STUDY GUIDE	
PROGRAM	**BDS**
COURSE TITLE	**Physiology**
ACADEMIC YEAR	**1st Year, 2023**
INTRODUCTION	Physiology is one of the essential basic science disciplines which dental students across Pakistan and outside study This discipline helps students learn about the functions of various systems of the body so that they are better able to understand the malfunctions at a later stage.
OUTCOMES	By the end of this course, students will be able to describe the functions of various body systems
DEPARTMENT INVOLVED	**Department Physiology**
LECTURE OBJECTIVES	By the end of the course, the students will be able to: FOUNDATION • Define the following terminologies: - osmotic pressure - tonicity - bulk transport - phagocytosis - pinocytosis • Discuss the importance of physiology in modern medicine • Discuss the basic life processes and survival needs of the body • Explain the principle of homeostasis as a central theme of physiology • Discuss the negative and positive feedback systems • Describe the body fluid compartments • Discuss the composition of body fluid compartments • Discuss the importance of cell as the basic unit of life • Describe the composition of cell membrane • Explain the structures and functions of cell and all its components • Discuss the types of membrane transport

	• Compare the various types of solutions with regard to their tonicity NERVE AND MUSCLE • Define the following terminologies: - motor unit - motor unit recruitment - simple muscle twitch - summation - tetanization - fatigue - synapse - Nernst potential - power stroke • List the sources of energy for muscle contraction and types of smooth muscles • Discuss the distribution of ions across the plasma • Discuss the resting potential and its importance • Write the Nernst equation • Describe the structures and functions of different parts of a neuron • Discuss the electrical and chemical synapses • Describe the initiation of action potential • Discuss the phases of action potential and its propagation in myelinated and non-myelinated nerve fibers • Explain the graph of action potential • Describe the structure and functional characteristics of skeletal muscle • Explain the role of actin and myosin in skeletal muscle contraction • Discuss the parts of neuromuscular junction (NMJ) • Discuss the steps of impulse transmission through neuromuscular junction • Discuss the physiological basis of disorders of NMJ

	• Discuss mechanism of skeletal muscle contraction and relaxation at molecular level • Describe the role of ATP in muscle contraction • Explain the phenomenon of excitation contraction coupling in skeletal muscle • Describe structure and function of sarcoplasmic reticulum and T-tubules • Differentiate between isotonic and isometric muscle contraction • Discuss the basis of muscle fatigue • Differentiate among the different types of muscle fibers on the basis of their structures and functions • Discuss the membrane and action potentials in smooth muscles • Discuss the contractile mechanism of smooth muscles • Discuss the nervous and hormonal controls of smooth muscle contraction • Compare smooth and skeletal muscles with regard to their structures and functions <u>BLOOD</u> • Define hemostasis, anemia and polycythemia • List the sites of erythropoiesis • List the contents and functions of platelets • Classify anemia on the basis of cell morphology and etiology • Describe the functions of blood and those of its components • Describe the structure and functions of erythrocytes • Draw a flow chart of RBCs production • Discuss the humoral, maturational and nutritional factors affecting erythropoiesis • Discuss the formation, functions, fate and pathologies of hemoglobin • Discuss various types of polycythemia

	• Explain the following:
	  - ABO blood types
	  - Rh blood types
	  - Mismatched blood transfusion hazards
	  - Erythroblastosisfetalis
	• Discuss the events of hemostasis
	• Discuss the intrinsic and extrinsic coagulation pathways
	• Discuss the fibrinolytic mechanism
	• Describe the factors that prevent clotting in normal vascular system
	• Discuss the conditions that cause uncontrolled bleeding
	• Discuss leukopoeisis and inflammation
	• Differentiate among the various types of white blood cells on the basis of their functions and physical characteristics
	• Describe immunity and its types
	• Discuss types and functions of T-lymphocytes
	• Discuss the structures of antigens and antibodies
	• Discuss the complement system
	• Describe hypersensitivity reactions
	
	<u>CARDIOVASCULAR SYSTEM</u>
	• Discuss the physiology of cardiac muscle
	• Discuss the importance of intercalated discs in cardiac muscle function
	• Compare various types of muscles with regard to their structure and functions
	• Discuss the structure of cardiac muscle with regard to its function
	• Discuss the cardiac action potential
	• Compare the skeletal muscle and heart on the basis of their action potentials
	• Discuss the electrical conduction system of the heart and the role of SA node

	• Draw electrocardiogram (ECG) of a normally functioning heart
	• Discuss the following:
	  - Myocardial events
	  - 12 ECG leads
	  - Tachycardia
	  - Bradycardia
	  - Myocardial infarction/ischemia
	  - Atrial flutter
	  - Atrial fibrillation
	  - Heart blocks
	• Define the cardiac vector and axis of heart
	• Discuss the cardiac cycle
	• Discuss cardiac output and Frank-Starling Law
	• Discuss the nervous and chemical factors that alter heart rate, stroke volume and cardiac output
	• Discuss the physical characteristics of circulation
	• Discuss the interrelationships of pressure, blood flow and resistance
	• Discuss vascular distensibility and functions of the arterial and venous systems
	• Discuss the systolic, diastolic, mean arterial and pulse pressures
	• Discuss short-, intermediate- and long-term regulations of blood pressure
	• Discuss the renin angiotensin aldosterone system
	• Describe the local control of blood flow
	• Discuss the humoral control of circulation
	• Explain the capillary system
	• Discuss the vasomotion and fluid-filtration across capillaries
	• Describe the physiological causes of shock

	RESPIRATORY SYSTEM • List the structures that make up the respiratory system in correct order • Discuss the functions of each structure of the respiratory system • Differentiate between the conducting and respiratory zones of respiratory passages • Describe the roles of muscles of respiration in breathing • Discuss the pressure gradients • Discuss the significance of dead space • Discuss the Boyle's Law • Describe lung volumes and capacities in adult male • Discuss the relationship of partial pressure with that of a gas mixture • Describe partial pressures of oxygen and carbon dioxide in venous and arterial blood, and alveolar air and cells • Discuss factors affecting exchange through the respiratory membrane • Compare inspired and alveolar air with regard to their composition • Discuss the role of partial pressure in gas transport by blood • Describe the transport of oxygen and carbon dioxide in blood • Discuss the role of hemoglobin in oxygen transport • Describe the factors affecting release and binding of oxygen to hemoglobin • Discuss Bohr's and Haldane effects • Interpret the oxygen hemoglobin dissociation curve graph • Describe the role of the four main groups of nuclei that control breathing • Discuss the factors that can influence rate and depth of breathing • Describe locations of chemoreceptors that monitor blood pH and gas concentrations • Discuss the role of chemoreceptors in the regulation of respiration • Discuss the causes of the following respiratory disorders/conditions:

	- Emphysema - Bronchitis - Asthma - Pneumonia - Pulmonary edema - Hypoxia <u>NERVOUS SYSTEM</u> • List the different types of sensory pathways • Describe the basic organization of the nervous system • Discuss the generation of action potential and transmission of nerve signal • Discuss synapse and its properties • Discuss transmission of electrical signals between neurons • Describe the general characteristics of receptors • Classify receptors according to location and stimulus type • Discuss receptor potential • Discuss the transduction of sensory stimuli into nerve impulses • Discuss the transmission of sensory information into CNS (DCML and anterolateral) • Discuss the various types of pain and pain receptors • Discuss dual pathways for transmission of pain signals into CNS • Discuss analgesia system in the brain and spinal cord • Describe the brain opioids system • Discuss the organization of the spinal cord for motor functions • Describe the role of muscle spindles and golgi tendon organs in muscle control • Discuss cord reflexes • Describe the pathway of pyramidal efferent tracts • Compare pyramidal and extra pyramidal tracts with regard to their origin, termination and function

	• Discuss the major functions of the mid brain, pons and medulla oblongata • Discuss the structure, functions, input and output connections of cerebellum • Describe various cerebellar disorders • Discuss the structure, functions, pathways and related disorders of basal ganglia • Discuss the components of the limbic system and their functions • Discuss the general organization and activation of ANS • Discuss the structures and functions of sympathetic, parasympathetic nervous system and adrenal medulla • Compare the divisions of the ANS with regard to the origin of preganglionic fibers, location of ganglia and neurotransmitter substances • Discuss the value of adrenal medullae in the function of the sympathetic nervous system <u>SPECIAL SENSES</u> • Describe the physiological functions of each part of the eye • Mention the refractory surfaces of eye and the various errors of refraction and their corrections • Explain the accommodation reflex • Discuss the structure of retina and the fluid system of the eye • Discuss the photochemistry of vision and image formation • Discuss the visual pathway and associated lesions • Discuss the physiological anatomy of ear • Describe the role of ossicles in the process of hearing • Discuss conductive and perceptive deafness • Describe the role of Auditory Pathway in hearing • Discuss the role of vestibular apparatus in monitoring equilibrium

	• Discuss the various types of taste sensations and their perceptions on the tongue • Describe location and activation of taste buds • Describe the gustatory pathway • Describe the location and activation of the olfactory receptors • Discuss the primary sensations of smell • Describe the olfactory pathway • Define the anosmia, hyposmia and dysosmia <u>ENDOCRINE SYSTEM</u> • List the major endocrine glands and their locations • Classify hormones • Discuss the secretion, transport, clearance and mechanisms of action of various hormones • Describe the hormone receptors and their activation • Differentiate between endocrine and exocrine glands • Describe the structural and functional relationships of the hypothalamus-pituitary unit • Discuss the control, sites of action and functions of the adenohypophysis hormones • Discuss the effects of hypo- and hyper-secretions of adenohypophysis hormones • Compare the functions of the neurohypophysis with that of the hypothalamus • Discuss the synthesis, secretions and effects of anterior and posterior pituitary hormones • Describe the formation, secretion, functions and regulation of thyroid hormones • Discuss disorders of thyroid hormones • Discuss the mode of action of insulin release

	• Discuss the functions of insulin, glucagon, somatostatin and pancreatic polypeptide • List the hormones that regulate the calcium and phosphate homeostasis • Discuss the functions of parathyroid hormone, vitamin D and calcitonin Describe hypo- and hypercalcemia • Describe the sites of formation, functions and control of secretion of mineralocorticoids and glucocorticoids • Discuss Cushing syndrome and Cushing and Addison's Diseases <u>DIGESTIVE SYSTEM</u> • Describe the structural and functional organizations of the digestive system • Discuss the physiological anatomy of the gastrointestinal tract (GIT) • Discuss the characteristic features of the smooth muscles of the GIT • Discuss the neural and hormonal control of the GIT (Enteric Nervous System) • Describe the role of interstitial cells of Cajal in generation of basic electrical rhythm (BER) of the GIT • Describe the types of GIT reflexes • Relate the role of interstitial cells of Cajal with smooth muscle contractile activity • Compare the effects of parasympathetic and sympathetic nervous activity in modulating GI activity • Describe the composition and functions of saliva • List the factors that increase salivary secretion • Discuss the nervous regulation of salivary secretion • Discuss the chewing and swallowing reflexes • Describe the functions of lower esophageal sphincter • Discuss the mechanisms that prevent food from entering the nasal cavity and larynx during swallowing

	• List the functions of stomach • Describe the components of gastric juice and their functions • Discuss the phases of gastric secretory activity, gastric emptying and its regulation • Describe the types of movement in small intestine • Discuss the inhibition of motility and secretion in the stomach • Discuss peristaltic rush and migrating motor complex • List structures that increase the absorptive surface area of the small intestine • Differentiate between segmentation and the migrating motor complex of the small intestine • Discuss the factors affecting the motility and secretion of food in the stomach • Discuss the glands of small intestine with regard to their secretions and functions • Describe the functions of each enzyme of the intestinal brush border • Describe the absorption of each type of nutrients in the small intestine • Discuss the composition, formation, conduction and functions of bile and bile salts • Describe the functions and emptying of gallbladder • Describe the composition and functions of pancreatic secretion • Explain the phases of pancreatic secretion • Discuss the role of hormones in regulating pancreatic secretion • Describe the structure, functions and major types of movements of large intestine • Discus the defecation reflex • Discuss functions of internal and external anal sphincters • Discuss the secretion and role of the following GIT hormones: - Cholecystokinin

	- Secretin - GIP - Gastrin - Gastrin Releasing Peptide - Pancreatic Polypeptide - Somatostatin - Vasoactive Intestinal Polypeptide - Motilin <u>URINARY SYSTEM</u> • Discuss the functional anatomy of kidney • Define nephron and its types • Describe various parts of a nephron • Discuss the functions of kidney • Define GFR • State the normal range of GFR • Describe the glomerular filtration membrane and its function • Discuss the forces that promote and oppose glomerular filtration • Calculate net filtration pressure • Discuss the significance of auto-regulation of GFR • Describe the regulation of glomerular filtration by hormones and the nervous system • Discuss the passive and active mechanisms of transport for tubular reabsorption • Discuss the reabsorption of fluid by peritubular capillaries • Discuss tubular reabsorption and regulation along different parts of a nephron • Define tubular load and Tubular transport maximum (Tm) • Discuss the tubular secretion processes in different parts of a nephron • Discuss the osmotic gradient • Discuss the counter current mechanism

	• Discuss the renal mechanisms for excreting diluted urine • Discuss the roles of anti-diuretic hormone and osmoreceptors • Discuss the role of bladder in accommodating a wide range of urine volume • Describe the neural reflex pathway that regulates emptying of bladder • Discuss the effect of following hormones on kidney: - ADH - Aldosterone - Angiotensin II - ANP • - PTH

PRACTICALS	By the end of the course in Physiology, students will be able to perform the following practicals: **Foundation** i. Osmotic Fragility **Blood** i. Drawing Blood and blood Sampling, using a Microscope ii. Hemoglobin Estimation, iii. ESR, iv. Preparation of blood smear, DLC, v. Neubauer's Chamber vi. RBC Count vii. PCV viii. Clotting time ix. Bleeding Time x. Blood Grouping **Locomotor System** i. Using a Power lab ii. Interpretation of Simple Muscle Twitch, Summation, Fatigue, Tetanization **CVS** i. Arterial pulse examination ii. ECG iii. Heart Sound iv. Blood Pressure v. Refractory period **Respiratory System** i. Lung volume and Capacities, ii. Spirometry **Neurosciences** i. Superficial Reflexes ii. Deep Reflexes iii. Cerebellar function test iv. Cranial nerve Examination v. Body Temperature **Special senses** i. Visual Acuity, ii. Perimetry iii. Tuning fork test

	iv. Taste and smell
INTERNAL ASSESSMENT	10% (Pre-professional Examination, Midterm Examination, Assignments and Class Presentations)
ANNUAL EXAMINATION	90% (MCQS, OSPE)
COURSE EVALUATION	This course will be evaluated as per JSMU & HEC policies