COURSE OF STUDIES

for

Master of Philosophy

in

Physiology

UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

Physiology is the study of normal function of the human body. It is the science that helps the physician to distinguish normal from the abnormal. This curriculum has been designed for M.Phil. in Physiology, keeping national and international standards in view, for postgraduate students who wish to continue their journey in research and teaching of Physiology in the medical colleges of the country and abroad. Care has been taken to ensure that this curriculum meets the guidelines, criteria, and standards of the Pakistan Medical and Dental Council (PMDC) and Higher Education Commission (HEC). It is designed for medical graduates of the Pakistani medical colleges, who come from diverse educational, social, and cultural backgrounds.

This curriculum is based on the SPICES model (student centered, problem based, integrated, community oriented and systematic). Various forms of learning theory such as traditional, experiential, constructivist and behavioral learning theories have been kept in mind.

The curriculum is divided into two years, having four semesters with major and minor subjects. Additionally, credit hours are reserved for the professional and teaching skills apprenticeship (PTSA).

Mission Statement:

To develop a group of professionally competent scholars (M.Phil.) in the subject of Physiology as basic medical physiology teachers who can also undertake and supervise research in the field of their chosen specialization for the benefit of society at large.

Program Educational Objectives:

1. To produce highly qualified physiologists who possess thorough knowledge of the subject along with learning laboratory techniques in the relevant field.
2. As graduates of Physiology and Cell Biology, they will be able contribute to the higher concepts of serving the community through medical teaching and research.
3. To enhance the understanding of the subject at large and disseminating this knowledge the graduate and research students and through them having a

positive progressive and affirmative role in the community to transform undergraduate medical education.

4. To inculcate and incorporate the utilization of new knowledge and technologies in the field and their adaptation for the local conditions to benefit the local communities and population.
5. To enhance the scientific writing and presentation skills for preparing the postgraduate students to present their work in seminars and symposia through academic writing classes and journal club during the course work.
6. To help develop liaisons with the foreign universities and centers of excellence for the benefit of the students/researchers for harnessing the new technologies and their utilization for the local population.

Program Learning Outcomes:

At the end of the M.Phil. program, our students will:

1. develop a comprehensive and in-depth knowledge of Physiology and Cell Biology, research techniques in the relevant field, and a thorough knowledge of the literature, applicable to their own research.
2. show abilities in the critical evaluation of current research and research techniques and methodologies.
3. develop interactive teaching skills and protocols for understanding and disseminating knowledge.
4. to conduct independent research and collaborative studies to solve the common basic and clinical research problems related to their field.

SCHEME OF STUDIES (2-Year)
MPhil. Physiology
Distribution of Courses (within semester)

Semester #	Course code	Course title	Credit hours		
			Theory	Practical	Total
1		Biostatistics and Research Methodology	2	0	2
	PHY701	General Physiology, Cell biology and genetics	1		8
	PHY702	Blood and Cardiovascular Physiology	2	1	
	PHY703	Endocrinology and Reproduction	2		
	PHY704	Respiratory Physiology	1	1	
		Elective Course (BCM701= Biochemistry)	2	0	2
2	PHY705	Neurophysiology	3	2	8
	PHY706	Nerve and Muscle Physiology	1		
	PHY707	Renal, body fluids, acid base and thermoregulations	1		
	PHY708	Gastrointestinal Physiology	1		
		Elective Course (One of the following: Histology and microanatomy Immunology and serology General Pathology/Pathophysiology Cytogenetics and Molecular Biology	2	0	2
3	Research (Thesis)		6		6
4	Professional & Teaching Skills Apprenticeship (PTSA)		2		2
(Total: 30)					

Course Title: General Physiology, Cell Biology and Genetics (PHY701)

Contact Hours: 16	Credit Hours: 1+0
Theory = 16	Theory = 1
Practical = 0	Practical = 0
Total = 16	Total = 1

Course objectives:

This course will familiarize the students with basic concepts in cell biology and subsequently cellular basis of a disease process.

Learning Outcomes:

By the end of this course, students will be able to:

1. Describe the term homeostasis and classify the feedback mechanisms.
2. Describe the cellular components and relate the function of cellular organelles with their pathophysiology.
3. Appraise the genetic control of cells and its disruption leading to disease.
4. Develop an insight regarding the basic metabolic mechanisms that govern metabolism and chemical processes in the cells.

Course Outline:

1. Functional Organization of the Human Body and Control of the "Internal Environment"
2. The Cell and Its Functions
3. Genetic control of protein synthesis, cell function and cell reproduction.
4. Physiological Chemistry

Suggested Readings:

1. Cell Biology by T.D. Pollard, W.C. Earnshaw,2002 (Reprinted 2004) Saunders/Elsevier
2. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier

3. Cell and Molecular Biology by Bruce Alberts et al. 4th Edition, 2002
4. Ganong's Review of Medical Physiology, 26th ed.

Course Title: Blood and Cardiovascular Physiology (PHY702)

Contact Hours: 32+48	Credit Hours: 2+1
Theory = 32	Theory = 2
Practical = 48	Practical = 1
Total = 16	Total = 3

Course objectives:

By the endo of this course students will develop a deep insight regarding the physiological mechanisms that govern the functions of human cardiovascular and circulatory system.

Learning Outcomes:

The students will be able to:

1. Explain the basic physiology of cardiovascular system.
2. Explain ECG and interpret changes.
3. Explain and classify common cardiovascular conditions.
4. *Analyze* factors leading to hypertension.
5. *Explain* the electrical conductivity of the heart and factors that lead to common dysrhythmias.
6. Explain circulatory dynamics in detail.
7. Explain the changes in blood flow and their effects in common congenital heart defects.
8. Describe the normal composition of blood, types of anemia, bleeding and clotting mechanisms and also gain insight into the bleeding and clotting disorders.
9. Describe the general processes involved in specific immunity (including descriptions of antigens and antibodies).
10. Explain the differences among primary, secondary and passive immunity.
11. Describe the general nature and function of the compliment system.

12. Explain how specific immunity explains ABO blood compatibility.

Course Outline:

A- The Heart

1. Cardiac Muscle; The Heart as a Pump and Function of the Heart Valves
2. Rhythmical Excitation of the Heart
3. The Normal Electrocardiogram
4. Electrocardiographic Interpretation of Cardiac Muscle and Coronary Blood Flow Abnormalities: Vectorial Analysis
5. Cardiac Arrhythmias and Their Electrocardiographic Interpretation

B-The Circulation

1. Overview of the Circulation; Biophysics of Pressure, Flow, and Resistance
2. Vascular Distensibility and Functions of the Arterial and Venous Systems
3. The Microcirculation and Lymphatic System: Capillary Fluid Exchange, Interstitial Fluid, and Lymph Flow
4. Local and Humoral Control of Tissue Blood Flow
5. Nervous Regulation of the Circulation, and Rapid Control of Arterial Pressure
6. Role of the Kidneys in Long-Term Control of Arterial Pressure and in Hypertension: The Integrated System for Arterial Pressure Regulation
7. Cardiac Output, Venous Return, and Their Regulation
8. Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease
9. Heart Valves and Heart Sounds; Valvular and Congenital Heart Defects
10. Circulatory Shock and Its Treatment

C-Blood Physiology

1. Red Blood Cells, Anemia, and Polycythemia
2. Resistance of the Body to Infection: I. Leukocytes, Granulocytes, the Monocyte-Macrophage System, and Inflammation
3. Resistance of the Body to Infection: II. Immunity and Allergy Innate Immunity
4. Blood Types; Transfusion; Tissue and Organ Transplantation

5. Hemostasis and Blood Coagulation

Practicals:

Hematology:

Manual and automated experiments for determination of hematocrit (PCV), ABO & Rh blood groups, ESR, Hemoglobin, bleeding & clotting time, RBC count, Red cell indices, TLC and DLC, and Platelet count.

Cardiovascular system:

Examination of arterial pulse, ECG recording & interpretation, arterial B.P, apex beat & the normal heart sounds, JVP / Tripple response, and recording of ECG on a normal healthy subject using traditional methods and modern data acquisition systems.

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.

Course Title: Endocrinology and Reproduction (PHY703)

Contact Hours: 32+0	Credit Hours: 2+0
Theory = 32	Theory = 2
Practical = 0	Practical = 0
Total = 32	Total = 2

Course objectives:

By the end of this course, students will be able to develop an insight regarding the basic physiological and pathophysiological mechanisms that relate to endocrinology and reproduction in humans.

Learning Outcomes:

By the end of this course students will be able to:

1. Demonstrate/illustrate how the homeostatic model applies to every endocrine system in normal physiology and disease.
2. Demonstrate/illustrate the effects of hormones on reproduction, growth, development, stress, and metabolism as examples.
3. Demonstrate/illustrate the biochemical and cellular processes of chemical communication involved in endocrinology.
4. Demonstrate/illustrate the concept of interplay between physiological systems and within target cells between signaling pathways; i.e., how many hormones affect the secretion and actions of other hormones.
5. Demonstrate/illustrate endocrine systems disruption with respect to synthesis, secretion, transport, receptors, mechanisms of action, and metabolism/excretion.
6. Demonstrate/ illustrate the normal and abnormal mechanisms related to the human reproductive system.

Course Outline:

A- Endocrinology

1. Introduction to Endocrinology
2. Pituitary Hormones and Their Control by the Hypothalamus
3. Thyroid Metabolic Hormones
4. Adrenocortical Hormones
5. Insulin, Glucagon, and Diabetes Mellitus
6. Parathyroid Hormone, Calcitonin, Calcium and Phosphate Metabolism, Vitamin D, Bone, and Teeth

B- Reproduction

1. Reproductive and Hormonal Functions of the Male
2. Female Physiology Before Pregnancy and Female Hormones
3. Pregnancy and Lactation

C- Fetal and Neonatal Physiology

1. Growth and functional development of fetus

2. Organ system
3. Adjustment to extra uterine life
4. Problems of prematurity

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology

Course Title: Respiration (PHY704)

Contact Hours: 16+48	Credit Hours: 1+1
Theory = 16	Theory = 1
Practical = 48	Practical = 1
Total = 64	Total = 2

Course objective:

By the end of this course, students will be able to develop a deep understanding and insight regarding the physiological mechanisms related to respiration and humans and to correlate them with the diseased states.

Learning Outcomes:

After studying this course, students should be able to:

1. describe and illustrate the main anatomical structures of the respiratory system and the mechanics of inspiration and expiration.
2. discuss the factors that affect pulmonary ventilation.
3. outline the mechanisms of O_2 and CO_2 transport in the blood.
4. demonstrate an understanding of the control of the respiration rate.

Course Outline:

A- Respiration

1. Pulmonary Ventilation
2. Pulmonary Circulation, Pulmonary Edema, Pleural Fluid
3. Physical Principles of Gas Exchange; Diffusion of Oxygen and Carbon Dioxide Through the Respiratory Membrane
4. Transport of Oxygen and Carbon Dioxide in Blood and Tissue Fluids
5. Regulation of Respiration
6. Respiratory Insufficiency—Pathophysiology, Diagnosis, Oxygen Therapy

B- Environmental Physiology

1. Aviation, high altitude and space physiology
2. Physiology of deep-sea diving and other hyperbaric conditions
3. Exercise physiology

Practicals:

Determination of respiratory rate, recording of pulmonary volumes & capacities & their clinical interpretation, and PEFR.

Suggested readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.

Course Title: Neurophysiology (PHY705)

Contact Hours: 48+48	Credit Hours: 3+1
Theory = 48	Theory = 3
Practical = 48	Practical = 2
Total = 96	Total = 4

Course objectives:

By the end of this course, students will be able to develop a deep understanding of the physiology of the nervous system and will be able to correlate it with pathophysiology.

Learning Outcomes:

By the end of this course students will be able to:

1. Develop an understanding of the basic principles of sensory, motor, and autonomic nervous system physiology with the relevant clinical corelates.
2. Discuss the basic physiological principles related to special senses.
3. Develop an understanding of the physiological mechanisms that form the basis of higher mental functions.

Course Outline:

A-Sensory system

1. Organization of the Nervous System, Basic Functions of Synapses, and Neurotransmitters
2. Sensory Receptors, Neuronal Circuits for Processing Information
3. Somatic Sensations: I. General Organization, the Tactile and Position Senses
4. Pain Receptors and Their Stimulation- Dual Pathways for Transmission of Pain Signals into the Central Nervous System - Pain Suppression (“Analgesia”) System in the Brain and Spinal Cord

B- The Nervous System. The Special Senses

1. The Eye- Optics of Vision
2. The Eye: II. Receptor and Neural Function of the Retina
3. The Eye: III. Central Neurophysiology of Vision
4. The Sense of Hearing
5. The Chemical Senses—Taste and Smell

C- The Nervous System: Motor and Integrative Neurophysiology

1. Motor Functions of the Spinal Cord; the Cord Reflexes
2. Cortical and Brain Stem Control of Motor Function
3. Contributions of the Cerebellum and Basal Ganglia to Overall Motor Control

4. Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory
5. Behavioral and Motivational Mechanisms of the Brain—The Limbic System and the Hypothalamus
6. States of Brain Activity—Sleep, Brain Waves, Epilepsy, Psychoses

D- The Autonomic Nervous System and the Adrenal Medulla

1. General organization
2. Basic characteristics
3. Reflexes and Pharmacology

E- Cerebral Blood Flow, Cerebrospinal Fluid, and Brain Metabolism

1. Cerebral blood flow
2. Cerebrospinal Fluid
3. Brain Metabolism

Practicals:

Special Senses:

Examination of the special senses for vision, olfaction, gustation, hearing, and balance.

Nervous system:

Examination of sensory system, motor system, cranial nerves, cerebellar system, superficial and deep reflexes.

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.

Course Title: Nerve and muscle physiology (PHY706)

Contact Hours: 16+0	Credit Hours: 1+0
Theory = 16	Theory = 1
Practical = 0	Practical = 0
Total = 16	Total = 1

Course objectives:

By the end of this course, students will be able to develop an understanding of the physiological processes related to nerve and muscle physiology.

Learning Outcomes:

By the end of this course students will be able to:

1. Develop an understanding of the mechanism of transport through cell membrane.
2. Explain the detailed structure and functions of nerve and muscles.
3. Develop a deep understanding of nerve physiology.

Course Outline:

1. Transport of Substances Through Cell Membranes
2. Membrane Potentials and Action Potentials
3. Contraction of Skeletal Muscle
4. Excitation of Skeletal Muscle: Neuromuscular Transmission and Excitation-Contraction Coupling
5. Excitation and Contraction of Smooth Muscle

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.

Course Title: Renal, body fluids, acid base balance and temperature regulation (PHY707)

Contact Hours: 16+0	Credit Hours: 1+0
Theory = 16	Theory = 1
Practical = 0	Practical = 0
Total = 16	Total = 1

Course objectives:

By the end of this course, the students will be able to corelate the basic mechanisms that govern the functions of the renal system with the clinical abnormalities.

Learning Outcomes:

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

1. Discuss detailed physiology of kidney and urinary tract.
2. Identify role of renal system in maintaining blood pressure and acid base balance
3. Enlist functions of kidney and pathologies related to them.
4. Explain method of electrolyte balance and pathologies related to it.
5. Highlight pathologies related to kidneys and their distinctive clinical features.
6. describe the detailed functions of skin and barriers.
7. describe the physiological changes in the body systems with ageing process.
8. explain the mechanism of temperature regulation and describe the concepts of conduction, convection and radiation.

Course Outline:

A- Renal

1. The Body Fluid Compartments: Extracellular and Intracellular Fluids; Edema
2. Urine Formation by the Kidneys
3. Glomerular Filtration, Renal Blood Flow, and Their Control
4. Urine Formation by the Kidneys. Tubular Reabsorption and Secretion

5. Urine Concentration and Dilution; Regulation of Extracellular Fluid Osmolarity and Sodium Concentration
6. Renal Regulation of Potassium, Calcium, Phosphate, and Magnesium; Integration
   of Renal Mechanisms for Control of Blood Volume and Extracellular Fluid Volume

B- Acid-Base Regulation

1. Acids and bases
2. Buffers of the body
3. Renal correction of acidosis and alkalosis
4. Clinical causes of acid base disorders

C- Temperature regulation

1. Skin – Structure and functions of skin.
2. Physiology of Ageing- Physiological changes with advancing age.
3. Body Temperature Regulation, and Fever – Conduction, Convection, Radiation.

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.
4. Physiological Basis of Aging and Geriatrics 4th Edition by Paola S. Timiras

Course Title: Gastrointestinal tract and Metabolism (PHY708)

Contact Hours: 16+0	Credit Hours: 1+0
Theory = 16	Theory = 1
Practical = 0	Practical = 0
Total = 16	Total = 1

Course objectives:

By the end of this session students will be able to develop an understanding of the physiology and pathology of the gastrointestinal tract.

Learning Outcomes:

Upon completion of this course, students will be able to:

1. Describe the normal functions of the gastrointestinal system at a level required for an understanding of clinical medicine.
2. Discuss the endocrine and neural mechanisms controlling gastrointestinal physiology at a level required for an understanding of clinical medicine.
3. Explain how these systems act in an integrated manner to regulate overall body functions.
4. Correlate how failure of these normal physiologic functions and integrations are associated with diseases.
5. Demonstrate the ability to apply physiological principles of clinical and basic science relevancy by multiple choice examination, research assignments, and problem sets.

Course Outline:

A- GIT

1. General Principles of Gastrointestinal Function—Motility, Nervous Control, and Blood Circulation
2. Propulsion and Mixing of Food in the Alimentary Tract
3. Digestion and Absorption in the Gastrointestinal Tract
4. Physiology of Gastrointestinal Disorders

B- Metabolism

1. Metabolism of Carbohydrates, and Formation of Adenosine Triphosphate
2. Lipid Metabolism
3. Protein Metabolism
4. The Liver as an Organ
5. Dietary Balances; Regulation of Feeding; Obesity and Starvation; Vitamins and Minerals

Suggested Readings:

1. Textbook of Medical Physiology by A.C. Guyton and J.E. hall, 14th Edition, 2015. Saunders/Elsevier
2. Ganong's review of medical physiology.
3. Berne & Levy Physiology.

Course Title: Professional & Teaching Skills Apprenticeship (PTSA)

Credit Hours:02

Professional Skills Apprenticeship credit hours: 01

Teaching Skills Apprenticeship credit hours (CMT): 01

Professional Skills Apprenticeship:

Course objectives:

By the end of this course, students will be able to develop their skills related to the teaching of physiology and be able to conduct research.

Course learning outcomes:

Students will be able to:

1. Conduct a lecture, practical or tutorial independently.
2. Perform new techniques in the physiology laboratory for promotion of research.
3. Write a grant for funding of the project.

Course content:

1. Modern Physiological Techniques:
   Performance of ultrasonic bone profiling, spirometry, Nerve conduction study, electromyography, ELISA, spectrophotometry, DNA and RNA isolation with Nanodrop quantification, Power Lab and PCR.
2. Participate and present research in a National/International conference.
3. Identify conduction abnormalities on ECG
4. Identify common endocrine abnormalities and plan treatment options

Suggested readings:

ABC of Learning and Teaching in Medicine, 3rd Edition. Peter Cantillon, Diana F. Wood, Sarah Yardley ISBN: 978-1-118-89217-6 September 2017 BMJ Books

The Grant Application Writers workbook by SW Russel.

A guide to research methodology, biostatistics and research methodology. CPSP and WHO.

Artificial DNA methods and applications. CRC press YE Khudyakov and HA Fields.
RNA Methodologies by Farell.
Immunoassays: Essential Data by R. Edwards. Wiley.

Teaching Skills Apprenticeship

All students of M Phil programme will get registered for the CMT Certification in the final semester. Completing the course work and successfully getting certified for CMT, which is a patent of UHS, will be a compulsory integral component of PTSA (Professional and Teaching Skills Apprenticeship) for the 4th semester of all M Phil programs at UHS.