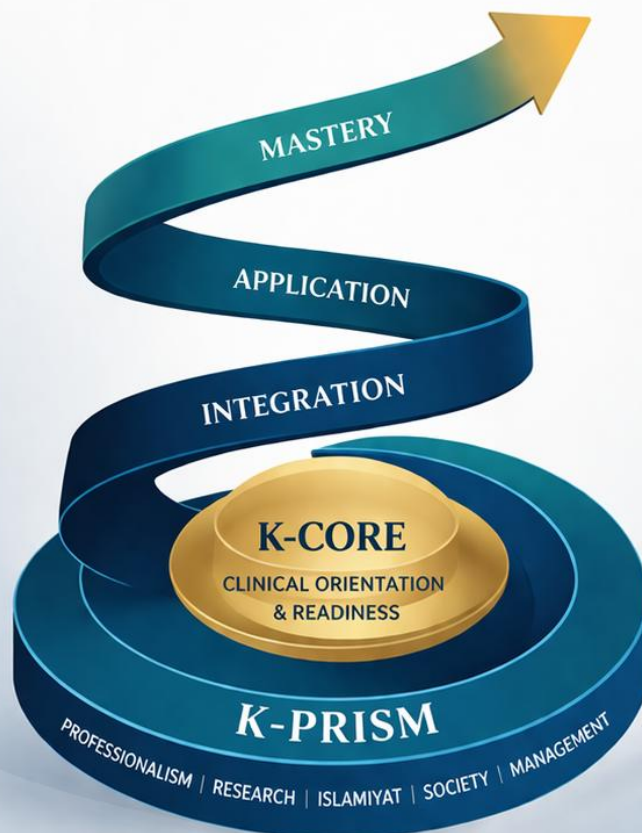




STUDY GUIDE

KING EDWARD MEDICAL UNIVERSITY, LAHORE

MBBS YEAR I | ACADEMIC SESSION 2025-2026



7 STAR DOCTOR ATTRIBUTES (PM&DC)

-  CARE PROVIDER
-  DECISION MAKER
-  COMMUNICATOR
-  COMMUNITY LEADER
-  MANAGER
-  RESEARCHER
-  PROFESSIONAL

FIRST YEAR MBBS
ACADEMIC YEAR 2025-2026

Building Competence Through Integration



ACKNOWLEDGMENT

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Prof. Dr. Tehreem Fatima, Dean, Basic Sciences, KEMU

Prof. Dr. Abrar Ashraf Ali, Director Medical Education, KEMU

Dr. Muhammad Zeeshan Sarwar, Controller of Examination, KEMU

Dr. Muhammad Qasim, Associate Professor, Anatomy, KEMU

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COMPOSED AND COMPILED BY

Dr Faiza Irem

Additional Director, Medical Education, KEMU

Associate Professor, Biochemistry Department

ACKNOWLEDGMENTS

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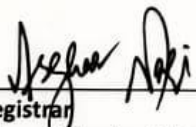
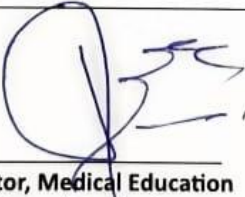

 The Registrar King Edward Medical University Lahore	 Director, Medical Education King Edward Medical University Lahore	 Controller of Examinations King Edward Medical University Lahore
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Welcome to King Edward Medical University

In the 2025-26 academic year, the first-year MBBS program at KEMU has transitioned from the traditional subject-based curriculum to a Modular Integrated Curriculum. This approach promotes meaningful learning by organizing teaching into system-based modules where related disciplines are taught in a coordinated manner. By integrating basic medical sciences and emphasizing clinical relevance, the curriculum helps students develop a deeper understanding of concepts and their application in medical practice.

Purpose of the Study Guide

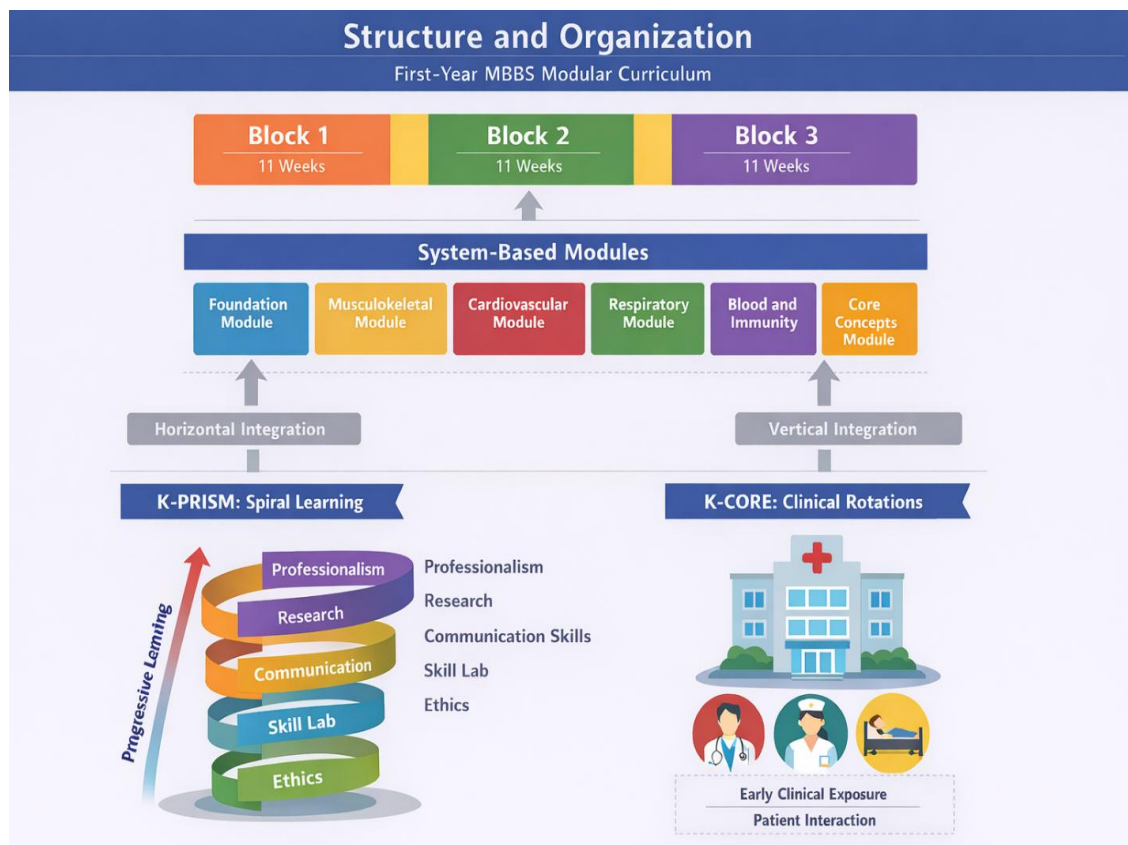
This Study Guide has been developed to assist first-year MBBS students in navigating the Modular Integrated Curriculum effectively. It provides an overview of the modules, learning objectives, teaching strategies, assessment methods, and recommended learning resources. The guide is intended to help students understand what is expected of them in each module and to facilitate organized, focused learning.

The study guide also outlines the structure of the modules, including the sequence of topics, integration of different basic science disciplines, and opportunities for early clinical exposure where applicable. By clearly describing learning outcomes and educational activities, it aims to promote self-directed learning, critical thinking, and active student participation.

Students are encouraged to use this guide as a roadmap for their academic journey, helping them plan their studies, prepare for assessments, and appreciate the connections between different disciplines within the medical sciences.

Program Goals

1. Develop a strong conceptual foundation in the basic medical sciences, including Anatomy, Physiology, and Biochemistry, enabling students to understand the normal structure and function of the human body.
2. Promote horizontal integration by coordinating teaching across basic science disciplines within each module so that students learn related concepts in a coherent and meaningful manner.
3. Introduce vertical integration by linking basic science knowledge with its clinical relevance, helping students appreciate the application of foundational concepts in medical practice.
4. Foster critical thinking and problem-solving skills through integrated learning activities, small group discussions, and self-directed learning.
5. Encourage active and lifelong learning by developing the skills required for self-directed learning and independent study.
6. Develop professional attitudes, ethical values, and communication skills as emphasized through the K-PRISM framework, preparing students for their future roles as responsible healthcare professionals.
7. Strengthen core competencies in foundational biomedical sciences through the K-CORE component, ensuring that essential concepts and principles are mastered.
8. Promote teamwork, professionalism, and respect for patients and human dignity, particularly during laboratory work, cadaveric dissection, and early clinical exposure.
9. Prepare students for progressive learning in subsequent years of the MBBS program by establishing a strong academic and professional foundation.



K-PRISM

These courses are designed to introduce students to essential themes in professional and personal development and will be revisited in increasing depth in subsequent years. These will be spirally integrated into the curriculum and will be monitored by the Department of Medical Education. Attendance is mandatory and will be included in internal assessments.

Topics included in K-PRISM are:

1. Learning and teaching in Medical Education
2. Skills Lab
3. Communication Skills for Medical Students
4. Islamic Studies and Ethics
5. Professionalism.
6. Foundations of Behavioral Sciences
7. Research Methodology and Medical Innovation (capstone project)
8. Healthy Lifestyle and Wellbeing in Medicine (community medicine)
9. Introduction to Artificial Intelligence
10. Documentation
11. IT skills
12. Leadership, management, and team building
13. Entrepreneurship
14. Minimum service delivery system (MSDS)
15. Geriatrics

K-CORE

Structured weekly clinical rotations for first-year MBBS students are being introduced as a strategic initiative to promote early professional identity formation and effectively bridge the gap between basic sciences and clinical practice. These rotations are thoughtfully designed to align with the integrated and modular curriculum. Each week, students will participate in a two-hour clerkship session, providing meaningful and developmentally appropriate exposure to real clinical environments. This early clinical engagement aims to enhance contextual learning, reinforce theoretical knowledge, and cultivate essential professional attitudes and skills.

Attendance in these clinical rotations is mandatory and will form an integral component of internal assessment.

Teaching and Learning Strategies

The following strategies will be used.

- 1. Interactive Lecture:** Lectures are designed to encourage active participation rather than passive listening. Students will be engaged through questioning, problem-solving, and clinical correlations. They must be prepared, participate in discussions, and clarify concepts during the session.
- 2. Flipped Classroom:** In selected topics, students will review learning materials (videos, reading assignments, study notes) before class. Classroom time will focus on discussion, problem-solving, and clarification of difficult concepts. They should complete the assigned pre-class preparation to contribute actively during in-class discussions.
- 3. Small Group Discussions (SGD):** Students will work in small groups to analyze concepts and clinical cases. SGDs aim to promote critical thinking, teamwork, and communication skills. They must participate actively, respect group members' opinions, and contribute to problem-solving.
- 4. Peer-Assisted Learning (PAL):** Students may engage in peer teaching sessions under faculty supervision. This approach enhances understanding through collaborative learning and reinforces key concepts. They will prepare assigned topics and contribute constructively during peer discussions.
- 5. Self-Directed Learning (SDL):** Students will be encouraged to develop lifelong learning habits. Guidance and learning objectives will be provided. They will identify learning needs, consult recommended resources, and demonstrate understanding during follow-up discussions or assessments.
- 6. Case-Based Learning (CBL):** Clinical cases will be used to integrate biochemical principles with real-life medical scenarios. This method strengthens clinical reasoning and application skills. They will analyze the case, apply knowledge, and participate in a guided discussion.
- 7. Practical Laboratory Sessions:** Laboratory sessions provide hands-on experience in test performance and using laboratory equipment. Emphasis is placed on skill development, accuracy, safety, and interpretation of results. They will follow laboratory safety protocols, perform procedures competently, and interpret findings accurately.
- 8. Cadaveric dissection:** Cadaveric dissection provides students with direct, hands-on exposure to the structure of the human body. These sessions also promote respect for the human body and reinforce the importance of professionalism and teamwork in medical training. They will handle cadaveric material with respect and professionalism, actively participate in dissection, follow laboratory safety and ethical guidelines, and correlate observed structures with theoretical knowledge.

Timetable

Day	08:00-10:00		10:00-10:30	10:30-11:30	11:30-12:30	12:30-02:30	
Monday	Practical Histology C Physiology A Biochemistry B Tutorial Biochemistry D		REAK	Biochemistry Lecture	Anatomy Lecture	Anatomy Demonstration	Anatomy Dissection
Tuesday	Practical Histology A Physiology B Biochemistry D Tutorial Biochemistry C			Physiology Lecture	Anatomy Lecture	Anatomy Demonstration	Anatomy Dissection
Wednesday	Practical Histology D Physiology C Biochemistry A Tutorial Biochemistry B			Anatomy Lecture	Biochemistry Lecture	Anatomy Dissection	
Thursday	Practical Histology B Physiology D Biochemistry C Tutorial Biochemistry A			Biochemistry Lecture	Physiology Lecture	Anatomy Demonstration	Anatomy Dissection
Friday	Physiology Tutorial		10:00 – 11:00 Physiology Lecture		11:00 – 12:00 K – PRISM		
Saturday	08:00 – 09:00 K – PRISM	09:00 – 10: 30 K – CORE	BREAK 10:30 – 11:00	11:00 – 12:00 Physiology Lecture	12:00 – 01:00 Biochemistry Lecture	01:00 – 02:00 Anatomy / SDL	

ASSESSMENT PLANNER – 2026
FIRST YEAR MBBS
Tentative Dates

BLOCK 1

31st January 2026 to 14th May 2026

BLOCK 2

16th May 2026 to 14th September 2026

BLOCK 3

15th September 2026 to 9th December 2026

Professional examination
1st January 2027

ASSESSMENT	SUBJECT	DATE (proposed)	Assessment Tool
Foundation Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Musculoskeletal Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Block 1		Written: 11th May 2026 OSPE: 12th to 14th May 2026	SEQ MCQ OSPE OSVE
Cardiovascular Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Respiratory Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Block 2		Written: 9th September 2026 OSPE: 11th to 14th September 2026	SEQ MCQ OSPE OSVE
Blood & Immunity Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Core concepts Module	Anatomy	End module	SEQ/MCQ/VIVA/OSPE
	Biochemistry		
	Physiology		
Block 3		Written: 5th December 2026 OSPE: 7th, 8th and 9th December 2026	SEQ MCQ OSPE OSVE

Structure of Block Assessment

Total marks: 200

1. Written paper: 120 marks:

65 MCQs × 1 mark each = 65 marks

09 SEQs × 5 marks each = 45 marks

2. OSPE/ OSVE: 90 marks

12 OSPE stations × 5 marks each = 60 marks

03 OSVE stations × 10 marks each = 30 marks

01 (OSVE) station each of Anatomy, Biochemistry, and Physiology

Structure of the Professional Examination

Total marks: 1000

1. The Professional Examination shall consist of four written papers, as follows:

Paper 1: Course content of Block 1

Paper 2: Course content of Block 2

Paper 3: Course content of Block 3

Paper 4: Islamic Studies

75 MCQs / 1 mark = 75 marks

09 SEQs / 5 marks = 45 marks

2. Structured viva (OSVE) in the subjects of Anatomy, Physiology, and Biochemistry.

3.

PAPER	SUBJECTS	WRITTEN Marks	Internal Assessment Theory	OSVE Marks	Internal Assessment Practical
Paper 1	Block 1	120	30	120	30
Paper 2	Block 2	120	30	120	30
Paper 3	Block 3	120	30	120	30
Islamic studies		100			

Policies

Module Assessment Policy

- Departments shall conduct Module assessments
- Departments may utilize any appropriate assessment tool, as per academic guidelines.
- Module attendance refers to attendance in all lectures and sessions delivered within that module, including integrated teaching sessions.
- Total marks for module assessments shall remain standardized across all modules.
- No remedial assessment will be offered for a failed/ absent module assessment.

Block Assessment Policy

1. Block assessments shall be conducted at the end of each block by the respective block committees.
2. Block 1 committee will be headed by the Anatomy department.
3. Block 2 committee will be headed by the Physiology department.
4. Block 3 committee will be headed by the Biochemistry department.
5. To appear in the Block Assessment, a student must have an overall 75% and a minimum of 60% attendance in each subject.
6. A student debarred from the Block assessment due to a shortage of attendance will have to make up for the attendance afterwards (in vacation period & not during the academic session) , to be eligible to appear in Block Remedial.
7. Each subject component of the written examination (Anatomy, Physiology, Biochemistry, Spiral) must be passed individually with a minimum score of 50%.
8. Each subject component of OSPE must be passed individually, with a minimum score of 50%.
9. Written and OSPE components are independent, and both must be passed separately.
10. Internal assessment of each subject will be calculated at the end of each Block and will be submitted to the examination department.
11. Internal assessment will be included in the SUMMATIVE written and OSVE Exam.
 - a) The written component will include the weightage of block attendance in lectures and tutorials, module results, and block assessment (written component) results.
 - b) OSVE will include the weightage of attendance in practicals, practical copy, and block exam (OSPE/OSVE) results.
 - c) Internal assessment will also include K-CORE, K-PRISM attendance, and professional evaluation.
12. One single remedial will be taken before the Prof exam for each block assessment, which will be allowed only for students:
 - a) Having attendance not less than 50%
 - b) Failed any block assessment/ remedial.
 - c) Absent in block assessment due to reasons such as sickness, accident, or close degree relative death, having valid proof /evidence for it.
 - d) No reason other than stated will be entertained for remedial.

Professional Examination Policy

1. The Professional Examination shall serve as the summative assessment for the Basic Sciences curriculum and will be conducted at the end of each academic year.
2. The examination department will conduct the professional examination.
3. **Eligibility Criteria:**
 - a. Attendance required to appear in the Professional examination should be 75%, with 60% attendance in each subject. (Anatomy, Physiology, Biochemistry, Spiral Subjects)
 - b. The student should have passed all three block assessments.
 - c. Name should be included in the list of eligible students submitted by the block management committee.
 - d. Evidence of fee submission.
4. **Declaration of results:**
 - a. To pass the written assessment, candidates must achieve a minimum score of 50% in every individual subject (Anatomy, Physiology, Biochemistry, and Spiral Subjects). Failure to reach this threshold in any single component will result in an overall failure of the written paper.
 - b. To pass the OSVE, candidates must achieve a minimum score of 50% in every individual component (Anatomy, Physiology, and Biochemistry). All three sections must be passed independently to receive an overall passing grade.
 - c. Both written and OSVE need to be separately passed.
 - d. If a student fails in any component of the written assessment (Anatomy, Physiology, Biochemistry, spiral subjects) or OSVE (Anatomy, Physiology, Biochemistry), the student will have to appear in a supplementary examination in both the written & OSCE components.
 - e. Passing marks required for Islamic Studies/Ethics and Pak Studies will be 33. These marks will not contribute to the total marks of the professional examination and the determination of position.

DEPARTMENT OF ANATOMY & HISTOLOGY

Vision and Mission

The mission of the Department of Anatomy, King Edward Medical University, is to deliver high-quality, integrated anatomical education through student-centered teaching, clinically oriented learning, and competency-based assessment; to promote research and scholarly activity in anatomical sciences; and to contribute to improved healthcare outcomes through academic excellence and professional development.

History

The Department of Anatomy at King Edward Medical University (KEMU), Lahore, is one of the oldest and most fundamental basic science departments of the institution. Its origins trace back to 1860, with the establishment of the Lahore Medical School, the precursor of KEMU.

Message from the Chairperson – Department of Anatomy & Histology & Dean Basic Sciences, King Edward Medical University

Dear Students,

Welcome to the first year of your medical education. This academic year marks the introduction of our Integrated Modular Curriculum, a significant step toward modern, competency-based medical training. Moving beyond isolated subjects, this approach enables meaningful integration of Anatomy with other basic and clinical sciences, fostering deeper understanding and stronger clinical reasoning.

This reform reflects our commitment to academic excellence, professional integrity, and holistic medical development. I encourage you to engage actively, think critically, and take ownership of your learning. The foundation you build now will shape your future as competent, compassionate, and responsible physicians.

Anatomy remains the structural foundation of your basic sciences training, forming the conceptual framework upon which all future clinical learning is built. A sound understanding of human structure macroscopic, microscopic, developmental, and radiological is essential for safe practice, accurate diagnosis, and professional competence. Our department is dedicated to ensuring that your anatomical education is rigorous, clinically contextualized, and aligned with contemporary standards.

The curriculum is guided by the institutional pillars of **K-CORE** and **K-PRISM**, ensuring that each module integrates scientific depth with the broader ethical, professional, societal, and reflective dimensions of medical practice. Embedded within this framework is the expectation that you cultivate strong research habits and embrace the mindset of a lifelong learner, both of which are indispensable in an evolving healthcare landscape.

Our approach aligns with the competencies of the Seven-Star Doctor as per PMDC requirement and adheres to the global quality benchmarks of the World Federation for Medical Education (WFME), ensuring that your training meets internationally recognized standards.

As you begin this journey, remember that your success will be built on a foundation of consistent effort, a questioning mind, and a commitment to academic integrity. We remain committed to supporting your growth in both knowledge and character.

Prof. Dr. Tehreem Fatima

Chairperson, Anatomy & Histology Department

Dean, Faculty of Basic Sciences

King Edward Medical University, Lahore

FACULTY OF DEPARTMENT OF ANATOMY & HISTOLOGY

Sr No.	FACULTY	DESIGNATION	QUALIFICATION
1.	Prof. Tehreem Fatima	Professor & Chairperson Department of Anatomy & Histology Dean, Basic Sciences – KEMU	MBBS M.Phil. Anatomy MCPS – HPE
2.	Prof. Samar Ashraf	Professor of Anatomy	MBBS, M.Phil. Anatomy, CHPE
3.	Dr. Sarah Khan	Associate Professor	MBBS, M.Phil. Anatomy PhD Scholar CHPE
4.	Dr. M. Qasim Muneer	Associate Professor	MBBS, M.Phil. Anatomy, ICMT MSc. Epidemiology & Biostatistics
5.	Dr. Tooba Inam	Assistant Professor	MBBS, M.Phil. Anatomy CHPE
6.	Dr. Amna Zia	Assistant Professor	MBBS, M.Phil. Anatomy CHPE
7.	Dr. Anum Hafeez Dogar	Assistant Professor	MBBS, M.Phil. Anatomy CHPE
8.	Dr. Uzma Batool	Assistant Professor	MBBS, M.Phil. Anatomy ICMT
9.	Dr. Shumaila Sohail	Assistant Professor	MBBS, M.Phil. Anatomy CHPE
10.	Dr. Faiza Hanif	Senior Demonstrator	MBBS, M.Phil. Anatomy CHPE
11.	Dr. Ayesha Khalid	Senior Demonstrator	MBBS, M.Phil. Anatomy
12.	Dr. M. Oneeb Saleemi	Senior Demonstrator	MBBS, BSc.
13.	Dr. Adeen Ahmad	Demonstrator PG – Trainee	MBBS

14.	Dr. Mehwish Mustafa	Demonstrator PG – Trainee	MBBS
15.	Dr. Aqsa	Demonstrator PG – Trainee	MBBS
16.	Dr. Iqra	Demonstrator PG – Trainee	MBBS
17.	Dr. Maryam Raza	Demonstrator (Visiting Faculty)	MBBS
18.	Dr. Ramsha Mubeen	Demonstrator (Visiting Faculty)	MBBS

ANATOMY CONTENT

1. General Anatomy
2. General & Systemic Embryology
3. General & Systemic Histology + Laboratory Work
4. Gross Anatomy of Upper Limb
5. Gross Anatomy of Lower Limb
6. Gross Anatomy of Thorax

Recommended Textbooks

1. **Gray's Anatomy for Students** — Richard L. Drake, A. Wayne Vogl, Adam W. M. Mitchell (Elsevier)
2. **Clinically Oriented Anatomy** — Keith L. Moore, Arthur F. Dalley, Anne M.R. Agur (Wolters Kluwer)
3. **Last's Anatomy** — Chummy S. Sinnatamby (Elsevier)
4. **Snell's Clinical Anatomy by Regions** — Richard S. Snell (Lippincott Williams & Wilkins).
5. **Cunningham's Manual of Practical Anatomy** — R. J. Last, Patrick W. Tank (Oxford University Press)
6. **Langman's Medical Embryology** — T. W. Sadler (Lippincott Williams & Wilkins)
7. **The Developing Human: Clinically Oriented Embryology** — Keith L. Moore, T.V.N. Persaud, Mark G. Torchia (Elsevier)
8. **Wheater's Functional Histology** — Barbara Young, Philip Woodford, Jonathan O. W. Warren (Elsevier)
9. **Junqueira's Basic Histology** — Anthony L. Mescher (McGraw Hill)

10. Neuroanatomy through Clinical Cases — Hal Blumenfeld (Sinauer Associates)

- **diFiore’s Atlas of Histology with Functional Correlations** — Victor P. Eroschenko, H. K. Prasanna; 1st South Asian Edition (2022, Wolters Kluwer)

MODULE: FOUNDATION (5 weeks)

Topics	Specific Learning Objectives
<p><u>General Anatomy:</u> Introduction to Human Body & Language of Anatomy</p>	<ul style="list-style-type: none"> • Describe the anatomical position as the standard reference. • Explain anatomical planes and axes in relation to movement and imaging. • Use standard anatomical terminology accurately. • Identify common body positions and their basic clinical relevance. • Describe fundamental body movements at major joints. • Outline the structural organization of the body and its divisions. • Explain the general body plan and integration of organ systems. • Recognize the clinical relevance of anatomy in surface landmarks, variation, and procedural safety. • Interpret basic X-ray, CT, and MRI using anatomical planes and terminology.
<p><u>General Anatomy:</u> Skin & Subcutaneous Tissue</p>	<ul style="list-style-type: none"> • Describe the structural layers of skin and their key features. • Identify skin appendages and their anatomical organization. • Differentiate thick and thin skin structurally. • Describe subcutaneous tissue and its regional variation. • Describe deep fascia and its structural modifications. • Explain fascial relationships in the spread of infection or fluid. • Outline dermatomes and cutaneous nerve distribution. • Explain the anatomical basis and classification of burns.
<p><u>General Anatomy:</u> Osteology</p>	<ul style="list-style-type: none"> • Classify bones by shape, development, and region. • Describe the gross structure of a typical long bone. • Describe the basic microscopic organization of bone. • Outline bone development and ossification centers. • Describe the vascular and neural supply of bone. • Explain the functional morphology of bones. • Describe the anatomical basis of common fractures. • Recognize basic clinical applications of bone anatomy.
<p><u>General Anatomy:</u> Chondrology</p>	<ul style="list-style-type: none"> • Identify the structural features of cartilage, including chondrocytes, lacunae, and extracellular matrix. • Classify types of cartilage (hyaline, elastic, fibrocartilage) and describe their distinguishing anatomical characteristics. • Describe the distribution and functional significance of hyaline cartilage in the body. • Describe the distribution and functional significance of elastic cartilage in the body. • Describe the distribution and functional significance of fibrocartilage in the body. • Explain the vascular and nutritional characteristics of cartilage, including reliance on diffusion.

	<ul style="list-style-type: none"> • Differentiate the three types of cartilage based on gross appearance, texture, and anatomical context. • Relate the structural features of cartilage to clinical relevance, including degenerative changes and limited healing capacity.
<p>General Anatomy</p> <p>Arthrology</p>	<ul style="list-style-type: none"> • Classify joints structurally and identify examples. • Describe the basic components of synovial joints. • Outline key features of fibrous and cartilaginous joints. • Explain the vascular, neural, and lymphatic supply of joints. • Describe factors contributing to joint stability. • Explain joint movements in relation to synovial joint types. • Describe basic biomechanical principles of joint movement. • Relate joint structure to common clinical correlations.
<p>General Embryology:</p> <p>Gametogenesis and Chromosomal Theory of Inheritance</p>	<ul style="list-style-type: none"> • Molecular regulation and Signaling pathways – Gene transcription, Genomic imprinting, regulators of gene expression, induction and organ formation, Cell-signaling, SHH master gene, Planar cell polarity, NOTCH pathway • Interpret normal and altered patterns of cell division. • Describe spermatogenesis and its stages of maturation. • Describe oogenesis, including meiotic stages and polar body formation. • Explain the structure and chromosomal constitution of mature gametes. • Describe normal meiotic chromosomal behavior. • Explain the chromosomal basis of inheritance and karyotype. • Identify common numerical and structural chromosomal abnormalities. Down’s, Edward’s, Patau’s, Klinefelter, Turner, triple X, cri-du-chat, microdeletions, Angelman, Prader-Willi, Miller-Dieker, 22q11, Fragile X Syndromes. • Outline embryologically relevant mechanisms producing abnormal gametes. • Relate chromosomal and gamete abnormalities to basic clinical implications.
<p>General Embryology:</p> <p>From Ovarian Cycle to Implantation</p>	<ul style="list-style-type: none"> • Outline key ovarian and menstrual cycle events relevant to fertilization. • Describe ovum and sperm transport through the female genital tract. • Explain the process of fertilization. • Describe stages of early embryonic development. • Explain the role of trophoblast and inner cell mass. • Describe implantation and early placental development. • Identify the embryological basis of abnormal implantation. • Outline embryological principles of contraception and assisted fertilization. • Describe and prescribe Contraceptive Methods to couples and resolve cases of infertility.
<p>General Embryology:</p> <p>The Week of Twos</p>	<ul style="list-style-type: none"> • Describe formation of the bilaminar embryonic disc. • Explain trophoblastic differentiation. • Describe development of the amniotic cavity and amnion. • Describe formation and modification of the yolk sac. • Explain formation of extraembryonic mesoderm and chorionic cavity. • Outline the establishment of uteroplacental circulation. • Abnormal implantation – Ectopic Pregnancy, Hydatidiform Mole • Describe formation and significance of the early chorion. • Recognize the basis of the “Week of Twos”.

<p><u>General Histology:</u></p> <p>Cytoskeleton, Cell Surface Modification & Nucleus</p>	<ul style="list-style-type: none"> • Describe components and organization of the cytoskeleton. • Outline nuclear structure and chromatin types. • Describe cell surface specializations and their microscopic features. • Explain the histological basis of primary ciliary dyskinesia. • Describe histological features of cell injury and cell death. • Enumerate the cell surface modifications • Describe the histologic appearance (TEM) of each Apical Modification; Cilia, Microvilli, Stereocilia etc. • Discuss the functional correlations of modifications with their structure • Immotile Cilia Syndrome (Kartagener’s Syndrome) • Clinically correlate the cell surface modifications with their syndromes • Draw and label ALL cell surface modifications
<p><u>General Histology:</u></p> <p>Epithelium</p>	<ul style="list-style-type: none"> • Classify covering epithelium by layers and cell shape. • Describe major epithelial types. • Describe the basement membrane ultrastructure. • Explain the organization of glandular epithelium. • Classify exocrine glands by structure and pathway. • Describe mechanisms of epithelial secretion. • Identify major epithelial cell junctions. • Relate epithelial structure to histological function.
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Introduction to Gross Anatomy of Upper Limb</p>	<ul style="list-style-type: none"> • Identify regions and compartments of the upper limb. • Describe key surface landmarks of the upper limb. • Outline the osteological framework of the upper limb. • Describe compartmental organization of the upper limb. • Identify major muscle groups and their actions. • Describe primary joint movements of the upper limb. • Outline major nerves and vessels of the upper limb. • Recognize relevant surface-to-deep anatomical relationships.
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Clavicle</p>	<ul style="list-style-type: none"> • Identify the clavicle and determine its side and orientation. • Describe the anatomical features of the clavicle. • Identify major muscular and ligamentous attachments. • Outline clavicular ossification and its intramembranous origin. • Describe and perform the articulations of the clavicle. • Explain the clinical significance of clavicular fractures. • Recognize the functional role of the clavicle in upper-limb positioning.
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Pectoral Region</p>	<ul style="list-style-type: none"> • Identify boundaries and surface landmarks of the pectoral region. • Describe pectoral muscles and their attachments, nerve supply, and actions. • Outline fasciae of the pectoral region. • Describe major neurovascular structures of the pectoral region. • Identify axillary lymph nodes related to the pectoral region. • Recognize key surface-to-deep dissection relationships. • Explain clinical correlations of the pectoral region.
<p><u>Gross Anatomy of Upper Limb</u></p>	<ul style="list-style-type: none"> • Identify the location, extent, and surface landmarks of the breast. • Describe anatomical layers and relations of the breast. • Outline the structure of the mammary gland. • Describe the arterial supply of the breast.

Breast	<ul style="list-style-type: none"> Describe venous drainage of the breast. Identify the nerve supply of the breast. Outline lymphatic drainage of the breast. Explain key clinical correlations of breast anatomy.
<u>Gross Anatomy of Upper Limb</u> Scapula	<ul style="list-style-type: none"> Identify the scapula and determine its side and orientation. Describe major anatomical features of the scapula. Outline muscle attachments of the scapula. Describe scapular articulations and functional joints. Summarize the ossification pattern of the scapula. Explain key clinical correlations of the scapula. Recognize the role of the scapula in shoulder girdle movements.
<u>Gross Anatomy of Upper Limb</u> Axilla	<ul style="list-style-type: none"> Identify the boundaries, apex, base, and walls of the axilla. Describe the axillary fascia and sheath. Identify major contents of the axilla. Describe the axillary artery and its branches. Outline formation and drainage of the axillary vein. Identify axillary lymph node groups and drainage pathways. Recognize key surface-to-deep relationships in the axilla. Explain clinical correlations of axillary anatomy.
<u>Gross Anatomy of Upper Limb</u> Brachial Plexus	<ul style="list-style-type: none"> Describe formation and components of the brachial plexus. Distinguish supraclavicular and infraclavicular parts and branches. Outline muscular and cutaneous distribution of major terminal nerves. Identify key anatomical relations of the brachial plexus. Describe segmental innervation of the upper limb. Recognize the anatomical basis of brachial plexus injuries. Explain the nerve basis of scapular winging. Relate anatomical variations of the plexus to clinical significance.
<u>Gross Anatomy of Upper Limb</u> Scapular Region	<ul style="list-style-type: none"> Identify boundaries and surface landmarks of the scapular region. Describe muscles of the scapular region and their actions. Outline intermuscular spaces and transmitted structures. Describe key neurovascular structures of the region. Explain the scapular anastomosis and its significance. Relate regional anatomy to scapular movements. Describe common clinical correlations of the scapular region. Recognize relevant surface-to-deep dissection relationships.
<u>Gross Anatomy of Upper Limb</u> Joints of Pectoral girdle	<ul style="list-style-type: none"> Describe the articular surfaces and joint types of the sternoclavicular and acromioclavicular joints. Identify major ligaments stabilizing the pectoral girdle joints. Describe capsular, disc, and synovial features of these joints. Outline joint movements contributing to shoulder girdle mobility. Describe the neurovascular supply of the pectoral girdle joints. Explain the mechanics and coordination of scapular movements. Recognize key clinical correlations of pectoral girdle joints. Identify relevant surface and dissection landmarks.

Practicals	Specific Learning Objectives
Staining & Artefacts	<ul style="list-style-type: none"> • Describe the purpose of common stains (especially H&E) and recognize how key tissue components appear. • Understand and recall the commonly used stains in histology laboratory and their special purposes. • Identify common artefacts (folds, tears, bubbles, shrinkage) and understand how they arise. • Distinguish true tissue features from artefacts and record observations with simple labeled drawings.
Simple Epithelium	<ul style="list-style-type: none"> • Identify simple squamous, cuboidal, and columnar epithelium on prepared slides under low/high power. • Recognize key structural features (cell shape, nucleus position, polarity). • Correlate structural features with basic functions (diffusion, absorption, secretion). • Distinguish simple epithelium from stratified types in routine microscopy. • Record observations through clear, labeled microscopic drawings.
Stratified Epithelium	<ul style="list-style-type: none"> • Identify major types of stratified epithelium (keratinized, non-keratinized, transitional) on prepared slides. • Recognize key features such as multiple cell layers, surface cell morphology, and presence/absence of keratin. • Correlate structural differences with protective and barrier functions. • Distinguish stratified epithelium from simple epithelium during routine microscopy. • Record findings using accurate, labeled microscopic drawings.
Glandular Epithelium	<ul style="list-style-type: none"> • Identify exocrine and endocrine glands and recognize basic glandular arrangements (acinar, tubular, cords). • Distinguish serous, mucous, and mixed secretory cells on prepared slides. • Recognize ducts and classify them as simple or compound. • Correlate structural features with modes of secretion and basic glandular functions. • Record observations with clear, labeled microscopic drawings.

MODULE: MUSCULOSKELETAL (6 weeks)

Topics	Specific Learning Objectives
<p><u>General Anatomy</u></p> <p>Myology</p>	<ul style="list-style-type: none"> • Classify muscle tissue types. • Describe gross and microscopic structure of skeletal muscle. • Relate muscle architecture to mechanical function. • Outline structural features of smooth and cardiac muscle. • Describe muscle attachments and actions. • Explain muscle innervation and motor units. • Identify vascular supply of muscles. • Recognize muscular connective tissue elements. • Correlate muscle anatomy with selected clinical conditions.
<p><u>General Histology</u></p> <p>Connective Tissue</p>	<ul style="list-style-type: none"> • Describe the general composition of connective tissue. • Classify connective tissue types. • Identify major connective tissue fibers histologically. • Describe resident and wandering connective tissue cells. • Explain the structural role of ground substance. • Describe microscopic differences between loose and dense connective tissue. • Identify specialized connective tissues. • Relate connective tissue structure to selected clinical correlations.
<p><u>General Histology</u></p> <p>Adipose Tissue</p>	<ul style="list-style-type: none"> • Classify adipose tissue types. • Describe histological features of white adipose tissue. • Describe histological features of brown adipose tissue. • Outline developmental and regional distribution of adipose tissue. • Explain histogenesis of adipocytes. • Identify the connective tissue framework of adipose tissue. • Relate adipose structure to functional roles. • Recognize key clinical correlations of adipose tissue.
<p><u>General Histology</u></p> <p>Cartilage</p>	<ul style="list-style-type: none"> • Describe the microscopic structure of cartilage. • Identify ultrastructural features of cartilage matrix. • Classify cartilage types histologically. • Describe the perichondrium and its role. • Explain mechanisms of cartilage growth. • Describe the limited repair capacity of cartilage. • Compare cartilage and bone microscopically. • Recognize key clinical correlations of cartilage.
<p><u>General Histology</u></p> <p>Bone</p>	<ul style="list-style-type: none"> • Describe the microscopic structure of bone tissue. • Identify major bone cells and their features. • Distinguish compact and spongy bone histologically. • Describe the Haversian system of bone. • Explain intramembranous and endochondral ossification. • Describe the microscopic organization of the growth plate. • Outline vascular pathways of bone. • Correlate bone histology with selected clinical conditions.

<p><u>General Histology</u></p> <p>Muscle Tissue</p>	<ul style="list-style-type: none"> • Describe the microscopic and ultrastructural organization of muscle tissues. • Identify histological features of skeletal muscle. • Identify ultrastructural features of cardiac muscle. • Describe histological features of smooth muscle. • Compare connective tissue coverings of muscle. • Explain regenerative capacities of muscle tissues. • Recognize histopathological bases of selected muscle disorders. • Correlate muscle microstructure with functional differences.
<p><u>General Embryology:</u></p> <p>3rd Week of Development</p>	<ul style="list-style-type: none"> • Describe gastrulation and formation of the primitive streak. • Explain formation of the three germ layers and their early derivatives. • Describe formation and role of the notochord. • Outline differentiation of intraembryonic mesoderm and early outcomes. • Describe somite formation and axial segmentation. • Explain early cardiovascular development. • Describe trophoblastic modifications and chorionic villi formation. • Outline early placental development and the allantois. • Laterality defects – Situs inversus, situs ambiguous, heterotaxy, Kartagener’s Syndrome, X- linked heterotaxy, role of neurotransmitter 5-HT
<p><u>General Embryology</u></p> <p>The Embryonic Period</p>	<ul style="list-style-type: none"> • Describe the timeline and significance of the embryonic period. • Explain neurulation and neural crest derivatives. • Outline germ-layer differentiation into major organ primordia. • Describe somite formation and differentiation. • Explain formation and partitioning of the intraembryonic coelom. • Describe embryonic folding and its effects on body form and gut formation. • Outline early development of the umbilical cord. • Identify key external features and methods of embryonic age estimation. • Correlate embryonic development with vulnerability to teratogens and congenital anomalies. • Neural Tube defects, Capillary Hemangiomas, Endodermal congenital malformations
<p><u>General Embryology</u></p> <p>The Fetal Period</p>	<ul style="list-style-type: none"> • Describe the timeline and defining features of the fetal period. • Outline patterns of fetal growth and body proportions. • Describe maturation of major organ systems during the fetal period. • Identify external features used for fetal age estimation. • Describe structural organization of fetal membranes, placenta, and umbilical cord. • Outline anatomical features of fetal circulation and major shunts. • Recognize clinical relevance of fetal development. • Correlate fetal structural development with gestational milestones. • Erythroblastosis fetalis, Fetal Hydrops, The Placental barrier, Umbilical cord abnormalities, Amniotic bands, Amniotic Fluid abnormalities • Fetal membranes in twins Dizygotic twins, monozygotic twins, twinning abnormalities • Parturition – Preterm Birth
<p><u>General Embryology</u></p>	<ul style="list-style-type: none"> • Classify congenital anomalies by origin. • Describe mechanisms underlying congenital anomalies. • Identify major genetic causes of birth defects.

<p>Birth Defects & Prenatal Diagnosis</p>	<ul style="list-style-type: none"> • Describe important environmental teratogens and critical periods. principles of teratology (Infectious agents, Physical agents, Chemical agents, Hormones & Maternal Disease) • Explain the concept of critical periods in development. • Outline principles of prenatal screening. • Describe basic methods of prenatal diagnosis – USG, Amniocentesis, CVS, PUBS, Maternal serum screening and Non-invasive Prenatal Screening • Fetal Therapy – Fetal Transfusion, Fetal Medical Treatment, Fetal Surgery, Stem Cell Transplantation and Gene Therapy • Describe basic methods of prenatal diagnosis. • Correlate congenital anomalies with their embryological basis. • Identify key preventive strategies for congenital anomalies.
<p><u>Special Embryology</u></p> <p>Development of Muscular System</p>	<ul style="list-style-type: none"> • Describe the embryological origin of skeletal, cardiac, and smooth muscle tissues from mesodermal derivatives. • Explain differentiation of paraxial mesoderm into somites and formation of myotomes. • Describe subdivision of myotomes into epaxial and hypaxial components and their derivatives. • Outline molecular and cellular mechanisms involved in myogenesis, including myoblast proliferation, alignment, and fusion into myotubes. • Explain migration of hypaxial muscle precursor cells into limb buds and body wall. • Describe development of limb musculature in relation to dorsal and ventral muscle masses. • Outline development of smooth muscle from splanchnic mesoderm and its distribution in viscera and vessels. • Describe embryological development of cardiac muscle and its early functional significance. • Correlate developmental processes of the muscular system with selected congenital anomalies and neuromuscular disorders. Poland sequence, Prune belly Syndrome, Muscular Dystrophy (Duchene & Becker)
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Arm</p>	<ul style="list-style-type: none"> • Identify boundaries, compartments, surface landmarks of the arm and shoulder. • Describe muscles of the anterior compartment of the arm. • Describe muscles of the posterior compartment of the arm. • Outline major vessels of the arm and their branches. • Describe nerves of the arm and their key relations. • Explain the structure and stabilizing factors of the shoulder joint. • Describe the anatomical basis of shoulder abduction. • Recognize key surface-to-deep dissection relationships. • Correlate arm and shoulder anatomy with common clinical conditions.
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Forearm</p>	<ul style="list-style-type: none"> • Identify the bones of the forearm and their major features. • Describe the elbow and radioulnar joints. • Describe muscles of the anterior compartment of the forearm. • Describe muscles of the posterior compartment of the forearm. • Explain the anatomical basis of pronation and supination. • Outline major vessels of the forearm. • Describe nerves of the forearm and their key relations.

	<ul style="list-style-type: none"> • Demonstrate important surface anatomy landmarks of the forearm and elbow. • Identify common clinical correlations of forearm anatomy.
<p><u>Gross Anatomy of Upper Limb</u></p> <p>Hand</p>	<ul style="list-style-type: none"> • Identify the bones of the hand and their articulations. • Describe major joints of the hand and their movements. • Outline intrinsic muscles of the hand and their actions. • Describe fasciae and compartments of the hand. • Identify the arterial supply of the hand and palmar arches. • Describe the nerve supply of the hand and its distribution. • Explain fascial spaces of the hand and spread of infection. • Describe mechanics of grip and intrinsic–extrinsic muscle roles. • Explain movements of the thumb and fingers. • Correlate hand anatomy with common clinical conditions.
Practicals	Specific Learning Objectives
Cells & Fibers of C.T.	<ul style="list-style-type: none"> • Identify major connective tissue cells (fibroblasts, macrophages, plasma cells, mast cells, adipocytes) on routine slides. • Recognize collagen, elastic, and reticular fibers under light microscopy and relate them to staining characteristics. • Distinguish loose from dense connective tissue based on cell density and fiber arrangement. • Correlate cell and fiber types with basic supportive and protective functions. • Record microscopic findings with simple, labeled drawings.
Connective Tissue	<ul style="list-style-type: none"> • Identify major Connective Tissue Types according to their classification • Recognize and differentiate between Dense C.T. (Regular & Irregular) with examples, Loose Areolar C.T., Embryonic C.T. (mesenchyme), • Draw and label relevant diagrams after observing under the microscope.
Hyaline Cartilage	<ul style="list-style-type: none"> • Identify hyaline cartilage on prepared slides by its glassy matrix and chondrocytes in lacunae. • Recognize isogenous groups and territorial vs interterritorial matrix. • Distinguish perichondrium and describe its role in growth and repair. • Correlate structural features with functions in support, flexibility, and smooth joint surfaces. • Record observations with clear, labeled microscopic drawings.
Elastic + Fibrocartilage	<ul style="list-style-type: none"> • Identify elastic cartilage by its elastic fiber network and chondrocytes in lacunae. • Identify fibrocartilage by its thick collagen bundles and rows of chondrocytes. • Distinguish these cartilages from hyaline cartilage based on matrix composition and fiber content. • Correlate structural features with functional roles in flexibility (elastic) and tensile strength (fibrocartilage). • Record observations with clear, labeled microscopic drawings.
Compact + Spongy Bone	<ul style="list-style-type: none"> • Identify compact bone by osteons, Haversian canals, lamellae, and lacunae with canaliculi. • Identify spongy (cancellous) bone by trabeculae, marrow spaces, and absence of osteons.

	<ul style="list-style-type: none"> • Distinguish compact from spongy bone based on organization, density, and vascular arrangement. • Recognize osteocytes, osteoblasts, and osteoclasts in routine sections where visible. • Record microscopic findings using clear, labeled drawings.
<p>Cardiac, Skeletal, Smooth Muscles</p>	<ul style="list-style-type: none"> • Identify skeletal, cardiac, and smooth muscle on prepared slides using key features (striations, nuclei position, branching, intercalated discs). • Distinguish these muscle types based on fiber arrangement, cell shape, and connective tissue organization. • Correlate structural characteristics with basic functional roles (voluntary movement, rhythmic contraction, visceral motility). • Recognize perimysium, endomysium, and fascicle organization where applicable. • Record observations through simple, accurate labeled drawings.

MODULE: CARDIOVASCULAR (6 weeks)

Topics	Specific Learning Objectives
<p><u>General</u> <u>Anatomy:</u> Angiology</p>	<ul style="list-style-type: none"> • Describe the organization of systemic and lymphatic circulation. • Classify blood vessels by structure and function. • Explain anastomoses, collateral circulation, and end arteries. • Describe structure and roles of lymphatic vessels and lymph nodes. • Use key angiology terminology accurately. • Recognize common clinical correlations of vascular and lymphatic anatomy.
<p><u>Systemic</u> <u>Embryology:</u> Development of Body Cavities & Diaphragm</p>	<ul style="list-style-type: none"> • Describe formation of the intra-embryonic coelom and body cavities. • Explain development and role of dorsal and ventral mesenteries. • Ventral Body Wall Defects, Diaphragmatic hernias • Describe embryological partitioning of the thoracic cavity. • Explain development and components of the diaphragm. • Relate embryonic folding to final organ positioning. • Identify congenital anomalies related to coelomic and diaphragmatic development. • Correlate cardiac developmental errors with congenital anomalies – Laterality anomalies, abnormalities of cardiac looping, Total anomalous pulmonary venous return (TAPVR), teratogenic insult to cardiac development, Holt-Oram Syndrome, Heart-hand syndromes, hypertrophic cardiomyopathy, ventricular inversion, L-transposition of Great Arteries, HRHS, HLHS, Atrial Septal Defects, Ventricular Septal Defects
<p><u>Systemic</u> <u>Embryology:</u> Development of Heart</p>	<ul style="list-style-type: none"> • Describe formation of the primitive heart tube. • Explain cardiac looping and chamber alignment. • Describe septation of the heart and valve formation. • Explain development of the cardiac outflow tracts. • Describe establishment of fetal circulation and shunts. • Correlate cardiac developmental errors with congenital anomalies.
<p><u>Systemic</u> <u>Embryology:</u> Development of Arterial System</p>	<ul style="list-style-type: none"> • Describe embryological origins of the major arterial systems. • Explain transformation of the aortic arches into definitive arteries. • Describe remodeling of the dorsal aortae and their adult derivatives. • Explain the fate of vitelline and umbilical arteries. • Correlate vascular remodeling with adult arterial patterns. • Identify clinically important arterial developmental anomalies. • Describe the Fetal Circulation & its functional importance and importance of termination
<p><u>Systemic</u> <u>Embryology:</u> Development of Venous System</p>	<ul style="list-style-type: none"> • Describe embryological origins of the major venous systems. • Explain venous remodeling leading to formation of the SVC and azygos system. • Describe vitelline vein contributions to the portal venous system. • Explain formation of the IVC from its embryological segments. • Correlate venous remodeling with definitive adult venous patterns. • Identify clinically important congenital venous anomalies.
<p><u>General</u> <u>Histology:</u></p>	<ul style="list-style-type: none"> • Describe microscopic structure of arterial and venous walls. • Differentiate vessel types histologically. • Describe structural types of capillaries.

Vascular Histology	<ul style="list-style-type: none"> • Explain functional significance of vascular structural specializations. • Correlate vessel histology with hemodynamic principles. • Recognize histopathological features of common vascular diseases.
<u>Systemic Histology:</u> Cardiac Histology	<ul style="list-style-type: none"> • Describe microscopic and ultrastructural features of cardiac muscle. • Explain structure and significance of intercalated discs. • Describe organization of myocardium and conducting fibers. • Correlate cardiac microstructure with functional properties. • Identify key histopathological changes in cardiac disease.
<u>Gross Anatomy of Thorax:</u> Skeleton of Thorax	<ul style="list-style-type: none"> • Describe osteological features of ribs, thoracic vertebrae, and sternum. • Explain thoracic cage articulations and their role in respiration. • Describe biomechanics of thoracic cage movements. • Identify anatomical variations of the thoracic skeleton and their implications. • Correlate thoracic skeletal anatomy with common clinical conditions. • Explain anatomical basis of sternal clinical procedures.
<u>Gross Anatomy of Thorax:</u> Thoracic Apertures	<ul style="list-style-type: none"> • Describe the boundaries and skeletal components of thoracic apertures. • Identify structures traversing the thoracic apertures. • Explain spatial relationships at the superior thoracic aperture. • Correlate anatomical variations with thoracic outlet syndrome. • Describe clinical and surgical relevance of the thoracic outlet.
<u>Gross Anatomy of Thorax:</u> Thoracic Wall Proper	<ul style="list-style-type: none"> • Describe the layered structure of the thoracic wall. • Explain the course and distribution of intercostal nerves and vessels. • Identify functional significance of thoracic wall layers. • Correlate thoracic wall anatomy with common clinical procedures. • Explain venous collateral pathways of the thoracic wall. • Describe surgical and functional relevance of thoracic wall anatomy.
<u>Gross Anatomy of Thorax:</u> Pericardium & Heart	<ul style="list-style-type: none"> • Describe the anatomy of the pericardium and its layers. • Identify external features and surfaces of the heart. • Describe internal anatomy of the heart and its chambers. • Explain coronary circulation and cardiac conduction pathways. • Correlate cardiac anatomy with common clinical conditions. • Describe anatomical bases of cardiac diagnostic and interventional procedures.
<u>Gross Anatomy of Thorax:</u> Great Vessels	<ul style="list-style-type: none"> • Identify the origin, course, branches, and termination of mediastinal great vessels. • Describe anatomical relations of the great vessels within the mediastinum. • Outline formation and drainage of the SVC, brachiocephalic veins, and azygos system. • Recognize key landmarks and common variations of mediastinal great vessels.
Practicals	Specific Learning Objectives
Large Elastic & Muscular Artery	<ul style="list-style-type: none"> • Identify elastic arteries on slides by multiple elastic lamellae within the tunica media. • Identify muscular arteries by a prominent internal elastic lamina and smooth-muscle–dominant media. • Distinguish elastic from muscular arteries based on wall architecture and relative layer composition. • Record microscopic features using clear, labeled drawings.

<p>Arterioles, Venules</p>	<ul style="list-style-type: none"> • Identify arterioles on slides by their small lumen, 1–2 layers of smooth muscle, and relatively thick wall. • Identify venules by their wider lumen, thin wall, and sparse smooth muscle. • Distinguish arterioles from venules based on wall thickness, lumen size, and endothelial appearance. • Record key microscopic features through simple, labeled drawings.
<p>Capillaries</p>	<ul style="list-style-type: none"> • Identify capillaries on slides by their single endothelial cell layer and minimal supporting tissue. • Distinguish continuous, fenestrated, and sinusoidal capillaries based on lumen size and wall characteristics when demonstrable. • Recognize capillaries in relation to surrounding tissues (muscle, glands, connective tissue). • Record observed features with clear, labeled microscopic drawings.
<p>Veins</p>	<ul style="list-style-type: none"> • Identify veins on prepared slides by their wide, irregular lumen and thin wall relative to arteries. • Recognize the predominance of tunica adventitia and sparse smooth muscle in the tunica media. • Distinguish veins from arteries and venules based on wall thickness, lumen shape, and layer organization. • Record key microscopic features using simple, labeled drawings.
<p>Heart L.S.</p>	<ul style="list-style-type: none"> • Identify the myocardium, endocardium, and epicardium in longitudinal sections of the heart. • Recognize cardiac muscle fibers in longitudinal orientation, including branching and intercalated discs where visible. • Distinguish connective tissue elements (fibrous skeleton, endomysium) associated with cardiac muscle. • Record observed structural features with clear, labeled microscopic drawings.

MODULE: RESPIRATORY (5 weeks)

Topics	Specific Learning Objectives
<p><u>Systemic Embryology:</u></p> <p>Development of Respiratory System</p>	<ul style="list-style-type: none"> Describe the embryological origin of the respiratory system. Explain branching morphogenesis and stages of lung development. Describe the development of the larynx, trachea, bronchi, and lungs. Explain the formation of the pleura and pleural cavities. Correlate developmental milestones with functional respiratory maturation. Identify common congenital respiratory anomalies. Describe and explain the common congenital respiratory anomalies, Tracheoesophageal fistulas (TEFs), RDS / Hyaline Membrane Disease, Ectopic lung lobes, congenital cysts of the lung
<p><u>Systemic Histology:</u></p> <p>Histology of Respiratory Tree</p>	<ul style="list-style-type: none"> Describe the microscopic organization of the respiratory tract. Explain epithelial and structural transitions along the airway. Describe histological features of bronchi, bronchioles, and alveoli. Correlate respiratory histological specializations with function. Identify key histopathological changes in common respiratory diseases.
<p><u>Gross Anatomy of Thorax:</u></p> <p>Respiratory Tree & Lungs</p>	<ul style="list-style-type: none"> Describe the gross anatomy of the trachea and bronchial tree. Identify bronchopulmonary segments and their clinical relevance. Describe external features of the lungs and pleural reflections. Identify structures at the lung hilum and their arrangement. Explain vascular and lymphatic supply of the lungs. Correlate respiratory anatomy with mechanics of respiration and common clinical conditions.
<p><u>Gross Anatomy of Thorax:</u></p> <p>Mediastinum</p>	<ul style="list-style-type: none"> Describe boundaries, subdivisions, and contents of the mediastinum. Explain anatomical relationships among mediastinal structures. Correlate mediastinal anatomy with common clinical conditions. Describe compressive effects of mediastinal pathology. Explain relevance of mediastinal anatomy in imaging and surgical approaches.
<p><u>Gross Anatomy of Thorax:</u></p> <p>Joints of Thorax</p>	<ul style="list-style-type: none"> Describe and classify the major joints of the thoracic cage. Explain articulations and movements of thoracic cage joints in respiration.
<p><u>Gross Anatomy of Thorax:</u></p> <p>Respiratory Movements</p>	<ul style="list-style-type: none"> Describe the biomechanics of breathing and thoracic joint mobility. Explain coordinated actions of thoracic muscles and diaphragm in ventilation. Correlate thoracic mechanics with normal ventilation and clinical conditions affecting chest wall movement.
Practicals	Specific Learning Objectives
<p>Epiglottis</p>	<ul style="list-style-type: none"> Identify the epiglottis on slides by its core of elastic cartilage. Recognize the surface epithelia: non-keratinized stratified squamous on the lingual side and respiratory epithelium on the laryngeal side (when demonstrable). Distinguish underlying connective tissue, glands, and cartilage boundaries. Record key microscopic features using clear, labeled drawings.

Larynx	<ul style="list-style-type: none"> • Identify major laryngeal tissues on slides, including respiratory epithelium, stratified squamous epithelium (at vocal folds), and underlying connective tissue. • Recognize laryngeal cartilages (hyaline and elastic) and distinguish their boundaries in section. • Identify seromucous glands and their distribution within the laryngeal mucosa. • Record microscopic features with clear, labeled drawings.
Trachea	<ul style="list-style-type: none"> • Identify tracheal respiratory epithelium with cilia and goblet cells on prepared slides. • Recognize the C-shaped hyaline cartilage rings and intervening connective tissue. • Identify the trachealis smooth muscle and submucosal seromucous glands. • Record key microscopic features using clear, labeled drawings.
Lungs Panoramic View	<ul style="list-style-type: none"> • Identify the overall lung architecture on panoramic sections, including bronchi, bronchioles, alveolar ducts, and alveoli. • Distinguish conducting airway walls (cartilage, smooth muscle, glands) from terminal respiratory structures. • Recognize alveolar septa, capillary networks, and basic tissue organization across lung regions. • Record panoramic features with simple, labeled microscopic drawings.

MODULE: BLOOD & IMMUNITY (6 weeks)

Topic	Specific Learning Objectives
<p><u>General Anatomy:</u></p> <p>Lymphoid System</p>	<ul style="list-style-type: none"> • Identify major components of the lymphoid system. • Describe gross and microscopic organization of lymphoid organs. • Explain anatomy and distribution of lymphatic vessels. • Outline major lymphatic drainage pathways of the body. • Classify regional lymph node groups and their drainage areas. • Explain functional roles of lymphoid tissues. • Correlate lymphatic anatomy with common clinical conditions. • Describe anatomical basis of metastatic spread via lymphatics. • Recognize surgical and imaging relevance of lymphoid structures.
<p><u>Systemic Embryology:</u></p> <p>Development of Axial Skeleton</p>	<ul style="list-style-type: none"> • Describe somite formation and differentiation into sclerotome, dermatome, and myotome. • Explain the role of the notochord in vertebral body and disc formation. • Describe re segmentation of sclerotomes and its significance. • Outline stages of vertebral development and formation of vertebral components. • Explain embryological development of ribs. • Describe formation and segmentation of the sternum. • Correlate developmental disruptions with axial skeletal anomalies (EXCLUDING SKULL) ,Vertebral Defects, Rib Defects, Sternal Defects • Discuss clinical significance of axial skeletal embryology.
<p><u>General Histology:</u></p> <p>Lymphoid Organs</p>	<ul style="list-style-type: none"> • Identify histological components of primary and secondary lymphoid organs. • Describe microscopic architecture of lymphoid organs. • Explain cortical medullary organization of thymus & its role in T-cell maturation. • Describe the bone marrow microenvironment supporting lymphoid development. • Describe structural organization of lymph nodes. • Explain histological features of the spleen and splenic circulation. • Describe structural patterns of MALT. • Correlate lymphoid histology with immune functions. • Recognize pathological changes in lymphoid tissues microscopically. • Discuss the histological basis of diagnostic evaluation of lymphoid disorders.
<p><u>General Histology:</u></p> <p>Microscopic Anatomy of Immune System</p>	<ul style="list-style-type: none"> • Identify major immune cell types and their microscopic features. • Describe distribution of immune cells in tissues and organs. • Explain microscopic organization of innate and adaptive immune components. • Describe mechanisms of immune surveillance and antigen sampling. • Explain histological basis of antigen processing and presentation. • Outline microscopic features of acute and chronic inflammation. • Correlate immune histology with common immunological conditions. • Recognize tissue changes associated with infectious processes. • Discuss diagnostic relevance of immune system histology.

<p><u>Gross Anatomy of Lower Limb:</u></p> <p>Gluteal Region</p>	<ul style="list-style-type: none"> • Identify boundaries, surface landmarks, and layers of the gluteal region. • Describe gluteal muscles and their nerve supply and actions. • Explain organization and functional role of gluteal fasciae. • Describe major neurovascular structures of the gluteal region. • Identify sciatic foramina and transmitted structures. • Locate the safe intramuscular injection site using surface landmarks. • Correlate gluteal anatomy with hip movements, gait, and posture. • Explain the anatomical basis of sciatic nerve injury. • Describe gluteal bursae and their clinical relevance. • Discuss anatomical factors in deep gluteal and compartment syndromes. • Recognize common clinical conditions of the gluteal region.
<p><u>Gross Anatomy of Lower Limb:</u></p> <p>Thigh –</p> <p>Anterior, Posterior, Medial</p>	<ul style="list-style-type: none"> • Describe boundaries, fascial layers, and compartments of the thigh. • Identify thigh muscles by compartment and their actions. • Explain compartmental innervation of the thigh. • Describe arterial supply of the thigh. • Outline venous drainage of the thigh and its clinical relevance. • Identify the femoral triangle and its contents. • Describe the adductor canal and adductor hiatus. • Correlate thigh compartment anatomy with gait and posture. • Explain the anatomical basis of major thigh nerve lesions. • Discuss compartment syndrome of the thigh. • Recognize common clinical conditions of the thigh and their anatomical basis.
<p><u>Gross Anatomy of Lower Limb:</u></p> <p>Knee Joint & Popliteal Fossa</p>	<ul style="list-style-type: none"> • Describe articulating surfaces of the knee joint and their functional significance. • Explain the roles of major knee ligaments in joint stability. • Describe menisci, their attachments, vascularity, and functions. • Identify important bursae around the knee and their clinical relevance. • Explain mechanisms of knee stability and locking–unlocking. • Describe the joint capsule, synovial membrane, and compartments of the knee. • Identify boundaries of the popliteal fossa. • Describe contents and spatial relationships within the popliteal fossa. • Explain the anatomical basis of popliteal artery aneurysm. • Describe mechanisms of nerve entrapment around the knee. • Correlate knee anatomy with common clinical conditions. • Discuss clinical significance of the popliteal fossa in procedures and trauma.
<p>Practicals</p>	<p>Specific Learning Objectives</p>
<p>Cells of Immune System</p>	<ul style="list-style-type: none"> • Identify major immune cells on slides and smears (lymphocytes, plasma cells, macrophages, neutrophils, eosinophils, basophils). • Recognize distinguishing microscopic features such as nucleus shape, cytoplasmic granules, and cell size. • Distinguish immune cells within lymphoid tissues (nodes, spleen, thymus). • Record observed cellular features with clear, labeled drawings.
<p>Lymph Node</p>	<ul style="list-style-type: none"> • Identify the major structural regions of a lymph node: capsule, cortex, paracortex, and medulla.

	<ul style="list-style-type: none"> • Recognize lymphoid follicles (primary and secondary) and medullary cords/sinuses on prepared slides. • Distinguish the organization of lymphocytes, macrophages, and supporting reticular tissue. • Record key microscopic features using clear, labeled drawings.
Spleen	<ul style="list-style-type: none"> • Identify splenic white pulp (lymphoid follicles, periarteriolar lymphatic sheath) and red pulp on prepared slides. • Recognize the central artery, splenic cords, and sinusoids within their respective regions. • Distinguish overall splenic architecture, including capsule and trabeculae. • Record key microscopic features with clear, labeled drawings.
Thymus	<ul style="list-style-type: none"> • Identify thymic cortex and medulla on prepared slides and distinguish their cellular density. • Recognize Hassall’s corpuscles as characteristic structures of the medulla. • Distinguish capsule, septa, and lobular organization of the thymus. • Record observed microscopic features with clear, labeled drawings.
Tonsils	<ul style="list-style-type: none"> • Identify the epithelial covering (stratified squamous or respiratory epithelium) depending on tonsil type. • Recognize lymphoid follicles with germinal centers beneath the epithelium. • Identify tonsillar crypts and distinguish surrounding connective tissue. • Record key microscopic features using clear, labeled drawings.

MODULE: CORE CONCEPTS (5 weeks)

Topics	Specific Learning Objectives
<p><u>General Anatomy:</u></p> <p>Nervous System</p>	<ul style="list-style-type: none"> • Describe the structural organization of the nervous system into CNS and PNS. • Explain functional divisions of the nervous system. • Identify morphological features of neurons and their roles in impulse transmission. • Describe types and functions of neuroglial cells in CNS and PNS. • Outline structural components of a peripheral nerve. • Explain formation and branching of spinal nerves and plexuses. • Describe dermatomes and myotomes and their clinical relevance. • Explain basic organization of neural circuits and pathways. • Correlate nervous system anatomy with common clinical conditions. • Discuss anatomical basis of UMN vs. LMN lesions and peripheral neuropathies.
<p><u>Systemic Embryology:</u></p> <p>Development of Limbs & Appendicular Skeleton</p>	<ul style="list-style-type: none"> • Describe appearance time & formation of upper & lower limb buds • Explain establishment of limb axes and roles of AER, ZPA, and ectodermal signals. • Explain establishment of limb axes and roles of AER, ZPA, and ectodermal signals. • Describe mesenchymal condensation, skeletal patterning & ossification of limbs. • Explain joint formation and development of synovial structures. • Outline development and compartmentalization of limb musculature. • Describe formation of peripheral nerves and dermatomal patterning in limbs. • Explain vascular development and arterial remodeling of limbs. • Describe limb rotations and their effects on definitive anatomy. • Correlate developmental disruptions with congenital limb anomalies. • Meromelia, Amelia, Phocomelia, Micromelia, Brachydactyly, Syndactyly, Polydactyly, Cleft Hand and foot, Hand-foot-genital Syndrome, Holt-Oram Syndrome, Osteogenesis imperfecta, Marfan Syndrome, Arthrogryposis, Club Foot, Congenital Absence of Radius, Transverse limb deficiency, congenital hip dislocation etc. • Discuss clinical implications of abnormal limb development.
<p><u>Systemic Embryology</u></p> <p>Development of Integumentary System</p>	<ul style="list-style-type: none"> • Describe epidermal development from surface ectoderm. • Explain dermal development from mesenchymal sources. • Describe neural crest origin and migration of melanocytes. • Outline embryological development of hair follicles. • Explain development of skin glands. • Describe embryological development of nails. • Correlate developmental disruptions with congenital skin anomalies, pigment disorders, dermatoglyphics, abnormalities of hair distribution & mammary gland. • Discuss embryological basis of acquired skin disorders. • Explain regional variations in skin development and their clinical relevance.
<p><u>General Histology</u></p> <p>Nervous Tissue</p>	<ul style="list-style-type: none"> • Identify major components of nervous tissue and their microscopic features. • Classify neurons structurally and functionally. • Describe structural organization of a neuron and its functional correlations. • Explain types and functions of neuroglial cells in CNS and PNS. • Describe microscopic structure of synapses and neurotransmission.

	<ul style="list-style-type: none"> • Explain myelination in CNS and PNS and its role in conduction. • Identify organization of peripheral nerves and fiber types. • Discuss cellular events in nerve injury and repair. • Correlate histological alterations with neurological disorders. • Recognize histopathological features of demyelinating diseases.
Systemic Histology Integumentary System + Mammary Glands	<ul style="list-style-type: none"> • Describe histological organization of the integumentary system. • Explain microscopic differences between thick and thin skin. • Describe histological structure of skin adnexal glands and hair follicles. • Describe histological architecture of the mammary gland. • Compare mammary gland histology across developmental and functional states.
Gross Anatomy of Lower Limb: Leg	<ul style="list-style-type: none"> • Describe fascial organization and compartmentalization of the leg. • Identify muscles of leg compartments and their actions. • Explain the course and functional distribution of major leg nerves. • Describe the arterial supply and venous organization of the leg. • Identify superficial and deep venous systems and their clinical relevance. • Explain major leg tendons and their roles in ankle mechanics. • Correlate compartmental anatomy with gait and functional movements. • Discuss the anatomical basis and presentation of compartment syndrome. • Explain mechanisms and consequences of common leg nerve injuries. • Describe anatomical basis of shin splints. • Recognize major vascular conditions affecting the leg. • Relate surface landmarks to underlying structures for clinical examination.
Gross Anatomy of Lower Limb: Foot	<ul style="list-style-type: none"> • Identify bones and major joints of the foot and their permitted movements. • Describe arches of the foot and their supporting structures. • Explain the organization and function of the plantar fascia. • Identify intrinsic muscles of the foot and their roles. • Describe the extrinsic tendons of the foot and their actions. • Explain the neurovascular supply of the foot. • Describe the biomechanical organization of the foot in gait and balance. • Correlate foot anatomy with common deformities and plantar conditions. • Explain the anatomical basis of nerve entrapment syndromes of the foot. • Recognize injuries affecting gait and foot stability. • Relate surface landmarks of the foot to underlying structures.
Practicals	Specific Learning objectives
Cells of the Nervous System	Identify, draw & label the types of neurons & neuroglia
Peripheral Nerve	Identify, draw & label the light microscopic structure of the peripheral nerve
Spinal & Autonomic Ganglia	Identify, draw & label the light microscopic structure of sensory ganglia & autonomic ganglia
Thick & Thin Skin	Identify, draw & label the microscopic differences between thick and thin skin. Identify the microscopic features of adnexal glands & hair follicles
Mammary Glands	Identify the microscopic features of the mammary gland across developmental and functional states.

Department of Physiology

Vision and Mission

The mission of the Department of Physiology, King Edward Medical University, is to deliver high-quality, integrated physiology education through student-centered teaching, clinically contextualized learning, and evidence-based assessment; to promote research and scholarly excellence in basic and applied physiology; and to contribute to improved healthcare outcomes by building a strong foundational understanding of human body functions in health and disease.

History

King Edward Medical University traces its origins to the establishment of the Lahore Medical School in 1860, one of the earliest medical institutions in the subcontinent. Dr. J.B. Scriven, appointed as the first Principal on 10th October 1860, also pioneered the teaching of Physiology, laying both academic and administrative foundations. In 1916, the Department of Physiology was formally housed in the Bahawalpur Block, a purpose-built structure generously donated by Sir Sadiq Muhammad Khan Abbasi, Nawab of Bahawalpur. This significant contribution provided the department with the infrastructure necessary for organized teaching and academic advancement.

Message from the Chairman of Physiology

It is a privilege to serve as Head of the Department of Physiology at King Edward Medical University — an institution rooted in tradition, excellence and service. Our department stands on a strong academic foundation, and it is our collective responsibility to preserve these standards while preparing our students for the evolving demands of modern medicine.

Physiology is the cornerstone of clinical understanding. I encourage our students to approach it not merely as a subject to pass, but as a discipline to master. A clear grasp of physiological principles will shape your clinical reasoning, decision-making, and lifelong professional competence.

We are committed to providing an environment that promotes critical thinking, ethical conduct, collaborative learning, and meaningful research. Your curiosity, discipline, and integrity will determine the heights you achieve.

You are the future of healthcare in our nation. May you pursue knowledge with dedication and use it in the service of humanity with compassion and responsibility.

May Allah Almighty guide us all in our shared journey of learning and service.

Prof. Dr. Muhammad Shoaib

Head of Physiology Department

Faculty

Sr. No.	FACULTY	DESIGNATION	QUALIFICATIONS	COORDINATOR
1.	Prof. Dr. Muhammad Shoaib	Chairman & HOD	MBBS, MPhil, CMT	
2.	Dr. Maryam Rao	Associate Professor	MBBS, MPhil, CMT	
3.	Dr. Abeer Fatima	Associate Professor	MBBS, MPhil, CHPE	DPT & AHS
4.	Dr. Seher Naeem	Assistant Professor	MBBS, MPhil, CHPE, FCPS	1 st Year MBBS
5.	Dr. Madiha Akram	Assistant Professor	MBBS, MPhil, CMT	2 nd Year MBBS
6.	Dr. Farkhanda Sajjad	Senior Demonstrator	MBBS, MPhil, CHPE	
7.	Dr. Hina Anis	Demonstrator	MBBS, MPhil, PhD (Health & Policy)	
8.	Dr. Laraib Fatima	Postgraduate Trainee	MBBS	

Syllabus Contents

1. Homeostasis & Internal Body Environment
2. Cell Physiology
3. Transport across the Cell Membrane
4. Nerve Physiology
5. Autonomic Nervous System
6. Muscle Physiology (Skeletal, Smooth & Cardiac)
7. Cardiovascular System
8. Respiratory System
9. Blood & Immunity
10. Thermoregulation
11. Sports Physiology

Learning resources

Theory	1. Textbook of Medical Physiology, 15th Edition by Arthur C. Guyton 2. Review of Medical Physiology, 26th Edition by Ganong 3. Essentials of Medical Physiology, 6 th Edition by Mushtaq Ahmed 4. Human Physiology 9th Edition by Sherwood
Practical	Physiology Practical Notebook

MODULE: FOUNDATION (5 weeks)

Learning objective:

This module introduces the basis of all topics to be covered in successive modules.

Topic	Specific Learning Objectives
Introduction to Physiology	<ul style="list-style-type: none"> • Define physiology • Classify different branches of physiology • Explain the importance of physiology in medical and clinical sciences • Understand functional organization of human body from cell to systems
Concept of Body Fluid and Internal Environment	<ul style="list-style-type: none"> • Describe distribution of total body water • Differentiate between the composition of ECF & ICF with respect to cations & anions • Understand the concept of internal environment
Homeostatic Control System	<ul style="list-style-type: none"> • Define homeostasis • Describe homeostatic mechanisms of the major functional systems • Describe the characteristics of control system of the body. • Enlist four control mechanisms of body • Understand the mechanism of positive, negative, feed forward & adaptive control feedback with examples • Define & comprehend gain of control system
Cell membrane	<ul style="list-style-type: none"> • Describe the structure of cell membrane • Enlist the types of cell membrane proteins (Integral & peripheral) • Enumerate the functions of membrane proteins • Define and enumerate the functions of cell Glycocalyx • Explain the importance of membrane Rafts, Spectrin, Ankyrin
Cytoplasm & Cell organelles	<ul style="list-style-type: none"> • Enlist membrane bound and non - membrane bound organelles • Enlist functions of RER, SER, Golgi apparatus & ribosomes • Differentiate between lysosomes & peroxisomes • Discuss the functions of nucleus • Enlist the major processes of ATP consumption in the body • Enlist the components & function of cell cytoskeleton (molecular motors & axonal transport)
Cell Locomotion & Functional systems	<ul style="list-style-type: none"> • Explain cell ingestion • Define and enlist types of endocytosis • Explain the mechanism of pinocytosis & mechanism of exocytosis

Cellular control mechanisms	<ul style="list-style-type: none"> • Describe the cell cycle • Differentiate between Apoptosis & Necrosis • Explain Cell differentiation • Discuss characteristics of cancer cells
Transport across the cell membrane	<ul style="list-style-type: none"> • Enumerate modes of transport mechanism across the cell membrane • Enlist different types of diffusion • Discuss aquaporins • Illustrate facilitated diffusion • Enlist various types of ion channels with examples • Define & classify active transport • Describe various types of active transport (primary & secondary) with examples • Discuss functions and significance of Na/K ATPase pump
Diffusion / Equilibrium Potentials, Nernst potential & Goldman Equation	<ul style="list-style-type: none"> • Describe the normal distribution of Na⁺, K⁺, Ca and Cl⁻ across the cell membrane • Explain Diffusion potentials of Na & K • Explain Nernst potential • Explain the effects of altering the concentration of Na⁺, K⁺, Ca on the equilibrium potential for that ion. • Explain physiological basis of Goldman equation • Clarify the role of Goldman equation in generation of RMP
Resting Membrane Potential in Neurons	<ul style="list-style-type: none"> • Define resting membrane potential • Describe the physiological basis of generation of RMP. • Explain the effects of hyperkalemia and Hypokalemia on the Resting Membrane Potential • Name the membrane stabilizers • Explain the physiological basis of action of Local Anesthetics
Introduction to Nerve Physiology & Classification of nerve fibers	<ul style="list-style-type: none"> • Describe the physiological anatomy of neurons • Enlist the functions of neuroglial cells • Explain process of myelination in Central Nervous System & Peripheral Nervous System • Explain the mechanism of conduction in myelinated and unmyelinated nerve fibers • Elaborate significance of saltatory conduction • Classify neurons functionally • Classify nerve fibers according to Erlanger & Gasser Classification • Discuss the properties of nerve fibers • Define stimulus • Describe various types of stimuli and response • Define rheobase, chronaxie & their significance
Action Potential in a neuron	<ul style="list-style-type: none"> • Define Action Potential of Neurons • Enlist the Properties of action potential • Describe monophasic action potential • Describe the ionic basis of an action potential

	<ul style="list-style-type: none"> • Explain the phases of action potential • Describe the mechanism of propagation of action potential • Explain absolute and relative refractory period • Explain the role of other ions in action potential. • Elaborate the effect of hypo/hypercalcemia on action potential & neuron excitability. • Elaborate the effect of hypo/hyperkalemia on action potential. • Explain physiological basis & properties of graded potential & compound action potential. • Differentiate between action potential and graded potential
Conduction of nerve Impulse & related abnormalities	<ul style="list-style-type: none"> • Classify and explain Physiological basis of different types of synapses • Elaborate how signal transmission takes place across chemical synapse • Describe the ionic basis of excitatory Post Synaptic Potential (EPSP), Inhibitory Post Synaptic Potential (IPSP), End Plate Potential (EPP) • Enlist the types of nerve injury • Explain Wallerian degeneration • Describe the process of regeneration of nerve fiber • Describe the causes, features & pathophysiology of Multiple sclerosis, GB syndrome.
Fundamentals of Autonomic Nervous System (ANS)	<ul style="list-style-type: none"> • Discuss the components of ANS • Explain the physiological anatomy of sympathetic and parasympathetic nervous system • Describe the types of adrenergic and cholinergic receptors and their functions • Explain the fundamental effects of sympathetic and parasympathetic on various organs/ system of body
Practicals	Specific Learning Objectives
Introduction to Microscope	<ul style="list-style-type: none"> • Identification of different parts and their uses
Introduction to Wintrobe & Westergen tube & Determination of ESR	<ul style="list-style-type: none"> • Identify the Wintrobe and Westergen tubes
Introduction to Neubauer's chamber, Red Blood Cell (RBC) pipettes & White Blood Cell (WBC) pipette	<ul style="list-style-type: none"> • Complete study of Neubauer's slide & relevant calculations

Introduction to centrifuge machine & determination of PCV	<ul style="list-style-type: none">• Identification of different parts
Protocol of Consent taking for Lab and Clinical Procedure	<ul style="list-style-type: none">• Demonstrate protocol for obtaining informed consent

MODULE: MUSCULOSKELETAL (6 weeks)

TOPIC	LEARNING OUTCOMES
Introduction to Skeletal Muscle	<ul style="list-style-type: none"> • Explain the physiological anatomy of skeletal muscle • Describe the physiological structure of sarcomere • Differentiate b/w skeletal, smooth, and cardiac muscle
Molecular Mechanism & characteristics of skeletal muscle contraction	<ul style="list-style-type: none"> • Describe the sarco-tubular system & its importance in muscle Contraction • Discuss the Sliding Filament Model/ Walk-Along Theory of muscle contraction • Draw and describe Length duration curve Load and velocity of contraction • Differentiate between isometric and isotonic contraction by giving examples
Energetics of Muscle contraction	<ul style="list-style-type: none"> • Enumerate and explain energy sources (ATP, creatine phosphate, glycolysis) • Describe the important metabolic systems that supply energy for muscle contraction
Properties & regulation of skeletal muscle contraction	<ul style="list-style-type: none"> • Compare the fast and slow muscle fibers. Define motor unit • Discuss recruitment and its effect on force of contraction • Explain the mechanism of summation and Tetanization. • Describe staircase effect/Treppe phenomena • Discuss the mechanism of skeletal muscle fatigue. • Explain the remodeling of skeletal muscle to match functional demand • Describe the development of macro motor units in poliomyelitis.
Clinical correlations Disorders of Skeletal Muscle	<ul style="list-style-type: none"> • Explain the physiological basis of rigor mortis • Explain the pathophysiological basis of muscular dystrophy
Neuromuscular junction (NMJ)	<ul style="list-style-type: none"> • Describe the physiological anatomy of NMJ • Discuss the mechanism/steps of NMJ transmission & generation of End Plate Potential • Explain features, pathophysiology & treatment of myasthenia Gravis
Drugs acting on Neuromuscular Junction (NMJ)	<ul style="list-style-type: none"> • Describe the enhancers & blockers of the NMJ along with their mechanism of action``
Excitation- Contraction Coupling in skeletal muscle	<ul style="list-style-type: none"> • Explain the mechanism of spread of muscle action potential • Discuss the steps/ events of excitation contraction coupling in skeletal muscle • Describe the pathophysiological basis of malignant hyperthermia

Introduction to Smooth Muscle	<ul style="list-style-type: none"> • Differentiate between types of smooth muscles (unitary vs multiunit) • Describe mechanism of contraction in smooth muscle in comparison to skeletal muscle • Explain the regulation of smooth muscle contraction by calcium ions • Explain the nervous and hormonal control of smooth muscle contraction • Explain the phenomena of stress relaxation and reverse stress relaxation in smooth muscles.
Latch mechanism in smooth muscles	<ul style="list-style-type: none"> • Explain the latch mechanism • Describe the significance of latch mechanism
Neuromuscular Junctions of Smooth Muscle	<ul style="list-style-type: none"> • Explain the physiological anatomy of neuromuscular junction of smooth muscle • Explain the excitatory and inhibitory transmitters secreted at NMJ of smooth muscles
Action Potentials in Smooth Muscle	<ul style="list-style-type: none"> • Explain the types of membrane & action potentials in smooth muscles
Smooth muscle contraction without action potential	<ul style="list-style-type: none"> • Explain the depolarization of multi-unit smooth muscle without action potentials • Explain the local tissue factors & hormones that can cause smooth muscle contraction without action potential • Discuss the mechanisms of smooth muscle excitation or inhibition by hormones or local tissue factors
Introduction to Cardiac muscle	<ul style="list-style-type: none"> • Discuss the structure of cardiac muscle • Explain the functional significance of arrangement of cardiac muscle fibers • Discuss the properties of cardiac muscles
Action Potentials in Cardiac Muscle	<ul style="list-style-type: none"> • Describe & illustrate the phases of action potential of ventricular muscle along with the ions involved • Describe & illustrate the phases of action potential of SA node • Explain the mechanism of self-excitation/ auto-rhythmicity of SA node. • Differentiate between action potential generated in ventricular versus SA nodal fiber • Define and give the duration of the Absolute and relative refractory period in cardiac muscle.
Excitation-contraction coupling in cardiac muscle	<ul style="list-style-type: none"> • Describe the mechanism of Excitation-contraction coupling & relaxation in cardiac muscle
Practicals	Specific Learning Objectives

Isometric & Isotonic Muscle contractions	Demonstration of different types of muscle contraction
Examination of the precordium	Locate apex beat and assess its position and character
RBC count	Demonstrate correct technique
WBC count	Demonstrate correct technique
Platelet count	Perform hemoglobin estimation

MODULE: CARDIOVASCULAR (5 weeks)

Topics	Specific Learning Objectives
Cardiac Cycle	<ul style="list-style-type: none"> • Explain & illustrate pressure & volume changes of left ventricle during cardiac cycle. • Correlate electrical (ECG), mechanical (Heart sounds), and pressure changes during the cardiac cycle (Wiggers' diagram) • Enlist, draw, and explain the physiological basis of atrial pressure waves in relation to cardiac cycle. • Explain & draw the aortic pressure curve
Function Of the Ventricles as Pumps	<ul style="list-style-type: none"> • Describe the Outflow of Blood from the Ventricles During Systole • Define cardiac output, stroke volume, end diastolic volume & end systolic volume • Explain & illustrate Ventricular Volume-Pressure graph • Describe the Frank Starling mechanism. • Describe the autonomic regulation of heart pumping • Describe the effect of potassium, calcium ions & temperature on heart function. • Define chronotropic effect- positive and negative. • Define the inotropic effect: positive and negative. • Define dromotropic effect: positive and negative • Describe the location of adrenergic & cholinergic receptors in heart. • Name the receptors present in coronary arterioles. • Explain sympathetic & parasympathetic effects on heart rate & conduction velocity
Conducting system of heart	<ul style="list-style-type: none"> • Draw and explain the conducting system of heart • Describe the transmission of the cardiac impulse from SA node to ventricular muscles along with time duration & conduction velocity • Describe the physiological basis and significance of AV nodal delay. • Explain SA node as the pacemaker of the heart • Explain the ectopic pacemaker
Fundamentals of ECG	<ul style="list-style-type: none"> • Enlist and explain the physiological basis of ECG • Describe durations of waves, intervals, and segments of normal ECG • Describe the standard limb leads, Augmented limb leads & precordial leads. • Define Einthoven's Triangle & Einthoven's law. • Explain the physiological basis of upright T wave in normal ECG.
Interpretation of ECG & mean Cardiac Axis	<ul style="list-style-type: none"> • Define and plot the mean cardiac axis. • Enlist the physiological & pathological causes of right axis deviation of heart. • Enlist the physiological & pathological causes of left axis deviation of heart. • Describe the abnormalities of T wave and their causes • Describe the location and significance of J point in ECG • Explain the physiological basis of current of injury. • Enlist the ECG changes in angina pectoris. • Enlist the ECG changes in myocardial infarction

Effect of electrolyte on ECG	<ul style="list-style-type: none"> • Describe the effect of hypokalemia and hyperkalemia on ECG • Describe the effect of hypocalcemia and hypercalcemia on ECG.
Cardiac arrhythmia	<ul style="list-style-type: none"> • Define tachycardia and enlist its causes. • Define bradycardia and enlist its causes • Describe the effect of hypokalemia and hyperkalemia on ECG • Describe the effect of hypocalcemia and hypercalcemia on ECG. • Define tachycardia and enlist its causes. • Define bradycardia and enlist its causes. • Classify arrhythmias • Explain the physiological basis of sinus arrhythmia. • Explain the physiological basis of reflex bradycardia in Athletes. • Explain the carotid sinus syndrome. • Enlist the causes of atrioventricular block. • Explain the types of atrioventricular blocks. • Explain the ECG changes in 1st, 2nd & 3rd degree heart block. • Explain the cause, physiological basis & ECG changes in Stokes Adam syndrome/ventricular escape. • Enlist the causes of premature contractions. • Explain the causes and ECG changes of premature atrial contractions. • Explain the physiological basis of pulses deficit. • Explain the causes and ECG changes in Premature Ventricular Contraction • Enlist the causes and ECG findings in Long QT syndrome. • Explain the causes, physiological basis, features, ECG changes & management of premature heartbeat. • Explain the causes, physiological basis, features, ECG changes & management of atrial fibrillation. • Explain the causes, physiological basis, features & ECG changes of ventricular fibrillation. • Explain the physiological basis, features & ECG changes of atrial flutter. • Compare Flutter and Fibrillations
Heart sounds	<ul style="list-style-type: none"> • Enlist the different types of heart sounds and explain the physiological basis of each. • Enlist the causes of 3rd & 4th heart sounds. • Explain the causes of splitting of 2nd heart sound • Explain the causes & physiological basis of murmurs caused by valvular lesions. • Enumerate abnormal heart sounds and describe the physiological basis of each
Organization of Circulation	<ul style="list-style-type: none"> • Explain the functional parts of circulation (arteries, arterioles, capillaries, veins, venules).
Principles of Blood flow	<ul style="list-style-type: none"> • Explain the pressures in systemic & pulmonary circulation • Explain the types of Blood flow and significance of Reynolds number.

Local & Humoral Control of Blood flow	<ul style="list-style-type: none"> • Describe local control of blood flow according to tissue needs. • Discuss humoral control of local blood flow. • Explain long term control of local blood flow • Describe vascular control by ions and other chemical factors. • Name the organs in which auto regulation of blood flow occurs • Explain the metabolic & myogenic mechanisms
Nervous Regulation of circulation	<ul style="list-style-type: none"> • Explain the role of autonomic nervous system for regulating the circulation. • Describe the vasomotor center. • Explain the control of vasomotor center by higher nervous centers. • Explain emotional fainting/vasovagal syncope • Identify vessels constituting micro-capillaries • Enumerate hydrostatic and osmotic factors that underlying Starling's hypothesis for capillary function.
Rapid control of arterial blood pressure	<ul style="list-style-type: none"> • Explain the role of nervous system in rapid control of arterial blood pressure. • Explain the regulation of arterial blood pressure during exercise. • Enlist different mechanisms for short term regulation of arterial blood pressure. • Explain the role of baroreceptors in regulation of arterial blood pressure • Explain the role of chemoreceptors in regulation of arterial blood pressure • Discuss the role of Atrial volume reflexes/ Bainbridge reflex in control of blood pressure. • Describe reflex responses to increased blood volume which increase blood pressure and atrial stretch. • Describe the role of CNS ischemic response in regulation of blood pressure. • Explain the Cushing reflex • Explain the role of abdominal compression reflex to increase the arterial blood pressure.
Role of kidneys in long term Regulation of Arterial Blood Pressure	<ul style="list-style-type: none"> • Illustrate the role of renin angiotensin system for long term control of blood pressure. • Illustrate the regulation of blood pressure in response to increase in ECF volume. • Illustrate regulation of blood pressure in response to increase in salt intake.
Cardiac output	<ul style="list-style-type: none"> • Define cardiac output, cardiac index & venous return with their normal values. • Discuss the factors regulating cardiac output. • Discuss factors regulating venous return
Skeletal muscle circulation	<ul style="list-style-type: none"> • Explain the regulation of skeletal muscle blood flow at rest & during exercise.
Coronary circulation	<ul style="list-style-type: none"> • Explain the physiological anatomy of coronary circulation. • Explain the regulation of coronary blood flow. • Explain the physiological basis of angina, myocardial & subendocardial infarction.
Cardiac Failure	<ul style="list-style-type: none"> • Define cardiac failure

	<ul style="list-style-type: none"> • Classify it into systolic and diastolic failure • Explain pathophysiology of compensated & decompensated heart failure
Practicals	Specific Learning Objectives
Examination of Precordium	<ul style="list-style-type: none"> • Locate apex beat and assess its position and character
Examination of Arterial Pulses	<ul style="list-style-type: none"> • Demonstrate correct technique for palpation and assessment
Recording of Normal Blood Pressure	<ul style="list-style-type: none"> • Demonstrate accurate measurement technique
Effect of Posture & Exercise on Normal Blood Pressure	<ul style="list-style-type: none"> • Record BP in different postures and after exercise
Determination of JVP	<ul style="list-style-type: none"> • Demonstrate correct positioning and technique for estimation of JVP
Recording of ECG	<ul style="list-style-type: none"> • Perform correct electrode placement and record a normal ECG

MODULE: RESPIRATORY (5 weeks)

Learning objective:

In this module students will be able to establish structural & physiological foundations of respiratory system.

Topics	Specific Learning Objectives
Breathing Mechanics & Ventilation	<ul style="list-style-type: none"> • Enlist the muscles of inspiration and expiration in quiet breathing • Enlist the muscles of inspiration and expiration in labored breathing • Explain the components of the work of breathing • Discuss the mechanics of pulmonary ventilation • Define alveolar, pleural & transpulmonary pressure • Explain abnormal patterns of breathing (periodic, kussmaul) • Explain the causes and pathophysiology of sleep apnea
Lung compliance	<ul style="list-style-type: none"> • Define lung compliance • Enlist the factors that affect lung compliance • Draw the compliance diagram of air filled and saline filled lungs • Enlist the components of surfactant • Describe the role of surfactant in lung compliance • Explain the role of surfactant in premature babies
Lung volume and capacities	<ul style="list-style-type: none"> • Define the different lung volumes and capacities and their clinical significance • Enlist the lung volumes and capacities that cannot be measured by spirometer. • Define dead space & explain its types & functions • Define alveolar ventilation. • Define minute respiratory volume
Obstructive & Restrictive Lung Diseases	<ul style="list-style-type: none"> • Discuss FEV1/ FVC ratio and its clinical significance • Discuss FEV1/FVC ratio in relation to Bronchial Asthma. • Discuss FEV1/FVC ratio in relation to Chronic Obstructive Pulmonary disease/restrictive lung diseases • Discuss FEV1/FVC ratio in relation to pulmonary embolism
Pulmonary Circulation	<ul style="list-style-type: none"> • Describe the blood volume of the Lungs • Describe the pressures in the pulmonary system. • Describe the distribution and regulation of blood flow through the lungs. • Explain pulmonary capillary dynamics. • Describe the mechanics of blood flow in the three blood flow zones of the lung • Describe the effect of heavy exercise on pulmonary arterial pressure. • Describe the function of pulmonary circulation when left atrial pressure rises as a result of left-sided heart failure

Pulmonary Edema, and Pleural Fluid	<ul style="list-style-type: none"> • Discuss pathophysiology and common causes of pulmonary edema. • Explain the safety factors that prevent pulmonary edema. • Explain the physiological basis of the presence of normal fluid in the pleural cavity. • Define pleural effusion and give its causes.
Principles of Gaseous Exchange	<ul style="list-style-type: none"> • Explain the ultrastructure of respiratory membrane • Discuss the factors affecting diffusion of gases across the respiratory membrane • Explain the diffusion capacity of respiratory membrane for oxygen and carbon dioxide • Explain differences in the partial pressures of atmospheric, humidified, alveolar air and explain physiological basis of change in each pressure
Transport of oxygen in the blood	<ul style="list-style-type: none"> • Explain the different forms of transport of oxygen in the blood • Draw and explain oxy-hemoglobin dissociation Curve • Enlist the factors that cause rightward shift of Oxyhemoglobin dissociation curve. • Enlist the factors that cause leftward shift of Oxyhemoglobin dissociation curve • Explain the Bohr's effect
CO poisoning	<ul style="list-style-type: none"> • Draw and explain the effect of CO poisoning on oxyhemoglobin dissociation curve • Explain the pathophysiology, features, and treatment of CO poisoning • Define cyanosis & enlist its types and causes
Transport of CO₂ in the blood	<ul style="list-style-type: none"> • Enlist different forms in which CO₂ is transported in the blood. • Explain the carboxyhemoglobin dissociation curve. • Explain the Haldane effect. • Explain the chloride shift/Hamburger phenomenon. • Define the respiratory exchange ratio (RER)
VA/Q (Ventilation Perfusion Ratio)	<ul style="list-style-type: none"> • Explain the alveolar oxygen & carbon dioxide pressure when VA/Q = infinity, zero & normal • Explain the concept of physiological shunt when VAQ ratio is less than normal • Explain the concept of physiological dead space when VA/Q ratio is above normal
Protective Reflexes	<ul style="list-style-type: none"> • Enlist the respiratory & non-respiratory functions of lungs. • Explain the nervous (autonomic) control of bronchiolar musculature • Trace the reflex arc of cough reflex and sneeze reflex
Aviation and space	<ul style="list-style-type: none"> • Explain the principal means by which acclimatization occurs • Explain the events that occur during acute mountain sickness • Enlist the features of chronic mountain sickness
Deep sea diving	<ul style="list-style-type: none"> • Explain the pathophysiology, features, prevention and treatment of decompression sickness
Nervous regulation of respiration	<ul style="list-style-type: none"> • Enumerate the components of respiratory centers and explain their functions. • Explain the inspiratory RAMP signal • Explain the Herring Breuer reflex lung inflation reflex and its clinical significance

Chemical control of respiration Exercise and respiration	<ul style="list-style-type: none"> • Explain the location of chemo sensitive area and peripheral chemoreceptors • Explain the effect of hydrogen ions & carbon dioxide on the chemo- sensitive area • Explain the role of oxygen in the control of respiration/peripheral chemoreceptors • Explain the regulation of Respiration during Exercise
Hypoxia	<ul style="list-style-type: none"> • Enlist the effects of acute hypoxia • Explain the hypoxia inducible factor a master switch for body response to hypoxia • Define and explain different types of hypoxias
Pathophysiology of Lung Diseases	<ul style="list-style-type: none"> • Explain the pathophysiology of Tuberculosis, pneumonia, COPD & Asthma • Enlist different causes of dyspnea • Differentiate between cardiac and respiratory dyspnea • Outline management strategies for dyspnea
Pneumothorax	<ul style="list-style-type: none"> • Enlist the causes of Pneumothorax • Describe the signs and symptoms of Pneumothorax
Pleuritis	<ul style="list-style-type: none"> • Enlist the causes of Pleuritis • Describe the signs and symptoms of Pleuritis • Discuss the management of Pleuritis
Bronchitis	<ul style="list-style-type: none"> • Enlist the causes of Bronchitis • Discuss the signs and symptoms of Bronchitis • Discuss the management of Bronchitis
Pneumonia	<ul style="list-style-type: none"> • Discuss the management of pneumonia • Discuss the sign symptoms of pneumonia • Discuss the management of pneumonia
Asthma	<ul style="list-style-type: none"> • Classify different types of asthma • Discuss the signs and symptoms of asthma • Discuss the management of asthma
Tuberculosis	<ul style="list-style-type: none"> • Classify different types of Tuberculosis • Discuss the signs and symptoms of tuberculosis • Discuss the management of Tuberculosis
Acute respiratory distress syndrome	<ul style="list-style-type: none"> • Classify different types of acute respiratory distress Syndrome • Discuss the signs and symptoms of acute respiratory distress syndrome • Discuss the management of acute respiratory distress syndrome
Respiratory Failure	<ul style="list-style-type: none"> • Define respiratory failure • Describe various types of respiratory failure • Enlist various causes of respiratory failure • Outline management strategies of respiratory failure
Practicals	Specific Learning Objectives
Examination	<ul style="list-style-type: none"> • Demonstrate systematic procedure

of Respiratory System	
Spirometry	<ul style="list-style-type: none"> • Perform spirometry following standard procedure • Identify and interpret basic spirometric parameters (TV, VC, FEV₁, FVC, FEV₁/FVC)
Stethography	<ul style="list-style-type: none"> • Demonstrate breathing movements in a graphical form
Determination of Oxygen saturation by Pulse Oximeter	<ul style="list-style-type: none"> • Accurately measure oxygen saturation
Determination of Peak Expiratory Flow meter	<ul style="list-style-type: none"> • Accurately measure Peak Expiratory Flow

BLOOD & IMMUNITY MODULE (6 weeks)

Topics	Specific Learning Objectives
Blood Composition	<ul style="list-style-type: none"> • Enumerate the functions of blood • Explain the composition of blood • Enumerate plasma proteins • Describe the functions of plasma proteins • Explain the causes of hypoproteinemia • Explain pathophysiology of edema
Red Blood Cells	<ul style="list-style-type: none"> • Define Hematopoiesis • Explain the role of Growth inducers and differentiation inducers in hematopoiesis • Explain different types of Bone marrows • Describe the morphology of RBC • Discuss the characteristics of red blood cells • Enumerate the different sites of erythropoiesis at different ages • Discuss steps of erythropoiesis • Enumerate factors that regulate erythropoiesis • Explain Erythropoietin • Discuss Erythropoietin synthesis and release • Explain the significance of vitamin B12 and folic acid in maturation of red blood cell
Hemoglobin	<ul style="list-style-type: none"> • Enumerate the types of normal hemoglobin in different ages of life • Explain the role of Iron in Hemoglobin formation. • Define blood indices, give their normal values & enumerate the conditions in which these values are disturbed • Enlist the abnormal types of hemoglobin
Anemia	<ul style="list-style-type: none"> • Define, classify and explain anemia on the basis of morphology and cause • Discuss the effects of anemia on the body
Polycythemia	<ul style="list-style-type: none"> • Define polycythemia • Explain types of polycythemias • Discuss the effects of polycythemia on the body
White Blood Cells	<ul style="list-style-type: none"> • Enumerate the types of white blood cells • Describe the characteristics and functions of Neutrophils • Explain the process of defense against invading agent by neutrophils • Define leukocytosis and leukopenia • Explain the effects of leukemia on body • Explain the process of defense against invading agent by macrophages • Discuss different lines of defense during inflammation

	<ul style="list-style-type: none"> • Explain the functions of neutrophils and macrophages in spread of inflammation (walling off effect) • Define the Reticuloendothelial system Enlist the different components of Reticuloendothelial system • Explain the characteristics and functions of basophils • Explain the characteristics and functions of eosinophils and enlist conditions in which these cells are raised.
Immunity	<ul style="list-style-type: none"> • Define & classify immunity • Explain humoral & Innate immunity. • Elaborate cell mediated immunity. • Describe the structure of antigen and immunoglobulin • Describe the role of Helper T-cells in cell mediated immunity • Enlist the types of Immunoglobulins along with their functions • Explain the role of memory cells in enhancing antibody response (secondary response) • Describe the mechanism of action of antibodies Elaborate the complement system.
Tolerance	<ul style="list-style-type: none"> • Elaborate Immune tolerance • Explain the process of clone selection during T cell processing • Discuss the failure of tolerance mechanism
Immunization	<ul style="list-style-type: none"> • Discuss immunization. • Define passive Immunity • Explain features and physiological basis of delayed reaction allergy. • Explain features and physiological basis of Atopic Allergy • Explain features and physiological basis of Anaphylaxis, urticaria and hay fever
Blood Types & Blood group Incompatibility	<ul style="list-style-type: none"> • Enumerate different blood group types. • Explain the basis of ABO and Rh blood system • Explain the Landsteiner law • Discuss the pathophysiology, features and treatment of ABO and RH incompatibility. • Enlist the changes that take place in the stored Blood.
Blood mismatch Transfusion reactions	<ul style="list-style-type: none"> • Discuss the features and complications of mismatched blood transfusion reaction • Describe the Hazards of blood transfusion. Transfusion reactions • Elaborate the Transplantation of Tissues and Organs
Transplantation of tissues	<ul style="list-style-type: none"> • Explain the process of tissue typing • Integrate with pathology Transplantation of tissues • Explain the prevention of Graft Rejection by suppressing immune system
Hemostasis Platelets	<ul style="list-style-type: none"> • Describe the mechanisms by which hemostasis is secured • Discuss the characteristics and functions of platelets • Explain the mechanism of formation of platelet plug

Coagulation factors	<ul style="list-style-type: none"> • Enlist the clotting factors in blood • Explain the conversion of prothrombin to thrombin & formation of fibrin Fibers • Explain the intrinsic & extrinsic clotting pathway. • Name & explain the mechanism of anticoagulants used in laboratory. • Explain the factors that prevent intravascular coagulation • Explain the role of Calcium ions in intrinsic and extrinsic pathways • Enlist the vitamin-K dependent clotting factors • Explain the prothrombin time, International Normalized Ratio and its clinical significance.
Coagulation disorders	<ul style="list-style-type: none"> • Enlist and explain the conditions that cause excessive bleeding • Coagulation disorders • Define thrombocytopenia • Enlist the causes and consequences of Thrombocytopenia
Practicals	Specific Learning Objectives
Estimation of Hemoglobin	<ul style="list-style-type: none"> • Perform hemoglobin estimation
Differential Leucocyte Count	<ul style="list-style-type: none"> • Identify and differentiate various leukocytes
Normal & abnormal RBC, Hct & Hb	<ul style="list-style-type: none"> • Interpret normal & abnormal hematological indices
Normal & abnormal TLC, DLC & platelet report	<ul style="list-style-type: none"> • Interpret normal & abnormal total and differential leukocyte counts
Determination of Blood Group	<ul style="list-style-type: none"> • Correctly perform ABO and Rh blood grouping
Determination of Bleeding Time	<ul style="list-style-type: none"> • Demonstrate correct technique
Determination of Clotting Time	<ul style="list-style-type: none"> • Demonstrate correct technique

MODULE: CORE CONCEPTS (5 weeks)

Topics	Specific Learning Objectives
Regulation of Core Body Temperature	<ul style="list-style-type: none"> • Define core body temperature and explain its physiological set point • Explain the roles of hypothalamus, skin, and viscera in thermoregulation
	<ul style="list-style-type: none"> • Describe mechanisms of heat production (basal metabolism, muscle activity, shivering) • Describe mechanisms of heat loss (radiation, conduction, convection, evaporation)
	<ul style="list-style-type: none"> • Explain physiological responses to hyperthermia & hypothermia • Relate thermoregulatory failure to clinical conditions such as fever, heat stroke, or hypothermia
Sports Physiology	<ul style="list-style-type: none"> • Describe muscle metabolic systems in exercise • Discuss the energy systems used in different sports • Explain the effect of athletic training on performance • Differentiate between fast & slow twitch muscle fibers • Describe adaptations in major body systems during exercise • Explain VO₂ max and its significance
Integration of ANS across all systems	<ul style="list-style-type: none"> • Integrate autonomic regulation of all body systems
Practicals	Specific Learning Objectives
Recording of core body temperature	<ul style="list-style-type: none"> • Demonstrate correct technique
Osmotic Fragility	<ul style="list-style-type: none"> • Demonstrate correct procedure
Triple response	<ul style="list-style-type: none"> • Demonstrate elicitation of triple response

DEPARTMENT OF BIOCHEMISTRY

Vision and Mission

The mission of the Department of Biochemistry, King Edward Medical University, is to deliver high-quality, integrated biochemistry education through student-centered teaching, clinically relevant learning, and evidence-based assessment; to promote research and scholarly activity; and to contribute to improved healthcare outcomes through academic excellence.

History

The department was first established in King Edward Medical College, Lahore, on 29th April 1980, as a separate entity. Prof. Abdus Salam was its founding head. In 1990, the University of Punjab awarded status to the subject to be separately examined in the MBBS degree program thereafter. The department's legacy is built on excellence, fostering a dynamic academic environment for medical students.

Message from the Chairman - Department of Biochemistry King Edward Medical University, Lahore

It gives me great pleasure to welcome the new batch of First Year MBBS students to the Department of Biochemistry at King Edward Medical University. The beginning of medical education is an exciting and transformative journey, and this study guide has been designed to help you navigate the learning process effectively.

In accordance with the modern trends in medical education, the First Year MBBS curriculum follows a modular block system, where different basic sciences are taught in an integrated manner. Within this framework, Biochemistry will not be taught as an isolated subject; rather, it will be integrated with related disciplines such as Anatomy, Physiology, and clinical concepts to provide a comprehensive understanding of human biology and disease processes.

Our teaching approach emphasizes conceptual understanding, clinical correlation, and practical application. Through lectures, small-group discussions, practical sessions, and problem-based learning activities, students will develop the ability to apply biochemical principles to real-world medical scenarios. This integrated and practical approach will help build a strong foundation for understanding pathophysiology, diagnostics, and therapeutic strategies in clinical medicine.

This study guide outlines the learning objectives, course structure, teaching strategies, assessment methods, and practical components of the Biochemistry module. Students are encouraged to use it as a roadmap for their learning and to actively engage in all academic activities.

I encourage all students to approach Biochemistry with curiosity and dedication. A solid understanding of biochemical principles is essential for becoming a competent and thoughtful physician.

I wish you great success in your medical education and look forward to your active participation in the academic life of the department.

Prof. Dr. Muhammad Shakil

MBBS, MCPS, M.Phil, Ph.D., CMT

Chairman, Department of Biochemistry

King Edward Medical University, Lahore

Faculty

Sr. No.	FACULTY	DESIGNATION	QUALIFICATION	COORDINATOR
1.	Prof. Dr. M. Shakil	Professor	MBBS, MCPS, MPhil, PhD, CMT	Head of Department
2.	Dr. Faiza Irem	Associate Professor	MBBS, MPhil, MCPS-HPE	1 st year MBBS 2 nd year MBBS
3.	Dr. Sehrish Lodhi	Assistant Professor	MBBS, MPhil (Biochemistry), MPhil (Genetics), CHPE	1 st year MBBS
4.	Dr. Amna Ihsan	Assistant Professor	MBBS, MPhil, PhD Scholar, CHPE	2 nd year MBBS
5.	Dr. Mushayyada Rathore	Assistant Professor	MBBS, MPhil	2 nd year MBBS Practicals
6.	Dr. Mehwish Iftikhar	Assistant Professor	MBBS, MPhil, PHD, CHPE	1 st year MBBS
7.	Dr. Ammara Niaz	Senior Demonstrator	MBBS, MPhil, CHPE	1 st year MBBS Practicals
8.	Dr. Hamza Touqeer	PG Scholar	MBBS, MPhil Scholar	1 st year MBBS Tutorials
9.	Dr. Irfan Bashir	PG scholar	MBBS, MPhil Scholar	2 nd year MBBS Tutorials
10.	Miss Amber	Biochemist		1 st and 2 nd year MBBS Practicals

COURSE DESCRIPTION

Biochemistry is a foundational preclinical course that provides medical students with a comprehensive understanding of the molecular basis of human health and disease. The course explores the structure and function of biomolecules, enzymology, metabolism, molecular genetics, nutrition, and the biochemical basis of systemic disorders.

The curriculum is delivered through an integrated modular approach, linking biochemical principles with anatomy, physiology, pathology, and clinical medicine. Emphasis is placed on clinically relevant applications, enabling students to correlate biochemical mechanisms with disease processes such as diabetes mellitus, cardiovascular disorders, metabolic syndromes, anemia, and inherited metabolic diseases.

By the end of the course, students will be able to apply biochemical concepts in clinical reasoning, interpret laboratory investigations, and understand the molecular basis of common medical conditions.

Syllabus Contents

1. Cell
2. Cell membrane
3. Chemistry of carbohydrates
4. Chemistry of lipids
5. Chemistry of proteins
6. Vitamins
7. Minerals
8. Enzymology
9. Nutrition
10. Chemistry of Nucleic acid
11. Water and pH
12. Body Buffers

Learning resources

1. Harper’s Illustrated Biochemistry (Latest Ed.)
2. Lippincott’s Illustrated Reviews: Biochemistry (Latest Ed.)
3. Lehninger Principles of Biochemistry (Selective Reading)
4. Marks illustrated Basic Biochemical Biochemistry.
5. Mushtaq Ahmad – Essentials of Medical Biochemistry (Vol 1 & 2)
6. Tietz Textbook of Clinical Chemistry and Molecular Diagnostics
7. Stryer Biochemistry.

SYLLABUS OUTLINE

MODULE: FOUNDATION

This module introduces the basis of all topics to be covered in successive modules.

Topics	Specific Learning Objectives
Cell	<ul style="list-style-type: none"> • Explain the composition and function of the cell membrane. • Discuss transfer of material across the membrane. • Correlate clinical disorders associated with defective transport across the cell membrane. • Explain the physicochemical properties of a cell. • Osmolality and osmolarity, Gibbs-Donnan equilibrium, viscosity, surface tension.
Cell organelle	<ul style="list-style-type: none"> • Explain the structure and functions of mitochondria. • Identify their marker enzymes and analyze their role in maintaining cellular health and mitochondrial diseases.

Membrane receptors	<ul style="list-style-type: none"> • Classify cell surface and intracellular receptors with examples. • Describe the structure and signaling mechanism of intracellular (cytoplasmic/nuclear) receptors, with examples (steroid, thyroid, vitamin D receptors). • Illustrate components and actions of G-protein coupled receptors. • Explain the pharmacological actions of drugs acting on cell surface and intracellular receptors by correlating receptor type, signaling pathway, and clinical effects.
Lipid chemistry	<ul style="list-style-type: none"> • Describe the structural classification of lipids and relate it to their biological functions. • Describe the classification, structure, and biological significance of fatty acids. • Define and explain the significance of saponification, iodine number, acid number, and rancidity of fats and oils.
Protein and amino acid chemistry	<ul style="list-style-type: none"> • Classify standard amino acids based on charge and polarity of side chains. • Differentiate essential vs non-essential amino acids • Classify amino acids into glucogenic, ketogenic, or both. • Explain acidic and basic properties of amino acids. • Illustrate the titration curve of Alanine.
CHO chemistry	<ul style="list-style-type: none"> • Classify carbohydrates based on sugar units (monosaccharides, disaccharides, oligosaccharides, polysaccharides). • Describe the features and significance of biologically important monosaccharides. • Explain various forms of isomerism.
Practicals	Specific Learning Objectives
Safety Protocols	Introduction to Laboratory Safety Protocols
Laboratory Instruments	Introduction to laboratory instruments i.e, Water bath, Centrifuge, Spectrophotometer, and pH meter.
Biuret test	Perform the Biuret test for the detection of proteins.
Heat coagulation test	Perform the Heat coagulation test for the detection of proteins.
Benedict's test	Perform Benedict's test and interpret results for reducing sugars
Hay's sulfur test	Perform Hay's sulfur test for the detection of bile salts

MODULE: MUSCULOSKELETAL 6 weeks

This module introduces the biochemical basis of cardiovascular disease and integrates it with relevant disciplines.

Topics	Specific Learning Objectives
Proteins: Structure & Organization	<ul style="list-style-type: none"> • Describe various levels of protein structure. • Explain the role of hydrogen bonds, hydrophobic interactions, disulfide bonds, and ionic interactions in protein folding. • Discuss the biochemical basis and consequences of protein misfolding.
Fibrous protein	<ul style="list-style-type: none"> • Describe the synthesis and post-translational modifications of collagen and elastin. • Explain the role of vitamin C in collagen synthesis. • Discuss the biochemical basis of scurvy, osteogenesis imperfecta, Marfan's syndrome, Ehlers-Danlos syndrome, and muscular dystrophies.
GAGs	<ul style="list-style-type: none"> • Describe the structure and function of glycosaminoglycans (GAGs). • Differentiate proteoglycans, glycoproteins, and peptidoglycans. • Relate carbohydrate macromolecules to bone and cartilage matrix.
Vitamins	<ul style="list-style-type: none"> • Classify Vitamins • Discuss sources, synthesis, and significance of Vitamin D. • Discuss sources, synthesis, and significance of Vitamin E. • Discuss sources, synthesis, and significance of Vitamin K. • Discuss sources, synthesis, and significance of Vitamin C. • Describe the roles of vitamins K and C in maintaining connective tissue integrity and collagen synthesis. • Correlate deficiencies of vitamins with clinical conditions, such as rickets, osteoporosis, and osteomalacia.
Myoglobin	<ul style="list-style-type: none"> • Describe the Structure and functions of Myoglobin.
Muscle metabolism	<ul style="list-style-type: none"> • Discuss synthesis and degradation of glycogen • Enlist Glycogen storage diseases. • Discuss the role of glycogen metabolism in muscle contraction. • Discuss the role of creatinine in muscle metabolism. • Biochemical significance of Lactic acidosis under anaerobic conditions. • Explain Mitochondrial Myopathies.
Enzymology	<ul style="list-style-type: none"> • Classify enzymes. • Explain the mechanism of enzyme action. • Discuss various types of enzyme inhibition and their significance. • Enumerate various types of enzyme regulation. • Discuss the role of serum markers in the diagnosis of muscular dystrophies.
Practicals	Specific Learning Objectives

Heat coagulation test	Perform the Heat coagulation test to detect proteins and interpret the results based on the principle of protein denaturation.
Spectrophotometer	Demonstrate the basic operation of a spectrophotometer and explain its application in quantitative biochemical analysis.
Quantitative estimation of serum calcium	Perform quantitative estimation of serum calcium and interpret results in relation to normal physiological ranges and clinical conditions.
Quantitative estimation of serum phosphate	Perform quantitative estimation of serum phosphate and interpret results in relation to metabolic and bone disorders.

MODULE: CARDIOVASCULAR (6 weeks)

This module introduces the biochemical basis of cardiovascular disease and integrates it with relevant disciplines.

Topics	Specific Learning Objectives
Chemistry of Lipids	<ul style="list-style-type: none"> • Analyze the role of dietary fats in heart health (omega-3 & omega-6) • Explain the biological significance of essential fatty acids. • Define eicosanoids, identify their major classes (prostaglandins, thromboxane, leukotrienes), and their significance. • Correlate disturbances in eicosanoid pathways with clinical conditions such as inflammation, myocardial ischemia, and thrombosis. • Discuss the structure and biochemical significance of serum cholesterol. • Elaborate on the biomedical significance of lipid peroxidation and its relevance in oxidative stress and disease.
Lipoprotein metabolism	<ul style="list-style-type: none"> • Explain the Structure and function of lipoproteins. • Classify apolipoproteins and their roles. • Discuss Reverse cholesterol transport and its CVS health benefits. • Discuss the Biochemical basis of Atherosclerosis (foam cell formation) • Classify Hyperlipoproteinemia and discuss their sign and symptoms
Cardiac energy metabolism	<ul style="list-style-type: none"> • Discuss ATP production in cardiac muscle (preference for fatty acids vs glucose) • Discuss metabolic changes in ischemia/hypoxia and shift to anaerobic glycolysis, lactate accumulation • Classify High-energy phosphate compounds (Creatine kinase & CK-MB relevance in MI)
Cardiac markers	<ul style="list-style-type: none"> • Analyze the role of enzymes in clinical diagnosis and therapeutics. • Explain the term isoenzymes with examples and significance. • Describe the diagnostic role of cardiac troponins (T and I), CK-MB, and LDH-1, AST in the diagnosis of myocardial injury, including the concept of the “flipped LDH pattern.” • Compare the sensitivity and specificity of major cardiac biomarkers for acute myocardial infarction (MI).

Nutrition	<ul style="list-style-type: none"> • Explain the concept of caloric value of foods. • Describe the factors influencing Basal Metabolic Rate (BMR) and Total Energy Requirement. • Calculate energy requirements based on age, sex, and activity level. • Explain the significance of glycemic index and glycemic load. • Describe the functions and benefits of dietary fiber. • Describe protein quality and protein requirements across the lifespan • Discuss the biochemical and clinical features of marasmus and kwashiorkor. • Discuss the health effects of saturated fats, trans fats, and omega-3 fatty acids. • Describe Protein Energy Malnutrition (PEM) and its biochemical impact. • Explain the biochemical basis and health risks of obesity. • Outline nutritional requirements during pregnancy, lactation, infancy, and aging.
Practicals	Specific Learning Objectives
Estimation of serum ALT	Perform quantitative estimation of serum ALT and interpret results in relation to hepatocellular injury.
Estimation of serum AST	Perform quantitative estimation of serum AST and interpret results in relation to liver and muscle disorders.
Estimation of CK-MB	Perform quantitative estimation of CK-MB and interpret results in the biochemical diagnosis of myocardial injury.

MODULE: RESPIRATORY (5 weeks)

This module introduces the biochemical basis of respiratory diseases and integrates it with relevant disciplines.

Topics	Specific Learning Objectives
Water, pH and Buffers	<ul style="list-style-type: none"> • Explain the ionization of water, weak acids, and bases. • Define pH and pI (isoelectric pH) and demonstrate pH determination. • Explain pKa and Ka and illustrate the titration curve of a weak acid. • Apply the Henderson–Hasselbalch equation to calculate buffer pH and composition. • Describe the mechanism of action of body buffers (bicarbonate, phosphate, protein, ammonia).
Amino acid buffer	<ul style="list-style-type: none"> • Describe the dissociation and titration of amino acids. • Explain the importance of amino acids in pH maintenance. • Discuss the buffering action of proteins in blood.
Hemoglobin	<ul style="list-style-type: none"> • Describe the molecular mechanism of cooperative oxygen binding in hemoglobin. • Explain the effects of 2,3-BPG, CO₂, and pH on hemoglobin function. • Interpret oxygen dissociation curves of myoglobin and hemoglobin. • Discuss the biochemical basis of hemoglobinopathies, i.e., sickle cell anemia, thalassemia, etc

Chemistry of lipids	<ul style="list-style-type: none"> • Classify phospholipids. • Describe the structure and biologic significance of phospholipids, glycolipids, sulfolipids and gangliosides • Discuss the biological significance of surfactant and its role in respiratory distress syndrome • Discuss the synthesis and degradation of glycosphingolipid
Emphysema	Discuss the biochemical basis and pathophysiology of α 1-antitrypsin deficiency.
Practicals	Specific Learning Objectives
Laboratory solutions	Prepare laboratory solutions of required concentration accurately using appropriate calculations and standard laboratory techniques.
Unit conversions and concentration calculations	Perform accurate unit conversions and concentration calculations relevant to biochemical laboratory practice.
using a pH meter	Measure the pH of a given solution using a pH meter and interpret results based on acid–base principles.
Organic constituents of urine	Identify and interpret the normal organic and inorganic constituents of urine using standard qualitative biochemical tests.
Inorganic constituents of urine	Identify and interpret the abnormal inorganic constituents of urine using appropriate qualitative laboratory methods.

MODULE: BLOOD & IMMUNITY (6 weeks)

This module introduces the biochemical basis of blood and immunity and integrates it with relevant disciplines.

Topics	Specific Learning Objectives
Blood chemistry	<ul style="list-style-type: none"> • Describe the major components of blood. • Explain the primary functions of blood in transport, regulation, and protection. • Differentiate between plasma and serum based on composition and method of extraction. • Relate the clinical applications of plasma and serum in diagnostic testing and transfusion medicine.
Plasma proteins	<ul style="list-style-type: none"> • Classify plasma proteins and list the functions of plasma proteins. • Describe the role of plasma proteins in maintaining osmotic pressure and fluid balance. • Discuss the electrophoretic pattern of plasma proteins and interpret changes in diseases. • Correlate alterations in plasma protein levels with clinical conditions
Immunoglobulins	<ul style="list-style-type: none"> • Identify structural components of immunoglobulins. • Differentiate between major classes of immunoglobulins based on structure and function. • Explain the biochemical basis of antigen–antibody interaction. • Correlate the role of immunoglobulins with humoral immunity and clinical relevance (e.g., allergy, immune deficiency).
Heme metabolism	<ul style="list-style-type: none"> • Outline the steps of heme biosynthesis, • Discuss porphyria’s and their biochemical basis. • Discuss the catabolism of heme and its transport to the liver. • Explain the biochemical basis of different types of jaundice. <p>Interpret laboratory patterns of bilirubin, urobilinogen, and related tests in jaundice</p>
Minerals	<ul style="list-style-type: none"> • Discuss the biochemical role of iron and trace elements in hematopoiesis.
Vitamins	<ul style="list-style-type: none"> • Discuss the biochemical role of vitamins in hematopoiesis. • Explain sources, functions, and deficiency manifestations of folic acid. • Explain sources, coenzyme form, functions, and deficiency manifestations of cobalamin. • Explain sources, coenzyme form, functions, and deficiency manifestations of vit B-6.
Body buffers	<ul style="list-style-type: none"> • Explain the role of buffers in the regulation of blood pH.
Practicals	Specific Learning Objectives
Phlebotomy	Standardized Phlebotomy Procedure
Serum Albumin	Quantitative estimation of serum Albumin
Serum total protein	Quantitative estimation of serum total protein
Serum Bilirubin	Quantitative estimation of serum Bilirubin
Serum alkaline phosphate	Quantitative estimation of serum alkaline phosphate

MODULE: CORE CONCEPTS (5 weeks)

This module introduces the biochemical basis of topics that are essential for Biochemistry, but are independent of horizontal integration

Topics	Specific Learning Objectives
Chemistry of CHO	<ul style="list-style-type: none"> • Explain the properties and biomedical significance of disaccharides. • Discuss glycosidic bonds and their significance. • Discuss the structural and functional characteristics of homopolysaccharides.
Chemistry of nucleotide	<ul style="list-style-type: none"> • Describe the structural components of nucleotide. • Differentiate between purine and pyrimidine bases, nucleosides, and nucleotides with examples. • Explain the major biological functions of nucleotides, including their role in energy transfer (ATP, GTP), coenzyme structure, and signal transduction (cAMP, cGMP). • Describe the biochemical structure and components of nucleic acids (DNA • Describe the structure and biomedical role of synthetic derivatives of purines and pyrimidines (e.g., in chemotherapy). • Detail the structure, function, and specific types of RNA (e.g., mRNA, tRNA, rRNA).
Vitamins	<ul style="list-style-type: none"> • Describe sources, functions, and deficiency disorders for vitamins A, B₁, B₂, B₃, B₅, B₇. • Discuss diseases associated with metabolic abnormalities of the above vitamins.
Minerals	<ul style="list-style-type: none"> • Discuss the biochemical function of Sulphur. • Discuss biochemical significance of trace elements (Se, I, Cr, Mn, Cd, F) in health and disease.
Nutrition	<ul style="list-style-type: none"> • Calculate Specific Dynamic Action (SDA) and Respiratory Quotient (RQ). • Calculate caloric requirements in special conditions such as pregnancy, lactation, infancy, and old age.
Practicals	Specific Learning Objectives
Barfoed Test	Tests for Disaccharides. Barfoed test
RQ & BMR	Calculation of RQ and BMR

*Thank
you!*