7 Nervous System

Learning objectives

This chapter aims at facilitating students to

1. understand the human Nervous System.
2. understand the structure and functions of the neuron.
3. understand the important parts of the brain and the spinal cord.
4. understand the functions of the endocrine glands.
5. understand the behavioural implications of the endocrine functioning.

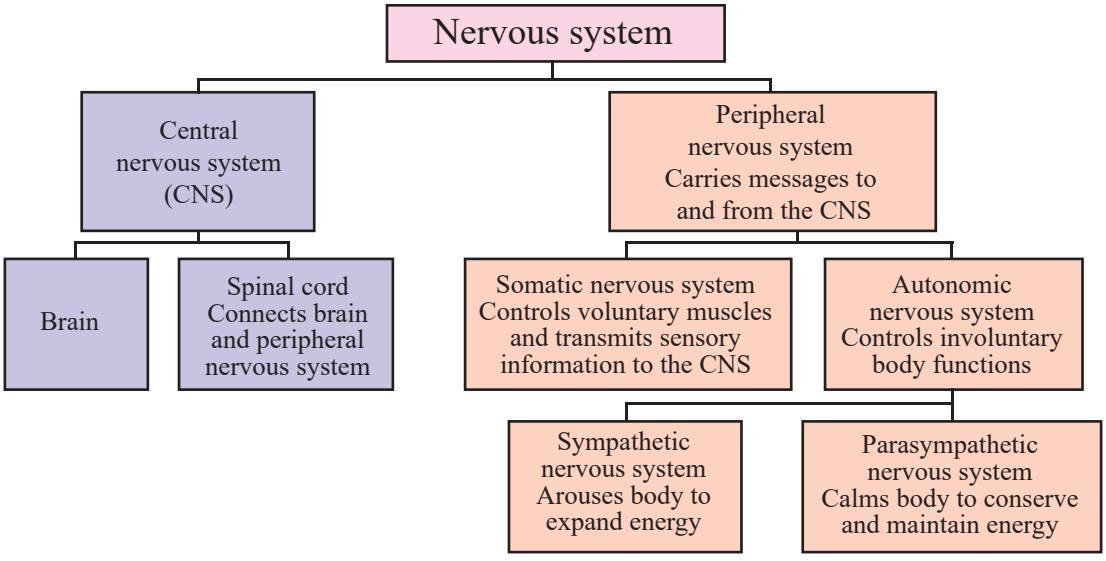

Fig. 7.1 Nervous system

7. 1 Nervous system

Nervous system is the complex network of neurons that carry signals from brain to body and body to brain. Human nervous system is most complicated yet highly developed among all living creatures.

Our nervous system consists of two major parts and the division of the nervous system is as follows :

Central Nervous System and Peripheral Nervous System.

Central Nervous System consists of Brain and Spinal Cord. We will discuss it later on.

Peripheral Nervous System consists of Somatic and Autonomic Nervous System.

Somatic Nervous System is further divided into sensory and motor system of the body. Somatic Nervous System consists of sensory nerves (afferent nerves) and motor nerves (efferent nerves). Sensory nerves sends messages from body to brain and motor nerves messages from brain to body.

Autonomic Nervous System is further divided into Sympathetic and Parasympathetic Nervous System.

Autonomic Nervous System controls internal activities of human body including heart rate, breathing, digestion, disposal of waste products and toxins.

Sympathetic nervous system prepares our body to face stressful and threatening situations. It prepares us for "flight or fight" reaction. For example : when you are chased by a dog, that time your heart beat, palpitation increases and you start sweating. The job of the system is just opposite to it's name.

Parasympathetic Nervous System takes over when the situation becomes normal. When this system takes over, your heart rate, palpitation and sweating becomes normal. We regain our cool and composed state. It directs our body to store energy for emergencies.

Activity 1 :

Few activities are given below. Identify the system which dominates during these activities.

1. Picking up an object from the ground.
2. Shivering when we sense danger.
3. Feeling composed when we feel safe.
4. Increase in heart rate when we sense that we are going to meet with an accident.

Before discussing about Central Nervous System, we have to first introduce ourselves with basic unit of nervous system, that is Neuron. Neurons are the " Building Blocks" of nervous system.

7.1.1 Neuron

When a person sees a tiger, the image of the tiger falls on his retina and is further convert into electrical signals.

This electrical signal reaches the brain with the help of optic nerve. The brain identifies the image as Tiger which is ferocious animal. When this message reaches to the particular part of brain, brain sends message to run away and to execute this, neural message will be sent to his legs. These are specialized network of cells that transmits messages from brain to body and from body to brain. These cells are known as neurons. Neuron consists of Dendrites, Axon, Cell body and Terminal Button or Telodendria. Cell body is the body of neuron. Nucleus of the neuron absorbs the food and keep the cell alive. The neural message comes in through the dendrites which are branches like structure of the neuron. The neural message goes out from Axon of the neuron. At the end of Axon there are end buttons, it is a bulb like structure which contains chemicals called as **neurotransmitters**. Neuro transmitters are the chemical messengers. The neural message jumps across the synapse in order to reach to dendrite of another neuron. When the neural message is passing through, it excites or inhibits the neurotransmitter in it. This chemical reaction decides our reaction to various situations of our life.

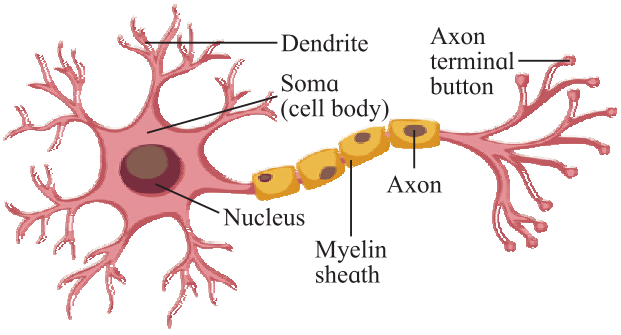

Fig. 7.2 Neuron

7.1.2 Synapse

Is a gap between two neurons. When neural message passes from end buttons to dendrite of another neuron, it has to cross this chemical gap. As neurons are not directly connected to each other, we don't have fixed reactions to every situation. We get various reactions to variety of situations. From here, we get observable reactions.

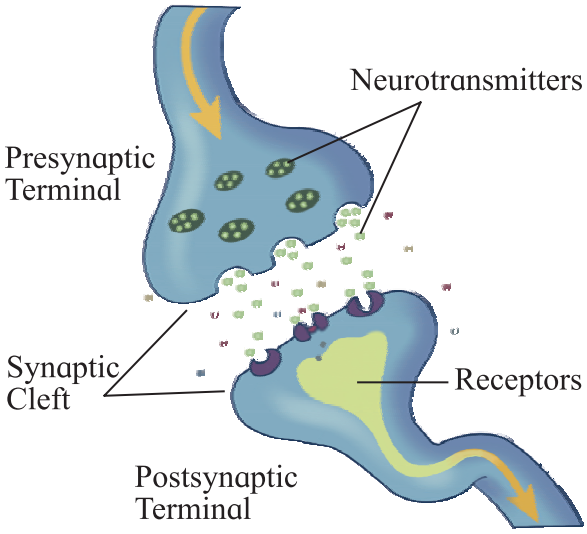

Fig. 7.3 Synapse

7.1.3 Neurotransmitters

We have already learnt about neurotransmitters.

The important neurotransmitters are-

1. Acetylcholine :

It is a chemical that motor neurons of nervous system releases to activate muscles.

2. Dopamine :

It is released by the brain which plays a number of roles. If the level of dopamine is normal, we experience happy, pleasant feeling. It also plays important role in motivational process.

3. Norepinephrine :

It increase force of skeletal muscles especially during fight or flight response.

4. Serotonin :

It plays a role mainly in cognition, reward, learning, memory and also controls wakefulness, sleep, hunger, thirst, liking.

5. Glutamate :

It helps in learning, memory and maintaining sugar level.

6. GABA (Gama Amino Butyric Acid) :

If it is less, it leads to convulsions and body cannot control body movements.

It is chief inhibitory neurotransmitter i.e. it's principal role is to reduce excitability of neurons throughout the nervous system.

After knowing about the basic structure of nervous system, let us now move to Central Nervous System. Central nervous system includes Brain and Spinal Cord.

As you might have realized by now, study of Psychology can't be completed without studying brain. Our brain plays important role in whatever we do, and also in higher order mental processes like thinking, reasoning and emotions. In this part, we will look at the basic structure and function of the brain.

7. 2 Brain

Brain helps to adapt to the environment and it tries to analyze, store and synthesize the information it receives. Brain plays important role in every aspect of our lives like decision making, emotional experience and social interactions.

Brain consists of three major parts. Hind brain, Mid brain and Fore brain.

7.2.1 Hind brain

Important parts of hind brain are Cerebellum, Brain stem and Reticular Activation System.

1) Cerebellum :

It consists of two parts and helps in maintaining body posture and body balance. It helps in coordination of the movements.

2) Brain stem :

It is divided into two parts namely Medulla oblongata and Pons.

A) Medulla oblongata :

it is 'vital center' of the brain. As it controls functions as breathing rate, pulse rate, blood pressure and digestion, it receives messages from higher centers of the brain.

Do you know this?

Why are we suppose to wear helmet while riding a bike?

While riding a bike, if someone meets with an accident, the person falls back on his head. Most of the time Hind brain or to be specific Medulla oblongata is damaged which will lead to instant death. So we are suppose to wear helmet while riding a bike.

B) Pons :

It is a bridge between two hemispheres. It sends and receives information from lower parts of the brain. It helps relaying messages between cerebellum and cortex.

3) Reticular Activation System :

This is "Alarm clock" of the body. We are awake before time if we have to catch early morning train. It happens as our reticular activating system elicits this response.

It is also called as Reticular Formation which contains a bunch of neurons and it's main function is to maintain wakefulness, concentration and alertness.

7.2.2 Mid brain

It is a bridge between forebrain and hindbrain. It consists of two parts: superior and inferior Colliculus. Its function is to send information to the upper part of the brain and to control eye movements.

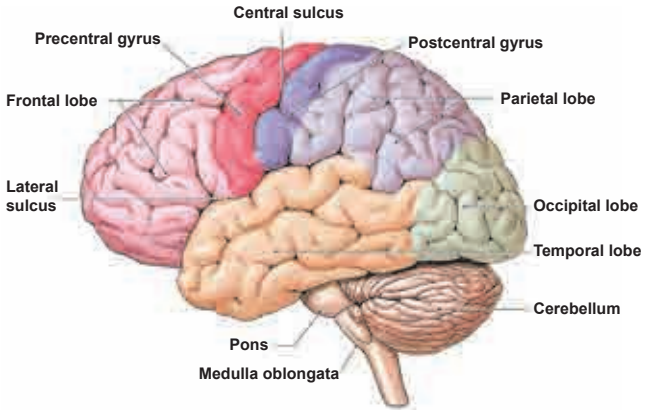

Fig. 7.4 Human Brain

7.2.3 Fore brain

The main parts are

Cerebrum :

It is the largest part of the brain. It's outside cover is of grey colour and is called as cerebral cortex. Cerebral cortex controls higher order menal processes such as attention, perception, learning, memory. The surface of cerebral cortex is divided into two halves: right hemisphere and left hemisphere. Neurons from right hemisphere controls left side of body and vice versa. Left hemisphere controls language, spatial relation and pattern recognition. They are connected by bundle of fibres called as corpus callosum.

Try this

We have neurons which jump across the hemisphere and controls another part of the body. If a person's right side of the body is paralyzed, nurons from the left side of his body stop functioning and the person becomes handicapped even if he has another set of healthy neurons in the other side of his body. If we train ourselves to use both parts of our body equally, we will not be dependent on others for help even if we get paralysis attack. So try to use both sides of your body while performing daily routine tasks like brushing teeth, combing hair etc.

Each hemisphere is divided into four lobes.

1) Frontal lobe :

It controls motor actions, thinking, memory and reasoning. It has Broca's area which helps us in speech production.

2) Parietal lobe :

It helps us in understanding information regarding skin like touch, pressure, pain and temperature.

3) Occipital lobe :

It controls our vision. It is visual processing center. It controls sense of hearing, smell and taste. It has Wernicke's area which helps in understanding of language.

4) Temporal Lobe :

Just above the ears, in the cortex is temporal lobe. Hearing, understanding language, memory for language take place because of temporal lobe.

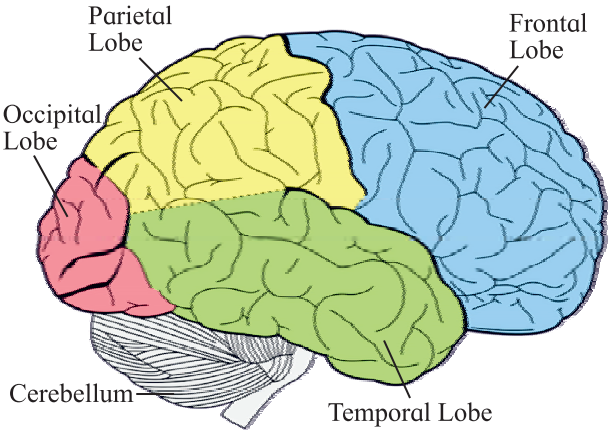

Fig. 7.5 Human Brain Lobes

7.2.4 Limbic System :

Another important part of the brain is limbic system. Parts of limbic system are

a) Hippocampus :

This is storage of our long term memories. If a person gets Alzheimer's disease, his hippocampus is mainly affected.

b) Amygdala :

It stores emotional memories of our experiences. We experience emotions due to this part, especially fear.

c) Thalamus :

It is called as relay station of the brain. It receives all the information from the body and sends it to various parts of brain.

d) Hypothalamus :

It controls major bodily needs like hunger, thirst, sex and temperature regulation and sleep. (Primary needs of any individual). It is also called as the pleasure center of our body.

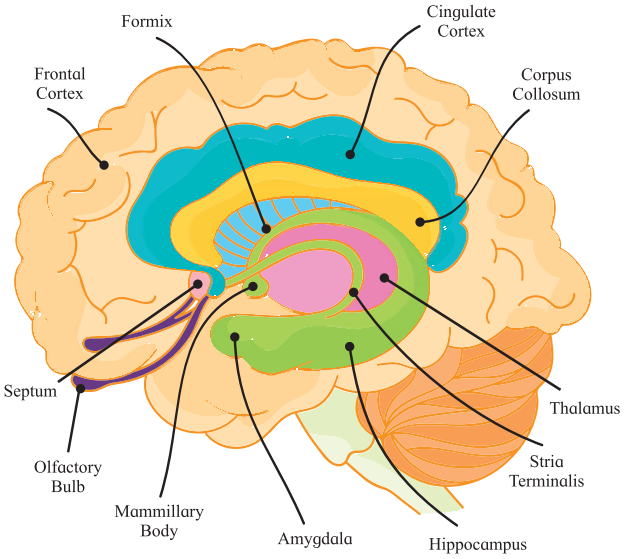

Fig. 7.6 Limbic System

7.2.5 Pillars of better brain functioning

1. Physical and mental exercise :

People who exercise regularly have lower risk of developing Alzheimer's disease. Exercise improves blood flow and memory. It also stimulates chemical changes in the brain that improves learning, mood, and thinking.

2. Brain and nutrition :

Nutrition plays important role in brain functioning. Nutritional deficiency may lead to some neurological problems so understanding the need of nutrition for brain is essential.

Human brain consumes enormous amount of energy. Despite representing only 2% of body's total mass, human brain consumes 20% of body's total energy because of increased metabolic need of human beings. As evolution took place, human life became more complicated and demanding. As a result, need for nutrition by the brain kept on increasing to face these challenges.

Nutrition plays important role during developing years so to optimize the functions of brain. It is also essential during old age to avoid degeneration of cells. Nutrition for brain will enhance brain functioning. It will prevent as well as help in treating neurological disorders.

Today human brain is exposed to high level of stress which results in the process called as oxidation. Any food which is high in Antioxidants like almonds, dark chocolate, onions, berries, mangoes, sea food can help to control ill effects of oxidation.

3. Tackle your medical problems :

Hypertension, diabetes, obesity, depression, head trauma, higher cholesterol and smoking increases the risk of dementia. You can control and reduce these risks by going for regular health check ups and taking medication whenever necessary.

4. Sleep & Relaxation :

Sleep energizes the brain, improves mood and immune system by clearing wastage and toxins from the body. This may reduce abnormal protein of the brain called beta-amyloid plaque, which is related to Alzheimer's disease. Practicing meditation and managing stress will help to control age-related decline in brain health.

5. Mental Fitness :

Brain exercises improve your brain's functioning and promote new brain cell growth, decreasing chances of developing dementia. A person can keep his brain simulated by solving puzzles, problems, watching stimulating movies, by thinking about different issues or by learning something new.

6. Social Interaction :

Spending time with others, participating in stimulating conversation, and staying in touch and connected with family and friends is good for your brain health. Studies have shown that those who interact more with others show less decline in their memory.

After brain, let us discuss about Spinal cord

7. 3 Spinal Cord

It is second important part of the central nervous system. It extends from neck to waist. It's main function is to send information from brain to body and from to body to brain and to control reflex actions like salivation, knee jerk, blinking of eyes etc. **Reflex action is an involuntary and nearly instantaneous movement in response to stimulus.** Spinal cord is connected to the periphery through 31 pairs of spinal nerves. Each spinal nerve is joined to spinal cord through two routes: dorsal and ventral route. If dorsal routes are injured we will not have sensations and if ventral routes are injured, we will not be able to move our body and control reflex actions also. These are quick and simple patterns of behaviour without the involvement of brain. For example: knee jerk, sneezing, blinking of eyes.

Activity 2 :

Think of the following actions. Which of them would be reflex actions and which of them will not be reflex actions?

1) Throwing a ball in a cricket match.
2) Closing the eyes if someone brings a finger too close to them.
3) Removing the hand when you accidently touch a thorn.
4) Immediate movement of the knee when tapped just below it.
5) Touching a hot object and pulling back your hand.

7.4 Glands

You must be aware of the physical and psychological changes you are experiencing at the stage of puberty. For boys, your body mass increases, facial hair, pubic hair develop, your voice become hoarse. In case of girls, your body structure changes, pubic hair develop, mood swings occur and you experience your first menarche. Both sexes, develop curiosity and liking towards opposite sex. You can't understand these changes and as a result, you may find it difficult to adjust with them. There is lack of concentration and mood swings occurring along with these changes. You are aware of these facts that these changes are taking place due to glandular system of your body.

So now you may be curious to know about the glands .

Glands are specialized groups of cells or organs that secrete chemical substances. There are many glands and they all fall into two categories : endocrine and exocrine.

7.4.1 Exocrine Glands

Exocrine glands directly release their secretions into the organ or tissue. Exocrine glands have separate ducts for it's secretion. Therefore they are also called as duct glands. For example : sweat gland, tear gland etc.

7.4.2 Endocrine Glands

Endocrine glands secrete chemical substances into the bloodstream. They are called as ductless gland as they don't have separate duct.

The chemical substances secreted by endocrine glands are called hormones. Hormones are like messengers that are responsible for certain behaviours or absence of reactions.

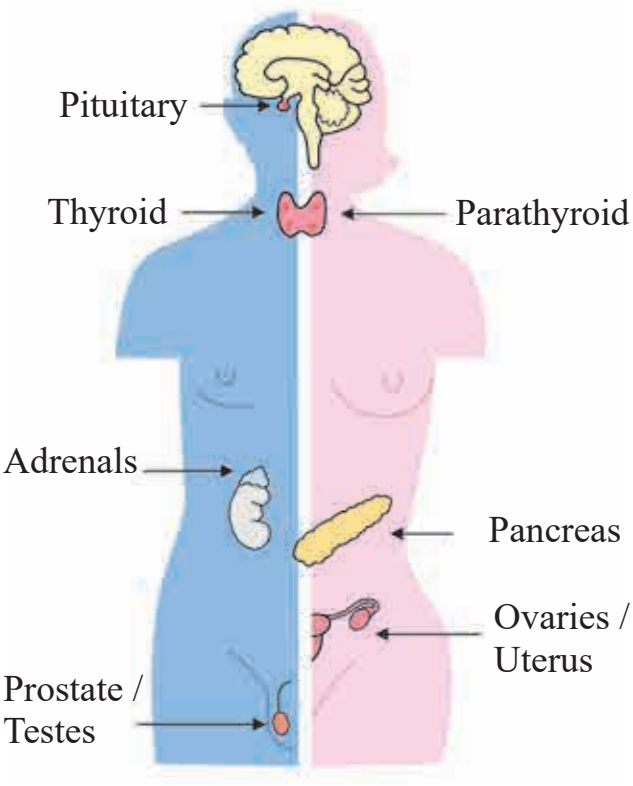

Fig. 7.7 Endocrine Glands

Name of Gland	Hormone	Function/Effects	Hypersecretion	Hyposecretion
1) PITUITARY (a) ANTERIOR LOBE : It is also called as master gland as it helps other glands to produce their secretions and secretes majority of hormones.	Somatotropin, Growth Hormone, Adrenocortico-tropic Hormone.	1) Helps growth of the body 2) Helps adrenal gland 3) Required for nourishment of foetus.	1) Gigantism - person becomes very huge 8-9 feet tall. 2) Acromegaly - the person has features of chimpanzee, large bones, big face with huge jaw, very long hands with long fingers	1) Dwarfism- a person is very short 2-3 feet tall but with normal intelligence.
(b) POSTERIOR LOBE	Oxytocin Pituitrin Thyrotrophic Follicle stimulating Luteinizing hormone Endorphins	Creates feeling of happiness, helps smooth muscle functioning of stomach helps thyroids Helps nourishment of fetus Helps to create neurotransmitters		
2) Thyroid	Thyroxin	Maintains rate of metabolism	Grave's disease- person loses his weight, irritated mood, sleeplessness and sweating palms,	1) Cretinism among children- the child is mentally and physically slow 2) Myxedema among adults - a person becomes very huge, lacks motivation and energy, complains about weakness

Name of Gland	Hormone	Function/Effects	Hypersecretion	Hyposecretion
3) Parathyroid	parathyroxin	Maintains calcium and phosphate balance	Person feels nauseated, vomiting sensation, feels sleepy and relaxed.	Person lacks motivation, energy, weakness and muscle cramps, spasms.
4) Adrenal (cortex)	Cortin or cortisone	Maintains level of water, sugar and sodium	Increase in sexual drive, females start looking like males, heavy bones, moustache, hoarse voice.	Very lazy, lacks sexual drive and hunger, weight loss.
(medulla)	Adrenalin (fear) Noradrenaline (anger)	Plays important role in emotional excitement	Increase in heart beat, blood pressure and breathing rate.	
5) Gonads (sex gland) (a) Testes in males	Androgen and testosterone	Secondary sex characteristics in males, voice becomes hoarse. They get moustache and beard.	Development of bones and muscles, tendency towards sexual behaviour, very energetic and aggressive behaviour.	Males do not have desire for sex, voice remains childlike.
(b) Ovaries in females	Estrogen and progesteron	Secondary sex characteristics in females, feminine looks develop, menarche starts.		
6) pancreas	Insulin and glycogen	Maintains blood sugar level	Reduces blood sugar. Hyperglycaemia, person lacks energy and motivation, may faints and go to coma.	Person gets diabetes, quite hungry, very tired, restless and irritated behaviour, frequent and uncontrolled urination.

Summary :

- Human behaviour can not be understood without the study of the nervous system. The nervous system is subdivided into Central and Peripheral Nervous System. The CNS consists of Brain and the Spinal Cord. The brain consists of the fore brain, mid brain and the hind brain.
- The PNS includes the Somatic and the Autonomic Nervous System (ANS)
- The Autonomic Nervous System consists of Sympathetic and Parasympathetic Nervous System.
- Glands are of two types: Exocrine and Endocrine glands.
- Endocrine glands secrete vital chemical substances called hormones. There is a strong impact of the hormones upon human behaviour.

Key Terms :

- Nervous System
- Neuron
- CNS
- PNS
- Cerebral Cortex
- Frontal lobe
- Parietal lobe
- Temporal lobe
- Occipital lobe
- Midbrain
- Superior Colliculus
- Inferior Colliculus
- Hind brain
- Hypothalamus
- Hippocampus
- Amygdala
- Pons
- Spinal cord
- Exocrine glands
- Endocrine glands
- Hormones

Exercise

Q. 1. (A) Complete the following statements with appropriate options.

1. Brain is a part of ..... nervous system.

   a. Central *b. Peripheral*

   c. Somatic

2. ..... are the building blocks of the nervous system.

   a. Cells *b. Neurons*

   c. Tissues

3. ..... nervous system prepares us for the fight or flight responses.

   a. Somatic *b. Parasympathetic*

   c. Sympathetic

4. The gap between two neurons is called .....

   a. Synapse *b. Joint*

   c. Vacuum

(B) I. Match the following pairs.

A	B
1. Thyroxin	a) Pituitary
2. Epinephrine	b) Parathyroid
3. Parathormone	c) Thyroid
4. Androgen	d) Adrenal gland
5. Somato tropic hormones	e) Salivary gland
	f) Sex glands

(C) Identify the odd item from the following series of words.

1. Frontal lobe, Parietal lobe, Thalamus, Occipital lobe
2. Dopamine, Serotonin, Norepinephrine, Uric Acid, GABA
3. Dendrite, Nucleus, Tectum, Axon, Synapse
4. Knee jerk, Sneezing, Thinking, Blinking of eyes
5. Thyroid, Sweat glands, Adrenal gland, Gonads, Pituitary gland

(D) Identify which hormones with hypo secretion or hyper secretion would lead to the following conditions.

1. Abnormal height, gigantism
2. Hyper activity, speedy metabolism
3. Cretinism
4. Stunted growth, dwarfism.
5. Myxedema, fatigue, sluggishness, depression
6. Increased appetite, over activity, restlessness, lack of concentration

Q. 2. Which part of the brain is involved in processing the following information.

1. Smelling a flower
2. Maintaining balance while standing upright
3. Comprehending a speech
4. Memorizing a childhood experience
5. Feeling touch
6. Seeing a picture
7. Feeling hungry
8. Feeling afraid

Q. 3. Answer the following questions in 35 to 40 words.

1. Explain the functions of hypothalamus.
2. Describe the functions of each of the four lobes.
3. Explain the functions of: Amygdala and Hippocampus.
4. What is a synapse? How does a nerve impulse travel from one to another neuron?
5. Which are the important parts of the hind brain? Explain their functions.
6. How do endocrine glands affect our behaviour?

Q. 4. Write short notes.

1. Autonomic Nervous System
2. Limbic System
3. Neurotransmitters
4. Pituitary gland

Q. 5. Compare and contrast.

1. Sympathetic Nervous System and Parasympathetic Nervous System
2. Exocrine glands and Endocrine glands

Q. 6. Answer in 150 to 200 words.

1. Explain the functions of various parts of the human brain.
2. Explain the significance of endocrine glands in human behaviour.

   State the functions of any five endocrine glands in detail.