

# Syllabus for Physiology

## 1. Introduction to Physiology: The Cell and General Physiology

- a) Functional Organization of the Human Body and Control of the "Internal Environment"
- b) The Cell and Its Functions
- c) Genetic Control of Protein Synthesis, cell function, and cell reproduction

## 2. Membrane Physiology, Nerve, and Muscle

- a) Transport of Substances Through Cell Membranes
- b) Membrane Potentials and Action Potentials
- c) Contraction of Skeletal Muscle
- d) Excitation of Skeletal Muscle: Neuromuscular Transmission and Excitation-Contraction Coupling
- e) Excitation and Contraction of Smooth Muscle

## 3. Heart

- a) Cardiac Muscle; The Heart as a Pump and Function of the Heart Valves
- b) Rhythmical Excitation of the Heart
- c) The Normal Electrocardiogram
- d) Electrocardiographic Interpretation of Cardiac Muscle and Coronary Blood Flow Abnormalities:
- e) Vectorial Analysis
- f) Cardiac Arrhythmias and Their Electrocardiographic Interpretation

## 4. Circulation

- a) Overview of the Circulation; Biophysics of Pressure, Flow, and Resistance
- b) Vascular Distensibility and Functions of the Arterial and Venous Systems
- c) The Microcirculation and Lymphatic System: Capillary Fluid Exchange, Interstitial Fluid, and Lymph
- d) Local and Humoral Control of Tissue Blood Flow
- e) Nervous Regulation of the Circulation and Rapid Control of Arterial Pressure
- f) Role of the Kidneys in Long-Term Control of Arterial Pressure and in Hypertension: The Integrated
- g) System for Arterial Pressure Regulation
- h) Cardiac Output, Venous Return, and Their Regulation
- i) Muscle Blood Flow and Cardiac Output During Exercise; the Coronary Circulation and Ischemic Heart Disease
- j) Cardiac Failure
- k) Heart Valves and Heart Sounds; Valvular and Congenital Heart Defects
- l) Circulatory Shock and Its Treatment

## 5. Body Fluids and Kidneys

- a) The Body Fluid Compartments: Extracellular and Intracellular Fluids; Edema
- b) The Urinary System: Functional Anatomy and Urine Formation by the Kidneys
- c) Glomerular Filtration, Renal Blood Flow, and Their Control
- d) Renal Tubular Reabsorption and Secretion
- e) Urine Concentration and Dilution; Regulation of Extracellular Fluid Osmolarity and Sodium Concentration

- f) 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
- h) Diuretics, Kidney Diseases

## **6. Blood Cells, Immunity, and Blood Coagulation**

- a) Red Blood Cells, Anemia, and Polycythemia
- b) Resistance of the Body to Infection: I. Leukocytes, Granulocytes, the Monocyte-Macrophage System, and Inflammation
- c) Resistance of the Body to Infection: II. Immunity and Allergy
- d) Blood Types; Transfusion; Tissue and Organ Transplantation
- e) Hemostasis and Blood Coagulation

## **7. Respiration**

- a) Pulmonary Ventilation
- b) Pulmonary Circulation, Pulmonary Edema, Pleural Fluid
- c) Principles of Gas Exchange; Diffusion of Oxygen and Carbon Dioxide Through the Respiratory Membrane
- d) Transport of Oxygen and Carbon Dioxide in Blood and Tissue Fluids
- e) Regulation of Respiration
- f) Respiratory Insufficiency - Pathophysiology, Diagnosis, Oxygen Therapy

## **8. Aviation, Space, Deep-Sea Diving and Gravitational Physiology**

- a) Aviation, High Altitude physiology, acclimatization and Space Physiology
- b) Physiology of Deep-Sea Diving and Other Hyperbaric Conditions
- c) Effect of microgravity on cardiorespiratory performance and Physiological control measures

## **9. The Nervous System: A. General Principles and Sensory Physiology**

- a) Organization of the Nervous System, Basic Functions of Synapses, and Neurotransmitters
- b) Sensory Receptors, Neuronal Circuits for Processing Information
- c) Somatic Sensations: I. General Organization, the Tactile and Position Senses
- d) Somatic sensations: II. Pain, Headache, and Thermal Sensations

## **10. The Nervous System: B. The Special Senses**

- a) The Eye: I. Optics of Vision
- b) The Eye: II. Receptor and Neural Function of the Retina
- c) The Eye: III. Central Neurophysiology of Vision
- d) The Sense of Hearing
- e) The Chemical Senses - Taste and Smell

## **11. The Nervous System: C. Motor and Integrative Neurophysiology**

- a) Motor Functions of the Spinal Cord; the Cord Reflexes
- b) Cortical and Brain Stem Control of Motor Function
- c) Contributions of the Cerebellum and Basal Ganglia to Overall Motor Control
- d) Cerebral Cortex, Intellectual Functions of the Brain, Learning, and Memory

- e) Behavioral and Motivational Mechanisms of the Brain - The Limbic System and the Hypothalamus
- f) States of Brain Activity - Sleep, Brain Waves, Epilepsy, Psychoses, and Dementia
- g) The Autonomic Nervous System and the Adrenal Medulla
- h) Cerebral Blood Flow, Cerebrospinal Fluid, and Brain Metabolism

## 12. **Gastrointestinal Physiology**

- a) General Principles of Gastrointestinal Function - Motility, Nervous Control, and Blood Circulation
- b) Propulsion and Mixing of Food in the Alimentary Tract
- c) Secretory Functions of the Alimentary Tract
- d) Digestion and Absorption in the Gastrointestinal Tract
- e) Physiology of Gastrointestinal Disorders

## 13. **Metabolism and Temperature Regulation**

- a) Metabolism of Carbohydrates and Formation of Adenosine Triphosphate
- b) Lipid Metabolism
- c) Protein Metabolism
- d) The Liver as an Organ
- e) Dietary Balances; Regulation of Feeding; Obesity and Starvation; Vitamins and Minerals
- f) Energetics and Metabolic Rate
- g) Body Temperature Regulation and Fever

## 14. **Endocrinology and Reproduction**

- a) Introduction to Endocrinology
- b) Pituitary Hormones and Their Control by the Hypothalamus
- c) Thyroid Metabolic Hormones
- d) Adenocortical Hormones
- e) Insulin, Glucagon, and Diabetes Mellitus
- f) Parathyroid Hormone, Calcitonin, Calcium and Phosphate Metabolism, Vitamin D, Bone, and Teeth
- g) Reproductive and Hormonal Functions of the Male (and Function of the Pineal Gland)
- h) Female Physiology Before Pregnancy and Female Hormone
- i) Pregnancy and Lactation
- j) Fetal and Neonatal Physiology

## 15. **Exercise, Work & Sports Physiology**

- a) Benefits of physical fitness, guidelines for fitness.
- b) Types of exercise - static and dynamic, muscle fiber types. Energy metabolism during exercise.
- c) Physical training - principle, methods and types.
- d) Physiological benefits of high altitude training.
- e) Nutrition and weight control- obesity and exercise, methods of weight control. Exercise and aging- physiological changes during aging, benefits of exercise in old age.
- f) Environment and exercise- physiological changes and health risk during exercise in extreme environment (cold, hot and humid, high altitude, deep sea, Space). Exercise for special population- children and adolescent, men and women, old age, disabled.

- g) Measurement techniques of endurance levels, Effect of exercise on endurance, stroke volume and Cardiac output - factors regulating cardiac output.
- h) Cardiorespiratory changes during exercises. Oxygen- Hb saturation curve, Myoglobin, Bohr effect, chloride shift and Haldane effect.
- i) Microgravity
- j) Concept of Yoga- Physiological benefits of yoga for endurance/performance and therapeutic aspect

**16. Ergonomics & Occupational Health:**

- a) Different domains of Ergonomics and its applications
- b) Physiological factors in ergonomics: Physiological variation during work, fitness, health, work load and work capacity
- c) Cognitive ergonomics: Cognitive process, perception and attention, memory and learning
- d) Manual material handling - Health problems, risk factors, guidelines of material handling
- e) Anthropometry: Static and dynamic anthropometry, instrument used, data collection, analysis and uses of anthropometry in design. Body composition: methods of assessment and applications
- f) Occupational Health - factors affecting, occupational health hazards - mechanical, chemical, biological, environmental hazards - heat stress, cold stress, noise, vibration, ultra-violet radiation
- g) Occupational diseases - Pneumoconiosis, silicosis, asbestosis, bagassosis, byssinosis, anthrocosis