

# CURRICULUM

## I MBBS

### ANATOMY

#### **HUMAN ANATOMY**

##### **(i) GOAL:**

The broad goal of the teaching of undergraduate students in Anatomy aims at providing comprehensive knowledge of the gross and microscopic structure and development of human body to provide a basis for understanding the clinical correlation of organs of structures involved and the anatomical basis for the disease presentations.

##### **(ii) OBJECTIVES:**

###### **(A) KNOWLEDGE:**

At the end of the course the student shall be able to:

(a) Comprehend the normal disposition, clinically relevant interrelationships, functional and cross sectional anatomy of the various structures in the body;

(b) Identify the microscopic structure and correlate elementary ultra structure of various organs and tissues and correlate the structure with the functions as a prerequisite for understanding the altered state in various disease processes;

(c) Comprehend the basic structure and connections of the central nervous system to analyze the integrative and regulative functions of the organs and systems. He/She shall be able to locate the site of gross lesions according to the deficits encountered.

(d) Demonstrate knowledge of the basic principles and sequential development of the organs and systems; recognize the clinical stages of development and the effects of common teratogens. He/She shall be able to explain the developmental basis of the major variations and abnormalities.

###### **(B) SKILLS:**

At the end of the course the student shall be able to:

- a) Identify and locate all the structures of the body and mark the topography of the living anatomy.
- b) Identify the organs and tissues under the microscope;
- c) Understand the principles of karyotyping and identify the gross congenital anomalies;

- d) Understand the principles of newer imaging techniques like Ultra sound, Computerised Tomography Scan, Interpretation of plain and contrast X - rays.
- e) Understand clinical basis of some common clinical procedures i.e.intre-muscular and intravenous injection, lumbar puncture, kidney biopsy etc.

**(B) INTEGRATION:**

From the integrated teaching of other basic sciences, student shall be able to comprehend the regulation and integration of the functions of the organs and systems in the body and thus interpret the anatomical basis of disease processes.

**SYLLABUS - PAPER - I**

The course in Human Anatomy is to provide an understanding of the structure of the human body as a foundation for the scientific study and practice of medicine.

**GENERAL ANATOMY: The word "Anatomy" denotes "Applied Anatomy"**

Descriptive terms

General features and classification of bones

General features and classification of joints

General features and classification of tissues

General features of muscle and fascia

General features of nerves and Organisation of nervous tissue

**GROSS ANATOMY**

Dissections of important areas to be done; Prosected specimens could replace the rest of the dissections.

Detailed origin and insertion of muscles to be replaced by essential attachments and emphasis to be placed on the understanding of the function.

**Upper and Lower Extremities**

Muscles	Names; Location; Essential attachments; important Relations, Blood supply; Nerve supply and Action
Joints	Names; Types of joints; Movements; Muscles Responsible

**Equal emphasis for all joints of the extremities**

<b>Vessels and Nerves</b>	Commencement, Course and Termination of vessels important relations and distribution. Commencement, Course and Termination of nerves Root value, relations and distribution.
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<b>Lymphatics</b>	Knowledge of lymphnodes; areas of drainage
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## **Emphasis on important areas of venous and lymphatic drainage**

**Osteology** Names of bones and side identification; parts and attachments; Growing ends. Important centres of ossification.

**In all areas, relevant and necessary applied and clinical aspects to be told and emphasized upon**

### **ABDOMEN AND PELVIS**

**Abdominal wall viscera** Anterior Abdominal wall; Inguinal canal; Posterior Abdominal wall; Peritoneal cavity – Greater and lesser sacs Peritoneal ligaments; Sub-diaphragmatic spaced pelvic floor and Ischiorectal fossa Basic knowledge of perineal spaces Name; Position; Important peritoneal and other Relations; Blood supply; Nerve supply; Histology and Microstructure portal vein and porta-systemic Anastomosis Important arteries; Inferior venacava.

**OSTEOLOGY** Sacrum and Coccyx Features of Typical and Atypical lumbar vertebra Bony pelvis – sex determination & diameters

### **PAPER II**

#### **THORAX:**

**Thoracic cage** Walls of thorax; Names and Types of joints of Thorax; Mediastium – sub divisions, boundaries and Contents (including Heart and Pericardium)  
Lungs and Pleura  
Diaphragm

**Osteology** Features of typical and atypical thoracic vertebrae  
Features of typical and atypical ribs  
Features of sternum

#### **HEAD AND NECK:**

**Scalp & Neck** Scalp Face Sub- occipital triangle Anterior & Posterior triangles of neck. Structures in the neck

**Cranial cavity** Cranial fossae and structures related Duramater and dural venous sinuses Parotid region Temporal and  
**Other areas** Infra-temporal fossae Submandibular region Mouth;

	Tongue; Palate; Pharynx; Larynx; Nose and nasal cavity; Para-nasal air sinuses; Orbit; Eyeball; Organs of Hearing & Equilibrium
<b>Vessels and Lymphatics</b>	The blood vessels and lymphatics of Head and Neck
<b>Autonomic Nervous System</b>	Nerves – Cranial nerves and plexuses Ganglia; Outflow of ANS and distribution
<b>Osteology</b>	Names & Location of bones of skull; Bony cranial cavity sub divisions; foraminae; Bony fossae, Features of typical & atypical cervical vertebrae
	<b>BRAIN AND SPINAL CORD:</b>
<b>Spinal cord</b>	Spinal cord & Meninges Parts & Tracts of spinal cord, blood supply Brain & Meninges, blood supply Parts of brain and functional components Base of brain; hind brain; mid brain; Diencephalon; Cerebrum; Cerebellum.
	<b>EMBRYOLOGY:</b>
<b>General Embryology</b>	Oogenesis; Spermatogenesis; Fertilization Bilaminar and Trilaminar germ discs; Embryonic period; Placenta; Amnion; Umbilical cord Organogenesis; Basic teratology; Twinning
<b>Special Embryology</b>	Gastro-intestinal system and spleen Urinary and genital systems Diaphragm Heart & Aortic arch derivatives Respiratory system Face; Palate; Tongue; Brachial apparatus, Endocrine system, Vertebral column, Parts of neural tube & derivatives, Visual and auditory apparatuses. Outline of development of limbs
	<b>HISTOLOGY:</b>
<b>General Histology</b>	Cell; Epithelia; Glands; Connective tissue; Cartilage; Bone; Muscle; Nervous tissue Lymphoid tissue; Skin and its appendages
<b>Special Histology</b>	Respiratory system; Vascular system; Salivary glands & Gastro-intestinal system Urinary system

Reproductive system (male & female) Endocrine system; Muco-cutaneous junctions; Eye lid and parts of eyeball; Olfactory epithelium; Taste buds; Internal ear; CNS – Medulla, Pons, Mid brain, Cerebellum, Cerebrum, Spinal cord, Nerve ganglia.

### **GENETICS:**

Structure of chromosome; Karyotyping; Chromosomal aberrations (Numerical & Structural); Structure of gene; Mutation; Single gene inheritance; Autosomal Inheritance; Sex linked inheritance.

### **SURFACE ANATOMY:**

<b>Extremities</b>	Bony landmarks, SM of important vessels and nerves.
<b>Abdomen</b>	Regions and Planes of Abdomen. SM of superficial and deep inguinal rings SM of Stomach, Liver fundus of Gallbladder, Spleen, Duodenum Pancreas, IC junction, Base of Appendix, Kidneys and Abdominal part of ureter, Root of mesentery, Abdominalaorta and Inferior venacava
<b>Thorax</b>	Borders of Hear, Valves Pleura Pleura and Lungs Major vessels
<b>Head &amp; Neck</b>	Vertebrall levels of Hyoid bone, Thyroid cartilage, Cricoid Cartilage Thyroid gland; Larynx; SM of Common carotid artery, Internal jugular vein, Facial artery Parotid gland and duct Palatine tonsil Inion, Nasion, Pterion, Important dural venous sinuses
<b>Brain</b>	Central sulcus, Sylvian sulcus

### **RADIOLOGICAL ANATOMY**

X- rays – Principle pf X- ray- Pain and Contrast X-rays- Principles of Ultrasound and CT scan – CT scan at T3, T4 and L1 levels.

**TEACHING SCHEDULE: Teaching Hours - 650 Hrs.**

Introduction	1 week
General Anatomy	
General Embryology	
General Histology	
Upper extremity	6 weeks
Lower extremity	5 weeks
Abdomen and Pelvis	10 weeks
Thorax	3 weeks
Head and Neck	11 weeks
Brain & Spinal cord	4 weeks
TOTAL	40 weeks

**HORIZONTAL INTEGRATION:**

The preclinical departments together plan the Horizontal Integration.

To stress the importance of clinical and applied Anatomy.

- a) Display study questions on the notice board weekly, pertaining to the region covered.
- b) At the end of a region students be given cases of that region for study, presentation, analysis and discussion, Example: Leprosy patients with nerve lesions of the Upper Extremity at the end of the study of Upper Extremity.
- c) Invite clinicians to give guest lectures and demonstrations to highlight the anatomical basis of the clinical conditions. Example:
  - a. Importance of the venous drainage of Lower Extremity and varicose veins.
  - b. Anatomical basis of transplant.
  - c. Anatomical basis of hernia and repair.

**UNIVERSITY EXAMINATION PATTERN**

**PAPER I:** General/ Applied Anatomy  
General Embryology  
General Histology  
Upper and Lower extremities  
Abdomen and Pelvis  
(along with essential Embryology and Special Histology)

**PAPER II:** Thorax  
Head and Neck  
Brain (along with Essential embryology and Special Histology)

**RECOMMENDED BOOKS:**

1. Cunningham's Manual - vol. I, II, III
2. Human Anatomy - B.D. Chaurasia
3. Human Anatomy - T. S. Ranganathan
4. Human Anatomy - I. B. Singh
5. Human Anatomy - Datta
6. Clinically Oriented Anatomy - Keith L moore
7. A textbook of Human neuroanatomy - Inderbir Singh
8. Atlas of Histology - Difiore's
9. Text book of Human Histology - Inderbir Singh
10. Medical Embryology - Langman
11. Human Embryology - Inderbir Singh
12. Essentials of Human Genetics - Bhatnagar, Kothari (or) Metha

**REFERENCE BOOKS:**

1. Grays Anatomy
2. Clinical Anatomy - Snell
3. Clinical Neuro Anatomy - Snell
4. Grant's Atlas - Gross Anatomy
5. Atlas of Human Anatomy - Sobotta (vol I & II)
6. Last's anatomy - R.J Last
7. Surgical Anatomy - McGregor
8. Surface and Radiological anatomy - A.Halim
9. Atlas of Human Anatomy - Frank, H.Netter.M.D

# PHYSIOLOGY

## HUMAN PHYSIOLOGY INCLUDING BIO-PHYSICS

### (i) Goal

The broad goal of the teaching of undergraduate students in physiology aims at providing the student comprehensive knowledge of the normal functions of the organ systems of the body facilitate an understanding of the physiology basic of health of disease.

### (ii) Objectives

#### (a) Knowledge

At the end of the course the student will able to:

- (1) explain the normal functioning of all the organ systems and their interactions for well coordinated total body function;
- (2) assess the relative contribution of each organ system to the maintenance of the milieu interior;
- (3) elucidate the physiological aspects of normal growth and development;
- (4) describe the physiological response and adaptations to environmental stresses;
- (5) list the physiological principles underlying pathogenesis and treatment of disease.

#### (b) Skills

At the end of the course the student shall be able to:

- (1) conduct experiments designed for study of physiological phenomena;
- (2) interpret experimental / investigative data;
- (3) distinguish between normal and abnormal data derived as a result of tests which he/she has performed and observed in the laboratory.

#### (c) Integration

At the end of the integrated teaching the student shall acquire an integrated knowledge of organ structure and function and its regulatory mechanisms.

### (B) Biophysics

#### (a) Goal and Objectives

The broad goal of teaching Biophysics to undergraduate students is that they should understand basic physical principles involved in the functioning of body organs in normal and diseased conditions.

Total time for teaching Biophysics	= 5 hours
Out of which: 1. Didactic lectures	= 3 hours
2. Tutorial /group discussion	= 1 hour
3. Practical	= 1 hour



**(b) Topic distribution**

**(1) Lectures**

- (i) Physical principles of transport across cell membranes and across capillary wall.
- (ii) Biopotentials
- (iii) Physical principles governing flow of blood in heart and blood vessels.
- (iv) Also physical principles governing flow of air in air passages.

**(2) Tutorial / group discussion**

On the topic covered in didactic lectures

**(3) Practicals Demonstration of**

- (a) Biopotential on oscilloscope
- (b) Electro Encephalogram (E.E.G.)
- (c) Electro Myelogram (E.M.G.)
- (d) Electro Cardiogram (E.C.G.)

**SYLLABUS OF PHYSIOLOGY**

**Theory**

**GENERAL PHYSIOLOGY**

**CELL FUNCTION** : Morphology of cell components & Functions

**BODY FLUIDS** : Compartments - volume and composition Units for measuring concentration of solutes

**TRANSPORT ACROSS**

The cell Membrane: Homeostasis - Intra cellular communication

**TISSUE (HISTOPHYSIOLOGY)**

- 1. **MUSCLE:** Structure of skeletal and cardiac muscle - Neuro muscular junction. Excitation - contraction coupling - muscle contraction. Types of skeletal muscle fibres changes induced by training. Types of smooth muscle - structure and functional properties - Innervation.
- 2. **NERVE:** Neurons and Neuroglia - Nerve fibre - Excitation and conduction - Ionic basis - Measurements of Electrical Events. Classification of Nerve Fibres.

**BLOOD**

- 1. Composition, Function, Volume & Measurements of Blood Plasma. Functional characterization of plasma proteins. Oncotic pressure.
- 2. **R. B. C.** Morphology, Function, Erythropoiesis, Anaemias, Reticulocytes, Haemoglobin.
- 3. **W. B. C :** Morphology, Function, Leucopoiesis, Immune Mechanism
- 4. **Platelets:** Morphology, Function, Formation
- 5. **Blood Types:** ABO system Rh system Blood transfusion
- 6. **Haemostasis:** Antocoagulants
- 7. **Lymph, Reticulo Endothelial system**

## DIGESTION

1. Salivary digestion - deglutition
2. Digestion in stomach, Movements, Vomiting
3. Pancreatic Juice
4. Bile - Liver and gall bladder
5. Succus Entericus
6. Motility of small intestine
7. Digestion and Absorption of various food stuffs - Carbohydrate, Protein and fat, mineral and vitamin absorption.
8. Large Intestine - Secretion and Motility - Dietary Fibre - Defaecation
9. Gastro - Intestinal Hormones

## EXCRETION

1. Functional anatomy of Excretory System : Nephron in detail
2. Renal Circulation : Auto regulation, Renal function Tests
3. Glomerular Filtration: Tubular function - Water excretion, counter current mechanism.
4. Acidification of urine, bicarbonate excretion regulation of Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>, H<sup>+</sup> Ions.
5. Innervation and Function of bladder, micturition: Filling and emptying, diuretics.
6. Structure and functions of skin.

## ENDOCRINE GLANDS

Introduction - Hormonal regulation

Receptors - Second messengers

### 1. PITUITARY GLAND

Introduction, Physiological anatomy of Pituitary gland, Hypothalmo

Hypophyseal portal system, Anterior Pituitary Hormones :

Physiology of Growth - clinical correlates, Releasing factors, Intermediate lobe, Posterior pituitary. Hormones : Synthesis, secretion, actions.

### 2. HYPOTHALAMUS - HORMONES - FUNCTIONAL ANATOMY

Interrelationship between Hypothalamus, Anterior & Posterior Pituitary and target organs, Clinical correlation - Hypo & Hypersecretion.

### 3. THYROID GLAND - PHYSIOLOGICAL ANATOMY

Formation, secretion, Transport and metabolism of T<sub>3</sub> & T<sub>4</sub> - Effects of thyroid hormone & Regulation of its secretion - Hypo & Hypersecretion - clinical correlation calcitonin.

### 4. PARATHYROID GLANDS

Ca. & Phosphorus Metabolism - Bone physiology - Vit. D. & Calciferol.

Physiological Anatomy, secretions. Transport and functions of parathormone. Effects of other hormones and hormonal agents on calcium homeostasis - Hypo & Hypersecretion - clinical correlation.

## 5. PANCREAS

Introduction – Islet structure – Biosynthesis and secretion of Insulin, Fate, effects, mechanism of action of insulin – clinical correlation – Hypo & Hypersecretion – Diabetes Mellitus, Regulation of Insulin secretion  
Glucagon, other islet cell hormones and their effects.

## 6. ADRENAL GLANDS

Introduction, Adrenal Medulla – Morphology – biosynthesis functions and regulation of adrenal medullary hormones – Pheochromocytoma, Adrenal cortex – structure – biosynthesis of adrenal cortical hormones – transport, metabolism and excretion of adrenal cortical hormones, Effects of adrenal androgens and oestrogens, Glucocorticoids – physiological effects, Regulation of secretion, Mineralocorticoids – regulation of aldosterone secretion – role played by it in the regulation of salt balance, Adrenocortical hypo & hyperfunction in humans.

## 7. MINOR ENDOCRINE GLANDS: Kidney, Pineal body, Thymus, Atrium of heart

## 8. LOCAL HORMONES – bradykinin, substance P, Prostaglandin, Histamin, Serotonin, etc.

## REPRODUCTION

1. Introduction – Sex differentiation and chromosomal sex in brief factors influencing differentiation of genitalia.
2. Male gonads and genitalia – structure – gametogenesis erection, emission and ejaculation – semen composition endocrine function of testis – biosynthesis, secretion and action of hormones control of testicular function – abnormalities.
3. Female gonads and genitalia – ovarian function – menstrual cycle hypothalamus, Pituitary, Ovary, Uterus, Vagina cyclic changes Biosynthesis, secretion and actions of oestrogens and progesterone.
4. Fertilization and conception – contraception – corpus luteum of pregnancy – Chorion and placenta – hormones – pregnancy tests – physiology of – pregnancy tests – physiology of pregnancy – Labour – Lactation

## RESPIRATION

1. Introduction – Functional Anatomy of Respiratory system.
2. Mechanism of respiration – Diffusion and Transport of Gases.
3. Regulation of respiration, Neural and Chemical.
4. Pulmonary circulation.
5. Respiratory adjustments in Health and Disease.
6. Hypoxia – types, Oxygen therapy, periodic breathing Asphyxia,
7. Dysbarism, Cyanosis, effect of exercise, high altitude Physiology – Mountain sickness – Space Physiology.
8. Artificial respiration.

## **CARDIO VASCULAR SYSTEM**

### **Introduction**

1. Structure and properties of cardiac muscle - Action potential
2. Origin and spread of cardiac impulse. Sinus arrhythmia.
3. E.C.G. - 12 Leads - Tracing in Lead II, correlation with action potential and cardiac cycle.
4. Cardiac Cycle - mechanical events - JVP and radial arterial pulse tracing.
5. Cardiac output - Measurement - Factors affecting
6. Haemodynamics - pressure at different segments of vasculature.
7. Arterial blood pressure - systolic pressure, diastolic pressure, pulse pressure, Mean arterial pressure - normal values, methods for evaluating blood pressure - factors for maintenance and regulation - Hypertension - Nervous and humoral regulation of blood pressure.
8. Starling forces - Formation and reabsorption of tissue fluid. Patho Physiology of shock.
9. Regional circulation - pulmonary, cerebral, coronary, splanchnic, cutaneous & foetal circulations.
10. Cardio Vascular changes during exercise

## **SPECIAL SENSES**

### **Introduction**

1. Vision - Functional Anatomy - aqueous humour - glaucoma. Image forming mechanism - Refractory error. Layers of Retina - Photoreceptors - Photochemistry of vision - Light and dark adaptation - electrical responses, electro retinogram - visual pathway, lesions - colour vision - movements.
2. Hearing - functional anatomy - middle ear function - cochlea, auditory pathway - hearing defects - tests for hearing, audiogram.
3. Smell - receptor organ and pathway, physiology of olfaction - abnormalities.
4. Taste - Receptor organ and pathway, physiology of taste - abnormalities.

## **CENTRAL NERVOUS SYSTEM**

### **General Neurophysiology**

1. Neuron - structure, type - neuroglia - nerve degeneration, regeneration - denervation hypersensitivity.
2. Sensory Receptors - classification and function. Electrical and Ionic events in receptors - Receptor potential.
3. Synapse and junctional transmission - properties neural transmission - synaptic plasticity and learning.
4. Reflexes - Introduction - Mono and poly synaptic reflexes properties.
5. Spinal cord - groups of cells - Transverse section - Anterior Nerve root, posterior nerve root - Ascending tracts: Posterior column and Anterolateral systems, spinocerebellar tracts.

6. Pain - types - pathways - referred pain - pain inhibiting pathways.
7. Descending tracts - pyramidal and extra pyramidal tracts, complete section and hemisection of spinal cord

### **Special Neurophysiology**

1. Cerebral cortex - layers, lobes, methods of study, function of each lobe.
2. Thalamus - Thalamic nuclei, connections, functions, thalamic syndrome.
3. Basal Ganglia - Nuclei, connections, circuits, functions, Lesions of Basal Ganglia - clinical correlates.
4. Hypothalamus - Nuclei, connection, functions - Lesions - experimental and clinical syndromes.
5. Reticular formation - Ascending and Descending Pathways, ARAS & EEG.
6. Sleep - Theories - Physiological changes during sleep - REM & NREM Sleep - Disorders of sleep.
7. Cerebellum - lobes - cortex, circuitry - Deep Nuclei, connections, functions cerebellar syndrome - cerebellar function tests.
8. Vestibular Apparatus - Semicircular canal, otolith organs - Mechanism of equilibrium.
9. Maintenance of posture, tone equilibrium - Muscle spindle types.
10. Autonomic Nervous system - Organisation, division with examples of autonomic reflexes, chemical transmission.
11. Limbic system - parts, circuits, functions.
12. Higher functions: Mechanism of speech - mechanism of learning - mechanism of memory, types - conditioned reflexes.
13. C.S.F. formation, circulation, absorption, function, lumbar puncture.

### **SYSTEMS COVERED**

#### **PAPER - I**

- 1) Muscles and Nerve
- 2) Blood, Spleen and Lymph
- 3) Digestive system
- 4) Excretory system, Acid base balance and fluid compartments
- 5) Endocrinology
- 6) Reproductive system

#### **PAPER - II**

- 1) Respiratory System
- 2) Cardiovascular system
- 3) C.N.S
- 4) Special Senses

## **MAJOR EXPERIMENTS**

### **I. HAEMATOLOGY**

1. R. B. C. Count
2. Total (WBC) Count
3. Differential (WBC) Count
4. Absolute Eosinophil Count
5. Platelet Count

### **II. CLINICAL EXAMINATION**

1. Recording of Blood Pressure
2. Examination of Respiratory System
3. Examination of Cardiovascular system
4. Examination of Cranial Nerves
5. Examination of sensory and motor system
6. Examination of superficial and deep reflexes

## **MAJOR EXPERIMENTS**

### **I. HAEMATOLOGY**

1. Estimation of Haemoglobin
2. ABO Blood Grouping
3. Rh typing
4. Bleeding time and clotting time

### **II. CLINICAL EXAMINATION**

1. Determination of timed vital capacity and tidal volume
2. Determination of Respiratory rate
3. Recording of ECG

### **CLINICAL EXAMINATION**

## **MINOR EXPERIMENTS SKILLS**

1. Demonstration of Tracheal Position
2. Outlining the cardiac borders by percussion
3. Cardiac Auscultatory Area
4. Demonstration of Plantar Reflex
5. Demonstration of Knee Jerk
6. Demonstration of Light Reflex
7. Demonstration of Accommodation Reflex
8. Evaluation of Colour vision
9. Evaluation of Refractory errors

## **CHARTS**

1. Simple Muscle Twitch
2. Beneficial Effect
3. Load and After Load
4. Effect of Temperature
5. Genesis of Tetanus
6. Fatigue
7. Properties of Cardiac Muscle
8. Effect of Stimulation of Vagus Nerve
9. Action of Acetylcholine and Adrenaline on Heart
10. Action of Ions on Heart
11. Gigantism
12. Dwarfism
13. Acromegaly
14. Cushing's Syndrome
15. Myxoedema
16. Cretin
17. E.S.R. Reading and interpretation
18. P.C.V. Reading and interpretation
19. Specific Gravity of Blood Reading and interpretation
20. Osmotic Fragility Test and interpretation

## **CALCULATION**

1. Blood Indices
2. Lung Volumes
3. Renal Function Tests

### **TEXT BOOKS RECOMMENDED FOR THE I MBBS**

1. Text Book of Physiology for Vol I Vol II – A.K. Jain – Latest edition
2. Essentials of Medical Physiology – Indu Khurana – Latest Edition
3. Concise Medical Physiology – Sujit.K.Chaudhuri – 6<sup>th</sup> edition

### **REFERENCE BOOKS**

1. Text book of medical Physiology – Guyton – 11<sup>th</sup> Edition
2. Review of Medical Physiology – Ganong – Latest Edition

### **PRACTICAL BOOKS**

1. Manual of Practical Physiology
2. Hutchison's Clinical Methods – Swash Michael – Latest Edition

# BIOCHEMSITRY

## Biochemistry Including Medical Physics and Molecular Biology

### (i) Goal:

The broad goal of the teaching of undergraduate students in biochemistry is to make them understand the scientific basis of the life processes at the molecular level and to orient them towards the application of the knowledge acquired in solving clinical problems.

### (ii) Objectives:

#### (a) Knowledge:

At the end of the course, the student shall be able to:

- (1) Describe the molecular and functional organization of a cell and list its sub cellular components;
- (2) Delineate structure, function and inter-relationships of biomolecular and consequences of deviation from normal;
- (3) Summarize the fundamental aspects of enzymology and clinical application wherein regulation of enzymatic activity is altered;
- (4) Describe digestion and assimilation of nutrients and consequences of malnutrition;
- (5) Integrate the various aspects of metabolism and their regulatory pathways;
- (6) Explain the biochemical basis of inherited disorders with their associated sequelae;
- (7) Describe mechanisms involved in maintenance of body fluid and BH homeostasis;
- (8) Outline the molecular mechanisms of gene expression and regulation, the principles of genetic engineering and their application in medicine;
- (9) Summarize the molecular concept of body defenses and their application in medicine;
- (10) Outline the biochemical basis of environmental health hazards, biochemical basis of cancer and carcinogenesis;
- (11) Familiarize with the principles of various conventional and specialized laboratory investigations and instrumentation analysis and interpretation of a given data;
- (12) Suggest experiments to support theoretical concepts and clinical diagnosis.

#### (b) Skills:

At the end of the course, the student shall be able to:

- (1) Make use of conventional techniques / instruments to perform biochemical analysis relevant to clinical screening and diagnosis;
- (2) Analyze and interpret investigative data;



(3) Demonstrate the skills of solving scientific and clinical problems and decision making

**(c) Integration:**

The knowledge acquired in biochemistry shall help the students to integrate molecular events with structure and function of the human body in health and disease.

## SYLLABUS

### 1. Cell

#### **Sub cellular components – Molecular and functional organization.**

Plasma membrane, cytoplasm, Nucleus and sub cellular components like Mitochondria, Endoplasmic reticulum, Lysosomes, Peroxisomes, Cytoskeleton, Golgi apparatus etc.

### II. Biomolecules

#### **Introduction**

- a) Chemistry of carbohydrates – Monosaccharides, disaccharides – homo and hetero polysaccharides.
- b) Chemistry of Lipids – classification, fatty acids, Eicosanoids and derivatives. Triglyceride, Phospholipids, Cholesterol and lipoprotein
- c) Chemistry of protein – classification of amino acids, peptides, peptide hormones, eg. Insulin, Glucagons, parathyroid hormone, and few pituitary hormones. Plasma proteins – classifications, method of separation and electrophoretic pattern of plasma protein in health and disease. Protein structure and function.
- d) Nucleic acid: Nucleotides – DNA and RNA structure, nucleic acid analogous of medical importance.
- e) Structure of Haemoglobin, Myoglobin – structural relationship with the function. Abnormal Haemoglobin – congenital and acquired.
- f) Vitamins and minerals – (in brief details in Nutrition)

### III. Enzymes

Fundamental aspects of enzymology – definition, classification, mechanism of action, factors affecting enzyme activity – enzyme regulation – co enzymes – Isozymes – enzymes of clinical importance.

### IV. Nutrition

#### **Digestion and assimilation of Nutrients**

- Carbohydrates, Proteins, Lipids, Vitamins and Minerals.
- Nutritional requirements – RDA, SDA, Balanced diet and limiting amino acids
- Vegetarianism
- Consequences of Malnutrition of Marasmus, Kwashiorkor, over nutrition.

## **V. Metabolism and Regulatory pathways**

### 1) Introduction to metabolism

- a) emphasize the purpose of metabolism like energy production, Interconversion and synthesis of important Biomolecules etc.
  - b) High energy compounds
  - c) Biological oxidation - enzymes involved - oxidative phosphorylation - theories - shuttles.
- ### 2) Metabolic pathways, regulation and metabolic errors

## **Carbohydrates**

Glycolysis - HMP pathway - gluconeogenesis - Uronic acid pathway - glycogen metabolism - fructose and galactose metabolism and TCA cycle. Regulation of blood glucose - diabetes mellitus - hypoglycemia - hyperglycaemia. Inborn errors of carbohydrate metabolism. Clinically important investigations pertaining to carbohydrate metabolism - reduction test of urine, differential diagnosis for glycosuria including chromatography. Blood sugar values, glycosylated haemoglobin, fructosamine.

## **Lipid Metabolism:**

Synthesis of fatty acid oxidation - energetics of oxidation, ketone bodies, metabolism of unsaturated fatty acids - prostaglandin - Prostacyclin - Thromboxanes - Triglycerides - Phospholipids - sphingolipids - Cholesterol and its derivatives. Apoproteins - Fatty liver lipotropic factors. Clinically important investigation pertaining to lipids and lipoproteins.

## **Protein metabolism**

Dynamic state of body proteins - interorgan transport of amino acids - Ammonia production - Transport and body amino acids pool - its disposal Urea cycle. Metabolism of individual amino acids. Biologically important compounds obtained from amino acids including gamma aminobutyric acid and polyamines.

Clinically important investigation pertaining to protein metabolism - Total protein - albumin - globulin - AG. Ratio - Serum protein electrophoresis - Blood urea - BUN - Serum creatinine clearances - Amino acid chromatography for screening inborn errors.

## **Integration of Metabolism**

Main control sites of metabolic pathways and key enzymes.

Metabolic adaptation during fed state and starvation

Metabolism in Principal organs like liver, RBC, adipose tissue, muscle, kidney, heart & brain.

## **Nucleic acid metabolism**

Purine and pyrimidine synthesis and degradation - salvage pathways abnormalities of nucleic acid metabolism.

## **Metabolism of Haemoglobin, Prophyrias and Bilirubin**

Prophyrias, Abnormal haemoglobin and jaundice and investigations pertaining to these disorders.

## **VI. Gene expression and regulation**

### **1) Principles of genetic Engineering and their application in Medicine.**

Basics of Genetics – Chromosomal structure – arrangement of coding sequence and genetic code.

Biosynthesis of proteins with posttranslational modification.

### **2) Cell Cycle**

DNA replication and its repair – RNA synthesis and processing – Mutation.

### **3) Gene Expression and Regulation.**

Operon concept, genetic switch – Gene rearrangement – gene amplification – Gene protein interaction.

Genetic engineering techniques and their application in medicine. Restriction enzymes, Vectors genome library – DNA probes – Blot transfer techniques.

Recombinant DNA technology, PCR – Polymerase Chain Reaction – Clinical application of genetic engineering.

## **VII. Inborn errors:**

Biochemical basis of inherited disorders with their associated sequelae.

Introduction to various types of inheritance and types of mutation defect in relation to various inherited disorders.

a) **Carbohydrates:-** Glycogen storage disease, galactosaemia G6PD deficiency. Lactose intolerance, fructose intolerance, fructosuria, Pentosuria.

b) **Lipids:-** Disorders of FA Oxidation, Sphingolipidosis, Dyslipoproteinaemias,

c) **Protein:-** Urea cycle disorders, inborn errors associated with each amino acid.

d) Porphyrins, hyper bilirubinemia (congenital and acquired)

e) Hyperuricaemia, gout, Orotic Aciduria, Lesch Nyhan Syndrome

f) Neonatal screening for and prenatal diagnosis of inborn errors.

## **VIII. Homeostasis:**

Mechanisms involved in the maintenance of body fluids and pH homeostasis.

Metabolism of water and electrolytes homeostasis of PH – buffer system, Role of kidney and Lungs – Acids base disorders.

Bloods gas analysis and its interpretation and correlation to acid base disorders.

## **IX. Immunity**

Molecular concept of body defence and application in medicine.

Immunoglobulin structure, type, synthesis and function – Antigen binding – monoclonal antibodies – Hyper and hypogammaglobulinaemia immuno

deficiency and AIDS – biochemical methods of assessing the Immunoglobulin RIA, ELISA.

## **X. Environmental Hazards and Cancer**

1. Biochemical basis of Environmental Hazards – occupational hazards (lead, organo phosphorus compounds etc.) Hazards due to modern industrialization (HS) and traffic pollution (CO) Xenobiotics.
2. Biochemical basis of cancer and carcinogenesis – Timour markers.

## **XI. Laboratory Investigations**

Principles of various conventional and specialized Laboratory Investigations and instrumentation analysis and interpretation of data.

1. Principles of conventional and specialized lab investigation including instrumentation analysis.
  - a) Conventional : manual colorimetric methods for biochemical parameter (dealt with in practical classes)
    - Flame photometer
    - Spectroscopy
  - b) Specialized : automated techniques semi and random auto analyzer – ELISA – RIA – Fluorimetry – Blood Gas Analyzer.
2. Interpretation of data
  - Normal ranges of biochemical parameters – causes for deviation from normal.

## **XII. Clinical Chemistry**

### **Experiments to support theoretical concept and clinical diagnosis.**

Biochemical tests to determine the functional ability of an organ – liver function test – Renal function test, Pancreatic function test.

Investigation pertaining to hormones – Mode of action of hormone and its function –Thyroid function test- Para thyroid function tests – Adrenal function tests.

Biochemical tests to confirm the clinical diagnosis of a diseases and their interpretation. Jaundice (haemolytic, hepatic and obstructive) – Cirrhosis liver – Acute Renal failure, chronic renal failure, Nephrotic syndrome – Myocardial infraction – Diabetes mellitus, (mild, moderate and severe). – Renal glycosuria – Alimentary glycosuria – Rickets – Hypo and hyperparathyroidism – Hypo and hyper thyroidism – Pancreatitis.

Metabolic acidosis alkalosis

Respiratory acidosis Alkalosis

Both uncompensated and compensated.

## **BIOCHEMISTRY PRACTICAL SYLLABUS**

Spotters and Clinical Exercises

### **(I) SPOTTERS**

The student must identify the spotter and write some important uses of the spotter.

1. pH meter
2. Colorimeter
3. Centrifuge
4. Ryles tubes
5. Urino meter
6. Copper sulphate
7. Spectroscope
8. Electrophoresis apparatus
9. Oxyhaemoglobin
10. Methaemoglobin
11. Corboxyhaemoglobin
12. Glucosazone / Fructosazone
13. Lactosazone
14. Maltosazone
15. Haemin crystals
16. Electrophoresis paper – normal pattern
17. Electrophoresis paper – nephritic syndrome
18. Electrophoresis paper – multiple myeloma
19. Chromatography paper
20. Picric acid
21. Benedict's qualitative reagent
22. Structure of RNA
23. Structure of cholesterol
24. Structure of fructose

### **(ii) Suggest investigations for a case of**

1. Jaundice
2. Diabetes mellitus
3. Acute renal failure
4. Proteinuria
5. Oedoma
6. Rickets
7. Myocardial infraction
8. Alkalosis
9. Acidosis
10. Glycosuria
11. Aminoaciduria
12. Hyper and Hypo Parathyroidism
13. Hyper and Hypothyroidism

**(iii) Calculate**

1. Albumin Globulin ratio with total protein and albumin values.
2. Calculate minute volume from 24 hour urine volume
3. Calculate Creatinine clearance with required parameters given.

**(iv) Interpret**

1. Electrophoresis patterns normal, cirrhosis liver, Hepatic syndrome
2. Normal GTT and diabetes mellitus glycosurias
3. Acute pancreatitis
4. Myocardial infraction
5. Acute renal failure and nephritic syndrome
6. Acidoses, Alkaloses
7. Hype and hype thyroidism
8. Hype and hypr parathyroidism
9. Rickets
10. Jaundice

**UNIVERSITY EXAMINATION PATTERN**

The following topics shall be covered in each question paper.

**Paper - I**

1. Molecular and functional organization
2. Chemistry, Digestion, Absorption and Metabolism of carbohydrate and Metabolic errors
3. Chemistry, Digestion, Absorption and Metabolism of lipids and Metabolic errors
4. Enzymes
5. Vitamines
6. Electron transport chain and biological oxidation
7. TCA Cycle an integration of metabolism
8. Nutrition
9. Porphyrins, Haemoglobin and Bilirubin metabolism

**Paper - II**

1. Chemistry, digestion, absorption and metabolism of protein and Inborn errors of metabolism
2. Chemistry and metabolism of nucleic acids and errors of metabolism
3. Molecular biology
4. Water, Electrolytes
5. pH and its regulation
6. Cancer and Xenobiotics
7. Minerals
8. Hormones
9. Laboratory Instrumentation, investigation and interpretation