Physiology Department

CMH Institute of Medical Sciences (CIMS)

Multan

Student Study Guide

1st Year MBBS

2025

Departmental Vision Statement

Welcome to the Department of Physiology at CMH Institute of Medical Sciences (CIMS) Multan. Our main objective is the provision of resources and opportunities that encourage excellence in learning among students and faculty and to provide impeccable service to the institute.

Our priority for medical students is to equip them in the discipline of Human Physiology, by imparting knowledge and understanding of structure and functions of human system; to foster the development of professional skills through a well-designed curriculum based on experiments, training, and research.

We are very pleased to have an outstanding team contributing to the success ofthe Department of Physiology.

We strive to continue to provide exceptional teaching to our students.

Best Regards

Head of Department

Assistant Professor

Dr. Sidra Arshad

Contents

Details of Faculty

Sr. No.	Name	Designation	Qualification
1.	Dr. Sidra Arshad	HOD & Assistant Professor	MBBS, FCPS (Physiology)
2.	Dr. Faiza	Assistant Professor	MBBS, FCPS (Physiology)
3.	Dr. Iqra Imtiaz	Demonstrator	MBBS
4.	Dr. Iqra Ameen	Demonstrator	MBBS/ FCPS Physiology Trainee
5.	Dr. Huda Asif	Demonstrator	MBBS/ FCPS Physiology Trainee
6.	Dr. Hina Akram	Demonstrator	BDS
7.	Dr. Mahnoor Fatima	Demonstrator	MBBS
8.	Dr Rida Fatima	Demonstrator	MBBS
9.	Dr. Mahnoor saleem	Demonstrator	MBBS
10.	Dr. Naila khattak	Demonstrator	MBBS

Curricular Map

Blocks	Module	Duration	Teaching Methodology	Assessment Methodology
Block I	Introduction to medicine Cell structure and function Musculoskeletal I	15 weeks	• Lectures • CBL • SDL • Practical	Integrated Tests: At end of each module theory & OSPE End of Block Exam: Theory, OSPE, Viva Voce
Block II	Cardiovascular system I	10 weeks	• Lectures • CBL • SDL • Practical	Integrated Tests: At end of each module theory & OSPE End of Block Exam: Theory, OSPE, Viva Voce
Block III	Respiratory System I Musculoskeletal II	10 weeks	• Lectures • CBL • SDL • Practical	Integrated Tests: At end of each module theory & OSPE End of Block Exam: Theory, OSPE, Viva Voce

Preamble

Integration has been accepted as an important educational strategy in medical education. NUMS believes in continuous curriculum revision through regular reviews and feedback of stakeholders. This curriculum has been updated with Correlation as a minimum level of integration in MBBS. This curriculum is outcome based, patient centered, community relevant, promotes health and prevents disease. It has been revised by the faculty of basic and clinical sciences from constituent/affiliated colleges in collaboration with NUMS Academic Directorate and NUMS department of Health Professions Education.

Curriculum perspective

NUMS curriculum is evolved taking into consideration constructivist and behaviorist with some element of cognitivist approach. It allows students to construct their own knowledge based on what they already know and to use that knowledge in purposeful activities requiring decision making, problem solving, and judgments.

Level of integration

NUMS will follow Correlation i.e level 7 of Harden's level of Integration in first four years. The emphasis remains on disciplines or subjects with subject-based courses taking up most of the curriculum time. Within this framework, an integrated teaching session or course is introduced in addition to the subject-based teaching. This session brings together areas of interest common to each of the subjects. Though the teaching is discipline based, topics are correlated and taught with clinical context for better understanding and application of concepts. However clinical teaching increases gradually with advancing years. MBBS Year V is for clerkships

Curricular organization and structure

a. NUMS MBBS curriculum in the first three years shall be delivered in a System Based Modular Format with clinical relevance. However, in year III, students shall get clinical exposure through rotations in the wards and OPDs and in Year IV & V through clerkships

b. There will be three blocks in year I, each will have modules, duration of which depends upon the number and complexity of the objectives to be achieved in that module

c. The curriculum will be delivered by modular teams of multidisciplinary basic science faculty and relevant clinical faculty.

d. The planning and delivery will be coordinated by year coordinators who will guide module coordinators of their respective years for efficient implementation

e. Modular Coordinator will be responsible for teaching and assessment during each module. S/he will be appointed by HoDs in coordination with HPE team

f. Clinical Coordinator will be responsible for placement, teaching and assessment during clinical rotations

g. All NUMS colleges will provide study guides of each module to the students

1) To attain the integration in MBBS program, teaching shall be done in three spirals Basis of Medicine (Spiral I -Years I & II): The syllabus will be integrated horizontally around systems of the body in which Anatomy, Physiology and Biochemistry will be taught with clinical relevance. Additional chunks of content will be added in a module that exactly does not fit in the central theme of the module.
2) Longitudinal themes (English, Clinical Photography & videography and Research Methodology & EBM) are an integral part of year I. However, assessment of these subjects will be the responsibility of institute itself
3) Islamiat and Pakistan Studies will be assessed by the University in second professional exam
4) Apart from attending daily scheduled sessions, students should engage in selfdirected learning to achieve the desired objectives
5) Professional Exams will be block wise. There will be three papers, one paper for each block

Competencies

The focus of this curriculum is on the roles of a general physician as identified by PMC. These are skillful, knowledgeable, community health promoter, critical thinker, professional and role model, researcher and leader. Competencies focused in year I and II are: -

- Medical Knowledge
- Procedural skills
- Problem solving
- Communication skills
- Professionalism
- Research

Outcomes

By the end of years, I & II, students should be able to:

a. Correlate the developmental and anatomical knowledge of different organ systems of human body to their physiological and biochemical basis
b. Communicate clearly and effectively.

c. Apply theory of clinical photography and videography to practice in simulated & clinical settings.

d. Discuss the basic principles of research

Contact Hours Physiology Year-I: 225 hours

Educational Strategies

(These are proposed, but institutes can use other evidence-based teaching methodologies that suit their context)

a. Interactive Lectures
b. Small group discussion
c. Lab practical
d. Skill lab
e. Problem based learning/ Case based learning
f. Tutorials
g. Integrated sessions using any of the above strategies
h. Self-directed learning (SDL) and directed self-learning (DSL)

Internal Assessment

- Formative assessment (low stake) is at faculty discretion like mid module test and other class tests.
- There will be two end of blocks and one pre-annual examination in year I, which contributes towards the weighting of internal assessment i.e 20% in first professional MBBS Examination. There will be no 3rd EOB exam.

Annual Professional Examination (80% weightage)

- The University will take the first professional Examination at the end of the academic year.
- There will be three papers (block wise) of 150 marks each, with MCQs and SEQs/SAQs in 70: 30 ratios.
- Each theory paper has three sections of Anatomy, Physiology and Biochemistry with total 40 Marks of each subject in each paper.
- There will be 3 x Integrated Practical Exam and structured viva block wise of 150 Marks each. Rotation Plan is attached as Annex-B
- English and Elective course will be assessed by the institute itself. Pass marks will be 50%.
- It is mandatory to secure min. 50% marks in each subject in prof papers (I,II & III) in theory and practical separately
- Supplementary Exams – student will repeat the block-wise paper in which he/she secures less than 50% Marks (both theory & Practical) in any section.

MBBS YEAR I
BLOCK I
MODULE I
Introduction to Medicine
Duration: 02 weeks

Learning outcomes	Learning Objectives/ Content	Instructional strategies	Assessment tool
At the end of this module, students will be able to:			
Recognize the history and importance of medicine as a profession.	• Recognize the importance of Medicine in human life • Understand the evolution of modern medicine	Lecture	-
Recognize the role of different disciplines in studying the human body	Comprehend different medical disciplines, departments and faculty	Lecture	-
Acknowledge the interdisciplinary nature of medical education and practice	Comprehend the basic concepts of Physiology, Anatomy, Biochemistry and clinical subjects	Lecture	-
Develop a sense of professional identity.	Identify themselves as a part of new community of practice	White coat ceremony	Self-assessment through feedback proformas
	Relate the personal experiences and their impact on personal and professional identity formation	Small Group Discussion/ Concept Map	Formative
Analyze the importance of ethics and professionalism in medicine	Apply the ethical boundaries of conduct as a student	Small Group Discussion	Formative
	Comprehend the importance of professionalism for medical doctor	Small Group Discussion	Formative
Enhance their English language skills	• Improve communication skills in English, with a specific focus on medical terminology and effective patient-doctor interactions. • Exhibit a more comprehensive command of the English language to facilitate clear and accurate medical communication.	Small Group Discussion	Essay/ Assignments
Appreciate the significance of green initiatives in healthcare and identify ways to contribute to sustainability.	• Cultivate an understanding of sustainability and environmental consciousness in the context of healthcare. • Recognize and promote eco-friendly practices in medical settings, such as reducing waste, conserving resources, and minimizing the carbon footprint.	Small Group Discussion	Formative

MBBS YEAR I
BLOCK I
MODULE II
Cell structure and function
Duration: 07 weeks

Learning Outcomes	Subject Learning Outcomes	Teaching & Learning Strategies	Proposed Assessment Strategies
By the end of the session, students should be able to;			
Cellular Basis of Health and Disease			
Analyze cellular structure and their physiological roles to understand their clinical significance.	**Physiology** • Describe the parameters needed for the control of the 'internal environment' • Differentiate between the intracellular and extracellular fluid compartments • List the typical value and normal range for plasma Na+, K+, H+(pH), HCO3-, Cl-, Ca2+, and glucose, and the typical intracellular pH and concentrations of Na+, K+, Cl-, Ca2+, and HCO3- • Explain Homeostasis and the factors that are regulated through homeostasis • Recognize the interplay of various organ systems in maintaining homeostasis • Compare and contrast positive, negative and feed forward feedback mechanisms as the control systems of the body. • Narrate examples of each feedback control system • Discuss the outcomes of failure of the feedback control system of homeostasis **Cell Organelle** • Discuss the functional organization of human body • Differentiate membranous organelles from non-membranous organelles • Restate the structure & function of nucleus, nuclear membrane, Chromatin & Chromosomes, Nucleoplasm & Nucleolus • Compare the structure & function of smooth endoplasmic reticulum & RER • Appreciate the importance of Golgi apparatus in packaging and storage of newly formed proteins • Discuss the structure & functions of vaults • Discuss the synthesis, types & functions of ribosomes • Summarize the structure & functions of secretory vesicles • Discuss the physiological anatomy of mitochondria & discuss its functions in special relation to energy		

	synthesis • Compare and contrast the functions of lysosomes & peroxisomes **<u>Cytoskeleton and cell locomotion</u>** • Discuss the structure & function of cell cytoskeleton (microtubules, microfilaments & intermediate filaments) • Recall movements of cells (amoeboid, ciliary & flagellar movements) **<u>Genetic Control of cell function</u>** • Comprehend Genetic control of cell functions and cell division **<u>Cell membrane</u>** • Describe the composition of a human cell membrane • Diagram its cross section, and explain how the distribution of phospholipids and proteins influences the membrane permeability of ions, hydrophilic and hydrophobic compounds • Enlist the various functions of integral and peripheral proteins in the cell membrane **<u>Transport of substances through cell membrane</u>** • Classify various modes of transport of substances across the cell-membrane • Compare and contrast amongst the processes of osmosis, diffusion & facilitated diffusion (transport of micro molecules) • Compare and contrast the process of exocytosis & endocytosis (transport of macromolecules) **<u>Active Transport of substances through membranes</u>** • Explain the process of primary active transport with examples • Give an account on the structure, working and important functions of Na+ / K+ pump • Enlist other active transport pumps present in human body e.g. sarcoplasmic reticulum Ca2+ pump, and gastric H+ pump • Grasp concept of Secondary active transport.		

	• Differentiate co-transport & counter-transport with examples • Describe how energy from ATP hydrolysis is used to transport ions such as Na+, K+, Ca2+, and H+ against their electrochemical differences (e.g., via the Na+ / K+ pump,)		

	<u>Clinical Relevance</u>
	
	• Compare & contrast apoptosis & necrosis
	• Explain the pathophysiology of cancer and aging (General disorders), polycystic kidney disease.
	• Recognize the cause of Kartagener syndrome
	• Apply biochemical functions of cellular biomarkers in clinical context
	• Correlate associated disorders of various cell organelles:
	• Endoplasmic Reticulum (ER):
	  • Cystic Fibrosis
	  • Non-Alcoholic Fatty Liver Disease (NAFLD)
	• Lysosomes:
	  • Gaucher Disease
	  • Tay-Sachs Disease
	• Peroxisomes:
	  • Zellweger Syndrome
	• Plasma Membrane:
	  • Hereditary Spherocytosis
	  • Familial Hypercholesterolemia
	• Cytoskeleton:
	  • Duchenne Muscular Dystrophy
	• Cytoplasmic Inclusions:
	  • Parkinson's Disease
	• Elaborate the role of membrane transport mechanisms in health and disease:
	  • Cholera
	  • Pertussis
	• Cystic Fibrosis		

RBC - Pallor/ Jaundice			
Integrate physiological and Biochemical knowledge of red blood cells to analyze relevant clinical Disorders	**Physiology** **Composition & Functions of blood** • Make a flow sheet diagram of cellular and fluid composition and general functions of blood. **Erythropoisis in bone marrow** • Enlist sites of hemopoiesis in the body during different stages of life. • Make a flow sheet diagram of various stages of erythrogenesis with explanation of their relevant features and sizes during different stages of differentiation of RBC's. • Enlist different growth & differentiation inducers involved in erythropoiesis • Identify the factors in regulation of erythropoiesis and maturation of RBC with relative importance of hypoxia in inducing erythropoiesis. • Appreciate the role of erythropoietin in regulating RBC production. • Discuss the role of vitamin B12 & folic acid in maturation of RBC	SGD, LGIS & CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva
Inflammation & Immunity – Leucocytosis/ Leucopenia			
Correlate the histological, and physiological knowledge of white blood cells and cytokines with their clinical significance	**Physiology** **WBC- Morphology** • Enlist different types of white blood cells and discuss their physiological characteristics. • Define the terms: leukopenia, leukocytosis • Neutrophila, neutropenia, eosinophilia, eosionpenia, Basophilia & basopenia. • Make a flow sheet diagram showing steps involved in leukopoiesis. • Enlist the factors necessary for leukopoiesis. • Describe the role and functions of white blood cells in providing protection to the body against invading organism. • Demonstrate proficiency in preparing and staining blood films for the identification of white blood cell (WBC) morphology. • Identify morphological features of various types of WBCs for identification. **Innate immunity + complement system** • Define innate immunity. Discuss the mechanisms involved in innate immunity.	SGD, LGIS & CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva

	• Comprehend basis of innate immune system of the body and tissues related with innate immunity. • Discuss the role of natural killer cells & interferons in innate immunity. • Identify the specific role of interferons against virus infected cells and discuss their mechanism of action **Monocyte-macrophage system** Appraise the composition and functions of reticulo endothelial system. **Line of defense against infection & phagocytosis** • Explain the lines of defense against infection: role of neutrophils & macrophages. • Discuss the role of eosinophils & basophils. **Inflammation** • Define inflammation. • Discuss causes, cellular features and five cardinal signs of inflammation. • Explain the process of inflammation. • Give an account on process of "walling-off" involved in inflammation. • Describe pathophysiology of necrosis **General concept of T & B lymphocytes. Active & passive immunity** • Enlist the types of immunity. • Discuss the mechanism involved in development of immunity. Discuss the processing of T & B lymphocytes in human body. • Give a brief account on lymphocyte cloning. • Define immunization & enlist its types. • Discuss the role of memory cells involved in the process of immunization. • Compare & contrast active and passive immunity. • Describe the physiological basis of vaccination. **B-cell immunity** • Comprehend the concept of humoral immunity. • Discuss the structure of antibodies. • Classify antibodies. Discuss their functions. • Explain the role of antibodies in B-cell immunity **Mechanisms of action of antibodies** • Discuss the mechanisms through which antibodies directly attack an invading agent. • Give an account on the indirect action of antibodies on		

	invading agent through complement system. • Enlist the various complement proteins and their functions. **Allergy /Hypersensitivity** • Explain different types of allergy. Discuss the mechanism involved in development of an allergy & hypersensitivity.		
	• Explain the role of basophils and mast cells in the release of inflammatory mediators in response to allergens reagen binding. • Discuss the anti-allergic role of eosinophil. **T-cell immunity** • Discuss the role of antigen presenting cells in cell-mediated immunity. • Explain role of helper T cells, cytotoxic T cells and suppressor T cells in T cells immunity. • Discuss the role of interleukins released by helper T cells in facilitating both B & T cell immunity. • Comprehend the role of CD4 & CD8 markers in identification of an invading agent. **Autoimmunity & Transplant rejection** • Define autoimmunity. Discuss the pathophysiological process involved in development of autoimmunity • Discuss the pathophysiological process involved in transplant rejection of tissues by human body. • Discuss the mechanisms involved in immune tolerance.		
	Clinical Relevance • Interpret the significance of altered level of leucocytes • Describe the clinical disorders associated with Plasma Proteins and Immunoglobulins: o Edema o Malnutrition o Multiple Myeloma	Integrated sessions/CBL /LGIS	MCQs, SAQs, SEQs, OSPE, Structured
Blood grouping and Transfusion – Transfusion Reaction			
Apply the physiological knowledge of blood grouping to analyze the relevant clinical	**Physiology** **Blood groups** • Describe the principles of blood grouping and cross matching. • Tabulate the various blood groups. • Tabulate the genotype & phenotypes of ABO blood group system.	SGD, LGIS & CBL	MCQs, SAQs, SEQs, OSPE, Structured

conditions	**Rh blood group system** Comprehend different Rh blood group systems and their significance • Tabulate the genotype & phenotypes of Rh blood group system.		Viva
	Clinical Relevance • Identify the need of cross matching to avoid blood group incompatibility. • Discuss the pathophysiology of Erythroblastosis Fetalis, its treatment and precautions	Integrated sessions/CBL /LGIS	
Hemostasis & Coagulation - Bleeding/ Coagulation Disorders			
Corelate the physiological mechanisms of hemostasis, the roles of pro-coagulants and anti-coagulants, and the biochemical impact of enzyme and vitamin deficiencies to understand relevant clinical disorders	**Physiology** **Hemostasis** • Discuss the four steps involved in blood coagulation. • Discuss the morphology, development & functions of platelets in all the four steps of blood coagulation. • Discuss the role of alpha & dense granules in platelet plug formation. **Coagulation pathway** • Comprehend the physiology of clotting factors and mechanism of blood clotting. • Compare & contrast intrinsic and extrinsic pathway of clotting. **Bleeding disorder** • Discuss the effect of deficiency of platelets and clotting factors in hemostasis. • Discuss the pathophysiology of blood dyscrasias like Vitamin K deficiency, Hemophilia and Thrombocytopenia • Compare & contrast Hemophilia with Thrombocytopenia. • Recall the functioning/changes in the coagulation pathway in case of deficiency of clotting factors	SGD, LGIS & CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva
	Clinical Relevance • Correlate decreases in platelet count/ functional defects of platelets and bleeding diathesis (ITP) • Correlate deficiencies of clotting factors VIII & IX with its varied clinical manifestations (Hemophilia) • Overview of role of Vitamin C & K in bleeding disorders	Integrated sessions/CBL /LGIS	

Suggested Linkers	
Cellular Basis of Health and Disease	Chromosomal disorders/ Hyperbilirubinemia / Nutritional Anemia
RBC	Pallor/ Jaundice
Inflammation & Immunity	Leucocytosis/ Leucopenia
Blood grouping and Transfusion	Transfusion Reaction
Hemostasis & Coagulation	Bleeding/ Coagulation Disorders

Practicals	
Physiology	• Lab Protocols and study of microscope • Study of Neubauer's chamber • Determination of RBCs count using Neubauer's chamber • Determination the Total leukocyte Count • Determination of DLC • Platelet count. (Demonstration only) • Determination of Hemoglobin in the blood. (Sahli's method) • Determine Red cell indices • Estimate haematocrit (PCV) levels • Estimation of ESR • Determination of ABO & Rh blood groups • Estimate bleeding and clotting time • Osmotic fragility of RBCs

Physiology Practical			
Learning Outcome	**Learning objective**	**Instructional Strategy**	**Assessment**
Study Neubauer's chamber in detail using compound Microscope judiciously	**SKILLS** • Identify different parts of the compound/binocular microscope. • Carefully handle the microscope, and set its coarse and fine adjustments and magnifications using different lenses. • Identify the counting chambers and dimensions of different squares on the counting grid and recall the principle of hemocytometry. • Focus the counting grid for RBC and WBC counting under low and high magnification • Analyze the role of diluting fluids and their composition in hemocytometry. • Count the cells on the slide using Thomas rule in RBCs counting squares of Neubauer's chamber. **ATTITUDE:** • Practice the art of handling equipment carefully and experimenting with taking relevant precautions	Practical Demonstration	OSPE Structured viva
Determine RBC count by using Neubauer's chamber	**SKILLS** • Estimate the red blood cell count by taking blood in RBC pipette and diluting it with Hayem's fluid • Apply the method of charging Neubauer's chamber. • Count the cells on the slide using Thomas's rule, in the WBCs counting squares of Neubauer's chamber. **ATTITUDE:** • Practice the art of taking consent from the subject before performance.	Practical Demonstration	OSPE Structured viva

	• Demonstrate the art of explaining the procedure effectively to the patient. • Use aseptic technique to prick and draw blood for the procedure.		
Platelet count. (Demonstration only)	**SKILLS** • Apply manual method for platelet counting in a blood sample • Count platelets on the counting chamber • Identify pipette for platelet count and recall its diluting fluid composition **ATTITUDE:** • Practice the art of taking consent from the subject prior to performance of the procedure. • Communicate the procedure effectively to the patient. • Use aseptic technique to prick and draw blood for the procedure	Practical Demonstration	Structured viva
Determination of Hemoglobin in the blood. (Sahli's method)	**SKILLS** • Apply correct technique for pricking blood • Identify Sahli's pipette and apparatus with its parts • Avoid errors during estimation of hemoglobin by taking proper precautions	Practical Demonstration	Structured viva
Determine Red cell indices	• Calculate and interpret the red bood cell indices.	Practical Demonstration Practical Demonstration	Structured viva
Estimate haematocrit (PCV) levels	**SKILLS** • Measure the Hematocrit by properly centrifuging the blood and using Huxley's Hematocrit reader • Avoid errors in PCV estimation	Practical Demonstration	Structured viva

	• Identify buffy coat **ATTITUDE:**		
	• Practice the art of taking consent from the subject prior to performance of the procedure. • Communicate the procedure effectively to the patient. • Use aseptic technique to prick and draw blood for the procedure.		
Estimate ESR	**SKILLS** • Estimate ESR with Westergren and Wintrobe tubes **ATTITUDE:** • Practice the art of taking consent from the subject prior to performance of the procedure. • Communicate the procedure effectively to the patient. • Use aseptic technique to prick and draw blood for the procedure	Practical Demonstrations	OSPE Structured viva
Determine ABO & Rh blood groups	**SKILLS** • Use correct technique for prick • Deingtermine blood groups by using anti-sera and precautions to be observed. • Identify hemolysis after adding antisera to the sample • Mix the blood drops with anti- sera with separate stirrers for each drop/sample (A,B,D) **ATTITUDE** Practice the art of taking consent of patient prior to performance of procedure and communicate the procedure effectively to the patient.	Practical Demonstrations	OSPE Structured viva
Estimate bleeding & clotting time	**SKILLS** • Identify the methods for measurement of bleeding time and clotting time	Practical Demonstrations	OSPE Structured viva

	• Skillfully apply blood drop on filter paper • Note the time duration honestly with stop watch • Identify heparinized and non- heparinized capillary tubes • Break the capillary tube carefully without tearing the fibrin thread **ATTITUDE** • Practice the art of taking consent from the subject prior to performance of the procedure. • Communicate the procedure effectively to the patient. • Use aseptic technique to prick and draw blood for the procedure		
Determine the differential leukocyte count.	**SKILLS** • Prepare Blood film and stain effectively • Identify morphological features of various types of WBCs for identification. **ATTITUDE:** • Practice the art of taking consent from the subject prior to performance of the procedure. • Communicate the procedure effectively to the patient. Use aseptic technique to prick and draw blood for the procedure.	Practical Demonstrations	OSPE Structured viva
Osmotic fragility of RBC	• Observe the response of RBCs to hypotonic & hypertonic environment • Learn the conditions in which fragility of RBCs is increased	Practical Demonstrations	OSPE Structured viva

MBBS YEAR I
BLOCK I
MODULE III
Musculoskeletal System- I (MSK - I)
Duration: 06 weeks

Block I
Module III
Musculoskeletal System – I (MSK – I)

At the end of this module, students will be able to:

- Integrate the knowledge of the structure of upper limb with the physiological mechanisms underlying movement and muscle contraction, and the biochemical pathways involved in energy production and muscle metabolism and relate it with their clinical aspects

Learning Outcomes	Subject Learning Outcomes	Teaching & Learning Strategies	Proposed Assessment Strategies
FUNCTIONAL ORGANIZATION OF NERVE & MUSCLE			
	Physiology **Nerve Physiology** **Neuron & Synapse** • Define, and identify the following regions on a diagram of a motor neuron: dendrites, axon, axon hillock, soma, and an axodendritic synapse. • Classify synapses on anatomical & functional basis. • Elucidate structural and functional changes taking place in nerve fibers after injury. **RMP- Resting Membrane Potential** • Grasp concept of Nernst potential and its importance in generation of resting membrane potential. • Comprehend different mechanisms responsible for the genesis of membrane potential (role of channels, carrier proteins). • Describe the normal distribution of Na+, K+, and Cl- across the cell membrane, and using the Goldman equation, explain how the relative permeability of these ions create a resting membrane potential • Explain how the abnormal function of ion channels (channelopathies) can alter the resting membrane potential **Action Potential** • Define action potential. Draw different phases of action potential and explain ionic & electrical changes occurring during each	Integrated sessions/ CBL/LG IS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	phase of action potential • Differentiate between absolute and relative refractory periods • Discuss the role of positive feedback mechanisms in initiation of an action potential • Distinguish the effects of hyperkalemia, hypercalcemia, and hypoxia on the resting membrane potential & action potential Discuss the process of generation of nerve impulse and its transmission in different types of nerve fibers (myelinated and non characteristics. • Understand the concept of all or nothing principle in propagation of an action potential • Explain the concept of saltatory conduction • Discuss the properties of contiguous conduction • Differentiate between myelinated and non-myelinated nerve fibers based on their structure and characteristics **<u>Neuromuscular Junction</u>** • Illustrate neuromuscular junction, sequence of events taking place during • neuromuscular transmission and factors affecting this process		
	<u>Clinical Relevance</u> • Appreciate the effect of acidosis and alkalosis on synaptic transmission. • Explain the effect of hypocalcemia on permeability of sodium Channels. Explain the pathophysiology of Myasthenia Gravis.	Integrated sessions/ CBL/LG IS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	PHYSIOLOGY **Muscle Physiology** **Skeletal muscle morphology** • Illustrate the physiologic anatomy of skeletal muscle • Explain the structure of myosin molecule& its subunits and describe the function of the Subunits	SGD, CBL	MCQs, SEQs/ SAQs, OSPE, Structured Viva
	• Identify the structure of the thick and thin myofilaments and label the constituent proteins • Tabulate macroscopic, microscopic, functional differences of various types of muscles **Skeletal muscle contraction and relaxation** • Appreciate the ionic and chemical basis of muscle contraction and relaxation. • Explain how the cross-bridge cycle results in shortening of the muscle. • List the steps in excitation-contraction coupling in skeletal muscle, and describethe roles of the sarcolemma, transverse tubules, sarcoplasmic reticulum, thin filaments, and Ca++ • Describe the roles of ATP in skeletal muscle contraction and relaxation. • Explain the energy expenditure during muscle contraction • Appreciate the characteristics and differences between isometric and isotonic contraction with the help of examples. • Compare and contrast slow and fast muscle fibers • Explain the relationship of preload, afterload and total load in the time course of an isotonic contraction. **Properties of muscle Contraction-I** Explain the motor unit and its physiological importance. Explain the concept of: • Summation • Treppe • Skeletal muscle tone • Muscle fatigue • Tetanization • Contracture remainder • Muscle dystrophy	Integrated sessions/CBL/LG IS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	<u>Muscle remodeling + Rigor mortis</u> • Enlist types of muscle remodeling • Summarize the effects of hypertrophy, hyperplasia & atrophy on the skeletal muscle structure and function. • Explain the physiological basis of rigormortis **<u>Smooth muscle morphology & characteristics</u>** • Comprehend the types of smooth muscles. • Differentiate between types of action potentials produced in different smooth muscles and appreciate the role of autonomic innervation, mechanical and humoral factors in their generation • Appreciate characteristics of smooth muscles (slow cycling of myosin cross-bridge, low energy requirement to sustain contraction, latch mechanism & stress relaxation). **<u>Smooth muscle contraction and relaxation</u>** • Illustrate the sequence of events leading to smooth muscle contraction and relaxation. Give an account on the physiological anatomy of smooth muscle NMJ		
	Clinical Relevance • Explain pathophysiological basis of Duchenne muscular dystrophy (DMD) • Explain the mechanism of recovery of muscle contraction in poliomyelitis.	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

MBBS YEAR I
BLOCK II
MODULE IV
Cardiovascular System
Duration: 09 weeks

Preamble

This block focuses on cardiovascular system with basic understanding of structure of thorax. At the very outset medical student should understand that cardiovascular system has fundamental importance in all the fields of Medicine. Coronary artery diseases alone are one of the leading causes of morbidity and mortality worldwide. The course of this block is designed for first year MBBS students in an integrated manner.

Apart from attending daily scheduled sessions, students should engage in self-directed learning to achieve the desired objectives

Module Learning Outcomes:

By the end of this module, students should be able to:

1. Integrate the anatomical knowledge of the thorax and heart, physiological mechanisms of cardiac function, and lipids Medical Biochemistry, to relate with clinical conditions of cardiovascular system.
2. Correlate the developmental events of fetal period with relevant congenital anomalies.

Integrated Learning outcomes	Subject Learning outcomes	Teaching & learning strategies	Assessment Strategies
At the end of this module, students will be able to:			
1. Heart			
	<u>Physiology</u> • Differentiate the physiological arrangement of right and left hearts along with the parallel arrangement of systemic circulation. • Trace the path of blood flow through the whole circulatory system with comparisons of pressures in various components of heart and circulatory tree • Explain the basic functional anatomy of the atrioventricular and semilunar valves, and how they operate. • Compare cardiac and skeletal muscle with respect to: cell size, electrical connections between cells, and arrangement of myofilaments, ion permeability, and electrical resistance. • Describe role of gap junctions in creating a functional syncytium. • Explain the ionic mechanism of pacemaker automaticity and rhythmicity, and identify cardiac cells that have pacemaker potential and their spontaneous rate. • Identify neural and humoral factors that influence their rate. • Discuss the significance of "overdrive suppression" and "ectopic pacemaker". • Trace the normal sequence of cardiac activation (depolarization) beginning in the SA node, and the role played by specialized cells of the cardiac conductive system.	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	• Explain the functional significance of the slow conduction through the AV node (delay). Describe factors that influence conduction velocity through the AV node. • Draw a diagram and trace the path of spread of cardiac impulse through conductive system, atrial and ventricular myocardium and associate it with the function of heart. • Sketch a typical action potential in a ventricular muscle labeling both the voltage and time axes accurately. • Describe how ionic currents through various ion channels contribute to the four phases of the cardiac action potential. • Explain what accounts for the long duration of the cardiac action potential and the resultant long refractory period and the advantage of the long plateau of the cardiac action potential and the long refractory period • Contrast the duration of the action potential and the refractory period in a cardiac muscle and a skeletal muscle. • Sketch the temporal relationship between AP in a cardiac muscle and the resulting contraction of that cell. • Explain why cardiac muscle cannot remain in a state of sustained (tetanic) contraction. • Contrast the sympathetic and parasympathetic nervous system influence on heart rate and cardiac excitation in general. Identify which arm of the autonomic nervous system is dominant at rest and during exercise. • Discuss ionic mechanisms of these effects on both working myocardium and pacemaker cells. • Explain how changes in sympathetic activity alter ventricular work, cardiac metabolism, oxygen consumption and cardiac output.	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	• Recognize the location of vasomotor center. • Enlist the different parts of vasomotor center and their functions • Draw, in correct temporal relationship, the pressure, volume, heart sound, and ECG changes in the cardiac cycle. Identify the intervals of iso-volumic- contraction, rapid ejection, slow ejection, iso-volumic relaxation, rapid ventricle filling, slow ventricular filling and atrial contraction. • Compare the various phases of ventricular systole and ventricular diastole. Contrast the relationship between pressure and flow into and out of the left and right ventricles during each phase of the cardiac cycle. • Analyze various cardiac events in relation to each other • Define ejection fraction and calculate it from end diastolic volume, end systolic volume, and/or stroke volume. • Predict the change in ejection fraction that would result from a change in a) preload, b) afterload, and c) contractility. • Draw a ventricular pressure volume loop and label the phases and events of the cardiac cycle (ECG, valve movement). • Describe the role of Starling's Law of the Heart in keeping the output of the left and right ventricles equal. • Describe the difference in the way changes in preload and changes in contractility influence ventricular force development. • Define preload and contractility. • Explain why ventricular end-diastolic pressure, atrial pressure and venous pressure all provide estimates of ventricular preload. • Explain why ventricular end-diastolic pressure provides the most reliable estimate.	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	• Explain how arterial pressure influences afterload. • Describe the impact of changes in preload, afterload, and contractility in determining cardiac performance. • Define the term dipole. Describe characteristics that define a vector. Describe how dipoles generated by the heart produce the waveforms of the ECG. • Describe the electrode conventions used by clinicians to standardize ECG measurements. Know the electrode placements and polarities for the 12 leads of a 12 lead electro-cardiogram and the standard values for pen amplitude calibration and paper speed. • Name the parts of a typical bipolar (Lead II) ECG tracing and explain the relationship between each of the waves, intervals, and segments in relation to the electrical state of the heart. • Explain why the ECG tracing looks different in each of the 12 leads. Correlate between vector and lead, type and locations of leads and principles for vector analysis. • Recognize the significance of waves, segments and intervals of ECG recording. • Describe the timing and causes of the four heart sounds. • Examine the Heart Sound on Pulmonary, Aortic, Mitral and Tricuspid areas • Record & Interpret normal ECG by placing all the chest and limb leads on an SP • Perform Cardiopulmonary resuscitation on a dummy according to the American Heart Association Guidelines	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	Clinical relevance: • Describe the expected auscultation sounds that define mitral stenosis, mitral insufficiency, aortic stenosis, and aortic insufficiency and their physiological basis. • Comprehend congenital heart diseases like Patent Ductus arteriosus and Tetralogy of Fallot. • Outline neural and humoral factors that influence their rate and significance of "overdrive suppression" and "ectopic pacemaker". • Discuss current of injury and describe how it alters the ST segment of the ECG. • Analyze the alteration in conduction responsible for most common arrhythmias: i.e., tachycardia, bradycardia, A V block, bundle branch block, flutter, and fibrillation • Discuss the basis of common cardiac arrhythmias and relate with ECG changes. • Explain the mechanism of myocardial injury during MI and its complications. • Explain the ECG changes in case of ischemia and differentiate them from changes in infarction. • Differentiate between anterior wall MI, lateral wall MI, inferior wall MI and Posterior wall MI based on the leads involved. • Enlist the types of abnormal heart sounds (murmurs) • Correlate the systolic and diastolic murmurs with valvular heart diseases like stenosis and regurgitation • Explain the mechanism of myocardial injury during MI • Explain the ECG changes in case of ischemia and differentiate them from changes in infarction. • Correlate the ECG changes from the onset of MI to its progression and identification of changes of old MI.		

	• Differentiate between anterior wall MI, lateral wall MI, inferior wall MI and Posterior wall MI based on the leads involved • Discuss the basis of common cardiac arrhythmias, process that produce them and their clinical significance. • Employ the concept of sinus arrhythmia and its clinical significance. • Compare between first degree, second degree, and third degree heart blocks based on pathophysiology and ECG changes. • Describe the basis of overdrive suppression and Stokes Adams attacks • Assess changes in ECG and cardiac function during common abnormalities in ionic composition of body fluids. • Differentiate between fibrillation and flutter based on ECG findings • Describe the significance of defibrillation in emergency cardiac situations	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva
Vascular system			
	Physiology: • Interpret the Law of Laplace. Describe how it applies to ventricular function in the normal and volume overloaded (failing) ventricle. • Extrapolate the relationship between pressure, flow, and resistance in the vasculature. Apply this relationship to the arteries, arterioles, capillaries, venules, and veins. • Apply Poiseuille's law to understand the flow in distensible blood vessels. • Correlate vascular resistance and conductance of blood vessels and association	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	of flow in series vs. in parallel on total resistance. • Compare turbulent and laminar flow, the concept of pressure gradient, resistance to blood flow and its significance. • Compare the physiologic anatomy of different types of blood vessels and their importance. • Discuss the Physiology of vascular compliance, changes in compliance of blood vessels with age & comparison b/w the compliance of arteries versus veins. • Identify the origin of arterial pressure pulse and its propagation to the peripheral arteries. • Describe the factors damping the arterial pulse and abnormalities of arterial pulse. • Correlate the right atrial pressure with the factors affecting venous return to heart • Correlate the venous resistance with Venous valves and muscle pump and gravitational forces with reference to varicose veins • Describe how the theory of metabolic regulation of blood flow accounts for active hyperemia and reactive hyperemia. • Identify the role of PO2, PCO2, pH, adenosine, and K+ in the metabolic control of blood flow to specific tissues. • Diagram the synthetic pathway for nitric oxide (EDRF, endothelial derived relaxing factor), including substrate and the interplay between endothelium and vascular smooth muscle. • Describe the role of angiogenesis in providing a long term match of tissue blood flow and metabolic need. • Identify the cell membrane receptors and second messenger systems mediating the contraction of vascular smooth muscle by norepinephrine, angiotensin II, and vasopressin.	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	• Identify the cell membrane receptors and second messenger systems mediating the relaxation of vascular smooth muscle by nitric oxide, bradykinin, prostaglandins, and histamine. • Describe the involvement of endothelial cells in the regulation of vascular diameter and inflammatory responses. • Describe triple response • Explain the determinants of cardiac output i.e. stroke volume output and Heart rate and factors affecting them. • Appreciate the mechanics of low & high cardiac outputs along with their effects on heart. • Comprehend the factors affecting stroke volume, heart rate and total peripheral resistance. • Understand Fick's principle for the measurement of cardiac output. • Understand the concept of "mean systemic filling pressure," its normal value, and how various factors can alter its value. • Define venous return. Understand the concept of "resistance to venous return" and know what factors determine its value theoretically, what factors are most important in practice. • Construct a venous return curve. Predict how changes in right atrial pressure and mean systemic filling pressure effect the venous return • Understand the principles underlying cardiac output measurements using the Fick, dye dilution, and thermos-dilution methods. • Contrast the local and neural control of cerebral blood flow. Discuss the relative	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	important of O2, CO2, and pH in regulating cerebral blood flow. • Describe the structural components of the blood brain barrier and how this barrier impedes the movement of gases, proteins, and lipids from the blood to neurons. • Contrast the mechanisms of the two major types of stroke, hemorrhagic and occlusive stroke • Describe blood pressure measurement with a catheter and transducer and explain the components of blood pressure waveform. • Contrast the direct and indirect estimation of blood pressure with a sphygmomanometer. • Given systolic and diastolic blood pressures, calculate the pulse pressure and the mean arterial pressure. • Describe how arterial systolic, diastolic, mean, and pulse pressure are affected by changes in a) stroke volume b) heart rate c) arterial compliance d) total peripheral resistance • Comprehend the determinants of arterial pressure, factors affecting and mechanisms regulating blood pressure on short and long term basis. • Understand mean arterial pressure and its significance. • Contrast the sympathetic and parasympathetic nervous system control of heart rate, contractility, total peripheral resistance, and venous capacitance • Explain the sequence of events in the following that occur after an acute increase or decrease in arterial blood pressure. Include receptor response, afferent nerve, and CNS integration, efferent to the SA node,	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

	ventricles, arterioles, venules, and hypothalamus baroreceptor reflex, CNS Ischemic response, Chemoreceptor reflex, Cushing reaction • Explain the sequence of events mediated by cardiopulmonary volume receptors that occur after an acute increase or decrease in arterial blood pressure. Include receptor response, afferent, CNS integration, efferent to the heart, kidney, hypothalamus, and vasculature. • Explain the role of renin-angiotensin-aldosterone mechanism with the help of a flowsheet diagram in regulation of BP at intermediate term • Explain the significance of pressure diuresis and pressure natriuresis in long term regulation of BP • Contrast the relative contribution of short- and long-term mechanisms in blood pressure and blood volume regulation. • Examine the Radial Pulse and comment on rate, rhythm and character • Record the Blood Pressure of a Subject using palpatory and Auscultatory Method • Record the effects of posture and Exercise on Blood Pressure	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva
	Clinical relevance: • Interpret the histomorphological changes in atherosclerosis, arteriosclerosis and Marfan`s Syndrome. • Correlate the common congenital anomalies of arterial and venous system with normal developmental process. • Tabulate WHO criteria for categorizing different types of hypertensions. • Compare primary and secondary hypertension. Enlist causes of both. • Explain Hypercholesterolemia in relation with pathophysiology of Atherosclerosis	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

Lymphoid organs			
	Physiology: • Describe the principles of capillary dynamics, structure of interstitium, Starling's forces for fluid exchange across the capillary membrane and factors affecting thereof. • Recognize the concept of starling's equilibrium, and how the interstitial space is kept dry • Explain the mechanism of formation of interstitial fluid, its composition and factors creating starling's disequilibrium leading to the development of edema. • Describe how histamine alters the permeability of the post capillary venules, and how the loss of albumin into the interstitial space promotes localized edema. • Explain how edema develops in response to: o venous obstruction, o lymphatic obstruction, o increased capillary permeability, o heart failure, o tissue injury or allergic reaction, and o malnutrition. • Identify Types of edema, their pathophysiology and safety factors preventing edema formation	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva
	Clinical relevance: • Explain the histological basis of tonsillitis. • Summarize different types of edema, and safety factors preventing edema formation.		
Heart Failure & Shock			
Analyze the physiological mechanisms underlying cardiac failure and various types of shock, and correlate their	**Physiology** • Differentiate between the factors causing hyper-effective and hypo effective heart. • Differentiate the mechanisms underlying compensated and uncompensated heart failure. • Explain stages of development of shock.	SGD/ LGIS / Practical/ SDL/ CBL Integrated session	MCQs, SAQs, SEQs, OSPE, Structured Viva

clinical presentations with the physiological basis for treatment and management.	• Differentiate compensated and uncompensated shock **Clinical Relevance** • Differentiate between right and left heart failure based on their pathophysiology and clinical manifestation. • Outline the physiology of treatment of cardiac failure • Outline the etiology, presentation and management of: o Hypovolemic shock		
	o Cardiogenic shock o Anaphylactic shock o Neurogenic shock o Septic shock		

PHYSIOLOGY PRACTICALS			
Record the Blood Pressure of a Subject using palpatory and Auscultatory Method	• Demonstrate the use of stethoscope • Identify various parts of sphygmomanometer and stethoscope • Demonstrate the palpatory & auscultatory methods of recording blood pressure • Record the arterial blood pressure by properly placing the cuff 2.5 cm above the cubital fossa and placing the stethoscope on the brachial artery on the medial side of biceps tendon. • Recognize the 4 types of Korotokoff sounds, theirphysiological basis and relevance to systolic and diastolic blood pressure **ATTITUDE** • Practice the art of taking consent from the subject/patient prior to performance of procedure. • Communicate the procedure effectively to the patient	Practical	OSPE

Perform Cardiopulmonary resuscitation on a dummy according to the American Heart Association Guidelines	**SKILLS** • Identify factors/indications for CPR • Perform CPR according to American Heart Association guidelines • Practice the art of giving compressions on both adult and infant manikins • Demonstrate the use of Ambu bag with mask	Practical	OSPE
Demonstrate the Triple Response	**SKILLS** Demonstrate the three stages of response of skin (its microvessels) to blunt mechanical injury • Proficiently elicit local axon reflex by carefully applying a stroke on the skin	Practical	OSPE
Record & Interpret normal ECG by placing all the chest and limb leads on an SP	**SKILLS** **Recording of ECG** • Practice the procedure to record ECG by placing appropriate chest and limb leads on appropriate points and by adjusting the speed and calibration of the ECG machine • Properly position the patient observing the required precautions during the recording of ECG • Obtain a 12 lead ECG recording with a long lead II for measurement of heart rate and identification of irregular rhythm • Identify normal ECG waves, complexes, segments and intervals • Assess cardiac axis, rhythm, origin of cardiac impulse (pace maker) and calculate heart rate from ECG • Categorize the conditions affecting the ECG recording • Identify bradycardia, tachycardia, and MI by examining the ECG **ATTITUDE** • Practice the art of taking consent and communicating with the patient prior to conducting ECG • Explain the procedure, reassure and communicate the precautions to be taken by the patient	Practical	OSPE

Examine the Radial Pulse and comment on rate, rhythm and character	**Skill Recording of arterial pulse** • Record the Radial artery pulse by placing three fingers on radial side of semi-pronated arm and counting for one minute. • Observe the volume, rhythm and character of the pulse • Compare the radial pulse with the carotid and femoral pulses and note any delay • Palpate the carotid and dorsalis pedis pulses **ATTITUDE** • Introduce yourself to the subject/patient prior to performance of procedure and take consent • Explain the procedure of conducting arterial pulse measurement to the patient	Practical	OSPE
Examine the Heart Sound on Pulmonary, Aortic, Mitral and Tricuspid areas	**SKILLS** **Auscultation of heart** • Properly expose and position a subject and identify the different cardiac areas for auscultation of mitral, tricuspid, pulmonary and aortic valves • Demonstrate the auscultation of heart sounds by proper use of stethoscope • Differentiate between first and second heart sounds • Appraise the physiological basis of various heart sounds • Demonstrate the location and palpation of apex beat on precordium • Recognize the displacement of apex beat and its relevance to diseases of heart	Practical	OSPE
Determination of JVP	• Measure the JVP of simulated patient using an appropriate clinical method.	Practical	OSPE
Record the effects of posture and Exercise on Blood Pressure	**Measurement of arterial blood pressure** • Record the arterial blood pressure by properly placing the cuff 2.5 cm above the cubital fossa and placing the stethoscope on the brachial artery on the medial side of biceps tendon. • Record the effects of changing posture and performing standard exercise on blood pressure **ATTITUDE** • Practice the art of taking consent from the subject/patient prior to performance of procedure. • Communicate the procedure effectively to the patient	Practical	OSPE

PROPOSED LINKERS	
Thoracic wall & Mediastinum	Trauma to thoracic wall
Heart	Chest pain, Arrhythmias, Cyanotic Heart disease
Vascular System	Hypertension
Lymphoid organs	Edema
Fetal period & Placental Circulation	Intra Uterine Growth Retardation, Placenta Previa, Oligohydramnios, Polyhydramnios
Heart Failure & Shock	CCF, Shock

MBBS YEAR I
BLOCK III
MODULE V
Respiratory system
Duration: 04 weeks

Preamble

One of the unfortunate gifts of industrialization is varied respiratory illnesses. However, high prevalenceof chronic respiratory diseases, mortality and morbidity associated with it is a burden that is not limitedto affluent countries. According to a lancet report, nearly 545 million of world population (7.4% of world's population) suffers from chronic respiratory condition. However, disability remains highest in our part of the world (South Asia), where premature mortality from chronic respiratory diseases is highest! Risk factors for men include air pollution, cigarette and sheesha smoking causing rise in COPDcases. Amongst women, exceptions exist, as household air pollution from solid fuels and ambient particulate matter are the were the leading cause. Genetics also play a part in diseases like asthma, sarcoidosis, interstitial lung diseases. However, certain lifestyle and behavioral modifications can overcome genetic and environmental factors improving the morbidity. Therefore, a firm understandingof the respiratory system is very important for undergraduate students so that they can manage thesediseases in clinical settings reducing disease burden in society.

This module focuses on respiratory system along with knowledge of Bioenergetics and Biological Oxidation and Vitamin. The research methodology will be taught as a part of the longitudinal theme.

Apart from attending daily scheduled sessions, students should engage in self-directed learning to achieve the desired objectives

Module Learning outcomes:

By the end of this module, students should be able to:

1. Integrate the anatomical knowledge of respiratory systems with their physiological and biochemical basis to interpret the presentation of common clinical conditions related to respiratory tract.
2. Correlate the development of body cavities and diaphragm with the common congenital anomalies

Learning Outcomes	Subject Learning Outcomes	Teaching & Learning Strategies	Proposed Assessment Strategies
At the end of this module, students will be able to:			
Diaphragm & Pleura (Pneumothorax, Pleurisy, Congenital Diaphragmatic Hernia)			
Correlate the anatomy of diaphragm, pleura, ribs and sternum with its functions and biochemical basis in normal and disease state.	**Physiology** • Discuss the respiratory and non-respiratory functions of respiratory system. • Summarize the mechanism of cough and sneeze reflex • Discuss functions of respiratory muscles and their role in quiet and forceful respiration. • Correlate various pressures acting on lungs and chest wall. • Interpret the change in alveolar, intra-pleural and trans-pulmonary pressures during each phase of respiration. **Pulmonary Compliance** • Explain lung and chest wall compliance. • Discuss the composition & role of surfactant in alveolar surface tension. • Comprehend the concept of work of breathing. **Lung volumes and capacities** • Correlate static & dynamic lung volumes/capacities with the help of normal spirogram **Chemical and neural regulation of respiration** • Explain different group of neurons composing respiratory center. • Discuss Hering-breuer reflex. • Discuss the regulation of respiration by interplay of central & peripheral chemoreceptors	SGD, LGIS & CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva

	Clinical Relevance: • Correlate the anomalies of ventral body wall and diaphragm with normal development • Explain the clinical scenario related to diaphragmatic hernia and phrenic nerve lesions with anatomical reasoning • Explain the embryological basis of Vertebral defects (Klippel-Feil Syndrome, Spina bifida, Chordoma, variations in number of vertebrae, Hemivertebrae, Rachischisis), Rib defects (Accessory ribs, Fused ribs, Cervical rib) and Defects of sternum • Justify anatomical basis of referred shoulder tip pain in diaphragmatic irritation. • Recognize signs, symptoms and radiological findings of pleural effusion, pneumothorax, empyema and hemothorax. • Discuss pathophysiology of acute respiratory distress syndrome in infants. • Differentiate between obstructive & restrictive lung diseases based on spirometry • Correlate the biomedical significance of Phospholipids in Acute Respiratory Distress Syndrome (ARDS) • Discuss the clinical significance of Phospholipids (Paroxysmal nocturnal hemoglobinuria, Niemann pick disease, role of phospholipases in poisoning)	Integrated sessions/CBL/LGIS	MCQs, SAQs, SEQs, OSPE, Structured Viva

Lungs			
Relate the anatomical structures and physiological functions of lungs, to its clinical significance	**Physiology** **Pulmonary Circulation** • Differentiate between pressure in systemic and pulmonary circulation. • Appraise the dynamics of fluid exchange across lung capillary membranes. • Discuss safety factor in prevention of pulmonary edema • Describe the pulmonary blood flow in three zones of lung **Principles of gas exchange and gas laws** • Explain concept of partial pressure gradients and their effect on gas exchange	LGIS, SGD,	MCQs, SAQs, SEQs, OSPE, Structured Viva
	on the basis of Fick's law, Boyle's law, Dalton's law and Henry's law. • Explain the basis of differences in partial pressures of alveolar and atmospheric air. • Describe the renewal of alveolar air. • Discuss the factors affecting gas diffusion through respiratory membrane **Dead Space** • Discuss effect of dead space on alveolar ventilation • Associate the changes in respiratory membrane in common respiratory diseases **Ventilation perfusion Ratio** • Explain ventilation perfusion ratio in light of physiological dead space and shunt in all zones of lungs • Comprehend the concept of respiratory quotient	LGIS, SGD,	MCQs, SAQs, SEQs, OSPE, Structured Viva

	Clinical Relevance: • Describe the mechanism of development of pulmonary edema and pleural effusion. • Associate how ventilation perfusion ratio changes in various common respiratory diseases	Integrated session/LGIS/CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva
Oxygen & Carbon dioxide transport (Carbon Monoxide Poisoning)			
Compare the different modes of gas transport in blood (oxygen and carbon dioxide) and correlate with the biochemical aspect of gaseous exchange	**Physiology** • Appraise the mechanism of oxygen transport in the arterial blood. • Discuss the role of Hb in oxygen transport, keeping in view oxygen-hemoglobin dissociation curve and how this curve shifts in various conditions. • Discuss the various chemical forms in which CO2 is transported in blood. • Interpret the normal CO2 dissociation curve in relevance with Haldane, Bohr effect and chloride shift.	LGIS, SGD, Practical	MCQs, SAQs, SEQs, OSPE, Structured Viva
	• Describe the structure of Hemoglobin and Myoglobin • Elaborate the globin gene organization • Discuss various types of Hemoglobin and explain its functions in detail • Correlate the Oxygen binding capacity of hemoglobin and myoglobin with reference to the O2- Hb dissociation curve • List various factors affecting and regulating the oxygen binding capacity of hemoglobin	LGIS, SGD, Practical	MCQs, SAQs, SEQs, OSPE, Structured Viva
	Clinical Relevance: • Explain the clinical disorders related to oxygen-Hb binding capacity (Carbon Monoxide Poisoning, Cyanide poisoning and Methemoglobinemia)	Integrated session/LGIS/CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva

Abnormal breathing patterns			
Analyze the physiological and biochemical mechanisms underlying abnormal breathing patterns, hypoxia, and hypercapnia and appraise the role of hyperbaric oxygen therapy in different respiratory diseases	**Physiology** **Abnormal breathing patterns** • Identify and discuss different factors causing abnormal breathing patterns (irritants, brain edema, anesthesia) **Hypoxia and hyperbaric oxygen therapy** • Discuss various types of hypoxia, their effects and role of oxygen therapy (hyperbaric oxygen therapy). • Summarize cyanosis and dyspnea • Discuss hypercapnia & its association with various forms of hypoxia	LGIS, SGD	MCQs, SAQs, SEQs, OSPE, Structured Viva
	Clinical relevance • Discuss pathogenesis and clinical features of obstructive lung diseases (Chronic Bronchitis, Asthma, Emphysema; Bronchiectasis) • Comprehend the concept of Cheyne-Stokes breathing • Discuss pathophysiology of sleep apnea. • Elaborate the biochemical basis of emphysema • Discuss the causes and pathophysiology of pneumonia and TB • Summarize pathogenesis and clinical features of different obstructive & restrictive lung diseases • Summarize the role of hyperbaric oxygen therapy in different respiratory diseases	Integrated session/LGIS/CBL	MCQs, SAQs, SEQs, OSPE, Structured Viva

Examine respiratory system on an SP in a proper sequence of inspection, palpation, percussion and auscultation	Examine respiratory system on an SP in a proper sequence of inspection, palpation, percussion and auscultation	Practical	OSPE/ Structured Viva
Study the spirometer and operate the instrument Record the lung volume and capacities by using Student's Spirogram	Identify parts of Spirometer and its uses Record Tidal Volume, Inspiratory Reserve volume, and Expiratory reserve volume, vital capacity by using Student's spirometer and Kymograph and label it Record the forced expiratory Volume by using Student's spirometer and Kymograph and label it Calculate & interpret the FEV1/FVC ratio	Practical	OSPE/ Structured Viva
Measure Peak Expiratory Flow Rate (PEFR) and report the reading	Measure Peak Expiratory Flow Rate (PEFR) by Wright's peak expiratory flow meter	Practical	OSPE/ Structured Viva
Analyze respiratory acidosis and respiratory alkalosis with the help of Arterial Blood Gases (ABG) report	Interpret ABG reports to diagnose respiratory acidosis and respiratory alkalosis	Practical	OSPE/ Structured Viva

Linkers of Integrated Session;

PROPOSED LINKERS	
Diaphragm & Pleura	Pneumothorax, Pleurisy, Congenital Diaphragmatic Hernia
Lungs	Bronchogenic Carcinoma
Oxygen & Carbon dioxide transport	Carbon Monoxide Poisoning
Abnormal breathing patterns	Hypoxia

MBBS YEAR I
BLOCK III
MODULE VI
MUSCULOSKELETAL SYSTEM – II
Duration: 05 weeks

Block- III
Module - VII
MUSCULOSKELETAL SYSTEM II

Integrated Learning Outcome	Subject Learning Outcomes	Teaching & Learning Strategies	Proposed Assessment Strategies
At the end of this module, students will be able to:			
Adjustment of Biomechanics in Human Body in unusual environment (Acute mountain sickness, Electrolyte Imbalance)			
Relate the effect of unusual environments on human body	**Physiology** • Compare the physiological basis of high altitude acclimatization in natives & nonnatives • Elucidate the effects of G forces and microgravity on the body • Discuss the effects of increased pressure on deep sea divers. • Explain the functioning of SCUBA diving **Clinical Relevance** • Interpret O2 and CO2 toxicity occurring at high pressures in sea depth • Compare and contrast acute and chronic mountain sickness (HACE & HAPE) • Discuss the pathophysiology of Caissons disease • Discuss different modes of artificial respiration	LGIS, SGD,	MCQs, SAQs, SEQs, OSPE, Structured Viva

Learning Outcome	**Learning Objectives**	Instructional strategy	Assessment
Record the effects of Exercise on Blood Pressure	**Measurement of arterial blood pressure** • Record the effects of performing standard exercise on blood pressure **ATTITUDE** • Practice the art of taking consent from the subject/patient prior to performance of procedure. • Communicate the procedure effectively to the patient	Practical	OSPE

Linkers of Integrated Sessions

PROPOSED LINKERS	
Bone & Muscle Energy Metabolic System	Muscle fatigue
Lungs Adjustment of Biomechanics in Human Body in unusual environment	Acute mountain sickness, Electrolyte Imbalance

Sample Questions

Multiple Choice Questions

- Select the most suitable option in the following MCQs

23-year-old child has hyperlipidemia and his investigations carried out at a tertiary care hospital revealed deficiency of hexoseaminidase-A enzyme and abnormal deposition of triglycerides in his liver and spleen. Which cellular organelle is most likely affected in this child?

a) Endoplasmic reticulum
b) Golgi apparatus
c) Lysosomes
d) Perosisomes

An individual is bitten by a dog with rabies and begins to develop antibodies against the rabies. These antibodies are harvested and transferred to unimmunized individuals to confer protection more rapidly for these individuals. This is an example of:

a)Active immunity
b)Passive immunity
c)Natural immunity
d)Acquired immunity

Structured Answer Question:

Question:

A 28-year-old woman presents with complaints of progressive muscle weakness, especially towards the evening. She reports difficulty in keeping her eyelids open and chewing food after prolonged activity. Her symptoms improve after rest. On examination, she has bilateral ptosis and fatigable weakness of facial muscles. A provisional diagnosis of Myasthenia Gravis is made.

a) What is the most likely disease she is suffering from? Also, describe the underlying pathophysiology of this condition. (2 marks)

b) List three diagnostic tests and briefly mention the role of acetylcholinesterase inhibitors in treatment. (3 marks)

Key:

a) **Diagnosis:** Myasthenia Gravis
Pathophysiology: Autoimmune destruction or blockage of acetylcholine receptors at the neuromuscular junction, leading to impaired synaptic transmission and muscle weakness.

b) Diagnostic tests (any 3):

- Anti-acetylcholine receptor antibody test
- Electromyography (EMG) with repetitive nerve stimulation
- Edrophonium (Tensilon) test
- Chest imaging to check for thymoma

- **Role of acetylcholinesterase inhibitors:**
  - They inhibit the breakdown of acetylcholine, increasing its availability at the neuromuscular junction, thereby improving muscle strength.

Objectively Structured Practical Examination (OSPE)

Unobserved OSPE station

Marks: 2 **Time Allowed: 1 min**

a) What lung function test can be performed by using this apparatus? 1 mark
b) Give two physiological factors that affect this lung function? 1 mark

Observed Station

Marks: 04 Time Allowed: 04 minutes

For Candidate:

Task:

Focus a lymphocyte under the microscope using the slide of blood smear provided. 04

Observed Station 1

Marks: 04 Time Allowed: 04 minutes

For Examiner:

Key:

1. Switches on the power supply of the microscope and fixes the slide on the stage of microscope. 0.5
2. Look at the slide first under low power and then under high power. 01
3. Uses the coarse and fine adjustment knobs correctly to focus the lymphocyte 01
4. Uses cedar wood oil for focusing at 100X. 0.5
5. Identifies and focuses a lymphocyte correctly. 01

Recommended and Reference Books

1. Guyton and Hall Textbook of Medical Physiology, 14th edition

2. Ganong's Review of Medical Physiology, 26th edition

3. Human Physiology: From Cells to System by Lauralee Sherwood, 9thedition

4. Berne and Levy Physiology by Bruce M. Koeppen and Bruce A. Stanton,7th edition,

5. Essentials of Medical Physiology by Jaypee Brothers. 7th Ed