Na + channels exert positive feedback.



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-21-638.jpg?cb=1502001532

K + channels exert negative feedback



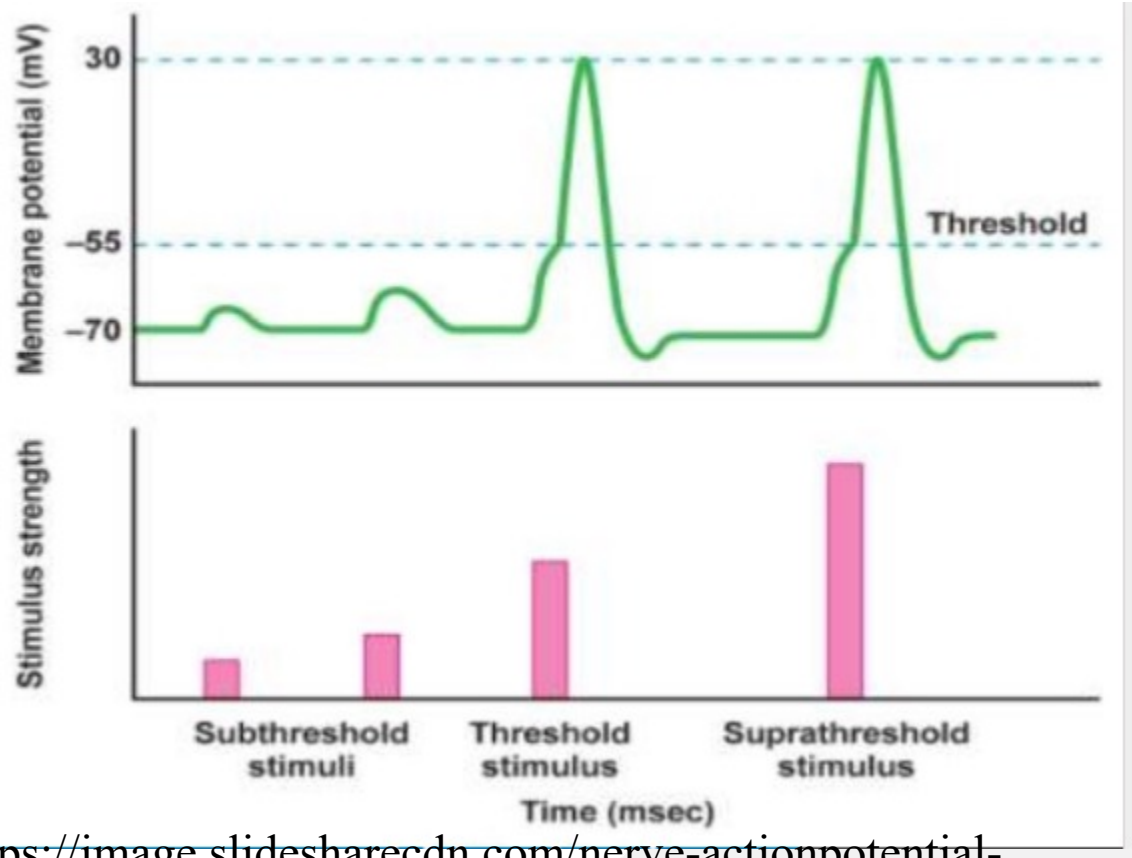
https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-21-638.jpg?cb=1502001532

ALL-OR-NONE ACTION POTENTIALS

- The all-or-none law is the principle that the strength by which a nerve or muscle fiber responds to a stimulus is independent of the strength of the stimulus.

- If that stimulus exceeds the threshold potential, the nerve or muscle fiber will give a complete response; otherwise, there is no response.

ALL-OR-NONE ACTION POTENTIALS



https://image.slidesharecdn.com/nerve-actionpotential-170806063624/95/nerve-action-potential-25-638.jpg?cb=1502001532

CONCLUSION

- Theses cells are recognized for their role in communication within the CNS in partnership with neurons.

two major types of glial cells in the vertebrate nervous system

- A momentary change in electrical potential associated with the passage of an impulse along the membrane of a muscle cell or nerve cell.

ASSESSMENT PATTERN

Assessment Pattern	Total Marks
1st Hourly Test	36
2nd Hourly Test	36
Surprise Test	12
Assignment (3)	10
Quiz	4
End Semester Examination	60

REFERENCES

- C.B.Powar, 2010.Cell Biology.5th Ed,Himalyan Publishing House.
- Leshie Cromwell, Fred.J. Weibell and Erich.A.Pfeiffer. 2003. Biomedical instrumentation and measurements. 2nd edition, PHI.
- John G. Webster 1998. Medical Instrumentation: Applications and Design, 3rd edition, Jon Wiley and Sons, New York.
- Jeremy M. Berg, John L. Tymoczko and Lubert Stryer. 2006. "Biochemistry," 6th Ed. W.H. Freeman and Co. Ltd.
- Robert Weaver. 2012 "Molecular Biology," 5th Edition, MCGraw-Hill.
- Jon Cooper, , **2**004. "Biosensors A Practical Approach" Bellwether Books.
- Martin Alexander, 1994 "Biodegradation and Bioremediation," Academic Press.

THANK YOU

For queries
Email: subject_code_2020@gmail.com