

Department of Physiology



**Study Guide
1st year BDS**

**Sharif Medical & Dental College,
Lahore**



PREFACE

Study Guide can make a major contribution to learning. They are sometimes likened to a tutor sitting on the student's shoulder-available 24 hours a day to advise the student what he/she should be doing at any stage in their study. Study guides are different from textbooks. They apprise the student at the beginning of an academic session about the course outline, the teaching methodology to be followed throughout the year, learning objectives of each academic activity and the assessment methodology to be followed in an academic session. At SMDC we follow the traditional annual academic schedule in which the subject of Physiology is taught in the First academic year of a medical student. Keeping in view the mission of UHS, Lahore and vision of our institute we have designed a training program which is intensive and at the same time interesting for the young minds. This guide includes details about various teaching activities which are to take place throughout the academic year along with the time allocation of each. A list of lectures to be conducted in this session with names of the instructors is attached. Broad learning outcomes of every section from the course accompanied by specific learning objective of every lecture are also included. A complete list of practical work to be carried out in the laboratory is part of this document. Details of various assessments and testing methodology are included and marks distribution for the subject in the 1st Professional examinations has been given. Names and email contacts of faculty have also been mentioned to foster better interaction between the teacher and the taught. A list of prescribed text and reference books forms part of this study guide. Since this document is the first of its kind we intend to improve upon it in light of the student-feedback every year. We shall be focusing on integrating research and education and the fusion of technology and clinical care in endeavour to produce graduates who can provide cutting edge in healthcare. We shall imbibe in our students the highest values of medical ethics to be exemplary physicians who can be a source of enlightenment for others and be leaders in their fields.

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Date: 17-08-2021



VISION & MISSION OF UHS

Qualitative and Quantitative Revolution in Medical Education and Research through Evolution and there by improve Health Care delivery to Populace.

UHS shall be innovative global center of excellence in learning and research, supporting a community of scholars and professionals committed to serving society, promoting the development of students to reach their true potential in becoming competent, ethical, caring, and inquiring health professionals for the benefit of the country and the wider world.

MISSION OF SMDC

Sharif Medical & Dental College is dedicated to best serve the nation through preservation and dissemination of advanced knowledge and educating the students by latest trends in learning and research reaching levels pars excellence.

The Institution is committed to provide standardized quality medical education to its students by inculcating professional knowledge, skills and responsibilities in them with the aim of:

- Preparing them as modern physicians having initiative to act as future leaders in their respective fields and becoming lifelong learners.
- Encouraging the spirit of critical thinking through research and publication.
- Building up an understanding of the ethical values compatible with our religion, culture and social norms.
- Developing a sense of being responsible citizens of the society possessing professional competence and instilling in them the values of hard work and dedication thus preparing them to be accountable to the stakeholders and the state.

The Institution is devoted to keep abreast its faculty with the latest trends in Medical Education encompassing teaching/learning methodologies, assessment tools, research opportunities and professionalism to facilitate their professional development, competencies and commitment towards continues learning.

Our patient-centered mission is achieved by outstanding medical care & services in professional practice with due emphasis and focus on our local health needs.

Our mission further elaborate upon establishing academic and research facilities in areas of local demand under global gold standards and leading advancement in research, education & patient care.

VISION OF SMDC

To be recognized for the provision of a safe and functional environment conducive to collaborative teaching & learning, comfortable working atmosphere, and conducting world class research through professionalism and excellence.



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PLANNED TEACHING ACTIVITIES FOR 1st YEAR BDS

PMC has allocated 250 hours of teaching in the subject of Physiology for the 1st Year BDS course. In order to meet this requirement following teaching modules have been planned. These modules have been carefully designed to impart core knowledge of Physiology in a manner that an undergraduate student can grasp the subject fully and is adequately prepared for university examinations.

Lectures:

A total of 252 lectures are planned for the entire year. The lectures will be conducted by the Professor, Associate and Assistant Professors or by Senior Demonstrator in the subject of Physiology. The lectures will be interactive and students should actively participate in them to clear their doubts. Interactive lectures using multimedia, white boards will introduce concepts, theories, and application of the subject by using relevant examples. The students are required to take notes of the lectures and study the topic with the help of prescribed text books in light of the learning objectives of the topic enunciated by the teacher at the beginning of each lecture.

Class Activities (PBL):

Problems based learning classes will be conducted from time to time throughout the academic year. A clinical scenario with short history will be discussed at the end of relevant topics. Students are exposed to Group Discussion & Q/A Session with teachers in Small Groups twice a month. During this time complex concepts and practical application is further explained.

Practical classes:

Clinical important concepts are augmented by performing practicals in Physiology Lab. Like Blood Counts, blood pressure recording, and examination of 12 Cranial Nerves. One practical class has been planned per week.

Tutorials (SGD):

Important topics of modules taught in lectures & practicals are discussed again for more elaboration in Tutorial Classes. One tutorial class per week is proposed throughout the academic session. The class is divided into 02 batches. Topics for the tutorial will be notified at least one week before the class.

Two instructors, one senior and one junior, will be deputed for every batch. During this interactive session the students must clear their concepts regarding the topic by actively engaging with their respective teachers.

Class Presentations:

Class presentations are conducted in the Tutorials to allow the students to demonstrate the knowledge about an important topic in Physiology and improve their communication skills.

Class Assignments:

Some of the important topics which are core curriculum of the subject are given to the students to prepare their assignments. Grading of these assignments give good feedback to the teachers and prepare the students for university exams.



TRAINING PROGRAM FOR LECTURES

Introduction to Human Physiology teaches about the basic knowledge of Human Physiology, its various branches and their importance along with the Cellular Organization starting from unicellular to multicellular level in eukaryotes. Homeostasis deals with the functional harmony of various Human Systems to ensure maintenance of a nearly constant internal environment within the human body. Genetics deal with the basic concepts of Transcription and Translation and Functional Organization explains various cellular organelles and their associated functions.

1. Cell & General Physiology:

S.No	Title of Lectures	Name of Instructor
1	Introduction to Human Physiology	Dr. Sana Javaid
2	Homeostasis	Dr. Sana Javaid
3	Functional Organization Of Cell	Dr. Sana Javaid

2. Membrane Transport Physiology:

S.No	Title of Lectures	Name of Instructor
1	Structure of Cell Membrane	Dr. Sana Qanber
2	Diffusion	Dr. Sana Qanber
3	Active Transport	Dr. Sana Qanber

3. Nerve & Muscle Physiology:

(i) Nerve Physiology:

S.NO	Title of Lectures	Name of Instructor
1	Nerve Physiology: Neurons & Neuroglia	Dr. Sana Qanber
2	Membrane Potentials & Action Potential	Dr. Sana Qanber
3	Nerve Degeneration & Regeneration	Dr. Sana Qanber
4	Synapses	Dr. Sana Qanber

(ii) Muscle Physiology:

S.NO	Title of Lectures	Name of Instructor
1	Muscle Physiology	Dr. Sana Qanber
2	Functional Organization of Skeletal Muscles	Dr. Sana Qanber
3	Skeletal Muscle Contraction	Dr. Sana Qanber
4	Properties of Skeletal Muscles	Dr. Sana Qanber
5	Neuromuscular Junctions Transmission in Skeletal Muscle	Dr. Sana Qanber
6	Excitation Contraction Coupling in Skeletal Muscles	Dr. Sana Qanber
7	Smooth Muscle & its Types	Dr. Sana Qanber
8	Smooth Muscle Contraction:	Dr. Sana Qanber
9	Properties of Smooth Muscle	Dr. Sana Qanber



10	Action Potential and Neuromuscular Junction in Smooth Muscle	Dr. Sana Qanber
11	Muscle Physiology	Dr. Sana Qanber
12	Functional Organization of Skeletal Muscles	Dr. Sana Qanber

4. Blood Physiology:

S.NO	Title of Lectures	Name of Instructor
1	Red Blood Cells, Anemia and Polycythemia	Prof. Dr. Ghazal Mansoor
2	Plasma Proteins	Prof. Dr. Ghazal Mansoor
3	RBC structure & functions, measurement, metabolism & enzymes	Prof. Dr. Ghazal Mansoor
4	Erythropoiesis	Prof. Dr. Ghazal Mansoor
5	Iron Metabolism	Prof. Dr. Ghazal Mansoor
6	Hb synthesis & types, Hemoglobin paths	Prof. Dr. Ghazal Mansoor
7	Classification of Anemias & different types of Anemia	Prof. Dr. Ghazal Mansoor
8	Types of polycythemia & its effects on body	Prof. Dr. Ghazal Mansoor
9	WBC Classification, structure & functions, Inflammations & lines of Defences	Prof. Dr. Ghazal Mansoor
10	Immunity, Classification Development and Inner Immunity	Prof. Dr. Ghazal Mansoor
11	Cellular Immunity	Prof. Dr. Ghazal Mansoor
12	Humoral Immunity.	Prof. Dr. Ghazal Mansoor
13	ABO Blood Grouping, Rh Blood Grouping, Erythroblastosis, Fetalis, Cross Matching and Blood Transfusion, Hazards of mismatched transfusion	Prof. Dr. Ghazal Mansoor
14	Tissue and Organ Transplant	Prof. Dr. Ghazal Mansoor
15	Details Events of Hemostasis & Blood Coagulation and Blood Coagulation Tests, PT, APTT, INR	Prof. Dr. Ghazal Mansoor
16	Fibrinolytic System, Anticoagulation of Blood in Human Body	Prof. Dr. Ghazal Mansoor
17	Coagulant & Anticoagulant Thromboembolism, DVT	Prof. Dr. Ghazal Mansoor

5. Respiration:

S.NO	Title of Lectures	Name of Instructor
1	Introduction to Respiratory System	Dr. Nazish Jamil
2	Pulmonary ventilation	Dr. Nazish Jamil
3	Mechanics of Respiration	Dr. Nazish Jamil
4	Lung volumes and capacities	Dr. Nazish Jamil



5	Pulmonary Compliance	Dr. Nazish Jamil
6	Respiratory Membrane & Diffusion of Gases	Dr. Nazish Jamil
7	Diffusion of gases & Oxygen transport	Dr. Nazish Jamil
8	Oxygen transport & Dissociation curve	Dr. Nazish Jamil
9	Carbon dioxide transport	Dr. Nazish Jamil
10	Nervous regulation of respiration	Dr. Nazish Jamil
11	Chemical regulation of respiration	Dr. Nazish Jamil
12	Pulmonary circulation and V_a/Q ratio	Dr. Nazish Jamil
13	Hypoxia	Dr. Nazish Jamil
14	Cyanosis/Asphyxia/ Hypercapnia	Dr. Nazish Jamil
15	Respiratory abnormalities	Dr. Nazish Jamil
16	Respiratory adjustment during exercise	Dr. Nazish Jamil
17	Obstructive lung Diseases/ Restrictive lung diseases	Dr. Nazish Jamil

6. Human Responses in Varied Environments:

S.NO	Title of Lectures	Name of Instructor
1	High Altitude physiology	Dr. Nazish Jamil
2	Deep sea physiology	Dr. Nazish Jamil

7. Cardiovascular System (CVS)

(i) Heart:

S.NO	Title of Lectures	Name of Instructor
1.	Physiologic anatomy of heart and cardiac action potential	Dr. Qurat-ul-Ain
2.	Conductive system	Dr. Qurat-ul-Ain
3.	Cardiac cycle	Dr. Qurat-ul-Ain
4.	ECG	Prof. Dr. Ghazal Mansoor
5.	Arrhythmias:	Prof. Dr. Ghazal Mansoor

(ii) Circulation:

S.NO	Title of Lectures	Name of Instructor
1	Hemodynamics of circulation	Dr. Rabia Sattar
2	Control of Local Blood:	Dr. Rabia Sattar
3	Capillary dynamics:	Dr. Rabia Sattar
4	Cardiac output	Dr. Rabia Sattar
5	Venous return	Dr. Rabia Sattar
6	Arterial blood pressure	Dr. Rabia Sattar
7	Cardiac failure	Dr. Rabia Sattar
8	Heart sounds	Dr. Rabia Sattar
9	Circulatory shock:	Dr. Rabia Sattar
10	Effect of exercise on CVS	Dr. Rabia Sattar



8. Body Fluids & Kidney:

(i) Body Fluids:

S.No.	Title of Lectures	Name of Instructor
1	The Body Fluid Compartments and their Abnormalities	Dr. Rabia Sattar
2	Water Balance	Dr. Rabia Sattar
3	Edema	Dr. Rabia Sattar

(ii) Renal Physiology:

Sr. No.	Title of Lectures	Name of Instructor
1	Introduction to renal physiology	Dr. Rabia Sattar
2	GFR and its regulation	Dr. Rabia Sattar
3	Processing of glomerular filtrate; tubular reabsorption and secretion	Dr. Rabia Sattar
4	Plasma clearance	Dr. Rabia Sattar
5	Regulation of Potassium Calcium, Phosphate and Magnesium	Dr. Rabia Sattar
6	Regulation of B.P.	Dr. Rabia Sattar
7	Renal regulation of osmolarity	Dr. Rabia Sattar
8	Formation of dilute concentrated urine	Dr. Rabia Sattar
9	Acid Base balance	Dr. Rabia Sattar
10	Acid base disorders	Dr. Rabia Sattar
11	Diuretics	Dr. Rabia Sattar
12	Micturition	Dr. Rabia Sattar
13	Kidney Diseases	Dr. Rabia Sattar

9. Endocrinology:

S.No.	Title of Lectures	Name of Instructor
1	Introduction to endocrinology	Dr. Sana Javaid
2	Mechanism of action of hormones	Dr. Sana Javaid
3	Hypothalamus and Pituitary gland physiological anatomy and its control	Dr. Sana Javaid
4	Growth hormone	Dr. Sana Javaid
5	Thyroid gland	Dr. Sana Javaid
6	Adrenal gland	Dr. Sana Javaid
7	Adrenal medullary hormones	Dr. Sana Javaid
8	Abnormalities of adrenal gland	Dr. Sana Javaid
9	Calcium regulating hormones	Dr. Sana Javaid
10	Insulin, Glucagon, and Diabetes Mellitus	Dr. Sana Javaid



10. Gastrointestinal Tract (GIT):

S.No.	Title of Lectures	Name of Instructor
1	GIT Physiology	Dr. Nazish Jamil
2	Chewing/Swallowing reflex	Dr. Nazish Jamil
3	Functions of Stomach and gastric emptying	Dr. Nazish Jamil
4	Functions of small intestine	Dr. Nazish Jamil
5	Functions of Large intestine	Dr. Nazish Jamil
6	Defecation reflex	Dr. Nazish Jamil
7	Vomiting reflex	Dr. Nazish Jamil
8	Hormones of GIT	Dr. Nazish Jamil
9	Functions of liver	Dr. Nazish Jamil
10	GIT Disorders	Dr. Nazish Jamil

11. Special Senses:

S.No.	Title of Lectures	Name of Instructor
1	Chemical senses (olfaction)	Dr. Qurat-ul-Ain
2	Chemical senses (gustatory)	Dr. Qurat-ul-Ain
3	Hearing physiology External ear	Dr. Qurat-ul-Ain
4	Middle Ear	Dr. Qurat-ul-Ain
5	Inner Ear	Dr. Qurat-ul-Ain
6	Eye (Optics of vision)	Dr. Qurat-ul-Ain
7	Eye (Retina)	Dr. Qurat-ul-Ain
8	Color vision	Dr. Qurat-ul-Ain
9	Phototransduction	Dr. Qurat-ul-Ain
10	Visual pathway	Dr. Qurat-ul-Ain

12. Central Nervous System (CNS):

(i)Sensory System:

S.No.	Title of Lectures	Name of Instructor
1.	Functional organization of the Central Nervous system	Dr. Sana Qanber
2.	Major levels of Central Nervous System Functions	Dr. Sana Qanber
3.	Synapses	Dr. Sana Qanber
4.	Sensory Receptors	Dr. Sana Qanber
5.	Neuronal Pools	Dr. Sana Qanber
6.	Somatic Senses	Dr. Sana Qanber
7.	Sensory Cortex & Sensory Tracts/Pathways	Dr. Sana Qanber
8.	Pain Sensation	Dr. Sana Qanber
9.	Analgesia System in Brain & Spinal cord	Dr. Sana Qanber
10.	Pain and Associated Clinical Abnormalities	Dr. Sana Qanber
11.	Thermal Sensation	Dr. Sana Qanber



(ii). Motor System:

S.No.	Title of Lectures	Name of Instructor
1.	Muscle Sensory Receptors	Prof. Dr. Ghazal Mansoor
2.	Spinal Cord reflexes	Prof. Dr. Ghazal Mansoor
3.	Cerebral Cortex & Voluntary Motor Function	Prof. Dr. Ghazal Mansoor
4.	Motor Tracts/Pathways	Prof. Dr. Ghazal Mansoor
5.	Brain Stem and Control of Motor Function	Prof. Dr. Ghazal Mansoor
6.	Cerebellum & Motor Control	Prof. Dr. Ghazal Mansoor
7.	Basal Ganglia & Motor Control	Prof. Dr. Ghazal Mansoor
8.	Role of Cerebral Cortex in Learning	Prof. Dr. Ghazal Mansoor
9.	Speech & Communication	Prof. Dr. Ghazal Mansoor
10.	Memory	Prof. Dr. Ghazal Mansoor
11.	Behavioral & Motivational Mechanisms of Brain	Prof. Dr. Ghazal Mansoor
12.	Limbic System and Hypothalamus	Prof. Dr. Ghazal Mansoor
13.	Sleep	Prof. Dr. Ghazal Mansoor
14.	Epilepsy	Prof. Dr. Ghazal Mansoor
15.	Psychoses & Dementia	Prof. Dr. Ghazal Mansoor
16.	Cerebrospinal Fluid (CSF)	Prof. Dr. Ghazal Mansoor
17.	Brain Metabolism	Prof. Dr. Ghazal Mansoor



LIST OF LECTURES IN THE SUBJECT OF PHYSIOLOGY AND THEIR LEARNING OBJECTIVES

1. Cell & General Physiology:

Introduction to Human Physiology teaches about the basic knowledge of Human Physiology, its various branches and their importance along with the Cellular Organization starting from unicellular to multicellular level in eukaryotes. Homeostasis deals with the functional harmony of various Human Systems to ensure maintenance of a nearly constant internal environment within the human body. Genetics deal with the basic concepts of Transcription and Translation and Functional Organization explains various cellular organelles and their associated functions.

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Introduction to Human Physiology:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Enumerate various branches of Physiology.2. Define Human Physiology and its basic concept.3. Explain the Functional Organization of various body systems that make up a human body.4. Relate the importance of Human Physiology in maintenance of various vital body systems.
2	<p>Homeostasis:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Define various basic Human Systems.2. Define External and Internal Environments.3. Describe the Ionic Compositions of Extracellular and Intracellular Body fluids and their significance.4. Explain how various systems are working together to maintain a balanced internal environment.1. Explain various Feedback and Feed forward Mechanisms used for
3	<p>Functional Organization Of Cell:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Define Cell and its various organelles2. Differentiate and Describe membranous and non membranous organelles3. Explain structure and functions of various cellular organelles.4. Describe the processes of vesicular transports, Endocytosis and Exocytosis.5. Explain the role of cytoskeleton in locomotion of cell.



2. Membrane Transport Physiology:

Membrane Transport Physiology deals with various Transport mechanisms operable across Human Cell Membrane and their significance in controlling cellular structure and function:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	Structure of Cell Membrane: By the end of the topic students will be able to: <ol style="list-style-type: none"> 1. Describe the structure of Cell membrane in terms of permeability and non permeability of various substances across Cell membrane. 2. Define the Role of Lipids and Proteins in Cellular Transport. 3. Explain Transport of Substances through the Cell membrane.
2	Diffusion: By the end of the topic students will be able to: <ol style="list-style-type: none"> 1. Define Diffusion and describe its various types and their significance. 2. Explain the Process of Osmosis. 3. Describe the effects of solutions with different osmolarities on RBCs.
3	Active Transport: By the end of the topic students will be able to: <ol style="list-style-type: none"> 1. Describe the concept and mechanisms of Active Transport. 2. Define and explain Primary Active Transport Mechanism with examples. 3. Define and explain Secondary Active Transport Mechanism with examples.

3. Physiology of Excitable Tissues:

Nerve & Muscle are the two major excitable tissues. Physiology of Excitable tissues explains why Nerve and Muscle are called Excitable tissues and how do they respond to a characteristic stimulus by generating nerve action potential and muscle contraction.

i. Nerve Physiology:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	Neurons & Neuroglia: By the end of the topic students will be able to: <ol style="list-style-type: none"> 1. Define Neuron and explain its function. 2. Classify Neurons on the basis of structure and function. 3. Define Nerve fibers/Axons and explain their types on the basis of structure, function and velocity of conduction. 4. Explain Neuroglia, its types and functions.
2	Membrane Potentials & Action Potential: By the end of the topic students will be able to: <ol style="list-style-type: none"> 1. Define Nernst Potential and explain significance of Nernst equation. 2. Define Goldman Hodgkin Katz equation. 3. Describe Resting Membrane Potential and various factors contributing



	<p>in its establishment.</p> <ol style="list-style-type: none"> 4. Explain the phenomenon of Action Potential along a Nerve fiber. 5. Draw and Label an Action Potential along an unmyelinated axon. 6. Describe the re-establishment of ionic gradients post action potential and All & None Law. 7. Define After potentials. 8. Describe the phenomenon of Plateau and its importance. 9. Explain Self excitation in excitable tissues and phenomenon of Repetitive discharges. 10. Define Acute Local Potentials. 11. Differentiate between Action Potential and Graded Potential. 12. Describe the phenomenon of Saltatory conduction and its importance in a myelinated axon. 13. Explain Compound Action Potentials. 14. Describe Strength Duration Curve, its components, and significance. 15. Define and explain Physiological Properties of Nerve Fibers.
3	<p>Nerve Degeneration & Regeneration:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define Nerve Degeneration & Regeneration 2. Explain the types of degeneration 3. Describe the criteria for regeneration
4	<p>Synapses:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define a Synapse and explain its types. 2. Describe the steps of transmission along a Chemical Synapse. 3. Define anterograde and retrograde axonal transport.

ii. Muscle Physiology

1.	<p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define a Muscle. 2. Explain Physiological properties of a Muscle. 3. Compare and Contrast 3 different types of Muscle tissues, Skeletal, Smooth, and Cardiac.
2	<p>Functional Organization of Skeletal Muscles:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the Functional Organization of Skeletal Muscle. 2. Define a Sarcomere and identify its various components. 3. Draw and label a Sarcomere. 4. Explain changes in a relaxed and contracted Sarcomere. 5. Define Sarcoplasm and its composition.
3	<p>Skeletal Muscle Contraction:</p>

	<p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the structure of myofilaments, Actin and Myosin. 2. Describe the Walk along Theory of Skeletal Muscle Contraction. 3. Illustrate the Sliding Filament Model of Skeletal Muscle. 4. Enumerate the essential pre requisites for Skeletal Muscle Contraction. 5. Describe the process of Rigor Mortis and its Forensic Significance post mortem. 6. Differentiate between Active and Passive Muscle tension. 7. Differentiate between Preload and After load. 8. Illustrate a Simple Muscle Twitch. 9. Describe the differences between Fast and Slow Muscle Fibers. 10. Compare and contrast Isometric and Isotonic Muscle contractions with examples.
4	<p>Properties of Skeletal Muscles:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define Motor unit, Summation, and phenomenon of Tetanization. 2. Explain Staircase Phenomenon (Treppe). 3. Describe Muscle Fatigue. 4. Define Hypertrophy, Hyperplasia, and Atrophy.
5	<p>Neuromuscular Junctions Transmission in Skeletal Muscle:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define a Neuromuscular Junction (NMJ) and explain the steps of transmission along a Neuromuscular Junction. 2. Explain the effects of drugs on NMJ. 3. Describe the autoimmune muscle disease, Myasthenia Gravis.
6	<p>Excitation Contraction Coupling in Skeletal Muscles:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the phenomenon of Excitation Contraction Coupling in skeletal muscle. 2. Define Calcium Pulse.
7	<p>Smooth Muscle & its Types:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define structure of Smooth Muscle. 2. Know the major differences between Skeletal and Smooth Muscle Contraction. 3. Identify two types of Smooth Muscles. 4. Compare and contrast Multiunit and Unitary smooth muscles. 5. Identify the structural differences in smooth muscles from skeletal muscles.
8	<p>Smooth Muscle Contraction:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the role of Calmodulin in smooth muscle contraction. 2. Explain Excitation contraction coupling in Smooth Muscle.



9	<p>Properties of Smooth Muscle:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe Latch phenomenon. 2. Explain Stretch and Reverse Stretch relaxation.
10	<p>Action Potential and Neuromuscular Junction in Smooth Muscle:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define various types of Action Potentials in Smooth Muscle. 2. Explain NMJ and different neurotransmitters involved in smooth muscle.

4. Blood Physiology:

This course deals with the details reading blood cells & immunity. This serves to make the base for study of Blood Physiology & resonate use of knowledge in clinical practice. At the end of the course the student must be able to discuss the functions of blood, classify Anemias.

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Red Blood Cells, Anemia and Polycythemia:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define Blood 2. Describe its composition 3. Discuss the functions of blood
2	<p>Plasma Proteins:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the relevant functions of each plasma proteins 2. Enlist the factor that changes the dead space. 3. Discuss the significance of plasma proteins
3	<p>RBC structure & functions, measurement, metabolism & enzymes:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Describe the structure & functions of RBC's 2. Know the metabolic cycle in RBC's
4	<p>Erythropoiesis:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define erythropoiesis 2. Enumerate & explain the steps of erythropoiesis 3. Discuss the factors affecting erythropoiesis 4. Explain the role of erythropoietin
5	<p>Iron Metabolism:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the distribution of iron stores in the body 2. Give the daily requirement of iron for humans 3. Discuss the iron metabolism & importance in the body
6	<p>Hb synthesis & types, Hemoglobin paths:</p> <p>By the end of the lecture the student will be able to</p>



	<ol style="list-style-type: none"> 1. Define Hb. 2. Enumerate its types 3. Explain the structure & function of Hb. 4. Enlist the different types & abnormalities of Hb & discuss the effects 5. Fate of Hb
7	<p>Classification of Anemias & different types of Anemia: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define Anemia 2. Classify anemia mycological basis. 3. Classify anemia on the basis of etiology
8	<p>Types of polycythemia & its effects on body: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define polycythemia 2. Discuss its types with pathophysiology 3. Explain the effects of polycythemia on the body
9	<p>WBC Classification, structure & functions, Inflammations & lines of Defences: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Give classification of leukocytes with reference to structure & function of each type of WBC 2. Discuss inflammation & types and effects 3. Explain various lines of defences of our blood
10	<p>Immunity, Classification Development and Inner Immunity: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define Immunity 2. Give its types 3. Explain the development of immune system 4. Name various cells of blood taking part in immunity
11	<p>Cellular Immunity: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Name the cells involved in immunity 2. Explain the origin and functions of these cells
12	<p>Humoral Immunity: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 8. Define the humoral immunity 9. Classify antibodies 10. Explain the mechanism of generation of antibodies.
13	<p>ABO Blood Grouping, Rh Blood Grouping, Erythroblastosis, Fetalis, Cross Matching and Blood Transfusion, Hazards of mismatched transfusion: By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain ABO blood groups 2. Discuss the basis of classification 3. Define Landsteiner's Law



	<ol style="list-style-type: none"> 4. Discuss Rh blood groups & development of E.F. 5. Define cross matching 6. Give the possible hazards of blood transfusion 7. Discuss the complication & management.
14	<p>Tissue and Organ Transplant:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain what is tissue transplant 2. Describe the types & principle
15	<p>Details Events of Hemostasis & Blood Coagulation and Blood Coagulation Tests, PT, APTT, INR:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define the process of coagulation 2. Draw the cascade of each mechanism involved 3. Differentiate between internal & external mechanism 4. Define Prothrombin time APTT, INR & give their clinical importance 5. Give normal values of PT, APTT, INR
16	<p>Fibrinolytic System, Anticoagulation of Blood in Human Body:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain the fibrinolytic system 2. Discuss the functions of different components of fibrinolytic system
17	<p>Coagulant, Anticoagulant and Thromboemolism, DVT:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define & classify Anticoagulant 2. Discuss the mechanism of action of anticoagulant 3. Define Thromboemolism/ DVT 4. Give the causes of Thromboemolism

5. Respiration:

This course should aim at imparting knowledge on the Physiological aspects of Respiratory System, Deep Sea Physiology and High Altitude Physiology to understand the various parts, major functions and some common disease affecting the system. At the end of unit the student must know the functional Anatomy & Physiology of Respiratory System, understand the mechanics pulmonary ventilation, circulation, gases exchange and transport mechanism, regulatory mechanism of Respiration. Also able to discuss the Pathophysiology, prevention and treatment of related abnormalities.

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Introduction to Respiratory System:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define respiration. 2. Compare between external and internal respiration 3. Know the functional anatomy and various parts of respiratory tract.

	4. Describe respiratory and non-respiratory functions of respiratory system.
2	<p>Pulmonary ventilation:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define and compare the anatomical dead space/ physiological dead space, 2. Enlist the factor that changes the dead space. 3. Define total minute ventilation, alveolar ventilation, hyperventilation, hypoventilation, dyspnea, eupnea, and hypercapnia.
3	<p>Mechanics of Respiration:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the role of inspiratory and expiratory muscles during quiet and forceful respiration 2. Understand the mechanics of respiration 3. Understand various pressures acting on lungs and chest wall 4. Understand the change in alveolar, pleural and trans pulmonary pressures during each phase of respiration
4	<p>Lung volumes and capacities:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the normal lung volumes/capacities and correlate it with the volume changes in forceful respiration 2. Define the compliance of lung and elastic recoil. 3. Draw and label the compliance diagram and know the significance of hysteresis in the curve. 4. Identify the clinical conditions in which lung compliance is higher and lower than the normal.
5	<p>Pulmonary Compliance:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define surface tension, surfactants and atelectasis 2. Know the composition & role of surfactant in alveolar surface tension. 3. Understand the law of Laplace 4. Describe the pathophysiology of respiratory distress syndrome. 5. Explain the concept of work of breathing
6	<p>Respiratory Membrane & Diffusion of Gases:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Enlist the layers of respiratory membrane 2. Know the concept of diffusing capacity through respiratory membrane 3. Identify the factors affecting gas diffusion through respiratory membrane
7	<p>Diffusion of gases & Oxygen transport</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the mechanics of oxygen diffusion from alveoli to blood 2. Understand the mechanism of oxygen transport in the arterial blood,



	tissue fluid and cell
8	<p>Oxygen transport & Dissociation curve</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Discuss the role of Hb in oxygen transport 2. Draw and explain the normal oxygen-hemoglobin dissociation curve 3. Define P50. 4. Explain the factors that shift oxygen-hemoglobin dissociation curve to left and right. 5. Understand the concept of Bohr Effect.
9	<p>Carbon dioxide transport</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the various chemical form in which CO₂ is transported in blood 2. Explain the normal CO₂ dissociation curve 3. Understand the concept of Haldane effect and importance chloride shift
10	<p>Nervous regulation of respiration</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Identify different group of neurons composing respiratory center and their role. 2. Discuss the role of medullary and pontine center in respiration 3. Describe the role of pre-Bötzinger complex. 4. Describe the generation and control of cyclic breathing. 5. Understand the regulatory mechanism of hering-breuer inflation reflex 6. Know the role of other receptors and factor that involved in controlling the breathing mechanism 7. Explain the cough and sneeze reflex
11	<p>Chemical regulation of respiration</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Describe the central chemosensitive area & its stimulation by CO₂ and H⁺. 2. Explain the role of peripheral chemoreceptors for control of respiration 3. Determine the composite effects of PCO₂, pH, & PO₂ on alveolar ventilation
12	<p>Pulmonary circulation and Va/Q ratio</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the physiological anatomy of pulmonary circulation. 2. Discuss the pressure differences b/w pulmonary & systemic circulation 3. Understand the pulmonary blood flow & effect of hydrostatic pressure on it. 11. Identify the average V/Q ratio in a normal lung. 12. Discuss ventilation perfusion ratio (Va/Q) and its clinical significance.



	13. Explain the concept of physiological shunt
13	<p>Hypoxia</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define hypoxia and explain its types with characteristic features. 2. Describe the various causes and treatment of hypoxia. 3. Know the effects of hypoxia on the body
14	<p>Cyanosis/Asphyxia/ Hypercapnia</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Define and discuss the causes of cyanosis and asphyxia 2. Explain the effects of very high blood CO₂ levels on respiratory center
15	<p>Respiratory abnormalities</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Describe the periodic breathing, basic mechanism of Cheyne Strokes breathing, Kussmaul and Biot's breathing 2. Define sleep apnea and its pathophysiology.
16	<p>Respiratory adjustment during exercise</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know oxygen consumption and pulmonary ventilation during exercise 2. Explain the respiratory changes during exercise 3. Discuss the body's regulation of respiration during exercise 4. Describe the Oxygen Debt
17	<p>Obstructive lung Diseases/ Restrictive lung diseases</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Name the obstructive/Restrictive lung diseases 2. Discuss the causes and pathophysiology of Obstructive/ Restrictive lung Diseases 3. Draw and interpret the spirogram of Obstructive and restrictive lung Diseases 4. Define FEV₁/FEC ratio and its clinical significance. 5. Differentiate between obstructive and restrictive lung Diseases on the bases of Spirometry and FEV₁/FEC ratio. 6. Draw and interpret the spirogram of Obstructive and restrictive lung Diseases 7. Define FEV₁/FEC ratio and its clinical significance. 8. Differentiate between Obstructive and restrictive lung Diseases on the bases of Spirometry and FEV₁/FEC ratio.

6. Human Responses in Varied Environments:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>High Altitude physiology</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain physiologic responses to high altitude and space. 2. Explain the effects of acute and chronic mountain sickness.



	3. Describe the physiology of acclimatization
2	<p>Deep sea physiology</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Explain physiologic responses to deep sea diving and hyperbaric conditions. 2. Describe the clinical features, pathophysiology, prevention, and treatment of Nitrogen narcosis, Decompression sickness, Oxygen and carbon dioxide toxicity. 3. What is SCUBA diving? 4. Identify the uses of hyperbaric oxygen therapy.

7. Cardiovascular System:

CVS Physiology (HEART AND CIRCULATION)

The Cardiovascular System comprises the study of the blood circulation through the heart and great vessels. This module will cover a specific part of the cardiovascular system in an integrated form. The initial teaching learning activities will help you understand the normal structures of the system. This will be followed by the comprehensive introduction to the functions of the system. The methodologies used for teaching include lectures, tutorials, PBL, Practical, dissection and Lab work.

(i) Heart:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1.	<p>Physiologic anatomy of heart and cardiac action potential</p> <p>By the end of the lecture the student will be able to:</p> <ol style="list-style-type: none"> 1. Appreciate the physiological arrangement of right and left hearts along with the parallel arrangement of systemic circulation. 2. Know the physiologic anatomy of cardiac muscles, its functional syncytium and intercalated disc and difference between cardiac, skeletal and smooth muscles. 3. Know the phases of action potential in cardiac muscle and autorhythmic cells/ conducting system of the heart along with comparison of action potential in different tissues of the heart. 4. Associate movement of ions across the cell membrane with different phases of action potential.
2.	<p>Conductive system:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Comprehend importance and relationship between refractory period and mechanical periods. 2. Know the mechanism of generation and propagation of cardiac impulse in conductive system of heart. 3. Appreciate characteristics of spread of cardiac impulse through conductive system, atrial and ventricular myocardium and its association with the function of heart.

3.	<p>Cardiac cycle:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Understand various cardiac events in relation to each other 2. Understand and interpret cardiac cycle diagram 3. Comprehend preload and after load, its influence on stroke volume 4. The Frank-Starling's mechanism and role of autonomic regulation of heart rate and pumping action.
4.	<p>ECG:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Comprehend genesis of ECG, the way it is recorded and its relationship with the electrical axis of heart. 2. Understand significance of waves, segments and intervals of ECG recording.
5.	<p>Arrhythmias:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the basis of common cardiac arrhythmias, process that produce them and their clinical significance. 2. Evolve the concept of sinus arrhythmia and its clinical significance. Appreciate principal changes in ECG during myocardial ischemia and infarction. 3. Comprehend changes in ECG and cardiac function during common abnormalities in ionic composition of body fluids. 4. Understand the pathophysiology of ectopic focus and its clinical significance. 5. Appreciate the events of cardiac cycle and prospective changes in ECG, heart sounds, pressures and volumes during different phases thereof.

(ii) Circulation:

1	<p>Hemodynamics of circulation:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know the organization of circulatory systems i.e. Greater (Systemic) and Lesser (Pulmonary) circulations along with accessory circulatory system (Lymphatic). 2. The physiologic anatomy of different types of blood vessels and their importance. 3. Know the relationship between flow, resistance and conductance. Have the concept of blood flow, its types and significance of turbulent and laminar flow, the concept of pressure gradient, resistance to blood flow and its significance. 4. Understand the Physiology of vascular compliance? Changes in compliance of blood vessels with age and comparison between the compliance of arteries versus veins.
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	<p>5. Appreciate the origin of arterial pressure pulse and its propagation to the peripheral arteries. Know the factors damping the arterial pulse and abnormalities of arterial pulse.</p> <p>6. Know about the jugular venous pulse, its significance and differentiation from arterial pulse.</p>
2	<p>Control of Local Blood:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Know about acute and chronic control of local blood flow 2. Understand the theories of metabolic control of blood flow 3. Describe the active and reactive hyperemia 4. Explain the effects of blood flow control on total peripheral resistance
3	<p>Capillary dynamics:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the principles of capillary dynamics, structure of Interstitium, 2. Describe the Starling's forces for fluid exchange across the capillary membrane and factors affecting thereof. Have the concept of starling's equilibrium, and how of the interstitial space is kept dry? 3. Know the mechanism of formation of interstitial fluid, its composition and factors creating starling's disequilibrium leading to the development of edema. 4. Appreciate Types of edema, its pathophysiology and safety factors preventing edema formation.
4	<p>Cardiac output</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the determinants of cardiac output and factors affecting cardiac output. 2. Appreciate the mechanics of low and high cardiac outputs along with their effects on heart. 3. Comprehend the factors affecting stroke volume, heart rate and total peripheral resistance. 4. Understand Fick's principle for the measurement of cardiac output.
5	<p>Venous return:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Recognize the role of veins in blood flow, their functions and factors regulating venous return and significance of venous reservoirs. 2. Appreciate the equality of cardiac output and venous return. 3. Understand factors affecting venous return
6	<p>Arterial blood pressure:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none"> 1. Comprehend the determinants of arterial pressure, factors affecting and mechanisms regulating blood pressure on short and long term basis. 2. Understand mean arterial pressure and its significance.



	<ol style="list-style-type: none">3. The individual and integrative role of baroreceptors, chemoreceptor, volume receptors, arterial natriuretic factors and Renin-angiotensin – aldosterone system in regulation of arterial pressure.4. Understand the characteristics of regional circulations (skeletal muscles, pulmonary, coronary & cerebral) and factors regulating
7	<p>Cardiac failure:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none">1. Define cardiac failure, its pathophysiology and clinical manifestations2. Know the different types and treatment of cardiac failure
8	<p>Heart sounds:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none">1. Describe origin of heart sounds2. Know about murmurs3. Know about clinical importance of various heart sounds
9	<p>Circulatory shock:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none">1. Define shock, its types, stages of development and differences between compensated and uncompensated shock.2. Understand the pathophysiology of compensated and uncompensated shock.3. Comprehend the short term and long term compensatory mechanisms in circulatory shock.4. Know the pathophysiology of irreversible shock.5. Comprehend the general principles for the treatment of shock.
10	<p>Effect of exercise on CVS:</p> <p>By the end of the lecture the student will be able to</p> <ol style="list-style-type: none">1. Know the types and severity of exercise in different sports.2. Have the concept of general adaptive changes in muscles in response to increased and decreased physical activity.3. Know about the fuels available in body during rest and exercise.4. Comprehend cardiovascular and pulmonary changes (including oxygen consumption) during different grades of exercise.

6. Body Fluids and Kidney:

In this unit students will study the physiological aspects of Renal System which deals with the creation of waste products, Regulation of acid base balance, water and electrolytes balance and role of kidney in regulation of blood pressure. Renal diseases are common in community so the basics causes and pathophysiology of common understand Renal System Disorder. So, on the completion of unit student must be able to describe the Physiological Anatomy and functions of Kidney along with the related pathologies:



i. Body Fluids:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>The Body Fluid Compartments and their Abnormalities:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain total body water content and its distribution in different body compartments 2. Describe the components and quantitative measurements of body fluids. 3. Know the ionic composition of ECF and ICF
2	<p>Water Balance:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the basic principles of osmosis and osmotic pressure 2. Know the mechanism of maintenance of osmotic equilibrium between ICF and ECF 3. Explain the effect on ICF and ECF compartments when isotonic, hypotonic and hypertonic solution is added to ECF with concept of dehydration, rehydration, over hydration and edema.
3	<p>Edema:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define edema, its types. 2. Describe the causes of intracellular edema and extracellular edema 3. Understand the role of Starling forces in the development/ prevention of edema 4. Describe role of lymphatics in prevention of edema 5. Define safety factor and its role in the prevention of edema.

I Physiology:

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Introduction to renal physiology:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. State the major endocrine and none endocrine functions of the kidney 2. Know the brief physiological anatomy of kidney. 3. Define the components and types of the nephron and their interrelationships: renal corpuscle, glomerulus, nephron, and collecting-duct system. 4. Describe juxtaglomerular apparatus and its cell types. 5. Explain the processes involved in urine formation resulting from glomerular filtration, tubular reabsorption, and tubular secretion
2	<p>GFR and its regulation:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Know the composition of the glomerular filtrate and glomerular

	<p>capillary membrane</p> <ol style="list-style-type: none"> 2. Defines podocytes, foot processes, slit diaphragms ,glomerular mesangial cells and states their functions 3. Define GFR and discuss the determinants GFR. 4. Explain the factors affecting the GFR, role of sympathetic nervous system, hormones and autacoids that influence GFR. 5. Define renal blood flow, renal plasma flow, filtration fraction, their formulas and values. 6. Discuss the physiological control of renal blood flow. 7. Describe the effects of changes in afferent and efferent arteriolar resistances on renal blood flow 8. Define autoregulation of GFR and renal blood flow. 9. Describe the myogenic tubuloglomerular feedback mechanism of autoregulation
3	<p>Processing of glomerular filtrate; tubular reabsorption and secretion: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the mechanism of reabsorption and secretion by the renal tubules 2. Explain the passive and active mechanisms; the major characteristics of diffusion, facilitated diffusion, primary active transport, secondary active transport and endocytosis involved in tubular reabsorption 3. Explain the concept of transport maximum and gradient-time transport. 4. Draw and interpret the glucose titration curve. 5. Discuss the reabsorption and secretion along different parts of the nephron 6. Discuss the peritubular capillary and renal Interstitial fluid physical force 7. Explain the regulation of tubular reabsorption
4	<p>Plasma clearance: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Estimation of GFR by inulin clearance, plasma creatinine clearance & PAH clearance for estimation of renal plasma flow
5	<p>Regulation of Potassium Calcium, Phosphate and Magnesium: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the internal potassium distribution and factors that can alter potassium distribution between the intracellular and extracellular fluid 2. Understand the potassium secretion by principal cells of late distal and cortical collecting tubules 3. Explain different factors that regulate potassium secretion: plasma potassium concentration, aldosterone, tubular flow rate, and hydrogen ion concentration



	<p>4. Discuss the excretion and extracellular concentration of calcium ion , Phosphate and magnesium ion</p> <p>5. Identify the factors that alter renal calcium and phosphate excretion.</p>
6	<p>Regulation of B.P:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define the role of kidneys in pressure natriuresis and diuresis 2. Understand the renal regulation of body fluid volumes and arterial pressure 3. Explain role of nervous and hormonal factors in renal-body fluid feedback control
7	<p>Renal regulation of osmolarity:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the regulation of extracellular fluid osmolarity and sodium concentration by kidneys 2. Describe the osmoreceptor-ADH feedback system 3. Discuss the physiology and pathophysiology of ADH in the formation dilute and concentrated urine. 4. Understand the role of thirst in controlling extracellular fluid osmolarity and sodium concentration 5. Explain the role of angiotensin II and aldosterone in controlling extracellular fluid osmolarity and sodium concentration 6. Illustrate the concept of “Free Water” and osmolar clearances
8	<p>Formation of dilute concentrated urine:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concept of obligatory urine volume 2. Explain about the requirements for excreting a concentrated urine— high ADH levels and hyperosmotic renal medulla 3. Describe the countercurrent mechanism producing a hyperosmotic renal medullary interstitium 4. Discuss the role of distal tubule and collecting ducts in excreting a concentrated urine 5. Explain role of urea in hyperosmotic renal medullary interstitium and formation of concentrated urine 6. Describe the role of countercurrent exchange in the vasa recta in preservation of hyperosmolarity of the renal medulla 7. Explain the concentrating mechanism and changes in osmolarity in different segments of the tubule
9	<p>Acid Base balance :</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Know the basic concept of acid base, pH and buffers.

	<ol style="list-style-type: none"> 2. Explain the defenses against changes in hydrogen ion concentration: 3. Name the Buffer Systems operating in the Body 4. Discuss the bicarbonate buffer system, phosphate buffer system, proteins: important intracellular and extracellular buffers 5. Explain the respiratory regulation and renal control of acid-base balance 6. Describe the mechanism of acidification of urine and its importance.
10	<p>Acid base disorders:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the mechanism and effects of metabolic acidosis and alkalosis on human body and their compensations. 2. Discuss the Renal Correction of acidosis—increased excretion of hydrogen ions and addition of bicarbonate ions to the extracellular fluid 3. Discuss the renal correction of alkalosis—decreased tubular secretion of hydrogen ions and increased excretion of bicarbonate ions 4. Know the use of the acid-base normogram for diagnosis of acid base disorders. 5. Understand causes of acid base disorders. 6. Explain the concept of anion gap.
11	<p>Diuretics:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Classification of diuretics, their mechanisms of action, and tubular sites of action.
12	<p>Micturition:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the physiological anatomy and nerve supply of urinary bladder 2. Understand the mechanism of bladder filling; Cystometrogram 3. Explain the micturition reflex and facilitation and inhibition of micturition by higher centers 4. Discuss the abnormalities of micturition.
13	<p>Kidney Diseases:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Know the acute renal injury with its categories and their causes. 2. Discuss the physiological effects of acute kidney injury 3. Understand how the vicious cycle of chronic kidney disease lead to end-stage renal disease 4. Know the causes of chronic kidney disease 5. List the renal function test and discuss their clinical significance. 6. Understand the principle of dialysis.



7. Endocrinology:

Endocrine system coordinates and integrates the cellular activities in the human body. The objective of this unit is to know the basic concept of molecular endocrinology, knowledge of endocrine glands and their relation with hypothalamus of action, Physiological functions and the related disorders with the completion of this unit student must be able to identify the common endocrinological disorder.

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Introduction to endocrinology:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the general principle of endocrinology (classification, mechanism of action and feedback control). 2. Understand the hormone secretion, transport, and clearance from the blood
2	<p>Mechanism of action of hormones:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the intracellular signaling after hormone receptor activation. 2. Explain the second messenger mechanisms for mediating intracellular hormonal functions 3. Discuss the mechanism of action of hormones that act mainly on the genetic machinery of the cell 4. Describe measurement of Hormone Concentrations in the Blood 5. Understand the technique of ELISA
3	<p>Hypothalamus and Pituitary gland physiological anatomy and its control:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the neuroendocrine functions of the hypothalamus 2. Discuss the hypothalamic-hypophysial portal blood vessels of the anterior pituitary gland 3. Enumerate the hormones of anterior and posterior pituitary. 4. Explain the relation of posterior pituitary gland and hypothalamus 5. Describe formation, release and physiological functions of Oxytocin 6. Describe formation, release and physiological functions of ADH. 7. Discuss the etiology, clinical features, investigations and treatment of a patient with diabetes insipidus and SIADH.
4	<p>Growth hormone:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Identify the factors and hormones that affect growth beside the growth hormone. 2. Know the physiological functions of growth hormone and metabolic effect of growth hormone. 3. Identify the relationship between growth hormone and insulin-like growth factors

	<ol style="list-style-type: none"> 4. Discuss the regulation of growth hormone secretion 5. Describe the hypopituitarism and hyperpituitarism 6. Describe the etiology, clinical features , pathophysiology, investigations and treatment of Dwarfism, Sheehan's syndrome, Gigantism and Acromegaly 7. Describe the endocrine function of pineal gland and biological effect of melatonin hormone.
5	<p>Thyroid gland: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Enumerate the hormones secreted from thyroid gland 2. Describe synthesis, Secretion, transport , mechanism of action and regulation of thyroid hormones 3. Describe the physiologic function and effects of Thyroid Hormone on Growth, metabolism and body systems 4. Discuss Hypothyroidism and Hyperthyroidism
6	<p>Adrenal gland:</p> <ol style="list-style-type: none"> 1. By the end of the topic students will be able to: 2. Hormones of adrenal cortex 3. Know the physiological anatomy and histology of adrenal gland 4. Enumerate the hormones secreted from adrenal cortex 5. Discuss the synthesis, transport, fate and secretion of adrenocortical hormones 6. Describe the functions and regulation of the mineral corticoids/aldosterone 7. Describe the functions and regulation of the glucocorticoids 8. Discuss the abnormalities of adrenocortical secretion
7	<p>Abnormalities of adrenal gland: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the abnormalities of adrenal gland, Cushing disease/ syndrome, Addison disease, Pheochromocytoma, Conn's syndrome.
8	<p>Calcium regulating hormones: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Know the regulation of calcium and phosphate in the extracellular fluid and plasma 2. Discuss the hormones that play role in calcium homeostasis 3. Explain the activation and physiological role of vitamin D 4. Discuss the Physiological functions , mechanism of action and Control of the Parathyroid hormone 5. Explain the physiological functions of calcitonin in Calcium metabolism 6. Describe the pathophysiology of parathyroid hormone, vitamin D, and bone disease.



9	<p>Insulin, Glucagon, and Diabetes Mellitus:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the endocrine functions of the pancreas and regulation of blood glucose level. 2. Explain the Mechanism of action of insulin & its regulation 3. Describe the effects of insulin on carbohydrates, proteins and Fats metabolism 4. Explain functions and regulation of glucagon secretion 5. Describe the physiological actions of Somatostatins 6. Discuss diabetes mellitus & hypoglycemia.
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8. Gastrointestinal (GIT):

The GIT includes the digestive tract and its accessory organs, which process food into molecules by different enzymatic and hormonal actions. To be absorbed by the cells of the body, they pass through the esophagus, stomach, small & large intestines and waste products are eliminated. Digestive process is controlled by both hormones and nerves.

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Introduction to GIT:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the physiologic Anatomy of gastrointestinal tract. 2. Comprehend the role of intestinal cells of Cajal in the electrical activity of G.I smooth muscle 3. Discuss the enteric nervous system and its role in control of G. I function
2	<p>Chewing/Swallowing reflex:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the importance of chewing defines mastication and its mechanism. 2. Describe the process of swallowing. 3. Understand different stages of swallowing reflex. 4. Understand different steps of involuntary phase of swallowing. 5. Know how different types of peristalsis in esophagus are taking place. 6. Discuss the importance of esophageal sphincter.
3	<p>Functions of Stomach and gastric emptying:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Categorize different functions of stomach. 2. Understand the process of stomach emptying. 3. Describe hunger pains and their mechanism. 4. Explain MMC (migrating motor complex). 5. Explain the different factors regulating stomach emptying.



	<p>6. Know different hormones taking place in stomach.</p> <p>7. Comprehend the mechanism of HCl secretion.</p>
4	<p>Functions of small intestine:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss different types of movements taking place in small intestine. 2. Understand role of ileocecal valve. 3. Explain secretory functions of small intestine. 4. Define peristaltic rush.
5	<p>Functions of Large intestine:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain different colonic movements. 2. Classify movements of colon. 3. Understand the role of gastrocolic and duodenocolic reflexes in regulation of mass movements. 4. Explain the secretory functions of large intestine & its nervous control
6	<p>Defecation reflex:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the process of defecation. 2. Understand the pathway of defecation reflex. 3. Know different types of defecation reflex. 4. Know the pathophysiological bases of mega colon.
7	<p>Vomiting reflex:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the factors causing the process of vomiting. 2. Explain location of vomiting center in the brain and vomiting reflex. 3. Explain the role of chemoreceptor trigger zone for initiating vomiting.
8	<p>Hormones of GIT:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Classify different types of G.I.T hormones. 2. Understand the secretion of different hormones and their regulation.
9	<p>Functions of liver:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the type, cause and clinical features of Jaundice. Enlist and interpret liver function tests. 2. Describe the functions of liver and gall bladder. 3. Enlist and interpret liver function tests. 4. Know the synthetic functions of liver.
10	<p>GIT Disorders:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the causes and clinical findings of Dysphagia. 2. Describe Achalasia, peptic ulcer and Megacolon. 3. Explain the physiology of Diarrhea and constipation.



9. Special Senses:

In this unit the students will study the Physiological aspects of special senses and their clinical correlation. The Special Senses that have specialized organs devoted to vision (the eye), hearing and balance (the ear, which includes the auditory system and vestibular system), smell (the nose), taste (the tongue).

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1	<p>Chemical senses (olfaction):</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the physiology of olfaction its pathway and abnormalities. 2. Understand the olfactory transduction. 3. Discuss abnormalities related to olfactory mechanism
2	<p>Chemical senses (gustatory):</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the physiology of taste, its pathway and abnormalities. 2. Describe different taste transduction
3	<p>Hearing physiology External ear:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain physiological anatomy of external ear. 2. Enlist functions of external ear
4	<p>Middle Ear:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain physiological anatomy of middle ear. 2. Understand impedance matching 3. Explain attenuation reflex along physiological importance
5	<p>Inner Ear:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain physiological anatomy of the inner ear. 2. Discuss mechanism of hearing. 3. Describe the signal transduction for hearing and auditory pathway. 4. Explain the Phenomena of determination of the sound frequency, loudness and direction of sound. 5. Discuss deafness.



6	<p>Vestibular Sensation and Equilibrium Control:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define and locate Vestibular Apparatus. 2. Understand the Functional anatomy of Vestibular Apparatus. 3. Explain the role of Sensory Organs Utricle & Saccule in controlling orientation of head with respect to gravity. 4. Describe the sensitivity of stereocilia and kinocillium in detecting head direction. 5. Explain semicircular ducts and their role in detecting head rotation and direction. 6. Illustrate Static equilibrium and its control by Utricle and Saccule. 7. Explain the role of Neck proprioceptors and other factors in controlling equilibrium.
7	<p>Eye (Optics of vision):</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand structure of human eye. 2. Discuss the errors of refraction. 3. Understand fluid system of the eye
8	<p>Eye (Retina):</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain physiological anatomy of retina. 2. Explain photochemistry of vision. 3. Understand Wald visual cycle and night blindness. 4. Describe neural functions of the retina.
9	<p>Color vision:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe theories of color vision, primary colors. 2. Explain color blindness.
9	<p>Phototransduction:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe phototransduction cascade of receptor potential. 2. Understand mechanism of dark and light adaptation.
10	<p>Visual pathway:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Discuss the lesions of the visual pathway. 2. Discuss Argyll Robertson pupil and Horner's syndrome. 3. Define visual field, blind spot and abnormalities of visual field.

10. Central Nervous System (CNS):

The nervous system is a highly complex system of the Human body that helps all parts of the body to communicate with each other. The nervous system has three broad functions: Sensory input, information processing, and motor output. It has two major divisions; Central Nervous System (CNS) and Peripheral Nervous system



(PNS). Central nervous system (CNS) consists of the brain and spinal cord, and the peripheral nervous system (PNS) consists of nerve fibers that carry information between the CNS and other parts of the body (the periphery).

S.NO	TITLE OF LECTURES WITH LEARNING OBJECTIVES
1.	<p>Sensory System:</p> <p>Functional organization of the Central Nervous system: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe Basic Organization of the Central Nervous system. 2. Define a Neuron. 3. Explain types of Neurons. 4. Describe the structure and functions of Neurons. 5. Differentiate between the Sensory, integrative/processing, and motor parts of the nervous system.
2.	<p>Major levels of Central Nervous System Functions: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand three major levels of Central Nervous System. 2. Describe Spinal Cord level and its specific functional characteristics. 3. Explain the lower brain or subcortical level and associated with the subconscious control. 4. Describe the functions of Higher Brain or Cortical Level.
3.	<p>Synapses: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the synaptic functions of neurons. 2. Differentiate between types of synapses. 3. Explain transmission along a Chemical synapse. 4. Describe the role of excitatory and inhibitory receptors and second messenger system in the postsynaptic neuronal membrane. 5. Define Neurotransmitters. 6. Explain the criteria for labeling a substance as neurotransmitter. 7. Know the different classes of neurotransmitters. 8. Describe Excitatory and Inhibitory post synaptic potentials. 9. Illustrate the phenomenon of Summation in synapses. 10. Describe the special characteristics of synaptic transmission.
4.	<p>Sensory Receptors: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the type of sensory receptors and the stimuli detected by the sensory receptors. 2. Understand the concept of Differential Sensitivity. 3. Explain The Labeled Line Principle and its significance. 4. Define Receptor Potentials and explain their mechanism. 5. Illustrate Receptor Potential of Pacinian corpuscle. 6. Describe the mechanism of Adaptation of Receptors.
5.	Neuronal Pools:

	<p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define Neuronal Pools. 2. Describe transmission and processing of signals in neuronal pools. 3. Understand the concepts of divergence and convergence of signals in neuronal pools. 4. Explain prolongation of signals by neuronal pools by after discharge.
6	<p>Somatic Senses:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define and classify Somatic senses. 2. Differentiate three physiological types of somatic senses, mechanoreceptive somatic senses, thermoreceptive, and pain somatic senses. 3. Describe detection and transmission of Tactile Sensations. 4. Explain the structure and function of Tactile receptors. 5. Describe the structure and function of mechanoreceptors and free nerve endings.
7	<p>Sensory Cortex & Sensory Tracts/Pathways:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the sensory part of cerebral and Somatosensory Cortex. 2. Differentiate between Somatosensory areas I & II. 3. Describe the location and functions of somatosensory areas I & II. 4. Understand the functions of Somatosensory Association Areas. 5. Know the major sensory pathways for transmitting somatic signals into the Central nervous system. 6. Describe Dorsal medial Leminiscal tract (DCMLS), trace its pathway, and explain its functions. 7. Describe Anterolateral tract, trace its pathway & explain its functions.
8	<p>Pain Sensation:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define Pain Sensation 2. Classify types of Pain. 3. Understand different pain stimuli. 4. Describe the pain receptors and their characteristics. 5. Explain fast and slow pain fibers. 6. Describe dual pathways, Neospinothalamic and Paleospinothalamic pathways for pain transmission. 7. Compare & contrast Neospinothalamic and Paleospinothalamic pathways for pain transmission. 8. Describe various theories of pain.
9	<p>Analgesia System in Brain & Spinal cord:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the components of Analgesia system. 2. Explain the function of Analgesia system.



	<ol style="list-style-type: none"> 3. Describe the transmitter substances of Analgesia system. 4. Know the role of morphine opiate, endorphins, and enkephalins in producing analgesia.
10	<p>Pain and Associated Clinical Abnormalities: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe Referred pain with examples. 2. Explain the concept of visceral pain & illustrate its mechanism 3. Understand the concept of parietal pain caused by diseases of viscera & role of different pathways. 4. Know about common clinical abnormalities associated with pain e.g., Hyperalgesia, Herpes Zoster (Shingles), Tic Douloureux. 5. Explain the effects of Brown Sequard Syndrome upon one sided spinal cord transaction and its association with loss of pain & thermal sensations. 6. Describe Headache as a type of referred pain. 7. Explain intracranial and extracranial types of headache.
11	<p>Thermal Sensation: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain the grades of thermal sensations. 2. Describe different thermal sensory receptors. 3. Explain the mechanism of stimulation of thermal receptors. 4. Understand the transmission of thermal signals in the nervous system.
12	<p>Motor System; Motor Neurons & Motor functions of Spinal Cord: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain Spinal cord organization for motor functions. 2. Describe two major types of motor neurons in the spinal cord; Anterior Motor Neurons and Alpha Motor Neurons. 3. Understand the functions of interneurons and gamma motor neurons.
13	<p>Muscle Sensory Receptors: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Know the two sensory receptors in muscles; Muscle spindle and Golgi tendon organ. 2. Describe the structure of muscle spindle and Golgi tendon organ. 3. Explain the receptor function of muscle spindle and Golgi tendon organ. 4. Describe Muscle Stretch reflex and illustrate the role of muscle spindle in Muscle stretch reflex. 5. Understand the types of Muscle stretch reflex. 6. Explain the clinical applications of Muscle stretch reflex. 7. Describe Golgi Tendon Reflex & its significance.
14	<p>Spinal Cord reflexes: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Explain Flexor and Withdrawal reflexes and their neuronal mechanism.



	<ol style="list-style-type: none"> 2. Understand Crossed Extensor reflex and its significance. 3. Describe the phenomena of Reciprocal Inhibition and Reciprocal Innervations 4. Explain different reflexes of posture and locomotion. 5. Describe the Autonomic Reflexes in the spinal cord. 6. Understand the concept of Spinal Cord Transection and Spinal shock.
15	<p>Cerebral Cortex & Voluntary Motor Function: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Describe the Motor Cortex and its three subareas. 2. Explain the location and functions of Primary motor cortex, Premotor area, and Supplementary motor area. 3. Define and locate specialized motor areas in human cortex.
16	<p>Motor Tracts/Pathways: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand how signals are transmitted from Motor cortex to the Muscles. 2. Describe Corticospinal (Pyramidal) tract, trace its pathway, and explain its functions. 3. Explain Extrapyramidal Tracts for motor signal transmission. 4. Compare & contrast Pyramidal & Extrapyramidal tracts for motor control. 5. Explain minor motor pathways.
17	<p>Brain Stem and Control of Motor Function: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Identify different parts of Brain stem. 2. Understand the special control functions and command signals of the brain stem. 3. Describe the role of Reticular and Vestibular Nuclei in support of the body against gravity. 4. Explain role of pontine & medullary reticular systems in motor control. 5. Understand the control of antigravity muscles by vestibular nuclei. 6. Define and explain the concept of Decerebrate Spastic Rigidity.
18	<p>Cerebellum & Motor Control: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define & locate Cerebellum. 2. Describe the anatomical & functional areas of Cerebellum. 3. Explain the neuronal circuitry of Cerebellum (Afferent and Efferent Cerebellar pathways). 4. Describe the functional organization of Cerebellar cortex. 5. Enumerate Deep Cerebellar nuclei and enlist their functions. 6. Understand the differences in the role of Cerebellar Mossy and Climbing fibers in controlling motor functions. 7. Explain the coordination of motor control at three levels of

	<p>Cerebellum; Vestibulocerebellum, Spinocerebellum, Cerebrocerebellum.</p> <ol style="list-style-type: none"> 8. Describe the clinical signs and functions of cerebellum in detail. 9. Explain the clinical abnormalities of Cerebellum.
19	<p>Basal Ganglia & Motor Control: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand how Basal ganglia function as an accessory motor system in conjunction with other motor systems. 2. Enumerate Basal ganglia. 3. Describe the anatomical relations of Basal ganglia with other structures of the brain. 4. Explain the neuronal circuitry of Basal ganglia. 5. Describe the Putamen circuit, its significance and associated abnormalities. 6. Understand the role of Caudate circuit of Basal ganglia in cognitive control. 7. Describe the functions of Basal ganglia in reference to primitive motor cortex. 8. Explain different neurotransmitters in Basal ganglia. 9. Describe the role of Dopamine and GABA in controlling motor functions through Basal ganglia. 10. Explain Parkinson's Syndrome, its clinical manifestations, and treatment options.
20	<p>Role of Cerebral Cortex in Learning: By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the Physiological anatomy of Cerebral cortex. 2. Describe the Thalamocortical System and its significance. 3. Explain the functions of specific cortical areas and cortical association areas. 4. Define and locate the general interpretative area, Wernicke's area and describe its functions. 5. Understand the concept of Dominant Hemisphere. 6. Explain Prefrontal Association areas and their significance in human intellect.



21	<p>Speech & Communication:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Understand the function of Brain in Speech & Communication.2. Explain the Sensory & Motor aspects of speech.3. Describe Wernicke's Aphasia & Global Aphasia.4. Explain Motor aphasia and its association with the Broca's motor speech area.5. Illustrate the phenomenon of Articulation and explain the structures responsible for Articulation.
22	<p>Memory:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Understand the role of Corpus Callosum in transferring thoughts, memories and information between the two cerebral hemispheres.2. Explain the Physiological basis of Memory and role of synaptic facilitation and synaptic inhibition in memory.3. Classify and describe the mechanism of three principal types of Memories.4. Explain the term Consolidation of Memory.5. Define the role of Hippocampus in Memory.6. Describe Amnesia and its types.
23	<p>Behavioral & Motivational Mechanisms of Brain:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Explain the Activating systems of the Brain.2. Describe the role of Brain stem excitatory and inhibitory signals to control behavior and motivation.3. Understand the role of excitatory and inhibitory neurohormones, norepinephrine, dopamine, and serotonin in providing long periods of control.
24	<p>Limbic System and Hypothalamus:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Understand the role of Limbic system in controlling Behavior.2. Describe the functional anatomy of limbic system.3. Enlist parts of limbic system.4. Explain how Hypothalamus is the physiological centre of the limbic system.5. Trace the limbic system.6. Describe various functions of Hypothalamus in relation to its nuclei.7. Explain Reward and Punishment centers and their significance in controlling behavior.8. Define the role and functions of other parts of limbic system in behavior such as Hippocampus & Amygdala.9. Explain Kluver-Bucy syndrome

25	<p>Sleep:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Define Sleep & differentiate between sleep and coma. 2. Describe the two types of sleep, REM and NREM sleep. 3. Explain the basic theories of sleep. 4. Define the role of neuronal centers and neurohumoral substances in causing sleep. 5. Describe the physiological functions of Sleep. 6. Explain different types of Brain Waves, their origin, interpretation, and role of EEG. 7. Describe the changes in EEG during sleep and wakefulness.
26	<p>Epilepsy:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the concept of symptomatic seizures and Epilepsy. 2. Describe different types of Epilepsy. 3. Explain the treatment of Epilepsy.
27	<p>Psychoses & Dementia:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the role of different specific neurotransmitters in Psychoses. 2. Explain Depressive & Maniac-Depressive Psychoses. 3. Define Schizophrenia explain its pathophysiology. 4. Describe Alzheimer's disease and one of leading causes of dementia.
28	<p>Cerebrospinal Fluid (CSF):</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none"> 1. Understand the mechanism of cerebral blood flow and its regulation. 2. Describe cerebral microcirculation. 3. Explain Cerebral Stroke. 4. Define Cerebrospinal Fluid system. 5. Describe the general characteristics and composition of CSF. 6. Explain the site of synthesis of CSF. 7. Trace the pathway of flow of CSF in brain ventricles. 8. Describe the role of Arachnoidal villi in absorption of CSF. 9. Explain the functions of CSF. 10. Describe the Cushioning Effect. 11. Explain Coup and Counter coup brain injuries. 12. Describe the significance of measurement of CSF pressure and role of Lumbar Puncture. 13. Explain Hydrocephalus and its types. 14. Differentiate between Blood brain Barrier and Blood CSF barrier. 15. Compare and Contrast Hydrocephalus and Brain edema.



29	<p>Brain Metabolism:</p> <p>By the end of the topic students will be able to:</p> <ol style="list-style-type: none">1. Explain the total brain metabolic rate and metabolic rate of neurons.2. Describe the importance of continuous oxygen supply to brain.3. Understand the role of glucose in maintaining brain energy under normal conditions.
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PHYSIOLOGY PRACTICALS:

Haematology

1. Study and use of the microscope.
2. Describe the various parts & functioning of Haemocytometer (Neubar's chamber).
3. Calculate the red blood cell (RBC)count.
4. Determination of total leukocyte count (TLC).
5. Prepare and examine the blood smear and determine differential leucocyte count.
6. Estimate the hemoglobin levels by Sahli's method.
7. Determine the erythrocyte sedimentation rate (ESR).
8. Determine the packed cell volume (PCV).
9. Determine the bleeding and clotting time.
10. Determine the Blood groups.

Respiratory System

1. Clinical examination of respiratory system.
2. Determination of various lung volumes, capacities and their clinical interpretation by Spirometry.
3. Record the respiratory movements by using Stethograph.

Cardiovascular System

1. Examination of arterial pulse.
2. Examination of jugular venous pulse.
3. ECG recording and interpretation of normal ECG.
4. Recording of arterial blood pressure.
5. Effects of exercise and posture on blood pressures.
6. Clinical examinations of precordium/ auscultation of apex beat and normal heart sounds.

Nervous System

1. Examination of superficial reflexes.
2. Examination of deep reflexes.
3. Examination of motor system.
4. Perform the cerebellar function tests.
5. Examination of sensory system.
6. Study the triple response of Lewis.
7. Demonstrate the clinical tests for examination of 12 cranial nerves.

Special Senses

1. Plot the peripheral field of vision (Perimetry and confrontational methods).
2. Elicitation of light reflex (direct and consensual) and accommodation reflex.
3. Test the visual acuity for near and distant vision.
4. Examine the fundus of eye (Ophthalmoscopy).
5. Demonstrate the hearing and equilibrium test.
6. Testing the colour vision.
7. Test the senses of taste and smell.



ASSESSMENT PLAN

Following modes of assessment are planned for 1st Year BDS class in the subject of Physiology. This plan has been designed keeping in view the university curriculum and hopefully will facilitate the students in preparing for 1st Professional Examinations in the subject.

UNITS TESTS:

Two tests will be conducted from each unit. The test will comprise of MCQs and SEQs on the pattern of university examinations. A preparatory time of at least one week shall be given prior to these tests.

VIVA VOCE:

Viva for every unit will be conducted after the completion of each topic.

OSPE TESTS:

In order to prepare the students for practical examinations at least two OSPE tests will be conducted on the pattern of university examinations.

SEND-UPS:

This will be conducted at the completion of course exactly following the format of UHS Professional Exams. This will comprise of MCQ's, SEQ's and viva segments and a sizeable portion of the total course will be included in each of them.

INTERNAL ASSESSMENT:

Internal assessment will be calculated out of 20 on the basis of all these tests that will be conducted throughout the year.



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PRESCRIBED TEXT & REFERENCES BOOKS

Recommended Books:

- Textbook of Physiology by Guyton and Hall, Latest Ed,
- Review of Medical Physiology by William F. Ganong, Latest Ed, published by McGraw –Hill education.
- Practical Manuals

Reference Books:

- Human Physiology by Laurali Sherwood, Latest Ed, published by Yolando Cossio.
- Physiology by Berne and Levy, latest edition.
- Essentials of Medical Physiology by Prof. Mushtaq Ahmad.
- Physiology by Linda and Costanzo, Latest Ed, published by Elsevier Health Sciences.
- Essential of Medical Physiology (Jaypee), Latest Ed, published by Brothers Medical Publishers.