COURSE OF STUDIES

for

Doctor of Philosophy

in

Physiology

UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

Physiology is the study of the normal function of the human body. It is the branch of science that helps the physician to distinguish normal from the abnormal. This curriculum has been designed for PhD 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 postgraduates, who come from diverse educational, social, and cultural backgrounds.

Mission Statement:

To develop a group of professionally competent scholars (Ph.D.) in the subject of Physiology as basic medical science 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:

i. To produce highly qualified physiologists who possess a thorough knowledge of the subject along with learning laboratory techniques in the relevant field.
ii. As graduates of Physiology and Cell Biology, they will be able to contribute to the higher concepts of serving the community through medical teaching and research.
iii. To enhance the understanding of the subject at large and disseminating this knowledge to the graduate and research students and through them having a positive progressive and affirmative role in the community to transform undergraduate medical education.
iv. 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.
v. 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.

vi. 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 Ph.D. program, our students should be able to:

i. develop a comprehensive and in-depth knowledge of Physiology, research techniques in the relevant field, and a thorough knowledge of the literature, applicable to their own research.

ii. Demonstrate abilities in the critical evaluation of current research and research techniques and methodologies.

iii. develop interactive teaching skills and protocols for understanding and disseminating knowledge.

iv. to conduct independent research and collaborative studies to solve the common basic and clinical research problems related to their field.

SCHEME OF STUDIES (3-Year)

PhD Physiology

Semester #	Course code	Course title	Credit hours		
			Theory	Practical	Total
1		Advance Research Methodology	2	0	02
		Advance Biostatistics	2	0	02
	PHY818	Advanced metabolism in health, disease, and cancer	2		05
	PHY821	Basic, applied, and clinical physiology (blood, CVS, Endocrinology, Reproduction, and respiration)	3		
2		Advanced Laboratory Techniques			02
	PHY822	Advance physiology (Neurophysiology, nerve, and muscle, renal, GIT)	3		07
	PHY831	Seminars, Journal clubs	1		
	PHY841	Cellular Pathophysiology	3		
3	Research (Thesis)		30		30
(Total: 48)					

Course Title: Advanced metabolism in health, disease, and cancer (PHY818)

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

Course Objective:

By the end of this course, the PhD scholars will be able to develop a deep insight about the metabolic processes involved in health, disease, and cancer.

Learning outcomes:

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

1. Apply the knowledge of carbohydrate, fat, and protein metabolism and correlate it with the relevant clinical diseases.
2. Develop a deep insight about the physiological and pathological mechanism involved in neoplasia.

Course outline:

1. Metabolism of carbohydrates, and formation of adenosine triphosphate
2. Lipid metabolism
3. Protein metabolism
4. Liver and its role in metabolism
5. Regulation of feeing, obesity and starvation
6. Energetics and metabolic rate
7. Neoplasia

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. Porth's Pathophysiology. 10th ed by Tommie L Noris. Wolter's Kluwer

Course Title: Basic, applied, and clinical Physiology (blood, CVS, Endocrinology, Reproduction, and respiration) (PHY821)

Contact Hours: 48 + 0
Theory = 48
Practical = 0
Total = 48

Credit Hours: 3+0
Theory = 3
Practical = 0
Total = 3

Course Objective:

To develop a deep understanding regarding basic physiological principles of blood physiology, endocrinology and reproduction and respiratory physiology along with their clinical correlates and pathophysiology.

Learning Outcome:

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.
13. Demonstrate/illustrate the application of homeostatic model to endocrine system in normal physiology and disease.

14. Demonstrate/illustrate control and modification of physiology and behavior by hormones.
15. Demonstrate/illustrate the biochemical and cellular processes of chemical communication involved in endocrinology.
16. 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.
17. Demonstrate/illustrate the disruption in the endocrine systems with respect to synthesis, secretion, transport, receptors, mechanisms of action, and metabolism/excretion.
18. Demonstrate/ illustrate the normal and abnormal mechanisms related to the human reproductive system.
19. describe and illustrate the main anatomical structures of the respiratory system and the mechanics of inspiration and expiration.
20. discuss the factors that affect pulmonary ventilation.
21. outline the mechanisms of O_2 and CO_2 transport in the blood.
22. demonstrate an understanding of the control of the respiration rate.

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

D- 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

E- Reproduction

1. Reproductive and Hormonal Functions of the Male (and Function of the Pineal Gland)
2. Female Physiology Before Pregnancy and Female Hormones
3. Pregnancy and Lactation

F- Fetal and Neonatal Physiology

1. Growth and functional development of fetus
2. Organ system
3. Adjustment to extra uterine life
4. Problems of prematurity

G- 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

H- Environmental Physiology

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

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: Advance physiology (Neurophysiology, nerve, and muscle, renal, GIT) (PHY822)

Contact Hours: 48 + 0
Theory = 48
Practical = 0
Total = 48

Credit Hours: 3+0
Theory = 3
Practical = 0
Total = 3

Course Objective:

The PhD scholars will be able to develop a deep insight about the physiological and pathophysiological processes that govern the activities of nervous system, muscles, kidney, and GIT.

Learning Outcome:

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.
4. Develop an understanding of the mechanism of transport through cell membrane.
5. Explain the detailed structure and functions of nerve and muscles.
6. Develop a deep understanding of nerve physiology.
7. Discuss detailed physiology of kidney and urinary tract
8. Identify role of renal system in maintaining blood pressure and acid base balance
9. Enlist functions of kidney and pathologies related to them.
10. Explain method of electrolyte balance and pathologies related to it.
11. Highlight pathologies related to kidneys and their distinctive clinical features.
12. describe the detailed functions of skin and barriers.
13. describe the physiological changes in the body systems with ageing process.
14. explain the mechanism of temperature regulation and understand the concepts of conduction, convection and radiation.
15. Explain the normal functions of the gastrointestinal system at a level required for an understanding of clinical medicine.

16. Describe the endocrine and neural mechanisms controlling gastrointestinal physiology at a level required for an understanding of clinical medicine.
17. Discuss how these systems act in an integrated manner to regulate overall body functions.
18. Describe the effect of failure of these normal physiologic functions and integrations associated with some diseases.
19. 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-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

D- Nerve and Muscle

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

F- 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

G- 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

H- 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.

I- 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

J- 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.
4. Physiological Basis of Aging and Geriatrics 4th Edition by Paola S. Timiras

Course Title: Cellular Pathophysiology (PHY841)

Contact Hours: 48 + 0	Credit Hours: 3+0
Theory = 48	Theory = 3
Practical = 0	Practical = 0
Total = 48	Total = 3

Course Objective:

By the end of this course, the PhD scholars will develop a deep insight of the basic physiological principles that govern the function of cell. They will be able to identify the key mechanisms important for the pathophysiology of diseases related to the cell.

Learning Outcome:

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

1. Develop an understanding of health and disease.
2. Identify the characteristics of normal cells and tissues.
3. Corelate the mechanisms involved in cellular adaptation, injury and death.
4. Develop a deep insight of the genetic control of cell function.
5. Identify the major genetic and congenital disorders.

Course Outline:

1. Concepts of health and disease
2. Cell and tissue characteristics
3. Cellular adaptation, injury, and death
4. Genetic control of cell function and inheritance
5. Genetic and congenital disorders

Suggested Readings:

1. Porth's Pathophysiology: Concepts of altered health sciences. 10th edition by Tommie L Norris. Walters Kluwer

Compulsory Teaching Skills

For a thorough evaluation of students' understanding and critical thinking abilities, all PhD students in their respective disciplines will;

1. Design a comprehensive set of 50 Multiple Choice Questions (MCQs) and 25 Short Essay Questions (SEQs) for M. Phil students.

2. Plan 20 observed lectures focusing on key topics.

These assessments will provide Ph.D. students valuable experience in educational design and delivery. These will also enhance their interactive learning with the provision of real-time feedback.