SRM INSTITUTE OF SCIENCE AND TECHNOLOGY, RAMAPURAM CAMPUS
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

ANSWER KEY SUBMISSION

Date of Exam & Session	15/09/2022 & AN	Category of Exam	CLA1
Course Name	Artificial Neural Networks	Course Code	18CSE388T
Name of the Faculty submitting	Ms.P.Vidyasri	Date of submission of Answer Key	19/08/2022
Department to which the faculty belongs to	CSE	Total Marks	25

PART - A (5x1 = 5)
ANSWER ALL THE QUESTIONS

Q.No	Questions	Marks
1	**Choose the estimated number of neurons in human cortex?** a) 10^8 b) 10^5 **c) 10^{11}** d) 10^{20}	1
2	**Who proposed the first perceptron model in 1958?** a) McCulloch-Pitts b) Marvin Minsky c) Hopfield **d) Rosenblatt**	1
3	**Choose these action potential events in their proper sequence:** **1. The neuron is stimulated at the dendrites** **2. K+ gates open** **3. The neuron is in a polarized "resting" state** **4. Na+ gates open** **5. The cell is fully depolarized** **6. The cell is fully repolarized** a) 1, 2, 4, 3, 5, 6 **b) 3, 1, 4, 5, 2, 6** c) 4, 6, 2, 1, 5, 3 d) 1, 4, 2, 6, 5, 3	1
4	**Find the right option:** **i. Electric synapse requires a direct, strong connection between sender and receiver** **ii. Chemical synapse needs a connection between the source and the target** **iii. Neurotransmitters carry the information into the nucleus of the cell.** a) i,ii,iii are true **b) i,iii are true** c) ii,iii are true d) i alone is true	1
5	**Choose the right hierarchy of light processing information:** a) Bipolar cells->Ganglion cells->Photoreceptors b) Photoreceptors->Ganglion cells->Bipolar cells c) Photoreceptors->Amacrine Cells->Bipolar cells **d) Photoreceptor->Bipolar cell->Ganglion cell**	1

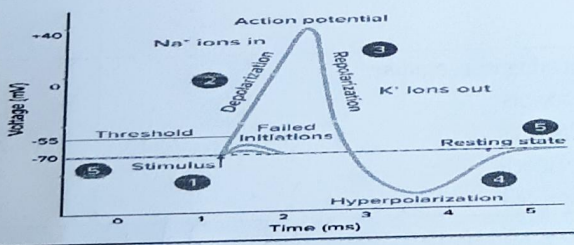
PART - B (2x4= 8)

ANSWER ALL THE QUESTIONS

Q.No	Questions	Marks
6	**Explain why receptors cells are called specialized cells?** Sensory neurons detect information such as sounds, light, touch, smell, taste, and temperature through receptors on their surface. Information travels through nerves (relay neurons) from the sensory neurons to the brain. Receptor cells are nerve endings or specialized cells in sensory neurons that have the ability to respond to an environmental stimulus. It is the receptor cells that begin the process of sensation and perception.	2 2
7	**Compare Biological Neural Networks with Artificial Neural Networks.** Artificial neural network or Neural network or just Neural net. The term "Artificial Neural Network" is derived from "Biological neural networks" that develops the structure of a human brain. The inventor of the first neuro computer, Dr. Robert Hecht-Nielsen, defines a neural network as, "... a computing system made up of a number of simple, highly interconnected processing elements, which process information by their dynamic state response to external inputs." The biological neurons are linked to each other in a weighted way and when stimulated they electrically transmit their signal via the axon.	2 2

PART - C (1x12 = 12)

ANSWER THE QUESTIONS

Q.No	Questions	Marks
8a	**Explain in detail about the Electrochemical processes in the neuron and its components.** The neurons show a difference in electrical charges or ions, a potential. In the membrane of the neuron, the charged atoms (ions) are different from the charged atoms on the outside. The difference is called membrane potential. Certain kinds of ions more often or less often than on the inside. This descent or ascent of concentration is called a Concentration gradient. We assume that no electrical signals are received from the outside, the membrane potential is −70 mV, (millivolts and the minus sign indicates that the inner surface is negative). Diffusion happens due to: **Concentration gradient:** If the concentration of an ion is higher on the inside of the neuron than on the outside, it will try to diffuse to the outside and vice versa. Potassium ions K^+ diffuses through the membrane. Other charged ions like Chloride Cl^-, collectively called A^-, remains within the neuron. Negative ions are not permeable. The inside of the neuron becomes negatively charged. **Electrical Gradient:** The intracellular charge is very strong. Therefore, it attracts positive ions. The neuron is activated by changes in the membrane potential. Sodium Na+ and potassium K+ can diffuse through the membrane. Sodium diffuses slowly, potassium faster. They move through channels within the membrane, the sodium channel and potassium channels. The opening of these channels changes the concentration of ions within and outside of the membrane, it also changes the membrane potential. These controllable channels are opened as soon as the accumulated received stimulus exceeds a certain threshold. The threshold potential lies at about -55 mV. As soon as the received stimuli reach this value, the neuron is activated and an electrical signal, an action potential, is initiated. Action potentials (those electrical impulses that send signals around your body) are a temporary shift in the neuron's membrane potential caused by ions suddenly flowing in and out of the neuron. Sodium-Potassium Pump maintains the concentration gradient.  	2 2 2

		Marks
	Resting state: Only the sodium and potassium channels are permeable to open. The membrane potential is at -70 mV and actively kept there by the neuron. **Stimulus up to the threshold:** A stimulus opens channels so that sodium can pour in. The intracellular charge becomes more positive. As soon as the membrane potential exceeds the threshold of -55 mV, the action potential is initiated. **Depolarization:** Sodium wants to pour into the cell because there is a lower intracellular than extracellular concentration of sodium. The cell is dominated by a negative environment which attracts the positive sodium ions. This massive influx of sodium drastically increases the membrane potential up to approx. +40 mV i.e., the action potential. **Repolarization:** Sodium channels are closed and the potassium channels are opened. The positively charged ions want to leave the positive interior of the cell. The interior of the cell is once again more negatively charged than the exterior. **Hyperpolarization:** Sodium as well as potassium channels are closed again. At first the membrane potential is slightly more negative than the resting potential. This is due to the fact that the potassium channels close more slowly. Positively charged potassium effuses because of its lower extracellular concentration.	6
9b	**Distinguish between different types of eyes and give an outline of common light sensing organs with suitable diagrams.** Sensory organs can detect electromagnetic radiation. The wavelength range of the radiation perceivable by the human eye is called visible range or simply light. The different wavelengths are perceived by the human eye as different colors. Visible range of electromagnetic radiation is different for each organism. Some cannot see colors; some perceive additional wavelength ranges. Fast flying insects (dragon fly) and crustaceans (crabs, lobsters, crayfish, shrimps) are example of compound eye. The compound eye consists of a great number of small, individual eyes. Each individual eye has its own nerve fiber which is connected to the insect brain. The spatial resolution of compound eyes must be very low and the image is blurred. Octopus species are example of Pinhole eyes, similar to a pinhole camera. A pinhole eye has a very small opening for light entry. It projects a sharp image onto the sensory cells behind. The spatial resolution is much higher than in the compound eye. Single lens eyes combine the advantages of the other two eye types, but they are more complex. The light sensing organ common in vertebrates is the single lens eye. The resulting image is a sharp, high-resolution image of the environment at high or variable light intensity. Lens eyes with their high angular resolution seem to more useful for pattern recognition, whereas the compound eyes, with their poor resolution, specialized for movement perception. Light enters through an opening (Pupil) and is projected onto a layer of sensory cells in the eye (Retina). The size of the pupil can be adapted to the lighting conditions by means of the iris muscle. These differences in pupil dilation require to actively focus the image. The single lens eye contains an additional adjustable lens. The retina not only receive information but is also responsible for information processing, done by several layers of information processing cells. **Photoreceptors:** The deepest layer of neurons processes the light first. Rods are responsible for vision at low light levels. Cones are active at higher light levels, are capable of color vision. Photoreceptors are only cells in the retina that can convert light into nerve impulses (cause action potentials). Photoreceptor layer then transmits these impulses next layers, namely to bipolar neurons and on to ganglion neurons. **Horizontal cells and Bipolar cells:** The horizontal cells receive information from the photoreceptors and transmit it to a number of surrounding bipolar neurons. Bipolar cells are responsible for transmitting signals from	4 2 3

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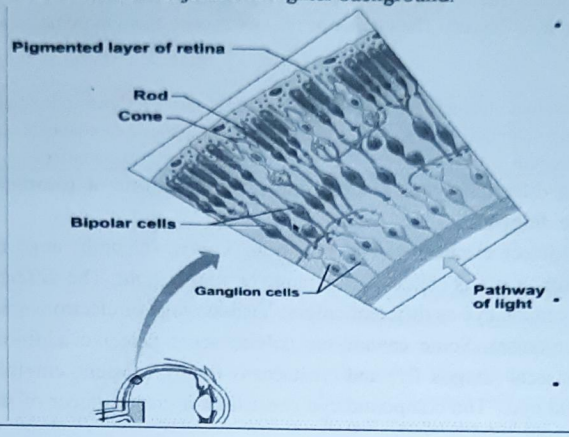
photoreceptors to a retinal ganglion cell.

Amacrine cell and Ganglion cell:

The amacrine cells receive their inputs from the bipolar cells and transmits to the ganglion neurons. Ganglion cell relays signals from bipolar and amacrine cells to the brain through long projections, optic nerve. The bipolar and horizontal cells respond to the Glutamate (glu) released by the photoreceptor cells. **3**

The bipolar cells have two different functional properties:

- The active bipolar cells are depolarized by glu and inhibits ganglion cells.
- Ganglion cells detect light objects in a darker background.
- The inhibit bipolar cells are hyperpolarized by glu and activates ganglion cells.
- Ganglion cells detect dark objects in a lighter background.



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