CHANDIGARH UNIVERSITY

Discover. Learn. Empower.

INSTITUTE-UNIVERSITY INSTITUTE OF ENGINEERING

ACADEMIC UNIT-II

Computer Science Engineering

Subject Name-Biology For Engineers

Subject Code- 20SZT148

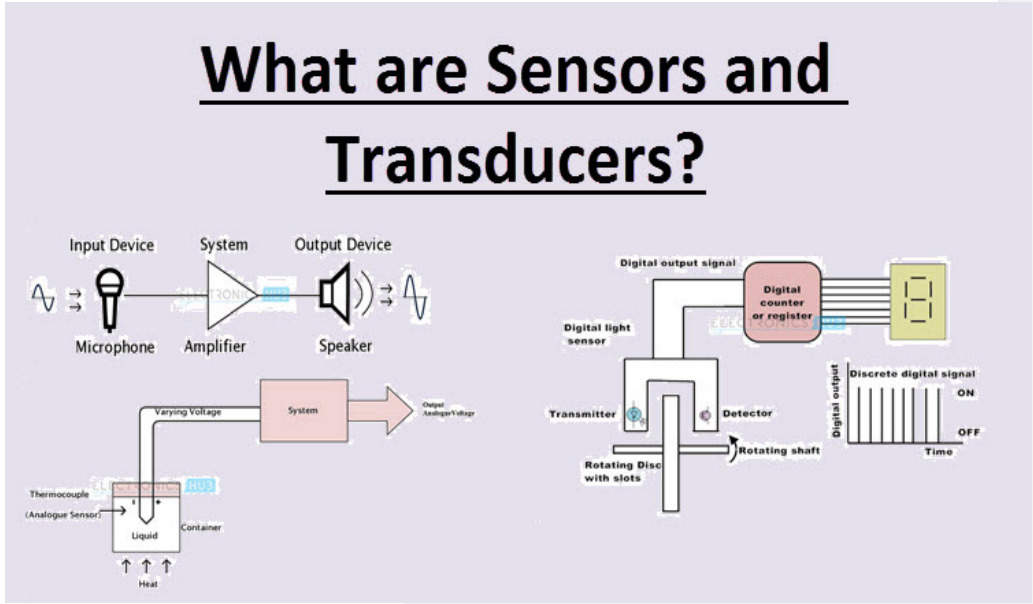
RECEPTORS AND TRANSDUCERS

DISCOVER . LEARN . EMPOWER

RECEPTORS AND TRANSDUCERS

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**

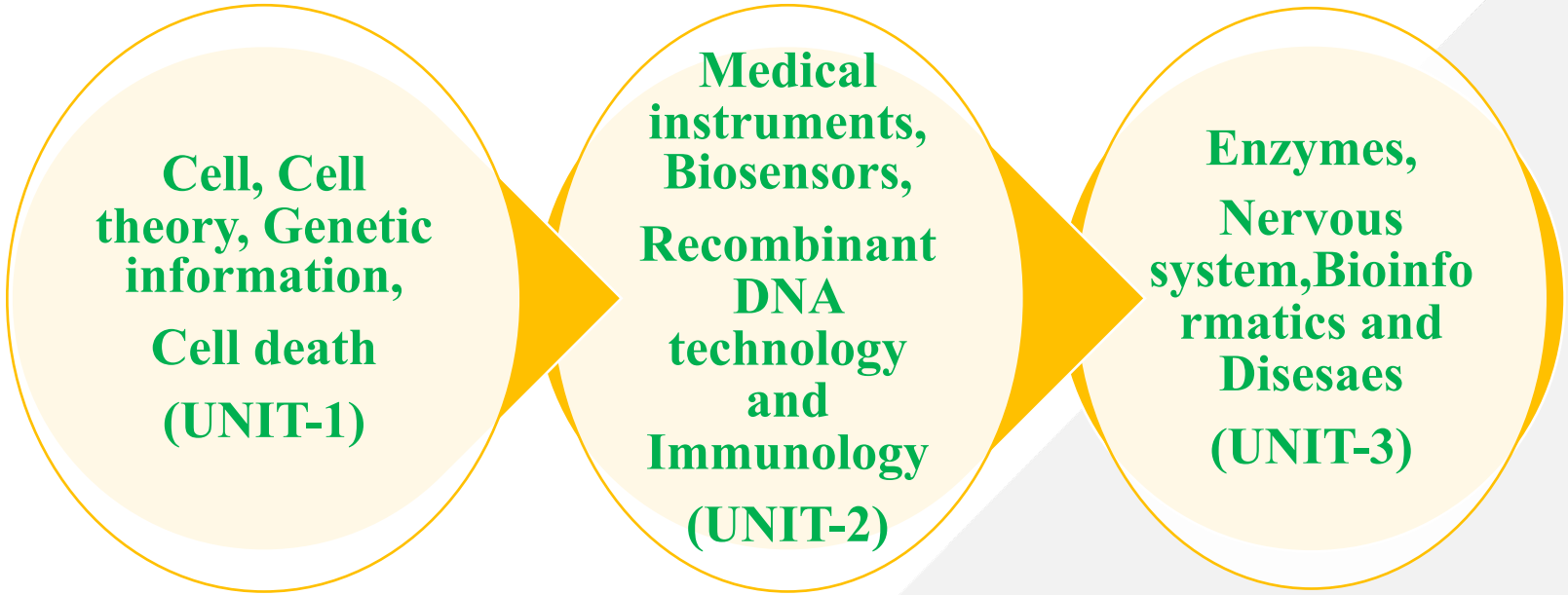


Will be covered in this lecture

:

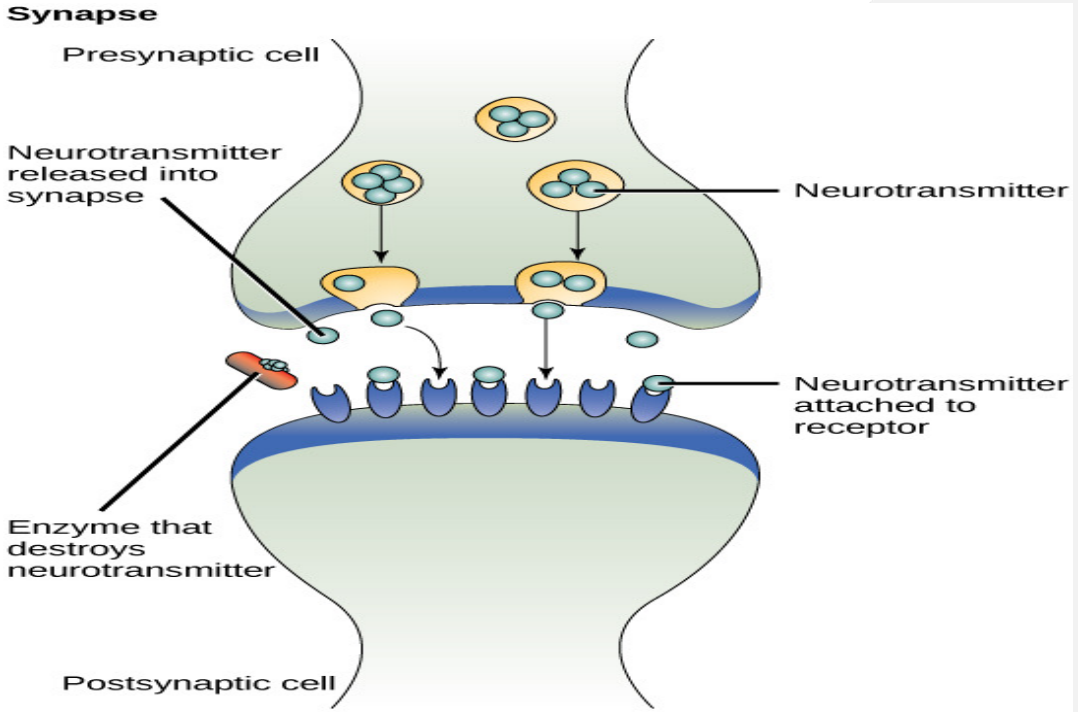
https://www.electronicshub.org/sensors-and-transducers-introduction/

BIOLOGY FOR ENGINEERS



RECEPTORS

- Certain specialized structures are present at the interface of stimulus and afferent nerve fibers.
- These specialized structures convert any type of energy into electrical energy or action potential in afferent fiber.
- This action is known as transduction. Hence receptors act as biologic transducers.



:

https://courses.lumenlearning.com/boundless-biology/chapter/signaling-molecules-and-cellular-receptors/

RECEPTORS

- **Due to presence of receptors, CNS can exert its influence on:**
- 1. Perception of stimulus
- 2. Regulation of many of the activity.
- When stimulus acts on receptor, there is some amount of electrical change occurring in receptor. This is known as receptor potential.
- When stimulus acts on a receptor, there is conformational change in the membrane of receptor, which increases permeability of membrane for Na^+.
- Hence there will be influx of Na^+ from ECF to ICF causes depolarization, and results in a graded potential called generator or receptor potential.

CLASSIFICATION OF RECEPTORS

- **Based on type of stimulus for which they respond, they can be classified into:**
- 1. Mechanoreceptors (Fig. 9.3) respond for mechanical energy, like touch, pressure, vibration. These receptors are present in almost all parts of body.

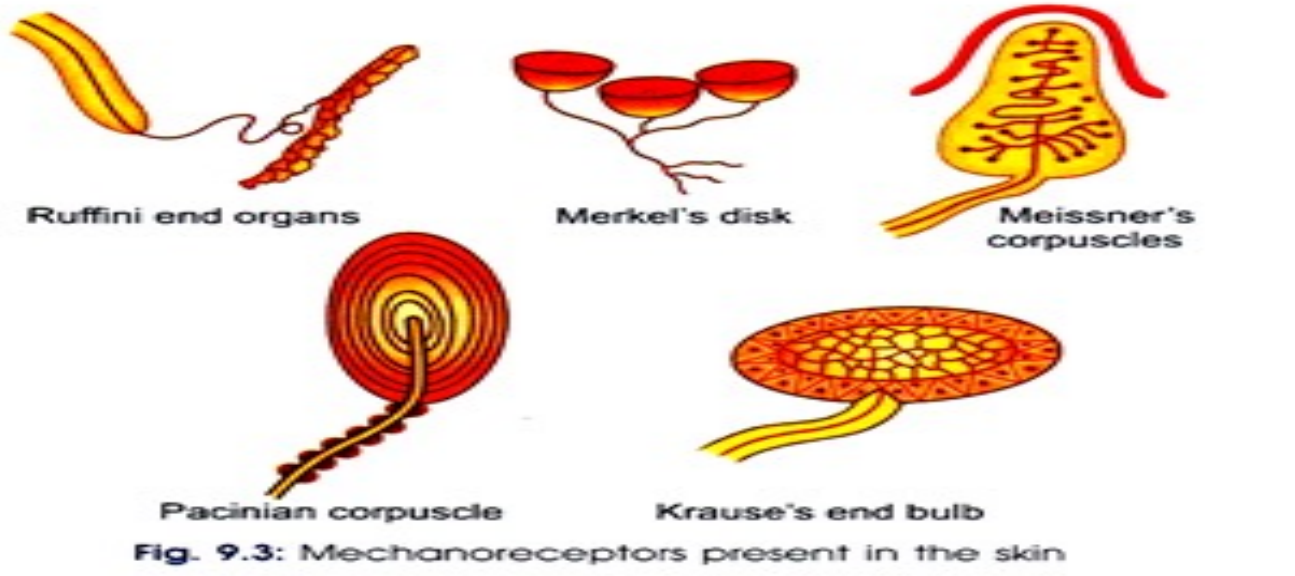


Fig. 9.3: Mechanoreceptors present in the skin

https://www.biologydiscussion.com/nervous-system/receptors-meaning-classification-and-properties/62823

CLASSIFICATION OF RECEPTORS

- **In skin, there are:**
- i. Merkel's disk
- ii. Meissner's corpuscle (touch receptors)
- iii. Pacinian corpuscle, etc.

- **In visceral regions, are:**
- i. Barorceptors
- ii. Volume receptors
- iii. Auditory receptors, etc.

CLASSIFICATION OF RECEPTORS

2. Chemoreceptors respond for chemical energy.

- **Some of the examples for chemoreceptors are:**
- i. Taste receptors
- ii. Olfactory receptors
- iii. Osmoreceptors

3. Thermoreceptors get stimulated by warmth/cold energy. Thermoreceptors are present in skin (peripheral) and in hypothalamus (central).

CHEMORECEPTORS

•A **chemoreceptor**, also known as **chemosensor**, is a specialized sensory receptor cell which transduces a chemical substance to generate a biological signal.

•This signal may be in the form of an action potential, if the chemoreceptor is a neuron, or in the form of a neurotransmitter that can activate a nerve fiber if the chemoreceptor is a specialized cell, such as taste receptors,[or an internal peripheral chemoreceptor, such as the carotid bodies.

CHEMORECEPTORS

- **Peripheral chemoreceptors** located in the heart convey messages to the central nervous system about chemical levels in the blood, including oxygen and carbon dioxide.

- **Central chemoreceptors**, located in the respiratory center at the base of your brain, monitor the levels of carbon dioxide and oxygen by detecting changes in the pH levels of the cerebral spinal fluid.
- If, for example, your oxygen levels are too low, your central and peripheral chemoreceptors convey a message that triggers an increase in respiration.

THERMORECEPTORS

- **Thermoreceptors** are specialized nerve cells that are able to detect differences in temperature.
- Cold receptors start to perceive cold sensations when the surface of the skin drops below 95 ° F.They are most stimulated when the surface of the skin is at 77 ° F and are no longer stimulated when the surface of the skin drops below 41 ° F. This is why your feet or hands start to go numb when they are submerged in icy water for a long period of time. Hot receptors start to perceive hot sensations when the surface of the skin rises above 86 ° F and are most stimulated at 113 ° F.
- But beyond 113 ° F, pain receptors take over to avoid damage being done to the skin and underlying tissues.
- Thermoreceptors are found all over the body, but cold receptors are found in greater density than heat receptors.

BARORECEPTORS

- **Baroreceptors** are mechanoreceptors located in the carotid sinus and in the aortic arch. Their function is to sense pressure changes by responding to change in the tension of the arterial wall. The baroreflex mechanism is a fast response to changes in blood pressure.
- Blood pressure is constantly monitored by **baroreceptors**. **Baroreceptors** are special receptors that detect changes in your blood pressure. If the blood pressure within the aorta or carotid sinus increases, the walls of the arteries stretch and stimulate increased activity within the **baroreceptors**.
- **Baroreceptors** are specialized mechanoreceptors in the walls of blood vessels. They communicate to the brain whether blood pressure is too low or high, so that the brain can adjust the blood flow accordingly. They are located on both arteries and veins.

OLFACTORY RECEPTORS

- Olfactory **receptor**, also called **smell receptor**, protein capable of binding odour molecules that plays a central role in the sense of **smell** (olfaction).
- These **receptors** are common to arthropods, terrestrial vertebrates, fish, and other animals.
- **Olfactory receptors** are found in a patch of **olfactory** epithelium that lines the medial and lateral walls of the roof of the nasal cavity.
- **Olfactory receptor cells** are primitive, specialized, bipolar neurons whose nuclei are in the base of the epithelium.

TRANSDUCERS

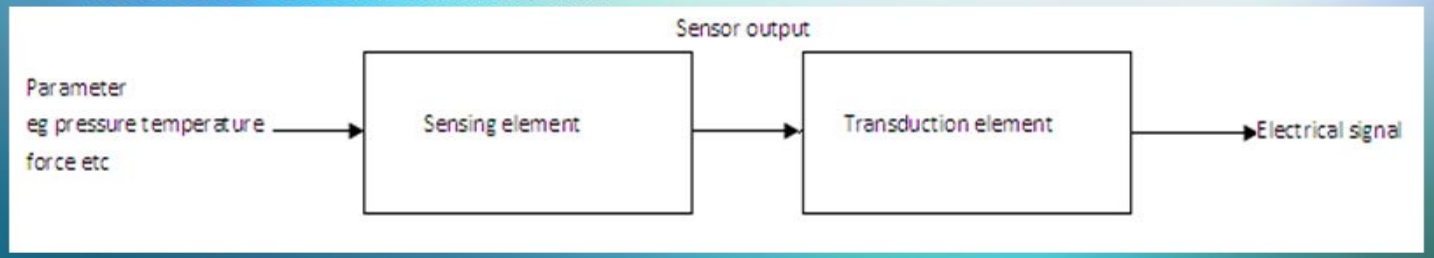
- A device which transforms a non - electrical physical quantity (i.e. temperature, sound or light) into an electrical signal (i.e. voltage, current, capacity…)
- A device that is capable of converting the physical quantity into a proportional electrical quantity such as voltage or current.

- Transducer contains two parts –
- (a) The sensing element (sensor) – A device producing measurable response to change in physical conditions.
- (b) The transduction element – that convert the sensor output to suitable electrical form.

TRANSDUCERS

BLOCK DIAGRAM OF TRANSDUCERS

- Transducer contains two parts that are closely related to each other i.e. the sensing element and transduction element.
- The sensing element is called as the sensor. It is device producing measurable response to change in physical conditions.
- The transduction element convert the sensor output to suitable electrical form.



https://slideplayer.com/slide/10925230/

SELECTION FACTORS OF TRANSDUCERS

- **Sensitivity:** The transducer must be sensitive enough to produce detectable output.
- **Operating Range:** The transducer should maintain the range requirement and have a good resolution over the entire range.
- **Accuracy:** High accuracy is assured.
- **Transient and frequency response** : The transducer should meet the desired time domain specification like peak overshoot, rise time, setting time and small dynamic error.
- **Environmental Compatibility:**transducer selected to work under specified environmental conditions maintains its input- output relationship.
- **Insensitivity to unwanted signals:** The transducer should be minimally sensitive to unwanted signals and highly sensitive to desired signals.v

CONCLUSION

- **Receptors** are special structures that can be found in cell membranes. These are made of protein molecules such as glycoproteins.
- **Receptors** bind (attach) to specialised molecules.
- The process is called signal transduction: The binding starts a chemical change on the inside of the membrane.
- The word "**Transducer**" is the collective term **used for** both Sensors which can be **used to** sense a wide range of different energy forms such as movement, electrical signals, radiant energy, thermal or magnetic energy etc, and Actuators which can be **used to** switch voltages or currents.

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

APPLICATIONS

- Improving quality of life is one of the main benefits of integrating new innovations into medicine. Medical technologies like minimally-invasive surgeries, better monitoring systems, and more comfortable scanning equipment are allowing patients to spend less time in recovery and more time enjoying a healthy life.
- To Improve Diagnosis and Treatment for Patients.
- To Support Remote Monitoring of Chronic Diseases.
- To Improve Patient Safety and Drug Management.
- To Facilitate Better Long Term Disease Management.
- To Decrease Costs While Improving Patient Care Outcomes.

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