

Ph.D. Entrance Syllabus for Physiology **Theory**

General Physiology

Introduction to Physiology. Principles of Homeostasis. Structure of cell membrane, Intercellular communications. Mechanisms of Transport across cell membrane. Body Fluid compartments. Blood volume. Apoptosis and aging.

Hematology

Blood-Functions, composition, properties. Plasma proteins.

Red Blood cells. Morphology, composition, functions, normal RBC count and variation properties, Red Blood Cell Indices.

Hemoglobin-structure, normal content, functions, types, abnormal Hb. Factors influencing and regulating Erythropoiesis.

Life span of RBC and its destruction, jaundice. Anaemia-definition, classification (etiological, morphological), physiological basis of Anaemia, Investigations.

White Blood Cells

Classification, morphology, life span. Properties and functions. Normal total and differential count, Absolute count. Variations. Leucopoiesis.

Immunity. Definition, Types-innate and acquired, Humoral and cellular

Mechanism of immune response, plasma cell, immunoglobulins. Autoimmune disorders, AIDS.

Platelets. Morphology, properties and functions, normal count, variations, thrombopoiesis and factors influencing this. Reticuloendothelial system.

Haemostasis.

Primary (Vasospasm, platelet plug formation) and secondary (extrinsic and intrinsic mechanism of coagulation of blood). Clot retraction.

Anticlotting mechanism in vivo. Anticoagulants used in lab and vitro. Bleeding disorders.

Tests for bleeding disorders. Thrombosis and Embolism.

Blood groups ABO and Rh system, inheritance, differences, Bombay Blood group. Landsteiner's law I and II.

Other minor blood groups, etc. Blood grouping and cross matching, concept of universal donor and recipient.

ABO & Rh incompatibility. Management and preventive measures, Medico-legal and clinical importance.

Blood transfusion-indications, precaution and complications.

Blood bank-anticoagulants used, Change during storage. Transfusion of blood components with special reference to recent advances. Lymph formation, circulation & functions.

Tissue fluid-formation, circulation and functions. Starling's hypothesis-edema formation.

Cardiovascular System

Functional anatomy of heart and blood vessels. Properties of cardiac muscle.

Conducting system of heart. Part of conducting system, origin and spread of cardiac impulse. Abnormal pacemakers, Conduction defects.

Cardiac cycle: Definition, phases, events of cardiac cycle. Volume and Pressure changes in different chambers and major vessels. Heart sounds-causes character Physiological basis. Arterial Pulse genesis, character of normal pulse, common abnormalities. Venous blood flow venous tone, valves, factors affecting blood flow.

Correlation between different events of cardiac cycle.

Non invasive investigation of cardiology. ECG. Definition, Principles of recording of ECG. Leads. Normal tracing in all leads.

In lead II- normal waves, interval and segments, how HR is determined, correlation with action potential and phases of cardiac cycle.

Clinical uses of ECG.

Abnormal ECG pattern in myocardial infarction, cardiac arrhythmias. Effect of changes in ECF K^+ , Ca^{++} and Na^{++} .

Conduction defects. Cardiac output.

Definition, normal values, variations. Methods of measurement.

Regulation of cardiac output Correlation of normal ECG pattern with events of cardiac cycle in a diagram. Haemodynamics

Functional organisation and its correlation with structures of vascular system.

General principles, including physical laws governing flow of blood in heart and blood vessels Pressure-resistance - flow relationship.

Laminar flow, turbulent flow Reynold's number, critical closing volume.

Importance of peripheral resistance venous circulation, venous tone.

Regulation of blood flow local and general. Arterial Blood pressure.

Systolic and diastolic pressure definition, normal values, variation.

Define End pressure Perfusion and lateral pressure, Bernoulli principle. Pulse pressure, Mean arterial pressure.

Determination of systolic and diastolic pressure Measurement.

Regulation neural and humoral (short term, intermediate and long term).

Cardiovascular reflexes. Local regulation including regulation of blood flow, vasoconstrictor and vasodilator substances secreted by endothelium. Effects of gravity, Posture and Exercise on BP, Hypertension & hypotension, Regional circulation, Circulatory shock. Types, Pathophysiology stages, compensatory mechanism. Cardio-vascular adjustments in health and disease. Goldblatt Hypertension

Respiratory system

Introduction to organisation and functional anatomy of respiratory system. Functions of different parts of respiratory system including non respiratory functions. Mechanism of respiration. Surfactant. Law of Laplace-application.

Measurement of pulmonary ventilation.

Lung volumes and capacities.

Ventilation-pulmonary and alveolar. Dead space-Anatomical & Physiological.

Pressure-volume relationship. Elastic behavior of lungs, Lung compliance, dynamic and specific.

Airway resistance, work of breathing factors affecting bronchial tone. Pulmonary blood flow. Volume pressure factor influencing unique feature. Ventilation-perfusion ratio and its importance.

Pulmonary gas exchange. Composition of inspired air, alveolar and expired air, partial pressure gas composition of arterial and venous blood.

Mechanism of gas exchange. Structure of blood gas barrier factors affecting diffusion across respiratory membrane, diffusion capacity. O_2 transport in blood.

O_2 dissociation curve. CO_2 transport in blood. CO_2 dissociation curve.

Regulation of respiration

Neural control. Chemical control. Interaction between these chemical stimuli. Hypoxia.

Definition: Types, clinical features differences. Oxygen therapy.

Cyanosis, asphyxia and dyspnea, Definition CO poisoning.

Periodic breathing. Cheyne-stoke's and Biots breathing, voluntary hyperventilation.

Environmental physiology. High altitude, rapid ascent, mountain sickness, acclimatization.

Effect of UV rays, dysbarism. Effect of increased barometric pressure. Nitrogen narcosis,

High pressure nervous syndrome, Oxygen toxicity

Decompression sickness (Caissons disease). Pulmonary function tests.

Artificial respiration. Mouth to mouth, Holger-Neilson method mechanical methods, ventilators.

Gastro intestinal system.

Introduction to G.I Physiology. General organization of G.I tract Neural control of G.I function, enteric nervous system.

Mechanism of enzyme secretion by glands in general, Salivary glands. Functional anatomy (types and location) with relevant history.

Saliva:- Composition, functions, control of secretion Conditioned and unconditioned reflexes. Disturbances in salivary secretion.

Gastric secretion.

Functional anatomy of stomach and different gastric glands. Gastric juice: Composition functions, phases of secretion and regulation. Gastric HCL secretion-mechanism and regulation of secretion.

Mucosal barrier Pathophysiology of peptic ulcer. Pancreatic secretion –exocrine pancreas. Functional anatomy with relevant history.

Pancreatic juice: Composition, function and regulation of secretion. Applied importance. Liver and gall bladder.

Functions of Liver, Functional anatomy with relevant histology.

Composition and functions of bile, control of secretion. Function of gall bladder.

Enterohepatic circulation, jaundice. Small intestine. Functional anatomy with relevant history.

Composition, regulation secretion and functions of intestinal juice.

Small intestine-functions.

Movements of G.I Tract. Electrophysiology of smooth muscle in the GIT. Peristalsis. Mastication. Deglutition.

Gastric motility-types regulation, abnormal movements (vomiting, diarrhea).

Gastric emptying-duration factors affecting. Movements of small intestine.

Large intestine. Function-secretory, motor, absorptive, synthesis of short chain fatty acids. Defecation reflex. Role of dietary fibre, bacterial flora.

Renal Physiology

Introduction to Functions of kidney-homeostasis as an endocrine organ. Functional anatomy of kidney. Renal circulation.

Juxtaglomerular apparatus. Glomerular filtration. Clearance value. Tubular function. Tubular reabsorption.

Water, sodium, glucose, water, urea, electrolytes-sites, mechanism involved. Tubular secretion. Filtered load Tubular maximum, glomerulo tubular feedback and renal threshold. Acidification of urine. Concentration of urine.

Counter current system multiplier exchanger. Cortico medullary gradient, Osmotic gradient along renal tubules. Diuresis. Micturition. Functional anatomy of bladder and Innervation of bladder. Filling and emptying of bladder, Cystometrogram.

Micturition reflex and its higher control, voluntary control. Abnormalities of micturition. Urine, Normal volume, constituents.

Abnormal constituents –albuminuria glucosuria. Polyuria, Oliguria, Anuria.

Dialysis-artificial Kidney. Renal function tests. Skin and temperature regulation.

Structure and functions of skin. Methods of heat conservation and loss in human body.

Regulation of body temperature. Hyperthermia, fever, heart, stroke, hypothermia, cold injuries (frost bite).

Nerve –Muscle physiology

Excitable tissue. Definition, properties. Neuron.

Structure of typical neuron types properties & functions. Stimulus

Definition, types threshold subthreshold, suprathreshold. Nerve fibres.
Types, classification, and functions. Resting membrane potential.
Nerve action potential. Transmission of nerve impulses. Peripheral nerve injury.
Neuromuscular junction. Functional anatomy, transmission of impulses across neuromuscular junction. Neuromuscular blocking drugs.
Applied clinical aspects. Muscles. Classification. Skeletal muscle
Structures including molecular details. Action Potential. Molecular basis of muscle contraction. Types of muscle contraction. Muscle types-fast and slow.
Energy sources, and metabolism in muscle at rest and during contraction. Muscular changes during exercise. Length-tension relationship.
EMG. Fasciculation, fibrillation. Cardiac muscle. Structure Properties Action Potential.
Length-tension relationship. Smooth muscle. Types, Structure, innervation and neuromuscular junction. Potentials. Mechanism of contraction-Excitation-contraction coupling.
Plasticity.
Length-tension relationship.

Nervous system

Organisation of nervous system.
General organisation. Functional anatomy of brain and spinal cord.
Brain-lobes, functions, Brodmann's areas. Neuron, neuroglia-functions.
Spinal cord-Functional anatomy. Cross section with location of sensory, motor and autonomic neuron and tracts.
Cerebro spinal fluid. Ventricles of brain, Blood-brain barrier-importance.
CSF-formation, circulation, composition, functions, Lumbar puncture. Synapse and its types.
Functional anatomy of typical chemical synapse and synaptic transmission. Synaptic potential.
Properties of synapse. Synaptic inhibition.
Neurotransmitters and neuromodulators. Reflex action.
Definition, reflex arc components. Classification with examples.
Sensory receptors. Classification (recent view), types (phasic and tonic). properties-adaptation. Receptor potential, comparison with action potential. Sensation.
Classification. Sensory tracts. Organisation of sensory pathways.
Tracing of pathway from body and face. Pain sensation-details.
Different types of pain, Modulation of pain spinal level & supra spinal level.
Visceral pain, referred pain, radiating pain, clinical correlates. Altered pain sensations.
Thalamus. Functional anatomy, nuclei-classification, connection, Functions of thalamus.
Thalamic syndromes. Sensory cortex.
Location-primary area, secondary area association area. Salient histological features, Sensory homunculus, Definition, Reflex arc.
Classification of reflexes with examples. Stretch reflex, inverse stretch reflex, reciprocal Innervation, withdrawal reflex. Motor cortex.
Motor area. Motor homunculus. Descending tracts.
General organisation, Pyramidal and extra pyramidal tract and their functions.
Upper motor neuron and lower motor neuron and their lesion. Effect of lesions at various levels hemiplegia, paraplegia, monoplegia. Spinal cord injuries.
Injuries of spinal cord complete transection, incomplete transection, hemisection.
Section of anterior and posterior root, injury to motor nerve. Basal ganglia.
Organisation, connections, functions Disorders.
Cerebellum. Functional anatomy, functional and evolutionary divisions, functions.
Deep cerebellar nuclei, connections in relation to functions. Neuronal circuit.
Cerebellar lesion. Reticular formation. ARAS, Descending reticular system Control of muscle tone. Functions.
Limbic System. Organisation, connection and functions.

EEG and sleep. Define EEG, principle of recording. Normal waves, clinical uses. Vestibular apparatus. Functional anatomy.

Connections and vestibular pathway, functions. Muscle tone, posture, equilibrium.

Basis of maintenance-stretch reflex, higher control. Postural reflexes mention with levels of integration (detail not required). Regulation of muscle tone and posture. Hypothalamus.

Functional anatomy, Nuclei, connections and functions. **Higher functions of the brain. Learning. Memory. Speech.**

Autonomic nervous system. Organisation and functions.

Special Senses

Olfaction

Receptor, pathway, lesion.

Taste buds, receptor, primary taste sensations, pathway, lesion.

Vision.

Functional anatomy of eye.

Chambers of eye, intraocular fluids. Lens-characteristics, change with age, aphakia, cataract.

Retina- Histology, Macula lutea, fovea centralis. Basic optics. Optical system of the eye.

Refractive media of eye.

Concepts of reduced eye, image formation on retina. Emmetropic eye, Far and near points.

Accommodation and accommodation reflex (Near response). Errors of refraction, Presbyopia.

Contact lenses. Visual receptor (cones and rods).

Structure in detail.

Visual pigments, role of vitamin A. Photo transduction.

Adaptations of visual receptors-Dark adaptation and light adaptation.

Electrophysiology of receptors, receptor potential, lateral inhibition. Electroretinogram.

Duplex theory of vision, photopic and Scotopic vision. Muscles of eye.

Names, nerve supply and movements of eyeball.

Corresponding points double vision and squint. Color vision.

Primary, secondary and complementary colors. Hue, brightness and saturation.

Receptor. Trichromatic and Opponent process Theory.

Color blobs-location and function. Color blindness.

After images, contrasts. Visual pathway.

Monoocular and binocular vision. Visual signal-processing in the Retina.

Pathway-important feature to be specified at all levels. Effects of lesion at different levels.

Macular sparing (recent views). Visual cortex-all areas and functions. Visual

reflexes. Pupillary light reflex, direct and indirect pathway, lesion. Accommodation reflex-

pathway lesion. Corneal reflex pathway. Test of vision -field of vision visual acuity, color vision.

Audition.

Acoustics frequency, amplitude of sound pitch, intensity, and quality of sound.

Functional anatomy of the ear. Function of external middle and inner ear.

Hair cell physiology Mechanism electrical conduction by hair cells. Endocochlear

potential. Discrimination of pitch (travelling wave theory) and intensity of sound. Auditory

pathway. Sound localization, pitch discrimination masking of sounds. Deafness Audiometry

Endocrinology

General endocrinology. Names and organisation of Endocrine glands in human body. Hormone-definition and classification. Mechanism of actions of hormone.

Control of secretion of hormones in general +ve and -ve feed back. Abnormalities of hormone

functions Hormonal assay. Hypothalamus. Functional anatomy, hormone their physiological

actions. Interrelationship between hypothalamus and pituitary glands. Infundibulum-

Hypothalamo pituitary tract and portal system. Pituitary gland. Functional anatomy cell

types. Hormones of anterior and posterior pituitary. Growth hormones, Physiological action

and regulation of secretion, Hyper and hypo functions. Other hormones to be dealt with the

target glands. Mention intermediate lobe hormones-pro opiomelanocortin and MSH. Thyroid gland. Hormone-biosynthesis, transport, physiological action (physiologic, pharmacologic and pathologic and regulation of secretion (H-P T axis). Thyroid function Tests. Hyper and hypo function in children and adults. Pancreas-endocrine. Functional anatomy, Hormones physiological action and regulation of secretion. Hyper and hypo- function. Insulin-receptors and insulin resistance. Glucagon, Somatostatin, Pancreas & polypeptic Adrenal gland. Adrenal cortex. Functional anatomy. Hormones of adrenal cortex glucocorticoids, mineralcorticoids, sexsteroids. Biosynthesis, transport, physiological action and regulation of secretion. Hyper and hypo function. Adrenal medulla. Hormones(catecholamines) regulation of secretion, clinical aspects. Calcium homeostasis. Normal calcium metabolism. PTH, calcitonin and vitamin D target organ and physiological actions. Hypocalcemia and tetany.

Endocrine glands

Pituitary gland, thyroid, adrenal, Pancreas, Parathyroid, Pineal. Body, thymus, heart, endothelium. Mechanism of actions and physiological action of hormones. Physiology of growth and development. Physiology of reproduction. Genetic basis of sexual differentiation. Differentiation and development of reproductive system. Factors influencing development of genitalia. Puberty, normal, precocious and delayed puberty.

Reproductive system

Functional anatomy. Oogenesis, ovulation, Corpus luteum. Ovarian hormones, control of ovarian function By H-P-Gonadal axis. Pituitary gonadotropins (FSH, LH). Ovarian, Uterine and vaginal changes during menstrual cycle. Hormonal regulation. Abnormalities of ovarian functions. Menarche, menopause, Andropause, Castration before and after Puberty. Fertilisation, implantation, corpus luteum of pregnancy. Placenta-functions, Placental hormones, Foetoplacental unit. Pregnancy tests, Parturition-physiology of labor Oral contraceptives and their actions. Contraception-temporary and permanent methods in male and female and their Physiological basis.