

Detailed Objectives for Learning Medical Physiology

2014- 36th Batch

Department of Physiology

Faculty of Medicine

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Chapter 1

GENERAL ASPECTS

1. GENERAL OBJECTIVES

The aim of the course is to develop basic understanding of the functions of the body and their applications in management of patients and to develop skills in assessing the functions of systems of the body and basic clinical examination. At the end of the course the students should be able to,

- Describe the basic principles of homeostasis, water and electrolyte balance, acid base balance, energy balance and temperature regulation.
- Describe the role of various systems of the body, how they function, the mechanisms that regulate them and the factors that alter the functions.
- Outline how pathological factors interfere with the functions of these systems and how altered functions of these systems cause disease.
- Describe the physiological basis of various tests used to assess the functions of these systems and interpret the results obtained.
- Mention the names of common chemical agents that alter the functions of these systems and outline the mechanism of their actions.
- Investigate blood for haemoglobin concentration, red cell count, white cell count, differential count, bleeding time, clotting time, blood groups and packed cell volume.
- Measure body fat, measure blood pressure, lung volumes, pulmonary ventilation, concentration of oxygen and carbon dioxide in alveolar air, metabolic rate, body temperature, urine flow and specific gravity of urine
- Feel arterial pulse and recognize rate, regularity and volume of the pulse, identify normal heart sounds, identify waves and intervals in normal E.C.G, record respiratory movements, perform cardiorespiratory resuscitation and examine basic sensory and motor functions and special sensations.
- Having attained the knowledge and skills mentioned above, the student should view man as a whole organism and not a collection of systems, apply the knowledge and skills in understanding and managing patient problems and keep on continued study of Physiology.

The teaching learning activities include lecture discussions, practical classes, tutorials and clinical demonstrations. Lecture discussions will be delivered by the departmental staff where students are informed of the topics well in time and are expected to read up based on the objectives given to them at the beginning of the course as a book. Practical classes will be conducted in the laboratory with the aim of developing basic clinical skills related to Physiology and to demonstrate important physiological principles. Tutorials will be in different forms such as free oral question-answer sessions, answer writing sessions, sessions for students to clear their doubts and so on as requested by the students. Clinical demonstrations are conducted to illustrate clinical significance of pre-clinical learning by bringing selected patients from the Teaching Hospital or showing relevant video clips and demonstrating the clinical application of the basic sciences at the end of each section. All these activities will be interactive encouraging student participation and performance instead of simple delivery of information. The Clinical Departments of the Faculty will be conducting the clinical demonstrations and, if need arises, consultants from the Teaching Hospital will be invited as Visiting Lecturers. In addition, video shows on functions of various systems are shown to illustrate their structure and function.

Further, there will be formative evaluations at the end of or during the course of each section or system. The marks of in-course assessments conducted at the end of each term will be given to students and the answers will be discussed with the students. The students are given detailed

objectives for the course in physiology and guides for each practical class developed by the department as teaching material.

2. AIMS OF THE PHYSIOLOGY PRACTICAL COURSE

The students are expected to benefit from the practical classes in the following ways.

1. Learn and acquire skills.
2. Familiarize with normograms.
3. Gain skill in designing simple experiments.
4. Familiarize with the use of simple statistical concepts and interpret them.
5. Practice observing and recording.
6. Gain skills in recording an experiment, tabulating and condensing data.
7. Learn to draw valid conclusions from available data.
8. Gain knowledge of concepts of validity, reliability, precision, and errors in measurements.
9. Supplement to oral classes.
10. Apply physiological learning to health and community problems.

Chapter 2 **BODY FLUIDS**

1. HOMOEOSTASIS

1. Define physiology.
2. State the relevance of Physiology to Medicine.
3. Define “internal environment” of an organism.
4. Define homoeostasis.
5. Interpret “constancy or stability” of internal environment.
6. List the compositional variables in the internal environment.
7. Name the organ systems and their role in homoeostasis.
8. Name the components of a homoeostatic regulatory mechanism.
9. Name the systems that integrate the different homoeostatic mechanisms.
10. Recognize the importance of homoeostasis for the survival of self and species.

2. BODY COMPOSITION AND FLUIDS

1. Describe the composition of the body and how it changes with age.
2. Describe the factors that affect the composition.
3. Discuss the association between body fat and health.
4. Describe the methods available to measure the body water, body fat and lean tissue.
5. Measure the body weight, height, hip circumference, waist circumference and body fat by skin fold thickness.
6. Relate the above parameters to health of a person.
7. Recall the definition of equivalent solution, molar solution, osmole, and osmolar solution.
8. Describe the distribution of water in the body and state the respective amounts in various compartments.
9. Describe the methods for determining extracellular, intracellular, and interstitial fluid volumes.
10. State the approximate intake and loss of water of a normal adult per day.
11. List the major anions and cations present in the extracellular, intracellular, and interstitial fluids and state approximate concentrations of each.
12. Define osmosis, osmolarity, and osmolality
13. State the total osmolality of the body fluids and explain the difference between calculated and observed osmolality of body fluids.
14. Define crystalloid and colloid osmotic pressure of the plasma and state the values for plasma and interstitial fluid osmotic pressure.

15. Describe the Starling forces and exchange of fluid between plasma and interstitial fluid.
16. Describe the exchange of substances between cells and the extracellular fluid
17. Describe the role of lymphatics in maintaining the the tissue fluid volume and composition
18. Describe the regulation of the volume and composition (osmolality, sodium and potassium concentrations) of body fluids:
 - 18.1. the role of osmo-receptors and volume receptors.
 - 18.2. renal mechanisms in general and juxta-glomerular apparatus in particular
 - 18.3. endocrine mechanisms such as ADH, Aldosterone and ANP.
19. State the common causes of oedema and explain their mechanisms.
20. Outline the problems of oedema
21. State the common causes of dehydration and their mechanisms
22. Outline the problems of dehydration
23. State the solutions available for replacement in dehydration and their composition.
24. Explain the reasons for selecting solutions in different situations.
25. Explain the risks and precautions to be taken when each fluid is given.

Chapter 3

BLOOD

1. General

- 1.1. List the functions of the blood.
- 1.2. State the osmolality, viscosity, and specific gravity of the blood.
- 1.3. Explain the interaction of blood with the rest of the body.

2. Blood Volumes

- 2.1. State the blood volume of a standard reference adult male and female and express it as a percentage of the body weight.
- 2.2. State how blood volume alters in children and in old age
- 2.3. Describe the methods for measuring the blood volume.
- 2.4. Explain the significance of maintaining the blood volume.
- 2.5. State the amount of blood contained in different compartments of the circulatory system at any time and explain the physiological significance of this distribution.
- 2.6. Describe the mechanisms that maintain the blood volume.

3. Plasma

- 3.1. State the important constituents of plasma, their concentrations and their functions.
- 3.2. Describe the functions of different types of plasma proteins.
- 3.3. Describe the measurement of ESR and the factors that affect ESR and their clinical significance.
- 3.4. Describe the measurement of PCV and its significance

4. Red Blood Cells

- 4.1. State the features of the red cell.
- 4.2. List its functions.
- 4.3. Outline the properties of haemoglobin and the significance of these properties in relation to its functions.
- 4.4. Outline the variations in haemoglobin and their properties.
- 4.5. Describe the colour of Haemoglobin in different states and its significance
- 4.6. Define cyanosis, identify the presence of cyanosis and describe its significance.
- 4.7. Describe erythropoiesis and its regulation
- 4.8. State the life span of red cells and explain its normal destruction
- 4.9. List the nutrients and other factors that limit it and describe the physiological basis of the limitation.
- 4.10. Describe the causes of the deficiencies of these nutrients and give the dietary sources of these nutrients.

- 4.11. Define anaemia and classify the types of anaemia and give example for each type.
- 4.12. Outline the changes in the red cell parameters and appearance in the above states
- 4.13. Explain and perform the tests that can be carried out in blood to identify the type and causes of anaemias.
- 4.14. Give the causes of polycythaemia and outline its complications.

5. Thrombocytes

- 5.1. Describe the features of platelets, the constituents and their functions.
- 5.2. Describe production of thrombocytes.
- 5.3. Outline the consequences of thrombocytopenia and thrombocytosis and give examples.
- 5.4. Describe and perform bleeding time and explain its significance.

6. Hemostasis

- 6.1. List different hemostatic mechanisms.
- 6.2. Describe the genesis and the relevance of vascular spasm in hemostasis.
- 6.3. Describe the importance of platelets in arresting capillary bleeding and repair of blood vessels.
- 6.4. Outline the reactions leading to the formation of thrombin inside the vessels and in the tissues.
- 6.5. Describe the reactions leading to the formation of fibrin threads and their stabilization.
- 6.6. Describe the factors that prevent clot formation and that dissolve clots in the circulation.
- 6.7. Describe the fate of blood clot.
- 6.8. Name the sources of different clotting factors
- 6.9. Give examples for clotting disorders and their mechanisms
- 6.10. Describe the tests to assess the clotting mechanism and outline their significance.
- 6.11. Measure clotting time.
- 6.12. Describe the reduction of clotting tendency with examples of drugs used.

7. White Blood Cells and Defense Reaction

- 7.1. Describe the histological appearance of the leucocytes.
- 7.2. Perform total and differential white cell count.
- 7.3. Describe leucopoiesis.
- 7.4. Describe the function of each granulocyte and the relevance of the cytoplasmic inclusions to their functions.
- 7.5. Describe the macrophage system (Reticulo-endothelial system).
- 7.6. Define immunity, innate immunity and acquired immunity.
- 7.7. Describe the components of innate immunity.

- 7.8. Outline the changes seen in acute inflammation.
- 7.9. Define antigen and antibody.
- 7.10. Outline the “processing” of lymphocytes in newborn and describe the classification of lymphocytes.
- 7.11. Describe the functions of each type of lymphocytes
- 7.12. Define humoral immunity, explain the types of antibodies and outline their reactions.
- 7.13. Outline the complement system and its functions.
- 7.14. Define cellular immunity and outline the reactions.
- 7.15. Define hypersensitivity and outline its consequences.
- 7.16. Outline the immune dysfunction and the possible causes
- 7.17. Define auto-immune disorders, outline their mechanisms, and give some examples.
- 7.18. Explain the principle of immunization and its clinical significance

8. Blood Groups and Transfusion

- 8.1. Define blood group and describe the inheritance of ABO and Rh antigens.
- 8.2. List the blood group antibodies found in different individuals and explain their reactions with red cells of other groups.
- 8.3. Outline transfusion reactions and steps taken to prevent them.
- 8.4. Explain the consequences of feto-maternal incompatibility especially in relation to Rh system and the ways of preventing the incompatibility.
- 8.5. Perform blood grouping.
- 8.6. Describe the collection and storage of blood in blood banks.
- 8.7. Describe the precautions to be taken before blood collection
- 8.8. Outline the needs for blood transfusion and the risks involved in it.
- 8.9. List the blood products that can be used to various patients and give reasons for using them.

9. Tissue Transplantation

- 9.1. Explain the basis of tissue typing.
- 9.2. Explain the reactions to transplanted tissues and the reasons for rejection.
- 9.3. Outline the principle of treatment to minimize rejection

Chapter 4

EXCITABLE TISSUES AND AUTONOMIC NERVOUS SYSTEM

1. Nerve
 - 1.1. Recall the microscopic appearance of a typical nerve cell.
 - 1.2. Outline the methods of recording electrical events in nerve tissue.
 - 1.3. Describe the electrical properties of axons with reference to the following and their ionic basis:
 - a. Resting membrane potential.
 - b. Adequate stimulus.
 - c. Local response.
 - d. Latent period.
 - e. Action potential.
 - f. Refractory period.
 - g. Spread of impulse.
 - h. Salutory conduction.
 - 1.4. Describe “all or none” law and mention the potential that obey this law and the potential that gives graded response
 - 1.5. Describe the factors that affect velocity of conduction of nerve impulse.
 - 1.6. Explain the classification of nerve fibers.
 - 1.7. Outline the effects of ischaemia, local anesthetics and pressure on nerve conduction
 - 1.8. Describe the structure of synapses.
 - 1.9. Explain the chemical basis of transmission across the synapse
 - 1.10. Outline the fate of neurotransmitters after release
 - 1.11. Describe the electrical properties of dendrites and cell bodies and describe the genesis of EPSP and IPSP.
 - 1.12. Explain summation (temporal and special) in synaptic transmission.
 - 1.13. Describe the genesis of action potential at the axon hillock.
 - 1.14. Explain the mechanisms of interfering in the synaptic transmission by drugs with examples.
 - 1.15. Describe divergence and convergence of nerve impulse.
 - 1.16. Outline the principles of nerve conduction studies and the significance of these studies.

2. Muscle

- 2.1 Recall the light microscopic and electron microscopic appearance of skeletal, cardiac, and smooth muscles and relate the arrangement of the filaments to the bands seen under light microscope.
- 2.2 Describe the electrical properties of these muscles with special references to variation in resting membrane potential and action potential.
- 2.3 Define refractory period, explain how it differs in different muscle types and correlate it with their function.
- 2.4 Describe the ionic basis of electrical changes and their consequences.
- 2.5 Define pace maker potential and explain how it is generated in cardiac and smooth muscles
- 2.6 Describe the innervation of each of the muscle types (skeletal, cardiac and smooth muscles)
- 2.7 Describe the neuro-muscular transmission in each muscle type and how it can be modified by disease and drugs.
- 2.8 Explain the excitation contraction coupling of the above muscles.
- 2.9 Describe the contractile properties and explain their significance to their functions.
- 2.10 Describe the response of skeletal muscle to single and repeated stimuli and explain sustained contraction.
- 2.11 Describe the changes in contraction due to repeated stimuli in skeletal muscle- staircase phenomenon and its significance in sports and tetanization
- 2.12 Describe the motor unit and its significance.
- 2.13 Outline the principles of electromyography and its applications.
- 2.14 Outline the effects of de-nerivation on the various muscle types.
- 2.15 Describe the relationship of initial length to the force of contraction and its significance in sports.
- 2.16 Differentiate the muscle types and explain why they are suitable for different types of sports or activities.

3. Autonomic nervous System

- 3.1 Define autonomic, sympathetic and parasympathetic nervous systems.
- 3.2 Describe the basic structure of sympathetic and parasympathetic systems with regards to afferents and efferents.
- 3.3 List the transmitters released by the nerve endings.
- 3.4 List the types of adrenergic and cholinergic receptors and their distribution in the body.
- 3.5 Describe the effects of stimulation and inhibition of these receptors.
- 3.6 Give examples of chemicals and drugs influencing the functions of autonomic nervous system and explain the mechanisms of action

Chapter 5

RESPIRATORY SYSTEM

1. General

- 1.1. Recall the structure of the thoracic wall, lungs, and air ways.
- 1.2. Recall the physical properties of gases and the gas laws.

2. Air ways

- 2.1. Describe the changes in the inspired air while it passes through the nasal cavity with regard to temperature, humidity, and foreign substances.
- 2.2. Explain the structural and functional adaptations seen in the nasal cavity to effect the above changes.
- 2.3. Describe the mechanisms found in trachea and in the lower respiratory tract to protect from dust particles and microorganisms.
- 2.4. Describe the special features of bronchioles and the factors affecting the patency of bronchioles.
- 2.5. Describe the cough and sneeze reflexes and their significance.
- 2.6. Outline the causation of exercise induced bronchial asthma and the precautions to avoid it.

3. Mechanics of ventilation

- 3.1. Recall the surface marking of the pleura and the lungs.
- 3.2. Describe the importance of elastic fibers in the thoracic wall and in lung parenchyma and explain the negative pressure in the pleural cavity at rest.
- 3.3. Describe the role of surface tension of the fluid in the pleura in keeping both pleurae adhered and its use in respiratory movement.
- 3.4. Describe the role of surfactant in the alveoli and the problem faced by the babies born without it.
- 3.5. Describe the movements of chest wall and diaphragm
- 3.6. Describe the changes in pleural pressure and the intra pulmonary pressure during normal and deep respiratory movements.
- 3.7. State the situations when positive pressure is found in pleural cavity and explain its mechanisms.
- 3.8. Define tidal volume, inspiratory reserve volume, expiratory reserve volume, vital capacity, forced vital capacity, forced vital capacity in the first second, peak flow rate, total lung capacity, dead space, minute ventilation, maximum voluntary ventilation and alveolar ventilation.
- 3.9. Classify the dead space and describe the effects of changing the dead space
- 3.10. Outline the need for tracheostomy and its problems
- 3.11. Measure lung volumes and ventilations mentioned above and describe their clinical significance.

- 3.12. Outline the causes of pneumothorax and the types of pneumothorax and explain its effects on respiratory and cardiac functions.
 - 3.13. Outline the causes and the differences between obstructive and restrictive diseases of the respiratory system with examples.
 - 3.14. Describe the tests to differentiate obstructive and restrictive respiratory diseases.
 - 3.15. Describe the compliance of the lung and the thoracic cage and the principles of its measurement.
 - 3.16. Mention examples of change in compliance.
4. Gas exchange in lungs
- 4.1. Describe the properties of substances that are consumed or excreted through respiratory system.
 - 4.2. State the partial pressure of gases especially that of oxygen and carbon dioxide found in atmosphere, alveoli, arterial blood, venous blood, the tissue fluid and the cells and explain the differences in different areas.
 - 4.3. Define the diffusing capacity and compare the of oxygen, carbon monoxide and carbon dioxide and describe the factors that influence the diffusion coefficient of gases across respiratory membrane.
 - 4.4. Describe the features of the lung and pulmonary circulation that contribute to efficient exchange of gases between blood and alveolus.
 - 4.5. List the layers in the respiratory membrane through which gases travel during exchange
 - 4.6. Describe the features of the respiratory membrane that facilitates gas exchange
 - 4.7. Describe factors that affect gas exchange across respiratory membrane and their clinical significance
 - 4.8. Define ventilation perfusion ratio and describe its significance in gas exchange.
 - 4.9. Describe the effects of gravity on blood flow and air flow to different parts of the lungs and the features that minimize these effects.
 - 4.10. Measure alveolar oxygen and carbon dioxide partial pressures
5. Gas transport and exchange with tissues
- 5.1. State the amounts of oxygen carried in solution and in combination with haemoglobin in arterial and venous blood.
 - 5.2. Describe the properties of haemoglobin that make it an efficient carrier of oxygen.
 - 5.3. Describe the relationship between the partial pressure of oxygen and the amount combined with haemoglobin- the sigmoid curve-and the advantages of this relationship.
 - 5.4. List the factors that affect the above relationship and describe their physiological significance.
 - 5.5. Describe the transport of carbon monoxide by the haemoglobin and its clinical significance.

- 5.6. State the colours of haemoglobin in different states and describe their clinical significance.
 - 5.7. Describe the delivery of oxygen to the tissues from the blood.
 - 5.8. Describe the properties of myoglobin and foetal haemoglobin, their function and their physiological significance.
 - 5.9. State the amounts of carbon dioxide carried in solution, as bicarbonate and in combination with haemoglobin and other proteins in arterial and venous blood.
 - 5.10. Describe the reaction of carbon dioxide with water and the importance of carbonic anhydrase in this reaction and the mechanisms that buffer the hydrogen ions produced.
 - 5.11. Describe the role of red cells in the transport of carbon dioxide as a source of carbonic anhydrase and buffer.
 - 5.12. Explain the volume changes that occur in red cells as they pass through the tissues and the lungs and the mechanisms responsible.
 - 5.13. Describe the reaction of carbon dioxide with haemoglobin and other plasma proteins to form carbamino-compounds.
 - 5.14. Explain the Bohr Effect and Haldane effect and their physiological significance.
6. Neural regulation of respiration
 - 6.1. State the locations of various respiratory centers in the brainstem and outline the inputs and outputs to the centers and the nervous pathway that controls the respiratory muscles.
 - 6.2. Outline the respiratory rhythmicity.
 - 6.3. Describe the pulmonary stretch reflex, Hering-Breuer reflex and the negative feedback system.
 - 6.4. Describe the roles of cerebral cortex, hypothalamus, and other receptors on respiratory reflex.
7. Chemical control of respiration
 - 7.1. Describe the structure and function of carotid and aortic bodies.
 - 7.2. Describe the blood flow to the carotid bodies and its significance.
 - 7.3. Define central and peripheral chemoreceptors and describe the effects of changes in concentrations of oxygen, carbon dioxide, and hydrogen ions on these receptors and on respiration and their adaptability.
8. Respiratory acid base balance
 - 8.1. Recall the buffer systems of the blood.
 - 8.2. Describe the change in hydrogen ion concentration as a regulator of respiration.
 - 8.3. Explain the output of carbon dioxide as a tool for excretion of acid.
 - 8.4. Describe the effects of change in respiration on acid base balance
 - 8.5. Describe the response of respiratory system to metabolic acidosis and alkalosis and, outline the causes of respiratory acidosis and alkalosis.

9. Hypoxia and oxygen therapy
 - 9.1. Define hypoxia and give the types of hypoxia.
 - 9.2. Describe each type of hypoxia with examples.
 - 9.3. Describe the change in the partial pressure of oxygen and oxygen content in alveolar air, arterial blood and in the tissues in each type of hypoxia.
 - 9.4. State the types of hypoxia that will be benefited by oxygen therapy and give reasons.
 - 9.5. Outline oxygen therapy and the risks involved in it.

10. Respiratory adjustments
 - 10.1. Describe the changes observed in the following situations and explain their mechanisms:
 - a. Physical exercise.
 - b. High altitudes.
 - c. Deep sea.
 - d. Pulmonary oedema.
 - 10.2. Demonstrate the effects of physical exercise on ventilation.
 - 10.3. Outline the process of acclimatization in high altitudes.
 - 10.4. Explain the decompression sickness.

11. Clinical evaluation
 - 11.1. Give examples of symptoms relevant to respiratory problems and explain the physiological basis of the symptoms.
 - 11.2. Describe the examination of respiratory system, describe the signs and give their interpretations
 - 11.3. Perform respiratory function tests- Peak Flow, tidal volume, Vital Capacity, Forced Vital Capacity, FEV₁, FEV₁% and maximum voluntary ventilation.

Chapter 6

HEART AND CIRCULATION

1. Introduction
 - 1.1. Describe the functions of cardiovascular system.
 - 1.2. List the components of the system.
 - 1.3. Surface mark the heart.
 - 1.4. Relate the gross structure of the heart to function in terms of regulator, collector, pump, and skeleton of the heart.
 - 1.5. Recall the properties of the cardiac muscle (chapter 4)
2. Electro-physiology of the heart
 - 2.1. Describe the distribution of junctional tissue (conduction system).
 - 2.2. Explain the genesis of pace maker potential and its ionic basis
 - 2.3. Describe the effects of autonomic and hormonal factors on the pace maker potential.
 - 2.4. Describe the spread of action potential across the heart.
 - 2.5. Explain the reason for the SA node being the physiological pace maker and the factors influencing it.
 - 2.6. Explain the delay of transmission across the AV node, factors that affect the transmission and their significance.
 - 2.7. Describe the sequence of the spread of ventricular depolarization and its significance.
 - 2.8. Describe the principles of electrocardiogram.
 - 2.9. Outline the methods of recording ECG and describe the precautions taken with reasons.
 - 2.10. Identify the waves and intervals in a typical ECG and correlate them with electrical events in the heart.
 - 2.11. List the information obtained from ECG and outline its uses with some examples.
3. Cardiac Cycle
 - 3.1. Describe the cyclical events of atria and ventricles.
 - 3.2. List the time sequence of the cardiac cycle of the heart in resting person.
 - 3.3. Describe the pressure changes observed in the ventricles, aorta, atria, and jugular vein during cardiac cycle.
 - 3.4. Describe the flow of blood at each phase of the cycle and state the volume of left ventricle at the end of each phase.
 - 3.5. Describe the changes in time sequences and stroke volume with increasing heart rate.
 - 3.6. Outline the methods of measuring the parameters mentioned above.
 - 3.7. Describe the mechanisms of valve closures and openings and relate them to the cardiac sounds.

- 3.8. Surface mark the areas where sounds from each valve is best heard
 - 3.9. Identify the first and second cardiac sounds.
 - 3.10. Explain the basis of split first and second sounds
 - 3.11. Outline the basis of third and fourth heart sounds
 - 3.12. Explain the basis of generation of murmurs in the heart
 - 3.13. Outline the value of cardiac sounds as aid to diagnosing defects in cardiac function.
4. Cardiac output
 - 4.1. Define cardiac output and cardiac index.
 - 4.2. State the relationship between cardiac output, stroke volume, and heart rate.
 - 4.3. Outline the methods of measurement of cardiac output
 - 4.4. Describe the effects of venous return, heart rate and peripheral resistance on cardiac output.
 - 4.5. Relate the venous return to Starling's law
 - 4.6. Describe the factors that affect venous return, heart rate and peripheral resistance.
 - 4.7. Explain the effects of cardiac nerves and circulating substances on cardiac cycle and output.
 - 4.8. Describe the relationship between heart rate and cardiac output.
5. Cardiac work and metabolism
 - 5.1. Explain the relationship between the tension on the wall of a chamber, thickness of the wall, its radius and the pressure in it.
 - 5.2. Explain the relationship between mechanical work and stroke volume, pressure and velocity of blood pumped.
 - 5.3. Outline the advantages and disadvantages of dilation of heart chambers and hypertrophy of musculature.
 - 5.4. Describe the metabolic needs of heart in relation to heart rate and cardiac output.
6. Vessels
 - 6.1. Describe the structural and histological features of Windkessel vessels, resistant vessels, exchange vessels, capacity vessels, and shunt vessels.
 - 6.2. State the amount of blood contained in each category of vessels at any time.
 - 6.3. Describe the genesis and transmission of arterial pulse.
 - 6.4. Describe the factors that affect the velocity of conduction and the characteristics of pulse wave.
 - 6.5. Feel all arterial pulses and determine the pulse rate
 - 6.6. Identify jugular venous pulse and differentiate it from carotid pulse

7. Hemodynamics

- 7.1. Describe the relationship between blood flow, pressure gradient, and resistance.
- 7.2. Explain the contribution made by radius of the vessel and viscosity of the blood to peripheral resistance.
- 7.3. Describe the differences between laminar flow and turbulent flow.
- 7.4. Describe the critical closing pressure.
- 7.5. Describe the methods available to measure the blood flow to an organ.
- 7.6. Describe the velocity, resistance, total cross sectional area and pressure changes in the different parts of the vascular system.

8. Blood pressure & cardiovascular regulation

- 8.1. Define blood pressure and explain the influence of cardiac output and peripheral resistance on blood pressure
- 8.2. Measure the Blood pressure
- 8.3. Recall the factors that affect the peripheral resistance- properties of blood and diameter of arterioles
- 8.4. Recall the factors that affect cardiac output
- 8.5. State the location of baro-receptors and explain the principles of their action
- 8.6. Describe the role of cardio inhibitory center and vasomotor center in the regulation of blood pressure
- 8.7. Describe the factors that act on vasomotor center and cardio inhibitory center and their effect on blood pressure and heart rate
- 8.8. Describe the role of angiotensin, aldosterone, and blood volume on maintenance of blood pressure
- 8.9. Explain “hypertension” and list some causes of hypertension and outline the consequences of hypertension.

9. Pulmonary circulation

- 9.1. Describe the special features of pulmonary circulation and relate them to the function of lungs.
- 9.2. Explain the factors that affect total blood flow through lungs.
- 9.3. Explain the factors that vary blood flow to different regions of the lung.

10. Splanchnic circulation

- 10.1. Describe the special features of splanchnic circulation in relation to its function in digestion and absorption.
- 10.2. Describe the metabolic, hormonal and nervous factors that regulate blood flow through these vessels.

11. Cerebral circulation

- 11.1. Describe the special features of cerebral circulation.
- 11.2. Explain the factors that help in maintaining the cerebral circulation constant.
- 11.3. Describe the factors that cause regional variation in cerebral blood flow.

12. Coronary circulation

- 12.1. Describe the special features of coronary circulation.
- 12.2. Explain the influence of mechanical, metabolic, hormonal and neural factors on coronary blood flow.
- 12.3. Describe the relationship between heart rate and blood flow to left ventricular musculature
- 12.4. Describe the relationship between aortic valvular disease and coronary circulation.
- 12.5. List the risk factors for ischaemic heart diseases and discuss the ways of avoiding them

13. Cutaneous circulation

- 13.1. Describe the special features of cutaneous circulation and relate it to thermoregulation.
- 13.2. Describe the factors that regulate blood flow through skin.
- 13.3. Describe the white reaction, triple response, and reactive hyperaemia.

14. Capillary circulation

- 14.1. Recall tissue fluid formation and reabsorption.
- 14.2. Describe the factors that regulate flow through capillaries.
- 14.3. Describe the special features of capillaries in liver, brain, and kidney.

15. Placental and fetal circulation

- 15.1. Describe the structure of placenta in relation to circulation.
- 15.2. Describe the effect of placenta on maternal circulatory system.
- 15.3. Describe the transfer of substances across the placenta, especially that of oxygen.
- 15.4. Explain the fetal circulation and describe the changes at birth

16. Cardiovascular adjustments

- 16.1. Explain the effects of postural changes on circulatory system.
- 16.2. Explain the effects of increased intra-thoracic pressure on circulation.
- 16.3. Explain the circulatory changes during physical exercise.
- 16.4. Explain the circulatory response to haemorrhage.
- 16.5. Explain the “peripheral circulatory failure’ (or shock) and outline the circulatory changes due to hypovolumic, vasogenic (or low resistance), and cardiogenic shock.
- 16.6. Describe the beneficial effects of regular physical exercise on cardiovascular system

17. Clinical evaluation

- 17.1. Give examples of symptoms relevant to cardiovascular problems (eg. Ischaemic heart diseases, heart failure, valvular heart diseases) and explain the physiological basis of the symptoms
- 17.2. Describe the examination of cardiovascular system, describe the signs observed and give their interpretations
- 17.3. Feel arterial pulse, measure blood pressure and demonstrate jugular venous pulsation
- 17.4. Perform basic life support (cardio-pulmonary resuscitation)

Chapter 7

GASTROINTESTINAL SYSTEM

1. Introduction

- 1.1. Recall the development of the gut.
- 1.2. Recall the macroscopic and microscopic structure of the gastrointestinal tract and the glands associated with it.
- 1.3. Describe the general pattern of the gastrointestinal tract and the variations seen in relation to the functions.
- 1.4. Recall the enteric nerve plexus, nerve supply and blood supply to different parts.
- 1.5. Describe the properties of the smooth muscles found in gastrointestinal tract.
- 1.6. Describe basic electrical rhythm, peristalsis, segmental movements and migrating motor complex.

2. Mouth and Pharynx

- 2.1. Outline the relationship of oral activity to emotional state.
- 2.2. Recall the names of the salivary glands and state the composition of the saliva.
- 2.3. Describe the functions of saliva and their significance.
- 2.4. Describe the regulation of secretion of saliva.
- 2.5. List the functions of the teeth and the factors that affect teeth.
- 2.6. Describe mastication and its control.
- 2.7. State the location of receptors that initiate deglutition reflex and explain the mode of stimulation.
- 2.8. State the location of the deglutition center and the afferents and efferents of the center.
- 2.9. Describe the effects brought about by the efferents of the deglutition reflex and their significance.
- 2.10. Describe the passage of food through the oesophagus (peristalsis vs gravity).
- 2.11. Outline the problems of deglutition (dysphagia)

3. Stomach

- 3.1. List the functions of the stomach and explain how stomach is adapted to perform these functions.
- 3.2. Describe the movements of the stomach in relation to mixing and emptying.
- 3.3. Describe the mechanisms that prevent reflux of gastric contents into oesophagus and outline the problems of gastro-oesophageal reflux.
- 3.4. Outline the principles of investigations for gastro-oesophageal reflux
- 3.5. List the components of gastric juice and name the cells that secrete them.
- 3.6. Describe the ultra-structure of the oxyntic cell and the mechanism of acid secretion.

- 3.7. Describe the change in pH of the blood due to acid secretion and its consequences.
- 3.8. State the location of the cells that secrete gastrin.
- 3.9. Describe the regulation of secretion and the actions of gastrin.
- 3.10. Describe the nervous and hormonal regulation of gastric secretion, motility and emptying.
- 3.11. Describe the mechanisms that protect the stomach from its secretions.
- 3.12. Outline the possible causes of gastric ulcer and their physiological basis.
- 3.13. Outline the investigations done to assess gastric abnormalities.
- 3.14. Describe the mechanism of vomiting and the risks of excessive vomiting.
- 3.15. Outline the effects of smoking and alcohol in stomach

4. Duodenum, liver and pancreas

- 4.1. List the endocrine and exocrine secretions of the duodenal glands and describe their functions.
- 4.2. Describe the regulation of the secretions of duodenum.
- 4.3. List the contents of pancreatic juice and their functions.
- 4.4. Describe the regulation of the exocrine pancreas.
- 4.5. List the secretory substances found in the bile and describe their function.
- 4.6. List the excretory substances found in bile and describe their relevance.
- 4.7. Describe the regulation of bile secretion.
- 4.8. Describe the functions of gall bladder and its regulation.
- 4.9. Outline the possible causes of duodenal ulcer and their physiological basis.
- 4.10. List the tests performed to assess the function of exocrine pancreas their physiological basis.
- 4.11. List the tests performed to assess the functions of the liver and their physiological basis.
- 4.12. Outline the effects of chronic alcohol consumption on liver and their consequences.

5. Small intestine

- 5.1. Recall the movements seen in small intestine and explain their importance.
- 5.2. Describe the regulation of intestinal movements and its relevance to paralytic ileus and peritoneal injury.
- 5.3. Outline the basis of abdominal sounds and their uses.
- 5.4. List the contents of the secretion of crypts of Lieberkühn and their functions.
- 5.5. List the enzymes found in the surface of the epithelium of the villi and desquamated cells and describe their functions.
- 5.6. Describe the mechanisms of absorption of carbohydrates, proteins, fats, vitamins, and minerals and state the sites of their absorption.

- 5.7. Describe the role of dietary fiber in controlling absorption and intestinal movements.
 - 5.8. Describe the adaptations found in the intestine for absorption and explain the circulatory problems of villus structure and how it is overcome.
 - 5.9. Outline the causes of intestinal obstruction and its consequences
 - 5.10. Outline the causes for defective absorption and its consequences
 - 5.11. State the volume input from the stomach, volume of intestinal secretions and volume and composition of the output into the caecum.
6. Large intestine and anus
- 6.1. Outline the intestinal flora of the large intestine and its problems and benefits.
 - 6.2. Describe the function of the lymphatic tissue found in the intestines and in the appendix.
 - 6.3. Outline the causes of failure of the intestinal defenses and its consequences.
 - 6.4. Describe the structure, function and the control of ileocecal sphincter (valves).
 - 6.5. List the substances absorbed in the large intestine and their significance.
 - 6.6. List the secretions of the large intestine, their regulation and explain their functions.
 - 6.7. State the composition of the faeces.
 - 6.8. Describe the features of sigmoid colon that makes it the place of storage of faeces.
 - 6.9. Describe the special features of rectum and its role in initiation of the defecation reflex.
 - 6.10. Describe the defecation reflex and the influence of higher centers on the reflex.
 - 6.11. Describe the gastro-colic reflex and the problems associated with it.
 - 6.12. Describe the effects of neurological lesions on defecation.
 - 6.13. Outline the causes of constipation and diarrhea and describe the physiological basis of their effects on the body.
 - 6.14. Describe the daily turnover of water, electrolytes and proteins in the gut.

Chapter 8

ENDOCRINOLOGY

1. General aspects
 - 1.1. Recall nervous and chemical mechanisms of regulation of cellular function.
 - 1.2. Outline the role of hormones in,
 - i. Homoeostasis
 - ii. Emergency situations.
 - iii. Growth and development.
 - iv. Reproduction.
 - 1.3. Describe the neuro-endocrine integration.
 - 1.4. Recall the concepts of feedback regulation in relation to hormonal activities.
 - 1.5. Explain the modes of transport available for hormones.
 - 1.6. Explain the mechanisms by which hormones alter cellular functions.
 - 1.7. Describe each hormone under the following wherever possible:
 - Source of secretion.
 - Sites of degradation.
 - Latent period and half-life.
 - Mode of transport.
 - Mechanisms of actions.
 - Physiological effects,
 - Regulation of secretion and the factors influencing secretion.
 - Features of excessive and under secretion
2. Insulin
 - 2.1. Recall the histology of the pancreas.
 - 2.2. Recall the blood supply of pancreas and the importance of its drainage through portal vein.
 - 2.3. Describe the actions of insulin in the metabolism of carbohydrate, protein and fat and its influence on growth.
 - 2.4. List the tissues that are not dependent on insulin for glucose usage.
 - 2.5. Describe the relationship of blood level of insulin to the concentration of insulin receptors and glucose transporters.
 - 2.6. Describe the effect of insulin on plasma potassium level and its significance.
 - 2.7. Describe the regulation of secretion of insulin and the factors that affect the secretion.
 - 2.8. Describe the effects of excess of insulin and outline the causes and its complications.
 - 2.9. Describe the effects of deficiency of insulin and their consequences.

- 2.10. Outline the types and risk factors of diabetes mellitus and its acute complications.
 - 2.11. Outline the advice given to patients with diabetes mellitus regarding diet and activity and describe physiological basis of the advice.
 - 2.12. Explain the physiological basis of the tests performed to assess insulin status.
3. Glucagon
 - 3.1. Describe the actions of glucagon.
 - 3.2. Describe the regulation of the secretion and the factors affecting the secretion.
 - 3.3. Describe the effects of over secretion of the hormone.
4. Thyroid Hormone
 - 4.1. Recall the histology of thyroid gland in active and resting states
 - 4.2. Recall the synthesis of thyroglobulin, iodination and condensation of Tyrosine residues.
 - 4.3. Recall the uptake of thyroglobulin and the release of thyroxin and triiodothyronine.
 - 4.4. Describe the transport of these hormones in the blood and the factors that affect transport.
 - 4.5. State the half-life and latent period of the two hormones and explain their significance.
 - 4.6. Compare the potency of T₃ and T₄
 - 4.7. Describe the mechanism of action and the effects on intracellular process such as metabolism of protein, carbohydrate, fat and energy expenditure.
 - 4.8. Describe the mode of action and the effects on heart.
 - 4.9. Explain the action on the nervous system, skeletal muscle and bones.
 - 4.10. Describe the regulation of secretion.
 - 4.11. Outline the causes and the risk factors that affect thyroid function
 - 4.12. Describe the features observed in hyper and hypo thyroidism in adults and children and their physiological basis.
 - 4.13. Describe the tests performed to assess the thyroid function.
5. Parathyroid Hormone and Thyrocalcitonin
 - 5.1. Recall the intake, excretion and blood level of calcium.
 - 5.2. Explain the deposition and removal of calcium in bone.
 - 5.3. Describe the activities of parathyroid hormone on bone, renal tubule and synthesis of 1, 25 dihydroxy cholecalciferol.
 - 5.4. Describe the actions of 1, 25 dihydroxy cholecalciferol in the intestine, kidney and bone.
 - 5.5. Describe the regulation of secretion of parathyroid hormone.
 - 5.6. Describe the regulation of secretion of calcitonin.

- 5.7. Describe the actions of calcitonin.
 - 5.8. Describe the actions of parathyroid hormone
 - 5.9. Describe the factors that affect the structure and strength of the bone
 - 5.10. Describe the features of hyper parathyroidism, hypo parathyroidism, osteomalacia, rickets and osteoporosis and explain the physiological basis of the features.
6. Catecholamines
- 6.1. Recall the embryonic origin of adrenal medulla and its relationship to sympathetic ganglia.
 - 6.2. Name the types of catecholamine receptors found in each tissue/organ and examples of the substances that stimulate and inhibit them.
 - 6.3. Describe the actions of adrenalin (epinephrine) and noradrenalin (norepinephrine) on,
 - a. Cardiovascular System,
 - b. Respiratory System,
 - c. Intermediary Metabolism, and
 - d. Other tissues in the body.
 - 6.4. Describe the similarities and differences between the actions of autonomic nervous system and secretions of adrenal medulla.
 - 6.5. Describe the regulation of secretion and its relevance to preparedness in emergency situations.
 - 6.6. Outline the clinical use of adrenaline and the possible problems associated with its administration
 - 6.7. Describe features of a person with excess secretion of catecholamines.
7. Adrenocorticotrophic Hormone
- 7.1. List the actions of ACTH on adrenal cortex.
 - 7.2. Explain the actions of ACTH on melanocytes.
 - 7.3. Describe the factors that regulate the secretion of ACTH.
8. Glucocorticoids
- 8.1. Recall the histology of adrenal cortex and the hormones secreted by the different layers.
 - 8.2. Recall the structure of the steroid hormones and the mode of transport in blood.
 - 8.3. Describe the actions of glucocorticoids on carbohydrate, protein and fat metabolism.
 - 8.4. Describe the permissive actions of glucocorticoids and its importance in stress.
 - 8.5. Describe the actions of glucocorticoids on the skin, elements of blood, bone, gastrointestinal tract, muscle and nervous system.
 - 8.6. Describe the influence of the hormone on inflammation and immune system.
 - 8.7. Describe the actions of glucocorticoids on electrolyte balance.

- 8.8. Describe the regulation of secretion of the hormone.
 - 8.9. Explain the features seen in patients with excess and deficiency of the hormone.
 - 8.10. Describe the physiological basis of the use of these hormones in clinical practice and the risks involved.
9. Mineralocorticoids
- 9.1. Describe the actions of this hormone in renal tubule.
 - 9.2. Mention the other sites where this hormone acts.
 - 9.3. Describe the factors that influence the secretion of the hormone.
 - 9.4. Explain the role of this hormone in fluid and electrolyte balance.
 - 9.5. Describe the features of patients with excess or deficiency of the hormone.
 - 9.6. Explain why life is not possible without this hormone.
10. Anti-Diuretic Hormone
- 10.1. State the site of synthesis and the mode of transmission to posterior pituitary and mechanism of release.
 - 10.2. State the mechanism of action in the tubules of kidney.
 - 10.3. Describe the action on vessels at pharmacological doses.
 - 10.4. Describe the regulation of secretion by osmo-receptor and volume receptor mechanisms.
 - 10.5. Describe the effect of ADH on water balance and its contribution to maintenance of osmolality and extracellular fluid volume.
 - 10.6. Describe the other factors that influence secretion and their effect on water balance.
 - 10.7. Describe the problems of ADH deficiency or receptor non-response.
 - 10.8. Explain the water deprivation test and its relevance.
11. Oxytocin
- 11.1. State the site of synthesis and the mode of transmission to posterior pituitary and the mechanism of release.
 - 11.2. Describe the actions in breast, uterus and vas deferens.
 - 11.3. Describe the regulation of secretion during parturition, suckling of breast and sexual act.
 - 11.4. Outline the basis for its use in clinical practice.
12. Growth hormone
- 12.1. Name the cell type that secretes growth hormone.
 - 12.2. Outline the secretion of somatomedins by the liver and other tissues and their actions.
 - 12.3. Describe the action of growth hormone on carbohydrate, fat and protein metabolism and the relationship to actions of insulin.
 - 12.4. Describe the action on somatic growth.

- 12.5. Describe the regulation of secretion by hypothalamus and its own feedback.
 - 12.6. Describe the other factors that influence secretion.
 - 12.7. Describe the changes and their physiological basis observed in patients with hyper secretion and hypo secretion of the hormone in young and adult patients.
13. Pituitary gland
- 13.1. Outline the development, structure and histology of the gland.
 - 13.2. Explain the nervous and humeral connections of the gland with hypothalamus.
 - 13.3. State the hormones secreted by different parts of the pituitary and their target organs.
 - 13.4. Describe the changes seen in panhypopituitarism.
14. Local Hormones
- 14.1. State the location of pineal gland.
 - 14.2. Describe the regulation of secretion of melatonin.
 - 14.3. Describe the proposed actions of melatonin in relation to diurnal cycle and puberty.
 - 14.4. Describe the sites of secretion, regulation of secretion, mechanisms of actions, and physiological actions of the following hormones:
 - a. Renin
 - b. Angiotensin
 - c. Erythropoietin
 - d. Gastrointestinal hormones
 - e. Leptin
 - f. Peptide YY
 - g. Histamine
 - h. 5 Hydroxy Tryptophan
 - i. Prostaglandins and related substances

Chapter 9

ENERGY BALANCE

1. General

- 1.1. Explain the need of energy for life.
- 1.2. State the law of conservation of energy.
- 1.3. State the units in which energy is measured.

2. Energy usage

- 2.1. Compare and contrast the energy release of an explosion, motor vehicle and human body.
- 2.2. List the activities of the body that require energy.
- 2.3. Define metabolic efficiency of muscles and compare it with mechanical devices.
- 2.4. Describe the role of ATP as the currency for usage of chemical energy in the body.
- 2.5. List the metabolic substrates that provide energy in the body and the metabolic end products of each substance.
- 2.6. State the preferred substrates of brain, heart and skeletal muscles and outline the consequences of deficiency of these substrates.
- 2.7. Explain the relationship between oxygen consumption and carbon dioxide production and energy metabolism.
- 2.8. Define respiratory quotient and respiratory exchange ratio and explain the factors that affect them.

3. Energy balance

- 3.1. State the energy balance equation.
- 3.2. Recall the body composition and state the amount of energy substances that are stored energy in the body.
- 3.3. State the amount of heat energy released by complete combustion of one gram (1 g) of carbohydrate, fat and protein in excess amounts of oxygen.
- 3.4. State the amount of heat energy released in combustion of carbohydrate, fat and protein by one liter (1 L) of oxygen.
- 3.5. Explain the similarities and differences in release of energy by combustion in the body and in the laboratory especially that of protein.
- 3.6. Describe the ports of entry and exit of energy into and out of the body and their effects on body energy store.
- 3.7. List the states of positive and negative energy balance and describe their physiological basis.

4. Measurements

- 4.1. Outline the method of measuring the chemical energy content of food items and excreta by bomb calorimetry.
- 4.2. Define energy eaten, energy absorbed and metabolizable energy intake and outline the methods of measuring them.
- 4.3. Describe the methods of measuring energy expenditure by direct calorimetry
- 4.4. Measure the energy expenditure [metabolic rate] by indirect calorimetry.
- 4.5. Outline methods of measuring energy storage by estimation of lean body and body fat.
- 4.6. Describe the merits and demerits of measuring body fat and body weight to indicate body energy store.
- 4.7. Explain the difficulties in measuring the components of the energy balance equation- namely metabolizable energy intake, energy expenditure and energy storage.

5. Regulation of Energy balance

- 5.1. Describe the constitutional, environmental, hormonal and other factors that affect energy metabolism.
- 5.2. Describe the relationship between the environmental temperature and metabolic rate (the U curve) and explain the mechanisms that cause increase in metabolic rate at both extremes of temperatures.
- 5.3. Define specific dynamic action of food (heat increment of food) and explain its effect on metabolic rate with reference to dietary protein, fat and carbohydrate.
- 5.4. Define basal metabolic rate and explain its relevance.
- 5.5. Describe the factors that affect energy intake and its regulation.
- 5.6. Describe the mechanisms postulated as regulators of energy expenditure and energy storage.

6. Energy requirements:

- 6.1. Outline the energy requirements at different phases of life
- 6.2. Describe the relation of energy requirement to physical activity.
- 6.3. State the amount of energy available in common food items and work out the energy consumed by a person in one day.
- 6.4. Recall the composition of the balanced diet in terms of energy content and nutrient content.

7. Abnormalities of Energy Balance

- 7.1. Outline the causes and associated health hazards of obesity.
- 7.2. Outline the causes and associated health hazards of anorexia nervosa and protein calorie malnutrition.
- 7.3. Describe the value of measuring body weight, skin fold thickness, and body mass index as indicators of state of health.

Chapter 10

TEMPERATURE REGULATION

1. General
 - 1.1. Differentiate between the core and surface temperatures.
 - 1.2. Explain the need for maintaining the core temperature at 37° C and state the viable range of temperatures.
 - 1.3. Measure body temperature.
 - 1.4. Describe the methods available to measure core temperature and merits and demerits of each method.
 - 1.5. Describe the diurnal and cyclical changes in temperature observed in healthy individuals.
2. Heat exchange and factors affecting body heat
 - 2.1. Describe the means of heat exchange between the body and the environment [conduction, convection, radiation and evaporation].
 - 2.2. Explain the effect of skin color, environmental temperature, clothing, wind and humidity in heat exchange.
 - 2.3. Describe the role of subcutaneous fat as an insulator.
 - 2.4. Describe the role of blood in bringing heat to surface across the fat insulation.
3. Regulation
 - 3.1. Describe the special features of the circulatory system which make it an important component of thermoregulation.
 - 3.2. State the locations of the thermo receptors.
 - 3.3. State the location of thermoregulatory center.
 - 3.4. Describe the action of efferents from the thermoregulatory center in the following:
 - a. Blood flow to skin.
 - b. Sweating.
 - c. Tension in skeletal muscle and shivering.
 - d. Behavioral changes.
 - 3.5. Describe the relative importance of the above mechanisms and state the temperatures at which they become operational.
 - 3.6. Describe the role of brown adipose tissue in heat production of infants.
4. Thermal comfort and Failure of thermoregulation
 - 4.1. Describe the factors that contribute to the feeling of thermal comfort.
 - 4.2. Describe the role of alcohol in providing thermal comfort and its risks.
 - 4.3. Describe the response of the skin to extreme cold (frost bite).
 - 4.4. Describe the effects of extreme hot and humidity on the body (heat stroke).

- 4.5. Describe the factors leading to hyperthermia and hypothermia
- 4.6. Explain the mechanism of fever (pyrexia) and outline the principles of drug treatment.
- 4.7. Outline the advantages and disadvantages of fever
- 4.8. Describe the advantages and disadvantages of the use of cold water and lukewarm water in hyperpyrexia.
- 4.9. Explain the need for special thermal care for preterm babies.

Chapter 11

RENAL PHYSIOLOGY

1. General
 - 1.1. Recall the microscopic and macroscopic structure of the kidney, ureters, urinary bladder and urethra.
 - 1.2. List and describe the functions of the kidney.
 - 1.3. Outline the nerve supply of the kidneys and their possible function.
2. Renal Circulation
 - 2.1. State the renal blood flow and plasma flow in a resting person.
 - 2.2. Describe the special features of the arteries and capillaries in kidneys especially in relation to glomerular and tubular functions.
 - 2.3. Describe the regulation of the renal blood flow.
 - 2.4. Describe the methods available to measure renal blood flow.
3. Glomerular function
 - 3.1. Describe the electron microscopic structure of the glomerulus and state the size of the pores found in each layer.
 - 3.2. State the hydrostatic pressures found at the beginning and end of the glomerular capillaries.
 - 3.3. Describe the forces responsible for glomerular filtration and compare it with filtration in other tissues.
 - 3.4. Define glomerular filtration rate and describe its measurement.
 - 3.5. List the factors that affect glomerular filtration rate and describe their significance.
 - 3.6. Define glomerular filtration fraction and describe the factors that affect filtration fraction.
 - 3.7. State the composition of the filtrate and describe how it differs from plasma.
 - 3.8. Outline how filtration could be altered in disease states.
4. Tubular Function
 - 4.1. List the substances absorbed in the proximal convoluted tubule and describe their mechanisms.
 - 4.2. Define transport maximum and state the value of transport maximum of glucose (T_{mG}).
 - 4.3. Define the renal threshold and state the value of the renal threshold for glucose.
 - 4.4. Describe the glycosuria – renal glycosuria and diabetes mellitus
 - 4.5. List the substances that diffuse out of the tubule, that are excreted in to the tubule and the substances that pass without any influence.

- 4.6. State the change in composition and the amount of the fluid that passes into the loop of Henle.
 - 4.7. Describe the special properties and the absorptive function of the descending and ascending loops of Henle.
 - 4.8. Describe the special properties and the absorptive function of the distal convoluted tubule.
 - 4.9. Describe the regulation of sodium absorption in the distal tubule and its significance in electrolyte balance.
 - 4.10. Describe the renal mechanism of potassium balance.
 - 4.11. State the composition of the fluid that leaves the distal convoluted tubule and its tonicity.
 - 4.12. Describe the properties of the distal convoluted tubule and the collecting duct and the action of Anti Diuretic Hormone on them.
 - 4.13. Outline the countercurrent exchange and multiplier systems and describe their importance in concentrating the urine and the regulation of water balance.
 - 4.14. Describe the excretion of urea and its relation to urine flow.
 - 4.15. State the urine flow of a healthy person.
 - 4.16. Define the obligatory urinary output and explain the physiological basis and clinical significance of it.
5. Acid base balance
- 5.1. Describe the excretion of hydrogen ions and re-absorption of bicarbonate in the proximal convoluted tubule.
 - 5.2. State the minimum pH that can be achieved in the tubule.
 - 5.3. Describe the mechanisms available to buffer excess hydrogen ions secreted in to the lumen.
 - 5.4. Describe the excretion of hydrogen in the distal tubule and its regulation.
 - 5.5. Explain the relationship between the excretion of hydrogen and potassium.
 - 5.6. Describe the renal and respiratory mechanisms that regulate acid-base balance and their effects on plasma pH and bicarbonate concentrations.
6. Renal function tests
- 6.1. Explain the term “clearance”.
 - 6.2. Describe the use of clearance in measurement of renal plasma flow, glomerular filtration rate and assessment of tubular function.
 - 6.3. Measure the urine flow and specific gravity of urine and explain their significance.
 - 6.4. List the other tests performed to assess renal function and describe their physiological basis.

7. Micturition

- 7.1. Describe the mechanism of transport of urine in the ureters.
- 7.2. List the nerves that are responsible for bladder sensation and contraction.
- 7.3. Describe the micturition reflex and its higher control.
- 7.4. Describe the emptying of urethra in males and females
- 7.5. Outline the effects of nerve lesions on micturition.

Chapter 12

REPRODUCTIVE PHYSIOLOGY

1. General
 - 1.1. Explain the differences between reproduction and other physiological functions of the body.
 - 1.2. Outline the biological basis of division of the community into males and females.
 - 1.3. Outline the emotional and instinctive nature of sexual behavior of the individuals.
 - 1.4. Outline the role of a male and a female in producing the offspring and the responsibility of each partner to this process.
 - 1.5. Outline the basis of gender
 - 1.6. Define reproductive health, describe its importance and describe the ways and means of achieving it.
2. Reproductive function in male
 - 2.1. State the source and regulation of androgens at different stages of life.
 - 2.2. Outline the development of the male genitalia and the role of chromosomal pattern and androgens in this process.
 - 2.3. Explain the possible mechanisms that initiate puberty.
 - 2.4. Explain the changes brought about by the androgens during puberty.
 - 2.5. Explain the regulation of secretion of testosterone and its functions in adults.
 - 2.6. Explain the stages of spermatogenesis and the factors that influence this process.
 - 2.7. Explain the role of epididymis and vas deferens in maturation and storage of sperms.
 - 2.8. List the constituents of the secretions of seminal vesicle and prostate gland and explain their relevance.
 - 2.9. Describe the characteristics of semen
 - 2.10. Describe the factors that affect male fertility.
 - 2.11. Explain the reflex mechanisms of erection, emission, and ejaculation and the influence of higher centers on these.
 - 2.12. Explain the changes in autonomic nervous system, cardiovascular system and the rest of the body during male sexual act.
 - 2.13. Outline the relevance of the physiology and psychology of sex in clinical practice.
3. Reproductive function in female
 - 3.1. State the source and regulation of oestrogens and androgens at different stages of life.
 - 3.2. Outline the development of the female genitalia and the factors that regulate the process.
 - 3.3. Explain the possible mechanisms that initiate puberty.

- 3.4. Explain the changes brought about by the oestrogens and androgens during puberty.
- 3.5. Describe the cyclical secretion of the gonadotrophins and the role of hypothalamus in the regulation of the secretion.
- 3.6. Describe the cyclical changes and hormonal output of the ovaries (ovarian cycle).
- 3.7. Describe the cyclical changes that occur in the uterus, especially in the endometrium (menstrual cycle), cervix of the uterus, vagina and the rest of the body.
- 3.8. Describe the factors that initiate menstrual flow, constituents and characteristics of the flow
- 3.9. Outline the causes and the consequences of abnormal menstrual flow.
- 3.10. Describe ovulation and its indicators.
- 3.11. Describe the fertile period in the menstrual cycle.
- 3.12. Explain the factors that influence movement of sperms in the female genital tract.
- 3.13. Explain the reflex mechanisms of activation of erectile tissue, mucus glands, and relaxation of the vaginal sphincters and the influence of higher centers on these.
- 3.14. Explain the changes in autonomic nervous system, cardiovascular system and the rest of the body during female sexual act.
- 3.15. Outline the relevance of the physiology and psychology of sex in clinical practice.

4. Pregnancy

- 4.1. Explain fertilization, transport of zygote and implantation in the uterus.
- 4.2. Outline the needs for contraception and the physiological basis of the male and female methods of contraception.
- 4.3. Outline the male and female causes of sub-fertility and the investigations to identify the cause of sub-fertility.
- 4.4. Outline the circumstances which necessitate assisted conception.
- 4.5. Explain the role of trophoblast in causing amenorrhea of pregnancy
- 4.6. Explain the development of placenta and its function in relation to,
 - a. supply of nutrients to fetus.
 - b. respiratory gas exchanges and the mechanisms that aid the process.
 - c. transfer of antibodies.
 - d. excretion of the waste products of the foetus.
- 4.7. List the hormones that are secreted by the placenta at different stages of pregnancy and the functions of these hormones in relation to the pregnancy and in preparing the mother for lactation.
- 4.8. Outline the changes that occur in the mother's body during pregnancy especially with regard to:
 - a. body weight,
 - b. metabolism,
 - c. cardiovascular system
 - d. respiration

- e. gastrointestinal tract, and
- e. endocrine function.
- 4.9. Explain the physiological basis of nutritional care during pregnancy.
- 4.10. Outline the possible mechanisms that initiate parturition.
- 4.11. Outline the events during parturition and the possible risks.
- 4.12. Explain the initiation of breathing of the baby and outline the care needed for the baby at that time.
- 4.13. Describe the changes that occur in the uterus and the rest of the body after parturition.

5. Lactation

- 5.1. Recall the histology of breast.
- 5.2. List the hormones that influence the development of breast, prepare it for lactation and describe their actions.
- 5.3. Describe the secretion of milk and the hormonal control of lactation especially with regard to prolactin, oxytocin and oestrogen.
- 5.4. Describe the factors that affect the secretion of oxytocin and prolactin and the importance of suckling of the breast by the baby in establishing lactation.
- 5.5. List the important constituents of colostrum and their physiological significance.
- 5.6. Outline the physiological basis of nutritional care of the lactating mother.
- 5.7. Explain the benefits of breast feeding to the baby, mother and in family planning.

Chapter 13

NEUROPHYSIOLOGY

1. Introduction
 - 1.1. Outline the functions of the nervous system
 - 1.2. Recall the phylogeny and ontogeny of the nervous system
 - 1.3. Recall the structure of the spinal cord
 - 1.4. Outline the importance of encephalization and the divisions of the brain
 - 1.5. List the structures and the functions of alar, basal and intermediate laminae.
 - 1.6. Recall the structure and function of the meninges
2. Cerebrospinal Fluid
 - 2.1. Recall the structure of central canal of the spinal cord, ventricles in the brain, sub-arachnoid space and the foramina through which they communicate
 - 2.2. Describe the choroid plexus
 - 2.3. Describe the secretion, circulation and re-absorption of CSF
 - 2.4. Describe the functions of CSF
 - 2.5. List the constituents of CSF, compare the concentrations with that of plasma and outline the changes in diseases
3. Sensory System (cutaneous sensation)
 - 3.1. Define receptor and receptive field
 - 3.2. Recall the membrane potentials and their ionic basis
 - 3.3. Describe the genesis of receptor potential and action potential
 - 3.4. List the sensory modalities
 - 3.5. Classify the receptors based on their properties
 - 3.6. Describe the pathways of transmission of various sensory modalities from the receptor to the sensory cortex.
 - 3.7. Describe the characteristics of sensory modalities in relation to type of fibers involved, velocity of conduction and inbuilt emotional response
 - 3.8. Describe the mechanisms that influence transmission of sensory modalities to the sensory cortex
 - 3.9. Outline the representation of the areas of the skin in sensory cortex
 - 3.10. List the advantages and disadvantages of pain sensation
 - 3.11. Describe fast and slow pain, their cause and their transmission
 - 3.12. Describe the sensations and transmission of sensations arising from deep structures and viscera
 - 3.13. Describe the autonomic effects of pain sensation and the basis of neurogenic shock

- 3.14. Outline the mechanisms that reduce or increase pain sensation
- 3.15. Outline the neural structures that are involved in perception of pain, collaterals from the main sensory pathway to these structures and the genesis of symptoms and signs that are associated with pain
- 3.16. Describe referred pain, its basis and the importance in clinical practice
- 3.17. Describe reflexes associated with somatic sensation
- 3.18. Describe the neural basis of somatic sensation
- 3.19. Examine the sensory system and describe the basis of deducing the site of lesion on the information gathered by clinical examination
- 3.20. Outline the function of sensory association area in the cortex and stereognosis

4. Motor System

- 4.1. Recall the properties of skeletal and smooth muscles
- 4.2. Differentiate the somatic and autonomic motor nervous systems and the exceptions
- 4.3. Outline the genesis and the principles of voluntary movement
- 4.4. Define the lower motor neuron [final common pathway]
- 4.5. Describe the motor unit and its significance
- 4.6. List the pathways that converge on the LMN
- 4.7. Describe the muscle spindle, its connections and functions
- 4.8. Describe the stretch reflex and inverse stretch reflex
- 4.9. Describe the withdrawal reflex
- 4.10. Describe the pyramidal [corticospinal] and extra pyramidal tracts
- 4.11. State the cortical areas that are involved in motor function and outline their functions
- 4.12. Outline the representation of the body in the primary motor cortex
- 4.13. Relate the difference in the cortical control of the axial and distal muscles to their functions
- 4.14. Describe the features of lower motor neuron lesion
- 4.15. List the features of upper motor neuron lesion during spinal shock and afterwards
- 4.16. Recall the structure and evolution of cerebellum
- 4.17. Outline the functional divisions of the cerebellum
- 4.18. List the functions of the cerebellum
- 4.19. List the afferents and the information carried by them to the cerebellum
- 4.20. Relate the afferents and efferents of the cerebellum to the functions of the cerebellum
- 4.21. List the features of cerebella dysfunction

- 4.22. List the nuclei that form the basal ganglia
- 4.23. List the functions of the basal ganglia and relate them to its connections.
- 4.24. List the features of basal ganglia dysfunction
- 4.25. List the posture regulating mechanisms at various levels of the nervous system and outline their significance.
- 4.26. Perform clinical examination of the motor system

5. Thalamus and Hypothalamus

- 5.1. Recall the location of the thalamus and its relations
- 5.2. Outline the gross subdivisions of the thalamus and their functions
- 5.3. Recall the location of the hypothalamus and its relations
- 5.4. Outline the gross subdivisions of hypothalamus
- 5.5. List the functions of hypothalamus and relate them to the autonomic nervous system and endocrine glands.

6. Limbic System

- 6.1. Outline the evolution of the limbic system
- 6.2. List the structures that form the limbic system and their connections
- 6.3. Outline the characteristics of limbic circuit and relate them to the emotional reactions.
- 6.4. Describe the functions of the limbic system as a whole
- 6.5. Describe the functions of amygdala, hippocampus and the hypothalamus and the effects of stimulation and lesions of these areas

7. Higher functions of the brain

- 7.1. Outline the structural divisions of the cerebral cortex
- 7.2. Map the functional areas of the cerebral cortex and state the function of each area
- 7.3. Describe the similarities and differences in structure and function of the two cortices and their relation to right or left handedness
- 7.4. Describe aphasias and outline the causes.

8. Sleep and arousal

- 8.1. Outline the principles of electroencephalogram
- 8.2. State the types of waves seen in EEG
- 8.3. Outline the mechanism responsible for the state of arousal
- 8.4. Outline the mechanisms responsible for sleep
- 8.5. Describe the stages of sleep and the changes at different ages

- 8.6. State the number of hours of sleep recommended at different ages
- 8.7. Describe the ratio of REM and NREM sleep at different ages
- 8.8. Describe the important sleep disorders
- 8.9. Discuss the contribution of sleep to health, learning and memory
- 8.10. Discuss the problems of sleep deprivation

9. Eye

- 9.1. Recall the structure of the eye
- 9.2. Describe the lacrimal gland, secretion of tears, circulation of tears and its functions
- 9.3. Describe the secretion of aqueous humor, its circulation and functions.
- 9.4. Describe the consequences of defective circulation of aqueous humor
- 9.5. Outline the nourishment of different parts of the eye
- 9.6. Recall the principles of refraction of light
- 9.7. Describe the image formation on the retina, near point, near response, abnormalities of refraction and the lenses used to correct them.
- 9.8. Recall the histology of the retina and the blood supply
- 9.9. Describe the optic disc and macula and identify them in a printed image of ophthalmoscopy
- 9.10. Describe the receptors, their response to light and their distribution in retina
- 9.11. Outline the role of amacrine cells and horizontal cells in modifying the image
- 9.12. Describe the convergence to ganglion cells at different parts of the retina
- 9.13. Describe the visual pathway to visual cortex
- 9.14. Outline the cortical mechanisms in perception of visual sense
- 9.15. Describe the field of vision including the blind spot and the abnormalities of field of vision and their causes
- 9.16. Describe the principle of color vision and color blindness
- 9.17. State the visual spectrum of different receptors, visual threshold and describe adaptation to light and dark
- 9.18. Describe the principle of visual acuity and the factors that determine visual acuity
- 9.19. Outline the process of perception of images and visual illusions
- 9.20. Describe the perception of depth in the field of vision
- 9.21. Describe the eye movements and outline the causes and consequences of strabismus
- 9.22. Describe light reflex

- 9.23. Examine the eye for intra ocular pressure, visual field, visual acuity, color vision and determination of the diameter of optic disc

10. Ear

- 10.1. Recall the properties of sound
- 10.2. Recall the structure of external, middle and internal ear
- 10.3. Describe perception of sound through the external ear and the factors that can block this
- 10.4. Recall the structure of the ossicles of the middle ear and the joints between them and their attachment to tympanic membrane and oval window
- 10.5. Describe the amplification and transmission of sound by the ossicles
- 10.6. Describe the action of tensor tympani and stapedius muscles and the auditory reflexes
- 10.7. Describe the mechanism of equalizing the external pressure with that of middle ear
- 10.8. Outline the factors that affect transmission through middle ear
- 10.9. Recall the structure of the internal ear
- 10.10. Describe the transmission of vibrations to the basilar membrane and the relationship between the frequency and the area of maximal vibration
- 10.11. Outline the auditory pathway up to the auditory cortex
- 10.12. Describe the neural factors that alter hearing
- 10.13. Outline the causes of deafness
- 10.14. Identify the type of hearing loss by tuning fork test and from audiogram

11. Vestibule

- 11.1. Recall the structure of the vestibule
- 11.2. Describe the response of receptors in vestibule to linear and rotational movements
- 11.3. Outline the vestibular pathway
- 11.4. Outline the causes of motion sickness and abnormal functions of the vestibule

12. Taste and Smell

- 12.1. Recall the evolution of the chemical senses
- 12.2. Recall the structure of taste buds and olfactory epithelium
- 12.3. Describe how taste substances and odorants reach the respective receptors
- 12.4. Describe the reflexes associated with taste and smell
- 12.5. Describe the properties of the receptors
- 12.6. Describe the emotional component of these receptors and their survival value

- 12.7. Outline the central connection of the receptors
- 12.8. List the taste modalities and different orders.
- 12.9. Discuss the chemical/structural basis of classification of taste and smell receptors
- 12.10. Describe pheromones and their role in human sexuality
- 12.11. Outline the abnormalities in taste and smell