

पाटन स्वास्थ्य विज्ञान प्रतिष्ठान, सेवा आयोग
प्राज्ञिक सेवा, शरीर क्रिया समूह, सहायक प्राध्यापक पद, नौ ख (९ ख) तहको
खुला र आन्तरिक प्रतियोगितात्मक परीक्षाको पाठ्यक्रम
Paper II: Technical Subject
Section (A) - 45 Marks

1. General and Cellular Physiology

- 1.1. General functional organization of human body
- 1.2. Cell-organelles and their functions.
- 1.3. Cell to cell and local communications, Transport across cell membrane
- 1.4. Body fluid compartments : Define and explain
- 1.5. Homeostasis: Definition, maintenance, control of internal environment, different regulatory systems in homeostasis.
- 1.6. Principles of control systems :
 - 1.6.1. General characteristics and components of biological control system.
 - 1.6.2. Concept of negative and positive feedback
 - 1.6.3. Correction, error and feedback gain
 - 1.6.4. Hormonal control mechanism: Definition of hormones, receptors and target cells.
Role of hormones in homeostasis.
 - 1.6.5. Neural control of mechanism: Role in homeostasis.
- 1.7. Membrane Potential:
 - 1.7.1. Resting membrane potential and action potential
 - 1.7.2. Receptor generator potential, properties and transduction
- 1.8. Synapses ultrastructure, properties, synaptic plasticity, neurotransmitters and mode of transmission.

2. Nerve and muscle physiology

- 2.1 Structure and functions of a neuron and neuroglia.
- 2.2 Nerve fibre types, function and nerve injury.
- 2.3 Molecular basis of resting membrane and action potential, compound action potential, Recording.
- 2.4 Structure and transmission across neuro-muscular junction.
- 2.5 Neuro-muscular blocking agents.
- 2.6 Skeletal Muscle:
 - 2.6.1 Functional anatomy and organization of skeletal muscle
 - 2.6.2 Skeletal muscle: properties, fiber types and applied aspects
 - 2.6.3 Molecular mechanism of skeletal muscle contraction-Membrane excitation; Excitation-contraction coupling; Sliding filament mechanism
 - 2.6.4 Mechanics of single fiber contraction
 - 2.6.5 Skeletal muscle energy metabolism
 - 2.6.6 Whole muscle contraction
 - 2.6.7 Characteristics of muscle contractility
 - 2.6.7.1 Contractile and elastic components of a muscle
 - 2.6.7.2 Concepts about muscle length
 - 2.6.7.3 Motor unit
 - 2.6.7.4 Contractile response
 - 2.6.8 Electromyography
 - 2.6.9 Disorders of skeletal muscles
 - 2.6.10 Muscle cramps, hypocalcemic tetany, muscular dystrophy, myasthenia gravis
- 2.7 Smooth Muscle
 - 2.7.1 Functional anatomy and organization

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- 2.7.2 Types of smooth muscles
- 2.7.3 Innervation and neuromuscular junction of smooth muscles
- 2.7.4 Process of excitability and contractility
- 2.7.5 Characteristics of smooth muscle excitation and contraction
 - 2.7.5.1 Slow excitation–contraction coupling
 - 2.7.5.2 Plasticity
 - 2.7.5.3 Latch phenomenon
 - 2.7.5.4 Marked shortening of a smooth muscle during contraction
 - 2.7.5.5 Energy required to sustain smooth muscle contraction
- 2.7.6 Excitation and inhibition of smooth muscles

3. Autonomic nervous system

- 3.1. Anatomical organization of nervous system
- 3.2. Functional organization of nervous system: Divisions, distribution and functions.
- 3.3. Higher control of autonomic nervous system.
- 3.4. Physiological role of autonomic nervous system.

4. Blood, reticulo-endothelial and immune system

- 3.5. Blood as a body fluid: Composition and functions of blood.
- 3.6. Plasma: Normal constituents.
- 3.7. Plasma Proteins: Types, concentrations, properties and functions.
- 3.8. Blood cells: Types, distribution and overview of haematopoiesis.
- 3.9. Erythrocytes - morphology, functions, fate, normal count, PCV, ESR, Fragility, haemolysis.
- 3.10. Erythropoiesis: Definition, stages and regulating factors.
- 3.11. Blood indices and their clinical usefulness.
- 3.12. Anemias and polycythemia
- 3.13. Leukocytes classification, morphology, normal counts, functions, development and related applied aspects.
- 3.14. Platelets morphology, functions, development and related applied aspects.
- 3.15. Blood groups
 - 3.15.1. Agglutinogens and agglutinins, Landsteiner's law, ABO and Rh group, minor blood groups
 - 3.15.2. Blood transfusion relation of blood groups, indications, hazards and storage of blood, inheritance, hemolytic disease of the new born.
- 3.16. Haemostasis: Physiology of coagulation, tests for clotting, clot retraction, and anticoagulation, Bleeding and coagulation disorders.
- 3.17. Reticuloendothelial system: Functions of spleen and lymph nodes.
- 3.18. Lymph and tissue fluids: Formation and functions.
- 3.19. Immunity and its disorders.

5. Respiratory system:

- 5.1. Functional anatomy of respiratory system
- 5.2. Mechanics of breathing: Movements of thoracic cage during respiration, muscles involved and their nerve supply, intrapleural and pulmonary pressure and volume changes, pressure-volume inter-relationships, lung compliance - surfactant, airway resistance, work of breathing.

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- 5.3. Spirometry, lung volumes & capacities: Definitions, normal values, significance and special features.
 - 5.4. Pulmonary gas exchange: Alveolar-capillary membranes, diffusion capacities, partial pressure gradients and factors influencing diffusion of gases, measurement of diffusion capacity using carbon monoxide.
 - 5.5. Applied physiology shunt and alveolar-capillary block
 - 5.6. Ventilation perfusion ratio and its importance in respiratory diseases.
 - 5.7. Gas Transport
 - 5.7.1. Oxygen transport - factors influencing the combination of hemoglobin with oxygen, oxygen-hemoglobin dissociation curve- plotting, features, physiological advantage of its shape, factors affecting its shift and Bohr's effect.
 - 5.7.2. Carbon dioxide transport - tissue uptake, carriage in blood and release at the lungs importance of red blood cell, chloride shift, role in acid base balance, Haldane effect.
 - 5.8. Regulation of respiration :
 - 5.8.1. Nervous mechanism: Respiratory centers-Medullary centers, Pontine centers, Connections of respiratory centers, Integration of respiratory centers, Factors affecting respiratory centers
 - 5.8.2. Chemical mechanism: Central chemoreceptors, Peripheral chemoreceptors, chemical and non-chemical influences on respiration, integrated response
 - 5.9. Respiration in unusual environments :
 - 5.9.1. High altitude hypoxia and space flight
 - 5.9.2. Deep sea diving: nitrogen narcosis, hyperbaric oxygen and oxygen toxicity.
 - 5.10. Abnormal breathing: Apnoea, hyperpnoea, tachypnoea, dyspnoea, Cheyne- stokes breathing and Biot's breathing- definition, features and physiological basis.
 - 5.11. Hypoxia, cyanosis and their types.
 - 5.12. Artificial respiration: Definition, types, principles, indications, advantages and disadvantages.
 - 5.13. Pulmonary function tests
 - 5.13.1. Measurement of lung volumes and capacities
 - 5.13.2. Measurement of functional residual capacity and residual volume
 - 5.13.3. Vital capacity
 - 5.13.4. Forced expiratory volume or timed vital capacity
 - 5.13.5. Respiratory minute volume
 - 5.13.6. Maximum breathing capacity or maximum ventilation volume
 - 5.13.7. Peak expiratory flow rate
 - 5.13.8. Restrictive and obstructive respiratory diseases
 - 5.14. Pulmonary abnormalities.
- 6. Cardiovascular system :**
- 6.1. Heart as a mechanical pump: Design of systemic and pulmonary circulation. Introduction of the venous pressure, flow and resistance. Types of blood vessels and their functions.
 - 6.2. Properties of myocardial cells: Site of generation of cardiac impulse- pace maker tissue.
 - 6.3. Mechanisms of spontaneous generation of impulses.
 - 6.4. Specialized conducting system and its importance
 - 6.5. Electrical properties of working myocardial cells.
 - 6.6. Molecular basis of contraction and excitation contraction coupling (in brief)
 - 6.7. All or none phenomenon, length-tension relationship.

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- 6.8. Frank-Starling Law, neural influences.
- 6.9. Effect of ions and chemicals on myocardial contractility.
- 6.10. Cardiac cycle : Mechanical and electrical events, pressure volume relationship
- 6.11. Electrocardiography: Definition, uses, principle, waves and their explanations. ECG recording techniques
- 6.12. Cardiac arrhythmias and their ECG interpretation
- 6.13. Cardiac output : Definition, normal values and variations, major determinants of cardiac output and regulation, Heart-lung preparation - measurement of cardiac output, Fick's principle and its application, indicator dye methods of measurement, Regulation of heart rate and stroke volume.
- 6.14. Hemodynamics: Definition of terms- pressure, flow, resistance, velocity etc. Laminar and turbulent flow, Poiseuille law, factors affecting blood flow and resistance, critical closing pressure
- 6.15. Various types of circulation, local regulation of blood flow to tissues.
- 6.16. Arterial Blood Pressure: Definition, normal value, variations, measurement, mean arterial pressure (MAP) and its determinants.
- 6.17. Regulation of arterial blood pressure:
 - 6.17.1. Short term reflex control: baroreceptors and their significance. Mechanism of reflex control and its limitations.
 - 6.17.2. Long term control: renal body fluid - pressure control mechanism,
 - 6.17.3. Hormonal mechanism
 - 6.17.4. Local mechanism
- 6.18. Regional circulation: Coronary, cerebral, cutaneous, splanchnic, skeletal muscle and fetal. Normal values, special features and regulation.
- 6.19. Cardiovascular changes during exercise.
- 6.20. Applied physiology: Cardiac failure, circulatory shock, hypertension, hypotension

7. Gastrointestinal system :

- 7.1. Introduction to gastrointestinal Physiology: Functions of GI System - individual parts. Innervation of the gut, regulation of GI functions - general overview.
- 7.2. Oral Cavity: Mastication and digestion in mouth and its importance.
- 7.3. Salivary secretion: mechanism, composition, functions and regulation.
- 7.4. Physiology of deglutition: Definition, stages and neural control and applied aspects.
- 7.5. Stomach : Overview of functions
 - 7.5.1. Physiology of gastric secretion - mechanism, composition, function and control.
 - 7.5.2. Experimental procedures to elucidate and phases of gastric secretion.
 - 7.5.3. Gastric motility - characteristics and control, gastric emptying and antral pump mechanism, peptic ulcer.
- 7.6. Pancreatic secretions: Composition, mechanism, functions and control.
- 7.7. Small intestine: Secretion, movement and control.
- 7.8. Large intestine: Functions, secretions, movements.
- 7.9. Gastrointestinal hormones and their role in secretomotor functions of the gut.
- 7.10. Defecation: Mechanism and control.
- 7.11. Physiology of vomiting, diarrhea and constipation.
- 7.12. Digestion, absorption and metabolism of carbohydrate, protein and lipid
- 7.13. Nutrition and vitamins.
- 7.14. Obesity and starvation.

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8. Hepatobiliary system :

- 8.1. Liver : Functions
- 8.2. Entero-hepatic circulation
- 8.3. Bile formation, secretion, regulation and jaundice
- 8.4. Physiological basis of liver function tests
- 8.5. Gall bladder: Functions, Mechanism and regulation of gall bladder contraction, applied aspects and Oral cholecystography

Section (B) - 55 Marks

9. The Body Fluids and Renal Physiology

- 9.1. Body fluid compartments and its regulation.
- 9.2. Renal circulation.
- 9.3. Urine formation involving processes of filtration, tubular reabsorption, secretion and concentration.
- 9.4. Water diuresis and osmotic diuresis.
- 9.5. Regulation of acid base balance.
- 9.6. Structure and function of a Juxta glomerular apparatus.
- 9.7. Renal mechanisms for the control of volume, blood pressure and ionic composition.
- 9.8. Innervations of bladder, micturition and abnormalities of micturition.
- 9.9. Artificial kidney, dialysis and renal transplantation.
- 9.10. Renal Function test: Properties and composition of normal urine, examination of urine – urinalysis, physical examination, microscopic examination, chemical analysis, examination of blood, examination of blood and urine
- 9.11. Diuretics, Renal failure.

10. Endocrinology

- 10.1. General Endocrinology
- 10.2. Mechanism of action and Regulation of hormones
- 10.3. Physiological actions and applied aspects of pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas and hypothalamus, Growth Hormone.
- 10.4. Estimation and assessment of Hormones.
- 10.5. Local hormones.
- 10.6. Endocrine functions of other organs: Pineal gland, thymus, kidneys, heart

11. Reproductive System

- 11.1. Introduction: Sexual differentiation and development.
- 11.2. Male reproductive system :
 - 11.2.1. Primary and accessory organs and their functions.
 - 11.2.2. Spermatogenesis and its regulation
 - 11.2.3. Testosterone- secretion, transport, metabolism, mechanism and physiological actions
 - 11.2.4. Control of testicular function - feedback mechanism and abnormalities.
- 11.3. Female reproductive system :
 - 11.3.1. Physiology of menstrual cycle
 - 11.3.2. Ovarian cycle, Uterine cycle, vaginal and cervical cycle
 - 11.3.3. Physiology of ovulation and its detection
 - 11.3.3.1. Ovarian hormones - Estrogen and progesterone - physiological actions and mechanism of action

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- 11.3.4. Control of ovarian function: feedback mechanism, menopause and abnormalities
- 11.3.5. Physiology of fertilization and implantation.
- 11.3.6. Physiology of pregnancy : Endocrine changes, foeto-placental unit, changes in mother during pregnancy, tests for pregnancy
- 11.3.7. Physiology of parturition : Role of oxytocin
- 11.3.8. Physiology of lactation : Role of oxytocin and prolactin
- 11.3.9. Infertility, contraception

12. Growth, Development and Genetics

- 12.1. Growth and development : Definition
 - 12.1.1. Physical growth - prenatal & postnatal period, pubertal growth, skeletal age and physical maturity
 - 12.1.2. Organ growth - differential growth of specific organs and tissues (Brain, head, lymphoid tissue, visceral and reproductive organs at various ages)
 - 12.1.3. Growth spurts in human's life-infancy and late puberty.
 - 12.1.4. Growth rates in boys and girls, mental growth and factors influencing growth-genetic, nutritional and hormonal
- 12.2. Disorders of normal growth
- 12.3. Abnormalities of foetal and postnatal growth
- 12.4. Hereditary short stature.
- 12.5. Physiology of ageing :
 - 12.5.1. Changes in various systems and mechanisms involved
 - 12.5.2. Factors affecting ageing.
- 12.6. Apoptosis.
- 12.7. Genetic control of protein synthesis, genetic code and regulation of gene expression, cell cycle and its regulation.
- 12.8. Applied genetics

13. Integumentary System

- 13.1. Skin: Functions
- 13.2. Sweat glands: Types, secretion and functions.
- 13.3. Thermoregulation: Mechanism, receptors
- 13.4. Hypothalamic thermostat
- 13.5. Acclimatization
- 13.6. Disorders of thermoregulation

14. Central Nervous System :

- 14.1. Introduction: Organization of the nervous system
 - 14.1.1. The structural and functional unit of nervous system.
 - 14.1.2. Neurons - types, functional components and morphology
- 14.2. Neuroglia - types, morphology, functions and classification of nerves
- 14.3. Signal transmission in the nervous system :
- 14.4. Graded potential - definition, characteristics and physiological significance
 - 14.4.1. Resting membrane potential - ionic basis
 - 14.4.2. Action potential - definition
 - 14.4.3. Ionic basis for electrical, chemical and excitability changes
 - 14.4.4. Propagation, mechanism and factors influencing the same.
- 14.5. Response of neurons and nerve fibers to injury
- 14.6. Types of injuries.
- 14.7. Types of changes - Wallerian degeneration and regeneration

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- 14.8. Factors influencing regeneration
- 14.9. Microenvironment of the neuron: CSF-composition, formation & circulation, Blood brain barrier and its importance
- 14.10. Synapse : Definition and types, structure, mechanism of transmission and properties
- 14.11. Sensory receptors : Definition, classification and properties
- 14.12. Reflexes : Definition and classification
 - 14.12.1. Reflex arc and stretch reflex
 - 14.12.2. Properties of reflexes and their clinical significance.
- 14.13. Somato-sensory system :
 - 14.13.1. Classification and characteristics of difference sensations
 - 14.13.2. Sensory pathways and regulation at the higher level
 - 14.13.3. Physiology of pain including referred pain
- 14.14. Control of posture and movement
 - 14.14.1. General Principles of organisation of motor control
 - 14.14.2. Effects of complete transection and hemisection of spinal cord
 - 14.14.3. Descending pathways involved in motor control
 - 14.14.4. Corticospinal (pyramidal) system and
 - 14.14.5. Corticobulbar (extrapyramidal) system
 - 14.14.6. Cortex, basal ganglia and cerebellum- motor control and their disorders
- 14.15. Reticular formation : Definition, connections and functions
- 14.16. Physiological basis of consciousness and sleep
- 14.17. EEG: Evoked potentials and their clinical significance.
- 14.18. Hypothalamus : Components, connections and functions
- 14.19. Thalamus : Components, connections, functions, thalamic syndrome
- 14.20. Limbic system : Components, connections and functions
- 14.21. Frontal, parietal, occipital and temporal lobe: components, connections, functions and effects of lesions
- 14.22. Higher cortical functions
- 14.23. Learning, memory, language and speech.

15. Special Senses

- 15.1. Visual system :
 - 15.1.1. Structure of eye and overview of functions
 - 15.1.2. Structure and function of cornea
 - 15.1.3. Aqueous humor - formation, circulation and drainage
 - 15.1.4. Intraocular pressure and functions
 - 15.1.5. Optics of vision - image forming mechanism
 - 15.1.6. Pupil and its functions
 - 15.1.7. Light reflex and accommodation
 - 15.1.8. Binocular and monocular vision
 - 15.1.9. Common errors of refraction
 - 15.1.10. Visual acuity and visual fields - clinical importance
 - 15.1.11. Ophthalmoscopy, retinoscopy and perimetry
 - 15.1.12. Photoreceptors - distribution, visual pigments and their functions
 - 15.1.13. Light and dark adaptation : photopic and scotopic vision
 - 15.1.14. Visual pathway - transduction, transmission, synaptic modulation and visual cortex.
 - 15.1.15. Effects of transection of visual pathway at various levels.
 - 15.1.16. Eye movements - neurophysiological basis of fixation of gaze and conjugate

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movements.

- 15.1.17. Physiology of colour vision - theories and electrophysiological aspects
- 15.1.18. Colour blindness - classification and tests.
- 15.2. Auditory system:
 - 15.2.1. Functional anatomy of ear and general properties of sound
 - 15.2.2. External ear - functions
 - 15.2.3. Middle ear - functions of tympanic membrane and ossicles,
 - 15.2.4. Mechanism of sound transmission, impedance matching, function of eustachian tube.
 - 15.2.5. Internal ear - structure and function of cochlea, sound transduction, electrical potentials from cochlea, pitch and intensity discrimination.
 - 15.2.6. Auditory pathway - receptive fields and tonotopic maps, binaural interactions, nerve pathway from the cochlea to the auditory cortex.
 - 15.2.7. Organization of auditory cortex and functions, sound localization
 - 15.2.8. Deafness : types, tests to diagnose deafness
 - 15.2.9. Audiometry and its clinical applications.
 - 15.2.10. The Vestibular System : Structure of labyrinth
 - 15.2.10.1. Vestibular transduction - response to rotational and linear acceleration.
 - 15.2.10.2. Central vestibular pathway
 - 15.2.10.3. Vestibulo-ocular reflex and its clinical importance
 - 15.2.11. Clinical tests for vestibular integrity, disorders of labyrinth
- 15.3. The Olfactory System: Location of receptors and pathways, physiology of olfaction and disorders of olfactory sensation.
- 15.4. The Gustatory System: Location of receptors and pathways, physiology of gustation and disorders of gustatory sensation.

16. Recent advances in physiology
