UNIT

15

Nervous System

POINTS TO REMEMBER

Coordination

This working together of various organs in a systematic, controlled and efficient way to produce proper response to various stimuli is called coordination.

Neuron or nerve cell

A neuron or nerve cell is the structural and functional unit of the nervous system.

Neuroglia

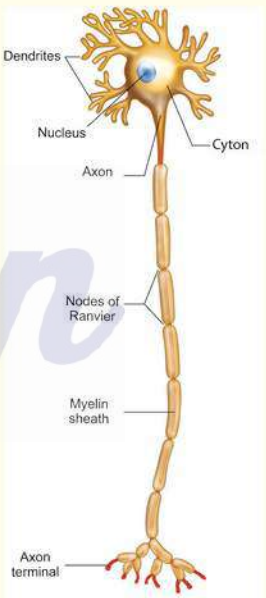
They are non-exciting, supporting cell of the nervous system. Neuroglia are also called as glial cells.

Nerve fibres

The nerve fibres are the long slender processes of neurons. A number of nerve fibres are bundled up together to form nerves.

Neuroplasm

It has a central nucleus with abundant cytoplasm called neuroplasm



Structure of Neuron

Nissl's granules

The cytoplasm has large granular body called Nissl's granules

Dendrites

These are the numerous branched cytoplasmic processes that project from the surface of the cell body.

Axon

The axon is a single, elongated, slender projection

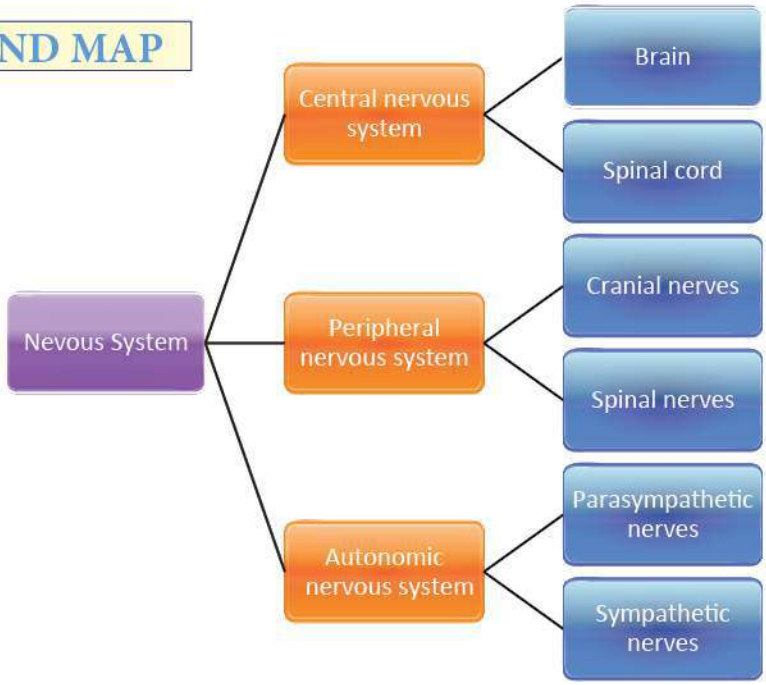
Synaptic knob

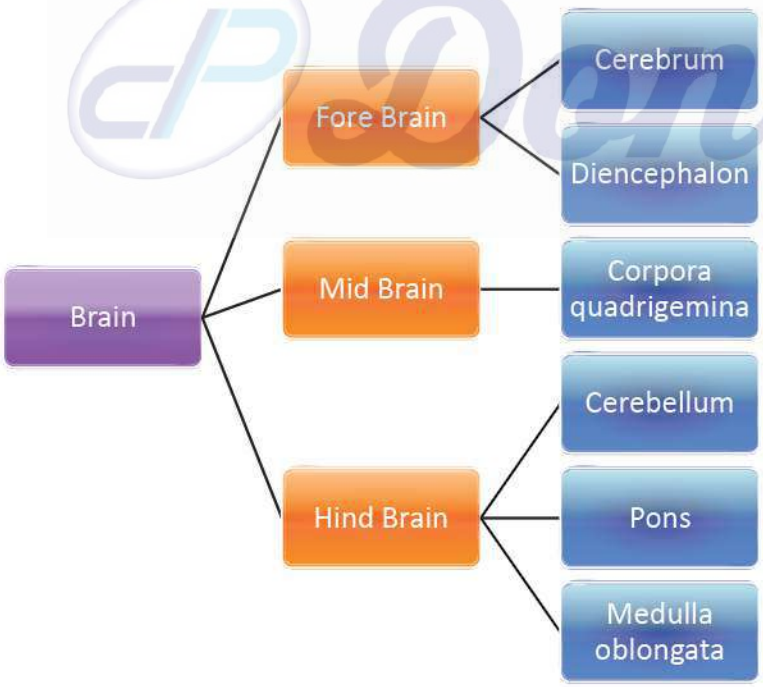
The end of axon terminates as fine branches which terminate into knob like swellings called synaptic knob.

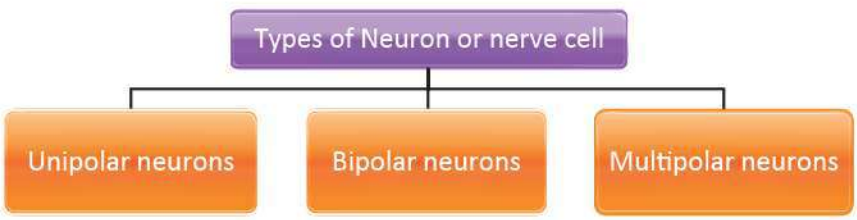
Axoplasm

The plasma membrane of axon is called axolemma , cytoplasm is called axoplasm

MIND MAP







Myelin sheath

The axons may be covered by a protective sheath called myelin sheath.

Schwann cells

Myelin sheath is further covered by a layer of Schwann cells.

Nodes of Ranvier

Myelin sheath breaks at intervals by depressions called Nodes of Ranvier. The region between the nodes is called as internode.

Synapse

A junction between synaptic knob of axon of one neuron and dendron of next neuron is called synaptic junction.

Unipolar neurons

Only one nerve process arises from the cyton which acts as both axon and dendron. Found in early embryos but not in adult.

Bipolar neurons

The cyton gives rise to two nerve processes of which one acts as an axon while another as a dendron. Found in retina of eye and olfactory epithelium of nasal chambers.

Multipolar neurons

The cyton gives rise to many dendrons and an axon. They are found in the cerebral cortex of the brain.

Nerve fibres

Nerve fibres are of two types based on the presence or absence of myelin sheath. Myelinated nerve fibre and Non-myelinated nerve fibre.

Neurons are of three types. Sensory or afferent neurons, Motor or efferent neurons and Association neurons.

Synaptic transmission

The flow of nerve impulses from axonal end of one neuron to dendrite of another neuron through a synapse is called synaptic transmission.

Neurotransmitters

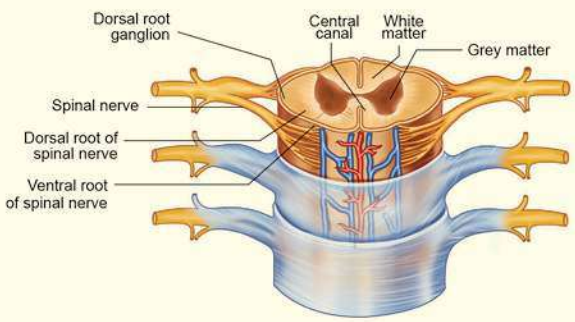
Neurotransmitters are the chemicals which allow the transmission of nerve impulse from the axon terminal of one neuron to the dendron of another neuron. The important neurotransmitter released by neurons is called Acetylcholine.

- Human nervous system is differentiated into central nervous system (CNS), peripheral nervous system (PNS) and autonomic nervous system (ANS).
- Brain is covered by three connective tissue membrane or meninges. They are Outer Duramater, Middle Arachnoid membrane, Inner Piamater.
- A human brain is formed of three main parts: (a) Forebrain (b) Midbrain and (c) Hindbrain.
- The forebrain is formed of cerebrum and diencephalon.
- Two cerebral hemispheres are interconnected by thick band of nerve fibres called Corpus Callosum.

- The outer portion of each cerebral hemisphere is formed of grey matter and is called cerebral cortex. The inner or deeper part is formed of white matter and is called cerebral medulla.
- The cortex is extremely folded forming elevations called gyri with depressions between them termed as sulci.
- Each cerebral hemisphere is divisble into a frontal lobe, a parietal lobe, a temporal lobe and an occipital lobe.
- Thalamus acts as a relay centre.
- Hypothalamus acts as a thermoregulatory (temperature control) center of the body.
- Mid brain consists of four rounded bodies called corpora quadrigemina that control visual and auditory (hearing) reflexes.
- Hindbrain is formed of three parts cerebellum, pons and medulla oblongata.
- Cerebellum is second largest part of the brain. It coordinates voluntary movements and also maintains body balance.
- 'Pons' a latin word meaning bridge. It relays signals between the cerebellum, spinal cord, midbrain and cerebrum. It controls respiration and sleep cycle.
- Medulla Oblongata has cardiac centres, respiratory centres, vasomotor centres to control heart beat, respiration and contractions of blood vessels respectively. It also regulates vomiting and salivation.

Overview of brain functions

Structure	Function
Cerebral cortex	Sensory preception, control of voluntary functions, language, thinking, memory, decision making, creativity
Thalamus	Acts as relay station
Hypothalamus	Temperature control, thirst, hunger, urination, important link between nervous system and endocrine glands
Cerebellum	Maintenance of posture and balance,coordinatevoluntary muscle activity
Pons and medulla	Role in sleep-awake cycle, cardiovascular, respiratory and digestive control centers



Structure of spinal cord

- The spinal cord contains a cerebrospinal fluid filled cavity known as the central canal.
- The brain is suspended in a special fluid environment called cerebrospinal fluid (CSF).

- There are two types of reflexes.
  i) Simple or basic reflexes: These reflexes are inbuilt and unlearned responses. Many of the actions we perform in our day to day life are simple reflexes.
  ii) Acquired or conditioned reflexes: These reflexes are the result of practice and learning.
- Most of the reflex actions are monitored and controlled by the spinal cord, hence also known as spinal reflexes.
- The pathway taken by nerve impulse to accomplish reflex action is called reflex arc.
- Stimulus is the heat which is sensed by receptor called as heat receptors or thermoreceptors in our hand.
- The sensory neuron transmits or conveys the message to the spinal cord.
- Motor neurons carry command from spinal cord to our arm.
- Nerves arising from brain are called cranial nerves. Nerves arising from spinal cord are called spinal nerves. In man, there are 12 pairs of cranial nerves. There are 31 pairs of spinal nerves.
- Autonomic nervous system (ANS) is also called as visceral nervous system as it regulates the function of internal visceral organs of our body through its two antagonistic (opposite) components sympathetic and parasympathetic systems.
- Electroencephalogram (EEG) is an instrument which records the electrical impulses of brain.

Textbook Evaluation

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. **Bipolar neurons are found in** ✶✶
   a) retina of eye b) cerebral cortex
   c) embryo d) respiratory epithelium

2. **Site for processing of vision, hearing, memory, speech, intelligence and thought is**
   a) kidney b) ear c) brain d) lungs

3. **In reflex action, the reflex arc is formed by**
   a) brain, spinal cord, muscle b) receptor, muscle, spinal cord
   c) muscle, receptor, brain d) receptor, spinal cord, muscle

4. **Dendrites transmit impulse _____ cell body and axon transmit impulse _____ cell body.**
   a) away from, away from b) towards, away from
   c) towards,towards d) away from, towards

5. **The outer most of the three cranial meninges is**
   a) arachnoid membrane b) piamater
   c) duramater d) myelin sheath

6. There are _____ pairs of cranial nerves and _____ pairs of spinal nerves. ★★
   a) 12, 31 b) 31, 12 c) 12, 13 d) 12, 21

7. The neurons which carries impulse from the central nervous system to the muscle fibre.
   a) afferent neurons b) association neuron
   c) efferent neuron d) unipolar neuron

8. Which nervous band connects the two cerebral hemispheres of brain?
   a) Thalamus b) Hypothalamus c) Corpus callosum d) Pons

9. Node of Ranvier is found in
   a) muscles b) axons c) dendrites d) cyton

10. Vomiting centre is located in
    a) medulla oblongata b) Stomach
    c) cerebrum d) hypothalamus

11. Nerve cells do not possess ★★
    a) neurilemma b) sarcolemma c) axon d) dendrites

12. A person who had met with an accident lost control of body temperature, water balance, and hunger. Which of the following part of brain is supposed to be damaged?
    a) Medulla oblongata b) cerebrum
    c) pons d) hypothalamus

Ans:

1.	a)	retina of eye	7.	c)	efferent neuron
2.	c)	brain	8.	c)	corpus callosum
3.	d)	receptor, spinal cord, muscle	9.	b)	axons
4.	b)	towards, away from	10.	a)	medulla oblongata
5.	c)	duramater	11.	b)	sarcolemma
6.	a)	12, 31	12.	d)	hypothalamus

II. Fill in the blanks

1. _____ is the longest cell in our body. ★★
2. Impulses travel rapidly in _____ neurons.
3. A change in the environment that causes an animal to react is called _____.
4. _____ carries the impulse towards the cell body.
5. The two antagonistic component of autonomic nervous system are _____ and _____.
6. A neuron contains all cell organelles except _____.
7. _____ maintains the constant pressure inside the cranium. ★★
8. _____ and _____ increases the surface area of cerebrum. ★
9. The part of human brain which acts as relay center is _____.

Ans:

1.	Neuron	6.	Centriole
2.	Association	7.	Cerebrospinal fluid
3.	Stimulus	8.	Gyri & Sulci
4.	Dendrites	9.	Thalamus
5.	Sympathetic and parasympathetic Systems		

III. State whether the following statements are true or false, if false explain why.

1. **Dendrons are the longest fibres that conducts impulses away from the cell body.** **False**

   Axons are the longest fibres that conducts impulses away from the cell body

2. **Sympathetic nervous system is a part of central nervous system.** ★ **False**

   Sympathetic nervous system is a part of Autonomic nervous system

3. **Hypothalamus is the thermoregulatory centre of human body.** **True**

4. **Cerebrum controls the voluntary actions of our body.** **False**

   Cerebellum controls the voluntary actions of our body

5. **In the central nervous system myelinated fibres form the white matter.** ★★ **True**

6. **All the nerves in the body are covered and protected by meninges.** **False**

   Brain is covered and protected by meninges.

7. **Cerebrospinal fluid provides nutrition to brain.** **True**

8. **Reflex arc allows the rapid response of the body to a stimulus.** ★ **False**

   Reflex action is the rapid response of the body to a stimulus

9. **Pons helps in regulating respiration.** **True**

IV. Match the following

1.

Column I		Column II	
1) Nissl's granules	-	a) Forebrain	(c)
2) Hypothalamus	-	b) Axon	(a)
3) Cerebellum	-	c) Cyton	(d)
4) Schwann cell	-	d) Hindbrain	(b)

V. Assertion and reasoning type

Understand the assertion statement. Justify the reason given and choose the correct choice.

a) Assertion is correct and reason is wrong
b) Reason is correct and the assertion is wrong
c) Both assertion and reason are correct
d) Both assertion and reason are wrong

1. **Assertion:** Cerebrospinal fluid is present throughout the central nervous system.
   Reason: Cerebrospinal fluid has no such functions.
   Ans: **(c)** Both assertion and reason are correct

2. **Assertion:** Corpus Callosum is present in space between the duramater and piamater.
   Reason: It serves to maintain the constant intracranial pressure.
   Ans: **(d)** Both assertion and reason are wrong

VI. Short answer questions

1. Define stimulus. ✶✶

- 'Stimulus' refers to the **changes** in the **environmental condition,** that are detected by **receptors** present in the body.
- A **receptor** is a cell or a group of cells that **receives** the stimuli.
- An **effector** is a part of the body which can **respond** to a stimulus.

2. Name the parts of the hind brain.

It is formed of three parts cerebellum, pons and medulla oblongata.

3. What are the structures involved in the protection of brain?

- Brain is protected by skull.
- Brain is covered by three connective tissue membrane or meninges. They are outer Duramater, middle Arachnoid membrane, inner Piamater. Meningeal membranes protect the brain from mechanical injury.
- The brain is suspended in a special fluid environment called cerebrospinal fluid (CSF). It acts as shock absorbing fluid and protects the brain from damage when it is subjected to sudden jerk.

4. Give an example for conditioned reflexes.

Drawing pictures on seeing a human being or a thing is an example of conditioned reflexes which requires conscious effort, acquired as a result of learning and practice.

5. Which acts as a link between the nervous system and endocrine system? ✶✶✶

- The **hypothalamus** is the link between the endocrine and nervous systems.
- The hypothalamus produces releasing and inhibiting hormones, which stop and start the production of other hormones throughout the body.

6. Define reflex arc. ✶

The pathway taken by nerve impulse to accomplish reflex action is called reflex arc.

VII. Differentiate between

1. Voluntary and involuntary actions. ✶✶✶

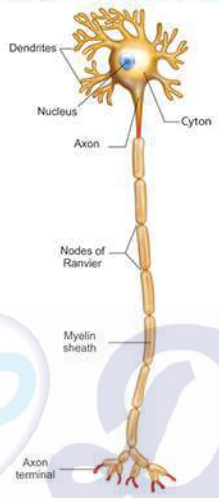
S.No.	Voluntary action	Involuntary action
1	An action which is under conscious control.	An action which is not under conscious control.
2	Voluntary action is controlled by the brain.	Involuntary action is controlled by the spinal cord.
3	All voluntary actions result in a muscular action.	Involuntary actions result in a muscular action or secretion from some gland.

2. Medullated and non-medullated nerve fibre.

S.No.	Medullated nerve fibre	Non-medullated nerve fibre
1.	It is also known as **myelinated** or **white** neuron.	It is also known as **non-myelinated** or **grey** neuron.
2.	It is found in the **white** matter of the brain.	It is found in the **grey** matter of cerebrum.
3.	The neuron is **enclosed** by myelin sheath.	The neuron is **not enclosed** by the myelin sheath.

VIII. Long answer questions:

1. With a neat labelled diagram explain the structure of neuron. ✶ ✶ ✶



Structure of Neuron

- A neuron typically consists of three basic parts. Cyton, Dendrites and Axon.

Cyton:

- Cyton is also called cell body or perikaryon.
- It has a central **nucleus** with abundant cytoplasm called **neuroplasm**.
- The cytoplasm has large granular body called **Nissl's granules** and the other cell organelles like mitochondria, ribosomes, lysosomes, and endoplasmic recticulum.
- Neurons **do not** have the ability to **divide**.
- Several neurofibrils are present in the cytoplasm that help in transmission of **nerve impulses** to and from the cell body.

Dendrites:

- These are the **numerous** branched **cytoplasmic** processes that project from the surface of the cell body.
- They conduct nerve impulses **towards** the cyton.
- The branched projections **increase** the **surface** area for receiving the **signals** from other nerve cells.

Axon:

- The axon is a **single, elongated, slender** projection.
- The end of axon terminates as fine branches which terminate into knob like swellings called **synaptic knob.**

- The plasma membrane of axon is called **axolemma**, while the cytoplasm is called **axoplasm.**
- It carries impulses away from the cyton.
- The axons may be covered by a **protective sheath** called myelin sheath which is further covered by a layer of **Schwann cells** called **neurilemma**.
- Myelin sheath breaks at intervals by depressions called **Nodes of Ranvier.**
- The region between the nodes is called as internode.
- Myelin sheath acts as **insulator** and ensures **rapid** transmission of nerve impulses.

Synapse:

- A junction between synaptic knob of axon of one neuron and dendron of next neuron is called synaptic junction.

2. Illustrate the structure and functions of brain. ★ ★ ★

A human brain is formed of three main parts:

- Forebrain
- Midbrain
- Hindbrain

Forebrain:

- The forebrain is formed of cerebrum and diencephalon.
- The latter consists of dorsal thalamus and ventral hypothalamus.

Cerebrum:

- It is the largest portion forming nearly two-third of the brain.
- The cerebrum is longitudinally divided into two halves as right and left **cerebral hemispheres.**
- Two cerebral hemispheres are interconnected by thick band of nerve fibres called **corpus callosum.**
- The outer portion of each cerebral hemisphere is formed of **grey matter** and is called cerebral cortex.
- The inner or deeper part is formed of **white matter** and is called cerebral medulla.
- The cortex is extremely folded forming elevations called **gyri** with depressions between them termed as **sulci** that increase its surface area.
- Each cerebral hemisphere is divisble into a frontal lobe, a parietal lobe, a temporal lobe and an occipital lobe.
- These lobes are also known as cerebral lobes and are associated with specific functions.
- Any damage in specific lobe inturn affects its function.
- The cerebrum is responsible for the thinking, intelligence, consciousness, memory, imagination, reasoning and willpower.

Thalamus

- Thalamus present in cerebral medulla is a major conducting centre for **sensory** and **motor signalling.**
- It acts as a **relay centre.**

Hypothalamus:

- It lies at the **base** of the **thalamus**.
- It controls **involuntary** functions like **hunger**, **thirst**, sleep, sweating, sexual desire, anger, fear, water balance, blood pressure etc.
- It acts as a **thermoregulatory** (temperature control) centre of the body.
- It controls the secretion of hormones from anterior pituitary gland and is an important link between **nervous system** and **endocrine system.**

Midbrain:

- It is located between thalamus and hind brain.
- The dorsal portion of the mid brain consists of four rounded bodies called corpora quadrigemina that control visual and auditory (hearing) reflexes.

Hindbrain:

- It is formed of three parts cerebellum, pons and medulla oblongata.

Cerebellum:

- It is **second largest part** of the brain formed of two large sized **hemispheres** and **middle vermis.**
- It coordinates voluntary movements and also maintains body balance.

Pons:

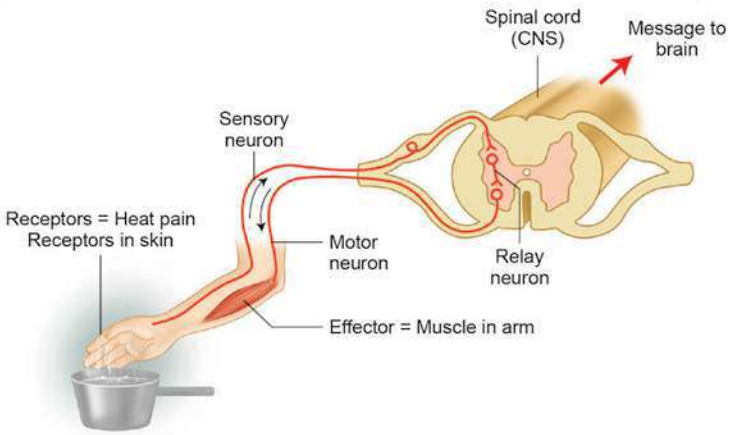
- 'Pons' a latin word meaning bridge.
- It is a bridge of nerve fibre that connects the lobes of **cerebellum**.
- It relays signals between the cerebellum, spinal cord, midbrain and cerebrum.
- It controls respiration and sleep cycle.

Overview of brain functions	
Cerebral cortex	Sensory preception, control of voluntary functions, language, thinking, memory, decision making, creativity
Thalamus	Acts as relay station
Hypothalamus	Temperature control, thirst, hunger, urination, important link between nervous system and endocrine glands
Cerebellum	Maintenance of posture and balance,coordinatevoluntary muscle activity
Pons and medulla	Role in sleep-awake cycle, cardiovascular, respiratory and digestive control centers

3. What will you do if someone pricks your hand with a needle? Elucidate the pathway of response with a neat labelled diagram.

- If someone pricks my hand with a needle, the **stimulus** is the **pain** which is sensed by receptors in our hand. This stimulus in turn triggers an impulse in **sensory neuron.**
- The sensory neuron **transmits** or conveys the message to the **spinal cord.**
- Spinal cord interprets the stimulus and the impulse is passed on to the **relay neuron** which in turn transmits it to a **motor neuron.**
- Motor neurons carry command from **spinal cord** to **our arm.**

- Muscle in our arm **contracts** and we withdraw our hand immediately.
- In this example, muscle is an effector organ which has responded to the prick.



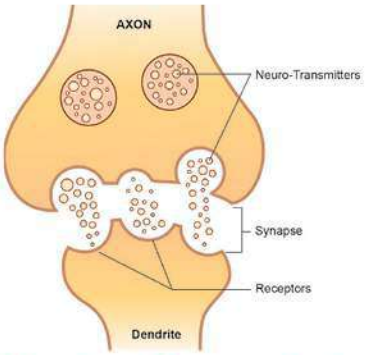
Reflex action and its pathway

4. Describe the structure of spinal cord. ★★

- Spinal cord is a **cylindrical structure** lying in the neural canal of the vertebral column.
- It is also covered by **meninges**.
- It extends from the **lower end** of **medulla oblongata** to the **first lumbar** vertebra.
- The posterior most region of spinal cord tapers into a thin fibrous thread like structure called **filum terminale.**
- Internally, the spinal cord contains a cerebrospinal fluid filled cavity known as the **central canal.**
- The **grey matter** of spinal cord is 'H' shaped.
- The upper end of letter **"H"** forms posterior horns and lower end forms anterior horns.
- A bundle of fibres pass into the posterior horn forming dorsal or afferent root.
- Fibres pass outward from the anterior horn forming ventral or efferent root.
- These **two roots** joins to form spinal nerves.
- The **white matter** is external and have bundle of nerve tracts.

5. How nerve impulses are transferred from one neuron to next neuron?

- All the information from the environment are detected by the **receptors** located in our **sense organs** such as the eyes, the nose, the skin, etc.
- Information from the **receptors** is transmitted as **electrical impulse** and is received by the dendritic tips of the neuron.
- This impulse travels from the **dendrite** to the cell body and then along the **axon** to its terminal end.
- On reaching the axonal end, it causes the nerve endings to release a chemical **(neurotransmitter)** which diffuses across a **synapse** and starts a similar electrical impulse in the dendrites of the next neuron, then to their cell body to be carried along the axon.
- The flow of nerve impulses from axonal end of one neuron to dendrite of another neuron through a synapse is called **synaptic transmission.**
- Neurotransmitters are the chemicals which allow the transmission of nerve impulse.
- The important neurotransmitter released by neurons is called **Acetylcholine**.



Nerve impulse transmission

6. Classify neurons based on its structure.

Structurally the neurons may be of the following types:

Unipolar neurons:

- Only one nerve process arises from the cyton which acts as both axon and dendron.

Bipolar neurons:

- The cyton gives rise to two nerve processes of which one acts as an axon while another as a dendron.

Multipolar neurons:

- The cyton gives rise to many dendrons and an axon

Unipolar (A), Bipolar (B) and multipolar (C) neurons

X. Higher Order Thinking Skills (HOTS)

1. 'A' is a cylindrical structure that begins from the lower end of medulla and extend downwards. It is enclosed in bony cage 'B' and covered by membranes 'C'. As many as 'D' pairs of nerves arise from the structure 'A'.

(i) What is A?

(ii) Name (a) bony cage 'B' and (b) membranes 'C'

(iii) How much pairs of nerves does D represent?

(i) 'A' is Spinal cord.

(ii) (a) vertebral column (b) meninges

(iii) 31 pairs of nerves

2. **Our body contains a large number of cells 'L' which are the longest cells in the body. L has long and short branch called as 'M' and 'N' respectively. There is a gap 'O' between two 'L' cells, through which nerves pass.**
Impulse transfer by release of chemical substance 'P'.
(i) Name the cells L.
(ii) What are M and N?
(iii) What is the gap O?
(iv) Name the chemical substance P.

(i) Nerve cells or neurons
(ii) Axon and Dendrites
(iii) Synapse
(iv) The chemical is Acetylcholine

Additional Questions

I. Choose the most suitable answer from the given four alternatives and write the option code and corresponding answer:

1. _____ are non exciting supporting cell of the nervous system.
a) Neuron b) Nerve fibre c) Neuroglia d) dendron

2. Cytoplasm inside the cyton is called _____
a) dendron b) neuroplasm c) protoplasm d) axon

3. Neurons which carry impulses from the sense organs to the central nervous system.
a) Motor b) Sensory c) Association d) Bipolar

4. Nerve fibre in which axon is covered by myelin sheath.
a) Myelinated b) Non myelinated
c) Efferent d) afferent

5. Unipolar neurons are found in the _____.
a) brain b) spinal cord
c) embryonic nervous tissue d) adult Nervous tissue

6. The sensory organs contain _____ neurons.
a) Unipolar b) Bipolar c) Multipolar d) Medullated

7. The part of the brain which controls emotional reactions in our body.
a) Cerebellum b) Cerebrum
c) Thalamus d) Hypothalamus

8. One of the following is a part of the brain stem
a) Fore brain and mid brain b) Mid brain and hind brain
c) Fore brain and hind brain d) Fore brain and spinal cord

9. Neurotransmitters are released at the synapse by _____
a) Dentrites b) Synaptic knobs
c) Organelles of cyton d) Myelin sheath of axon.

10. _____ controls the involuntary functions of visceral organs.
    a) Peripheral Nervous system b) Autonomic Nervous system
    c) Central Nervous system. d) Nervous system

11. It is a shock absorbing fluid and protects the brain ★
    a) neuroplasm b) axoplasm
    c) cerebrospinal d) cytoplasm

12. _____ acts as a thermoregulatory centre.
    a) cerebellum b) cerebrum c) pituitary gland d) hypothalamus

13. Neurotransmitters are released at the synapse by
    a) tips of dendrites b) synaptic knobs
    c) organelles of cyton d) axon

14. For minor surgeries in the body, doctors administer local anaesthesia to a part of the body, so that the pain will not be felt by the patient. At which part do you think, the nerve impulse is being arrested due to the effect of anaesthesia?
    a) At cyton b) At axon c) At synapse d) Dendrites

15. A nerve cell body with single process or fibre which acts both as axon and dendron. ★★
    a) Unipolar b) Bipolar c) Multipolar d) White neuron

16. _____ carry impulses from the sense organ to the central nervous system.
    a) Sensory b) Motor c) Bipolar d) Association

17. _____ are called as glial cells.
    a) Neuron b) Neuroglia c) Nervefibres d) Synapse

18. Fibers Pass outward from the anterior horn forming _____.
    a) Sympathetic b) Para sympathetic
    c) Spinal Nerves d) None of the above

19. _____ collects and removes wastes from the brain.
    a) Medulla oblongata b) Thalamus
    c) Spinal Cord d) Cerebrospinal fluid

20. The length of a nerve cell is _____ µm. ★
    a) 100 b) 50 c) 1000 d) 10

Ans:

1.	c)	Neuroglia	11.	c)	Cerebrospinal
2.	b)	Neuroplasm	12.	d)	Hypothalamus
3.	b)	Sensory	13.	b)	Synaptic knobs
4.	a)	Myelinated	14.	c)	At synapse
5.	c)	Embryonic nervous tissue	15.	a)	Unipolar
6.	b)	Bipolar	16.	a)	Sensory
7.	d)	Hypothalamus	17.	b)	Neuroglia
8.	b)	Mid brain and hind brain	18.	b)	Para sympathetic
9.	b)	Synaptic knobs	19.	d)	Cerebrospinal fluid
10.	b)	Autonomic Nervous System	20.	a)	100

II. Fill in the blanks

1. _____ is the structural and functional unit of brain.
2. _____ is a cell or group of cells which receives the stimulus.
3. _____ is a part of the body which can respond to a stimulus according to the instructions from the brain or the spinal cord.
4. _____ neurons are not enclosed by myelin sheath.
5. _____ is formed of sympathetic and parasympathetic nerves. ★
6. The plasma membrane of axon is called _____.
7. _____ is formed of brain and spinal cord.
8. Cytoplasm of axon is called _____.
9. The point of contact between the neighbouring nerve cells is called _____.
10. Neurotransmitters convert the electrical impulse into _____ impulse.
11. _____ consists of cerebrum, thalamus and hypothalamus.
12. _____ is responsible for thinking, memory and decision making.
13. _____ controls the body temperature, urge to eat, anger, fear, etc.
14. In the posterior end of the spinal cord is a fibrous thread like structure called _____.
15. The dorsal portion of the midbrain consists of four hemispherical bodies called _____. ★
16. _____ comprises of pons, cerebellum and medulla oblongata.
17. There are _____ pairs of cranial nerves that arise from the brain.
18. _____ controls the function of the vital organs of the body.
19. _____ is a tiny gland of the size of a pea attached to the hypothalamus of the brain.

Ans:

1.	Neuron	11.	Fore brain
2.	Receptor	12.	Cerebrum
3.	Effector	13.	Hypothalamus
4.	Grey	14.	Filum terminale
5.	ANS	15.	Corpora quadrigemina
6.	Axolemma	16.	Hind brain
7.	CNS	17.	12 pairs
8.	Axoplasm	18.	ANS
9.	Synapse	19.	Pituitary gland
10.	Chemical		

III. State whether the following statements are true or false, if false explain why.

1. **Sympathetic nervous system belongs to the PNS.** — **False**
   Sympathetic nervous system belongs to the ANS.
2. **Sensory neurons carry command from spinal cord to our arm.** ✶ — **False**
   Motor neurons carry command from spinal cord to our arm.
3. **Stimulus is passed to the spinal cord, to the relay neuron and then to the motor neuron.** — **True**
4. **Acquired reflexes are inbuilt and unlearned responses.** ✶✶ — **False**
   Simple reflexes are inbuilt and unlearned responses.
5. **Cerebrum maintains the posture and balance.** — **False**
   Cerebellum maintains the posture and balance.
6. **Hypothalamus plays an important role in sleep and awake cycle.** — **False**
   Pons and medulla plays an important role in sleep and awake cycle.
7. **A very long fibre with a branched distal end is called Axon.** — **True**
8. **Sensory hair cells of the sense organs are made up of multipolar neurons.**
   Sensory hair cells of the sense organs are made up of bipolar neurons. — **False**
9. **Grey neurons are not enclosed by myelin sheath.** ✶ — **True**
10. **The sensory hair cells of the sense organs are made up of unipolar neurons.** — **False**
    The sensory hair cells of the sense organs are made up of bipolar neurons.
11. **The innermost covering of the central nervous system is Pia mater.** — **True**
12. **Hypothalamus controls body temperature, urge to eat, anger, fear, etc.** — **True**

IV. Match the following

1. **Part of the brain**		**Function**	
1) Cerebrum	–	a) Respiration, sleep cycle	(c)
2) Thalamus	–	b) Vomitting, salivation	(d)
3) Hypothalamus	–	c) Thinking, intelligence consciousness	(e)
4) Cerebellum	–	d) Relay centre	(f)
5) Pons	–	e) Thirst, hunger, urination	(a)
6) Medulla Oblongata	–	f) Maintenance of posture and balance	(b)

V. Assertion and reasoning type

Understand the assertion statement. Justify the reason given and choose the correct choice.

a) If both A and R are true and R is correct explanation of A
b) If both A and R are true but R is not the correct explanation of A
c) A is true but R is false
d) Both A and R are false

1. **Assertion:** All spinal nerves are mixed nerves
   Reason: Each spinal nerve has a sensory root and a motor root.
   Ans: **(a)** If both A and R are true and R is correct explanation of A

2. **Assertion:** Dendrites are cytoplasmic projections from the surface of the cell body.
   Reason: Axon is a single elongated projection from the cell body. ★
   Ans: **(b)** If both A and R are true but R is not the correct explanation of A

3. **Assertion:** Thalamus acts as a relay centre.
   Reason: Thalamus is a major conducting centre for sensory and motor signalling.
   Ans: **(a)** If both A and R are true and R is correct explanation of A

VI. Answer in a sentence

1. **What is Myelin sheath?**
   In myelinated neurons an additional white fatty fibre covers the neurilemma. It is called myelin sheath.

2. **What is Schwann cells?** ★ ★
   Myelin sheath is further covered by a layer of Schwann cells.

3. **What are neurons?**
   Neurons are structural and functional unit of nervous system.

4. **What are nerve fibres?**
   Nerve fibres are long slender processes of nerve cells.

5. **What is cyton?**
   Cell body of a nerve cell is called cyton.

6. **What are dendrites?**
   Dendrites are numerous branched cytoplasmic processes that project from the surface of the cell body.

7. **What are Nissl's granules?**
   The cytoplasm of cyton has large granular body called Nissl's granules.

8. **What is axon?**
   The axon is a single, elongated, slender projection from the cell body.

9. **What is synaptic knob?**
   Axon terminates into fine branches which in turn terminates into knob like swellings called synaptic knob.

10. **What is neuroglia?** ★
    They are non exciting, supporting cell of the nervous system. They are also called as glial cells.

11. **What is neurilemma?**
    Axon is covered by a membrane called neurilemma.

VII. Short answer questions

1. What are Nodes of Ranvier?

Axon is covered by Myelin sheath which breaks at intervals by depressions called Nodes of Ranvier.

2. What are unipolar neurons?

- Only one nerve process arises from the cyton which acts as both axon and dendron.
- Unipolar neurons are found in embryonic tissue.

3. What are bi polar neurons?

- The cyton gives rise to two nerve processes of which one acts as an axon while another as a Dendron.
- Bipolar neurons are found in retina of eye and olfactory epithelium of nasal chambers.

4. What are multipolar neurons?

- The cyton gives rise to many dendrons and an axon.
- Multipolar neurons are found in cerebral cortex of brain.

5. What is nerve impulse?

The conduction of **stimuli** by nerve cells is called nerve impulse.

6. Name the divisions of Human Nervous System.

- Central Nervous system
- Peripheral Nervous system
- Autonomic Nervous system

7. Name the parts of the Central Nervous system. How are they protected? ★

- Central Nervous system consists of the Brain and the Spinal cord.
- They are protected by the skull and the vertebral column.

8. What are meninges?

The brain and the spinal cord is covered by **three protective covering** called meninges.

9. What is Corpora quadrigemina?

The dorsal portion of the mid brain consists of **four rounded bodies** called corpora quadrigemina.

10. What is the function of corpora quadrigemina?

Corpora quadrigemina **controls** the visual and auditory (hearing) reflexes.

11. What is brain stem?

Mid brain with hind brain together form the brain stem.

12. What is the function of Cerebral cortex? ★

Sensory perception, control of voluntary functions, language, thinking, memory, decision making, creativity.

13. What is the function of Thalamus?

Thalamus is a major conducting centre for sensory and motor signalling. It acts as a relay station.

14. What is the function of hypothalamus?

Temperature control, thirst, hunger, urination, important link between nervous system and endocrine glands.

15. What is the function of cerebellum?

Maintenance of posture and balance, coordinate voluntary muscle activity

16. What is the function of Pons and Medulla?

Role in sleep-awake cycle, cardiovascular, respiratory and digestive controlling centre.

17. What is filum terminale?

In the posterior end of the spinal cord is a fibrous thread like structure called filum terminale.

18. Classify nerve fibres.

Nerve fibres are of two types based on the presence or absence of myelin sheath.

- **Myelinated nerve fibre:** The axon is covered with myelin sheath
- **Non-myelinated nerve fibre:** The axon is not covered by myelin sheath.

Myelinated and non-myelinated nerve fibres form the white matter and grey matter of the brain.

19. What is conditioned reflex?

- Conditioned reflexes is also called **Acquired reflex**.
- These reflexes are the result of practice and learning.
- Playing harmonium by striking a particular key on seeing a music note is an example of conditioned reflexes which requires conscious training effort.

20. Write a short note on cerebellum.

- It is second largest part of the brain formed of **two** large sized hemispheres and middle vermis.
- It coordinates voluntary movements and also maintains body balance.

21. Meningitis – write notes. ★★

- Meningitis is an inflammation of the meninges.
- It can occur when fluid surrounding the meninges become infected the most common causes of meningitis are viral and bacterial infections.

22. Which food determines our brains integrity and ability? What are the sources of those food?

- The most crucial molecules that determine brains integrity and ability are Essential Fatty Acids (EFAS).
- EFAS cannot be synthesized and must be obtained from food.
- Fish, green vegetables, almond, walnut are rich sources of EFAS.

23. What are called Neurotransmitters? ★

- Neurotransmitters are the **chemicals** which allow the transmission of nerve impulse from the **axon** terminal of one neuron to the **dendron** of another neuron or to an effect or organ.
- The important neurotransmitter released by neurons is called **Acetylcholine**.

24. E.E.G – Give the importance of it in the medical world

- Electro encephalogram (EEG) is an instrument which records the **electrical impulses** of brain.
- An EEG can detect abnormalities in the brain waves and help in diagnoses of seizures, epilepsy, brain tumors, head injuries.

25. Which type of reflex action is yawning? Why?

- Yawning is a simple or basic reflex action.
- These reflexes are inbuilt and unlearned responses.
- We perform these actions without thinking.

VIII. Differentiate between

1. Cranial nerves and spinal nerves .

S.No.	Cranial nerve	Spinal nerve
1.	There are **12 pairs** of cranial nerves.	There are **31 pairs** of spinal nerves.
2.	Eg: Optic nerves of eye, eye muscles, muscles of iris and tear gland.	Eg: Dorsal and ventral root of spinal cord.

IX. Long answer questions:

1. List out the functions of various parts of the brain. ★★

Overview of brain functions	
Cerebral cortex	Sensory preception, control of voluntary functions, language, thinking, memory, decision making, creativity
Thalamus	Acts as relay station
Hypothalamus	Temperature control, thirst, hunger, urination, important link between nervous system and endocrine glands
Cerebellum	Maintenance of posture and balance,coordinatevoluntary muscle activity
Pons and medulla	Role in sleep-awake cycle, cardiovascular, respiratory and digestive control centers

2. How are Neurons classified according to the functions?

On the basis of functions neurons are categorised as:

- Sensory or afferent neurons which carry impulses from the sense organ to the central nervous system.
- Motor or efferent neurons which carry impulses from the central nervous system to effector organ such as the muscle fibre or the gland.
- Association neurons conduct impulses betweeen sensory and motor neurons.

3. Describe the structure of cerebrum. ★★

- It is the **largest portion** forming nearly two-third of the brain.
- The cerebrum is longitudinally divided into two halves as right and left cerebral hemispheres by a deep cleft called median cleft.
- Two cerebral hemispheres are interconnected by **thick band of nerve fibres** called corpus callosum.
- The outer portion of each cerebral hemisphere is formed of **grey matter** and is called cerebral cortex.
- The inner or deeper part is formed of **white matter** and is called cerebral medulla.
- The cortex is extremely folded forming elevations called **gyri** with depressions between them termed as sulci that increase its surface area.
- Each cerebral hemisphere is divisble into a frontal lobe, a parietal lobe, a temporal lobe and an occipital lobe.

- These lobes are also known as **cerebral lobes** and are associated with specific functions.
- Any damage in specific lobe in turn affects its function.

4. Name the fluid which protects the brain. Write its functions.

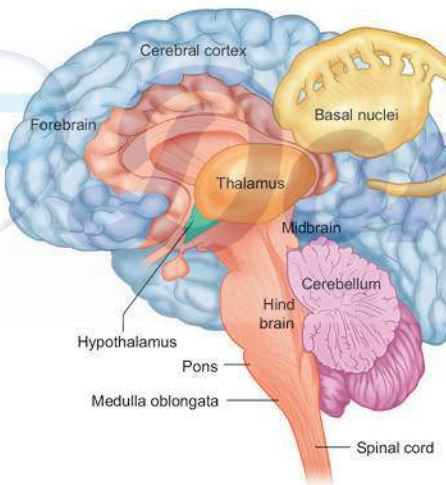
- The brain is suspended in a **special fluid** environment called cerebrospinal fluid (CSF).
- It is lymph like, watery fluid that surrounds and protects the brain within the skull.
- It also fills the central canal of the spinal cord.

Functions:

- It acts as shock absorbing fluid and protects the brain from damage when it is subjected to sudden jerk.
- It supplies nutrients to the brain.
- It collects and removes wastes from the brain.
- It is also responsible for maintaining a constant pressure inside the cranium

5. Draw the diagram of structure of brain and label the following parts.

a) Cerebral cortex **b) Thalamus**
c) Cerebellum **d) spinal cord**
e) Medulla oblongata



Structure of Brain

Unit Test - 15

Nervous System

Time : 1 hr **Marks : 30**

I. Choose the most suitable answer and write the code with the corresponding answer. 5 × 1 = 5

1. Dendrites transmit impulse _____ cell body and axon transmit impulse _____ cell body.
   a) away from, away from b) towards, away from
   c) towards,towards d) away from, towards
2. Vomiting centre is located in
   a) medulla oblongata b) Stomach
   c) cerebrum d) hypothalamus
3. Nerve fibre in which axon is covered by myelin sheath.
   a) Myelinated b) Non myelinated c) Efferent d) afferent
4. The sensory organs contain _____
   a) Unipolar b) Bipolar c) Multipolar d) Medullated
5. One of the following is a part of the brain stem.
   a) Fore brain and mid brain b) Mid brain and hind brain
   c) Fore brain and hind brain d) Fore brain and spinal cord

II. Answer the following questions in one or two lines. 5 × 2 = 10

1. Define stimulus.
2. What are the structures involved in the protection of brain?
3. Write a short note on cranial nerves.
4. What is conditioned reflex?
5. Differentiate betweenMedullated and non-medullated nerve fibre.

III. Answer the following questions in brief. 2 × 4 = 8

1. i) What is conditioned reflex?
   ii) Differentiate Medullated and non-medullated nerve fibre.
2. i) Write a short note on spinal nerves.
   ii) What is neuroglia?

IV. Answer the following questions in detail. 1 × 7 = 7

1. i) What are multipolar neurons?
   ii) Describe the structure of spinal cord.