B. Pharmacy 1st semester - Human Anatomy and Physiology 1** Notes**

UNIT – 2

Points to be covered in this topic

→ 1. INTEGUMENTARY SYSTEM 🌟 → 2. SKELETAL SYSTEM 🦴
→ 3. JOINTS 🔗

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1. INTEGUMENTARY SYSTEM 🌟

Structure and Functions of Skin

INTRODUCTION 📖

- Skin is the **largest organ** in the body.
- It forms a **protective covering** for the body which is in contact with the external environment.
- Skin plays an **important role** in the regulation of body temperature.
- Skin consists of **two layers**:
  - i. The outer layer is called **epidermis**
  - ii. The inner layer is called **dermis**

STRUCTURE OF SKIN 🪜

▶ EPIDERMIS

- It is the **outer layer** of the skin.

- It is composed of **stratified squamous epithelium**.
- Epidermis is divided into **five layers**, namely:

Layer No.	Layer Name	Characteristics
1	Stratum corneum	Most superficial layer; Contains keratin; Nuclei are absent
2	Stratum lucidum	Thin, transparent, glistening layer; Contains cytoplasm
3	Stratum granulosum	Contains spindle-shaped cells; Cytoplasm and nucleus present
4	Stratum spinosum	Contains polyhedral cells
5	Stratum germinativum	Single layer of columnar/cuboidal cells; Contains melanin pigments; Connected to dermis

1) STRATUM CORNEUM 💎

- This is the **most superficial layer**
- **Keratin** is present in the cells.
- The **nuclei are absent**.

2) STRATUM LUCIDUM ✨

- This is a **thin, more or less transparent, glistening layer**
- The cell contains **cytoplasm**.

3) STRATUM GRANULOSUM 🔬

- This layer contains **spindle-shaped cells**.
- The **cytoplasm and nucleus** are present in these cells.

4) STRATUM SPINOSUM 🏢

- It contains **polyhedral cells**.

5) STRATUM GERMINATIVUM 🌱

- This layer is composed of **single layer of columnar epithelium or cuboidal cells**.
- This layer is **connected to the dermis**
- **Melanin pigments** are present in this layer.

❑ DERMIS 🧬

- It is composed of **connective tissue** and is **highly vascular**.
- It is made up of **fibroelastic tissue** which maintains the texture of the skin.

▶ Glands of the dermis: 🏭

1. **Sebaceous gland**
2. **Sweat gland**
3. **Ceruminous gland**
4. **Hair roots and erector pili muscles**

1) SEBACEOUS GLAND 🧵

- They are **flask shaped glands**.

- They secrete an **oil-like material called sebum**
- They have a **duct which opens into a hair follicle**.
- It **prevents excess evaporation** of water from the skin and prevents drying of skin.
- Sebaceous glands are present in the skin of many parts of the body **except skin of palms of hands and soles of feet**.

2) SWEAT GLAND 💧

- There are **two types** of sweat glands **Eccrine glands and Apocrine glands**.
- **Eccrine glands** are present **all over the body**.
- **Apocrine glands** are present in **axilla, female genitalia and round the nipples**.
- **Eccrine glands** secrete **watery sweat** and **apocrine glands** secrete **milky sweat**.

3) CERUMINOUS GLAND 👂

- They secrete **wax in the external ear**.

4) HAIR ROOTS AND ERECTOR PILI MUSCLES 💪

- **Contraction** of these muscles produces **straightening of the hair**.

FUNCTIONS OF SKIN 🎯

1. The skin **protects the body** against injury and bacterial invasion.
2. It **regulates body temperature**.

3. The skin serves as a **medium for receiving the sensations** like touch, pressure and temperature.
4. It **excretes sodium chloride** and metabolites like urea.
5. It **maintains water and electrolyte balance**.
6. The skin **synthesizes vitamin D** from ergosterol of skin by the action of ultraviolet rays of sunlight.
7. It **synthesizes melanin** from tyrosine.
8. It **secretes sweat and sebum** which keeps the skin soft.
9. It **stores fat, water, chlorides and sugar**.

REGULATION OF BODY TEMPERATURE 🌡️

- The **normal body temperature** is **98.4°F (37°C)**.
- The normal body temperature is maintained by a **balance between heat production and heat loss**.
- Body temperature is controlled by **Heat regulating centre** present in the **hypothalamus**.

HEAT PRODUCTION 🔥

1. During **severe exercise**, by the increased activity of muscles.
2. By the **increased activity of liver** and other glands in the body.
3. **Increased intake of food** (proteins).
4. **Increased metabolism**, like oxidation of food stuffs and combustion of fat.
5. **Endocrine secretions** like adrenaline and noradrenaline.

HEAT LOSS ❄️

1. **Radiation**, body heat (temperature) is lost to the surrounding air.
2. **Conduction**, body heat is lost through clothing, bedding etc.
3. **Convection**, the hot air around the body moves up and it is replaced by cool air, and thus body heat is lost.
4. **Sweating**, the skin becomes cool and this leads to heat loss.
5. **Evaporation** of water from the skin, mucous membranes and respiratory passages, the body heat is lost.

Disorders of Integumentary System ⚠️

- **Acne** - Blocked skin follicles that lead to oil, bacteria and dead skin buildup in your pores.
- **Alopecia areata** - Losing your hair in small patches.
- **Atopic dermatitis (eczema)** - Dry, itchy skin that leads to swelling, cracking or scaliness.
- **Psoriasis** - Scaly skin that may swell or feel hot.
- **Raynaud's phenomenon** - Periodic reduced blood flow to your fingers, toes or other body parts, causing numbness or skin colour change.
- **Rosacea** - Flushed, thick skin and pimples, usually on the face.
- **Skin cancer** - Uncontrolled growth of abnormal skin cells.
- **Vitiligo** - Patches of skin that lose pigment.

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2. SKELETAL SYSTEM 🦴

Divisions of Skeletal System 🗂️

The skeletal system is divided into **two main divisions**:

1. **Axial Skeleton**
2. **Appendicular Skeleton**

❖ AXIAL SKELETON 📐

- Forms the **central axis** of the body
- Includes:
  - **Skull**
  - **Vertebral column**
  - **Rib cage**

❖ APPENDICULAR SKELETON 🦾

- Includes the **limbs** and their **attachments**
- Components:
  - **Upper limbs** (arms, forearms, hands)
  - **Lower limbs** (thighs, legs, feet)
  - **Pectoral girdle** (shoulder girdle)
  - **Pelvic girdle** (hip girdle)

Types of Bone 🧬

Based on Shape: 📏

1. **Long bones** - Found in limbs (femur, humerus)

2. **Short bones** - Found in wrists and ankles
3. **Flat bones** - Found in skull, ribs, sternum
4. **Irregular bones** - Vertebrae, some facial bones
5. **Sesamoid bones** - Patella (kneecap)

Based on Structure: 🔬

1. **Compact bone** - Dense, solid bone tissue
2. **Spongy bone** - Contains spaces filled with bone marrow

Salient Features and Functions of Bones

System	Major Bones	Functions
Axial Skeleton	Skull, Vertebrae, Ribs, Sternum	Protection of vital organs, Support for body axis
Appendicular Skeleton	Limb bones, Girdles	Movement, Support for appendages

❖ AXIAL SKELETON FUNCTIONS 🛡️

- **Protection** of brain, spinal cord, and thoracic organs
- **Support** for the head, neck, and trunk
- **Attachment site** for muscles
- **Maintenance** of upright posture

❖ APPENDICULAR SKELETON FUNCTIONS 🤸

- **Locomotion** and movement
- **Manipulation** of environment

- **Support** of body weight during movement
- **Attachment** for muscles of limbs

Organization of Skeletal Muscle 💪

❖ MUSCLE FIBER ORGANIZATION 🧬

- **Muscle fibers** are arranged in **bundles called fascicles**
- **Fascicles** are wrapped by **perimysium**
- **Individual muscle fibers** are surrounded by **endomysium**
- **Entire muscle** is covered by **epimysium**

❖ MUSCLE FIBER STRUCTURE 🔬

- Contains **myofibrils** - contractile elements
- **Myofibrils** contain **actin** and **myosin** filaments
- **Sarcomeres** - functional units of muscle contraction
- **Sarcoplasmic reticulum** - stores calcium ions

Physiology of Muscle Contraction ⚡

❖ SLIDING FILAMENT THEORY 🔄

1. **Muscle stimulation** by nerve impulse
2. **Calcium release** from sarcoplasmic reticulum
3. **Calcium binds** to troponin
4. **Tropomyosin shifts** exposing binding sites
5. **Myosin heads bind** to actin (cross-bridge formation)

6. **Power stroke** - myosin pulls actin filaments
7. **ATP hydrolysis** provides energy
8. **Muscle relaxation** when calcium returns to sarcoplasmic reticulum

❖ TYPES OF MUSCLE CONTRACTION 🏋️

1. **Isotonic contraction** - Muscle changes length
   - **Concentric** - muscle shortens
   - **Eccentric** - muscle lengthens
2. **Isometric contraction** - Muscle tension without length change

Neuromuscular Junction 🔌

❖ STRUCTURE 🧬

- **Motor neuron** - carries nerve impulse
- **Synaptic cleft** - gap between nerve and muscle
- **Motor end plate** - specialized region of muscle fiber
- **Acetylcholine receptors** - on muscle membrane

❖ MECHANISM OF TRANSMISSION ⚡

1. **Action potential** reaches motor neuron terminal
2. **Calcium channels** open
3. **Acetylcholine** released into synaptic cleft
4. **ACh binds** to receptors on muscle membrane
5. **Sodium channels** open causing depolarization
6. **Action potential** spreads across muscle fiber

7. **Acetylcholinesterase** breaks down ACh
8. **Muscle contraction** initiated

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3. JOINTS 🔗

Structural and Functional Classification 📋

❖ STRUCTURAL CLASSIFICATION 🏗️

Based on **material binding bones** and **presence of joint cavity**:

1. **Fibrous Joints**
   - Bones connected by **fibrous connective tissue**
   - **No joint cavity**
   - Generally **immovable**
2. **Cartilaginous Joints**
   - Bones connected by **cartilage**
   - **No joint cavity**
   - **Slightly movable**
3. **Synovial Joints**
   - Bones separated by **joint cavity**
   - **Freely movable**
   - Most **complex** joint type

❖ FUNCTIONAL CLASSIFICATION ⚙️

Based on **degree of movement**:

Type	Movement	Examples
Synarthroses	Immovable	Skull sutures, tooth sockets
Amphiarthroses	Slightly movable	Vertebral joints, pubic symphysis
Diarthroses	Freely movable	Shoulder, knee, elbow

Types of Joints 🎯

1. FIBROUS JOINTS 🪚

- **Sutures** - Found in skull
- **Syndesmoses** - Bones connected by ligaments
- **Gomphoses** - Tooth in socket

2. CARTILAGINOUS JOINTS 🏒

- **Synchondroses** - Connected by hyaline cartilage
- **Symphyses** - Connected by fibrocartilage

3. SYNOVIAL JOINTS 🦴

Most **complex** and **movable** joints

Components:

- **Joint cavity** - Space between bones
- **Articular cartilage** - Covers bone ends
- **Synovial membrane** - Lines joint cavity
- **Synovial fluid** - Lubricates joint
- **Joint capsule** - Surrounds joint

- **Ligaments** - Strengthen joint

Types of Joint Movements 🔁

❖ ANGULAR MOVEMENTS 📐

- **Flexion** - Decreasing joint angle
- **Extension** - Increasing joint angle
- **Hyperextension** - Extension beyond anatomical position
- **Abduction** - Movement away from midline
- **Adduction** - Movement toward midline

❖ ROTATIONAL MOVEMENTS 🌀

- **Rotation** - Movement around longitudinal axis
- **Circumduction** - Circular movement combining flexion, extension, abduction, adduction

❖ SPECIAL MOVEMENTS ⭐

- **Pronation** - Turning palm downward
- **Supination** - Turning palm upward
- **Inversion** - Turning sole inward
- **Eversion** - Turning sole outward
- **Protraction** - Moving forward
- **Retraction** - Moving backward
- **Elevation** - Moving upward
- **Depression** - Moving downward

Joint Articulations 🎪

❖ MAJOR JOINT ARTICULATIONS 🏆

Upper Limb:

- **Shoulder joint** - Ball and socket (glenohumeral)
- **Elbow joint** - Hinge joint
- **Wrist joint** - Condyloid joint

Lower Limb:

- **Hip joint** - Ball and socket (coxofemoral)
- **Knee joint** - Modified hinge joint
- **Ankle joint** - Hinge joint

Axial Skeleton:

- **Atlanto-occipital joint** - Condyloid joint
- **Atlantoaxial joint** - Pivot joint
- **Vertebral joints** - Various types

❖ JOINT STABILITY FACTORS 🔒

1. **Shape of articular surfaces**
2. **Ligaments** - Primary stabilizers
3. **Muscle tone** - Dynamic stability
4. **Atmospheric pressure** - Minor factor

❖ JOINT DISORDERS ⚠️

- **Arthritis** - Joint inflammation
- **Osteoarthritis** - Degenerative joint disease
- **Rheumatoid arthritis** - Autoimmune joint disease
- **Dislocation** - Bone displacement from joint
- **Sprain** - Ligament injury
- **Bursitis** - Inflammation of bursae

Summary 📚

This unit covers the **integumentary system** with detailed skin structure and functions, the **skeletal system** including bone types and muscle physiology, and comprehensive **joint classification** with movement types and articulations. Understanding these systems is crucial for comprehending human anatomy and physiology fundamentals.