



**STUDY GUIDE  
1<sup>st</sup> YEAR MBBS  
Y1 B1**

**DEPARTMENT OF MEDICAL EDUCATION**

**CMH KHARIAN MEDICAL COLLEGE**



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## **MISSION**

Our mission is to educate and produce exemplary doctors who practice ethical patient centered health care, discover and advance knowledge and are responsive to the community needs.

## **VISION**

To produce competent doctors equipped with sound knowledge based on scientific principles, imbued with ethics and moral values primed to serve the community through the profession.

Our aim is to

- Provide outstanding educational environment for medical students.
- Develop exemplary clinicians who are lifelong learners and provide the highest quality compassionate care and serve the needs of their community and thenation in the best traditions of medical profession.
- Ensure the highest ethical and professional standards in all of our deeds.

## **Exit Outcomes for the CKMC Graduate**

At the end of five years MBBS degree program graduate of CMH Kharian Medical College should be able to:

### **Knowledge**

- Integrate knowledge of basic and clinical sciences in disease prevention and promotion of health and well-being of community.

- Able to appraise varied information they would come across during professional work and testify innovative ideas to benefit human society through evidence-based health care practice
- Demonstrate scientific knowledge in all professional activities
- Demonstrate research skills which bring innovation and significance to health care practices.

### Skills

- Able to perform physical examinations, formulate provisional diagnosis with appropriate investigations to identify specific problems.
- Perform various common procedures to diagnose and manage non critical clinical problems.
- Demonstrate competency in life saving procedures.
- Exhibit propensity of critical thinking, problem solving and lifelong self-directed learning skills.

### Attitude

- Manifest ethical values and professionalism.
- Demonstrate professional attitude towards patients, their families, seniors and colleagues.
- Demonstrate dedication and professionalism when faced natural disasters in country.
- Demonstrate communication skills, inter professional skills and leadership.

<b>knowledge</b>	<b>Skill</b>	<b>Attitude</b>
Integrated knowledge of basic & clinical sciences	Communication skills	Ethical values
Patient centered care	Research skills	
Health promotion & disease prevention	Patient management skills	Professionalism
Community needs	Leadership skills	
	Critical thinking skills	

## Introduction to the Study Guide

Dear Students,

We, at the Department of Medical Education, CMH Kharian Medical College, have developed this study guide especially for you. This study guide is an aid to

- Inform you how this part of your syllabus has been organized.
- Inform you how your learning programs have been organized in this block.
- Help you organize and manage your studies throughout the block
- Guide you on assessment methods, rules and regulations.
- Communicate information on organization and management of the block. This will help you to contact the right person in case of any difficulty.
- Define the objectives which are expected to be achieved at the end of the block.
- Identify the learning strategies such as lectures, small group discussions, clinical skills, demonstration, tutorial and case-based learning that will be implemented to achieve the block objectives.
- Provide a list of learning resources such as books, and journals for students to consult in order to maximize their learning.

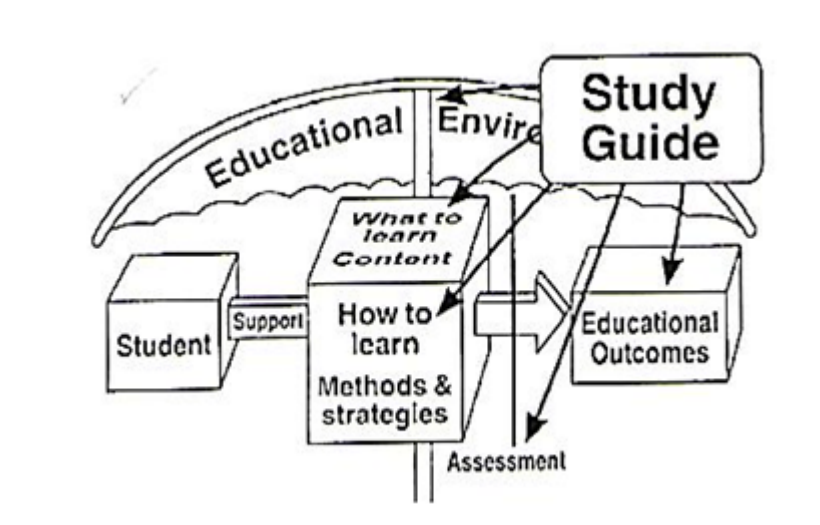


Figure 1 Objectives of study guide by Harden

## Curriculum Integration



Medical college curriculum shall be organized in blocks of modules. The modules are named after body system for example a module of blood in a block. The key details are as follows:

1. There shall be three blocks in first year MBBS comprising modules.
2. The blocks shall be labeled as 1, 2 and 3.
3. Each module in a block shall have a title. The name of the module shall represent the content taught and learned the majority of time in that module. Module shall be named after body systems.
4. The duration of three blocks shall vary between 8–11 weeks according to syllabus.
5. The syllabus shall be integrated horizontally around systems of the body.
6. There shall be vertical integration to the extent decided by the curriculum coordination committee.
7. Vertical integration shall be in case based learning sessions and in clinical lectures of basic sciences, scheduled in the structured training program.

## **Teaching and Learning Methods**

### **1: Small Group Discussions (SGD)**



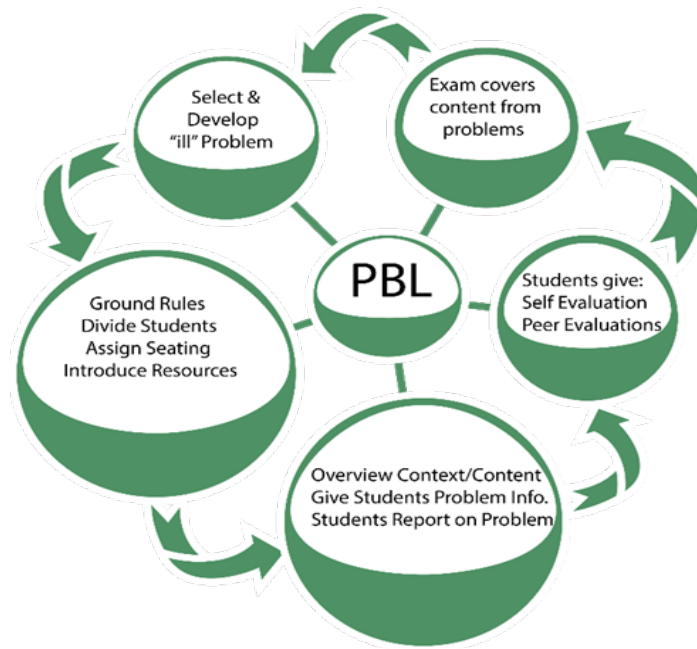
The topic will be taught in groups with the help of models and audiovisual aids. Pre-planned topics would help students to combine their wisdom in achieve learning objectives. Facilitator would be guiding to achieve learning objectives and making them on right track by clarify any misconception.

“Small group learning provides more active learning, better retention, higher satisfaction, and facilitates development of problem-solving and team-working abilities (Jahan, Siddiqui, AlKhouri, Ahuja, & AlWard, 2016).

### **2: Problem Based Learning (PBL)**

This is group learning comprising of 8-10 students guided by a facilitator. For a specific problem given to students two sessions of 2 hours would be scheduled to achieve the learning objectives. In the first session students will discuss problem based upon their existing knowledge among the group and will produce a list of their learning objectives for further study. In the second session students share, discuss with each other to build new knowledge.





PBL is a self-directed learning and that type of educational strategy most likely produce doctors who are prepared for lifelong learning and able to meet the changing needs of their patients (Spencer & Jordan, 1999).

### 3: Large Group Interactive Session (LGIS)



These are meant to give overview of certain course content. They should be interactive so that students can not only gain knowledge but should completely understand it. Students may clarify the difficult concepts in these sessions. The lecturer introduces a topic and explains the underlying phenomena through questions, pictures, videos of patient's interviews, exercises, etc. Students are actively involved in the learning process.

#### **4: Self Directed Learning (SDL)**



In this modern era of medical education, students assume responsibilities of their own learning according to the principles of adult learning. They can study independently, can share and discuss with peers, can take information from the sources of information college have like library, internet and teachers. Students will be provided time within the scheduled college hours for self-study.

#### **5: Hands on Training**

- **Lab session**



Histology, biochemistry, physiology practical will build skills in identification of normal histology of human body tissues. There would be test of these skills in OSPE exam.

- **Clinical Rotations**



The students will rotate in the clinical departments to see integration of knowledge into clinical practices.

Teaching and learning activities are meant to help students to gain new knowledge. It should be kept in mind that they are not meant to fully cover the objectives of the subject. It is therefore responsibility of students to attain more information to cover all objectives given in the overall objectives.

Class attendance and participation is of most important in gaining knowledge. If any help is needed module team can be contacted without any hesitation. Attendance will be strictly checked in different teaching activities. If attendance is **less than 75%**, students would not be allowed to sit for the examination.

Attendance in the examination is must and no students would be allowed to enter the examination area after starting the examination. In case of sickness, sick leaves from government/private hospitals or the emergency of the college hospital will only be entertained.

### **Assessment Format**

Assessment is a goal-oriented process (Angelo, 1995). We assess in order to check whether the learning objectives set at the initiation of the program are met or not and

to what extent (Amin, 2007).

**No student will be allowed to sit in the annual examination if attendance is below 75% in theory and practical separately.**

### **Assessment types**

The assessment will be continuous. The purpose of continuous assessment is formative and summative.

#### **Summative Assessment:**

The marks of this type of assessment contribute in the final university result through internal assessment. It comprises:

- CBL/tutorial assessment
- Scheduled tests
- Sub-stages
- End of block exam
- Pre-annual exam

Scheduled tests and sub-stages will be conducted intermittently throughout the block. Their schedule will be intimated through the time tables.

**The end of the block exam** will be conducted after completion of weeks of instruction. It will comprise one theory paper and one practical exam for Anatomy, Physiology and Biochemistry. (Table of specifications (TOS) for exam has been provided)

**Formative Assessment:** Tests may be quizzes, surprise tests/written assignments/self-reflection by students during the teaching time but their marks will not be added to internal evaluation marks. The purpose of formative assessment is to provide feedback to the students, for the purpose of improvement and to teachers to identify areas where students need further guidance.

### **Internal Assessment**

*(Will be submitted to the university before professional exam)*

- The weightage of internal assessment shall be 10 % in theory paper and 10 % in practical, in the annual professional examination (or 10 marks for 100 marks in theory and practical each)
- Scheduled tests, sub-stages, CBLs/tutorials, block examinations and pre-annual examinations, conducted by the college shall contribute towards internal assessment for professional examination.

### **Annual Professional Examination:**

- The professional examinations schedule will be provided by NUMS.
- There will be two components of the final result
  - (i) Examination-80 %      (ii) Internal Assessment- 20 %
- There will be one theory paper and one Practical exam for Anatomy, Physiology and Biochemistry each. For practical the class will be divided into batches. Each batch will have practical exam of one subject on the specified day, according to schedule.
- Theory & Practical assessment shall be of 100 marks each in Anatomy, Physiology and Biochemistry, making a **total of 200 marks for each subject**.
- The Annual Theory paper shall be of 80 marks. 20 marks of internal assessment of theory papers, conducted throughout the year will be added to it, to make annual theory assessment of 100 marks.

Similarly, the annual practical examination will be of 80 marks. 20 marks of internal evaluation of practical exams, conducted throughout the year will be added to it, to make annual practical assessment of 100 marks.
- The pass score shall be 50 out of 100, in theory and practical separately.

### **Schedule of examinations:**

#### **a) Continuous assessments schedule**

Schedule provided by each department in Time table.

#### **b) Formative tests:** Throughout the block

## Structured Summery of Y1B1

<b>Block Code</b>	Y1B1
<b>Pre requisite Block</b>	As per admission criteria
<b>Duration</b>	10 weeks
<b>Anatomy</b>	General anatomy, General embryology, General histology, Gross anatomy of upper limb
<b>Physiology</b>	Cell and Genetics, Nerve and Muscle and blood
<b>Biochemistry</b>	Cell, Chemistry of Proteins, Enzymes & hemoglobin
<b>Surgery</b>	Cell, breast cancer, fracture of upper limb, imaging techniques, imaging of upper limb
<b>Medicine</b>	Anemias, Bleeding disorders and Transfusion reaction
<b>BSP</b>	Communication skills, professionalism, leadership and management, ethics

## Block Development Committee

<b>Chairperson curriculum committee</b>	Principal Brig (Retd) Shoaib Nayyar Hashmi
<b>Director Medical education</b>	Dr Aasma Qaiser
<b>Block Planner</b>	Dr Aasma Qaiser
<b>Resource Persons</b>	<b>Anatomy: Dr Aneeqa</b> <b>Physiology: Dr Ahmed Murtaz</b> <b>Biochemistry: Dr Zeeshan</b> <b>Medicine: Maj. Usman</b> <b>Surgery: Dr Waqas Ali</b>
<b>Study Guide Developed By</b>	Department of Medical Education CMH Kharian Medical College Kharian

# Learning Outcomes



## Knowledge

- Acquire the basic science knowledge and terminology necessary to understand the normal structure and function of human body from biochemical to organ system level, as well as the concepts of diseases in the community, drug dynamics.
- Identify different anatomical planes and correlate the importance of these with clinical medicine.
- Explain the structure & development of MS.
- Explain the physiological anatomy, biochemistry affecting the functions of MS.
- Apply the knowledge of the basic sciences to understand pathophysiology of common fractures.
- Understand the constituents and functions of human blood
- Describe development of blood cell from stem cell.
- Describe the process of development of RBC, WBC and Platelets.
- Discuss the. Process of immunity.
- Describe the sequence of events involved in homeostasis
- Understand the physiology of conductive system of heart, cardiac cycle

	<ul style="list-style-type: none"> <li>• Explain different waves, segment and intervals of ECG and apply it to the interpretation of ECG</li> <li>• Understand the pathophysiology of edema, infarction, shock and thrombosis</li> <li>• Demonstrate effective communication skill strategies while history taking and examining the patients with CVS problems.</li> <li>• Describe the gross anatomy of mediastinum along with clear understanding of structures present in it.</li> <li>• Correlate between histological structure of respiratory membrane and its role in diffusion of gases.</li> <li>• Integrate the basic science knowledge with clinical sciences in order to describe the pathogenesis, clinical presentations of common respiratory disorders, e.g., COPD</li> </ul>
<b>Skill</b>	<ul style="list-style-type: none"> <li>• Dissect limbs to demonstrate their gross Anatomy and relationship to each other.</li> <li>• Identify histological features of parts of MS under microscope</li> <li>• Perform the steps to determine the normal RBC count and ESR</li> <li>• Identify the type of lymphoid tissue under microscope</li> <li>• Demonstrate the differences between live attenuated vaccine and toxoids</li> <li>• Perform, the steps to identify ABO and Rh typing</li> </ul>
<b>Attitude</b>	<ul style="list-style-type: none"> <li>• Demonstrate the effective attitude towards the colleagues</li> </ul>



- Demonstrate a professional attitude, team building spirit and good communication skills

## COURSE CONTENT

### FIRST YEAR MBBS Block 1 CODE Y1B1

**In case of online classes MIT and Assessment will be online via zoom meeting and Google classroom**

ANATOMY					
CELL					
Sr No	Topic / Theme	Learning outcomes	Learning objectives	MIT	Assessment Tool
1	CELL	<ul style="list-style-type: none"> <li>• Operate the microscope according to standard operating procedures while examining slides.</li> <li>• Apply the knowledge of cytoskeleton in understanding</li> </ul>	<p><b>Knowledge:</b></p> <ul style="list-style-type: none"> <li>• Enumerate various components of a typical animal cell</li> <li>• Explain the structure and functions of various components of cytoskeleton.</li> </ul> <p><b>Skill:</b></p> <ul style="list-style-type: none"> <li>• Identify the parts of microscope</li> <li>• Demonstrate working of microscope with focusing of slides at different magnifications</li> </ul>	LGIS Practical	MCQs/ SEQs/ SAQs/ OSPE VIVA

		the functions and structures of cellular modifications			
2	<b>Epithelium</b>	Correlate the microstructure of various types of epithelia with their functions and predict the outcomes that may result from altered structure.	<ul style="list-style-type: none"> <li>• Define epithelium</li> <li>• Classify epithelium with examples of each type</li> <li>• Classify glands with examples.</li> <li>• Define polarity</li> <li>• Differentiate different domains of an epithelial cell</li> <li>• List the structural modifications of apical, lateral, and basal domains of cell</li> <li>• Classify the apical modifications according to motility</li> <li>• Name the component of cytoskeleton contributing in each apical modification</li> <li>• Define metaplasia and correlate</li> </ul>	LGIS	MCQs/ SEQs/ SAQs/ OSPE VIVA

			<p>it with its clinical importance</p> <ul style="list-style-type: none"> <li>• Classify various types of cell junctions according to functions; providing examples of each</li> <li>• Identify histological features of different types of epithelia under light microscope</li> <li>• Illustrate different types of epithelia and write two points of identifications of each</li> <li>• Compare the histological features of serous and mucus acini under light microscope</li> <li>• Illustrate different types of exocrine glands and write two points of identification of each</li> </ul>		
<b>General Embryology</b>					

<b>3</b>	<b>gametogenesis</b>	Apply the knowledge of gametogenesis to explain numerical and structural chromosomal abnormalities that result from aberrations in this process	<ul style="list-style-type: none"> <li>• Explain the sequence of events of mitosis and meiosis with the help of illustrations and models</li> <li>• Elucidate the morphological changes in male and female gametes during their maturation</li> <li>• Define the following terms               <ul style="list-style-type: none"> <li>○ Haploid</li> <li>○ Diploid</li> <li>○ Euploid</li> <li>○ Aneuploid</li> <li>○ Triploid</li> <li>○ Polyploid</li> <li>○ Nondisjunction</li> <li>○ Monosomy</li> <li>○ Trisomy</li> <li>○ Mosaicism</li> <li>○ Translocation</li> </ul> </li> <li>• Define azoospermia and oligospermia</li> </ul>	LGIS	MCQs/ SEQs/ SAQs/ OSPE VIVA
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### GENERAL ANATOMY

<b>4</b>	<b>Introduction</b>	Use of general anatomical terms in describing the structure of different parts of body	<ul style="list-style-type: none"> <li>• Define and demonstrate the anatomical position</li> <li>• Describe the planes of body</li> <li>• Define the terms of position, movement and laterality</li> </ul>	LGIS/SGD	MCQs/SEQs/SAQs/OSPE VIVA
<b>5</b>	<b>Osteology</b>	Apply the general concept map of osteology in understanding the regional distribution of different bones of body	<ul style="list-style-type: none"> <li>• List examples and classify the bones on the basis of: <ul style="list-style-type: none"> <li>○ Development</li> <li>○ Region</li> <li>○ Size and shape</li> </ul> </li> <li>• Identify parts of a typical long bone</li> <li>• List different markings on dry bone with examples</li> <li>• Define osteogenesis and describe the steps of intramembranous and endochondral ossification</li> <li>• Elucidate the concept of bone growth and remodeling</li> <li>• Describe the blood supply of long bones</li> </ul>	LGIS/SGD	MCQs/SEQs/SAQs/OSPE VIVA

			<ul style="list-style-type: none"> <li>Enumerate the various types of cartilage with examples</li> </ul>		
<b>Gross Anatomy (Locomotor I-a)</b>					
<b>6</b>	<b>Clavicle</b>	Correlate the bony features of clavicle, scapula and humerus with their articulation's attachments and anatomical basis of relevant clinical presentations	<ul style="list-style-type: none"> <li>determine the anatomical position of clavicle and determine its side</li> <li>identify important bony landmarks of clavicle</li> <li>locate attachments of major muscles and ligaments attached on clavicle</li> </ul>	SGD	MCQs OSPE VIVA

<b>7</b>	<b>Scapula</b>		<ul style="list-style-type: none"> <li>• determine the anatomical position of scapula and determine its side</li> <li>• Identify important bony landmarks of scapula</li> <li>• locate attachments of major muscles and ligaments attached on scapula</li> </ul>	<b>SGD</b>	MCQs SEQs/SAQs OSPE VIVA
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8	<b>Humerus</b>		<ul style="list-style-type: none"> <li>• Determine the anatomical position of humerus and determine its side</li> <li>• Identify important bony landmarks of humerus</li> <li>• Locate attachments of major muscle and ligaments attached on humerus</li> <li>• Discuss the clinical implications in fractures of humerus at different sites</li> <li>• Correlate the nerves vulnerable to injury in fracture of humerus at different locations</li> </ul>	SGD	MCQs SEQs/SAQs OSPE VIVA
9	<b>Pectoral Region and Breast</b>	<ul style="list-style-type: none"> <li>• Correlate the knowledge of gross anatomy of pectoral region with relevant clinical presentations</li> <li>• Apply the knowledge of anatomy of</li> </ul>	<ul style="list-style-type: none"> <li>• Comprehend the structure of breast tissue</li> <li>• Justify the importance of fibrous septa in breast in relation to its carcinoma</li> <li>• Describe the blood supply and venous drainage of breast</li> </ul>	SGD/ CBL	MCQs SEQs/SAQs OSPE VIVA



		breast in analyzing the clinical presentation of breast cancer	<ul style="list-style-type: none"> <li>• Explain lymphatic drainage of four quadrants of breast</li> <li>• Justify clinical importance of sentinel lymph node</li> <li>• Trace the possible routes of metastasis of breast cancer</li> <li>• Tabulate the attachments, nerve supply and actions of muscles attaching upper limb to thoracic wall</li> <li>• Identify the muscles attaching upper limb to thoracic wall on models and prosected specimen</li> </ul>		

10	<b>Scapular region</b>	Correlate the knowledge of anatomy of scapular region with relevant clinical presentations	<ul style="list-style-type: none"> <li>• Tabulate the attachments, nerve supply and actions of muscles attaching upper limb to vertebral column</li> <li>• Tabulate the attachments, nerve supply and actions of muscles attaching scapula to humerus</li> <li>• Identify the boundaries and contents of quadrangular and triangular spaces</li> <li>• Comprehend the arteries and nerves present in this region</li> <li>• Describe the types of and movements at acromioclavicular and sternoclavicular joints</li> <li>• Describe types, ligaments articular surfaces, blood supply and nerve supply of shoulder joints</li> <li>• Elucidate the movements at shoulder joint with reference to axis and muscles producing them</li> <li>• Describe the factors providing stability to shoulder joint in spite</li> </ul>	SGD	MCQs SEQs/SAQs OSPE VIVA
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			<p>of wide range of movements it offers</p> <ul style="list-style-type: none"> <li>• Define rotators cuff and list its components</li> <li>• Elucidate the anastomosis around shoulder joints / scapula with the help of diagram</li> <li>• Analyze the anatomical basis of a case of winged scapula</li> <li>• Identify the muscles, ligaments and neurovascular structure of this region on prosected specimen and models</li> </ul>		
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## NERVE AND MUSCLE

### HISTOLOGY

<b>1</b>	<b>Muscular tissue</b>	Correlate knowledge of microstructure of various types of muscle with their function and predict the outcomes that result from altered structure	<u><b>Knowledge</b></u> <ul style="list-style-type: none"> <li>Describe the light microscopic characteristics of skeletal, cardiac and smooth muscles</li> <li>Tabulate the microscopic differences between three types of muscle</li> </ul> <u><b>skill</b></u> <ul style="list-style-type: none"> <li>Identify histological structure of three types of muscles under the light microscope</li> <li>Illustrate the light microscopic structure of three types of muscles with two identification points of each</li> </ul>	<b>LGIS/SGD Practica 1</b>	MCQs SEQs/SAQs OSPE VIVA
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### General Embryology

<b>2</b>	Ovulation, Fertilization, first and second week of development	Elucidate the embryological phenomena related to ovulation and fertilization till end of second week for application of that knowledge in understanding systematic embryology and analyzing relevant Clinical conditions	<u><b>Knowledge</b></u> <ul style="list-style-type: none"> <li>Correlate the menstrual and ovarian cycles with each other</li> <li>Describe the process of ovulation</li> <li>Define corpus luteum and corpus albicans</li> <li>Define fertilization</li> <li>Describe and illustrate the steps and outcomes of fertilization</li> <li>Describe the process of implantation</li> <li>Define the following               <ul style="list-style-type: none"> <li>Cleavage</li> </ul> </li> </ul>	LGIS	MCQs SEQs/SAQs OSPE VIVA
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			<ul style="list-style-type: none"> <li>○ Morula</li> <li>○ Blastula</li> <li>• Describe the sequential phases of human development during second week</li> <li>• Explain why the second week is known as “weeks of two ‘s’”</li> <li>• Enlist the sites of abnormal implantation and describe their clinical significance</li> <li>• Identify various phases of development on the given model</li> </ul>		
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### General Anatomy

<b>3</b>	<b>Myology</b>	Apply the general concept map of the topographic anatomy of muscles in understanding the regional distribution of muscles in the body	<ul style="list-style-type: none"> <li>• Enumerate three types of muscles, according to microscopic appearance and control</li> <li>• Enumerate the types of connective tissue associated with muscles</li> <li>• Classify skeletal muscles on the basis of shape and fiber architecture and group action providing example of each type</li> <li>• Describe blood supply and nerve supply of skeletal muscle</li> </ul>	LGIS/ SGD	MCQs/ SAQ/SEQ Viva Voce
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4	Neurology -1	Apply the knowledge of introduction to general principals of neurology in understanding the descriptive part in block-III	<ul style="list-style-type: none"> <li>Describe the organization of general principals of nervous system</li> <li>Enumerate components of central and peripheral nervous system &amp; describe their general features</li> <li>Describe the origin, course and distribution of a typical spinal nerve with the help of a diagram</li> <li>Define: <ul style="list-style-type: none"> <li>Dermatomes</li> <li>Receptors and effectors</li> </ul> </li> </ul>	LGIS/ SGD	MCQs/ SAQ/SEQ Viva Voce
<b>Gross Anatomy (locomotor I-b)</b>					
5	Axilla	Correlate the topographic arrangement of axillary contents with anatomical basis of various relevant clinical presentations	<ul style="list-style-type: none"> <li>Appraise the shape and extent of axilla</li> <li>Enumerate different structures forming various walls of axilla and identify their inter relationship</li> <li>Enumerate different contents of Axilla</li> <li>Describe the course, relations and distribution of vessels of Axilla</li> <li>Describe the formation and name of branches of brachial plexus</li> <li>Illustrate the brachial plexus</li> <li>Elucidate the drainage area of each group of Axillary lymph nodes</li> </ul>	SGD	MCQs/ SAQ/SEQ / OSPE Viva Voce

			<ul style="list-style-type: none"> <li>• Revisit the importance of axillary lymph nodes in metastasis of breast cancer</li> <li>• Analyze the anatomical basis of clinical presentation in case of injury to long thoracic nerve</li> <li>• Identified the boundaries and contents of axilla on prosected specimen and models</li> </ul>		
<b>6</b>	Radius and Ulna	Correlate the bony features of radius and ulna with their articulations, attachments and anatomical basis of relevant clinical presentations	<ul style="list-style-type: none"> <li>• Determine the anatomical position of Radius and Ulna and determine their sites</li> <li>• Identify important bony landmarks of radius and ulna</li> <li>• Locate attachments of major muscles and ligaments attached on Radius and Ulna</li> <li>• Discuss the anatomical basis of clinical implications in fracture of radius and ulna</li> </ul>	SGD	MCQs/ SAQ/SEQ / OSPE Viva Voce
<b>7</b>	Arm & Forearm	Correlate the knowledge of gross anatomy of arm and forearm with common clinical presentations.	<ul style="list-style-type: none"> <li>• Appraise the structures present in anterior and posterior compartments of arm</li> <li>• Tabulate the attachments, nerve supply and actions of muscles of anterior and posterior compartments of arm</li> <li>• Comprehend the neurovascular</li> </ul>	SGD	MCQs/ SAQ/SEQ / OSPE Viva Voce



			<p>structures of these compartments</p> <ul style="list-style-type: none"> <li>• Analyze the anatomical basis of clinical presentation in case of injury to axillary and musculocutaneous nerves</li> <li>• Describe the types, capsule and ligaments of elbow, superior and inferior radio-ulnar joints</li> <li>• Explain the movements of these joints with reference to axis and muscle performing these movements</li> <li>• Describe the blood supply and nerve supply of elbow joint</li> <li>• Justify the anatomical basis of carrying angle</li> <li>• Correlate the anatomy of these joints with clinical presentations of their dislocation</li> <li>• Enlist the boundaries and contents of cubital fossa in sequential order</li> <li>• Justify the clinical importance of blood vessels present in cubital fossa</li> <li>• Enlist superficial and deep muscles of anterior and posterior fascial compartments of forearm</li> </ul>		
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			<ul style="list-style-type: none"> <li>• Trace the course of nerves and arteries present in this region</li> <li>• Enlist the boundaries of anatomical snuff box and bony landmarks in its floor</li> <li>• Describe the attachments of and structures passing deep to flexor and extensor retinacula in a sequential order</li> <li>• Elucidate the anatomical basis of clinical presentation of compartment syndrome of forearm Volkmann's ischemic contracture, rupture of various tendons and tennis elbow</li> <li>• Identify the structures present in the models and prosected specimen of arm and forearm</li> <li>• Perform movements at elbow and radioulnar joints</li> <li>• Identify the bones and ligaments forming the elbow joint</li> <li>• Mark the boundaries and contents of cubital fossa on a model</li> </ul>		
<b>Hematology and immunology</b>					
<b>Anatomy</b>					
<b>General Histology</b>					

<b>1</b>	Connective Tissue	Correlate the knowledge of microstructure of various types of connective tissue, cartilage and bones with their function and to comprehend the outcomes that result from altered structure	<p><b><u>Knowledge</u></b></p> <ul style="list-style-type: none"> <li>• Enlist the components of connective tissue, its cells and matrix</li> <li>• Describe the structure of fibroblast and macrophage, enlist their functions</li> <li>• Classify connective tissue</li> <li>• Describe the characteristic features of each type</li> <li>• Explain the role of fibroblast in wound contraction</li> <li>• Describe the role of collagen in keloid and hypertrophic scar</li> </ul> <p><b><u>Skills</u></b></p> <ul style="list-style-type: none"> <li>• Identify different types of connective tissue under the microscope</li> <li>• Illustrate the types of connective tissue with two points of identification each</li> </ul>	LGIS Practical	MCQs/ SAQ/SEQ / OSPE Viva Voce
<b>2</b>	Cartilage		<p><b><u>Knowledge</u></b></p> <ul style="list-style-type: none"> <li>• Differentiate in tabulated form the types of cartilage with reference to composition, arrangement of chondrocytes, interstitial matrix and distribution</li> </ul> <p><b><u>Skill</u></b></p> <ul style="list-style-type: none"> <li>• <b>Identify different</b> types of cartilage under microscope</li> <li>• illustrate the types of cartilage with two</li> </ul>	LGIS	MCQs/ SAQ/SEQ / OSPE Viva Voce

			identification points of each		
<b>3</b>	Bone		<p><b><u>Knowledge</u></b></p> <ul style="list-style-type: none"> <li>describe the origin, histological structure and functions of the following <ul style="list-style-type: none"> <li>osteoprogenit or cells</li> <li>osteoblasts</li> <li>osteocytes</li> <li>osteoclasts</li> </ul> </li> <li>define periosteum and endosteum</li> <li>differentiate between primary and secondary bone</li> <li>describe the characteristic histological features of osteon</li> <li>apply knowledge of histology to explain clinical conditions like osteomalacia osteopetrosis and osteitis fibrocystic</li> </ul> <p><b><u>skill</u></b></p> <ul style="list-style-type: none"> <li>identify structure of compact and spongy bone under the light microscope</li> <li>illustrate the microscopic structure of compact and spongy bone with two identification points each</li> </ul>	LGIS	MCQs/ SAQ/SEQ / OSPE Viva Voce
<b>General embryology</b>					

4	Third week of development	Elucidate the embryological phenomena occurring during third week of development for application of that knowledge in understanding systemic embryology and analyzing relevant clinical conditions	<ul style="list-style-type: none"> <li>Enumerate the sequential phases of human development during third week</li> <li>Define the following: <ul style="list-style-type: none"> <li>Gastrulation</li> <li>Neurulation</li> </ul> </li> <li>Explain steps in formation of germ layers</li> <li>List the derivatives of all three germ layers</li> <li>Describe the formation of notochord and the establishment of body axes</li> <li>Elucidate the process of neurulation with reference to <ul style="list-style-type: none"> <li>Neural plate and neural tube</li> <li>Neural crest formation</li> </ul> </li> <li>Differentiate the features of primary, secondary and tertiary villi in the trophoblast</li> <li>Correlate the knowledge of embryology with embryological basis of <ul style="list-style-type: none"> <li>Sacrococcygeal teratoma</li> <li>Holoprosencephaly</li> <li>Situs inversus</li> </ul> </li> </ul> <p><b><u>Skill</u></b></p> <ul style="list-style-type: none"> <li>Identify the various phenomenon during third week of development on the</li> </ul>	LGIS	MCQs/ SAQ/SEQ / OSPE Viva Voce
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			given model and diagrams		
<b>General Anatomy</b>					
5	Arthrology	Apply the general concept map of the topographic anatomy of joints in understanding the regional distribution of joints in body.	<b><u>Knowledge</u></b> <ul style="list-style-type: none"> <li>Classify joints on the basis of presence and absence of joint cavity</li> <li>Classify synarthrosis (fibrous and cartilaginous) joints and provide examples</li> <li>Define diarthrosis/ synovial joint</li> <li>Enlist silent features of and types of movements possible at synovial joints</li> <li>Classify synovial joints on the following basis and provide examples               <ul style="list-style-type: none"> <li>Complexion of form</li> <li>Degree of freedom of movement</li> <li>Shape of articulating surface</li> </ul> </li> <li>Enlist factors responsible for the stability of synovial joints</li> <li>Describe the blood supply and nerve supply of synovial joint</li> </ul>	LGIS/SGD	MCQs SEQs/SAQs Viva Voce
<b>Gross Anatomy (locomotor I-c)</b>					

6	Hand	Correlate the knowledge of gross anatomy hand with common clinical presentations	<ul style="list-style-type: none"> <li>• Identify bones of an articulated hand</li> <li>• Elucidate the silent features of skin of palm and dorsum of hands and discuss its cutaneous innervation</li> <li>• Correlate palmer aponeurosis and its septa with palmer spaces</li> <li>• Enumerate small muscles of hand with their action and nerve supply</li> <li>• Describe the fibrous and synovial flexor sheaths of the hand</li> <li>• \explain the carpal tunnel with reference to its formation and contents</li> <li>• Analyze the anatomical basis of Dupuytren's contracture, carpal tunnel syndrome trigger finger and tenosynovitis of synovial sheaths Of flexor tendons</li> <li>• Describe boundaries and contents of spaces of palm</li> <li>• Analyze the clinical importance of spaces of palm, forearm spaces of Parona and pulp spaces</li> <li>• Revisits the insertion of long flexor and extensor tendons</li> <li>• Describe the blood supply of hands</li> <li>• Describe the formation of</li> </ul>	SGD	MCQs SEQs/SAQs OSPE Viva Voce
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			<p>superficial and deep palmar arches in hand</p> <ul style="list-style-type: none"> <li>• Trace the pathway and distribution of radial, median and ulnar nerves in hand</li> <li>• Identify the muscles, nerves and vessels of hand on prosected specimens and models</li> </ul>		
7	Wrist joint	Correlate the knowledge of gross anatomy of wrist joint with common clinical presentations	<ul style="list-style-type: none"> <li>• Describe the types, capsule and ligaments of wrist joint</li> <li>• Explain the movements of wrist joint with reference to axis and muscles performing these movements</li> <li>• Describe the blood supply and nerve supply of wrist joint</li> <li>• Correlate the anatomical knowledge with clinical presentations of wrist joint dislocation</li> <li>• Enumerate the structures endangered in case of fall on outstretched hand</li> <li>• Identify bones and ligaments of wrist joint in a prosected specimen or model</li> </ul>	SGD	MCQs SEQs/SAQs OSPE Viva Voce
8	Cutaneous innervation of supply of upper limb	Predict the area of sensory loss in case of injuries of different nerves of upper limb on the basis of anatomical knowledge of cutaneous innervation	<ul style="list-style-type: none"> <li>• Elucidate the cutaneous innervation of upper limb</li> <li>• Correlate the dermatome with the cutaneous innervation of specific nerves in arm and forearm</li> </ul>	SGD	MCQs SEQs/SAQs Viva Voce



			<ul style="list-style-type: none"> <li>• Illustrate the cutaneous innervation and dermatomes of upper limb</li> <li>• Identify the area of anesthesia in case of injury to different nerves</li> </ul>		
9	Injuries to brachial plexus and its branches	Analyze the area of motor and sensory loss in case of injuries to various branches of upper limb based on anatomical reasoning	<ul style="list-style-type: none"> <li>• Revisit the formation and branches of brachial plexus</li> <li>• Identify the points of injury and justify peculiar positions of upper limb in cases of Klumpke paralysis &amp; Erb-Duchenne palsy with anatomical reasoning</li> <li>• Identify the anatomical sites where different branches of brachial plexus are vulnerable to injury/compression</li> <li>• Correlate the lesion of following nerves with respective area of sensory and motor loss and peculiar positions of different parts of upper limb               <ul style="list-style-type: none"> <li>○ Axillary</li> <li>○ Long Thoracic</li> <li>○ Musculocutaneous</li> <li>○ Ulnar</li> <li>○ Median</li> <li>○ Radial</li> </ul> </li> </ul>	SGD	MCQs SEQs/SAQs Viva Voce
10	Venous and lymphatic drainage of upper limb	Summarize the lymphatic and venous drainage of upper limb in totality	<ul style="list-style-type: none"> <li>• Describe the formation and drainage of following veins               <ul style="list-style-type: none"> <li>○ Axillary Vein</li> <li>○ Basilic Vein</li> </ul> </li> </ul>	SGD	MCQs SEQs/SAQs Viva Voce OSPE

			<ul style="list-style-type: none"> <li>○ Cephalic Vein</li> <li>○ Median cubital vein</li> <li>• Discuss the lymphatic drainage of upper limb in detail</li> <li>• Identify the veins of upper limb in prosected specimens or models</li> </ul>		
11	Radiology	Correlate the skeletal framework of upper limb with its radiological appearance	<ul style="list-style-type: none"> <li>• Identify the bones and important bony landmarks of upper limb on AP and lateral view radiographs</li> </ul>	SGD	OSPE
12	Surface marking	Utilize the knowledge of topography of important neurovascular structures of upper limb in plotting the same on body surfaces and inferring relevant clinical presentations	<ul style="list-style-type: none"> <li>• Mark the following structure on surface of a subject or manikin               <ul style="list-style-type: none"> <li>○ Axillary nerve</li> <li>○ Brachial nerve</li> <li>○ Ulnar artery</li> <li>○ Radial artery</li> <li>○ Superficial palmar arch</li> <li>○ Deep palmar arch</li> <li>○ Cephalic vein</li> <li>○ Basilic vein</li> <li>○ Median cubital vein</li> <li>○ Axillary vein</li> <li>○ Musculocutaneous nerve</li> <li>○ Median nerve</li> <li>○ Radial nerve</li> <li>○ Ulnar nerve</li> </ul> </li> </ul>		

### List of practical's

	Topic	Learning Outcome	Learning Objective	MIT	Assessment
1	Epithelium-1	Understand the working of microscope to identify H& E-stained slides of different types of epithelium and appreciate their characteristic histological features to distinguish them from common pathological features in future	<ul style="list-style-type: none"> <li>Identify and illustrate parts of microscope</li> <li>Explain the working of microscope with focusing of slides at different at different magnifications</li> <li>identify and illustrate histological features of different types of stratified epithelia on microscope with two identification points of each</li> </ul>	Practical	OSPE/Viva Voce
2	Epithelium-2			Practical	OSPE/ Viva Voce
3	Glands		<ul style="list-style-type: none"> <li>Compare the histological features of serous and mucus acini under microscope</li> <li>Illustrate different types of exocrine glands</li> </ul>	Practical	OSPE/ Viva Voce
4	Connective tissue -1	Identify H & E stained slides of different components of and different types of connective tissue and appreciate their characteristics	Illustrate and identify different types of connective tissue with two points of identification each	Practical	OSPE/ Viva Voce
5	Connective tissue-2			Practical	OSPE/ Viva Voce

6	Muscular tissue	Identify H& E-stained slides of different types of muscles and appreciate their characteristic histological features to distinguish them from common pathological features in future	<ul style="list-style-type: none"> <li>Identify the histological structures of different types of muscles under the light microscope with two identification points of each</li> <li>Illustrate the histological structure of different types of muscle</li> </ul>	Practical	OSPE/ Viva Voce
7	Cartilage	Identify H& E-stained slides of different types of cartilage and appreciate their characteristic histological features to distinguish them from common pathological features in future	<ul style="list-style-type: none"> <li>Identify the histological structures of different types of cartilage under the light microscope with two identification points of each</li> <li>Illustrate the histological structure of different types of cartilage</li> </ul>	Practical	OSPE/ Viva Voce
8	Bone	Identify H& E-stained slides of different components and types of bones and appreciate their characteristic histological features to distinguish them from common pathological features in future	<ul style="list-style-type: none"> <li>Identify the structure of compact and spongy under the light microscope with two identification points of each</li> <li>Illustrate the microscopic structure of compact and spongy bone</li> </ul>	Practical	OSPE/ Viva Voce

## LIST of CBLs

### CBL 1

A 58 year old woman presents to her physician complaining of rib and back pain following a trip and fall accident. She was concerned that she may have broken something. On physical exam the physician notes some rib tenderness but also finds a palpable mass in her right breast. History revealed a strong family predisposition to breast cancer, however, she does not perform regular self-exams on her breasts and has not had a breast exam since her last check up several years ago. A mammogram, rib films and spine films are ordered by

her physician. The mammogram shows a large mass consistent with cancer in her right breast and bone films show multiple osseous lesions consistent with metastatic disease.

- a. What is the clinical importance of axilla in relation to breast diseases?
- b. Describe the general gross features of the breast and its blood supply.
- c. Describe the lymphatic drainage of breast.
- d. Enlist the routes of spread of breast cancer. How do the cancer cells metastasize from one breast to the other and to the brain?
- e. Breast cancer screening recommendations and controversies.
- f. Identify high risk groups.

### **CBL 2**

A 28-year-old dentist consults her physician, complaining that she feels tingling and slight pain in her right hand. The symptoms are localized to her thumb, index, middle and lateral side of her ring finger. The sensations are more intense at night or if she overworks. Recently, she has experienced some weakness in her grasp and finds it more difficult to hold her instruments. Also, movements of her right thumb are not as strong as before. On examination there was loss of power on certain movements of the thumb. She has impaired appreciation of light touch and pin pricks to the thumb, index, middle and lateral side of her ring finger, but sensation to her palm was not affected. Pressure and tapping over the flexor retinaculum causes tingling sensations. After a complete examination, the patient is diagnosed with carpal tunnel syndrome.

- a. What is the carpal tunnel? Enumerate its contents.
- b. What is meant by carpal tunnel syndrome? What causes this condition and how is it treated?
- c. Enlist the flexor tendons that traverse the carpal tunnel?
- d. Name a few conditions that can cause swelling of these tendons or their synovial sheaths?
- e. What is the anatomical basis of hypoesthesia / paresthesia in this case?
- f. Justify why the sensation in the central palm remained unaffected?
- g. Which movement of the thumb is most affected in this condition? Explain why?

### **CBL 3**

A 20 year old male presented to the OPD 10 days after he had a road traffic accident with complaints of difficulty in raising the left arm. On examination weakness and numbness in his left arm was observed with atrophy of left deltoid and supraspinatus. He also showed

reduced sensation to light touch along the upper lateral shoulder. He was diagnosed to have brachial plexus injury.

- a. Which part of the brachial plexus is most likely injured?
- b. What is the name given to a typical upper brachial plexus injury involving the upper roots?
- c. What will be the position of upper limb in this type of injury?
- d. What is the classic difference in the position of hand in upper and lower brachial plexus injuries?
- e. How and why are brachial plexus injuries common in obstetrics?
- f. What is the significance of the difference between a dermatome and a cutaneous area innervated by a peripheral nerve in this case?
- g. What is the reason of muscular atrophy and loss of sensation in this case?

## Physiology

### Cell

Sr.no	Topic/ theme	Learning Outcomes	Learning Objectives	MIT	Assessment tool
1	Homeostasis	Appraise the functional organization of human body and control of internal environment	<ul style="list-style-type: none"> <li>Recognize the interplay of various organ systems in maintaining homeostasis</li> <li>Identify the role of feedback mechanisms (positive, negative feed forward) in maintaining 'internal milieu'</li> <li>Differentiate between composition of intracellular and extra cellular fluid</li> </ul>	LGIS/SGD	MCQs/ SEQs/ SAQ/ structured viva
2	Cell physiology	Relate the structure of cell and its various components to metabolic processes, genetic control and locomotion	<ul style="list-style-type: none"> <li>Revisit the structure and function of cell and its organelles (cell membrane, cytoplasmic organelle, nuclear membrane, nuclear organelle)</li> <li>Distinguish various ways of food processing within a cell</li> </ul>	SGD/CBL	MCQs/ SAQ/ structured viva

			(ingestion, digestion, synthesis, extraction of energy from nutrients) <ul style="list-style-type: none"> <li>Recall movements of cells (amoeboid ciliary, flagellated)</li> <li>Explain the process of protein synthesis (transcription and translation)</li> <li>Classify various modes of transport of substances across the cell membrane</li> <li>Compare and contrast modes of transport of substances across the cell membrane with examples (osmosis, diffusion, facilitated diffusion, primary active transport, secondary active transport)</li> </ul>		
<b>Nerve and Muscle</b>					
1	Membrane potentials and action potentials	Differentiate various types and phases of action potentials on the basis of nerve morphology, concentration of	<ul style="list-style-type: none"> <li>Appraise basis of development of membrane potential across excitable membrane</li> </ul>	LGIS/SGD/CBL	MCQs/ SAQ/ structured viva



		ions in body fluids compartments and clinical significance	<ul style="list-style-type: none"> <li>• Recognized Nernst potentials and its importance in generation of membrane potential</li> <li>• Identify various factors/ mechanisms responsible for the genesis of membrane potential 9 role of channels, carrier proteins, stimuli)</li> <li>• Illustrate different phases of action potential mentioning details of ionic changes occurring during each phase of action potential</li> <li>• Distinguish types and importance of refractory period</li> <li>• Differentiate between myelinated and non-myelinated nerve fibers after injury</li> </ul>		
2	Excitation contraction coupling and NMJ	Correlate physiological mechanism of neuromuscular transmission and excitation-contraction coupling with	<ul style="list-style-type: none"> <li>• Tabulate macroscopic, microscopic functional diseases of various types of muscle</li> </ul>	LGIS/SGD/CBL	MCQs/ SAQ/ structured viva

		various neuromuscular diseases	<ul style="list-style-type: none"> <li>• Illustrate neuromuscular junction sequence of events taking place during neuromuscular transmission and factors affecting the processes</li> <li>• Explain the physiological importance of a motor unit</li> <li>• Describe the ionic and chemical basis of muscle contraction</li> <li>• Explain the energy expenditure during muscle contraction</li> <li>• Distinguish between phases of muscle contraction in detail</li> <li>• Relate the pathophysiology of neuromuscular transmission/ muscle contraction to various clinical presentations (</li> <li>• Tetanus, rigor mortis, tetanization, contracture, remainder, myasthenia gravis, drug acting on NMJ)</li> </ul>		
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			<ul style="list-style-type: none"> <li>Differentiate between isometric and isotonic contraction</li> </ul>		
3	Excitation and contraction of smooth muscle	Appreciate characteristics of smooth muscle contraction with their physiological significance	<ul style="list-style-type: none"> <li>Describe the role of SER in smooth muscle contraction</li> </ul>	LGIS/ SGD/ CBL	MCQs/ SAQ/ structured viva

### Blood

1	Hemopoiesis	Describe the morphology and genesis of blood cells	<ul style="list-style-type: none"> <li>Differentiate between various types of blood cells on the basis of their morphological and physiological characteristics</li> <li>Overview sites of hemopoiesis in the blood during different stages of life along with composition and functions of bone marrow</li> <li>Identify the factors regulating erythropoiesis and maturation of RBC</li> <li>Appreciate the composition of blood and general functions of blood</li> </ul>	LGIS/ SGD/ CBL	MCQs/ SAQ/ structured viva
2	Red blood cells dyscrasia	Differentiate various types of RBCs abnormalities	<ul style="list-style-type: none"> <li>Relate the morphology and physiology of</li> </ul>	LGIS/ SGD/ CBL	MCQs/ SAQ/ structured viva

		on the basis of etiology, pathophysiology and clinical presentations	<p>different types of hemoglobin with hemoglobinopathies</p> <ul style="list-style-type: none"> <li>• Compare and contrast different types of anemia on the basis of etiology, pathophysiology, clinical presentations and blood picture</li> <li>• Describe etiology, pathophysiology and clinical presentations of polycythemia</li> </ul>		
3	WBCs and immunity	Classify different types of immunity on the basis of cell type and their role in defense mechanism	<ul style="list-style-type: none"> <li>• Relate the morphology and physiology of different WBCs with clinical presentations of leucopenia, leukocytosis and leukemia</li> <li>• Appraise the clinical significance of RES reticuloendothelial system</li> <li>• Describe the pathophysiology of inflammation and necrosis</li> <li>• Describe the physiological basis of vaccination</li> </ul>	LGIS/SGD/CBL	MCQs/ SAQ/ structured viva
4	Hemostasis and blood coagulation	Compare and contrast various bleeding disorders	<ul style="list-style-type: none"> <li>• Identify role of cells and proteins</li> </ul>	LGIS/SGD/CBL	MCQs/ SAQ/ structured viva

			<p>involved in the process of maintaining hemostasis</p> <ul style="list-style-type: none"> <li>• Differentiate between the intrinsic and extrinsic regulations of blood coagulation</li> <li>• Discuss the morphology, etiology, pathophysiology and clinical presentation of thrombocytopenia, thrombocytosis and hemophilia</li> </ul>		
5	Blood grouping and transfusion reactions	Analyze transfusion reactions	<ul style="list-style-type: none"> <li>• Explain the principles of blood grouping keeping in view their physiological significance</li> <li>• Identify various blood groups and hazards of matched and mismatched blood transfusion with especial reference of Erythroblastosis fetalis</li> </ul>	LGIS/ SGD/ CBL	MCQs/ SAQ/ structured viva

## List of physiology practical

1	Introduction to microscope
2	Study Neubauer's chamber in detail using compound microscope judiciously
3	Determine RBC count by using Neubauer's chamber.
4	Determine the WBC count
5	Determine PCV
6	Determination of Hemoglobin in the blood. (Sahili's method)
7	Determination of DLC
8	Determine ABO blood grouping
9	Estimate bleeding and clotting time
10	Osmotic fragility of RBCs
11	Determine ESR
12	Determine red cell indices

## LIST OF CBLs

1	Introduction to CBL
2	Cancer
3	Case of Myasthenia Gravis
4	Case of Anemia
5	Case of Aids
6	Case of a transfusion reaction

## BIOCHEMISTRY

Sr no	Topic / theme	Learning outcomes	Learning objectives	MIT	Assessment Tool
1	Biochemistry of cell and cell membrane	Understand and apply the principles of biochemical techniques to explore cell, its organelles and functions those off	<ul style="list-style-type: none"> <li>Understand and categorize different types of cytological techniques</li> <li>Demonstrate and interpret basic techniques to study cell, separation of materials through centrifugation, chromatography and microscopy</li> <li>Differentiate cell organelle, their structure and biochemical functions (Mitochondria, Ribosomes, Golgi Apparatus, Endoplasmic reticulum, Lysosomes and Peroxisomes) and associated disorder.</li> <li>Describe detailed chemical composition of cell membrane and its bio chemical significance</li> <li>Describe the biochemistry of</li> </ul>	LGIS/ SGD/ CBL/ Practical/ Tutorial	MCQs/ SEQs/ SAQs/ OSPE/ Structured Viva

			membrane transport mechanism, active transport, passive transport, simple and facilitated diffusion <ul style="list-style-type: none"> <li>• Explain cellular communication, chemistry of messengers and receptors</li> </ul>		
2	Chemistry of amino acids and proteins	Understand the structure, function, classification and biochemical significance of amino acids	<ul style="list-style-type: none"> <li>• Explain the structure, functions and classification of amino acids on the basis of R group, polarity, charge, aromaticity, nutritional requirement and occurrence in proteins</li> <li>• Describe the behavior of amino acids with change in PH along with buffering role of amino acids and proteins in human body in PH maintenance</li> </ul>	LGIS/ CBL/ SDL	MCQs/ SEQs
		Understand the structure, function, classification and biochemical significance of proteins	<ul style="list-style-type: none"> <li>• Describe definition, biochemical importance and classification of proteins based on physiochemical properties, functional,</li> </ul>		



			<p>nutritional and structural basis</p> <ul style="list-style-type: none"> <li>• Illustrate the details of structure of proteins and their biochemical/ clinical significance</li> </ul>		
		Understand and demonstrate the biochemical techniques to study the structural and functional aspects of proteins	<ul style="list-style-type: none"> <li>• Describe the principles and methods of techniques for separation of proteins e.g., Salting out, Electrophoresis, Chromatography , NMR and Centrifugation</li> <li>• Illustrate the</li> </ul>	LGIS/ CBL/ SDL Practical	MCQs/ SEQs OSCE

			<ul style="list-style-type: none"> <li>• principal, methodology and types of electrophoresis</li> <li>• Illustrate the principal, methodology and types of Chromatography</li> <li>• Illustrate the principal, methodology and types of Centrifugation</li> </ul>		
		Know the chemistry and biochemical / clinical significance of plasma proteins	<ul style="list-style-type: none"> <li>• Explain the chemistry and mechanism of action of immunoglobins and their biochemical significance</li> <li>• Describe types and functions of plasma proteins and their clinical significance</li> </ul>		

3	Hemoglobin	To understand the structure, function, synthesis and degradation of hemoglobin	<ul style="list-style-type: none"> <li>Describe the structure, function and types of hemoproteins with special reference Hemoglobin, Oxygen and Carbon Dioxide transport</li> <li>Comprehend the concept of degradation of Heme, formation of bile pigments and formation of different types of Bilirubin</li> <li>Describe the mechanisms involved in the excretion of Bilirubin, Hyperbilirubine mia and its biochemical causes</li> </ul>	LGIS/ CBL/ SDL Practical	MCQs/ SEQs OSCE
		To apprehend the hemoglobinopathies , porphyria and Jaundice	<ul style="list-style-type: none"> <li>Explain Jaundice, its types and kernicterus, their biochemical mechanisms/ its significance</li> </ul>		
			<ul style="list-style-type: none"> <li>Explain Hemoglobinopat hies (sickle cell disease, SE disease, Thalassemia) and their biochemical causes</li> <li>Describe detailed</li> </ul>		

			biochemical background of Porphyria		
4	Enzymes	To understand structure, function, classification, biochemical significance and clinical importance of enzymes	<ul style="list-style-type: none"> <li>• Define different terms               <ul style="list-style-type: none"> <li>○ Enzymes</li> <li>○ Coenzymes</li> <li>○ Cofactors</li> <li>○ Halozyme</li> <li>○ Prosthetic group</li> <li>○ Ribozymes</li> <li>○ Isozymes</li> <li>○ Zymogens</li> </ul> </li> <li>• Classify enzyme and describe their mechanism of action</li> <li>• Explain different properties of enzymes and factors affecting enzyme activity</li> <li>• Illustrate enzyme kinetics in relation to Michaelis-Menten equation and Lineweaver-Burke plot</li> <li>• Describe enzyme regulations, activations, inhibition and biomedical importance of synthetic inhibitors</li> <li>• Understand role of enzymes in clinical diagnosis and therapeutics</li> </ul>	LGIS/ CBL/ SDL Practical	MCQs/ SEQs OSCE

## Practical's Bio Chemistry

Sr no	Topic	Learning Outcomes	Learning Objectives	MIT	Assessment Tool
1	Introduction to use of glassware	Justify use of different glassware along with identification	<ul style="list-style-type: none"> <li>Identify different types of glassware used in laboratory</li> <li>Describe the use of glassware used in laboratory</li> </ul>	Demonstration/ Practical	OSCE/ OSPE/ Practical performance
	Introduction to use of laboratory equipment's	Justify use of different instruments along with identification	Identify and interpret usage of different types of laboratory equipment's <ul style="list-style-type: none"> <li>Spintronic 20</li> <li>Micro Lab</li> <li>Incubator</li> <li>Water bath</li> <li>Hot oven</li> <li>Centrifuge machine</li> <li>Electronic balance</li> <li>Ph meter</li> </ul>		
2	Experiments on identification of proteins	Interpret the results of given experiment	<ul style="list-style-type: none"> <li>Biuret test</li> <li>Millon's Test</li> <li>Ninhydrin test</li> <li>Aldehyde test</li> <li>Sulphur Test</li> <li>Xanthoproteic test</li> <li>Sulfosalicylic Test</li> <li>Heat Coagulation Test</li> </ul>		
3	Experiments on Qualitative analysis of amino acids and proteins	Interpret the results of given experiment	<ul style="list-style-type: none"> <li>Scheme for the analysis of urine based on performed tests</li> </ul>		

			for the analysis of amino acids and proteins		
4	Chemical examination of urine for detection of amino acids and proteins		<ul style="list-style-type: none"> <li>• Estimation &amp; clinical interpretation of CK</li> <li>• Flame photometry &amp; estimation of electrolytes</li> </ul>		

## **CBLs/SDLs**

### **CBL 01**

#### Topic: Cell

A 27-year-old boy presented to ophthalmic OPD with rapid deterioration of vision in both eyes. He felt blurring of central in right eye eight weeks back which gradually increased and now developed similar symptoms in other eye. His visual acuity is 6/36 in right and 6/12 in left eye. On fundus examination optic disc showed edematous retinal nerve fiber layer and telangectatic vessels. A CT scan brain did not reveal any inflammatory or space occupying lesion before or after optic chiasma. These findings led the ophthalmologist to suspect LHON.

The buccal mucosa sample was sent to human molecular biology laboratory for identification of genetic mutation (if any) leading to the condition and confirmation of provisional diagnosis. The scientists in the lab separated mitochondria from the cells by disrupting the cells and centrifugation at 700g once and at 12000 g twice for 15 and 5 minutes. Sequencing of MT-ND1, MT-ND4, MT-ND4L and MT-ND6 genes was carried out and MT-ND1 was found to have point mutation. The diagnosis of LHON was confirmed. MT-ND1 is the gene spanning 3,307 to 4,262 of mtDNA and encodes for NADH dehydrogenase of ETC.

#### **RELATED INVESTIGATIONS:**

<b>Test Name</b>	<b>Result</b>
<b>Visual field testing</b>	Central vision deterioration
<b>CT Scan Brain</b>	Normal study

Mitochondria are one of the most important cell organelles and work mainly as powerhouse of the cell. Many of the enzymes of mitochondrial function are encoded by its own DNA called mtDNA which is inherited purely from mothers. Mutations and their transfer to next generation is found not only in nuclear DNA but also in mtDNA. Several diseases have been found to be caused by mitochondrial dysfunction which is due to mutations in mtDNA and examples include lactic acidosis, mitochondrial encephalopathy, stroke-like-episodes, LHON and Leigh syndrome.

### **LEARNING OBJECTIVES:**

1. Structure and function of different organelles of the cell.
2. Structure, function and pathology of Mitochondria

### **CBL 02**

#### **Topic: Cell (I- Cell Disease- lysosomal targeting problems)**

A female infant with a normal delivery after 38 weeks and normal intrauterine life showed the physical findings characteristic of I-cell disease. She manifested gargoyle face, progressive psychomotor retardation, and increased serum levels of lysosomal enzymes with decreased activities in peripheral blood lymphocytes. The diagnosis was made by the analyses of lysosomal enzymes. The child died at the age of 2 years and 3 months due to

respiratory insufficiency. By electron microscopy, various-shaped membrane-bound vacuoles were observed in the cytoplasm of various cells such as hepatocytes, myocardial muscle cells, epithelial cells of the renal glomeruli, proximal renal tubular cells, fibroblasts, and chondrocytes. By histochemical analyses we found that these intracytoplasmic storage vacuoles contained glycosaminoglycan and proteoglycan.

In general, peripheral blood smears are performed to obtain information with regard to various morphological features as an aid in the diagnosis of infection or malignancy. This report presents a patient with I cell disease (Inclusion cell disease), a fatal lysosomal storage disorder caused by a defect in an enzyme responsible for the transfer of mannose6-phosphate ligands to precursor lysosomal enzymes. As a consequence, most lysosomal enzymes are transported outside the cell instead of being correctly targeted into the lysosomes, resulting in the storage of macromolecules in lysosomes. I cell disease, with its heterogeneous clinical presentation, can be diagnosed by the presence of intracellular vacuole-like inclusions in lymphocytes and fibroblasts, high serum lysosomal enzyme activities, and a defect of N-acetylglucosamine-1-phosphotransferase. This report describes the morphological aspects of peripheral lymphocytes in a blood smear of a patient, the first clue to the final diagnosis of I cell disease. The observed vacuole-like inclusions in lymphocytes of this patient were negative for periodic acid Schiff (PAS) and Sudan black B staining, in contrast to earlier reports.

## LEARNING OBJECTIVES:

1. Structure and function of different organelles of the cell.
2. Structure, function and pathology of lysosomes
3. Enzyme processing and targeting to organelles

### **CBL 03**

#### Topic: Protein Chemistry (Emphysema- $\alpha$ 1 antitrypsin deficiency)

A 68-year-old Caucasian man with a 25 pack-year smoking history presented with new-onset dyspnea on exertion in the setting of workplace dust exposure. During his evaluation, he was found to have  $\alpha$ <sub>1</sub>-antitrypsin deficiency with evidence of development of pulmonary emphysema. Workplace spirometric monitoring over 10 years of surveillance for an on-the-job respirator fit program demonstrated a sharp downward slope in forced expiratory volume in one second, or FEV<sub>1</sub>, during his periods of most significant dust exposure, which was attenuated after discontinuation of his workplace exposure.

Blood and other body fluids contain a protein,  $\alpha$ 1-antitrypsin ( $\alpha$ 1-AT, A1AT, currently also called  $\alpha$ 1-antiprotease), that inhibits a number of proteolytic enzymes (also called proteases or proteinases) that hydrolyze and destroy proteins.  $\alpha$ 1-AT comprises more than 90% of the  $\alpha$ 1-globulin fraction of normal plasma.  $\alpha$ 1-AT has the important physiologic role of inhibiting neutrophil elastase—a powerful protease that is released into the extracellular space, and degrades elastin of alveolar walls, as well as other structural proteins in a variety of tissues. Most of the  $\alpha$ 1-AT found in plasma is synthesized and secreted by the liver. In the normal lung, the alveoli are chronically exposed to low levels of neutrophil elastase released from activated and degenerating neutrophils. This proteolytic activity can destroy the elastin in alveolar walls if unopposed by the action of  $\alpha$ 1-AT, the most important inhibitor of neutrophil elastase. Because lung tissue cannot regenerate, emphysema results from the destruction of the connective tissue of alveolar walls. Smoking causes the oxidation and subsequent inactivation of that methionine residue, thereby rendering the inhibitor powerless to neutralize elastase.

Smokers with  $\alpha$ 1-AT deficiency, therefore, have a considerably elevated rate of lung destruction and a poorer survival rate than nonsmokers with the deficiency.

## LEARNING OBJECTIVES:

1. Chemistry of amino acids
2. Levels of protein folding and how it is carried out



3. Classification of proteins.
4. Plasma proteins.
5. Proteolytic enzymes

## **CBL 04**

### **Topic: Protein Chemistry (Creutzfeldt Jakob Disease)**

A 70 years old man reported for the third time in last 3 weeks in medical OPD with progressive difficulty in walking. He had muscle stiffness, twitching and involuntary jerks in both legs. This patient was being treated by psychiatrists for depression, agitation, mood swings, memory loss and thought problems for 2 weeks immediately preceding the onset of current symptoms. Taking into account the rapid progression and pattern of symptoms he was provisionally diagnosed as a case of Creutzfeldt Jakob Disease. The findings of MRI, EEG and spinal tap were consistent with the diagnosis. Patient was put on supportive symptomatic treatment and relatives were counseled.

The protein misfolding which is contagious from abnormal to normal protein leads to prion diseases. Prion diseases, such as Creutzfeldt-Jakob disease, occur when

prion protein, which is found throughout the body but whose normal function isn't yet known, begins folding into an abnormal three-dimensional shape. This shape change gradually triggers prion protein in the brain to fold into the same abnormal shape. Through a process scientists don't yet understand, misfolded prion protein destroys brain cells. Resulting damage leads to rapid decline in thinking and reasoning as well as involuntary muscle movements, confusion, difficulty walking and mood changes.

### **LEARNING OBJECTIVES:**

1. Chemistry of amino acids
2. Levels of protein folding and how it is carried out
3. Abnormalities in protein structure/folding

## **CBL 05**

### **Topic: Hemoglobinopathies**

The following case study focuses on a 12-year-old boy who is referred by his family physician for jaundice, normocytic anemia, and recurrent acute bone pains.

Complete blood count (CBC) reveals a hemoglobin of 6.5 g/dl, MCV 82.3 fL, platelet count 465,000/ micro litre, white blood cell count 9800/micro litre, absolute neutrophil count

8500/micro litre, reticulocyte count 7 percent, and bilirubin 84 mg/dl. Blood film revealed numerous sickle cells. Sickle solubility test is positive.

Two years later, at age 14, the patient presented to the emergency with acute onset of hemiparesis. CT scan of the brain demonstrated an acute right MCA infarct. The combination of patient's medical history, current presentation, CBC, and peripheral blood film findings are most suggestive of a sickling disorder. High performance liquid chromatography and hemoglobin gel electrophoresis are the two most commonly employed techniques in the investigation of hemoglobinopathies. The diagnosis of any sickling disorder, however, requires two laboratory investigations, one of which must be the sickle solubility test. The lower limit of detection of hemoglobin S in a sickle solubility test is approximately 15 to 20 percent. Sickle solubility test done in sickle cell disease patients in infants till age of 6 months or right after transfusion gives false negative test. The 2<sup>nd</sup> important technique is gel electrophoresis of hemoglobin which separates hemoglobin variants based on the overall charge of the hemoglobin molecule.

The most likely cause of infarction in this patient is sickle cell disease.

### **Learning Objectives:**

1. Structure and functions of hemoglobin
2. Types of hemoglobin
3. Hemoglobinopathies

## **CBL 06**

### **Topic: Porphyrins and Hemoglobin (Hepatitis A)**

A 31 year old man presented with jaundice, nausea, anorexia, restlessness, lethargy, fatigue and dark color urine for three days. Color of his stools was normal and there was no itching on the skin. He was not having pyrexia and intensity of jaundice was not of fluctuating type. There was no history of significant weight loss. There was mild pain in the right hypochondrium. He did not have any known hemoglobinopathy. He was nonalcoholic and there was no history of use of any drug recently. Ultrasonography showed no fatty infiltration of liver.

### **Lab Investigations**

S/N	Test	Result	Reference values
1	Serum Total bilirubin	42 µmol/L	Adult 2-17µmol/L
2	Conjugated Bil (direct)	10 µmol/L	0-4 µmol/L
3	Unconjugated Bil (indirect)	32 µmol/L	0-13 µmol/L
4	Urine bilirubin	Present	Absent
5	Urinary urobilinogen	Increased	0-4 mg/ 24 hrs
6	Serum ALT	2800 U/L	Male Upto 42 U/L Female upto 32

7	ALP	54 U/L	132-365 U/L adults Levels higher in children
8	AST	40 U/L	Upto 37 U/L
9	GGT	32 U/L	Upto 30 U/L
10	Plasma haptoglobin	normal	-
11	Serum albumin	33 g/dL	35-50g/L
12	Hep B surface antigen (HBsAg) in serum	Negative	Negative
13	Anti HCV antibody (anti HCV Ab) in serum	Negative	Negative
14	Anti Hep A antibody (IgM)	Positive	Negative

Hepatitis A is a viral infection and resultant inflammation of the liver caused by Hep A virus. Unlike Hep B and C this virus does not cause chronic disease and causes acute severe and self-limiting hepatitis making the patient immune against this virus for rest of his life. Unlike Hep B and C which are transmitted through blood or sex, hep A virus is transmitted through orofecal route. Senescent RBCs are broken in spleen and heme and globin separated and globin degraded into amino acids in fixed leukocytes of spleen. Heme is oxidized to biliverdin and bilirubin which leaves reticuloendothelial system and travel in plasma in protein bound form. Hepatocytes uptake and conjugate bilirubin for excretion from body in biliary route. Viral infection of liver affects not only conjugation but also other functions of the liver like albumin synthesis. This results in jaundice hypoalbuminemia and edema (later in chronic cases only), though liver has got the capability to handle 300 times more bilirubin in normal state and a capacity of hepatocyte regeneration. Chronic cellular damage, fibrosis and regeneration leads to liver failure and a condition called cirrhosis of liver which is leading cause of death due to hep B and C infections.

### LEARNING OBJECTIVES:

1. Synthesis and degradation of heme
2. Metabolism of bilirubin in body
3. Role of hepatocyte in bilirubin handling and its diseases (inherited and acquired)

## Medicine

S. #	Topic/ Theme	Learning Outcomes	Learning Objectives/ Content	MIT	Assessment Tool
1.	Iron deficiency and nutritional Anemias	Correlate the relevant basic knowledge with clinical presentations	<ul style="list-style-type: none"> <li>• Discuss various causes of nutritional anemias.</li> <li>• Explain common causes of Iron deficiency anemia</li> <li>• Discuss the clinical presentation( sign and symptoms) of anemia</li> <li>• Explain the treatment options</li> </ul>	LGIS	
2.	Bleeding + Clotting Disorders		<ul style="list-style-type: none"> <li>• Discuss the common bleeding and clotting disorders</li> <li>• Explain the underlying cause of common bleeding and clotting disorders</li> <li>• Explain the treatment options</li> </ul>	LGIS	
3.	Transfusion Reactions		<ul style="list-style-type: none"> <li>• Discuss the importance of cross match</li> <li>• Explain the clinical features of a miss</li> </ul>	LGIS	

			<p>matched transfusion reactions</p> <p>Discuss the treatment options of a miss matched transfusion reaction</p>		
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## Surgery

S. #	Topic/ Theme	Learning Outcomes	Learning Objectives/ Content	MIT	Assessment Tool
4.	Cell	Recognize the effects of radiotherapy and chemotherapy on different components of cell.	Identify physical effects of radiation and chemotherapy on cell	LGIS	MCQs.
5.	Ca Breast	Analyze anatomical basics of metastasis of carcinoma of breast	<ul style="list-style-type: none"> <li>Revisit the lymphatic drainage of breast</li> <li>Trace possible routes of spread of breast cancer</li> </ul> <p>Identify the major sites of metastasis which can be the basis of clinical presentation.</p>	LGIS	MCQs
6.	Fractures of Upper Limb	Develop an understanding of effects of different types of nerve injuries and compressions at different levels of upper limb	<ul style="list-style-type: none"> <li>Identify peripheral nerve injuries and repair of upper limb</li> <li>Recognize injuries to brachial plexus, its effects,</li> <li>Explain nerve compressions syndrome</li> </ul>	LGIS	MCQs

			<ul style="list-style-type: none"> <li>Identify effects and causes of muscle injuries sprains, wasting, frozen shoulder</li> </ul>		
7.	Injuries to brachial Plexus	Analyzed the area of motor and sensory loss in case of injuries to various branches of brachial Plexus based on anatomical Reasoning.	<ul style="list-style-type: none"> <li>Revisit the formation and branches of the brachial plexus</li> <li>Identify the injuries and justify peculiar position of upper limb in Klumpke paralysis &amp; Erb-Duchenne palsy</li> <li>Describe the innervation of each compartment and the specific deficits that occur with lesions of individual nerves at different parts along the course of following nerves: <ul style="list-style-type: none"> <li>Musculocutaneous nerve</li> <li>Median nerve</li> <li>Radial nerve</li> <li>Ulnar nerve</li> </ul> </li> </ul> <p>Discuss the anatomical sites of lesion of nerve correlating them to sensory and motor loss within area of distribution</p>	LGIS	MCQ
8.	Fractures of Radius & Ulna	Relate the clinical presentation of different fractures of Radius & Ulna with anatomical Knowledge	<ul style="list-style-type: none"> <li>Identify the common sites of Fractures of Radius &amp; Ulna and discuss their common clinical presentations</li> <li>Correlate different Fractures of upper limb with nerve and vascular injuries.</li> </ul>	LGIS	MCQ

9.	Imaging Techniques	Correlate skeletal frame work of upper limb with its radiological appearance.	<ul style="list-style-type: none"> <li>Enumerate the commonly used Imaging techniques in clinical practice.</li> <li>Explain the principles of differential densities on Xrays.</li> <li>Identify the appearance of bone, cartilage, air, fluid and fat on X-rays.</li> </ul>	LGIS	MCQ
10.	Imaging of Upper Limb - I		<ul style="list-style-type: none"> <li>Differentiate between epiphyseal line and fracture line Identify the bones and important bony landmarks of upper limb on AP and lateral view.</li> </ul>		
11.	Imaging of Upper Limb - II		<ul style="list-style-type: none"> <li>Identify common sites of fractures of bones of upper limbs of radiograph and correlate with relevant nerve and vessels vulnerable to damage.</li> </ul>		

## Behavioral Sciences& Professionalism

Foundation Module (2 weeks)					
S. #	Topic/ Theme	Learning Outcomes	Learning Objectives/ Content	MIT	Assessment Tool
1	<b>Communication Skills</b>	Demonstrate knowledge of different techniques to collect accurate and relevant information.	<ul style="list-style-type: none"> <li>Fundamental concepts of communication</li> <li>Questioning and listening skills</li> <li>Role of Verbal,</li> </ul>	LGIS /SGD/ role paly	MCQ

			nonverbal and tools of communication		
2	<b>Professionalism</b>	Analyze the historical development of medicine as a discipline Use study skills for learning long texts	<ul style="list-style-type: none"> <li>History of medicine</li> <li>Early Greek</li> <li>Persian era</li> <li>Create a study timetable, managing schedule</li> </ul>	SGD	MCQ
3	<b>Communication Skills</b>	Apply the essential components of building interpersonal relationships	<ul style="list-style-type: none"> <li>Interpersonal communication</li> <li>Boundaries of a <i>doctor- patient relationship</i>.</li> <li>The role of families and the need to engage them</li> <li>Miscommunication and implications.</li> </ul>	SGD/ role play	Presentation / Assignment
4	<b>Professionalism</b>	Discuss the significance of deep and surface learning	Exploiting texts for surface and deep learning using graphic organizers	LGIS	Quiz
5	<b>Leadership &amp; Management</b>	Discuss the significance of team building and wellness	Wellness and team building	SGD/ videos	MCQs/ SAQs
6	<b>Ethics</b>	Discuss Islamic perspective of Ethics	<ul style="list-style-type: none"> <li>Islamic perspective of Ethics-I</li> <li>Why Ethics /Islamic Ethics?</li> <li>What is Ethical and What is Not?</li> <li>Quran and Ethics</li> </ul>	LGIS/ SGD	MCQs/ SAQs
7	<b>Communication Skills</b>	Discuss the different models of	<ul style="list-style-type: none"> <li>Bio psychosocial model,</li> </ul>	SGD	Quiz / Presentation



		Communication for enhanced understanding.	<ul style="list-style-type: none"> <li>Models of consultation through history (1948 - 2000)</li> </ul>		/ Assignment
8	<b>Professionalism</b>	Search web resources for given topics using criteria of credible search	<ul style="list-style-type: none"> <li>Learning via web resources</li> <li>Ethics in searching information</li> <li>Web resources</li> <li>Criteria for credible web resources Search: 15 milestones (BMJ), its core values, and advances in medicine-I</li> </ul>	SGD	MCQ
9	<b>Leadership &amp; Management</b>	Discuss the factors affecting personality development	<ul style="list-style-type: none"> <li>Human development of Personality,</li> <li>Emotional Intelligence</li> </ul>	SGD	Group project/ Assignment
10	<b>Ethics</b>	Define plagiarism and discuss the ethical boundaries involved	What is plagiarism Crossing the boundary How to avoid plagiarism	SGD/ Case study in consultation with Clinical faculty	SAQ/ Case study



## **Learning Resources**

### **Anatomy**

- a) Clinical Anatomy for Medical Students by Richard Snell (9th edition).
- b) Basic Histology Text and Atlas by Luiz Carlos and Junqueira (14th edition)
- c) Basic Histology by Laiq Hussain Siddiqui (5th Revised edition)
- d) Medical Embryology by Langman (14th edition).
- e) Essential Clinical Anatomy by Keith Moore (7th edition).
- f) The Developing Human by Keith Moore (10th edition).
- g) General Anatomy by Laiq Hussain Siddiqui.

### **PHYSIOLOGY**

- a) Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall.
- b) Human Physiology: From Cells to Systems, 9th Edition by Lauralee Sherwood.
- c) Ganong's Review of Medical Physiology, 25th Edition (LANGE Basic Science) by Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwen Brooks.
- d) Practical physiology by CL Ghai

- e) Electronic modes

## **BIOCHEMISTRY**

- a) Lippincott's illustrated reviews, 7<sup>th</sup> edition
- b) Harper's illustrated Biochemistry, 30<sup>th</sup> edition
- c) M.N Chatterjea Textbook of Biochemistry , 8<sup>th</sup> edition
- d) M.D Vasudevan, Sreekumari, M.D.S;Kannan, M.D. Vaidyanathan D.M Textbook of Biochemistry for medical students, 2016
- e) Practical Biochemistry Manual (Prof Maj Gen AK Naveed, Dr Shakir Khan)
- f) Electronic modes

### **Feedback on the study guide**

We value your feedback and will use it for improvement of this Study guide.

Kindly provide feedback for this study guide. At the email: [dme@ckmc.edu.pk](mailto:dme@ckmc.edu.pk)

### **References:**

HARDEN, J.M. LAIDLAW, E.A. HESKETH, R. M. (1999). AMEE Medical Education Guide No 16: Study guides-their use and preparation.

*Medical Teacher*, 21(3),248–265. <https://doi.org/10.1080/01421599979491>