PHYSIOLOGY

The goal of learning Physiology is to enable an undergraduate student to have a comprehensive knowledge of the n facilitates an understanding of the physiological basis of health and disease.

HUMAN PHYSIOLOGY

COMPETENCIES:

At the end of the I MBBS Physiology course, the student must:

- Have an understanding of the functioning of the different organ systems of the human body and their i homeostasis or a constant internal environment.
- Be able to apply the knowledge of physiological processes to comprehend mechanisms of disease and
- Be able to perform some basic laboratory tests and interpret their results
- Be able to perform clinical examination to assess various organ systems.

ii) OBJECTIVES

a) KNOWLEDGE

At the end of the course the student should be able to:

(1) Explain the normal functioning of all the organ systems and their interactions for maintenance of a constar

(2) Describe physiological responses and adaptations to changes in internal and external environment.

(3) Describe the physiological principles underlying pathogenesis and treatment of disease.

(4) List normal values and acceptable ranges for relevant physiological parameters

(5) Interpret results of the following laboratory tests:
(i) serum electrolytes, pH, osmolarity and blood gases
(ii) pulmonary function tests
(iii) renal function tests
(iv) cardiac function tests

(6) Diagnose conditions from symptoms and signs and investigative data provided in case scenarios dealing w
hematological, musculoskeletal, alimentary, endocrine, reproductive, renal, cardiovascular, respiratory, and ne

b) SKILLS

At the end of the course the student should have developed skills in/to:

(1) Basic hematological techniques:

(i) use and maintenance of a compound microscope
(ii) collection of blood by the finger prick method using aseptic techniques
(iii) performance of ESR, total WBC count, Differential count, hemoglobin estimation, PCV, Bleeding
(iv) Calculation of hematological indices

(2) Distinguish between normal and abnormal data derived from the tests mentioned above.

(3) Perform the following tests and clinical examinations in a normal subject with an understanding of the phy
the clinical need to do so. The student should be able to:

(i) Measure blood pressure, record ECG and perform clinical examination of the cardiovascular systen

(ii) perform tests of ventilatory function using spirometer and peak flow meter and perform clinical ex

(iii) do experiments towards understanding the effect of posture and various grades of exercise on card

(iv) perform clinical examination of the abdomen

(v) perform clinical examination of the nervous system including special senses

c) ATTITUDE:

The student must

(i) develop a scientific approach in the practice of clinical medicine

(ii) correlate disease manifestation with derangements of physiological mechanisms and understand ra

INTEGRATION

The teaching-learning program should be integrated horizontally and vertically, as much as possible, to enable processes in health, derangements in disease and rationale of treatment.

Number of hours:

Lectures + Tutorials:	280
Practicals + OSPE:	160
ECE:	40

	480

TOTAL HOURS ALLOCATED FOR PHYSIOLOGY AS PER MCI NORMS

S.No	*TOPICS*	*LECTURE AND TUTORIALS*	*PRACTICAL AND OSPE*	*ECE*
1	**General physiology and body fluids**	20 Hours	5 Hours	3 Hours
2	**Blood**	30 Hours	40 Hours	6 Hours
3	**Muscle**	15 Hours	5 Hours	3 Hours
4	**Gastrointestinal System**	15 Hours	12 Hours	3 Hours
5	**Endocrine System**	30 Hours	15 Hours	3 Hours
6	**Reproductive System**	20 Hours	5 Hours	2 Hours
7	**Excretory System**	25 Hours	10 Hours	2 Hours
8	**Respiratory System**	25 Hours	20 Hours	4 Hours
9	**Cardiovascular System**	35 Hours	20 Hours	5 Hours
10	**Central Nervous System**	45 Hours	22 Hours	6 Hours
11	**Special senses**	20 Hours	6 Hours	3 Hours
	TOTAL HOURS	**280 Hours**	**160 Hours**	**40 Hours**

The teaching learning methods employed will include

Theory

- Lectures
- Tutorials
- Small group discussion
- Case based learning
- Problem based learning
- Integrated teaching module
- Early Clinical Exposure

Practical

- Demonstration of Hematology Experiments
- System wise Clinical Examination
- OSPE
- OSCE
- Case Discussion
- Charts and calculation

THEORY AND PRACTICAL SYLLABUS

GENERAL PHYSIOLOGY AND BODY FLUIDS (Lectures + Tutorials 20 hours; Practicals + OSPE 5 hours; I				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVES**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Cell Organelles**	• Will be discussed in Biochemistry and Anatomy		
2	**Homeostasis and Feedback System**	• Describe the concept of maintenance of internal environment • Recognize that negative feedback is the most common type of physiological control	• State and describe examples of negative feedback • State and describe instances of positive feedback in human physiology	
3	**Body Fluids**	• List the different body fluid compartments, state the volume, osmolarity and electrolyte composition of each of the following compartments • Total body water, extracellular, intracellular, plasma, intravascular • Describe the term transcellular fluid • Measurement of volumes of compartments • Describe the Starling's forces that govern fluid exchange across the membranes separating the various compartments • Define Donnan effect and equilibrium • Use the Concept of electro neutrality in the fluid compartments to calculate 'Anion gap' • Define anion gap as the term referring	• Difference between tonicity and osmolarity • Edema and its causes • The dilution principle for measurement of body fluid compartments • Methods of measurement of body fluid compartments	Changes in electroly concentration in Vomiting, Diarrhoe severe dehydration burns Cause for oedema i Kwashiorkor, Liver failure, glomerulonephritis filariasis

		to unmeasured anions in plasma.		
4	**Cell Membrane**	• Describe with diagram the fluid mosaic model • State the composition of cell membrane in terms of lipids and proteins and describe how these are organised		
5	**Membrane Transport**	• Classify transport mechanisms as Passive and active with examples and differentiate between them. • List and describe the following passive transport processes with examples: o Simple diffusion of respiratory gases through lipid film o Diffusion of ions through ion channels ▪ Sodium, potassium, calcium and chloride channels ▪ Non-gated channels, voltage-gated, ligand-gated channels and mechano-gated channels o Facilitated diffusion - Glucose transporters (GluTs) o Osmosis • Describe the following active transport processes: o Primary active transport: ▪ sodium-potassium pump, o Secondary active transport: sodium-glucose co-transport (SGLT) and sodium-aminoacid co-transport • Describe the following transport processes by formation of membrane vesicles o Endocytosis	Describe the differences between channel and carrier-mediated transport processes State Fick's law of diffusion • Describe the following active transport processes: o Primary active transport: ▪ calcium pumps - plasma membrane calcium pumps (PMCA) and Sarco/endoplasmic reticulum calcium pumps (SERCA) ▪ Proton pumps - V-type H ATPase, H/K ATPase o Secondary active transport: sodium-hydrogen exchangers, sodium-calcium exchangers, Na/2Cl/K symport	State the mechanism of action of botulinu toxin and the basis o botox injections Channelopathies

		• Exocytosis		
6	**Membrane Potential**	• Describe the mechanisms involved in genesis of resting membrane potential (RMP) in a prototype cell • Recognise the RMP in a nerve or cardiac cell • Nernst or equilibrium potential 'Equilibrium potential' • Action potentials in neuron, skeletal muscle cell, Sino atrial node and cardiac ventricular cell	• Patch Clamp Technique • Cathode Ray Oscilloscope	• Describe the term 'Depolarizationble' in terms of inactivation of voltage –gated sodium channels during sustained partial depolarizat and therefore the inability of the tiss to develop new action potential

Blood (Lectures + Tutorials 30 hours; Practical + OSPE 40 hours; ECE				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVES**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Introduction**	• Describe the normal composition of blood • Describe the composition of plasma • State the difference between plasma and serum.	• State the difference between plasma and serum..	
2	**Plasma Proteins (Integration with Biochemistry)**	• State the site of production, normal range and describe the functions of Albumin • Discuss causes for decrease in serum Albumin levels with specific examples of disease conditions • Explain what is plasma oncotic pressure • Discuss the production, various types and role of Globulins (alpha, beta and gamma globulins)	• Causes for decrease in serum Albumin levels with specific examples of disease conditions • Discuss the significance of albumin/globulin ratio • Explain the cause for oedema in Kwashiorkor, Liver failure, glomerulonephritis and filariasis	• Acute Phase Proteins (Special consideration of Fibrinogen as an acute phase protein) • Describe the significance of C- Reactive protein
3	**Erythrocyte Sedimentation Rate (ESR):**	• Define and state normal values for ESR in men and women • Describe the factors influencing ESR (fibrinogen particularly) • Discuss the significance of ESR in disease states	• Estimate ESR by Wintrobe/Westergren's method of a provided sample of blood and interpret the result	
4	**RBC**	• Describe the physical characteristics of red blood cells • List causes and give explanation for physiological variations of the normal	• Explain morphological characteristics of individual stages of	

		RBC count • Explain the functions of RBCs • List the changes in sites of erythropoiesis with age • Illustrate the major changes that take place during the stages of erythropoiesis. • Describe the factors regulating/ affecting erythropoiesis, • Discuss the normal life span and destruction of RBCs	Erythropoiesis • Define Packed Cell Volume (PCV)/Hematocrit and state normal range for men and women • State the physiological variations in PCV	
5	**Hemoglobin**	• State the components of Hb, the various types of Hb and normal range of Hb in men and women • Briefly discuss the synthesis of haemoglobin • what is reduced hemoglobin. • Define and describe cyanosis • Discuss the types of jaundice • Abnormal Hemoglobin	• Estimate and interpret Hb content by Sahli's Acid Hematin method- Estimation of Hb • Abnormal Hemoglobin • Iron metabolism and iron overload • Discuss the synthesis of hemoglobin • Discuss carbon monoxide poisoning and treatment • Discuss Iron metabolism and iron overload	• Role of phototherapy in treating infants wit jaundice due to hemolysis
6	**Anaemia**	• Define anaemia • Classify anaemia based on etiology and morphology • Discuss the principles of treating anemias • Describe major symptoms, signs and effects of anemia	• State the normal reticulocyte count and its significance • Define reticulocyte response • Calculate and interpret red cell indices	• Discuss the principle and indications for Bon Marrow Transplantation

7	**Polycythemia**	• Define what is Polycythemia • Explain what is Polycythemia rubra vera • Discuss causes for secondary polycythemia • Explain what is relative polycythemia • Discuss the effects of polycythemia	• Classification of Polycythemia and its causes	• Discuss the principles of treating Polycythaemia
8	**Platelet**	• Describe the formation, structure, life span & removal of platelets • State the normal platelet count • Describe the functions of platelets. • Discuss the causes and effects of thrombocytopenia	• Details of the various granules in platelets	• Thrombocytopenic Purpura

9	**Hemostasis**	• Describe the processes involved in hemostasis such as:
		  • vasoconstriction
		  • Platelet plug formation
		  • Clotting or coagulation pathways
		  • Clot retraction
		• Describe anticlotting and fibrinolytic mechanisms in the body
		• List anticoagulants and their mechanism of action
		• Explain various causes for abnormal hemostasis
		• List the clotting factors and Explain
			• Explain various causes for abnormal hemostasis
			• Perform and interpret simple tests of hemostasis like bleeding time by Duke's method and clotting time by capillary method of Wright on oneself.
			• Explain and Interpret tests such as platelet count, Prothrombin Time, Activated Partial Thromboplastin Time
				• Explain Arachidonic acid metabolism - COX pathway (and lipooxygenase for completion)
				• Explain the role of Prostaglandins (and leukotrienes)
				• Discuss the role of Thrombolysis in therapeutics
				• Explain Disseminated

		the pathways of coagulation • Explain various causes for abnormal hemostasis • Perform and interpret simple tests of hemostasis like bleeding time by Duke's method and clotting time by capillary method of Wright on oneself by collecting blood using finger prick method using aseptic method • Explain Lee and White's method for determining clotting time	and clotting factor assays. • Discuss the use of anti-platelet agents in therapeutics	Intravascular Coagulation • Explain reason for thrombosis and embolism in atherosclerotic vascular disease an venous stasis
10	**Blood groups & Blood banking**	• Describe the importance of blood groups • Explain the genetic determination of blood groups • Describe the ABO system of blood grouping • State the frequency of different blood groups • Describe the Rh system of blood grouping • Explain the mechanism and consequence of ABO and Rh incompatibility • Explain the condition Erythroblastosis Fetalis, state preventive measure and treatment option for the same.	• Discuss the minor blood group systems. • Perform and interpret blood grouping/typing on oneself by collecting blood using finger prick method under aseptic conditions (or on a provided blood sample) • Explain the process and interpretation of blood cross match	• Bombay Blood Group

11	**WBC**	• State the normal Total and Differential count • Classify types of WBC as granulocytes, agranulocytes • Describe the morphology and functions of neutrophils, eosinophils, basophils, mast cells; Lymphocytes , monocytes. • Perform and interpret total leucocyte on their own blood / provided blood using aseptic precautions • List Conditions in which total leucocyte counts is increased or decreased. • List conditions in which counts of each type of WBC are increased or decreased • Describe the various cells that constitute the monocyte- macrophage system and state their function	• Make a peripheral blood smear on their own blood / provided blood • Perform and interpret the differential leucocyte count using aseptic precautions	• Monocyte-macrophage system and state their function
12	**Leucopoiesis**	• Outline the process of maturation of white blood cells		
13	**Immunity**	• Classify immunity and state the differences between innate and acquired immunity • Discuss the cells and mechanisms involved in innate • immunity • Name the lymphoid organs in the body and outline the development of T and B cells • Classify acquired immunity and mention the cells involved in acquired immunity • Describe the cells and mechanisms involved in cell mediated immunity • Describe the cells and mechanisms	• Classify immunoglobulins and state their functions • Explain primary and secondary immune response • Illustrate the role of Complement system in immunity	• Name important cytokines. • State their source and functions • Auto Immune Disease Immunodeficiency Syndrome • Organ transplant and • Immunosuppresio n

		involved in humoral immunity		
14	**Lymph**	• Describe the formation and composition of lymph • Illustrate the lymphatic circulation. • Discuss functions of lymph.	Discuss the pathophysiology of lymphedema	

Autonomic nervous system (Lecture 2 Hours)				
No	**Topic**	**SPECIFIC LEARNING OBJECTIVES**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Organization**	• Sympathetic and parasympathetic divisions • Pre-ganglionic neuron • Post-ganglionic neuron	• B type nerve fibres • Unmyelinated C fibres	
2	**Sympathetic division**	• Thoraco-lumbar outflow • Ganglia close to vertebral column • Post ganglionic neurons longer – travel along vessels to reach viscera • Adrenal medullary cells are neuroendocrine cells		
3	**Parasympathetic division**	• Cranio-sacral outflow • Supply to organs in head - through oculomotor, facial and glossopharyngeal nerves • Supply to thoracic and upper abdominal viscera- through the vagus • Supply to lower abdominal and Pelvic viscera- through S2, S3 and S4 sacral nerves • Ganglia are within or close to the organ of supply • post-ganglionic neurons are short		
4	**Chemical transmission**	• Acetylcholine - all pre-ganglionic neurons, post-ganglionic parasympathetic neurons, sympathetic post-ganglionic neurons that	• Acetylcholine has shorter duration of action due to the degradation by acetylcholinesterase • Nor-epinephrine has a	

		innervate sweat glands, • All other sympathetic post-ganglionic neurons secrete nor-epinephrine	longer duration of action Otto Loewi's experiment	
5	**Acetylcholine**	• Removal by acetylcholinesterase • Receptors • Muscarinic receptors - distribution and difference in action through these receptors • Nicotinic receptors – distribution	• Muscrarinic blocker – atropine • Ganglion blocker - hexamethonium	
6	**Catechol amines**	• Receptors • alpha 1 – vasoconstriction • alpha 2 • beta 1 increases heart rate • beta 2 – bronchodilation • beta 3	• phechromocytoma • Vanillyl mandelic acid • Nor-epinephrine has greater affinity for alpha receptors and epinephrine has greater affinity for beta receptors	
7	**General functions**	• Sympathetics - fight or flight respons	• Walter Cannon • Walter Cannon	
8	**Eye**	• Parasympathetic – Accommodation, miosis • Sympathetic – mydriasis	□ Parasympathetic – accommodation, miosis □ Sympathetic - mydriasis	
9	**Heart**	• SA node • Parasympathetic - decreases heart rate – muscarinic receptor • Sympathetic - Increases heart rate - beta 1 receptors • Atria & Ventricle • Parasympathetic - decreases		

		force of contraction • Sympathetic - increases force of contraction - beta 1 & 2 receptors • AV node and Purkinje fibers • Parasympathetic - decreases conduction velocity • Sympathetic - increases conduction velocity - beta 1 & 2 receptors		
10	**Lungs**	• Parasympathetic – bronchoconstriction • Sympathetic -Dilation - beta 2		
11	**Vessels**	• Arterioles • Sympathetic - vasoconstriction - α 1 & 2 • Veins • Sympathetic - constriction - α 1 & 2		
12	**Stomach and Intestine**	Parasympathetic o Increases motility & secretion o Relaxes sphincters □ Sympathetic o Decreases motility & secretion o Contracts sphincters		
13	**Gall Bladder**	• Parasympathetic – contraction • Sympathetic – relaxation		
14	**Urinary Bladder**	• Detrusor • Parasympathetic – contraction • Sympathetic – relaxation		

		• Sphincter • Parasympathetic – relaxation • Sympathetic – contraction		
15	**Male Organ**	• Erection – parasympathetic • Ejaculation – Sympathetic		
16	**Skin**	• Pilomotor - Sympathetic – contraction • Sweat glands • Parasympathetic - generalized dilute secretion		
17	**Liver**	• Sympathetic - glycogenolysis		
18	**Pancreas**	• Exocrine • Parasympathetic increases secretion • Sympathetic –decreases	• Endocrine • Sympathetic - decreases	
19	**Salivary Gland**	• Parasympathetic - profuse watery secretion • Sympathetic - thick viscous secretion rich in enzyme		
20	**Lacrimal Gland**	• Parasympathetic – secretion		
21	**Adipose Tissue**		• Sympathetic - lipolysis	
22	**Drugs**		• Atropine, Neostigmine, physostigmine • Propranalol, Salbutamol • Isoprenalin, dopamine	
23	**Higher Control**	• Hypothalamus, Medulla – RVLM	• Head ganglion - Sherrington	

Muscle (Lectures + Tutorials 15 hours; Practicals + OSPE 5 hours; EC				
No	**Topic**	**SPECIFIC LEARNING OBJECTIVES**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Skeletal Muscle Morphology**	• Describe and draw the structure of sarcomere marking actin filament, myosin filament, I band, A band, H band, Z line and sarcomere • Describe the functions of contractile and regulatory proteins involved in muscle contraction • Draw and describe the structure of the sarco-tubular system	• Describe the functions of other structural proteins like Titin, Desmin etc	• Role of Dystrophin in muscle Dystrophies
2	**Neuromuscular junction**	• Draw and Describe the structure of the neuromuscular junction • Describe the events involved in neuromuscular transmission • Describe the pathophysiology of diseases affecting the neuromuscular junction like myasthenia gravis • Describe the mechanism of action cholinesterase inhibitors • Motor Unit	• Pseudocholinesterase Lambert-Eaton Syndrome • Organophosphorus poisoning • EMG.	• Neuromuscular Blockers
3	**Muscle Contraction**	• Describe the molecular Basis of muscle contraction, events involved in excitation contraction coupling. • Explain the types of Muscle contraction • Describe the sliding filament theory of muscle contraction	Factors affecting force of contraction; pre-load, after load, beneficial effect. • Describe the physiological basis of the length-tension	• Types of Muscle fibres • Energy sources in muscle • Denervation hypersensitivity • Describe the

		• Role of ATP and calcium pumps in the mechanism of relaxation of the muscle • Describe the Factors affecting the force of contraction	relationship.	concept of oxygen debt
4	**Smooth Muscle**	• Structure, distribution, types, molecular mechanism of contraction	• Comparison between smooth, skeletal and cardiac muscle	
5	**Factors modulating smooth muscle contraction And Properties**	• List the various factors that modulate smooth muscle contraction like stretch, sympathetic nerveous system, circulating substances etc. • Describe the special properties of smooth muscle like latch-bridge mechanism and plasticity	•	

Gastrointestinal System (Lectures + Tutorials 15 hours; Practicals + OSPE 12 h				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVES**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Salivary Gland**	• Name the Salivary Glands • Functions of saliva. • Describe the regulation of salivary secretion	• Deficient salivation – Xerostomia	• Formation of saliva Composition of saliva
2	**Enteric nervous system**	• State the location and components of the enteric nervous system. • Explain the functions of the Myenteric plexus and Meissner's plexus • Explain the effect of the autonomic nervous system on the enteric nervous system	• Explain the physiological basis of Congenital Megacolon	
3	**Mouth and oesophagus**	• Explain the process of mastication • Outline the process of Deglutition. • State the importance of lower oesophageal sphincter	• Achalasia Cardia	• Gastro-esophageal reflux disease (GERD)
4	**Gastric secretion**	• Describe the composition and functions of gastric secretion • Describe the mechanism of gastric acid secretion • State the role of chief cells and parietal cells • Describe the different phases of gastric secretion • Discuss regulation of gastric secretion • Explain the importance of mucus-bicarbonate barrier • Explain the cause of acid peptic disease	• State an example of proton pump inhibitor and histamine receptor blocker • Explain the reason for Pernicious anemia • Physiological basis for the use of proton pump blockers and histamine receptor blockers for peptic ulcers	• Gastric Function Tests • Role of H.Pylori i peptic ulcers
5	**Liver and gall bladder**	• Explain the portal system • Describe the functions of liver	• Explain the pathophysiology of	• Explain the consequences of

	(Horizontal Integration)	• Describe the composition and functions of Bile • Explain Micelle formation and its functions • Explain what is emulsification of fat • Explain the process of Entero-hepatic circulation	• Portal Hypertension • Ascites • Gall Stone • Jaundice	liver Failure
6	**Gall Bladder**	• State the factors regulating bile secretion • Explain the function of Gall Bladder • Explain how concentration of Bile	• State the composition of gall stones and factors involved in the formation of gall stones	• State what is ERCP and when it is performed • State what is Cholecystectomy and what are the indication of the same
7	**Pancreatic secretion**	• List the Enzymes present in pancreatic juice and explain their functions • Explain the regulation of secretion the role of enterokinase	• Reason for the alkaline pH of pancreatic secretion and its importance	• what is pancreatitis • Explain Steatorrhoea
8	**Small Intestine**	• Explain the functional anatomy of the small intestine • Discuss the secretions of small intestine and their functions • Describe how small intestinal secretion regulated	• Enterokinase Malabsorption syndrome	• Cholera
9	**Gastric Motility**	• Explain the process of mixing of food in the stomach • Explain the factors influencing gastric motility and gastric emptying • Describe the mechanism of vomiting	• Explain the Chemoreceptor trigger zone • Discuss the role of Anti-emetics	• Dumping syndrom
10	**Movements of small intestine**	• Describe peristalsis • Explain the stimuli and factors which influence peristalsis • Describe 'segmentation contractions'	• State what is basic electrical rhythm of the gastrointestinal tract and it's role	• Define paralytic ileus

		and 'mixing contractions' and their functions • Explain what is Migrating Motor Complex		
11	**Large intestine & Movements of Large Intestine**	• Explain the functions of large intestine and formation of faeces • What is segmentation and mixing contractions of large intestine • Explain Defecation Reflex	• State the importance of dietary fibre • Constipation • What is Gastro colic reflex	• Pathophysiology o Hirschprung's Disease
12	**Digestion and Absorption**	• Digestion and Absorption of carbohydrates • Digestion and Absorption of proteins • Digestion and Absorption of fat	• Glucose Transporters • Fat soluble vitamins • Function of short chain fatty acids	• Lactose Intoleranc
13	**Iron Absorption**	• Absorption of Iron	• Transferrin, Ferritin • Hemosiderin • Hemosiderosis	
14	**GI Hormones**	• Source of Hormones • Functions and regulation of secretion of Gastrin, Cholecystokinin and Secretin		
15	**Water Movement in Intestine**	• Physiological basis of treatment of Diarrhoea	Cholera – Increased chloride and water secretion	

Endocrinology (Lectures + Tutorials 30 hours; Practicals + OSPE 15 hours;				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVE**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Introduction to Endocrinology**	• Define Hormone • Classify and list the hormones based on chemical nature • Mechanism of negative and positive feedback regulation of hormone release	• Describe the mechanism of action of hormones including the receptors and second messengers	• Hormone measurement • Radioimmuno Aassay • ELISA
2	**Hypothalamus**	• Describe the relationship between hypothalamus and pituitary including the Hypothalamohypophyseal tract and the hypothalamohypophyseal portal circulation • List the various releasing and inhibiting hormones released by the hypothalamus		
3	**Pituitary Gland**	• List the various types of secretary cells of Anterior and Posterior Pituitary • List the Hormones secreted by the anterior and posterior pituitary. **Growth hormone:** • List the important actions of growth hormone, its effects on growth and metabolism • Describe the regulation of growth hormone secretion • List important stimuli that increases or decreases the secretion of GH • **Prolactin:** • Describe the actions and regulation of prolactin secretion • List the features of excess Prolactin secretion	• Describe the physiological basis and importanrt features of abnormalities of growth hormone secretion like - Gigantism, acromegaly and pituitary dwarfism • Describe the mechanism of action of Growth hormone (JAK-STAT Pathway) • Explain howInsulin like growth factor (IGF) or Somatomedin mediates the actions of growth hormone	• Plasma Levels, • Plasma Protein Binding, and Metabolism • Prolactinoma

		• **Antidiuretic hormone (ADH)** • Explain the synthesis, release and mechanism, functions and regulation of actions of ADH • Discuss the disorders of ADH secretion - Diabetes Insipidus • **Oxytocin** • Explain the synthesis, release mechanism, functions and regulation of Oxytocin\List the functions of Oxytocin • Role in milk ejection reflex and parturition	• Types of Diabetes Insipidus • Panhypopituitarism • Shehan's Syndrome • Postpartum Pituitary Necrosis	• Syndrome of inappropriate hypersecretion of antidiuretic hormo (SIADH)
4	**Thyroid Gland (Horizontal and Vertical Integration)**	• Explain the functional Anatomy of Thyroid Gland • List the steps involved in the synthesis of thyroid hormones • Explain the mechanism of release of Thyroid Hormone • Explain the transport actions of thyroid hormone • Describe the regulation of thyroid hormone secretion • List the causes and features of Hypo secretion of thyroid hormones - Myxedema and Cretinism, Goitre and features of Hypothyroidism • List the causes and features Hypersecretion of thyroid hormones – Gigantism and Acromegaly • **Calcitonin** • Secretion and action of Calcitonin	• Explain the physiological basis for Simple Goitre • List the differences between dwarfism and cretinism	• Describe the important thyroid function tests and i clinical use

5	**Parathyroid Gland**	• **Parathormone** • Discuss the actions of parathyroid hormone • Describe the causes and features of hyper/hypoparathyroidism • Descibe Calcium Homeostasis • **Vitamin D (Calcitriol)** • Mention the sources, synthesis mechanism of action and • List the features of vitamin D deficiency in children and in adults – Rickets and Osteomalacia • **Calcitonin** • Actions of calcitonin	• List the different types of cells present in the Parathyroid Gland • Describe the secretion of parathyroid hormone • Explain he regulation of secretion of parathyroid hormone • Differences between Tetanus and Tetany	• List the causes of secondary hyperparathyroidis • Recognize its emerging role as ar immunomodulator.
6	**Adrenal Gland**	• List the hormones secreted by the different layers of Adrenal Cortex • Describe the Functional Anatomy of Adrenal Cortex • Describe the mechanism of action, functions and regulation of action of Mineralocorticoids, Glucocorticoids and sex steroids • Discuss the causes and features of Cushing's Syndrome and Addison's Disease • **Adrenal medulla:** • Synthesis and physiological effects of epinephrine and nor-epinephrine on various systems of the body • Factors that regulate the secretion of adrenal medullary hormones	• Disorders produced by the deficiency of enzymes involved in adrenocortical hormone synthesis • Diseases related to Mineralococorticoids • Conn's Syndrome • Aldosterone Escape • Atrial Natriuretric Peptide (ANP)	• Discuss the causes • Cushing's Syndrome • Adrenal Tumo • Adrenal Hyperplasia, • Secondary Hyperaldoster sm • List the features of Phaeochromocytom
7	**Endocrine Pancreas**	• Name the different cells present in the Islets of Langerhans • Physiological stimulus for Insulin secretion • List the target cells of Insulin and the cells that do not require insulin action	• Describe the steps in biosynthesis of Insulin and the origin of the C-peptide (Connecting peptide) • **Diabetes Mellitus:**	• Compare and contr Type I and Type II Diabetes Mellitus a their complications • Mention the clinica feature of Diabetes Mellitus

		for glucose uptake • Mention the mechanism of action of Insulin on its receptor • List the important actions of insulin • List the various factors that regulate insulin secretion • Describe the features of hypersecretion of Insulin and Hypoglycemia • **Glucagon** • List the important actions of glucagon	• Discuss the Pathophysiology of Diabetes mellitus • List the hormones that raise blood sugar level	• List the features of hypoglycemia and counter regulatory hormones • Diabetic Ketoacido
8	**Other Endocrine Glands**	• **Pineal gland** • Mention the role of hypothalamus and melatonin on circadian rhythm • **Thymus** • **Local Hormones**		
9	**Atrial Natriuretic Peptide (ANP)**	• List the important actions of ANP		

Reproductive Physiology (Lectures + Tutorials 20 hours; Practicals + OSPE 5 ho				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVE**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KNOW**
1	**Sex Determination**	• Differentiate between Genetic sex, Gonadal sex and phenotypic sex. • Describe the role of SRY gene and testis determining factor in development of gonads • Describe the role of testosterone and Mullerian inhibiting substance in the development of male and female internal genitalia	• Discuss the role of dihydrotestosterone in the development of external genitalia	• Describe the cause and features of abnormalitie of sex differentiation • (Klinefelter's syndrome • Turner's syndrome • XXX superfemale • Female – Pseudo hermaphroiditisim • Male – Pseudo hermaphroiditisim – androgen resistance)

2	**Male Reproductive Physiology**	• Describe the functional anatomy of the male reproductive tract (Testis seminiferous tubules, Sertoli cells, Leydig cells, Blood Testis barrier, Epididymis, Vas deferens, Seminal vesicle, Prostate gland).
		• Describe the blood- testis barrier and its function
		• Discuss factors that regulate Spermatogenesis
		• Describe the structure of spermatozoa
		• Describe the source, mechanism of action and functions of testosterone and dihydrotestosterone
		• State the source and functions of inhibin
			• Outline the steps involved in spermatogenesis
			• State the composition of semen and recognize use of semen analysis as a test to evaluate infertility
			• Discuss about abnormalities of the male reproductive system:
			  • Hypogonadism
			  • Cryptorchidism
				•

		• Discuss the hypothalamic and pituitary control on testicular function and Feed back control of testicular hormones on hypothalamus and pituitary • Describe the role of prostate, seminal vesicles in reproductive function • Describe the mechanisms that cause erection and ejaculation • State what is capacitation and discuss the changes that occur during capacitation	•	•
3	**Puberty** **Menopause** **Pituitary Gonadotropins (FSH,LH) and Prolactin**	• Describe the mechanism of action functions and regulation of secretion of pituitary gonadotropins and prolactin • Explain the changes that occur during puberty and describe the mechanism of onset of puberty • Define menopause and describe the physiological changes during menopause	• Discuss causes of precocious and delayed puberty	• Discuss the problems associated with Menopause

4	**Female reproductive system**	• Describe the Functional anatomy of the female reproductive system • Outline the stages of Oogenesis • State differences between oogenesis and spermatogenesis • Describe the development of ovarian follicles **(**Stages of follicle development, ovulation, luteinisation, luteal regression) • Describe the control of follicular development, ovulation and luteinisation (role of FSH, estrogen and LH) • Describe the process of follicle attrition • List the hormones produced by the ovary • Illustrate the synergistic role of thecal and granulosa cells in steroidogenesis • Discuss the mechanism of action and functions of estrogen and progesterone • Describe the feedback regulation of ovarian function • Describe the physiological changes occurring in ovaries, uterus, cervix , vagina and breast during a menstrual cycle • Discuss and illustrate the hormonal changes during the menstrual cycle (changes in FSH, LH, estrogen and progesterone)	• Differences between oogenesis and spermatogenes is • Discuss the physiological basis of use of synthetic estrogens and progestins as oral contraceptives • Describe the mechanism of ovulation • State the tests for ovulation and their physiological basis • Common causes of anovulatory cycles (physiological, PCOD) • Protein hormones produced by the ovary and state their source and functions • Identify common causes of anovulatory cycles (physiological, PCOD)	Define: • Menorrhagia, • Dysmenorrhea, • Amenorrhea, and • Premenstrual syndrome • Discuss role of selective estrogen receptor modulators • List important causes of male and female infertility • Assisted Reproductive Techniques (IVF) • Abnormalities leading to infertility • Assisted Reproductive Technics (IVF) (Gynaecology)

7	**Physiology of Pregnancy**	• Outline the process of fertilization, implantation and placental formation • Discuss the importance of corpus luteum of pregnancy • Discuss the functions of placenta. • Discuss the secretion and function of hCG from the placenta. • Describe the role of hormonal and mechanical factors influencing labor • Describe the changes that occur in the various organ systems in the mother during pregnancy	• Physiological basis of immunological tests for pregnancy based on hCG • Parturition • Source and functions of relaxin • Describe the fetoplacental unit	
8	**Lactation**	• Describe the Role of estrogen and progesterone in breast development • Describe the mechanism that causes initiation of lactation after delivery • Describe the role of Prolactin and prolactin inhibitory factor (Dopamine) in lactation • Describe the Milk ejection reflex	• Role prolactin inhibitory factor (Dopamine) in lactation • Discuss the effect of lactation on menstrual cycle	• Gynacomastia • Composition of human milk • Prolactinomas • Role of bromocriptine in preventio of lactation
9.	**Contraception**	• Classify contraceptive methods • Describe the physiological basis of the various methods of contraception	• Details of contraceptives devices, side effects	•

Excretory system (Lectures + Tutorials 25 hours; Practicals + OSPE 10 hours;				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVE**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KN**
1	**Functional Anatomy of Kidney** **Structure of Nephron**	• Describe the gross Anatomy of Kidney • Describe the structure of the cortical and Juxtamedullary nephrons • Describe the salient features of Renal circulation • Describe the structure of the juxtaglomerular apparatus.		
2	**Glomerular filtration and renal blood flow**	• Describe the structure of glomerular capillary membrane and the factors affecting glomerular filtration • Measurement of GFR • **Renal Blood Flow** • Discuss the factors determining and regulating renal blood flow and the mechanisms of autoregulation of renal blood flow • Explain Tubulo-glomerular feed back • **Juxtaglomerular Apparatus** • Explain the structure of Juxtaglomerular Apparatus Discuss the role of Juxtaglomerular Apparatus in Autoregulation of GFR and RBF (TG Feedback) and the regulation of blood pressure via the Renin-AT-Aldosterone axis.	• Concept of Renal Clearance • Inulin Clearance – to measure GFR • PAH clearance to measure RBF • Creatinine Clearance to assess GFR	• Proteinuria/ Albuminuria / Hemoglobinu
3	**Proximal Convoluted tubules (PCT)**	• Describe the reabsorption of sodium, chloride and water in the proximal tubule Describe the functioning of the	• The concept of the transport maximum for glucose, renal threshold,	

		important sodium transporters in PCT – sodium-glucose, sodium-aminoacid co-transporters and sodium-hydrogen exchanger in the luminal border, sodium-potassium pump in the basolateral border. • Describe the mechanism of glomerulotubular balance • Discuss the renal handling of glucose, bicarbonate and amino acids in the PCT • Recognize the almost complete reabsorption of glucose, bicarbonate and amino acids in the PCT • Describe the role of Carbonic anhydrase, the sodium-hydrogen exchanger in luminal border, and the bicarbonate transporter in basolateral border in bicarbonate reabsorption in the PCT	types of glycosuria (diabetes mellitus, renal, alimentary) • Describe the action of parathormone on PCT	

4	**Loop of Henle**	• Distinguish between permeability characteristics of the two limbs of loop of Henle.
		• Describe the role of the Na/2Cl/K transporter and the sodium potassium pump in the thick ascending limb (TAL)
		• Describe the function of the Function of LOH in the creation of hyperosmolar medullary interstitium (MI) by the two mechanisms :
		  • Active transport of salt in TAL segment
		  • Counter current multiplication of the active transport
		• Describe the role of the vasa recta in maintaining the hyperosmolarity of the medullary interstitium by counter-current exchange.
			• Mechanism of action of Loop diuretics (Furosemide) as due to blockade of Na/2Cl/K transporter	

5	**Distal Convoluted tubules (DCT)**	• Describe the regulated reabsorption of sodium (aldosterone) via Epithelial sodium channels (ENaC) and Na/Cl symporter in luminal border • Describe the regulated secretion of potassium (aldosterone) via potassium channels in luminal border • Describe the generation of bicarbonate including factors affecting this. • Describe the role of the Phosphate and ammonia as buffers in the formation of urine • Describe the action of Atrial Natriuretic peptide	• Mechanism of diuretic action of thiazide and amiloride • Action of Atrial Natriuretic peptide. • 'Aldosterone escape'.	• Features of hyperaldosteron and the occurr of metabolic alkalosis
6	**Collecting duct (CD)**	• Describe the role of ADH in regulated water absorption • Describe the role of the hyperosmolarity of the medullary interstitium, created by the Loop of Henle in producing a gradient for water absorption. • Describe the role of ADH in urea absorption, abetting the hyperosmolarity of MI. • Describe the role of aquaporins in water absorption.		
7	**Concentration of Urine**	• **Countercurrent Mechanism** • Countercurrent Multiplier • Countercurrent Exchanger • Role of Urea	• Bartter's Syndrome	
8	**Regulation of osmolarity, Na^+ and K^+ levels**	• Describe the role of osmoreceptors in sensing body fluid osmolarity. • Describe the mechanism of sensing thirst. • Describe the role of ADH, Aldosterone, Angiotensin II and ANP in sodium and water balance.	• List common causes and effects of hypo and hyper natremia • List common causes and effects of hypo and hyperkalemia	• Discuss the importance of intracellular sh of potassium • Discuss the us insulin/glucos infusions to tr

		• Discuss the effect of aldosterone in the renal handling of K^+ at DCT • Discuss the relationship between K^+ concentrations and the pH of blood.		hyperkalemia
9	**Regulation of Acid base balance**	• Describe the different buffer systems in the body • Explain the respiratory regulation of acid base balance • Describe the role of the kidney in regulation of acid base balance	• Explain the concept of Anion gap • List common conditions that can lead to primary acid base disorders.	• Identify Prima acid base disturbances i • Respiratory acidosis, • Respiratory alkalosis • Metabolic aci • Metabolic alk from Arterial gas and serum electrolyte val
10	**Micturition**	• Describe the innervation of Bladder and reflex pathway of micturition. •	• Explain the use of a cystometrogram to diagnose urinary problems	
11	**Renal Function Tests**	• List the abnormal constituents in urine • Recognize the normal urinary volume • Discuss the significance of the presence of albumin in urine • Discuss the role of serum creatinine in the measurement of renal function	• Concept of Anion gap	• Sigre Anderso Curve

Respiratory system (Lectures + Tutorials 25 hours; Practicals + OSPE 20 hou				
NO	**TOPIC**	**SPECIFIC LEARNING OBJECTIVE**		
		MUST KNOW	**DESIRE TO KNOW**	**NICE TO KN**
1	**Functional Anatomy**	• Functional Anatomy of the respiratory tract • Functions of nose and para-nasal sinuses • Conducting zone and respiratory zone • Pulmonary vasculature • Structure of alveolus & alveolo-capillary membrane	Examination of RS	
2	**Muscles of Respiration**	• Muscles of Inspiration and Expiration • Accessory Muscles of respiration		
3	**Surface Tension Surfactant**	• Surface Tension in air liquid interface • Law of Laplace • Role of surfactant	• Respiratory Distress Syndrome	
4	**Mechanics of respiration** **Pulmonary Ventilation**	• State the normal respiratory rate and define inspiration & expiration • List the muscles of inspiration, expiration & accessory muscles of respiration • Describe the movements of chest wall and the changes in chest wall dimensions produced by respiratory muscles • Recognise the difference between quiet breathing and forceful breathing • Discuss the factors affecting airflow between the atmosphere and alveoli • State the recoil nature of Lungs and		

		chest wall • State the values of intra alveolar pressure, Intra pleural pressure • Discuss the changes in alveolar and intra pleural pressures during respiration • Identify the sites of air way resistance • Indicate changes in airway resistance with inspiration and expiration • Explain the action of autonomic nervous system on bronchial tone • List histamine as a bronchoconstrictor • Recognise that airway resistance is increased in obstructive lung diseases • Define lung compliance and relate it to clinical conditions in which it is altered • State clinical conditions in which work of breathing is increased		

5	**Lung Volumes and Capacities**	• Define the lung volumes and capacities; state the normal values and discuss their physiological variations
		• Explain the recording of the Spirogram with a diagram and recognize the volumes and capacities which cannot be measured by spirometry
		• Record the lung volumes and capacities of a normal subject using a spirometer
		• Discuss the physiological significance of the Residual volume & functional residual capacity
		• Describe the forced expiratory spirogram and describe FEV_1, FVC and the FEV_1/FVC ratio and its variations in obstructive and restrictive lung diseases.
		• Define peak expiratory flow & state its normal value
		• Record peak expiratory flow in a
			• List the common causes Pathology & clinical features of obstructive and restrictive lung diseases.
			  • Asthma
			  • COPD
			  • Emphysema
			  • Chronic bronchitis
			• State the physiological basis of tests to differentiate them.
			• Recognize the flow-volume curves
			• Methods of determining FRC and RV
				• Methods of determining F and RV
				• Artificial vent

		normal subject • Record FEV_1, FVC and calculate the FEV_1/FVC ratio in a normal subject • Interpret altered values of absolute lung volumes, peak expiratory flow and FEV_1/FVC ratio in restrictive and obstructive lung diseases • Define minute ventilation, anatomical dead space, physiological dead space & alveolar ventilation • Discuss the effect of changes in respiratory rate and tidal volume on alveolar ventilation	• Helium dilution method • Whole body plethysmography • Measurement of dead space	
6	**Alveolar Ventilation**	• Total ventilation = Tidal Volume x Respiratory Rate • Dead Space and Classification • Alveolar Ventilation • Factors affecting alveolar ventilation	• Measurement of Dead Space	
7	**Pulmonary Circulation**	• State the normal rate of pulmonary blood flow & normal range of pulmonary blood pressures • Discuss the special features of pulmonary circulation, pulmonary veins, pulmonary vascular resistance, its response to hypoxia		
8	**Ventilation perfusion Ratio (V/Q Ratio)**	• Explain the regional differences in perfusion, ventilation & V/Q ratio in the lungs • State normal values of V/Q ratio and recognize that physiological dead space is associated with high V/Q and 'physiological shunt' is associated with low V/Q.	• Type I respiratory failure	• State the physiological mechanisms operating to k the lungs dry • Pulmonary hypertension • Pulmonary embolism • Cor-pulmonal
9	**Gas Exchange**	• Discuss the factors that affect rate of gas exchange at lung & tissue level, with application to clinical conditions	• Define Type I respiratory failure and state the common causes	

		• State Fick's law of diffusion • Discuss normal composition of atmospheric, tracheal and alveolar air and recognize the conditions which can affect it • Discuss the normal partial pressures of gases in blood entering and leaving lung • Explain oxygen uptake and carbon-dioxide elimination by lungs & tissues and state the normal rates of the same • Define respiratory exchange ratio and state its normal values • State normal time taken for gas equilibration & its application in exercise • State the physiological causes for normal alveolar-arterial oxygen difference • Explain the dependence of carbon dioxide elimination on ventilation • Define physiological shunt	• Explain Type I respiratory failure due to unequal V/Q distribution even when total ventilation and perfusion may be normal • State the Alveolar gas equation and discuss its application • Recognize that arterial PCO_2 is equal to alveolar PCO_2 and that arterial PCO_2 can be used in the alveolar gas equation • State the causes for abnormal Alveolar – arterial oxygen difference • Distinguish between intrapulmonary and extrapulmonary right to left shunts.	
10	**Transport of Oxygen**	• Explain the forms of oxygen transport in blood • Discuss hemoglobin affinity for oxygen • Explain & illustrate oxygen-hemoglobin dissociation curve and discuss the factors affecting it and the physiological advantages of the curve • Explain Bohr effect • Discuss oxygen carrying capacity of blood • Differentiate between oxygen content of blood & % oxygen saturation of hemoglobin • Define hypoxemia and hypoxia; explain the physiological basis of	• State the physiological basis of oxygen therapy as treatment for the different types of hypoxias	• State what pu oximetry mea

		types of hypoxia with examples • Define cyanosis and differentiate between conditions in which it occurs and may not occur		
11	**Transport of Carbon dioxide**	• Explain the forms of carbon dioxide transport in blood • Explain the role of chloride shift and Haldane effect		
12	**Regulation of Respiration**	• Express the concept of the sensors, central controller in brain & effectors in the respiratory control system • Describe the location and functions of the respiratory centres in brain; describe the current explanation for the basic rhythm of respiration • Describe the effects of neural inputs on respiration in terms of the voluntary cortical control, motor cortical input, limbic input, peripheral afferent inputs (Hering breuer reflexes, J receptor input, proprioceptor input, and other peripheral inputs) • Express the aim of chemical control of respiration; explain the role of peripheral and central chemoreceptors; explain the feedback control of ventilation to regulate gas exchange & maintain normal levels of arterial blood gases and pH • Discuss and compare the influence of arterial carbon dioxide and oxygen on ventilation in health and in disease • Describe Cheyne-stokes breathing, state its causes, explain the physiological and pathophysiological mechanisms that produce it; state the abnormality in Biot's breathing • Demonstrate the effect of apnoea &	• State the normal values of arterial blood gases (ABG) and interpret altered values • Define hypercapnoea and hypocapnoea • State the causes of asphyxia	• State the cause respiratory acid and alkalosis • Define Type II respiratory fail and mention its causes

		hyperventilation on respiration; demonstrate the effect of breathing through a tube and the effect of speech & cough on respiration		
13	**Physiological adaptations in special environments (High Altitude, Deep Sea Diving and Gravity)**	• State the physiological effects of zero gravity • State the physiological basis of Caisson's disease & Nitrogen narcosis • State the physiological adaptations occurring at high altitude Physiological effects of zero gravity • Aviation Physiology		
14	**Exercise**	• Describe the effects of exercise on the respiratory system and explain the physiological basis of these effects; explain the physiological need for these changes • Define VO_2 max and oxygen debt		
15	**Pulmonary Function Tests**	• Spirometry • Arterial Blood Gas Analysis • Peak Flow Meter • Pulseoxymetry		
16	**Miscellaneous**	• List the Non-Respiratory functions of lung • State the physiological mechanism of cough, sneeze and gag reflexes		
17	**Clinical examination of respiratory system**	• Demonstrate the methods of Clinical examination of the respiratory system • Recognize normal Clinical findings of respiratory system examination • State the abnormal findings that may be present in a patient and list the common clinical conditions in which these abnormalities occur and the physiological explanations for these abnormalities if any	• Pathology & clinical features of • Pleural effusion • Pneumothorax • Pneumonia, consolidation • Fibrosis • Collapse • Bronchiectasis	

Cardiovascular system (Lectures + Tutorials 35 hours; Practicals + OSPE 20 hour				
NO	TOPIC	SPECIFIC LEARNING OBJECTIVE		
		MUST KNOW	DESIRE TO KNOW	NICE TO KN
1	**Functional anatomy of heart**	• Describe the functional anatomy of the heart, with respect to its chambers, valves, input and output vessels, AV ring and electrical discontinuity, Conducting system, Coronary supply	Examination of CVS	
2	**Conducting system of Heart SA Node**	• Describe the following: • Contour of SA node action potential with a diagram, depicting the various phases (4, 0 and 3) • Prepotential (phase 4 depolarization) • Currents responsible for generation of SA node action potential: The funny current (I_f), T-type calcium current (ICa_T), L-type calcium current (ICa_L) •	• Intrinsic rate of the SA node and influence of autonomic nervous system, hormones and temperature. • Sinus arrhythmia, sinus bradycardia, sinus tachycardia • Record respiration with a stethograph or respiration belt transducer, as well as ECG or pulse simultaneously, to demonstrate respiratory sinus arrhythmia.	
3	**Atrial Cell**	• Recognize that AP in atrial cell is similar to ventricular cell (fast AP)	•	
4	**Ventricular Cell**	• Describe the contour of the ventricular action potential with the aid of a diagramDescribe the ionic currents responsible for phases 0,1,2,3,4 of the ventricular action potential • State the differences between the SA node action potential (slow AP) and the	• Be able to describe the mechanisms by which calcium is extruded from cytoplasm to terminate systole – the role of the Plasma membrane calcium ATPase and sodium-	• Be able to corr Starling's law sarcomere leng and actin-myos interaction • Identify the relationship be

		ventricular cell action potential (fast AP). • Describe how the action potential leads to an increase in cytosolic calcium concentration • Describe excitation-contraction coupling • State the basic concepts of the sliding filament theory of contraction	calcium exchanger (NCX)	heart failure ar sarcomere leng
5	**Cells of conducting pathway**		• State the type of: • AV node AP - similar to SA nodal cell (slow AP) • His Bundle cell: fast AP • Purkinje fibres: fast AP	
6	**Properties of Cardiac Muscle**	• Automaticity • Excitability • Conductivity • Contractility		
7	**Cardiac Cycle**	• Describe with a diagram, the chronological relationship of the following events shown on the same time axis: • ECG • Valvular events • Heart sounds • Pressure curves: Left ventricular pressure, Atrial pressure and aortic pressure • Ventricular Volume curve:	• Concept of Murmurs • Timing of Murmurs • State the timing of murmurs in various valvular and congenital heart defects • Cardiac Catheterization	
8	**Stroke Volume**	• Discuss the determinants of stroke volume	• Recognize echocardiographiy as a method of measuring stroke volume	
9	**ECG**	• Describe the electrocardiogram as a surface recording of electrical changes occurring on the external surface of the heart during the passage of an action	• List the ECG changes in the following conditions: • Myocardial ischemia • Myocardial infarction	• Heart Block • Ischemia • Infarction cha

		potential. • Describe the 12 Leads in which ECG is recorded. • State the rationale of recording from multiple leads. • Identify the lead which is commonly used to monitor patients continuously. • Describe the P, QRS, T and U waves of an ECG in lead II configuration and describe the electrical events responsible for these waves • Describe PR and QT intervals and state what they represent • Describe the significance of ST segment being on the isoelectric line in a normal ECG • Record an ECG in a human subject in all 12 leads • Calculate rate from a normal ECG tracing • Identify if every QRS complex is preceded by a P wave and if every P wave is followed by a QRS complex • State in what conditions the above will not happen	• Hyperkalemia • Ventricular tachycardia • State the causes for PR prolongation • Describe the types of Heart block as represented by ECG changes • Arrhythmias • Vector cardiogram • Calculation of axis • His bundle electrogram	
10	**Properties of cardiac muscle:** **Automaticity**	• Describe the function of the sinoatrial node as the pace-maker of the heart • Describe the determinants of heart rate and the neural and chemical regulation of heart rate • Describe the ionic currents responsible for rhythm-generation in the SA node	• Understand that there is redundancy in pace-maker function – if the sinus node fails, there are alternate sites of rhythm generation • Arrhythmias	
	Excitability and Refractoriness	• Define refractory period, describe its relation to the duration of the ventricular action potential, and state its physiological significance.	• Describe refractory period in terms of properties of voltage-gated sodium channels • State factors which cause	

			prolongation of action potential duration • Define Long QT syndrome	
	Conductivity	• Describe the normal mode of conduction of the cardiac impulse	• Alternate conducting pathways • Define the causes of arrhythmias in terms of abnormal site of rhythm-generation or re-entry	
	Contractility	• Describe the determinants of force of contraction of the ventricle in terms of o Preload (Starling's law) o Afterload o Inotropic status (contractility) o Frequency (or heart rate), (Bowditch phenomenon or Force-frequency relation) • Discuss the clinically measurable parameters reflecting preload, afterload and force of contraction of the heart • Describe Starling curves or ventricular function curves	• Discuss Ejection fraction (EF) as a measure of cardiac contractility (inotropic status). • State the different modes of and indications for Cardiac catheterization • State how echocardiography may be used as a non-invasive means to assess cardiac function	
11	**Cardiac Output**	• Definition of Stroke Volume, Cardiac Index, EDV, ESV, and EF • Discuss the determinants of cardiac output • Describe the regulation of cardiac output • Discuss high output and low output states	• Methods of Measuring Cardiac Output	• Discuss high o and low outpu states
12	**Heart Rate**	• Innervation of Heart – Parasympathetic and Sympathetic • Normal Values • Regulation of Heart Rate • Factors affecting Heart Rate		
13	**Vascular Physiology**	• Describe the function of Aorta and large Arteries as elastic, windkessel vessels • Describe what would happen to pulse	• **Discuss the role of capillaries** as exchange vessels	• State what wou happen to puls volume (as ass

		pressure in case of thickening and loss of elasticity of aorta • Describe the role of arterioles as resistance vessels • Describe the term Total Peripheral resistance (TPR) • Discuss the determinants of TPR and the relationship of TPR to blood pressure and cardiac output. • Discuss the role of arteriolar resistance as a determinant of blood flow to a specific organ • Discuss the determinants of arteriolar resistance in terms of Poiseulle's equation • Identify that the arteriolar diameter is the major determinant of arteriolar resistance • Discuss the global and local factors affecting arteriolar diameter and therefore the TPR, blood pressure and blood flow – vasodilator and vasoconstrictor mechanisms • Discuss the physiological role of endothelium-derived relaxing factor (EDRF) or Nitric oxide (NO)	• Describe the Starling's forces determining fluid movement across the capillary membrane • **Describe the function of Veins** as capacitance vessels • **Define the term Venous return** (VR) and discuss its role as preload • Describe the determinants of VR • Discuss the significance of assessing jugular venous pulse • Discuss the interactions between Right atrial pressure, VR and Cardiac output (CO)	by taking the r pulse) in case thickened arter • Discuss the physiological/p hysiological ro the following vasoactive substances: Histamine, bradykinin, serotonin, thromboxane A prostacyclin, E elin • Describe Veno return curves • Describe the interaction of Venous return Cardiac output curves • Discuss the cli significance of monitoring of
14	**Blood Pressure**	• Define the following terms: • Mean arterial blood pressure, Systolic pressure, Diastolic pressure, pulse pressure • Describe the determinants of blood pressure • Discuss the short-term (neural and hormonal) and long term (renal) mechanisms regulating blood pressure (with special reference to shock and exercise). • Demonstrate the method of	• Hypertension • Hypotension	

		measurement of blood pressure using a sphygmomanometer. • Describe the principle of measuring blood pressure by sphygmomanometry • Discuss other methods of measuring blood pressureby sphygmomanometer		
15	**Cardiovascular autonomic reflexes**	• Describe the physiological role of the following reflexes, their receptors, specific stimuli, afferent and efferent neural pathways, and the responses. • Baroreceptor reflexes • Chemoreceptor reflexes • Vasovagal syncope • Cushing's reflex • Bainbridge reflex • Bezold Jarisch reflex	• Define Diving reflex	
16	**Effects of exercise on cardiovascular system**	• Discuss the effects of exercise on the cardiovascular system • Demonstrate the effects of mild to moderate and high intensity exercise on the blood pressure and heart rate in a normal subject		
17	**Regional circulations**	• **Features and regulation of the following circulations:** • Coronary • Cerebral • Renal circulation - Auto-regulatory mechanisms (myogenic factors and Tubuloglomerular feedback) • Pulmonary (its pressures, hypoxic vasoconstriction) • Splanchnic • Cutaneous circulation and temperature regulation • Skeletal muscle • Recognize the importance of	• Discuss the term Coronary artery disease Define the following terms: Transient Ischemic attacks (TIA), Stroke, Cerebrovascular accidents (CVA) • List the effects of gravity and acceleration on CVS • Discuss the physiology of **Fetal** circulation before and after birth	

		sympathetic regulation versus local metabolic factors in the regulation of the regional circulations mentioned above.		
18	**Hypertension**	• State the normal ranges for systolic and diastolic blood pressures in the various age groups • Define hypertension	• Discuss the risk factors for essential hypertension and causes of secondary hypertension	
19	**Hypotension (Shock)**	• Define the term 'Shock' or Cardiovascular shock • State the different types of shock • Discuss the pathophysiology of the following types of shock: Hypovolemic, cardiogenic, Distributive (septic, anaphylactic, neurogenic) Obstructive	Describe the term Vasovagal syncope	
20	**Heart Failure**	• Define the term cardiac failure or heart failure. • State the clinical features of left heart failure and right heart failure. • Define the term congestive cardiac failure	• State some causes of heart failure • Discuss the physiological basis of treatment of heart failure	
21	**Myocardial infarction or heart attack**	• Define the following terms: • Angina • Ischemia • Myocardial infarction or heart attack • Discuss the major ECG changes in: • Myocardial ischemia • Myocardial infarction		
22	**Valvular diseases**		• State the causes for stenosis and regurgitation of the valves • State the murmurs associated with the various valvular defects	
23	**Congenital heart diseases**		• State the hemodynamic abnormalities and murmurs in ASD, VSD, PDA	

Central nervous system (Lectures + Tutorials 45 hours; Practicals + OSPE 2

NO	TOPIC	SPECIFIC LEARNING OBJECTIVE		
		MUST KNOW	DESIRE TO KNOW	NICE TO KN
1	**Organization of the nervous system**	CNS PNS o Somatic NS o Autonomic NS o Enteric NS		
2	**Neural Tissue**	• State the cell types present in the nervous system • Describe the morphology of different types of neurons and neuroglia • Describe the process of myelination and its significance • Differentiate between white matter and grey matter. • Define the terms 'nuclei' and 'ganglia'.		
3	**Nerve Fibres**	• Define the term 'Peripheral nerve'. • State the types of fibres in a mixed peripheral nerve. • Describe Ehrlanger & Gasser's classification of peripheral nerve fibres • Describe nerve injury, degeneration and regeneration of injured fibres	• Numerical classification of sensory fibres • Mechanism of axoplasmic transport • Wallerian degeneration	
4	**Electrical properties of the nerve cell membrane**	• Describe the ionic basis of Resting membrane potential of a nerve cell. • Describe the term electrotonic potentials with reference to: • 'receptor or generator potential' in a sensory receptor	• 'excitatory or inhibitory post-synaptic potentials (EPSP and IPSP)' in a post-synaptic neuron • 'end-plate potential' at the neuromuscular	• Strength-durat curve - Rheo voltage, chron & utilization t • Define the co of depolarisati

		• 'excitatory or inhibitory post-synaptic potentials (EPSP and IPSP)' in a post-synaptic neuron • 'end-plate potential' at the neuromuscular junction • Define the term 'Action potential' and describe the currents responsible for the different phases of the action potential in the neuron. • Describe the process of transmission of action potential in unmyelinated and myelinated neurons • Describe the phenomenon of saltatory conduction in a myelinated neuron. • List the factors affecting conduction velocity in a nerve.	junction	block in terms properties of voltage-gated sodium chann • Define the mechanism of action of local anaesthetics.
5	**Synapses**	Define the terms electrical & chemical synapse Describe the morphological features of a chemical synapse – pre and post synaptic neurons List the morphological types of chemical synapse – axosomatic, axodendritic and axoaxonic Describe the process of synaptic transmission. List the events in the pre-synaptic neuron, culminating in release of neurotransmitter. Describe the events in the post-synaptic neuron – Excitatory and inhibitory post-synaptic potentials, Summation (spatial and temporal) of synaptic inputs at the axon hillock, formation of action potential.	• Define the following properties of synapse: • One-way conduction • Synaptic delay • Convergence and Divergence of synapses • Spatial summation • Temporal summation • Define the term synaptic plasticity • Describe the differences between Pre-synaptic and post-synaptic inhibition. • Define the term Pre-synaptic facilitation	• Define synapt fatigue • Define the following syn phenomena Occlusion & subliminal fri effects
6	**Neurotransmitters**	• List the important small molecule neurotransmitters in the CNS and their receptors: • Glutamate and its ionotropic receptors:	• State whether the action of each of the above neurotransmitters on the various receptors is excitatory or inhibitory.	• Glutamate-inc excitotoxicity Organic brain syndromes – Schizophrenia

		NMDA, and non-NMDA • GABA • Glycine • Dopamine • Serotonin or 5-HT • Acetylcholine • Noradrenalin	• State the major excitatory neurotransmitter in the CNS • State the inhibitory neurotransmitters of the CNS. • State the mechanism of inhibition. • Denervation hypersensitivity • Criteria for a substance to be called a neurotransmitter	Depression (Psychiatry)
7	**Introduction to CNS**	• Anatomical parts of CNS • Functional divisions		
8	**Sensations**	• Classify the types of sensations (sensory modalities	• Describe the common attributes of sensory information – modality, location, intensity and duration	
9	**Sensory receptors**	• Differentiate between usage of the term 'Receptors' i.e., sensory receptors versus neurotransmitter or ligand receptors. • List the sensory receptor for each modality of sensation • Touch receptors • Receptors for proprioception • Pain and temperature receptors •	• Define rapidly adapting and slowly adapting receptors • Describe the mechanism of sensory transduction taking a particular receptor as example (e.g., pacinian corpuscle, hair cells of inner ear, rods and cones, muscle spindle etc)	

9	**Ascending sensory pathways** **Pathway for fine touch (Posterior Column)** **Pathway for proprioception** **(Dorsal and Ventral Spinocerebellar Tract)**	**Ascending sensory pathways** • Sensory Cortex – Primary sensory area SI and SII • Sensory Homenculus • Cortical Sensations • Cortical Plasticity **Three neuron pathway of sensory systems** • I order neurons, dorsal root ganglia, Fasciculi gracilis and cuneatus in posterior column and termination in medulla • II order neurons (cross over) : Medial lemniscus from medulla to contralateral thalamus • III order neurons: Thalamocortical neurons • Cortical termination of pathway: Post-central gyrus. • Sensory Cortex-Primary sensory area SI & SII **Important receptors for Proprioception (other than touch and pressure receptors):** • Muscle spindle (muscle length detectors) • Golgi tendon organ • Joint receptors (Pacinian corpuscles) • Fate of proprioceptive input: • Posterior column pathway – same as fine touch • Spinocerebellar tracts – dorsal and ventral; Clarke‟s column • Spinal reflex arcs – stretch and	• Medial to lateral arrangement of fibres in posterior column • Lateral to medial arrangement of fibres in spinothalamic tract	• State the mech proposed by V.S.Ramachar to explain the phantom limb phenomenon.

	Pathway for crude touch (Anterior Spinothalamic tract) **Pain and Temperature (Lateral Spinothalamic Tract)** **Sensations from face**	inverse stretch reflex arcs **Receptors for crude touch, pain and temperature : Mechanoreceptors, Nociceptors and Thermoreceptors** **Major pain pathway:** • I order neurons – end in spinal cord; Lissauer's tract; substantia gelatinosa • Fast pain through Aδ fibres and slow pain through C fibres • II order neurons cross over – forming lateral spinothalamic tract • III order neurons – thalamocortical, end in Post-central gyrus. • Pathway for sensations from face		

	Physiology of Pain	Briefly describe receptors for pain.
		• Describe the pathway for transmission of pain from receptors to the cortex.
		• Define the following terms: Substantia gelatinosa, Lissauer's tract, fast pain, slow pain.
		• State the type of peripheral nerve fibres carrying fast pain and slow pain respectively.
		• Describe the following phenomena:
		  • Referred pain
		  • Peripheral sensitization of pain
		  • Central sensitization of pain – (wind-up) – role of glutamate and NMDA receptors
		  • Dissociated anaesthesia
		  • Phantom limb pain
		• Describe descending pain control pathways: from Periaqueductal grey, Locus ceruleus and Nucleus Raphae magnus
			• Describe the gate control theory of pain
			• Discuss the principle of using pain balms and Acupuncture for pain relief.
			• List the endogenous opioids and the types of Opiate receptors.
			• Describe the role of endogenous opioids in pain transmission
				• List a few opi used to treat p

10	**Motor system**	• Describe the features of organization of the motor system. • Define UMN & LMN	• Arrangement of LMNs in the anterior horn • 'Motor homunculus'	

	Descending Motor Tracts	• List the descending tracts involved in motor control.
		• Describe origin, course, termination and functional role of the Pyramidal tracts. State why the pyramidal tracts are called so.
		• Describe the role of corticobulbar tracts.
		• List the extrapyramidal descending tracts.
		• State the origin, termination and physiological role of the following extrapyramidal tracts:
		  • Rubrospinal
		  • Pontine reticulospinal
		  • Medullary reticulospinal
		  • Lateral vestibulospinal
		• Describe the influence of the extrapyramidal tracts on spinal motor neurons & spinal reflexes
		• Describe the effects of lesion of the pyramidal and extrapyramidal tracts respectively on spinal motor neurons, spinal reflexes & muscle tone
			• Describe the physiological basis and the clinical significance of
			  • Decerebrate posture
			  • Decorticate rigidity	

11	**UMN and LMN Lesions**	• Describe the features and Physiological basis of Upper motor neuron & lower motor neuron lesion.
		• Describe the features of:
		  • Hemisection of spinal cord at a given level (e.g. T8, L3 etc)
		  • Brown Sequard syndrome
		  • Complete transaction of spinal cord at a given level.
			• Define the following terms: Hemiplegia, quadriplegia, paraplegia
			• Hemiparesis, quadriparesis & paraparesis
				• Definition of terminology:
				o Transient ische attacks
				o Stroke
				o Cerebrovascul accidents
				• Neurogenic bl

12	**Reflexes**	• Define the term 'reflex'.
		• Describe the components of a reflex arc with a diagram.
		• Classify reflexes:
		  • based on the location of receptors (deep and superficial)
		  • Based on number of synapses in the reflex arc (mono, di or polysynaptic)
		• Describe in detail, the stretch reflex and its physiological significance.
		• List the other terms which are commonly used to refer to the stretch reflex.
		• Identify that the clinically tested deep reflexes (or tendon jerks) are stretch reflexes.
		• Differentiate between alpha and gamma motor neurons.
		• Name the receptor for the stretch reflex and describe its basic structure with a diagram. State the functional role of gamma motor neurons.
		• State the effects of supraspinal influences on the stretch reflex
		• Describe the effects of UMN lesions.
		• Describe the effects of LMN lesions.
		• Describe the inverse stretch reflex arc. State the stimulus and response for the inverse stretch reflex.
		• Describe the functional role of Golgi tendon organ.
		• Describe the physiological basis of "Clasp-knife" rigidity
		• Describe the flexion withdrawal reflex. State its functional role?
		• Describe the afferent, efferent pathways and the centre of integration for the
			• Alpha-gamma co-activation
			• Physiological basis for Jendrassik's maneuver
			• Crossed extensor reflex
			• Importance of using a painless stimulus to elicit plantar response
			• Central excitatory state & irradiation of stimulus in spinal cord
			• Mass reflex & its use in spinal cord injury patients
			
			o Postural reflexes other than stretch reflex and crossed extensor reflex:
			o Brain stem reflexes:
			Righting reflexes (Midbrain)
			oLabyrinthine righting
			oNeck righting
			oBody on head righting
			oBody on body righting
			
			• Vestibular or Labyrinthine reflexes (Medulla)
			o Vestibulospinal or tonic labyrinthine reflex (TLR)
			Vestibulocollic reflex
			Vestibuloocular reflex (VOR)
			oVestibular placing reaction
			
			• Tonic neck reflexes (upper cervical cord)
				Tonic neck refle
				(upper cervical
				• Symmet tonic ne reflex (S
				• Other Primitiv reflexes:
				- Sucking reflex
				- Rooting reflex
				- Grasp reflex - 6 months
				- Plantar – Babin 1 year
				Should not rema active beyond 6- months of life.
				
				If they do, and th not integrated, th can interfere wit voluntary contro specific moveme and result in imn patterns of move (eg. Cerebral pal
				• The prir reflexes re-emer an adult brain in

		following superficial reflexes: Corneal, conjunctival, Abdominal, cremasteric • State the rationale in assessing superficial reflexes, while examining the nervous system. • Describe flexor and extensor plantar reflexes. • Recognize the importance of using a painless stimulus to elicit plantar response • Describe Babinski's sign and state its clinical significance. • List the physiological conditions, where plantar response is extensor. • Demonstrate how to elicit the clinically significant superficial and deep reflexes in normal subject.		
13	**Cerebellum**	• Describe the structure of cerebellum, its somatotopic organization, deep cerebellar nuclei, afferent pathways, internal connections, efferent pathways. • Name the afferent and efferent fibres of cerebellum • Describe the functions of cerebellum.	• Describe the features of cerebellar lesions • Describe cerebellar function tests.	• Cerebellar lesi

14	**Basal ganglia**	• Define the term basal ganglia.
		• List the nuclei forming the basal ganglia.
		• List the following:
		  • Input nuclei – which receive afferents from cortex
		  • Output nuclei – which send output to thalamus and spinal cord
		• Describe the internal connections between input and output nuclei – give details of the direct pathway and indirect pathway.
			• Describe the features of Parkinson's disease.
			• Describe the pathophysiological basis of Parkinson's disease.	

		• Describe the origin and termination of the nigro-striatal pathway. State the neurotransmitter in this pathway. • Describe the physiological role and clinical significance of the nigrostriatal pathway.		
15	**Reticular formation**	• Describe the organization of the reticular formation and its physiological role. • Describe the ascending Reticular Activation System	• List the neurotransmitters of various nuclei of RF. • Give an outline of afferent & efferent connections	
16	**Thalamus**	• List the groups of thalamic nuclei • Give an outline of connections of thalamus • List the functions of thalamus.	• List the important features of thalamic syndrome	
17	**Hypothalamus**	• List the major regions and functions of hypothalamus • Connections of hypothalamus • Describe the functions of the hypothalamus	Hypothalamic Obesity	
18	**Limbic system**	• State the components of Limbic system • Describe the physiological role of the limbic system Recognize the importance of Papez's contributions • Recognize the central role of amygdala.	• New concept of the Limbic System – Emphasis on amygdala. • Kluverbucy Syndrome • Shamrage	• Recognize differences bet the new concep Limbic circuit Papez's circuit • Identify nuclei involved in ad

19	**Cortex**	• Identify the major somatic and special sensory, motor & association areas in the cortex.
		• Recognize the somatotopy of the motor and somatic sensory areas (homunculi)
		• Recognize the phenomena of hemispheric specialization (dominance), handedness.
			Define the role of corpus callosum – inter-hemispheric transfer of information	• Sperry's Split Experiments
				• Dyslexia
				• Prefrontral Lobotomy
				• Define the following tern
				  • hemi-ne syndrom
				  • cortical

				blindnes • synaesth
20	**EEG**	• State the physiological basis of EEG, types of EEG waves, • Uses of EEG		
21	**Sleep**	• Define the various stages of a sleep cycle. • Distinguish between NREM and REM sleep.	Sleep Disorders • Hypersomnolence • Obstructive sleep apnea • Insomnia	• Theories of sle Wakw Cycle
22	**Language & speech**	• Define the role of Wernicke's & Broca's areas in language & speech • Define aphasia and state the site of lesion in motor and sensory aphasia		
23	**Learning and memory**	• Describe the classification of learning and memory • Describe the following phenomena of implicit or Non-declarative learning: o Non-associative – Habituation Sensitization o Associative – Classical conditioning Operant conditioning • Define Explicit or declarative memory. • Define the term synaptic plasticity • Describe the synaptic phenomenon associated with Short term memory. • Describe the phenomenon leading to long-term memory. • Describe the role of hippocampus in memory formation. • Describe the role of cerebellum in motor learning.	• List Alzheimer's disease and Korsakoff's psychosis as disorders of learning and memory	
24	**CSF**	• Describe the composition, Secretion, Circulation, Drainage and Functions	• Papilledema • Hydrocephalus	

		• Define Blood Brain Barrier • Define Blood CSF barrier		
25	**Cranial Nerves**	•	• Examine the integrity of the cranial nerves I-XII in a normal subject	

Special Senses (Lectures + Tutorials 20 hours; Practicals + OSPE 6 hours; ECE				
NO	TOPIC	SPECIFIC LEARNING OBJECTIVE		
		MUST KNOW	DESIRE TO KNOW	NICE TO KN
	EYE			
1	**Functional anatomy**	• List the structures within the eyeball • Name the extraocular muscles and describe their functions • Describe the functions of Iris, Ciliary body, Intra-ocular muscles, Lens, Aqueous humor, Vitreous body and Optic nerve • Describe the formation and drainage of aqueous humour	• State the normal range of intraocular pressure	
2	**Optics of eye**	• List the structures through which light passes before falling on the retina • State the important refracting surfaces of the eye and the extent of contribution of each to image formation. • State that the image formed on the retina is inverted and diminished in size. • Describe the role of crystalline lens in focusing the light rays and describe the changes that happen while focusing a near object – accommodation reflex • List the common refractive errors – Myopia, hypermetropia, presbyopia and astigmatism • Describe the cause for the refractive errors and explain their correction	• Concept of the „reduced eye" • Accommodative power of lens and near point of vision • "Reduced eye"	
3	**Retina**	• List the retinal cells contributing to the visual pathway. (photoreceptors,	• Cone & rod density distribution in retina	

		bipolar cells and ganglion cells) • Describe optic disc, macula lutea and fovea as important structural features in the retina • Classify photoreceptors – Rods and cones • List major structural and functional differences between rods and cones • Demonstrate visual acuity on a subject using Snellen's chart	• Convergence of synapses	
4	**Photo transduction**	• Visual pigments • "Dark current" – at rest in the photoreceptors • Hyperpolarizing receptor potential in rods & cones in response to light • Transmission of Action potential to the optic nerve.	• Decomposition of rhodopsin - biochemical steps involved Neurotransmitters involved • Wavelengths of light best absorbed by pigments	
5	**Light & Dark adaptation**	• Describe the changes that happen during dark and light adaptation	• Nyctalopia	
6	**Colour vision**	• Name the types of photoreceptors responsible for colour vision • Classify cones based on their spectral sensitivity • List the types of colour blindness • Describe theories of colour vision • Demonstrate the use of Ishihara's chart to check for colour blindness	• Color constancy and Purkinje shift • Theories of color vision	
7	**Optic Pathway**	• Draw and describe the optic pathway from the photoreceptors to the visual cortex • Describe the visual field defects produced by lesions at various levels of the pathway	• List the conditions producing pupillary constriction & pupillary dilatation	
8	**Pupillary Reflexes**	• Describe the pupillary light reflex pathway • Differentiate between direct and consensual pupillary light reflexes	• Describe the accommodation reflex pathway • List the features of	• Conditions producing pup constriction & pupillary dilat

		• Demonstrate direct and consensual light reflexes on a subject provided	Horner's syndrome Explain Argyll-Robertson pupil	
9	**Eye Movements**	• List the extraocular muscles and describe their actions • Name the cranial nerves innervating the extraocular muscles • List the types of eye movements (saccadic, smooth pursuit, vergences	• Saccadic & smooth pursuit movements • Opto-kinetic reflexes	
	EAR			
1	**Functional anatomy of the ear**	• List different parts of the ear. • Mention functions of outer ear • Describe the role of middle ear in impedance matching • List structures within the inner ear and specify their functions • Describe the importance of attenuation reflex		
2	**Inner Ear Function of cochlea**	• Draw the cross-section of cochlea with all 3 three scalae. • Describe the 'travelling wave theory' of hearing • Describe the function of basilar membrane in frequency discrimination - 'Place principle' of hearing	• Volley effect or Frequency principle of hearing	
3	**Sound**	• Physics of sound • Concept of the Decibel scale	• Noise - as an occupational hazard	
4	**Sensory transduction in cochlea**	• Recognize the importance of endocochlear potential and sensory transduction in the cochlea.		
5	**Processing of auditory signals**	• Describe the auditory pathway	• Describe the mechanisms underlying sound localization and masking effect of sounds	• Describe the concept of ton maps
6	**Assessment of hearing**	• Define an audiogram • Identify a normal air-conduction and bone-conduction tracing		• Principle of he aids

		• Identify conductive hearing loss and sensory neural hearing loss using audiogram • Describe the principle of Rinne's and Weber's test		
7	**Deafness**	• Types of deafness - Conductive & Neural	• Audiogram • Distinguish between conductive hearing loss and sensory neural hearing loss based on audiogram	• Speech Audior
	VESTIBULAR APPARATUS			
1	**Functional anatomy of vestibular apparatus**	• List the structures which make up vestibular apparatus and their functions		
2	**Mechanism of stimulation vestibular hair cell**	• Describe the mechanism of stimulation of otolith organs - deflection of hair cells using gravitational force/inertial force of otolith membrane • Describe the mechanism of stimulation of semicircular canals - deflection of hair cells using inertial force of endolymph		
3	**Vestibular pathway**	• Describe the connections of vestibular nucleus to the cortex and cerebellum • Describe the projections through vestibulospinal tracts • Describe the functions of Vestibular system - Maintenance of balance, equilibrium and posture	• Connections to cranial nerve nucleii controlling • Eye movements - Vestibulo-ocular reflex • Head & neck movements	
4	**Tests of Vestibular function**		• Identify nystagmus in a patient • Caloric test • Rotation in a Barany chair	• Meniere's disea
	SMELL			
1	**Microscopic anatomy of**	• Describe the arrangement of olfactory sensory neuron within the olfactory	• List the types of cells within the olfactory bulb	• Pheromones

	olfactory epithelium and olfactory bulb	epithelium	• Describe the connections of olfactory sensory neurons with cells in the olfactory bulb	
2	**The olfactory pathway**	• Describe the olfactory pathway from the olfactory sensory neurons to the cortex	•	•
	TASTE			
1	**Receptors for Taste**	• Describe the arrangement of taste cells within taste buds and organization of taste buds within papillae.		
2	**Basic qualities of taste sensation**	• The student must be able to: • List the four basic qualities of taste sensation • Demonstrate how to test for the four basic qualities of taste sensation	• List umami as the fifth taste sensation	
3	**Taste pathway**	• Draw and describe the taste pathway from the anterior two-third and posterior one-third of the tongue to the gustatory cortex		

REFERENCE LEARNING BOOKS

Text Book of Medical Physiology by Guyton and Hall – A South Asian Edition

Ganong's Review of Medical Physiology

Text Book of Physiology by Dir.Prof.A.K.Jain (Volume I & II)

Understanding Medical Physiology – A Text Book for Medical Students by RL Bij

Taylor's Physiological Basis of Medical Practice by O.P.Tandon and Y.Tripathi

Text Book of Human Physiology by Sarada Subramanyam A

Text Book of Practical Physiology by CL Ghai

Manual of Practical Physiology by Dir.Prof.A.K.Jain

THEORY EXAMINATION

Theory Examination - Pattern of Question Paper I and II

1	Essay	1 x 10 marks	= 10 marks
1.	Brief Answers	5 x 4 Marks	= 20 marks`
2.	Short Answers	10 x 2 Marks	= 20 marks

	Total		50 Marks

Physiology Practical Examination Including OSCE, OSPE and Viva

Practical : Total 40 marks

I Haematology : 16 marks (Major -10 marks, Minor 6 marks)

Major experiment

1. Total RBC Count
2. Total Leukocyte count
3. Differential count
4. Absolute Eosinophil count

(Students can be taught to dilute the blood, charge the chamber, focus the counting grid and on can be counted and the steps for calculation to be mentioned correctly. They need not count all

Minor experiment

1.Hemoglobin Estimation
2.Blood Grouping
3.Bleeding Time and Clotting Time
4.ESR or PCV

Suggestion:

(To avoid mouth sucking in doing hematology experiments with RBC and WBC pipettes inst micro pipettes can be used)

II Clinical Examination : 20 marks (CNS-10marks +CVS/RS–5marks+Clinical discuss marks) (One question from CNS Examination for 10 marks and one question from CVS/RS (Clinical Discussion includes giving a case scenario pertaining to the First M.B.B.S. level and identify the disease with the given data)
Charts will have a picture and two or three questions to be relevant to the picture given

III OSPE (2 Skilled stations): 2x2=4 marks (1 station in Hematology and one in clinical exar

VIVA : (20 marks)

General Physiology, Blood, Muscle, Digestive system - 6 marks
Endocrinology, Reproduction, excretory system - 4 marks
Cardiovascular system, Respiratory system - 4 marks
Central nervous system and Special senses - 6 marks

INTERNAL ASSESSMENT (40 marks) (Theory 20 & Practical 15 + Record 5)

Theory to asses knowledge	-	Periodic Test in the first week of Oct, Dec, Jan, Mar and and Model Exam Paper I & II in June last week.
Practical to asses skill	-	One Practical Exam in Hematology and one in clinical e Model Practical in June.
Viva to asses communication	-	Viva marks to be included in internal assessment calcula

MEDICAL ETHICS

Privacy and confidentiality of Students
Ethical Issues

INTEGRATED TEACHING

2 vertical and 3 horizontal integration to be done in each Academic Year
e.g. Horizontal – Gastric secretion, Liver, Kidney
Vertical – Anemia, Jaundice and Hemiplegia

RECORD

Record should be followed as recommended by this university

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