MODEL QUESTION AND ANSWER

SUBJECT- HAP-II

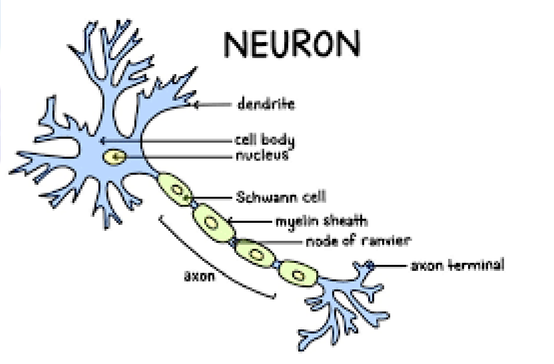
UNIT- 1

10 Marks

1. Describe the structure of neuron with a neat and labelled diagram. And write a short note on action potential.

A **neuron** is the structural and functional unit of the nervous system. It is a specialized cell responsible for transmitting nerve impulses. A neuron consists of the following parts:

1. **Cell Body (Soma or Perikaryon):**
   - Contains the nucleus and cytoplasm with organelles like Nissl bodies (rough endoplasmic reticulum and ribosomes).
   - Responsible for the metabolic activities of the neuron.
2. **Dendrites:**
   - Short, branched extensions arising from the cell body.
   - Receive impulses from other neurons and transmit them to the cell body.
3. **Axon:**
   - A long, single extension that conducts impulses away from the cell body.
   - Surrounded by myelin sheath (formed by Schwann cells in the PNS and oligodendrocytes in the CNS) which increases the speed of impulse conduction.
   - Contains **Nodes of Ranvier**, which are gaps in the myelin sheath that facilitate saltatory conduction.
4. **Axon Terminals:**
   - The branched end of the axon that forms synapses with other neurons or effector organs.
   - Releases neurotransmitters to transmit signals.



Action Potential

An **action potential** is a rapid, temporary change in the electrical membrane potential of a neuron, allowing it to transmit signals. It occurs due to the movement of ions across the neuron's membrane.

Phases of Action Potential

1. **Resting Membrane Potential (-70 mV)**
   - The neuron is at rest with a **negative charge inside** and a **positive charge outside**.
   - Maintained by the **Na^+/K^+ pump** (3 Na^+ out, 2 K^+ in).
   - Inside the neuron: High K^+, low Na^+.
   - Outside the neuron: High Na^+, low K^+.
2. **Depolarization (Up to +40 mV)**
   - A stimulus triggers **voltage-gated Na^+ channels** to open.
   - Na^+ rushes into the neuron, making the inside more **positive**.
   - Membrane potential moves from -70 mV to **+40 mV**.
3. **Repolarization (Back to -70 mV)**
   - Na^+ channels **close**, and **K^+ channels open**.
   - K^+ moves **out** of the neuron, restoring the negative charge inside.
4. **Hyperpolarization (-90 mV, Temporary)**
   - K^+ channels **stay open longer**, causing the membrane potential to become more negative than resting potential.
   - Na^+/K^+ pump restores the resting membrane potential to -70 mV.

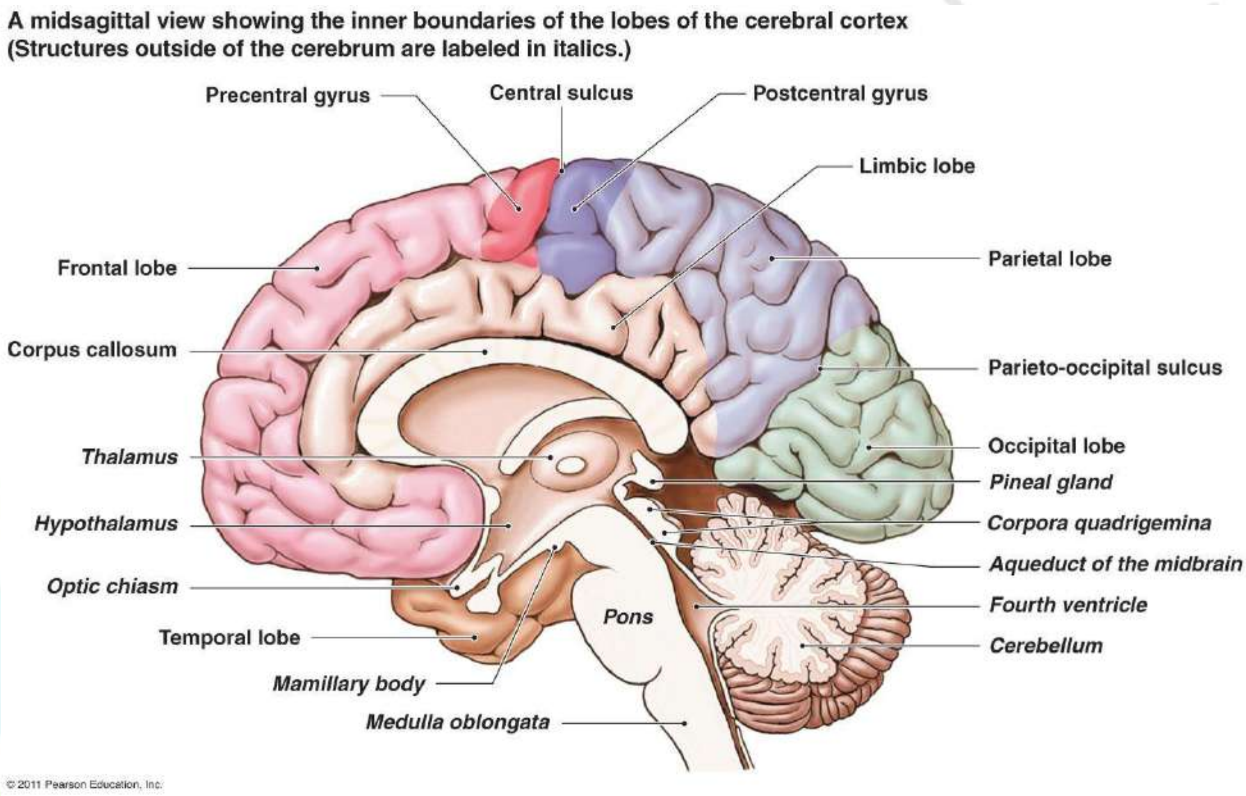
Clinical Importance

- Local anesthetics (e.g., lidocaine) block Na^+ channels, preventing action potentials → No pain transmission.
- Neurological disorders like multiple sclerosis involve myelin loss, slowing action potential conduction.

2. Discuss the structure and function of brain with a neat labelled diagram.

Structure and Function of the Brain

The **brain** is the control center of the body, responsible for processing sensory information, regulating bodily functions, and enabling cognition and emotions. It is divided into **three major parts**: the **forebrain, midbrain, and hindbrain**.



1. Structure of the Brain

A. Forebrain (Prosencephalon)

The largest and most developed part of the brain, responsible for higher cognitive functions. It includes:

i. Cerebrum

- Largest part of the brain, divided into **two hemispheres** (left and right).
- Surface has folds called **gyri** and grooves called **sulci** to increase surface area.
- Divided into **four lobes**:

Lobe	Function
Frontal Lobe	Controls reasoning, problem-solving, motor control, emotions, speech (Broca's area)
Parietal Lobe	Processes sensory input (touch, pain, temperature), spatial awareness

Lobe	Function
Temporal Lobe	Controls hearing, memory, language comprehension (Wernicke's area)
Occipital Lobe	Processes visual information

ii. Thalamus

- Relay centre for sensory signals (except smell) to the cerebral cortex.

iii. Hypothalamus

- Regulates **hormones, temperature, hunger, thirst, and autonomic functions**.
- Controls the **pituitary gland**, linking the nervous and endocrine systems.

iv. Limbic System

- Includes the **amygdala** (emotion, fear) and **hippocampus** (memory formation).

B. Midbrain (Mesencephalon)

- Located between the forebrain and hindbrain, responsible for **reflexes and motor movement**.
- Contains:
  - **Superior colliculi** (visual reflexes).
  - **Inferior colliculi** (auditory reflexes).
  - **Substantia nigra** (produces dopamine, affected in Parkinson's disease).

C. Hindbrain (Rhombencephalon)

Controls **basic life functions** like breathing and heart rate. Includes:

i. Cerebellum

- Coordinates **balance, posture, and motor learning**.

ii. Pons

- Connects different parts of the brain and helps in **breathing and facial movements**.

iii. Medulla Oblongata

- Controls **heart rate, blood pressure, breathing, and reflexes (coughing, sneezing, swallowing)**.

2. Functions of the Brain

Function	Associated Brain Part
Sensory processing	Thalamus, Parietal lobe
Motor control	Frontal lobe, Cerebellum
Memory formation	Hippocampus
Emotions and behavior	Limbic system, Amygdala
Hormonal regulation	Hypothalamus, Pituitary gland
Breathing and heartbeat	Medulla oblongata
Speech and language	Broca's area (speech production), Wernicke's area (comprehension)

Conclusion

The brain is a **highly specialized** organ that integrates sensory input, controls movement, maintains homeostasis, and enables thinking and emotions. Its complex structure allows humans to perform **both basic survival functions and higher cognitive tasks**.

3. Explain in detail about the gross structure and function of spinal cord.

Spinal Cord

The **spinal cord** is a cylindrical structure extending from the brainstem (medulla oblongata) to the lower back, acting as a communication link between the brain and the rest of the body. It is enclosed within the **vertebral column** and surrounded by meninges and cerebrospinal fluid (CSF) for protection.

Gross Structure of the Spinal Cord

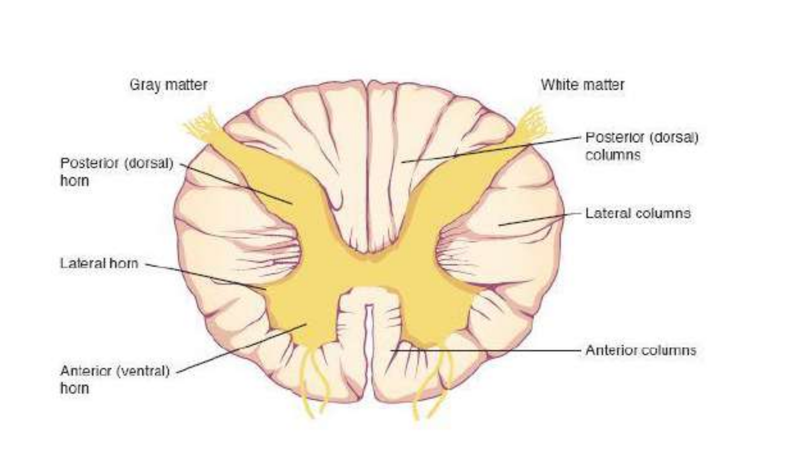
A. External Features

- Extends from the **medulla oblongata** to the **L1-L2 vertebral level** in adults.
- Ends at the **conus medullaris**, from which the **cauda equina** (bundle of nerve roots) continues.
- Protected by **vertebrae, meninges (dura mater, arachnoid mater, pia mater), and CSF**.
- Has **31 pairs of spinal nerves** that emerge through intervertebral foramina.

B. Internal Structure

The spinal cord consists of **gray matter and white matter**.

- **Gray Matter (H-shaped):**
  - Contains **neuron cell bodies**.
  - Divided into:
    - **Dorsal (Posterior) Horn** → Receives sensory input.
    - **Ventral (Anterior) Horn** → Sends motor signals.
    - **Lateral Horn** → Present in **thoracic and upper lumbar** regions (contains autonomic neurons).
- **White Matter:**
  - Composed of **ascending (sensory) and descending (motor) tracts**.
  - Organized into **funiculi** (anterior, lateral, and posterior columns).



Transverse section of spinal cord

Functions of Afferent and Efferent Nerve Tracts

A. Afferent (Sensory) Tracts → Carry sensory signals to the brain

Tract Name	Function	Pathway
Dorsal Column (Fasciculus Gracilis & Cuneatus)	Fine touch, vibration, proprioception	Spinal cord → Medulla → Thalamus → Cortex
Spinothalamic Tract (Lateral & Anterior)	Pain, temperature, crude touch	Spinal cord → Thalamus → Sensory cortex
Spinocerebellar Tract	Proprioception (body position)	Spinal cord → Cerebellum

B. Efferent (Motor) Tracts → Carry motor signals from the brain to muscles

Tract Name	Function	Pathway
Corticospinal Tract (Pyramidal Tract)	Voluntary movements	Cortex → Medulla → Spinal cord → Muscles
Extrapyramidal Tracts (Rubrospinal, Vestibulospinal, Reticulospinal)	Posture, balance, muscle tone	Brainstem → Spinal cord → Muscles

Reflex Activity of the Spinal Cord

A **reflex** is an automatic, rapid response to a stimulus, bypassing the brain for quick action. It is controlled by the **reflex arc**, which involves:

1. **Receptor** – Detects stimulus.
2. **Sensory (Afferent) Neuron** – Carries impulse to the spinal cord.
3. **Interneuron (in spinal cord)** – Processes the information.
4. **Motor (Efferent) Neuron** – Sends impulse to the effector.
5. **Effector (Muscle/Gland)** – Carries out the response.

Types of Reflexes

- **Monosynaptic Reflex (Simple Reflex Arc)** → Direct communication between sensory and motor neurons (e.g., **knee-jerk reflex**).
- **Polysynaptic Reflex** → Involves interneurons for more complex responses (e.g., **withdrawal reflex from pain**).

Conclusion

The spinal cord acts as a **relay center** for sensory and motor signals and is essential for **reflex actions**, allowing the body to react quickly to stimuli. Its complex structure ensures **efficient communication between the brain and peripheral nervous system**.

5MARKS

1. Write a short note on meninges of brain.

Meninges of the Brain

The **meninges** are three protective membranes that surround the **brain and spinal cord**, providing support, cushioning, and protection against injury. The three layers of meninges are:

1. **Dura Mater (Outer Layer):**
    - The **thickest and toughest** layer.
    - Has **two layers**:
        - **Periosteal Layer** (attached to the skull).
        - **Meningeal Layer** (forms folds like the **falx cerebri** and **tentorium cerebelli**).
    - Creates **dural venous sinuses** that drain blood from the brain.
2. **Arachnoid Mater (Middle Layer):**
    - Thin, web-like membrane beneath the dura mater.
    - Contains **arachnoid villi**, which absorb **cerebrospinal fluid (CSF)** into venous circulation.
    - Forms the **subarachnoid space**, which contains **CSF and blood vessels**.
3. **Pia Mater (Inner Layer):**
    - **Delicate and vascularized**, closely adheres to the brain surface.
    - Provides nutrients to the brain and spinal cord.

Functions of the Meninges

The **meninges** are three protective membranes (**dura mater, arachnoid mater, and pia mater**) that surround the brain and spinal cord. They perform several essential functions:

1. **Protection of the Brain and Spinal Cord**
    - Act as a **mechanical barrier**, preventing damage from trauma and sudden movements.
    - Contain **cerebrospinal fluid (CSF)**, which cushions the brain.
2. **Cerebrospinal Fluid (CSF) Circulation**

- The **subarachnoid space** (between the arachnoid and pia mater) houses CSF, which nourishes and protects the brain.
- **Arachnoid villi** help in CSF absorption into the venous system.

3. **Blood Supply Regulation**
   - The **pia mater** is rich in blood vessels that supply oxygen and nutrients to the brain and spinal cord.
   - The **dura mater** contains **venous sinuses**, which drain deoxygenated blood from the brain.
4. **Separation and Support**
   - The dura mater forms folds (**falx cerebri, tentorium cerebelli**) that **support and partition** different brain regions.
   - Prevents excessive movement of the brain within the skull.
5. **Prevention of Infections**
   - Acts as a **barrier** against infections, though pathogens can sometimes cross, leading to **meningitis**.

2. Write about the ventricles of brain.

Ventricles of the Brain

The **ventricles** are a system of **four interconnected, fluid-filled cavities** within the brain that produce, circulate, and store **cerebrospinal fluid (CSF)**. These ventricles are lined by **ependymal cells**, which help in CSF production and circulation.

Types of Brain Ventricles

1. **Lateral Ventricles (First and Second Ventricles)**
   - **Largest** ventricles, located in each cerebral hemisphere.
   - Each lateral ventricle has **anterior, posterior, and inferior horns**.
   - Connected to the **third ventricle** via the **interventricular foramen (Foramen of Monro)**.
2. **Third Ventricle**
   - **Narrow cavity** located in the **diencephalon**, between the two halves of the **thalamus**.

- Connected to the **fourth ventricle** via the **cerebral aqueduct (Aqueduct of Sylvius)**.

3. **Fourth Ventricle**
   - Located between the **pons and medulla (anteriorly)** and the **cerebellum (posteriorly)**.
   - Opens into the **subarachnoid space** through the **foramina of Luschka (lateral apertures)** and **foramen of Magendie (median aperture)**.
   - Continuous with the **central canal of the spinal cord**.

Functions of the Ventricular System

- **CSF Production:** Ventricles contain the **choroid plexus**, which produces **cerebrospinal fluid**.
- **CSF Circulation:** CSF flows from the lateral ventricles → third ventricle → fourth ventricle → subarachnoid space → spinal cord.
- **Cushioning and Protection:** CSF **absorbs shock** and protects the brain from trauma.
- **Waste Removal:** Helps remove metabolic waste and maintains the **brain's chemical balance**.

2marks

1. What is Neuroglia?

Neuroglia (Glial Cells)

Neuroglia, **supporting cells** of the nervous system that provide **structural and functional support** to neurons. Unlike neurons, they **do not generate nerve impulses** but are essential for maintaining homeostasis.

Types of Neuroglia:

1. **CNS Neuroglia:**
   - **Astrocytes** – Maintain blood-brain barrier, provide nutrients.
   - **Oligodendrocytes** – Form myelin sheath around CNS neurons.
   - **Microglia** – Act as immune cells, remove debris.
   - **Ependymal Cells** – Produce and circulate cerebrospinal fluid (CSF).
2. **PNS Neuroglia:**
   - **Schwann Cells** – Form myelin sheath around PNS neurons.
   - **Satellite Cells** – Support and nourish neurons in ganglia.

Function: Support, protect, and nourish neurons, aid in myelination, and help in immune defence.

2. Define Electrophysiology.

Electrophysiology

Electrophysiology is the study of the **electrical activity of cells and tissues**, particularly neurons and muscles. It examines **ion movement across membranes**, generating electrical signals like **resting membrane potential (-70 mV) and action potential**.

Applications:

- **EEG (Electroencephalography):** Records brain activity.
- **ECG (Electrocardiography):** Monitors heart electrical activity.
- **EMG (Electromyography):** Measures muscle electrical signals.

3. Define Action Potential.

An **action potential** is a rapid, transient change in the membrane potential of a neuron, allowing it to transmit electrical signals. It involves **depolarization** (Na^+ influx), followed by **repolarization** (K^+ efflux). The process is an **all-or-none response**, meaning the action potential either occurs fully or not at all when the threshold is reached.

It plays a key role in **neural communication**, muscle contraction, and sensory processing.

4. Define Synapse.

A **synapse** is a junction between two neurons or between a neuron and a target cell (e.g., muscle or gland) where **neurotransmitters** transmit signals. It consists of three parts:

1. **Presynaptic Terminal** – Contains neurotransmitters.
2. **Synaptic Cleft** – The small gap between neurons.
3. **Postsynaptic Membrane** – Contains receptors for neurotransmitters.

The synapse allows **chemical transmission of nerve impulses** across the gap, ensuring communication within the nervous system.

6. Define Neurotransmitters.

Neurotransmitters are **chemical messengers** that transmit signals across a synapse from one neuron to another or to a target cell (e.g., muscle or gland). They are released from the **presynaptic neuron** and bind to **receptors** on the **postsynaptic membrane**, triggering a response.

Common neurotransmitters include:

- **Acetylcholine** (muscle contraction, autonomic functions).
- **Dopamine** (mood, movement control, reward).
- **Serotonin** (mood regulation, sleep).

UNIT-II

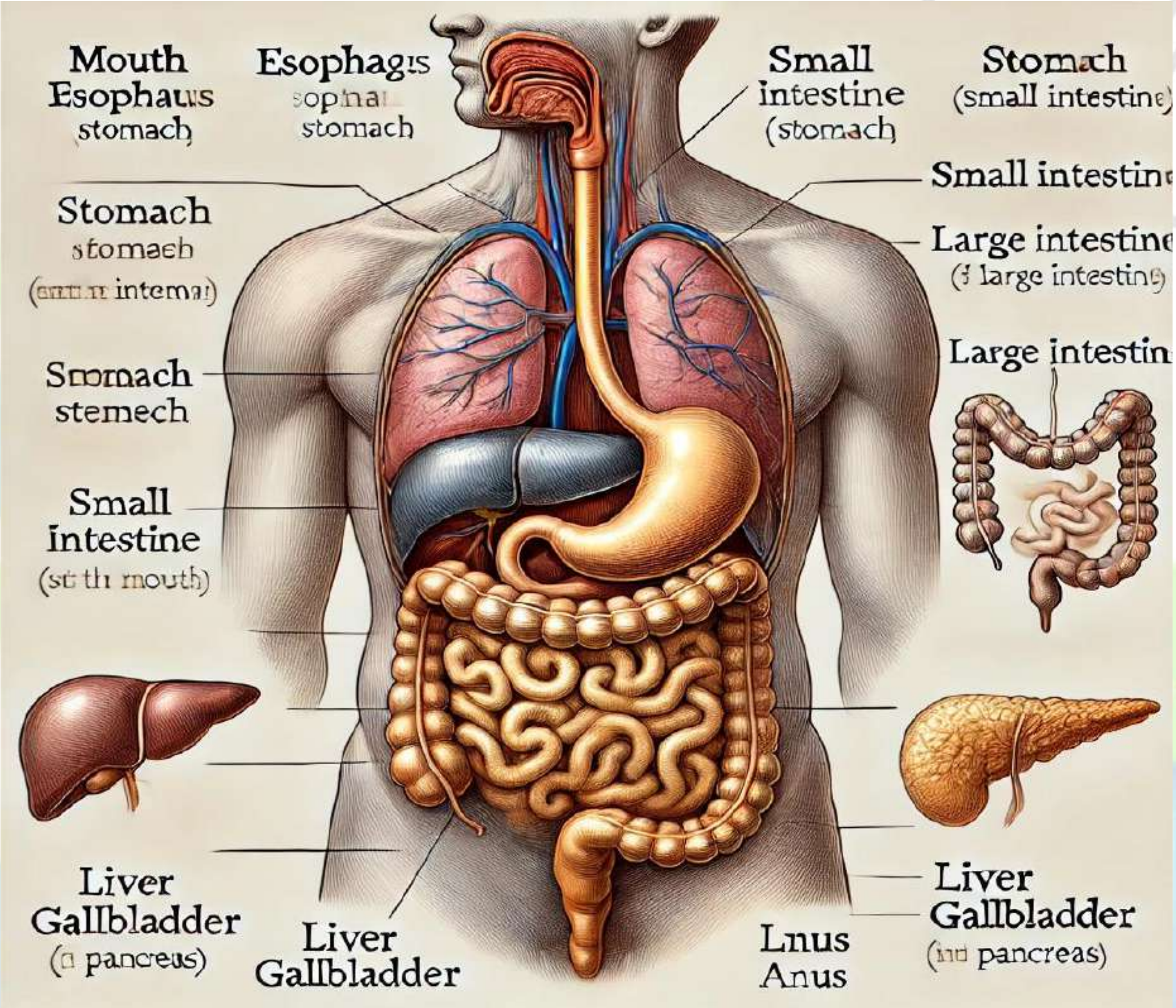
Digestive system

1. **With neat and labeled diagram describe different parts of digestive system. Write the mechanism of acid production. 10 marks**
2. **Describe regulation of acid production through parasympathetic nervous system. 10 marks**
3. **Draw and describe the anatomy of Digestive system. Briefly discuss about the role of pepsin in protein digestion. 10 marks**
4. **Discuss about anatomy and physiology of small intestine and large intestine. 10 marks**
5. **Write a note on anatomy and function of salivary gland. 10 marks**
6. **Write a note on anatomy and function of pancreas. 10 marks**
7. **Discuss about anatomy and physiology of small intestine. 5 marks**
8. **Discuss about anatomy and physiology of large intestine. 5 marks**
9. **Mention the salivary glands. Write the composition and functions of Saliva. 5 marks**
10. **Explain layers of GIT. 5 marks**
11. **Write the exocrine and endocrine secretions of Pancreas. 2 marks**
12. **Write the functions of saliva. 2marks**

ANSWER

1. **With neat and labeled diagram describe different parts of digestive system. Write the mechanism of acid production and regulation. 10 marks**

The digestive system is a complex series of organs and glands designed to convert food into essential nutrients for the body, and then eliminate waste.



Mouth

- Function: The process of digestion begins in the mouth. The teeth break down food into smaller pieces (mechanical digestion), and saliva (containing enzymes like amylase) starts breaking down carbohydrates (chemical digestion).

2. Esophagus

- Function: A muscular tube connecting the throat (pharynx) to the stomach. It moves food through peristalsis (wave-like contractions).

3. Stomach

- Function: The stomach churns food and mixes it with gastric juices (containing hydrochloric acid and digestive enzymes) to break down proteins into smaller particles.

4. Small Intestine (composed of three parts: duodenum, jejunum, ileum)

- Duodenum: The first section where bile and pancreatic juices are added for further digestion.
- Jejunum and Ileum: The primary sites for the absorption of nutrients into the bloodstream.

5. Liver

- Function: Produces bile, which helps digest fats. The liver also detoxifies chemicals and metabolizes drugs.

6. Gallbladder

- Function: Stores and concentrates bile produced by the liver, releasing it into the small intestine when needed for digestion.

7. Pancreas

- Function: Produces enzymes (amylase, lipase, proteases) that aid in digestion and releases them into the small intestine. It also produces bicarbonate to neutralize stomach acid.

8. Large Intestine (Colon)

- Function: Absorbs water, salts, and vitamins from indigestible food matter, and compacts waste into feces. The colon consists of the ascending, transverse, descending, and sigmoid colon.

9. Rectum and Anus

- Function: The rectum stores feces until they are expelled through the anus during defecation.

Acid Production in the Stomach:

- **Hydrochloric Acid (HCl)**:
  - HCl is the main component of gastric acid. It is crucial for breaking down food, killing harmful bacteria, and activating digestive enzymes.

- **Parietal Cells**: Specialized cells in the stomach lining produce HCl. These cells have receptors for various stimuli (hormones and neurotransmitters) that regulate acid secretion.

- **Mechanism of HCl Secretion**:
  - HCl is secreted by the parietal cells in response to stimulation by **histamine, gastrin, and acetylcholine**.
  - **Chloride ions (Cl^-)** and **hydrogen ions (H^+)** are secreted separately. The hydrogen ions (protons) are generated inside parietal cells from the breakdown of carbonic acid (H_2CO_3).
  - An enzyme called **H^+/K^+ ATPase (proton pump)** actively pumps hydrogen ions into the stomach lumen in exchange for potassium ions.
  - Chloride ions follow through chloride channels, and once in the stomach, H^+ and Cl^- combine to form HCl.

2. Describe acid production through parasympathetic nervous system. 10 marks

Or,

Describe three phases of regulation of acid production through PNS. 10 marks

The secretion of gastric acid is tightly regulated by a balance of stimulatory and inhibitory factors:

- **Stimulatory Factors:**
  1. **Gastrin**: A hormone produced by G cells in the stomach in response to food. It stimulates parietal cells to secrete HCl.
  2. **Histamine**: Released by enterochromaffin-like (ECL) cells in response to gastrin and acetylcholine. It binds to H2 receptors on parietal cells, increasing acid production.
  3. **Acetylcholine**: Released by the vagus nerve during the sight, smell, or taste of food, it stimulates both parietal cells directly and indirectly via gastrin and histamine release.
- **Inhibitory Factors:**
  1. **Somatostatin**: Produced by D cells in the stomach, it inhibits the release of gastrin, histamine, and reduces parietal cell acid production.
  2. **Prostaglandins**: Thesehelp protect the stomach lining by reducing acid production and increasing mucus secretion.
  3. **Low pH**: When the stomach pH drops too low (too acidic), feedback mechanisms reduce further acid production, such as reducing gastrin secretion.

1. Cephalic Phase

- **Stimulus**: This phase is triggered by sensory input such as the sight, smell, taste, or thought of food. It prepares the stomach for incoming food even before ingestion.

- **Mechanism**:

  - The **vagus nerve** is activated by sensory stimuli and sends signals to the stomach.

- **Acetylcholine (ACh)** is released, stimulating **parietal cells** to secrete HCl.
- ACh also stimulates **G cells** to release **gastrin** and **ECL cells** to release **histamine**, both of which further enhance acid production.

- **Contribution to Acid Secretion**: The cephalic phase accounts for approximately **30-50%** of the total acid secretion.

2. Gastric Phase

- **Stimulus**: The gastric phase is initiated when food reaches the stomach. The presence of proteins and distension (stretching of the stomach) activates this phase.
- **Mechanism**:
  - Distension of the stomach activates **stretch receptors**, leading to further stimulation of the **vagus nerve**.
  - Protein presence triggers **G cells** to release more **gastrin**, which further stimulates **parietal cells** to produce HCl.
  - Gastrin also increases histamine release from **ECL cells**, amplifying the acid production.
- **Contribution to Acid Secretion**: This phase accounts for approximately **50-60%** of the total gastric acid production.

3. Intestinal Phase

- **Stimulus**: This phase is triggered when partially digested food (chyme) enters the small intestine.
- **Mechanism**:
  - Initially, the presence of digested proteins in the duodenum (first part of the small intestine) can stimulate a small release of **gastrin** from intestinal cells, briefly increasing acid secretion.
  - As the chyme becomes more acidic and passes into the small intestine, the body activates **inhibitory signals** to slow down acid production.
  - **Somatostatin** is released, which inhibits the release of gastrin, histamine, and directly inhibits parietal cells from producing more HCl.
- **Contribution to Acid Secretion**: The intestinal phase only accounts for about **5-10%** of acid secretion, mostly as an inhibitory phase to prevent excessive acid production.

Protective Mechanisms:

The stomach has several mechanisms to protect itself from the corrosive effects of acid:

- **Mucus**: A thick mucus layer coats the stomach lining, preventing acid from damaging the cells.
- **Bicarbonate**: Secreted along with mucus, it helps neutralize any acid that comes in contact with the stomach lining.
- **Tight Junctions**: Cells lining the stomach have tight junctions to prevent acid from leaking into deeper tissues.

  Disturbances in acid regulation can lead to conditions like **gastritis**, **acid reflux**, or **peptic ulcers**, where the stomach lining is damaged due to excessive acid production or weakened defense.

3) Draw and describe the anatomy of Digestive system. Briefly discuss about the role of pepsin in protein digestion. 10 marks

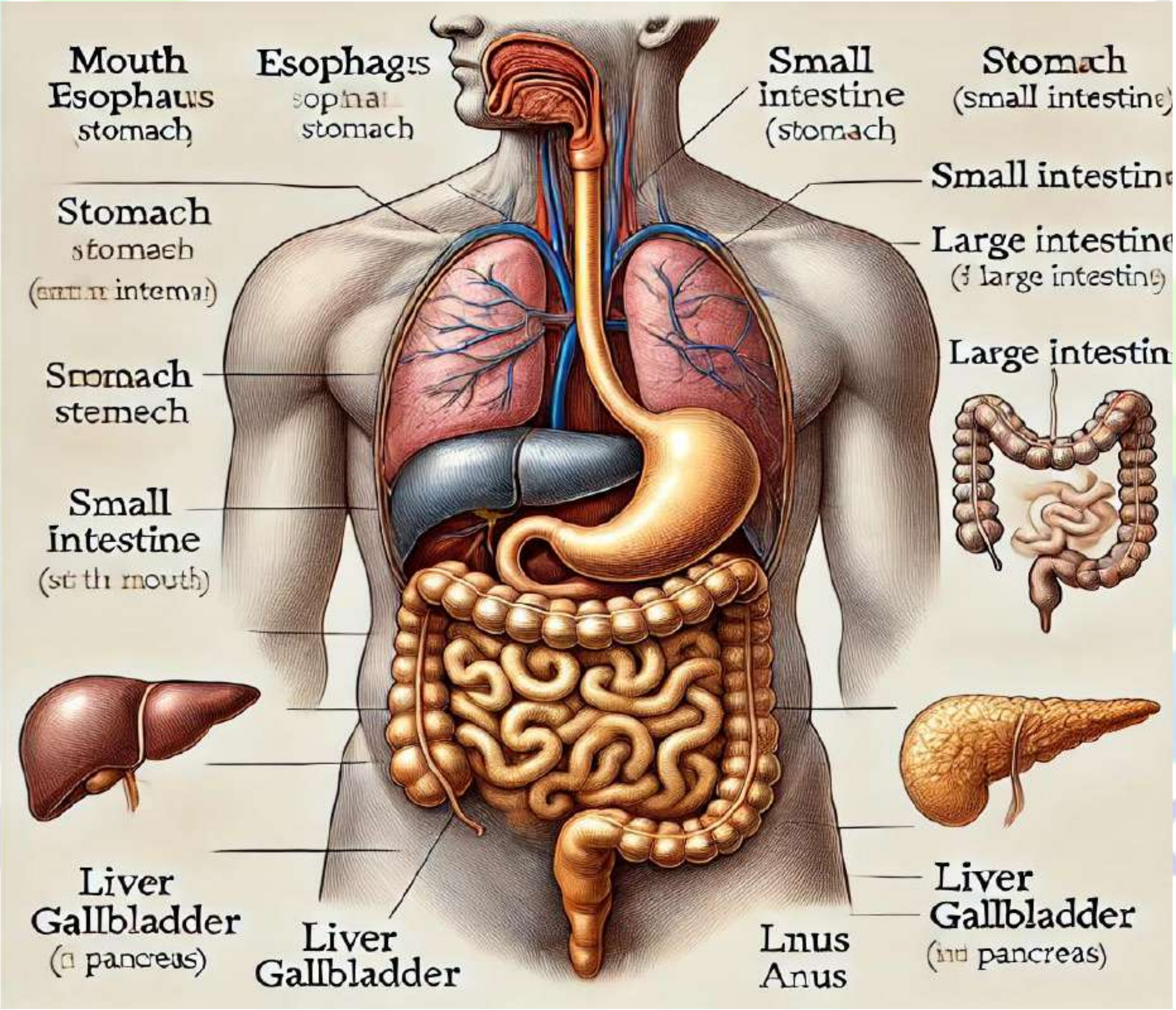
The digestive system is responsible for breaking down food, absorbing nutrients, and eliminating waste. It is composed of a series of hollow organs and glands that process food. The main parts of the digestive system are as follows:

1. **Mouth**:
   - **Function**: Mechanical digestion begins here with chewing, and **saliva** contains enzymes like **amylase** that start the breakdown of carbohydrates.
2. **Pharynx and Esophagus**:
   - **Function**: After food is chewed and swallowed, it passes through the **pharynx** and into the **esophagus**, which uses peristalsis (wave-like muscle contractions) to move food toward the stomach.
3. **Stomach**:
   - **Function**: The stomach is a muscular organ that secretes **gastric juice** (composed of hydrochloric acid and digestive enzymes). This acidic environment helps to break down food further and kill bacteria. It also initiates the digestion of proteins with the enzyme **pepsin**.
4. **Small Intestine**:
   - **Function**: This is the primary site for nutrient absorption. The small intestine is divided into three sections:
     - **Duodenum**: Receives chyme from the stomach and digestive enzymes from the pancreas and bile from the liver.
     - **Jejunum**: Absorbs nutrients such as carbohydrates and proteins.
     - **Ileum**: Absorbs remaining nutrients, including fats and bile acids.
5. **Large Intestine (Colon)**:

- **Function**: Absorbs water and salts from the remaining indigestible food matter and forms solid waste (feces). The large intestine is divided into the ascending colon, transverse colon, descending colon, and sigmoid colon.

6. **Rectum and Anus**:
   - **Function**: The rectum stores feces until they are expelled through the anus.

7. **Accessory Organs**:
   - **Liver**: Produces **bile**, which helps in the digestion of fats.
   - **Pancreas**: Secretes **digestive enzymes** (lipase, amylase, and proteases) and **bicarbonate** to neutralize stomach acid in the small intestine.
   - **Gallbladder**: Stores bile produced by the liver and releases it into the small intestine when needed.



Role of Pepsin in Protein Digestion:

Pepsin is an enzyme secreted by the **chief cells** in the stomach lining in its inactive form called **pepsinogen**. In the presence of **hydrochloric acid (HCl)**, pepsinogen is converted into its active form, **pepsin**. Pepsin plays a critical role in protein digestion:

- **Function**: Pepsin breaks down proteins into **polypeptides** by cleaving peptide bonds between amino acids.
- **Optimal pH**: Pepsin works best in the acidic environment of the stomach, at a pH of around 1.5 to 3.5.
- **Subsequent Steps**: The polypeptides generated by pepsin are further broken down into **amino acids** in the small intestine by other proteolytic enzymes, mainly from the pancreas.

4. **Discuss about anatomy and physiology of small intestine and large intestine. 10 marks**

The **small intestine** is the primary organ of digestion and nutrient absorption. It is a long, coiled tube measuring about **6 meters (20 feet)** in length and is divided into three main sections: the **duodenum**, **jejunum**, and **ileum**.

1. Anatomy of the Small Intestine:

- **Duodenum** (First Section):
  - The duodenum is about 25 cm (10 inches) long and is the first part of the small intestine. It connects to the stomach via the **pyloric sphincter**.
  - It receives **chyme** (partially digested food) from the stomach, as well as **bile** from the gallbladder and **digestive enzymes** from the pancreas, which are crucial for the breakdown of fats, carbohydrates, and proteins.
- **Jejunum** (Middle Section):
  - The jejunum is around **2.5 meters (8 feet)** long and is responsible for most of the digestion and absorption of nutrients. It has a rich blood supply and numerous folds, villi, and microvilli, which increase surface area for absorption.
- **Ileum** (Final Section):
  - The ileum is the longest section, about **3.5 meters (12 feet)** long, and ends at the **ileocecal valve**, which connects it to the large intestine. The ileum is specialized for absorbing vitamin B12, bile salts, and any remaining nutrients not absorbed by the jejunum.

Layers of the Small Intestine Wall:

The wall of the small intestine consists of several layers that contribute to its function:

1. **Mucosa**:
   - Contains specialized cells like **enterocytes** (for absorption), **goblet cells** (which secrete mucus), and **enteroendocrine cells** (which release hormones).
   - The mucosa forms finger-like projections called **villi** and microscopic extensions called **microvilli** to drastically increase the surface area for nutrient absorption.
2. **Submucosa**:
   - Contains blood vessels, nerves, and glands (like Brunner's glands in the duodenum) that support the mucosa.
3. **Muscularis Externa**:

- Contains two layers of smooth muscle: an inner circular layer and an outer longitudinal layer. These muscles generate the movements of the small intestine through **peristalsis** (propelling food forward) and **segmentation** (mixing the contents).

4. **Serosa**:
   - The outermost layer, which helps protect the small intestine and anchors it to the surrounding tissues.

2. Physiology of the Small Intestine:

- **Digestion**:
  - In the duodenum, chyme mixes with **bile** from the liver and gallbladder (to emulsify fats) and **pancreatic enzymes** (such as amylase, lipase, and proteases) to break down carbohydrates, fats, and proteins.
  - The jejunum and ileum continue this digestive process by secreting additional enzymes from their brush border, which assist in breaking down disaccharides, peptides, and fats into their simplest forms.
- **Absorption**:
  - The inner lining of the small intestine is highly specialized for absorption. It is covered in millions of tiny, finger-like projections called **villi**, which are further covered by **microvilli**, forming the **brush border**.
  - Nutrients (amino acids, monosaccharides, fatty acids, vitamins, minerals, etc.) are absorbed through these structures into the bloodstream and lymphatic system.
  - **Peristalsis**, a series of muscle contractions, moves chyme along the small intestine.

Anatomy and Physiology of the Large Intestine

The **large intestine**, or colon, is primarily responsible for absorbing water and electrolytes from indigestible food matter and forming and storing feces. It is about **1.5 meters (5 feet)** long and is divided into several parts: the **cecum**, **colon**, **rectum**, and **anus**.

1. Anatomy of the Large Intestine:

- **Cecum**:
  - The cecum is a pouch-like structure at the junction of the small and large intestines. It receives waste material from the ileum through the **ileocecal valve**. The **appendix**, a small finger-like projection, is attached to the cecum but has no essential digestive function.
- **Colon**:
  - The colon is divided into four regions:
    - **Ascending Colon**: Extends upward from the cecum on the right side of the abdomen.
    - **Transverse Colon**: Runs across the abdomen from right to left.
    - **Descending Colon**: Moves down the left side of the abdomen.
    - **Sigmoid Colon**: An S-shaped segment that leads to the rectum.

- **Rectum and Anus**:
  - The **rectum** is the final section, where feces are stored before being expelled.
  - The **anus** is the opening through which waste material leaves the body. It is controlled by two sphincters: an internal and an external sphincter.

The layers of the large intestine, from innermost to outermost, are:

1. **Mucosa**: Inner lining with epithelial cells, goblet cells for mucus secretion, and a thin muscular layer (muscularis mucosae).
2. **Submucosa**: Connective tissue with blood vessels, nerves, and glands.
3. **Muscularis Externa**: Two layers of smooth muscle (inner circular and outer longitudinal, with taeniae coli) for movement.
4. **Serosa (or Adventitia)**: Outer covering; serosa if intraperitoneal, adventitia if retroperitoneal.

These layers work to absorb water and move waste.

2. Physiology of the Large Intestine:

- **Absorption**:
  - The large intestine reabsorbs **water**, **electrolytes** (sodium, chloride), and **vitamins** (like vitamin K and some B vitamins produced by gut bacteria). About 90% of the water in chyme is absorbed here, making the remaining waste material more solid.
- **Formation of Feces**:
  - After absorbing water and electrolytes, the indigestible material (fiber, dead cells, and bacteria) is compacted into feces. This material is then stored in the **rectum** until excretion.
- **Gut Microbiota**:
  - The large intestine houses trillions of **beneficial bacteria** that play a role in fermenting indigestible carbohydrates (fiber), producing vitamins (e.g., vitamin K), and protecting against harmful bacteria.
- **Defecation**:
  - The movement of fecal matter is controlled by **peristalsis** and **mass movements** (strong contractions that move feces through the colon). Once the rectum is full, stretch receptors signal the brain to trigger the **defecation reflex**.
  - Voluntary relaxation of the external anal sphincter allows for the release of feces through the anus.

5) Write a note on anatomy and function of salivary gland. 10 marks

Salivary glands are exocrine glands located in the oral cavity responsible for producing and secreting saliva. Saliva plays a crucial role in digestion, oral health, and the facilitation of speech. There are three major pairs of salivary glands and several minor ones, each contributing to saliva production. The following is a detailed account of their anatomy and functions.

Anatomy of Salivary Glands

1. **Major Salivary Glands**: The major salivary glands are larger and responsible for the bulk of saliva production. They include:
   - **Parotid Glands**:
     - The largest salivary glands located near the ear, on both sides of the face, extending from the cheek to the lower jaw.
     - The parotid duct (Stensen's duct) opens into the oral cavity near the second upper molar.
     - The parotid glands secrete mainly **serous (watery) saliva**, rich in enzymes, especially amylase.
   - **Submandibular Glands**:
     - Located beneath the lower jaw (mandible), these are the second-largest salivary glands.
     - The submandibular duct (Wharton's duct) opens into the floor of the mouth, near the lingual frenulum.
     - These glands produce a **mixed secretion** of serous and mucous components, accounting for around 60-70% of saliva production.
   - **Sublingual Glands**:
     - The smallest of the major salivary glands, located beneath the tongue.
     - Their multiple small ducts open directly into the floor of the mouth.
     - They primarily produce **mucous saliva**, which is thicker and more viscous.
2. **Minor Salivary Glands**:
   - Scattered throughout the oral cavity (lips, cheeks, palate, and tongue), these glands are much smaller and produce small amounts of mucous-rich saliva.
   - They serve more localized roles in moistening the oral mucosa and aiding in oral hygiene.

Histology of Salivary Glands:

Salivary glands consist of **acini**, which are clusters of cells responsible for secreting the components of saliva. The acini are of two types:

- **Serous acini**: Secrete a watery, enzyme-rich fluid.
- **Mucous acini**: Secrete a thick, mucous-rich fluid.
- Some glands (like submandibular) contain both types, producing mixed secretions.

The glands are supplied with blood by branches of nearby arteries, and their secretion is controlled by the **autonomic nervous system**. Parasympathetic stimulation increases saliva production, while sympathetic stimulation reduces it.

Functions of Salivary Glands

1. **Digestion**:
   - **Salivary amylase** (produced primarily by the parotid glands) starts the digestion of carbohydrates in the mouth by breaking down starch into maltose and dextrin.
   - **Lingual lipase**, secreted by glands in the tongue, begins the digestion of fats, though this enzyme becomes more active in the stomach.
2. **Lubrication and Bolus Formation**:
   - Saliva moistens food, making it easier to chew and swallow. Mucous components help form the food into a **bolus**, facilitating smooth passage down the esophagus.
3. **Protection and Oral Hygiene**:
   - Saliva contains **antibacterial enzymes**, such as lysozyme, and **immunoglobulin A (IgA)**, which help protect against infections by controlling the growth of oral bacteria.
   - The continuous flow of saliva helps wash away food particles and debris, reducing the risk of dental caries and maintaining oral cleanliness.
4. **Buffering**:
   - The bicarbonate ions in saliva act as a buffer to maintain the pH of the oral cavity, neutralizing acids produced by bacteria that can erode tooth enamel.
5. **Taste**:
   - Saliva dissolves food particles, allowing the taste buds to detect flavors. Without sufficient saliva, taste perception would be significantly reduced.
6. **Speech**:

- Saliva keeps the mucous membranes of the mouth moist, which is essential for the movement of the tongue and lips during speech.

7. **Healing and Tissue Repair**:
   - Saliva contains growth factors that promote the healing of oral tissues, helping to repair minor injuries like cuts or ulcers.

The pancreas is a crucial gland in the digestive and endocrine systems, located in the upper abdomen, behind the stomach. It plays a dual role as both an exocrine gland, secreting digestive enzymes, and an endocrine gland, producing hormones involved in glucose regulation.

6) Write a note on anatomy and function of pancreas. 10 marks

Anatomy of the Pancreas

The pancreas is an elongated, tapered organ, about 15–20 cm long, and it is divided into four main parts:

1. **Head**:
   - The widest part of the pancreas, located within the curve of the duodenum (the first part of the small intestine).
   - The **uncinate process** is a small projection from the lower part of the head that lies behind important blood vessels.
2. **Neck**:
   - The short, narrow part of the pancreas located between the head and body.
   - It lies anterior to major blood vessels such as the superior mesenteric artery and vein.
3. **Body**:
   - The central part of the pancreas, which extends across the midline of the body.
   - It lies behind the stomach and in front of the spine.
4. **Tail**:
   - The narrow, tapered end of the pancreas located near the spleen, at the left side of the abdomen.

Duct System:

- The pancreas has two main ducts:

- **Main Pancreatic Duct (Duct of Wirsung)**: This runs the length of the pancreas and joins with the common bile duct to open into the duodenum through the **ampulla of Vater**.
- **Accessory Pancreatic Duct (Duct of Santorini)**: This smaller duct may drain into the duodenum separately, though it sometimes connects to the main duct.

Histology:

The pancreas is composed of two major types of tissue:

1. **Exocrine Tissue (Acini)**:
    - Comprises about 85% of the pancreas.
    - Made up of clusters of acinar cells that produce digestive enzymes.
    - These enzymes are secreted into the pancreatic ducts, which then deliver them to the small intestine.
2. **Endocrine Tissue (Islets of Langerhans)**:
    - Scattered throughout the pancreas, these are clusters of hormone-producing cells.
    - The islets contain several cell types:
        - **Alpha cells**: Produce glucagon (raises blood sugar).
        - **Beta cells**: Produce insulin (lowers blood sugar).
        - **Delta cells**: Produce somatostatin (inhibits the secretion of both insulin and glucagon).
        - **PP cells**: Produce pancreatic polypeptide (regulates pancreatic enzyme secretion).

Functions of the Pancreas

1. **Exocrine Function** (Digestion):
    - The exocrine pancreas produces digestive enzymes that are essential for breaking down food components in the small intestine. These enzymes include:
        - **Amylase**: Breaks down carbohydrates into sugars.
        - **Lipase**: Digests fats into fatty acids and glycerol.
        - **Proteases (trypsin and chymotrypsin)**: Break down proteins into amino acids.
    - These enzymes are secreted in an inactive form (zymogens) and activated in the duodenum to prevent digestion of the pancreas itself.

  - The pancreas also produces **bicarbonate** to neutralize stomach acid, protecting the intestinal lining and creating an optimal pH for enzyme function.

2. **Endocrine Function** (Blood Glucose Regulation):
    - The endocrine pancreas regulates blood glucose levels through the hormones it secretes:
        - **Insulin** (from beta cells): Lowers blood glucose by promoting the uptake of glucose into cells, especially in the liver, muscles, and fat.
        - **Glucagon** (from alpha cells): Raises blood glucose levels by stimulating the liver to release stored glucose.
        - **Somatostatin**: Modulates the secretion of both insulin and glucagon, providing balance in glucose regulation.
        - **Pancreatic Polypeptide**: Plays a role in the regulation of both the exocrine and endocrine pancreas, as well as gastrointestinal motility.

7) Discuss about anatomy and physiology of small intestine. 5/10 marks

The **small intestine** is the primary organ of digestion and nutrient absorption. It is a long, coiled tube measuring about **6 meters (20 feet)** in length and is divided into three main sections: the **duodenum**, **jejunum**, and **ileum**.

1. Anatomy of the Small Intestine:

- **Duodenum** (First Section):
    - The duodenum is about 25 cm (10 inches) long and is the first part of the small intestine. It connects to the stomach via the **pyloric sphincter**.
    - It receives **chyme** (partially digested food) from the stomach, as well as **bile** from the gallbladder and **digestive enzymes** from the pancreas, which are crucial for the breakdown of fats, carbohydrates, and proteins.
- **Jejunum** (Middle Section):
    - The jejunum is around **2.5 meters (8 feet)** long and is responsible for most of the digestion and absorption of nutrients. It has a rich blood supply and numerous folds, villi, and microvilli, which increase surface area for absorption.
- **Ileum** (Final Section):
    - The ileum is the longest section, about **3.5 meters (12 feet)** long, and ends at the **ileocecal valve**, which connects it to the large intestine. The ileum is specialized for absorbing vitamin B12, bile salts, and any remaining nutrients not absorbed by the jejunum.

Layers of the Small Intestine Wall:

The wall of the small intestine consists of several layers that contribute to its function:

5. **Mucosa**:

- Contains specialized cells like **enterocytes** (for absorption), **goblet cells** (which secrete mucus), and **enteroendocrine cells** (which release hormones).
- The mucosa forms finger-like projections called **villi** and microscopic extensions called **microvilli** to drastically increase the surface area for nutrient absorption.

6. **Submucosa**:
    - Contains blood vessels, nerves, and glands (like Brunner's glands in the duodenum) that support the mucosa.
7. **Muscularis Externa**:
    - Contains two layers of smooth muscle: an inner circular layer and an outer longitudinal layer. These muscles generate the movements of the small intestine through **peristalsis** (propelling food forward) and **segmentation** (mixing the contents).
8. **Serosa**:
    - The outermost layer, which helps protect the small intestine and anchors it to the surrounding tissues.

2. Physiology of the Small Intestine:

- **Digestion**:
    - In the duodenum, chyme mixes with **bile** from the liver and gallbladder (to emulsify fats) and **pancreatic enzymes** (such as amylase, lipase, and proteases) to break down carbohydrates, fats, and proteins.
    - The jejunum and ileum continue this digestive process by secreting additional enzymes from their brush border, which assist in breaking down disaccharides, peptides, and fats into their simplest forms.
- **Absorption**:
    - The inner lining of the small intestine is highly specialized for absorption. It is covered in millions of tiny, finger-like projections called **villi**, which are further covered by **microvilli**, forming the **brush border**.
    - Nutrients (amino acids, monosaccharides, fatty acids, vitamins, minerals, etc.) are absorbed through these structures into the bloodstream and lymphatic system.
    - **Peristalsis**, a series of muscle contractions, moves chyme along the small intestine.

8) Discuss about anatomy and physiology of large intestine. 5 marks

Anatomy and Physiology of the Large Intestine

The **large intestine**, or colon, is primarily responsible for absorbing water and electrolytes from indigestible food matter and forming and storing feces. It is about **1.5 meters (5 feet)** long and is divided into several parts: the **cecum**, **colon**, **rectum**, and **anus**.

1. Anatomy of the Large Intestine:

- **Cecum**:
    - The cecum is a pouch-like structure at the junction of the small and large intestines. It receives waste material from the ileum through the **ileocecal valve**. The **appendix**, a small finger-like projection, is attached to the cecum but has no essential digestive function.

- **Colon**:
  - The colon is divided into four regions:
    - **Ascending Colon**: Extends upward from the cecum on the right side of the abdomen.
    - **Transverse Colon**: Runs across the abdomen from right to left.
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- **Rectum and Anus**:
  - The **rectum** is the final section, where feces are stored before being expelled.
  - The **anus** is the opening through which waste material leaves the body. It is controlled by two sphincters: an internal and an external sphincter.

The layers of the large intestine, from innermost to outermost, are:

5. **Mucosa**: Inner lining with epithelial cells, goblet cells for mucus secretion, and a thin muscular layer (muscularis mucosae).
6. **Submucosa**: Connective tissue with blood vessels, nerves, and glands.
7. **Muscularis Externa**: Two layers of smooth muscle (inner circular and outer longitudinal, with taeniae coli) for movement.
8. **Serosa (or Adventitia)**: Outer covering; serosa if intraperitoneal, adventitia if retroperitoneal.

These layers work to absorb water and move waste.

2. Physiology of the Large Intestine:

- **Absorption**:
  - The large intestine reabsorbs **water**, **electrolytes** (sodium, chloride), and **vitamins** (like vitamin K and some B vitamins produced by gut bacteria). About 90% of the water in chyme is absorbed here, making the remaining waste material more solid.
- **Formation of Feces**:
  - After absorbing water and electrolytes, the indigestible material (fiber, dead cells, and bacteria) is compacted into feces. This material is then stored in the **rectum** until excretion.
- **Gut Microbiota**:
  - The large intestine houses trillions of **beneficial bacteria** that play a role in fermenting indigestible carbohydrates (fiber), producing vitamins (e.g., vitamin K), and protecting against harmful bacteria.
- **Defecation**:
  - The movement of fecal matter is controlled by **peristalsis** and **mass movements** (strong contractions that move feces through the colon). Once the rectum is full, stretch receptors signal the brain to trigger the **defecation reflex**.

- Voluntary relaxation of the external anal sphincter allows for the release of feces through the anus.

9) Mention the salivary glands. Write the composition and functions of Saliva.

5 marks

Salivary Glands

The salivary glands are responsible for producing saliva, which is essential for digestion, oral health, and maintaining moisture in the mouth. There are three major pairs of salivary glands:

1. **Parotid Glands:**
   - Located near the ears, these are the largest salivary glands.
   - They primarily secrete serous (watery) saliva rich in digestive enzymes, especially amylase.
2. **Submandibular Glands:**
   - Situated beneath the jaw (mandible), they produce both serous and mucous secretions.
   - These glands contribute the largest portion of saliva (about 60-70%) and produce a mixture of enzymes and mucus.
3. **Sublingual Glands:**
   - Located under the tongue, these glands are the smallest of the major salivary glands.
   - They predominantly produce mucous saliva, which is thicker and more viscous.

In addition to the major glands, there are many minor salivary glands located in the lips, cheeks, and palate that also contribute to saliva production**.**

Composition of Saliva

Saliva is a complex fluid composed of various substances that contribute to its multiple functions. The main components of saliva include:

1. **Water (99.5%):**
   - Provides the medium for dissolving food and helping in digestion and lubrication.
2. **Electrolytes:**
   - Sodium (Na^+), potassium (K^+), calcium (Ca^{2+}), chloride (Cl^-), bicarbonate (HCO_3^-), and phosphate (PO_4^{3-}) ions that help maintain the pH balance and provide buffering action.
3. **Enzymes:**

- Salivary amylase (ptyalin): Breaks down starch into maltose and dextrins, starting carbohydrate digestion in the mouth.
- Lingual lipase: Begins the digestion of fats, though it acts primarily in the stomach.
- Lysozyme: An antimicrobial enzyme that helps kill bacteria in the mouth.

4. **Mucins:**
   - Glycoproteins that provide lubrication by making the saliva more viscous, facilitating the formation of the food bolus and aiding in swallowing**.**
5. **Antibodies:**
   - Immunoglobulin A (IgA): Plays a role in immune defense by neutralizing pathogens and preventing infections in the oral cavity.
6. **Bicarbonate and Phosphate Buffers:**
   - Maintain the pH of the mouth at around 6.2-7.4, neutralizing acids produced by bacteria and protecting tooth enamel from decay.
7. **Other Organic Molecules:**
   - Includes growth factors, urea, and nitrogenous waste products, which are found in small amounts.
8. **Explain layers of GIT.** **5/10 marks**

The gastrointestinal tract (GIT) is a continuous tube that runs from the mouth to the anus and is responsible for digestion, absorption of nutrients, and excretion of waste. The walls of the GIT are composed of four main layers that are consistent throughout the entire tract, from the esophagus to the rectum, although the specific characteristics of these layers can vary depending on the specific region of the tract.

Here are the four main layers of the GIT, starting from the innermost to the outermost:

1. Mucosa

This is the innermost layer that comes into direct contact with the contents of the lumen (the space inside the GI tract). The mucosa itself has three sublayers:

- **Epithelium**:
  - The epithelial lining varies in different parts of the GIT, from **stratified squamous epithelium** in areas subjected to friction (such as the esophagus) to

simple columnar epithelium in areas involved in absorption and secretion (such as the stomach and intestines).
  - It contains **goblet cells**, which secrete mucus to lubricate and protect the lining.
  - In the intestines, specialized cells absorb nutrients and secrete digestive enzymes.
- **Lamina Propria**:
  - A layer of loose connective tissue that contains blood vessels, lymphatics, and immune cells.
  - It supports the epithelium and allows nutrients to enter the bloodstream or lymphatic system.
- **Muscularis Mucosae**:
  - A thin layer of smooth muscle that helps move the mucosa and enhances its contact with food to increase absorption.

2. Submucosa

- A layer of dense connective tissue located just beneath the mucosa.
- It contains **blood vessels**, **lymphatic vessels**, and the **submucosal nerve plexus (Meissner's plexus)**, which controls local blood flow and secretory activity.
- The submucosa also houses **glands** in certain areas (e.g., Brunner's glands in the duodenum) that secrete mucus or digestive enzymes.

3. Muscularis Externa

- This layer is responsible for the movement and mixing of food through the GIT via peristalsis and segmentation. It consists of two layers of smooth muscle:
  - **Inner Circular Layer**:
    - The fibers run around the circumference of the tract, constricting the lumen to mix and push contents along.
  - **Outer Longitudinal Layer**:
    - The fibers run lengthwise along the tract, shortening it and aiding in the propulsion of contents.
- Between these two layers lies the **myenteric plexus (Auerbach's plexus)**, a network of nerves that controls the contraction and relaxation of the smooth muscle for coordinated movements of peristalsis.

In some regions, such as the stomach, there is an additional **third layer of muscle** (the oblique layer) that aids in the mechanical digestion of food.

4. Serosa or Adventitia

- This is the outermost layer of the GIT and its nature varies depending on the location:
    - **Serosa**:
        - A smooth, slippery membrane consisting of a layer of simple squamous epithelium (mesothelium) and connective tissue. It is part of the visceral peritoneum and is found in intraperitoneal organs like the stomach and intestines.
        - The serosa reduces friction between the digestive organs and the surrounding tissues.
    - **Adventitia**:
        - In regions that are retroperitoneal (outside the peritoneal cavity), such as the esophagus and rectum, the outer layer is called the adventitia. It consists of loose connective tissue that anchors the organ to surrounding structures.

Summary of Functions of GIT Layers:

- **Mucosa**: Secretion (mucus, enzymes, hormones), absorption, and protection.
- **Submucosa**: Supports the mucosa, supplies blood and nerves, and allows for secretion.
- **Muscularis Externa**: Responsible for movement and mixing of contents (peristalsis and segmentation).
- **Serosa/Adventitia**: Provides outer covering, reduces friction (serosa), and connects organs to surrounding tissues (adventitia)

11. Write the exocrine and endocrine secretions of Pancreas. 2 marks

a) Exocrine Secretions:

- Digestive enzymes (amylase, lipase, proteases) for breaking down carbohydrates, fats, and proteins.
- Bicarbonate to neutralize stomach acid and create an optimal pH for enzyme function in the small intestine.

b) Endocrine Secretions:

- **Insulin** to lower blood glucose.

- **Glucagon** to raise blood glucose.
- **Somatostatin** to regulate insulin and glucagon secretion and slow digestion.
- **Pancreatic polypeptide** to regulate the exocrine pancreas and appetite**.**

12) Write the functions of saliva. **2 marks**

a) Aids in Digestion:

- Saliva contains amylase, an enzyme that begins the breakdown of starch into simpler sugars, initiating digestion in the mouth.

b) Lubricates and Protects the Oral Cavity:

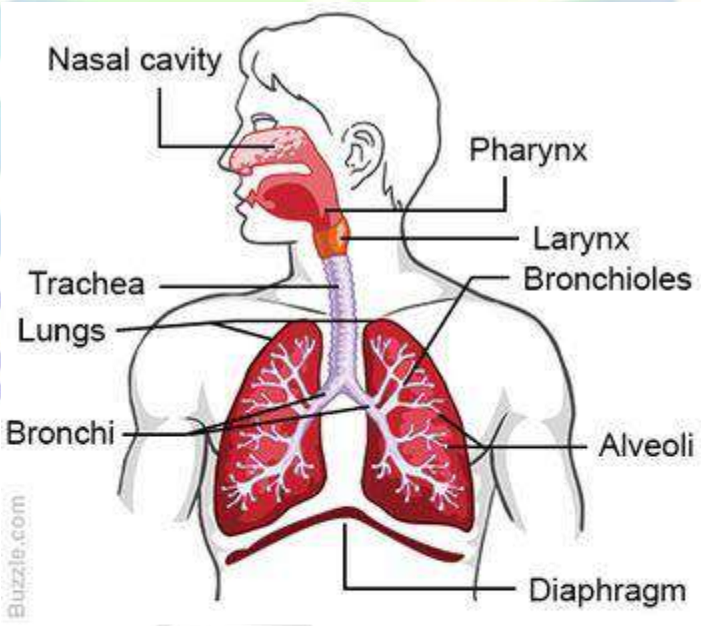
- Saliva moistens food, making it easier to chew and swallow, and protects the mouth and teeth by neutralizing acids and washing away food particles, reducing the risk of tooth decay and oral infections.

UNIT- 3

10 Marks

1. Define the Anatomy and Physiology of Respiratory system.

The **respiratory system** is a complex organ system responsible for the exchange of gases (oxygen and carbon dioxide) between the body and the environment. It consists of both **conducting** and **respiratory zones**, ensuring that air is filtered, warmed, and delivered to the



lungs, and that gas exchange occurs efficiently. Below is a detailed breakdown of the respiratory system, with special reference to the anatomy of the **lungs**.

1. Upper Respiratory Tract

The **upper respiratory tract** includes structures that filter, warm, and moisten air before it reaches the lungs.

- **Nose/Nasal Cavity**:
  - The primary **entry point** for air, lined with **mucosa** that filters dust and microbes. The nasal cavity also humidifies and warms air as it passes through. The **olfactory region** in the nose is responsible for the sense of smell.
- **Pharynx**:
  - The **throat** serves as a passage for both air and food. It is divided into three parts:
    - **Nasopharynx**: The portion that connects the nasal cavity to the throat.
    - **Oropharynx**: Located at the back of the mouth.
    - **Laryngopharynx**: Leads to the larynx and esophagus.
- **Larynx**:
  - Also known as the **voice box**, the larynx contains the **vocal cords** and is responsible for voice production. It functions as a passageway for air and prevents food from entering the trachea through the **epiglottis**.

2. Lower Respiratory Tract

The **lower respiratory tract** includes the structures involved in moving air into and out of the lungs.

- **Trachea**:
  - A rigid **tube** that extends from the larynx and divides into the two primary bronchi. It is composed of **C-shaped cartilage rings** that maintain its shape and prevent collapse during inhalation. The trachea is lined with **cilia** and **mucous membranes** that trap and move inhaled particles out of the airway.
- **Bronchi and Bronchioles**:
  - The trachea bifurcates into the **right** and **left primary bronchi**, each leading into the corresponding lung.
  - The bronchi branch into smaller **secondary (lobar) bronchi**, **tertiary (segmental) bronchi**, and eventually into **bronchioles**. The bronchioles are smaller and lack cartilage but are lined with smooth muscle that controls airflow.
  - **Terminal bronchioles** are the smallest airways, leading to the **respiratory bronchioles**, which transition into the **alveolar ducts**.

3. Anatomy of the Lungs

The **lungs** are the primary organs of respiration, where gas exchange occurs. They are located in the **thoracic cavity** and are separated by the **mediastinum**.

- **Lung Structure**:
  - The **right lung** has three lobes (superior, middle, inferior), while the **left lung** has two lobes (superior and inferior), with the left side being slightly smaller to accommodate the heart.
  - Each lung is enclosed by a double-layered membrane called the **pleura**, which consists of:
    - **Parietal pleura**: Lines the chest wall and diaphragm.
    - **Visceral pleura**: Covers the lungs themselves.
    - The **pleural cavity** between the two layers contains pleural fluid, which reduces friction during respiration.
- **Bronchial Tree**:
  - The bronchial tree is a branching system that ensures the distribution of air to all parts of the lungs. It begins with the **primary bronchi**, which divide into **secondary bronchi** (one for each lobe) and continue into smaller **tertiary bronchi**, ultimately leading to **bronchioles**.
- **Alveoli**:
  - The **alveoli** are tiny, sac-like structures at the end of the bronchioles where gas exchange occurs. The lungs contain about **300 million alveoli**, which provide a vast surface area for the exchange of oxygen and carbon dioxide.
  - Alveolar walls are lined with **type I alveolar cells** for gas exchange and **type II alveolar cells** that secrete **surfactant**, reducing surface tension and preventing alveolar collapse.

4. Gas Exchange and Blood Supply

- **Gas Exchange**:
  - In the **alveoli**, oxygen from the inhaled air diffuses across the **alveolar-capillary membrane** into the bloodstream, while carbon dioxide in the blood diffuses into the alveoli to be exhaled. This process is facilitated by the **partial pressure gradients** of the gases and the thin walls of the alveoli.
- **Blood Supply**:
  - The lungs receive blood from two sources:
    - **Pulmonary circulation**: Carries deoxygenated blood from the right side of the heart to the lungs for oxygenation.
    - **Bronchial circulation**: Provides oxygenated blood to the lung tissues (e.g., bronchi and alveoli).

5. Pleura and Its Function

The **pleura** serves as a protective barrier and is essential for normal lung function. It allows the lungs to expand and contract smoothly within the chest cavity.

- **Pleural Fluid**:
  - Found in the pleural cavity, this fluid reduces friction between the pleurae during respiration. It also maintains a **negative pressure** in the pleural space, helping keep the lungs inflated.

Function of the Lungs

The primary function of the lungs is to facilitate **gas exchange**—bringing oxygen into the body and expelling carbon dioxide. The lungs also help regulate **blood pH** by controlling the concentration of carbon dioxide. They participate in maintaining **homeostasis** and protect against harmful microorganisms via the **immune response** in the alveoli.

Clinical Relevance

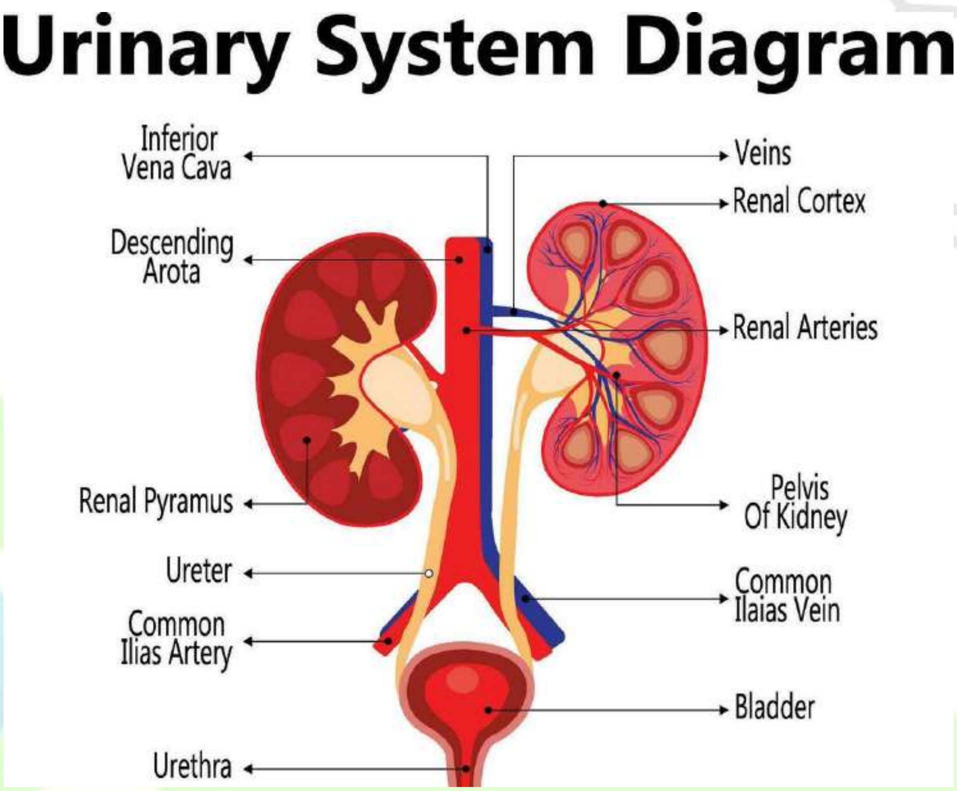
- **Pneumonia**: Infection that causes inflammation and fluid accumulation in the alveoli, impairing gas exchange.
- **Asthma**: Chronic condition in which the bronchi and bronchioles constrict, leading to difficulty in breathing.
- **Emphysema**: A type of chronic obstructive pulmonary disease (COPD) where alveolar walls are damaged, reducing surface area for gas exchange.
- **Lung Cancer**: Malignant growths that disrupt normal lung function and gas exchange.

Conclusion

The **respiratory system** and the **lungs** are integral for maintaining **oxygen levels** in the body and removing carbon dioxide. Their complex structure, including the airway system and alveolar network, ensures efficient gas exchange, vital for cellular metabolism and overall body function.

2. **Describe the Anatomy and Physiology of Urinary System.**

The **urinary system** (renal system) is responsible for the production, storage, and elimination of urine, which helps maintain body **fluid balance, electrolyte levels, and blood pressure regulation**. It consists of the **kidneys, ureters, urinary bladder, and urethra**.



1. Components of the Urinary Tract

(A) Kidneys (Primary Organ of the Urinary System)

The **kidneys** are **bean-shaped** organs located in the **retroperitoneal space**, one on each side of the vertebral column, at the level of **T12–L3 vertebrae**. The **right kidney** is slightly lower than the left due to the position of the **liver**.

External Structure of the Kidney

- **Renal Capsule** – A tough, fibrous outer covering that protects the kidney.
- **Renal Cortex** – The outer layer where filtration of blood occurs.
- **Renal Medulla** – The inner layer containing **renal pyramids**, which transport urine from the nephrons to the renal pelvis.
- **Renal Pelvis** – A funnel-shaped structure that collects urine before it enters the ureter.
- **Hilum** – The central indentation where blood vessels (renal artery, renal vein), lymphatics, and the ureter enter/exit.

Internal Structure of the Kidney

- **Nephrons** – The **functional units** of the kidney, responsible for filtering blood and producing urine. Each kidney contains about **1.2 million nephrons**.
- **Parts of a Nephron**:
  - **Glomerulus** – A network of capillaries that filter blood.
  - **Bowman's Capsule** – Surrounds the glomerulus and collects the filtrate.
  - **Proximal Convoluted Tubule (PCT)** – Reabsorbs essential substances like glucose, amino acids, and electrolytes.
  - **Loop of Henle** – Regulates water and sodium balance.
  - **Distal Convoluted Tubule (DCT)** – Further electrolyte and pH balance.
  - **Collecting Duct** – Transports urine to the renal pelvis.

Blood Supply of the Kidney

- **Renal Artery** – Supplies oxygenated blood to the kidney.
- **Glomerular Capillaries** – Involved in filtration.
- **Renal Vein** – Drains deoxygenated blood from the kidney.

Functions of the Kidney

- **Filtration of Blood** – Removes waste products like urea and creatinine.
- **Regulation of Fluid and Electrolyte Balance** – Maintains sodium, potassium, and water levels.
- **Blood Pressure Control** – Releases **renin**, which regulates blood pressure.
- **Erythropoiesis** – Produces **erythropoietin**, which stimulates red blood cell production.
- **Acid-Base Balance** – Regulates pH by excreting hydrogen and bicarbonate ions.

(B) Ureters (Urine Transport Tubes)

- Two **muscular tubes** (~25–30 cm long) that transport urine from the kidneys to the urinary bladder.
- They are lined with **transitional epithelium**, allowing expansion.
- Peristaltic waves push urine downward.

(C) Urinary Bladder (Urine Storage Organ)

- A **hollow, muscular organ** located in the pelvis, behind the pubic symphysis.
- Stores urine (~400–600 mL capacity in adults).
- The **trigone** is a triangular area between the openings of the **ureters** and **urethra**, sensitive to bladder filling.
- Lined with **detrusor muscle**, which contracts during urination.

(D) Urethra (Urine Exit Tube)

- A **tube** that transports urine from the bladder to the outside of the body.
- In males (~18–20 cm), it passes through the **prostate gland** and carries semen.
- In females (~4 cm), it is shorter and more prone to infections (**UTIs**).

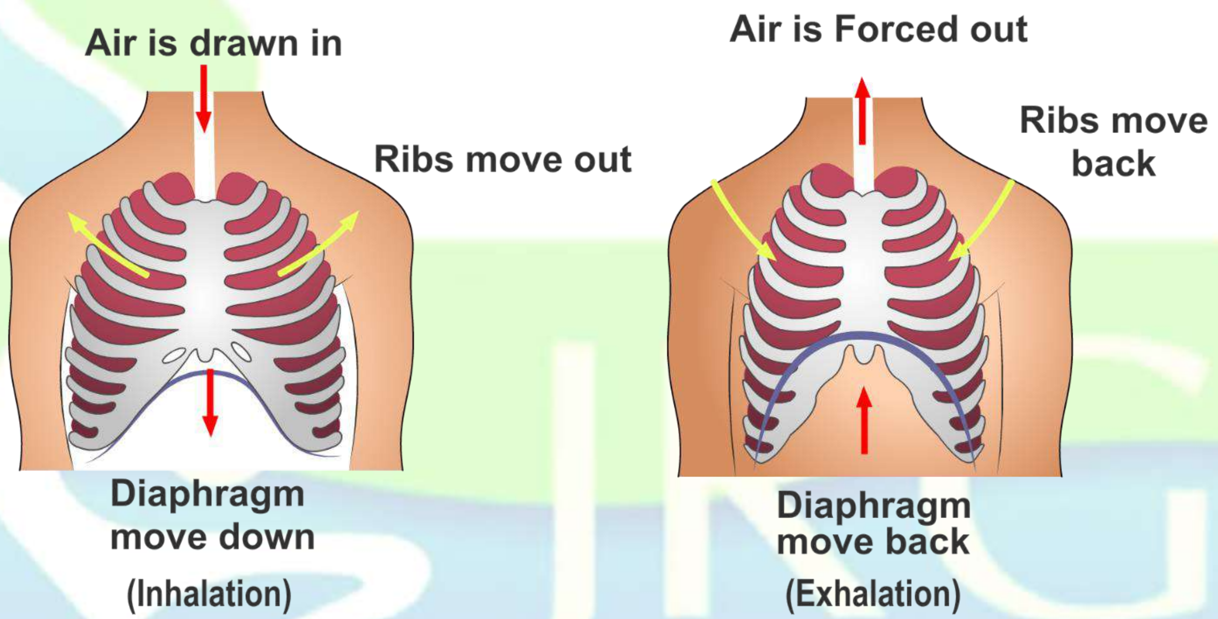
Conclusion

The **urinary system** plays a crucial role in **waste elimination, homeostasis, and blood pressure regulation**. The **kidneys** are the primary organs responsible for **filtration and urine production**, while the **ureters, bladder, and urethra** ensure proper storage and elimination of urine.

5 Marks

1. **Describe the mechanism of respiration.**

Respiration is the process of **gas exchange** between the body and the environment. It involves **pulmonary ventilation (breathing), external respiration (gas exchange in lungs), transport of gases, and internal respiration (gas exchange in tissues).**



1. Pulmonary Ventilation (Breathing)

Breathing consists of **inspiration (inhalation)** and **expiration (exhalation)**, governed by **Boyle's Law**, which states that pressure and volume are inversely related.

Inspiration (Active Process)

- **Diaphragm contracts** and moves downward.
- **External intercostal muscles contract**, expanding the rib cage.
- **Thoracic cavity volume increases**, lowering intrapulmonary pressure.

- Air rushes into the lungs due to the pressure gradient.

Expiration (Passive Process in Normal Breathing)

- **Diaphragm relaxes** and moves upward.
- **Intercostal muscles relax**, decreasing rib cage size.
- **Thoracic cavity volume decreases**, increasing intrapulmonary pressure.
- Air is pushed out of the lungs.

Forced expiration (e.g., during exercise) is active and involves abdominal muscles.

---

2. External Respiration (Gas Exchange in Lungs)

- Oxygen from **alveoli (high O_2 pressure)** diffuses into **capillary blood (low O_2 pressure)**.
- Carbon dioxide moves from **capillary blood (high CO_2 pressure)** to **alveoli (low CO_2 pressure)** for exhalation.

3. Transport of Gases

- **Oxygen**: **98%** binds to **hemoglobin** in red blood cells as **oxyhemoglobin (HbO_2)**, and **2%** dissolves in plasma.
- **Carbon Dioxide**: Transported as **bicarbonate ions (HCO_3^-) (70%)**, bound to hemoglobin as **carbaminohemoglobin (20%)**, and dissolved in plasma (**10%**).

4. Internal Respiration (Gas Exchange in Tissues)

- Oxygen diffuses from **capillaries (high O_2 pressure)** into **tissues (low O_2 pressure)** for cellular metabolism.
- Carbon dioxide from **tissues (high CO_2 pressure)** diffuses into **capillaries (low CO_2 pressure)** for transport back to the lungs.

5. Regulation of Respiration

- **Medulla oblongata** (Respiratory center) controls breathing rhythm.
- **Chemoreceptors in aortic & carotid bodies** detect **CO_2 levels and pH** and adjust breathing rate accordingly.

Conclusion

Respiration ensures oxygen delivery to tissues and removal of carbon dioxide. It is controlled by neural and chemical factors, maintaining **homeostasis** in the body.

2. **Describe the Lung Volume and Capacities.**

1. Lung Volumes and Capacities

The lungs can hold different amounts of air based on the body's needs. These are classified into **lung volumes** and **lung capacities**:

(A) Lung Volumes:

- **Tidal Volume (TV)**: Air inhaled or exhaled during normal breathing (~500 mL).
- **Inspiratory Reserve Volume (IRV)**: Extra air that can be inhaled after a normal inspiration (~3000 mL).
- **Expiratory Reserve Volume (ERV)**: Extra air that can be exhaled after a normal expiration (~1200 mL).
- **Residual Volume (RV)**: Air remaining in the lungs after maximum expiration (~1200 mL).

(B) Lung Capacities:

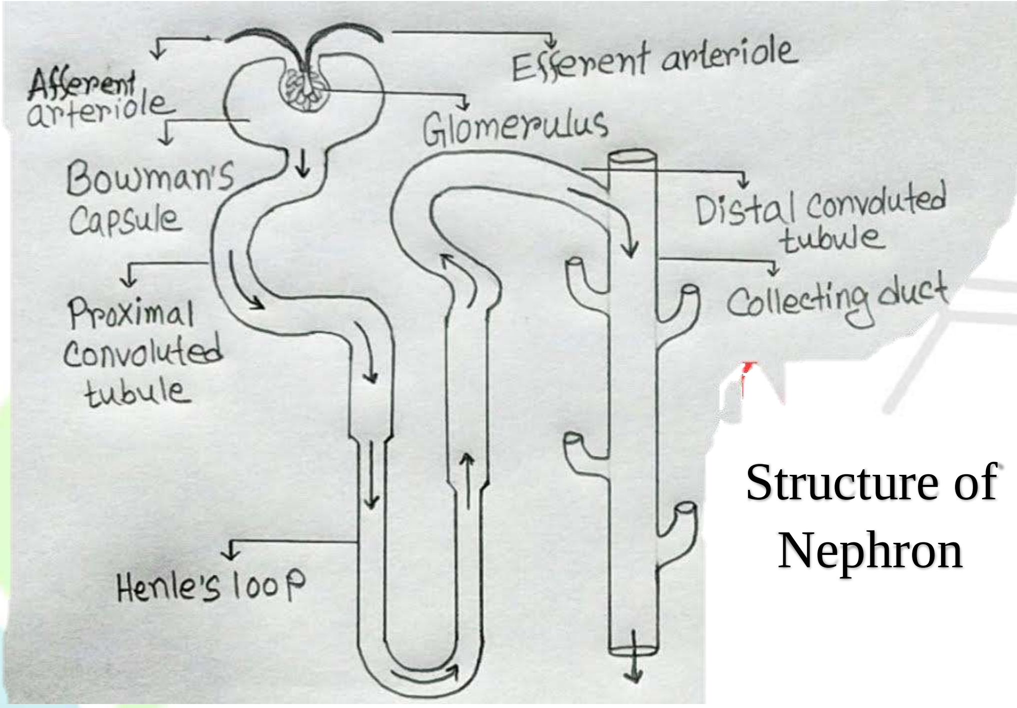
- **Inspiratory Capacity (IC) = TV + IRV (~3500 mL)**
- **Functional Residual Capacity (FRC) = ERV + RV (~2400 mL)**
- **Vital Capacity (VC) = TV + IRV + ERV (~4700 mL)**
- **Total Lung Capacity (TLC) = TV + IRV + ERV + RV (~6000 mL)**

Conclusion

Lung volumes and capacities determine **breathing efficiency**, while respiratory gases are transported via **hemoglobin and plasma**. These processes ensure **oxygen supply to tissues** and **carbon dioxide removal**, maintaining homeostasis.

3. **Describe the Anatomy and Physiology of Nephron.**

The **nephron** is the **structural and functional unit of the kidney**, responsible for **filtration, reabsorption, secretion, and excretion** to form urine. Each kidney contains about **1.2 million nephrons**.



Structure of Nephron

1. Anatomy of Nephron

Each nephron consists of two main parts:

(A) Renal Corpuscle (Filtration Unit)

- **Glomerulus**: A network of capillaries where blood filtration occurs.
- **Bowman's Capsule**: A double-walled structure surrounding the glomerulus that collects the filtrate.

(B) Renal Tubule (Processing Unit)

- **Proximal Convoluted Tubule (PCT)**: Reabsorbs **glucose, amino acids, water, and electrolytes** back into the blood.
- **Loop of Henle**: Maintains **water and salt balance** through countercurrent mechanisms.
- **Distal Convoluted Tubule (DCT)**: Regulates **pH, ions, and further water balance** under hormonal control.
- **Collecting Duct**: Transports urine to the renal pelvis; final water reabsorption occurs here.

2. Physiology of Nephron (Urine Formation)

The nephron performs the following functions:

(A) Glomerular Filtration (Blood to Tubule)

- Occurs in the **glomerulus** due to high blood pressure.
- Filters out **water, ions, glucose, and waste** while retaining blood cells and proteins.

(B) Tubular Reabsorption (Tubule to Blood)

- In the **PCT, Loop of Henle, and DCT**, essential substances like **glucose, sodium, and water** are reabsorbed into the bloodstream.

(C) Tubular Secretion (Blood to Tubule)

- **Unwanted substances** like hydrogen ions (H^+), potassium (K^+), and toxins are secreted into the tubule for elimination.

(D) Urine Concentration & Excretion

- **Hormones like ADH and Aldosterone** regulate water balance in the **collecting duct**.
- The final urine is collected in the **renal pelvis** and transported via the **ureters** to the bladder for excretion.

Conclusion

The **nephron** plays a crucial role in maintaining **fluid balance, electrolyte levels, pH, and waste removal** through urine formation.

4. Describe artificial respiration.

Methods of Artificial Respiration

(A) Mouth-to-Mouth Respiration (Rescue Breathing)

- The rescuer breathes air directly into the victim's lungs.
- Steps:
    1. Place the victim on their back.
    2. Tilt the head back to open the airway.
    3. Pinch the nose shut and give **one deep breath** into the mouth.
    4. Observe chest rise and repeat every **5–6 seconds** (for adults).

(B) Mouth-to-Nose Respiration

- Used when the mouth cannot be used due to injury.
- Air is blown into the nose while keeping the mouth closed.

(C) Bag-Valve-Mask Ventilation (BVM)

- A **self-inflating bag** connected to a **face mask** and an **oxygen supply**.
- Used in **hospitals, ambulances, and emergency settings** for effective ventilation.

(D) Mechanical Ventilation

- Performed using a **ventilator machine** in ICU settings.
- Provides controlled **oxygen supply** to critically ill patients.

2. Importance of Artificial Respiration

- Prevents **brain damage** due to lack of oxygen.
- Maintains **oxygen circulation** during emergencies.
- Helps revive a patient until **medical help arrives**.

Conclusion

Artificial respiration is a **critical emergency procedure** that can save lives in cases of respiratory failure. It should be performed properly to ensure effective oxygen delivery to the lungs.

5. Write a brief note on Resuscitation methods.

Methods of Resuscitation

(A) Cardiopulmonary Resuscitation (CPR)

- A life-saving technique combining **chest compressions and artificial respiration**.
- Steps:
  1. Check **responsiveness and breathing**.
  2. Call for emergency help.
  3. Perform **30 chest compressions** (at least **100–120 per minute**).
  4. Give **2 rescue breaths** (mouth-to-mouth or with a mask).
  5. Repeat the cycle until professional help arrives.

(B) Mouth-to-Mouth Resuscitation

- Used when the victim has **a pulse but is not breathing**.
- The rescuer breathes into the patient's lungs **every 5–6 seconds**.

(C) Automated External Defibrillator (AED)

- A portable device that **delivers an electric shock** to restart the heart.
- Used in **sudden cardiac arrest (SCA)** to restore normal heart rhythm.

(D) Heimlich Maneuver (Abdominal Thrusts)

- Used to **clear airway obstruction** caused by choking.
- The rescuer **stands behind the victim**, applies forceful inward and upward thrusts below the ribcage to expel the obstruction.

(E) Advanced Life Support (ALS)

- Performed by medical professionals using **oxygen therapy, intubation, IV medications**, and mechanical ventilation.

2. Importance of Resuscitation

- Helps prevent **brain damage** due to oxygen deprivation.
- Increases survival chances in **cardiac and respiratory emergencies**.
- Provides time for **medical assistance to arrive**.

Conclusion

Resuscitation is **crucial in life-threatening situations** and should be performed correctly. **CPR and AED use** are key techniques that can **significantly improve survival rates**.

2 Marks

1. Define Maturation Reflex?

The **micturition reflex** is the process of urination controlled by the **nervous system**. When the bladder fills (~400–500 mL), **stretch receptors** send signals to the **spinal cord (S2–S4)**, triggering the **detrusor muscle to contract** and the **internal sphincter to relax**. Urination occurs when the **external sphincter (voluntary control)** relaxes. The **parasympathetic system** stimulates urination, while the **sympathetic system** helps in urine storage.

2. Role of RAAS system for kidney disorders?

The **Renin-Angiotensin-Aldosterone System (RAAS)** regulates **blood pressure, fluid balance, and electrolyte levels**. In kidney disorders, **overactivation of RAAS** can lead to **hypertension, chronic kidney disease (CKD), and glomerular damage** due to excessive **vasoconstriction and sodium retention**. RAAS inhibitors like **ACE inhibitors and ARBs** help protect kidney function by reducing **blood pressure and proteinuria**.

3. Write about the Regulation of respiration?

Respiration is primarily regulated by the **medulla oblongata** and **pons** in the brainstem, which control the **rate and depth of breathing**. **Chemoreceptors** in the carotid and aortic bodies monitor **CO_2, O_2, and pH levels** in the blood, sending signals to the brain to adjust breathing accordingly. The **respiratory muscles** (diaphragm, intercostals) then adjust the rate of ventilation.

Medulla oblongata (Respiratory center) controls breathing rhythm.

Chemoreceptors in aortic & carotid bodies detect CO_2 levels and pH and adjust breathing rate accordingly.

4. What is the role of Kidneys in Acid-Base balance?

The kidneys help maintain acid-base balance by excreting **hydrogen ions (H^+)** and reabsorbing **bicarbonate ions (HCO_3^-)**. In response to increased acidity (low pH), the kidneys secrete more **H^+** into the urine and reabsorb more **HCO_3^-** to raise blood pH. Conversely, during alkalosis (high pH), they reduce **H^+** secretion and increase **bicarbonate excretion**, helping to lower blood pH.

UNIT – IV

Endocrine System

d) Discuss the Hormones secreted by the Hypothalamus?
Ans: **Hormones Secreted by the Hypothalamus**
The hypothalamus is a crucial part of the brain that links the nervous system to the endocrine system through the pituitary gland. It secretes hormones that regulate various physiological processes, mainly by controlling the activity of the pituitary gland. These hormones are divided into two categories:

1. Releasing Hormones
Releasing hormones stimulate the anterior pituitary to secrete specific hormones.

a) Gonadotropin-Releasing Hormone (GnRH)

- Stimulates the anterior pituitary to release **Luteinizing Hormone (LH)** and **Follicle-Stimulating Hormone (FSH)**.
- **Function**: Regulates reproductive processes, including ovulation and spermatogenesis.

b) Thyrotropin-Releasing Hormone (TRH)

- Stimulates the release of **Thyroid-Stimulating Hormone (TSH)** and prolactin from the anterior pituitary.
- **Function**: Controls thyroid gland activity and influences metabolism.

c) Corticotropin-Releasing Hormone (CRH)

- Stimulates the release of **Adrenocorticotropic Hormone (ACTH)**.
- **Function**: Regulates the adrenal cortex to produce cortisol, aiding in stress response and metabolism.

d) Growth Hormone-Releasing Hormone (GHRH)

- Stimulates the release of **Growth Hormone (GH)** from the anterior pituitary.
- **Function**: Promotes growth, tissue repair, and metabolism.

e) Prolactin-Releasing Hormone (PRH)

- Stimulates the release of **Prolactin**.
- **Function**: Encourages milk production in the mammary glands.

2. Inhibiting Hormones

Inhibiting hormones suppress the secretion of specific anterior pituitary hormones.

a) Growth Hormone-Inhibiting Hormone (GHIH) (Somatostatin)

- Inhibits the release of **Growth Hormone (GH)** and **Thyroid-Stimulating Hormone (TSH)**.
- **Function**: Regulates growth and metabolic rate.

b) Prolactin-Inhibiting Hormone (PIH) (Dopamine)

- Inhibits the release of **Prolactin**.
- **Function**: Prevents milk production when not needed.

3. Hormones Released into the Posterior Pituitary

The hypothalamus produces two hormones that are stored and released by the posterior pituitary.

a) Antidiuretic Hormone (ADH) (Vasopressin)

- **Function**: Regulates water balance by promoting water reabsorption in the kidneys and reducing urine production.

b) Oxytocin

- **Function**: Stimulates uterine contractions during childbirth and promotes milk ejection during breastfeeding.

Functions of Hypothalamic Hormones

1. Regulate the secretion of anterior pituitary hormones.
2. Maintain homeostasis, including temperature, thirst, and hunger.
3. Coordinate responses to stress and reproductive functions.
4. Control circadian rhythms through interactions with other brain regions.

The hypothalamus is central to the endocrine system, acting as the master regulator by linking neural signals to hormonal control.

e) What are the secretions of Pancreas and explain in detail?
Ans: **Secretions of the Pancreas**

The **pancreas** is a dual-function gland, acting as both an **exocrine** and an **endocrine** organ. Its secretions are vital for digestion and regulation of blood glucose levels.

1. Exocrine Secretions

The exocrine pancreas produces digestive enzymes and bicarbonate, which are secreted into the small intestine (duodenum) through the pancreatic duct.

a) Digestive Enzymes

1. **Amylase**:
   - Breaks down carbohydrates into simpler sugars (e.g., maltose).
2. **Lipase**:
   - Digests lipids into glycerol and free fatty acids.
3. **Proteases**:
   - Break down proteins into smaller peptides and amino acids.
   - Includes enzymes such as:
     - **Trypsin** (activated from trypsinogen).
     - **Chymotrypsin** (activated from chymotrypsinogen).
     - **Carboxypeptidase**.
4. **Nucleases**:
   - Degrade nucleic acids (DNA and RNA) into nucleotides.

b) Bicarbonate (HCO_3^-)

- Neutralizes stomach acid in the duodenum.
- Creates an optimal pH for enzyme activity.

2. Endocrine Secretions

The endocrine pancreas consists of **islets of Langerhans**, which secrete hormones directly into the bloodstream to regulate blood glucose levels.

a) Insulin

- Secreted by **beta cells**.
- **Function**: Lowers blood glucose levels by:
  - Facilitating glucose uptake by cells.
  - Promoting glycogen synthesis (glycogenesis) in the liver and muscles.
  - Inhibiting gluconeogenesis and lipolysis.

b) Glucagon

- Secreted by **alpha cells**.
- **Function**: Increases blood glucose levels by:
  - Stimulating glycogen breakdown (glycogenolysis) in the liver.
  - Promoting glucose production (gluconeogenesis).

c) Somatostatin

- Secreted by **delta cells**.
- **Function**: Regulates the secretion of insulin, glucagon, and digestive enzymes, preventing excessive hormone production.

d) Pancreatic Polypeptide

- Secreted by **PP cells** (or F cells).
- **Function**: Regulates pancreatic exocrine and endocrine functions, as well as appetite.

3) Very Short answer type Questions.

a) What is the difference between Exocrine and Endocrine glands?

Ans: -

Aspect	Exocrine Glands	Endocrine Glands
Definition	Glands that release their secretions through ducts to specific locations (e.g., surface of the skin or into body cavities).	Glands that release hormones directly into the bloodstream, without the use of ducts.
Mode of Secretion	Through ducts to external or internal surfaces.	Directly into the bloodstream.
Products Secreted	Enzymes, mucus, sweat, saliva, oil, and digestive juices.	Hormones (chemical messengers).

Explain the classification of hormones based on their chemical nature with examples.

Answer:
Hormones are classified based on their chemical nature as follows:

1. **Peptide/Protein Hormones:**
   - **Made of amino acids.**
   - **Water-soluble and cannot pass through the cell membrane.**
   - **Bind to extracellular receptors and use second messengers.**
   - **Examples: Insulin, Glucagon, Growth hormone (GH).**
2. **Steroid Hormones:**
   - **Derived from cholesterol.**
   - **Lipid-soluble, can pass through the cell membrane.**
   - **Bind to intracellular receptors to regulate gene expression.**
   - **Examples: Cortisol, Testosterone, Estrogen.**
3. **Amino Acid-Derived Hormones:**

- Synthesized from tyrosine or tryptophan.
- Can be water-soluble or lipid-soluble.
- Examples: Adrenaline (epinephrine), Thyroxine (T4), Melatonin.

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2. Describe the mechanism of hormone action with reference to second messengers and intracellular receptors.

Answer:
The mechanism of hormone action is categorized into:

1. **Hormones Acting via Second Messengers (Water-Soluble Hormones):**
    - These hormones bind to surface receptors.
    - They activate second messengers like cAMP (cyclic AMP), Ca^{2+}, or IP3 inside the cell.
    - This leads to enzyme activation and physiological effects.
    - Example: Adrenaline stimulates cAMP for glycogen breakdown.
2. **Hormones Acting via Intracellular Receptors (Lipid-Soluble Hormones):**
    - These hormones enter the cell and bind to intracellular receptors.
    - The hormone-receptor complex interacts with DNA and regulates gene expression.
    - Example: Cortisol regulates metabolism by altering gene expression.

---

3. Explain the structure and functions of the pituitary gland.

Answer:

- The pituitary gland, also called the "master gland," is located at the base of the brain.
- It has two lobes:
    1. **Anterior Pituitary (Adenohypophysis) – Secretes:**
        - Growth Hormone (GH) – Stimulates growth.

- Prolactin (PRL) – Milk production.
- Thyroid-Stimulating Hormone (TSH) – Regulates thyroid.
- Adrenocorticotropic Hormone (ACTH) – Stimulates adrenal cortex.
- Luteinizing Hormone (LH) & Follicle-Stimulating Hormone (FSH) – Control reproduction.

2. Posterior Pituitary (Neurohypophysis) – Stores and releases:
    - Oxytocin – Uterine contraction during childbirth.
    - Antidiuretic Hormone (ADH) – Water retention by kidneys.

Disorders:

- Gigantism/Acromegaly (Excess GH)
- Dwarfism (Deficiency of GH)

5-Mark Questions (Short Answer)

1. Differentiate between peptide hormones and steroid hormones with examples.

Answer:

Feature	Peptide Hormones	Steroid Hormones
Nature	Protein-based	Derived from cholesterol
Solubility	Water-soluble	Lipid-soluble
Receptor Location	Cell membrane	Inside the cell
Action Mechanism	Second messengers	Direct gene regulation
Example	Insulin, Glucagon	Cortisol, Testosterone

---

2. Explain the role of the pancreas as an endocrine gland and discuss its disorders.

Answer:

- **The pancreas has Islets of Langerhans, which secrete:**
  - **Insulin (β-cells): Lowers blood sugar.**
  - **Glucagon (α-cells): Raises blood sugar.**

Disorders:

- **Diabetes Mellitus (Type 1 & Type 2) – Caused by insulin deficiency or resistance.**
- **Hypoglycemia – Low blood sugar due to excess insulin.**

---

3. Write a short note on the pineal gland and its function in regulating biological rhythms.

Answer:

- **The pineal gland is located in the brain.**
- **It secretes melatonin, which regulates the sleep-wake cycle (circadian rhythm).**
- **It responds to light and dark signals from the environment.**

Disorder:

- **Disrupted melatonin levels can cause sleep disorders and seasonal affective disorder (SAD).**

---

4. Describe the functions of the thymus gland and its role in immunity.

Answer:

- **The thymus is located behind the sternum.**
- **It produces Thymosin, which helps in T-cell maturation for immune response.**
- **It is active in childhood and shrinks in adults.**

Disorder:

- **Thymic hypoplasia can lead to weak immunity.**

---

5. Discuss the disorders caused by hypo- and hypersecretion of thyroid hormones.

Answer:

- **Hypothyroidism (Low Thyroid Hormone)**
  - **Caused by iodine deficiency.**
  - **Symptoms: Weight gain, fatigue, slow metabolism.**
  - **Disorder: Goiter, Cretinism (children), Myxedema (adults).**
- **Hyperthyroidism (Excess Thyroid Hormone)**
  - **Symptoms: Weight loss, high metabolism, sweating.**
  - **Disorder: Graves' Disease (autoimmune).**

1-Mark Questions (Objective/Short Answer)

1. **Which hormone regulates blood sugar levels?**
   - **Answer: Insulin**
2. **Name the hormone responsible for regulating the sleep-wake cycle.**
   - **Answer: Melatonin**
3. **What is the main function of parathyroid hormone (PTH)?**
   - **Answer: Regulates calcium levels in the blood**
4. **Which part of the adrenal gland secretes adrenaline?**
   - **Answer: Adrenal medulla**
5. **What is the full form of TSH?**
   - **Answer: Thyroid-Stimulating Hormone**
6. **Name the gland also known as the "master gland."**
   - **Answer: Pituitary gland**
7. **Which hormone is responsible for the fight-or-flight response?**

- Answer: Adrenaline

8. What disorder is caused by insulin deficiency?
   - Answer: Diabetes mellitus
9. Name the disease caused by excess cortisol production.
   - Answer: Cushing's syndrome
10. What is the function of oxytocin?

- Answer: Stimulates uterine contractions during childbirth

UNIT – V

Reproductive System

1. Describe the anatomy and functions of the male reproductive system.

Answer:
The male reproductive system consists of:

1. Primary Sex Organs (Testes)
   - Produce sperm via spermatogenesis.
   - Secrete testosterone, responsible for male secondary sexual characteristics.
2. Accessory Glands
   - Seminal Vesicles: Secrete fructose-rich fluid for sperm nourishment.
   - Prostate Gland: Produces alkaline fluid to neutralize vaginal acidity.
   - Bulbourethral Glands: Secrete mucus for lubrication.
3. Duct System
   - Epididymis: Stores and matures sperm.
   - Vas Deferens: Transports sperm to the urethra.
   - Urethra: Common passage for semen and urine.
4. External Genitalia

- **Penis: Facilitates sperm transfer during intercourse.**
- **Scrotum: Regulates temperature for optimal sperm production.**

---

2. Explain the physiology of menstruation and the hormonal changes involved.

Answer:
The menstrual cycle lasts 28 days and has four phases:

1. **Menstrual Phase (Days 1-5)**
    - **Shedding of the endometrial lining occurs.**
    - **Estrogen & progesterone levels are low.**
2. **Follicular Phase (Days 6-14)**
    - **FSH (Follicle-Stimulating Hormone) stimulates follicle growth.**
    - **The growing follicle secretes estrogen, thickening the endometrium.**
3. **Ovulation (Day 14)**
    - **LH (Luteinizing Hormone) surge triggers ovulation (release of the egg).**
4. **Luteal Phase (Days 15-28)**
    - **The ruptured follicle forms the corpus luteum, secreting progesterone.**
    - **If fertilization occurs, pregnancy begins. If not, menstruation starts again.**

---

3. Explain the process of fertilization and early embryonic development.

Answer:

- **Fertilization occurs in the fallopian tube when a sperm fuses with an egg.**
- **The sperm penetrates the zona pellucida of the ovum using enzymes from the acrosome.**
- **Once a sperm enters, the ovum completes meiosis II, and a zygote is formed.**
- **The zygote undergoes cleavage (rapid mitotic divisions) and forms a blastocyst.**

- The blastocyst implants into the uterine wall, marking the beginning of pregnancy.

5-Mark Questions (Short Answer)

1. Describe the structure and functions of the female reproductive system.

Answer:
The female reproductive system includes:

1. **Ovaries**
   - Produce ova (eggs) and secrete estrogen and progesterone.
2. **Fallopian Tubes**
   - Site of fertilization and transport of the fertilized egg to the uterus.
3. **Uterus**
   - Supports embryo implantation and fetal development.
4. **Vagina**
   - Birth canal and site of sperm deposition.
5. **External Genitalia (Vulva)**
   - Includes labia, clitoris, and vestibule for protection and stimulation.

---

2. What are the differences between spermatogenesis and oogenesis?

Answer:

Feature	Spermatogenesis	Oogenesis
Location	Testes	Ovaries
Time of initiation	Begins at puberty	Begins before birth
Number of gametes	Produces millions of sperm daily	Produces one ovum per cycle

Feature	Spermatogenesis	Oogenesis
Completion	Continuous throughout life	Stops at menopause
Outcome	Four haploid sperm	One haploid ovum + 3 polar bodies

---

3. Explain the role of sex hormones in males and females.

Answer:

- **Male Sex Hormones**
    - **Testosterone: Develops male secondary sexual characteristics, stimulates sperm production.**
- **Female Sex Hormones**
    - **Estrogen: Regulates the menstrual cycle, maintains secondary sexual characteristics.**
    - **Progesterone: Prepares the uterus for pregnancy, maintains pregnancy.**
    - **FSH & LH: Regulate ovulation and menstrual cycle.**

---

4. What are the stages of pregnancy and their key developments?

Answer:

1. **First Trimester (0-12 weeks)**
    - **Organogenesis (formation of organs).**
    - **Heartbeat starts by the 5th week.**
2. **Second Trimester (13-26 weeks)**
    - **Fetal movements felt.**
    - **Organ systems mature.**
3. **Third Trimester (27-40 weeks)**

- Rapid growth.
- Lungs mature.
- Baby prepares for birth.

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5. Explain the process of parturition (childbirth).

Answer:

- **Stage 1 (Dilation Stage):**
  - Uterine contractions begin.
  - Cervix dilates to 10 cm.
- **Stage 2 (Expulsion Stage):**
  - Baby moves through the birth canal.
  - Mother pushes, and baby is delivered.
- **Stage 3 (Placental Stage):**
  - Placenta is expelled after childbirth.
  - Oxytocin helps with uterine contractions.

1-Mark Questions (Objective/Short Answer)

1. **Where does fertilization occur in the female reproductive system?**
   - Answer: Fallopian tube
2. **Which hormone triggers ovulation?**
   - Answer: Luteinizing Hormone (LH)
3. **What is the function of the corpus luteum?**
   - Answer: Secretes progesterone to maintain pregnancy
4. **Name the hormone responsible for milk production.**

- **Answer: Prolactin**

5. **What is the process of sperm formation called?**
   - **Answer: Spermatogenesis**
6. **Which hormone maintains pregnancy?**
   - **Answer: Progesterone**
7. **What is the term for the fusion of sperm and egg?**
   - **Answer: Fertilization**
8. **What is the gestation period of a human pregnancy?**
   - **Answer: 9 months (about 40 weeks)**
9. **Which structure carries sperm from the testes to the urethra?**
   - **Answer: Vas deferens**
10. **Which organ produces estrogen in females?**

- **Answer: Ovaries**

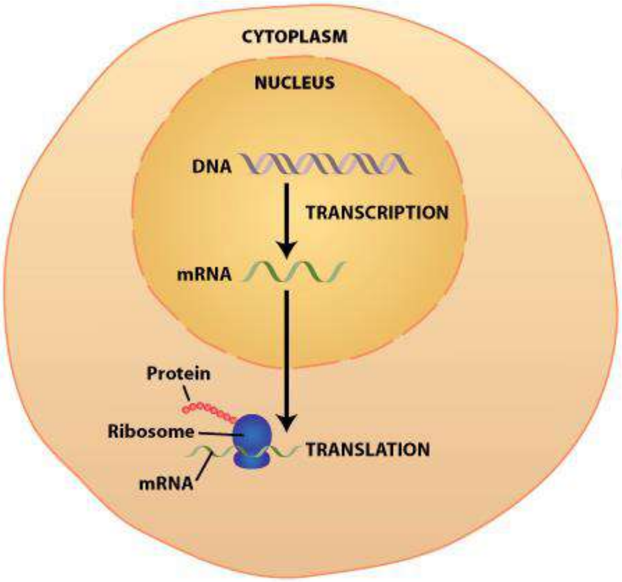
GENETICS

10 MARKS

1. **Give a detail view on protein synthesis.**

Protein Synthesis

Protein synthesis is the process by which cells create **proteins** based on the instructions encoded in the DNA. This occurs in two major stages: **Transcription** and **Translation**.



1. Transcription (DNA to mRNA)

Transcription is the process of copying the genetic information from **DNA** into **messenger RNA (mRNA)**.

- **Location**: Occurs in the **nucleus** in eukaryotic cells.
- **Steps**:
    1. **Initiation**: The enzyme **RNA polymerase** binds to the **promoter region** of a gene on the DNA.
    2. **Elongation**: RNA polymerase moves along the DNA strand, unwinding it and synthesizing the mRNA strand by adding complementary RNA bases (A-U, T-A, C-G, G-C).
    3. **Termination**: When RNA polymerase reaches the **terminator sequence**, the mRNA strand is released.

The resulting mRNA is a complimentary copy of the gene, which carries the genetic code out of the nucleus into the cytoplasm.

2. mRNA Processing (Eukaryotic Cells)

Before mRNA leaves the nucleus, it undergoes several modifications:

- **5' capping**: A protective cap is added to the 5' end.
- **Poly-A tail addition**: A string of adenine nucleotides (poly-A tail) is added to the 3' end.
- **Splicing**: Non-coding regions (introns) are removed, and the remaining coding regions (exons) are joined together.

The processed mRNA is now ready for **translation**.

3. Translation (mRNA to Protein)

Translation is the process where mRNA is used as a template to synthesize a **protein**. This occurs in the **cytoplasm** on **ribosomes**.

- **Location**: Takes place in the **cytoplasm**, specifically on the **ribosomes**.
- **Involved Components**:
  - **mRNA**: Contains the genetic code for the protein.
  - **tRNA (Transfer RNA)**: Carries amino acids to the ribosome.
  - **Ribosomes**: The site of protein synthesis, composed of rRNA and proteins.

Steps of Translation:

1. **Initiation**:
   - The **small ribosomal subunit** binds to the **mRNA** at the **start codon** (AUG).
   - The first **tRNA** molecule, carrying the amino acid **methionine**, binds to the start codon.
   - The **large ribosomal subunit** binds, forming a complete ribosome.
2. **Elongation**:
   - **tRNA molecules** with specific amino acids enter the ribosome.
   - The **anticodon** of the tRNA pairs with the **codon** of the mRNA.
   - The ribosome moves along the mRNA, linking the amino acids together through **peptide bonds**.
3. **Termination**:
   - When the ribosome reaches a **stop codon** (UAA, UAG, or UGA) on the mRNA, the process ends.
   - A **release factor** binds to the stop codon, causing the ribosome to release the newly formed protein.

4. Post-Translational Modifications

After translation, the protein may undergo several modifications:

- **Folding**: The protein folds into its **functional three-dimensional shape**.
- **Cleavage**: Some proteins are activated by cleavage, such as **insulin**.
- **Phosphorylation**: Addition of phosphate groups can activate or deactivate the protein.
- **Glycosylation**: Addition of carbohydrate chains.

These modifications are essential for the **final functionality** of the protein.

Conclusion

Protein synthesis is a crucial biological process that translates genetic information into functional molecules, allowing cells to produce the wide variety of proteins necessary for life. This process is highly regulated and involves the coordinated action of multiple cellular components.

2 MARKS

1. **Define gene?**

A **gene** is a segment of DNA that contains the instructions for synthesizing proteins or RNA molecules. Genes are the functional units of heredity, and they determine specific traits and characteristics in an organism.

- **Structure of Genes**: A gene consists of a **promoter region** (initiates transcription), a **coding sequence** (which is transcribed into RNA), and a **terminator region** (signals the end of transcription).

Function of Genes: - Genes direct the synthesis of proteins through a process known as **gene expression**.

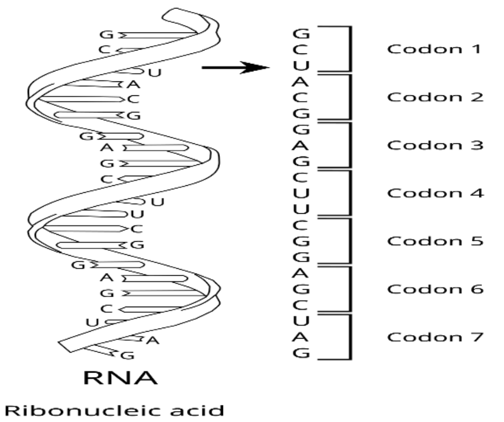
- **Transcription**: The gene's DNA sequence is transcribed into messenger RNA (**mRNA**).
- **Translation**: The mRNA is translated into a specific sequence of amino acids, forming a **protein**.

Proteins are responsible for most cellular functions, from catalyzing metabolic reactions to providing structural support to cells.

2. **Define DNA?**

DNA is a **molecule** that carries the genetic instructions used in the growth, development, functioning, and reproduction of all living organisms. It is made up of two long chains of **nucleotides** twisted into a double helix structure. Each nucleotide consists of a **sugar**, a **phosphate group**, and a **nitrogenous base** (adenine, thymine, cytosine, or guanine). DNA consists of two strands running in opposite directions, held together by **hydrogen bonds** between complementary nitrogenous bases:

- **Adenine (A)** pairs with **Thymine (T)**.
- **Cytosine (C)** pairs with **Guanine (G)**.



The backbone of DNA is formed by the **sugar-phosphate** chain, with the nitrogenous bases extending inward, forming the "rungs" of the helix.

3. Define Chromosomes?

Chromosomes are thread-like structures made of **DNA and proteins** found in the nucleus of eukaryotic cells. They carry genetic information in the form of genes. Humans have **46 chromosomes** (23 pairs), with one set inherited from each parent. Chromosomes are essential for **cell division**, as they ensure the accurate distribution of genetic material during **mitosis** and **meiosis**.

4. Define Genetic Pattern of inheritance?

Genetic pattern of inheritance refers to the way in which **traits** and **genes** are passed from parents to offspring through generations. These patterns are governed by the principles of **Mendelian genetics**, which include **dominant and recessive traits**, and can be categorized into patterns such as **autosomal dominant, autosomal recessive, X-linked**, and **co-dominance**, among others. The inheritance is determined by **alleles**, which are different forms of a gene.

5. Define mutations in DNA?

Mutations are changes in the DNA sequence that can affect gene function. They can occur spontaneously or be caused by environmental factors like radiation or chemicals. Mutations can lead to changes in protein structure and function, which may result in diseases or disorders.

6. What is the Role of DNA in Heredity?

DNA is passed from **parents to offspring**, transmitting genetic information and ensuring the inheritance of traits. This is facilitated by the processes of **DNA replication** and **cell division**:

- During **replication**, the DNA is copied, ensuring that each new cell gets an identical copy of the genetic material.
- In **meiosis**, DNA is reorganized and distributed to form **gametes** (sperm and eggs), contributing to genetic diversity in offspring.