

**CMH LAHORE MEDICAL COLLEGE AND IOD**



# **PHYSIOLOGY**

**STUDY GUIDE**

**FIRST YEAR MBBS**

**2022**

**Submitted by**

**Department of Physiology  
CMH Lahore Medical College and IOD**

**TABLE OF CONTENTS:**

Vision statement of NUMS.....	3
Mission statement of CMH LMC and IOD.....	4
Introduction to the department.....	5
List of Faculty.....	6
Introduction to the study guide.....	7
Why study guide.....	7
This study guide provides.....	7
Teaching and learning methods.....	7
Distribution of Modules and Topics.....	10
Table of specifications for examinations.....	11
Standard Operating Procedures for tests.....	13
List of fine and penalties: .....	14
Learning resources.....	15
Competencies focused in 1 <sup>st</sup> Year MBBS.....	16
Learning outcomes for overall 1 <sup>st</sup> year MBBS .....	17
Breakdown of topics.....	18
Academic calendar.....	19
Learning outcomes.....	20
Module I.....	20
Module II.....	24
Module III.....	28
Frequently asked questions.....	33
Examples of MCQs, PBQs.....	35

## VISION STATEMENT OF NUMS



The vision of National University of Medical Sciences is to improve the quality of life through education, research, innovation, and healthcare, thereby, contributing to endeavors to make Pakistan and this world better place to live in.

## MISSION STATEMENT OF CMH LMC and IOD



To provide an excellent learning and teaching environment, inculcating ethical values and social responsibilities in undergraduate and postgraduate medical & dental students and nursing & allied health sciences students to enhance the level of comprehensive healthcare in the Army/Country.

## **INTRODUCTION TO THE DEPARTMENT OF PHYSIOLOGY**

The Physiology Department was founded by Prof. Dr. Shahid Hasan, who under his able guidance encouraged faculty members to pursue post-graduate studies and inculcated a strong research culture in the department. This department made a steady and noteworthy progress since the inception of this collage, and played a major role in bringing the college to its present day outstanding ranking by Pakistan Medical and Dental Council.

The department is now headed by Prof. Dr. Farida Hafeez. Along with her, there is a team of experienced teachers who provide a strong learning and teaching environment for the students, not only in the field of academics, but also in research. The department has a library and a fully functional laboratory, complete with the modern data acquisition units such as BIOPAC and PowerLab. The laboratory can cater for the needs of undergraduate as well as post graduate students. The department is recognized by the National University of Medical Sciences for undergraduate MBBS and BDS classes. Additionally, this department is also recognized for classes of Doctor of Physiotherapy, Diploma in Medical Imaging and Bachelor of Science in Nursing by their relevant accreditation bodies. Recently, the department was recognized by the College of Physicians and Surgeons for FCPS in the subject of Physiology.

## LIST OF FACULTY

Dr. Farida Hafeez (Prof. and HoD)  
Dr. Ambreen Tauseef (Professor)  
Dr. Huma Saeed Khan (Assoc. Prof.)  
Dr. Farhat Ijaz (Assoc. Prof.)  
Dr. Qudsia Umaira Khan (Assoc. Prof.)  
Dr. Amna Nadeem (Senior Lecturer)  
Dr. Ayesha Khalid (Lecturer)  
Dr. Aamina Quddus (Lecturer)  
Dr. Sarah Saad (Lecturer)  
Dr. M. Aftab Toor (Lecturer)  
Dr. Azeem Khaliq (Lecturer)  
Dr. Sonia (Lecturer)

### WHO TO CONTACT:

Dr. Farhat Ijaz is the class coordinator for 1<sup>st</sup> Year MBBS. Students can contact her for any query during office hours.

Each module for 1<sup>st</sup> Year MBBS shall be taught by subject teachers as mentioned in the course schedule. Tutors will be assigned for the entire duration of a module. However, teachers assigned for small group discussions will change periodically to have a more homogenous exposure of all students with all teachers.

Subject teachers, tutors and practical demonstrators can be approached any time by any student to clarify their queries.

Additionally, Prof. Dr. Farida Hafeez may be contacted by any student.

## INTRODUCTION TO THE STUDY GUIDE

### Why Study Guide?

This study guide has been prepared for students of first year MBBS to:

- a. Inform the students about how the whole year has been broken up into three modules.
- b. Appraise the students on the teaching and learning modalities that will be used in these modules.
- c. Provide a frame work in the form of academic calendar to help students to organize their year.

### This study guide provides:

- a. Information on organization of each module. This will help the student to contact the right individual in case of a difficulty.
- b. A list of the module learning objectives.
- c. A break up of learning and teaching methods.
- d. A description of the learning resources such as recommended books.
- e. Information on the calculation and impact of internal assessment (continuous assessment throughout the year) on the overall score of a student.
- f. Information on the methods of assessment (PBQs, SEQs, MCQs and OSPE etc.)
- g. Information on examination policy, rules and regulations.

### Teaching and learning methods:

The following teaching / learning methods/strategies are used to promote learning:

#### 1. Lectures:

These are traditional teaching modalities. However, it is emphasized that these are not just didactic; instead these are more interactive with focus on active learning strategies.

#### 2. Tutorials:

These take place in four groups of 35 students each. A tutorial teacher is assigned to each group for ease of discussion and concept building. In 1<sup>st</sup> year MBBS, the assigned days for tutorial are Thursday and Friday.

#### 3. Small Group Discussions:

These happen at least 4 times in each module. Students are asked to hold discussions with peers and teachers in groups of 20 students each. Topics important from an examination point of view are covered and discussed to clarify any misconceptions.

#### 4. Practicals:

These take place in three groups of 50 students each. There is a demonstration to explain the steps of procedure and then the group is further subdivided into smaller groups of 15-17. Three faculty members accompany the students throughout the practical. Students are required to follow all laboratory SOPs as long as they are in the laboratory. All SOPs are displayed clearly in the Physiology Laboratory. In 1<sup>st</sup> year MBBS the assigned days for practicals are Monday to Thursday.

**5. Self-Study:**

Students are communicated certain study objectives and they take responsibility of their own learning. This is achieved by studying the prescribed text book, and holding discussions with class fellows. There is a dedicated self-study time that has to be utilized within and outside the college.

**6. Seminars and symposia:**

The department organizes seminars and symposia from time to time. Students can present their research papers in these seminars. An inter class and an intra class presentation competition is also conducted in these symposia.

**7. Online Activities:**

CMH Lahore Medical College has a fully functional Learning Management System. It is utilized for sharing video lectures, study resources such as books and PowerPoints of lectures, online quizzes and submission of assignments.

**8. Problem-Based Learning:**

This is a small group activity in which the discussion revolves around a real life problem. It is based on the Seven Jump process. Students are expected to consult their books, or reliable internet resources to develop a better understanding of a topic in a more integrated manner. (fig. 1 and 2)

### WHAT IS PROBLEM-BASED LEARNING

It is a method of learning in which learners (students) in small groups first encounter a problem, which are close to real life situations. The problem is generally discussed in two sessions.

#### FIRST SESSION:

Learners in small groups, using existing knowledge, discuss (in the presence of a tutor) and list what they do not know or are not sure of, about the problem. The list is known as learning issues (goals).

#### SELF-STUDY:

Learners have approximately three days' time to report. During this time, learners search for new information required to achieve the learning goals listed. In this process, learners are encouraged to consult various learning resources in addition to the textbooks. This does not require a tutor.

#### SECOND SESSION:

Learners discuss learning issues and application of new knowledge to the problem and summarize by integrating prior and new knowledge in understanding the problem.

**Fig. 1. What is Problem Based Learning (AMEE Medical Education Guide No. 15: Problem-based learning: a practical guide)**



- (1) Students, working in a group, clarify the text of the problem scenario
- (2) Students define the problem
- (3) Brainstorming is used to identify explanations for phenomena observed in the problem scenario
- (4) The group reaches interim conclusions about the problem
- (5) The group formulates the learning objectives
- (6) Students work independently to achieve the learning outcomes
- (7) The student group reconvenes to discuss the knowledge acquired

**Fig. 2. Seven jumps in PBL (AMEE Medical Education Guide No. 15: Problem-based learning: a practical guide)**

**POINT TO REMEMBER**

**75 % ATTENDANCE IS MANDATORY FOR ALL STUDENTS**

## DISTRIBUTION OF BLOCKS AND TOPICS

The National University of Medical Sciences follows a modular integrated teaching system. The course of First Year MBBS is divided into 3 blocks & each having an examination at the end.

Blocks	BLOCK-I 13 +1= 14 weeks					BLOCK-II 9+1= 10 weeks		BLOCK-III 9+1= 10 weeks		
Duration	02 wee ks	02 wee ks	06 weeks	03 Wee ks	1 w k	9 weeks	1 w k	04 Weeks	05 Week s	1 w k
Modules	Foundatio n I	Cell Structure & Function	MSK - I	Haem & Immunolo gy	E O B	Cardiovascul ar System	E O B	Respiratory system	MSK II	E O B
Disciplines	Anatomy, Physiology, Biochemistry, relevant clinical disciplines									
Across theyear	Behavioral Sciences, Research Methodology and Islamiat									

**Fig. 3. Distribution of Blocks and topics as per NUMS guidelines.**

## STANDARD OPERATING PROCEDURES FOR TESTS

During all departmental tests, students are expected to follow the given SOPs:

1. Uniform: All students must be in the proper college uniform and must bring their own stationary.
2. Seating arrangement: The Faculty members shall decide the seating arrangement as instructed by the hall in-charge. Students will not be allowed to have a seating arrangement based on personal preferences.
3. Entry in the examination hall: Candidates must ensure that they are seated in the examination hall 5 minutes before the appointed time. Candidates who come after the first 10 minutes will not be allowed to take the examination.  
Candidates will use only the front door of the lecture halls for entry/exit. The back door will be kept closed under all circumstances due to security reasons.
4. Since the question paper will be designed properly, leaving no room for any ambiguity, hence the candidates will not be allowed to communicate with any invigilator.
5. Students must switch off their mobile phones or keep those on silent mode prior to the start of the examination. Smart watches are also not allowed.
6. All bags, books and reading materials must be kept on the tables provided in the lecture hall.
7. No one will be allowed to leave the hall before the completion of the examination. Visits to the washroom will also not be allowed given the short duration of the examination.
8. Any student found using any unfair means will be severely reprimanded liable to cancellation of the examination.

**ANY STUDENT FOUND CHEATING WILL BE REPORTED TO THE  
COLLEGE DISCIPLINARY COMMITTEE IMMEDIATELY**

**STUDENTS WHO MISS PHYSIOLOGY CLASSES DUE TO TESTS IN OTHER  
SUBJECTS WILL BE DEBARRED FROM MODULE EXAMS**

**THERE WILL BE NO RE TAKE OF THE MODULE EXAMS UNLESS  
APPROVED BY MEDICAL EDUCATION DEPARTMENT**

**LIST OF FINE AND PENALTIES:**

In addition to the college policy on smoking, addiction and behavior, the following fines are implemented in all Physiology classes:

1. Rs. 1000/- for coming late in the 1st Lecture.
2. Rs. 2000/- for absenting from 1st Lecture / any single lecture
3. Rs. 3000/- Absent for one day
4. Rs. 1000/- for using mobile during the class / lecture unless otherwise asked by teacher to Google the disease / syndrome.
5. For improper dress, Rs. 500/- will be fined.
6. For any other discipline issue, fine may be charged as imposed by the competent authority.

**LEARNING RESOURCES:**

The following text books are recommended:

1. Text Book of Physiology, Guyton & Hall
2. Physiology by Linda Constanzo
3. Human Anatomy & Physiology by Elaine Marieb
4. Review Physiology by William. F. Ganong
5. Physiology by Dr. Mushtaq Ahmed
6. Text Book of Physiology by JAYPEE

For practical classes:

Manual of Practical Physiology by Brig. Mazhar Hussain.

Online study resources may be communicated to the students from time to time by the faculty members.

**REMEMBER**

**GUYTON AND HALL IS A VERY DETAILED BOOK. IT IS THE BEST BOOK FOR MAKING A CONCEPT IN THE SUBJECT OF PHYSIOLOGY**

**YOU WILL NEED TO STUDY IT REGULARLY. IT CANNOT BE CRAMMED UP A FEW DAYS BEFORE THE EXAM.**

**STUDY FROM IT, HIGHLIGHT IT, NOTE IMPORTANT POINTS, ADD SUMMARY POINTS ON SMALL STICKY NOTES AND IT WILL BE GOOD TO REVISE AT THE END**

### **COMPETENCIES FOCUSED IN 1<sup>ST</sup> YEAR MBBS**

1. Medical Knowledge
2. Problem solving
3. Procedural skills
4. Communication skills
5. Empathy
6. Professionalism
7. Leadership and Management skills
8. Research skills

**LEARNING OUTCOMES FOR OVERALL 1<sup>ST</sup> YEAR MBBS COURSE**

By the end of 1<sup>st</sup> Year MBBS, students should be able to:

1. Correlate the developmental and anatomical knowledge of cell, hematology, immunology, nerve, muscle, bone, cardiovascular and respiratory systems to their physiological and biochemical basis.
2. Perform basic examination skills related to basic concepts addressed
3. Apply the fundamental concepts to improve interpersonal communication
4. Use principles of effective learning for metacognition being a self-learner
5. Appraise the value of historical development regarding illness from ancient times to the present.
6. Develop the basic tenets of leadership and team work
7. Analyze multiple perspectives of ethics, Islamic and Pakistan studies
8. Discuss the basic principles of research

## BREAKDOWN OF TOPICS

	<b>Topic</b>	<b>Teacher Name</b>
<b>Block – I</b>	<b>Cell Physiology</b>	Dr. Sarah Saad
	<b>Nerve &amp; Muscle</b>	Prof. Dr. Ambreen Tauseef
	<b>Blood Physiology</b>	Dr. Farhat Assoc. Prof.
<b>Block – II</b>	<b>Heart</b>	Prof. Dr. Farida Hafeez
	<b>Circulation I</b>	Dr. Huma Assoc. Prof.
<b>Block – III</b>	<b>Circulation II</b>	Dr. Huma Assoc. Prof.
	<b>Respiration</b>	Dr. Qudsia Assoc. Prof.
	<b>High altitude and deep sea Physiology</b>	Dr. Amna Nadeem



**ACADEMIC CALENDER FOR THE YEAR 2022**

Weeks	Details	Dates	
		From	To
	Start of Class	14 Feb 2022	
	Principal Address / Orientation	14 Feb 2022	20 Feb 2022
1-2	Block I (2/11 Weeks)	21 Feb 2022	06 Mar 2022
3	<b>Sports Week (Tentatively)</b>	<b>07 Mar 2022</b>	<b>13 Mar 2022</b>
4-11	Block I (8/11 Weeks)	14 Mar 2022	08 May 2022
	<b>Pakistan Day (Holiday)</b>	<b>23 Mar 2022 (Wed)</b>	
	<b>Eid ul Fitr (Tentatively)</b>	<b>03-05 May 2022 (Tue-Thu)</b>	
12	<b>Block I Exam (1/10 Week)</b>	<b>09 May 2022</b>	<b>15 May 2022</b>
	Anatomy (Written & Viva)	09 May 2022 (Mon)	
	Biochemistry (Written & Viva)	11 May 2022 (Wed)	
	Physiology (Written & Viva)	13 May 2022 (Fri)	
13-16	Block II (4/9 Weeks)	16 May 2022	10 June 2022
17-21	<b>Summer Vacations (5x Weeks)</b>	11 June 2022	17 July 2022
22-25	Block II (4/9 Weeks)	18 July 2022	14 Aug 2022
	<b>Ashura (Tentatively)</b>	<b>08-09 Aug 2022 (Mon-Tue)</b>	
26	<b>Block II Exam (1/9 Weeks)</b>	<b>15 Aug 2022</b>	<b>21 Aug 2022</b>
	Anatomy (Written & Viva)	15 Aug 2022 (Mon)	
	Biochemistry (Written & Viva)	17 Aug 2022 (Wed)	
	Physiology (Written & Viva)	19 Aug 2022 (Fri)	
27-35	Block III (9/10 weeks)	22 Aug 2022	23 Oct 2022
36	<b>Block III Exam (1/10 weeks)</b>	<b>24 Oct 2022</b>	<b>28 Oct 2022</b>
	Anatomy (Written & Viva)	24 Oct 2022 (Mon)	
	Physiology (Written & Viva)	26 Oct 2022 (Wed)	
	Biochemistry (Written & Viva)	28 Oct 2022 (Fri)	
37	<b>Send Up Prep Leave (1x week)</b>	<b>29 Oct 2022</b>	<b>06 Nov 2022</b>
38-39	<b>Send Up Exam</b>	<b>07 Nov 2022</b>	<b>18 Nov 2022</b>
	Anatomy	07 Nov 2022 (Mon)	
	Biochemistry	10 Nov 2022 (Thu)	
	Physiology	14 Nov 2022 (Mon)	
	Send-Up Exam OSPE	15 Nov 2022	17 Nov 2022
40-44	Prep Leave NUMS Annual Exam (31x days)	18 Nov 2022	18 Dec 2022
	<b>NUMS Annual Exam</b>	<b>19 Dec 2022 onwards</b>	

## MODULE I

<b>Summary: Code</b>	<i>Y1M1 (year 1 module 1)</i>
<b>Name</b>	<b><i>Physiology</i></b>
<b>Duration</b>	<i>10 weeks</i>
<b>Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)</b>	Introduction 2. Cells and genetics 3. Blood 4. Loco motor (Upper limb)
<b>Subject Themes</b>	Cell, transport and general physiology + Genetics Nerve and membrane potential Muscle physiology Blood Immunity
<b>Prerequisite Module</b>	None
<b>Mode of Information Transfer (MIT)</b>	
Lectures	
Tutorials (PTT)	
CBL	
Practicals	
Class tests	

## PHYSIOLOGY LEARNING OUTCOMES MODULE I

Homeostasis	Recognize the interplay of various organ systems in maintaining homeostasis. Identify the role of feedback mechanisms (positive, negative, feed forward) in maintaining 'internal milieu'. Differentiate between composition of intracellular and extra cellular fluid
Cell and genetics	Revisit the structure and function of the cell and its organelles (cell Membrane, cytoplasmic organelles, nuclear membrane, nuclear organelles) Distinguish various ways of food processing within a cell (ingestion, digestion, synthesis, extraction of energy from nutrients) Recall movements of cells (amoeboid, ciliary, flagellated) Explain the process of protein synthesis (transcription and translation) Classify various modes of transport of substances across the cell-membrane

	<p>Compare and contrast modes of transport of substances across the cell-membrane with examples (osmosis, diffusion, facilitated diffusion, primary active transport, secondary active transport)</p>
Blood and related disorders	<p>Differentiate between various types of blood cells on the basis of their morphological and physiological characteristics.</p> <p>Overview sites of hemopoiesis in the body during different stages of life along with composition and functions of bone marrow.</p> <p>Identify the factors regulating erythropoiesis and maturation of RBCs.</p> <p>Appreciate the composition of blood and general functions of blood.</p> <p>Relate the morphology and physiology of different types of hemoglobin with hemoglobinopathies</p> <p>Compare and contrast different types of anemia on the basis of etiology, pathophysiology, clinical presentations and blood picture.</p> <p>Describe etiology, pathophysiology and clinical presentation of polycythemia.</p> <p>Relate the morphology and physiology of different WBCs with clinical presentations of leucopenia, leukocytosis and leukemia.</p> <p>Appraise the clinical significance of reticuloendothelial system.</p> <p>Describe pathophysiology of inflammation and necrosis</p> <p>Describe the physiological basis of vaccination.</p> <p>Identify role of cells and proteins involved in the process of maintaining hemostasis.</p> <p>Differentiate between intrinsic and extrinsic regulations of blood coagulation</p> <p>Discuss the morphology, etiology, pathophysiology and clinical presentation of thrombocytopenia, thrombocytosis and hemophilia</p> <p>Explain the principles of blood grouping keeping in view their physiological significance.</p> <p>Identify the various blood groups and hazards of matched and mismatched blood transfusion with especial reference to Erythroblastosis fetalis.</p>
Nerve and muscle	<p>Appraise basis of development of membrane potential across excitable membrane.</p> <p>Recognize Nernst potential and its importance in generation of membrane potential.</p> <p>Identify various factors/mechanisms responsible for the genesis of membrane potential (role of channels, carrier proteins, stimuli).</p> <p>Illustrate different phases of action potential mentioning details of ionic changes occurring during each phase of action potential.</p> <p>Distinguish types and importance of refractory period.</p> <p>Differentiate between myelinated and non-myelinated nerve fibers based on their structure and characteristics</p>

	<p>Elucidate structural and functional changes taking place in nerve fibers after injury.</p> <p>Tabulate the differences between three types of muscles.</p> <p>Illustrate neuromuscular junction, sequence of events taking place during neuromuscular transmission and factors affecting this process.</p> <p>Explain the physiological importance of a motor unit</p> <p>Describe the ionic and chemical basis of muscle contraction.</p> <p>Explain the energy expenditure during muscle contraction.</p> <p>Distinguish between phases of muscle contraction in detail.</p> <p>Relate the pathophysiology of neuromuscular transmission/ muscle contraction to various clinical presentations (tetanus, rigor mortis, tetanization, contracture remainder, myasthenia gravis, drugs acting on NMJ)</p> <p>Differentiate between isometric and isotonic contraction.</p> <p>Describe the role of SER in smooth muscle contraction.</p>
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**List of Practicals:**

Compound Microscope and study of Neubauer's chamber

RBC count by Neubauer's chamber.

WBC count-TLC

Platelet count. (Demonstration only)

Determination of Haemoglobin in the blood. (Sahili's method)

Red cell indices.

Estimation of haematocrit (PCV).

Estimation of ESR.

Determination of ABO & Rh blood groups.

Estimation of bleeding & clotting time.

DLC.

Osmotic fragility of RBC

Any other practical relevant to that Module

**Example of a PBL scenario:**

Mr. Zeeshan, a 43 years old mess waiter, reported in medical OPD with complaints of difficulty in standing for long duration while serving the meals, for last six months. His general physical examination revealed normal pulse, blood pressure and temperature. However, the doctor observed drooping of his eye lids. His symptoms ameliorated for several hours by administering a test dose of neostigmine. Laboratory investigations confirmed the presence of antibodies to nicotinic acetylcholine receptors in the blood and end plate potentials recorded on electromyography were weak. CT scan chest was normal. The physician managed the case conservatively by anticholinesterase drugs and patient responded to the treatment very well.

**Learning objectives:**

To learn the physiological basis of:

Skeletal muscle contraction especially for sustained contractions while standing.

Transmission of motor signals to skeletal muscle in nerve fibers.

Neuromuscular transmission at NMJ.

Factors/drugs that effect transmission at NMJ.

Pathophysiology and treatment options of myasthenia gravis.

**Resources:**

Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall.

Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood.

Ganong's Review of Medical Physiology, 24th Edition (LANGE Basic Science) by Kim E. Barrett,  
Susan M. Barman, Scott Boitano, Heddwen Brooks.

Electronic modes

**INTERESTING WEB-LINKS**



Cell Cycle: <https://www.youtube.com/watch?v=xsrH050wnIA>

Transcription and translation: <https://www.youtube.com/watch?v=2BwWavExcFl>

Protein synthesis: <https://www.youtube.com/watch?v=gG7uCskUOrA>

How WBCs work: <https://www.youtube.com/watch?v=0TvTyj5FAaQ>

Blood clotting: <https://www.youtube.com/watch?v=pqo3PDHR924>

Muscle contraction: <https://www.youtube.com/watch?v=ousflrOzQHc>

Neuromuscular junction: <https://www.youtube.com/watch?v=zbo0i1r1pXA>

## MODULE II

<b>Summary: Code</b>	<i>Y1M2</i>
<b>Name</b>	<i>Physiology</i>
<b>Duration</b>	<i>10 weeks</i>
<b>Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)</b>	1.Thorax 2.Cardiovascular system
<b>Subject Themes</b>	Cardiovascular Physiology
<b>Prerequisite Module</b>	<i>Y1M1</i>
<b>Mode of Information Transfer: MIT</b>	
<b>Lectures</b>	
<b>Tutorials (PTT)</b>	
<b>CBL</b>	
<b>Practicals</b>	
<b>Class tests</b>	

## PHYSIOLOGY LEARNING OUTCOMESFOR MODULE II

Physiologic anatomy of heart and cardiac action potential	<p>Appreciate the physiological arrangement of right and left hearts along with the parallel arrangement of systemic circulation.</p> <p>Recognize physiological anatomy of cardiac muscles, its functional syncytium and intercalated disc</p> <p>Differentiate between cardiac, skeletal and smooth muscles based on macro-, microscopic and functional differences, action potentials.</p> <p>Distinguish ionic changes in different phases of action potential within cardiac muscle</p> <p>Correlate the phases with ionic changes during pacemaker action potential in heart</p>
Cardiac cycle	<p>Illustrate pressure and volume changes during various phases of cardiac cycle</p> <p>Illustrate pressure-volume diagram of left heart</p> <p>Comprehend preload and afterload, its influence on stroke volume (The Frank-Starling's mechanism)</p> <p>Discuss the autonomic regulation of heart</p>

ECG	<p>Comprehend basis of ECG, different ECG Leads and their placements          Draw and label normal ECG showing various waves, segments and intervals          Understand significance of waves, segments and intervals of ECG          Calculate heart rate and various intervals and segments on an ECG          Appreciate relationship between vector and lead, type and locations of leads and principles for vector analysis in a normal heart          Discuss current of injury and differentiate between systolic and diastolic theories of current of injury          Appreciate the role of re-entry phenomenon in pathogenesis of ventricular fibrillation          Relate the ionic changes in cardiac tissues to ECG changes in sinus arrhythmias, pathological arrhythmias, ischemia, infarction and heart blocks.</p>
Hemodynamics of circulation	<p>Categorize the components of circulatory systems into. Greater (Systemic), Lesser (Pulmonary) circulations and accessory circulatory system (Lymphatic).          Analyze the relationship between flow, resistance and conductance.          Conceptualize the phenomenon of vascular compliance and resistance          Distinguish between turbulent and laminar flow based on significance, pressure gradient, resistance.          Appreciate formation, propagation, damping and abnormalities of arterial pressure pulse          Discriminate jugular venous pulse from arterial pulse based on location, appearance, origin, waves and significance</p>
Control of Local Blood	<p>Distinguish between acute and chronic control of local blood flow.          Conceptualize active and reactive hyperemia          Relate the blood flow control to total peripheral resistance</p>
Capillary dynamics	<p>Identify the principles of capillary dynamics and structure of Interstitium.          Analyze the role of starling forces and other safety factors (lymphatics, negative ISF pressure) in prevention of edema.          Appreciate Types of edema, its pathophysiology and safety factors preventing edema formation.          Differentiate between pitting and non-pitting edema based on its etiology, pathophysiology and clinical significance.</p>

Cardiac output	<p>Understand the determinants of cardiac output and factors affecting cardiac output.</p> <p>Appreciate the mechanics of low and high cardiac outputs along with their effects on heart.</p> <p>Comprehend the factors affecting stroke volume, heart rate and total peripheral resistance.</p> <p>Explain Fick's principle for the measurement of cardiac output</p> <p>List the functions of veins</p> <p>Identify factors regulating venous return and significance of venous reservoirs.</p> <p>Appreciate the equality of cardiac output and venous return.</p>
Arterial blood pressure	<p>Comprehend the determinants of arterial pressure, factors affecting and mechanisms regulating blood pressure on short- and long-term basis.</p> <p>Recognize mean arterial pressure and its significance.</p> <p>Comprehend the individual and integrative role of baroreceptors, chemoreceptor, volume receptors, arterial natriuretic factors and Renin-angiotensin -aldosterone system in regulation of arterial pressure.</p> <p>Understand the characteristics of regional circulations (skeletal muscles, pulmonary, coronary &amp; cerebral) and factors regulating them</p>
Heart sounds	<p>Analyze heart sounds regarding their origin, abnormalities(murmurs) and their clinical importance</p>
Muscle flow in exercise	<p>Identify types and severity of exercise in different sports.</p> <p>Conceptualize general adaptive changes in muscles in response to increased and decreased physical activity.</p> <p>Appraise fuels available in body during rest and exercise.</p> <p>Analyze cardiovascular and pulmonary changes (including oxygen consumption) during different grades of exercise.</p>
Circulatory shock	<p>Discriminate various types of shock, its types and stages of development</p> <p>Differentiate between compensated and uncompensated shock.</p> <p>Recognize the short term and long-term compensatory mechanisms in circulatory shock.</p> <p>Diagnose and treat various types of shock based on clinical scenarios and lab investigations</p>



**List of Practicals:**

Examination of the chest related to CVS  
CPR on dummy according to AHA guidelines  
Examination of arterial pulse.  
ECG recording & interpretation.  
Measurement of arterial B.P  
Effect of exercise & posture on BP  
Examination of the apex beat  
Auscultation of normal heart sounds.  
JVP / Triple response  
Demonstration of Blood Grouping  
Any other practical relevant to that Module  
List of Case Based Learning Scenerios:

**Example of PBL scenario:**

A 55 years old male was brought to cardiac emergency department with the history of severe left sided chest pain. His ECG showed ST segment elevation and significant Q waves in leads I, aVL and V6. These findings suggested that he sustained acute infarction of the left side of left ventricle. QRS complex was positive in lead aVF and predominantly negative in lead I. The treating doctor showed ECG to final year medical students and told that there was right axis deviation in the ECG as well.

**Learning objectives**

To know about basics of cardiac impulse generation and propagation  
To understand ECG leads and normal ECG  
To understand and interpret vector analysis  
To know Physiological basis of ST segment shift (current of injury)  
To understand ECG changes in acute myocardial infarction  
To understand physiology of treatment of acute myocardial infarction

**Resources:**

Guyton and Hall Textbook of Medical Physiology, 13th Edition by John E. Hall.  
Human Physiology: From Cells to Systems, 8th Edition by Lauralee Sherwood.  
Ganong's Review of Medical Physiology, 24th Edition (LANGE Basic Science) by Kim E. Barrett, Susan M. Barman, Scott Boitano, Heddwen Brooks.  
Electronic modes

## INTERESTING WEB-LINKS



Cardiac impulse: <https://www.youtube.com/watch?v=RYZ4daFwMa8>

Heart sounds: <https://www.youtube.com/watch?v=dBwr2GZCmQM&vl=en>

Cardiac cycle: <https://www.youtube.com/watch?v=6umGlcGFd68>

## MODULE III

<b>Summary: Code</b>	<i>Y1M3</i>
<b>Name</b>	<b><i>Physiology</i></b>
<b>Duration</b>	<i>10 weeks</i>
<b>Broad Themes of Module (Theme: a subject that is being integrated a majority of time of module)</b>	Lower Limb Respiratory System
<b>Subject Themes</b>	Physiology of respiration Deep sea physiology Aviation/space physiology High altitude physiology Exercise physiology
<b>Prerequisite Module</b>	Y1M1&Y1M2

<b>Mode of Information Transfer: MIT</b>
<b>Lectures</b>
<b>Tutorials (PTT)</b>
<b>CBL</b>
<b>Practicals</b>
<b>Class tests</b>

## PHYSIOLOGY LEARNING OUTCOMES FOR MODULE III

Introduction to Respiratory System	Recognize the functional anatomy of various parts of respiratory system Highlight the non-respiratory functions of respiratory tract
Pulmonary Mechanics	Distinguish functions of inspiratory and expiratory muscles during quiet and forceful respiration Correlate normal lung volumes/capacities to various pressures and volume changes during forceful respiration
Pulmonary Compliance	Discern lung and chest wall compliance Identify composition & role of surfactant in alveolar surface tension State concept of work of breathing
Respiratory Membrane & Diffusion of Gases	Appreciate the layers of respiratory membrane in detail Appraise concept of diffusing capacity through respiratory membrane Identify factors affecting gas diffusion through respiratory membrane

Diffusion of gases & Oxygen transport	State the mechanics of oxygen diffusion from alveoli to blood Distinguish mechanism of oxygen transport in the arterial blood, tissue fluid and cell
Oxygen transport & Dissociative curve	Identify the role of Hb in oxygen transport Analyze normal oxygen-hemoglobin dissociation curve by explaining factors that shift oxygen-hemoglobin dissociation curve to right and left
Carbon dioxide transport	Identify various chemical form in which CO <sub>2</sub> is transported in blood Discern normal CO <sub>2</sub> dissociation curve explaining Bohr effect, haldane effect and chloride shift
Nervous regulation of respiration	State different group of neurons composing respiratory center Review nervous control of inspiration and respiratory rhythm Recognize the regulatory mechanism of hering-breuer inflation reflex
Chemical regulation of respiration	Appraise location, function and stimulation (by CO <sub>2</sub> and H <sup>+</sup> ) of central chemosensitive area Identify the role of peripheral chemoreceptors for control of respiration Determine the composite effects of PCO <sub>2</sub> , pH, & PO <sub>2</sub> on alveolar ventilation
Pulmonary circulation Va/Q	Appreciate pressure differences b/w pulmonary & systemic circulation Analyze the pulmonary blood flow and effect of hydrostatic pressure on it and the concept of ventilation perfusion ratio
Hypoxia	Identify various causes of hypoxia Analyze effects of hypoxia on the body and role of oxygen therapy in different types of hypoxia
Cyanosis/Asphyxia/ Hypercapnia	List causes of cyanosis and asphyxia Enunciate hypercapnia & its association with various forms of hypoxia Interpret effects of very high blood CO <sub>2</sub> levels on respiratory center
Obstructive lung diseases	Discuss the causes and pathophysiology of obstructive lung diseases and evaluate its effects on respiration
Restrictive lung diseases	Discuss the causes and pathophysiology of Restrictive lung diseases and evaluate its effects on respiration Draw and explain the spirogram of obstructive and restrictive lung diseases Differentiate between Obstructive and restrictive lung disease based on spirometry and FEV <sub>1</sub> / FVC ratio
Hazards at High Altitude	Analyze the mechanism of acclimatization of the body to low O <sub>2</sub>

	Identify and explain the causes of natural acclimatization in natives of High altitude Study the principles of acclimatization
Deep sea diving	Analyze changes in physiology under deep sea Describe the pathophysiology, clinical features, prevention and treatment modalities of Decompression sickness, Nitrogen Narcosis, Oxygen and carbon dioxide toxicity Identify uses of hyperbaric oxygen therapy
Space physiology	Explain the effects of G forces and microgravity on the body
Respiratory adjustment during exercise	Correlate the various muscle metabolic systems used as energy substrates with the type of exercise i.e. aerobic and anaerobic. Relate the effects of types of exercise, muscle fatigue and VO <sub>2</sub> max on exercise performance Explain the significance of oxygen debt. Describe the effects of training on the heart and coronary circulation and how these changes contribute to an increase in VO <sub>2</sub> max
AMS/HAPE/HACE	Explain causes, pathophysiology & clinical features of AMS/HAPE/HACE State prevention and treatment of AMS/HAPE/HACE

**List of Practicals:**

Examination of the chest related to respiratory system (respiratory rate)

Auscultation of breath sounds

Spirometry: Lung volumes and opacities

Spirometry: FEV<sub>1</sub> and FVC

Stethography.

PEFR Peak Expiratory Flow Rate

Respiratory acidosis and alkalosis with the help of ABGs.

Any other practical relevant to that Module

List of Case Based Learning Scenerios:

**Example of PBL scenario:**

A 10-year-old boy is brought to the emergency department because of difficulty in breathing that developed while playing football. The boy has a history of allergies, including a pollen allergy, but never previously showed this level of respiratory difficulty. He now complains of tightness in the chest. There is no family history of allergies or asthma. Both parents smoke cigarettes.

**PHYSICAL EXAMINATION**

Vital Signs: Temp 37°C, Pulse 120/min, Resp rate 30/min and shallow, BP 110/95 mm Hg

Physical Examination: Patient is wheezing, anxious, and short of breath. The wheezing is more prominent on exhalation, and there is an extended forced expiratory phase. The chest antero-posterior diameter appears large for age and size. The nasal mucosa is edematous, and the pharynx is coated with a clear postnasal discharge.

A beta2-adrenergic agent was administered by an inhaler, and the symptoms quickly subsided. The patient's anxiety was relieved, and heart rate and breathing rate returned to normal. The patient was scheduled for pulmonary function tests.

#### LABORATORY STUDIES

Spirometry: Normal values. When challenged with methacholine, however, a hyperreactive broncho constriction occurred with decreased FEV<sub>1</sub>, decreased forced vital capacity, and increased residual volume. Forced spirometry flow/volume loop: Scooping, diminished peak flow.

DIAGNOSIS : Asthma

#### **Learning objectives:**

After discussion you should be able to:

List the passages through which air passes from the exterior to the alveoli, and describe the cells that line each of them.

List the major muscles involved in respiration, and state the role of each.

Define the basic measures of lung volume and give approximate values for each in a normal adult.

Define lung compliance and airway resistance.

Compare the pulmonary and systemic circulations, and list some major differences between them.

Describe basic lung defense and metabolic functions.

Define partial pressure and calculate the partial pressure of each of the important gases in the atmosphere at sea level.

Define hypoxia and describe differences in subtypes of hypoxia.

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Electronic modes

## INTERESTING WEB-LINKS



Mechanism of breathing: <https://www.youtube.com/watch?v=wc2K1Olt4Q8>

Spirometry: <https://www.youtube.com/watch?v=yJzbiVUL58Y>

Gas exchange: <https://www.youtube.com/watch?v=6qnSsV2syUE>

## FREQUENTLY ASKED QUESTIONS

### **Q. How many module examinations are there?**

There will be THREE module examinations.

### **Q. Is there an end of year examination?**

Yes, there is a pre-annual examination, also known as a send up examination. This will decide the final internal assessment. A summative examination called as the 1<sup>st</sup> professional MBBS examination will be conducted by NUMS at the end of 1<sup>st</sup> year MBBS.

### **Q. What contributes to formative assessment?**

Tutorial assessments conducted with tutorials, class participation, scores received in small group discussions and grades assigned will contribute toward the formative assessment.

### **Q. Is there a grading system for formative assessment?**

A grading system is devised by the teachers depending upon the nature of the task. An example may be:

90% and above =	A+
85 to 89% =	A
80 to 84% =	A-
75 to 79% =	B+
71 to 74% =	B
68 to 70% =	B-
64 to 67% =	C+
61 to 63% =	C
55 to 60% =	C-



**Q. Will all modes of assessment be used in examinations?**

Depending upon the nature of the examination, MCQs and SEQs may be used for theoretical aspects, and OSPE may be used for practical examinations.

**Q. What is the minimum attendance required for appearing in the professional exam?**

A minimum of 75 % attendance is compulsory.

**Q. Are students notified about the results?**

Yes. Students are notified as soon as a test result is compiled. Parents are also communicated on a quarterly basis.

**Q. Am I required to wear an overall?**

Yes. Students are required to wear an overall at all times in physiology classes and practicals.

**Q. What is a recall based MCQ?**

It is a simple MCQ/SEQ that requires the student to recall or recognize any fact that has been remembered previously. It is a level C1 question based on Millers classification.

**Q. What is an application based MCQ?**

This type of a question requires interpretation of data or facts. It requires candidates to use their base of knowledge to interpret data or other information and come to some conclusion. It is a level C2 question based on Millers classification.

**Q. What is an application based SEQ/PBQ?**

Problem solving items require the candidate to assess a situation, synthesize with information from their base of knowledge, and then correctly solve a problem or make a decision.

**RECALL BASED MCQ**

Platelets are responsible for causing vasoconstriction after an injury to the vessel wall because they secrete:

- a. Fibrin-stabilizing factor
- b. Growth factor
- c. Prostaglandins
- d. Thromboxane A<sub>2</sub>

Correct answer: d

Reference: Guyton 13<sup>th</sup> edition, page 483

**APPLICATION BASED MCQ**

A 3-year old boy is brought to the family physician with a history of bleeding from gums. His mother explains that her father also had a similar condition. On examination, the boy has bruises all over his legs and knees. He is suffering from:

- a. Calcium deficiency
- b. Hemophilia
- c. Thrombocytopenia
- d. Vitamin K deficiency

Correct answer: b

Reference: Guyton 13<sup>th</sup> edition page 490

**APPLICATION BASED SEQ  
PROBLEM BASED QUESTION (PBQ)**

A 22-year old female presents to the OPD with complaints of fatigue and shortness of breath. Her history reveals heavy menstrual bleeding for the last 8 months, with the menstruation lasting for 2 weeks in each month. Her complete blood examination reveals hypochromic microcytic anemia.

- a) What is the pathophysiology of anemia in this patient? (1)
- b) Write the various steps of synthesis of hemoglobin. (4)