

SCHEME OF STUDIES FOR BS PHYSIOLOGY

Sr. No.	Course Code	Course Title	Credit Hour
Semester 1			
1	PHS-300	Functional Anatomy	4 (3-1)
2	PHS-303	Cell and Molecular Biology	3 (2-1)
3	PHS-502	Biology of Development	3 (3-0)
4	ICP-321	Ideology and Constitution of Pakistan	2 (2-0)
5	ENG-321	Functional English	3 (3-0)
6	ISL-321/322	Islamic Studies/Ethics (for Non-Muslims only)	2 (2-0)
7	THQ-1	Teachings of Holy Quran	0 (0-0)
Total Credits			17
Semester 2			
1	PHS-302	Applied Physiology	3 (2-1)
2	PHS-405	Physiology of Blood and Extracellular Fluid	3 (2-1)
3	PSY-321	Introduction to Psychology	2 (2-0)
4	CCE-421	Civics and Community Engagement	2 (2-0)
5	QTR-421	Quantitative Reasoning I	3 (3-0)
6	ENG-322	Expository Writing	3 (3-0)
7	PST-321	Pakistan Studies	2 (2-0)
Total Credits			18
Semester 3			
1	PHS-401	Physiology of Digestion & Metabolism	3 (2-1)
2	PHS-403	Physiology of Respiratory System	3 (2-1)
3	PHS-407	Renal Physiology	3 (2-1)
4	GSC-321	The Science of Global Challenges	3 (3-0)
5	QTR-422	Quantitative Reasoning II	3 (3-0)
6	ICT-321	Applications of Information and Communication Technologies	3 (3-0)
7	THQ-2	Teachings of Holy Quran	0 (0-0)
Total Credits			18
Semester 4			
1	PHS-402	Cardiovascular Physiology	4 (3-1)
2	PHS-404	Nerve and Muscle Physiology	3 (2-1)
3	PHS-406	Homeostasis	2 (2-0)
4	PHS-410	General Immunology	3 (2-1)

5	BIN-422	Introduction to Bioinformatics	3 (2-1)
6	ENP-422	Entrepreneurship	2 (2-0)
Total Credits			17
Semester 5			
1	PHS-501	Neurophysiology	4 (3-1)
2	PHS-503	Endocrinology	3 (2-1)
3	PHS-505	General and Systemic Pharmacology	4 (3-1)
4	PHS-507	Principles of Human Nutrition	3 (3-0)
5	PHS-509	Human and Animal Behavior	3 (2-1)
6	THQ-3	Teachings of Holy Quran	0 (0-0)
Total Credits			17
Semester 6			
1	PHS-504	Reproductive Physiology	3 (2-1)
2	PHS-506	Physiology of Sensory System	3 (2-1)
3	PHS-508	Comparative Physiology	3 (2-1)
4	BCH-608	Clinical Biochemistry	3 (2-1)
5	BIT-405	Introduction to Biotechnology	3 (2-1)
6	SAT-507	Biostatistics	3 (3-0)
Total Credits			18
Semester 7			
1	PHS-601	Electrophysiology	3 (2-1)
2	PHS-603	Sports & Exercise Physiology	3 (2-1)
3	PHS-607	Pathophysiology	3 (2-1)
4	PHS-609	Research Methods in Biosciences	3 (3-0)
5	PHS-613	Biomedical Laboratory Diagnostics	3 (1-2)
6	THQ-4	Teachings of Holy Quran	0 (0-0)
Total Credits			15
Semester 8			
1	CAP-630	Capstone Project	3 (0-3)
2	INT-631	Internship	3 (0-3)
3	PHS-634	Seminar	1 (0-1)
Total Credits			7
Grand Total			127

Sr. No.	Category	No. of Courses	Credit Hours
1	Disciplinary/Major Courses	26	79

2	General Education Courses	12	30
3	Interdisciplinary Courses	4	12
4	Field Experience/Internship	1	3
5	Capstone Project	1	3
Total		44	127

Semester 1

PHS-300	Functional Anatomy	4 (3-1)
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Course Vision:

To provide understanding of:

- Basic functions of human tissues, organs and systems
- Components of individual systems and role in body functions.
- Regulation of physiological functions through different body system.
- Physiological processes related with individual system.

Course Contents:

Introduction: Organization of the human body, Basic anatomical terminologies, body planes, points, and cavities. Anatomical terminology.

Tissue: Tissue types of the body. Blood, connective tissue, epithelium, cartilage, and bone.

Osteology: structure of bone, classes of bones and comparative aspects, myology; types, structure, naming conventions of muscles and associated structures, and comparative aspects.

Arthrology: structural and functional classification of joints, structure of synovial joints, gait mechanics; statics and dynamics.

Myology: Microscopic and gross anatomy of muscles. Muscle types. Names of muscles present in the body.

Integumentary system: Skin and its modifications, Hair, and Nails.

Practical:

1. **Microscopy:** parts and function of microscope, use of microscope.
2. Histological slides of different tissues
3. **Osteology:** study of whole body skeleton, study of bones names and their location.
4. **Myology:** study of body muscles, their names and location.

Recommended Books:

Tortora, G. J. and Grabowski, S. R., Principles of Anatomy and Physiology, 11th ed; John Wiley and Sons, 2006 (Recommended Textbook).

Marieb, E. N., Human Anatomy and Physiology, 7th ed; Benjamin/Cummings Science Publishing.
William Henry Howell, A Textbook of Physiology for Medical Students and Physicians. General Books, 2010.

Shier, Hole's Essentials of Human Anatomy & Physiology 10/e. McGraw-Hills, 2008

Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology, 12th ed; W. B Saunders, 2005.

Shier, D., Butler, J., Lewis, R., Hole's Essentials of Human Anatomy and Physiology, 8th ed; McGraw-Hill, 2003.

Waugh, A., Grant, A., Ross and Wilson Anatomy and Physiology in Health and Illness, 9th ed; Churchill Livingstone, 2002.

PHS-303**Cell and Molecular Biology****3 (2-1)****Course Vision:**

- To knowledge about the ultra-structure of cell and its organelles
- Transportation across cell membranes
- Functions of cell organelles

Course Contents:

Ultrastructure of cell: Basic properties of cells, Prokaryotic and eukaryotic cells, Viruses. Function of various cellular organelles with special emphasis on the relationship of membrane structure, Cytoskeleton, and cell motility. microfilaments and microtubules; Receptor proteins.

Role of organelles: The role of mitochondria and chloroplast in cellular metabolism and energy transformation, role of ribosomes and endoplasmic reticulum in protein synthesis and protein transduction, Enzymes, the role of endoplasmic reticulum in drug metabolism, Golgi apparatus and cell secretions, role of lysosomes and metabolic disorders due to defects of lysosomal function.

Cellular processes: Plasma membrane composition, structure, and function. The movement of substances across cell membranes. The endomembrane system. Membrane permeability, transport, endocytosis, phagocytosis, pinocytosis and cell to cell interaction.

Nucleus: The structure and function of the nucleus, Genes and chromosomes

Central Dogma: Cell replication, transcription, translation, splicing, and mutation.

Cell signaling and Cancer

Practical:

1. To demonstrate the process of osmosis and diffusion using cell membranes.
2. To prepare osmotic fragility curve of different cells.
3. Preparation of temporary slides of various cell types.

4. To study different cell types through permanent slides.
5. Staining and study of budding in yeast cell
6. Counting of prokaryotic cells (bacteria) and blood cells by using hemocytometer.
7. To measure the cell size with the calibrated ocular micrometer.
8. Introduction to molecular techniques, PCR, Sequencing, Gel Electrophoresis

Books Recommended:

Karp, G., Cell and Molecular Biology: Concepts and Experiments, 5th ed; John Wiley and Sons, Inc., 2008 (Recommended Textbook).

Lodish H, Bresk A., Matsumura, P., Kaiser, C. A., Kriger, M., Scott, M. P., Zipursky, S. L. and Darnel J., Molecular Cell Biology, 5th ed;. W. H. Freeman and Co., New York. 2004.

Roberties, E. D.P. and Roberties, E. M. F. Cell and Molecular Biology, 8th ed. Lippin Cott William and Willkins, New York, 2001.

PHS-502	Biology of Development	3 (3-0)
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Course Vision:

To study the role of male and female reproductive system in the body.

To understand the developmental phases during the process of sexual maturation.

Course Contents:

Gender, its identity and sexuality, Roles of gonadotrophic hormones, somatomammotrophic polypeptides, cytokines, steroids and other such hormones in reproduction along with their mechanism of action, Hormones of testis and ovaries with their functions, spermatogenesis and folliculogenesis and their hormonal regulation, Female reproductive cycles, Puberty and maturation of hypothalamic-pituitary gonadal axis, Coitus and fertilization, Implantation, Maternal recognition of pregnancy, maintenance of gestation, Parturition, Lactation, Post-partum anoestrous, Fertility and infertility. Reproductive states in aging.

Practical:

1. To study the histology of male and female reproductive organs with the help of slides
2. Study of female reproductive cycle through vaginal smear in mice
3. To observe the morphology and motility of sperm in testicular tissue
4. Effects of hormones on cyclic activity,
5. Influence of gonadectomy on the targets,
6. Metabolic pattern in different reproductive states.

Books Recommended:

- Knobil, I. and Neill, J. The Physiology of Reproduction. Raven Press, New York, 2005.

- Molina, P E. Endocrine Physiology. McGraw Hill, Boston, 2003.

ICP-321	Ideology and Constitution of Pakistan	2 (2-0)
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Relevant to Concerned Department

ENG-321	Functional English	3 (3-0)
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Relevant to Concerned Department

ISL-321/322	Islamic Studies/Ethics (for Non-Muslims only)	2 (2-0)
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Relevant to Concerned Department

Semester 2

PHS-302	Applied Physiology	3 (2-1)
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Course Contents:

Introduction to the human physiology; functional organization, relationship between structure and function of the human body. Homeostasis, importance negative and positive feedback mechanism. Integumentary system; Layers of skin and types of glands, Functions of the skin, hair and glands, diseases related to skin, Body temperature , its types and its regulation The musculoskeletal system: Physiological anatomy of muscles and their types., Functional characteristics of skeletal muscle, smooth muscle and cardiac muscle, Properties of muscles , The events of muscle contraction and relaxation in response to an action potential in a motor neuron., Neuromuscular junction , Distinguish between aerobic and anaerobic muscle contraction., Muscle hypertrophy and atrophy. The nervous system; functional anatomy of nervous system, Functions of all the parts of central nervous system,, Functions of various cranial nerves., Division of peripheral nervous system (somatic and autonomic ns), The classification and function of neurons, neuroglial cells and their components. , Resting membrane potential and an action potential., Difference between sympathetic and para sympathetic ns, Difference between somatic and autonomic nervous system, The types and function of a synapse and reflex arc , Diseases related to nervous system. The functions of the specialized sense organs; Eye---- physiology of site, accommodation, optic nerve and optic chiasma, Ear---- functions of the internal, middle and external ear, Physiology of the hearing and balance, Smell----- physiology of olfactory nerve, Taste -----physiology of taste, Location of the taste buds, Physiology of speech. The endocrine system; Functions of the endocrine system, Chemical signals, receptors and hormones, the endocrine glands and their hormones, Other hormones. Blood; Composition of blood and plasma, Functions of blood, Formed elements , Stages of cell development, Blood grouping, Coagulation mechanism. The cardiovascular system; Functional anatomy cardiac system,, Functions of the heart , Electrical activity of the heart origin and propagation of cardiac impulse , Phases of the cardiac cycle , Heart sounds , Regulation of heart

functions--- intrinsic and extrinsic, Functions of the peripheral circulation , The physiology of circulation , Pulmonary circulation , Cardiac circulation, Systemic circulation: arteries , Veins , Local control of blood vessels , Nervous control of blood vessels , Regulation of arterial blood pressure, The function of lymphatic system, tonsils, lymph nodes, the spleen and the thymus. Respiratory system; Functional anatomy of respiratory system, Functions of the respiratory system beginning at the nose and ending with the alveoli., Ventilation and lung volumes, Pulmonary function tests, Gas exchange and gas transport in the blood, Diseases related to respiratory system. The digestive system; Functions of each organ of the digestive system including major salivary glands, Movements and secretions in each organ of the digestive system and their regulation, Physiology of digestion, absorption, and transport, Diseases related to digestive system. Excretory system; Functional anatomy of urinary system, Tubular system of kidney, Urine production, urine movement, Regulation of urine concentration and volume, Body fluid compartments, Regulation of extracellular fluid composition, Regulation of acid-base balance. Immunity; Define immunity, innate immunity, adaptive immunity, Antigens and antibodies, Primary and secondary responses to an antigen, Antibody-mediated immunity and cell-mediated immunity, Role of lymphocyte in immunity regulation,

Practical:

- Determination of human pulse rate
- Determination of blood pressure (by auscultatory and palpatory method)
- The effect of exercise and posture of b.p
- Determination of visual acuity for distant vision
- Determination of visual acuity test for near vision
- Determination of abo blood group system.
- Determination of rh blood group system
- To study hemocytometer
- Count the total number of rbcs/mm³ of your own blood
- Examination of cranial nerves

Recommended Books:

- Essentials of anatomy and physiology by Seelay, Stephens and Tate. 4th edition
- Ross & Wilson anatomy and physiology.
- Human physiology. Stuart ira fox. 7th edition
- Text book of Medical Physiology Guyton
- Essential of medical physiology vol.1 & 2 by Mushtaq Ahmad.
- Lecture notes on human physiology by bray jj, cragg, pa macknight

Objectives:

- To provide the understanding of different body fluid compartments and their role in maintaining homeostasis.
- To provide the concept of hemopoiesis and blood group systems.
- To understand the mechanisms of hemostasis.

Course Contents:

Body fluid Compartments: Classification, composition of body fluids, regulation of fluid composition and volume, regulation of fluid exchange and osmotic equilibrium between intra and extra cellular fluid, interstitial fluid, colloidal osmotic pressure.

Blood: Hemopoiesis, stem and progenitor cells, differentiation of blood cells. Composition and function, synthesis of plasma proteins, protease inhibitors and colloid osmotic pressure.

Erythropoiesis: Overview, regulation of erythropoiesis, development of erythroid lineage. Red blood cell development, Hemoglobin synthesis, structure and function, iron metabolism, transport and storage. Destruction of RBCs. Diseases; anemia, polycythemia and thalassemia.

Leukopoiesis: Development, morphology and functions of granulocytes and agranulocytes, macrophages, distribution, functions and fate. Leucopenia, leukemia and leucocytosis.

Megakaryopoiesis: Megakaryocytes Morphology, synthesis, distribution. Functions of platelet and its role of platelets in hemostasis.

Hemostasis: Coagulation factors, Natural Inhibitors. The blood coagulation cascade. The contact activation system. Fibrinolytic system and Anticoagulation system.

ABO system: Introduction, Principles of ABO Group determination. The Rh system, Hemolytic disease of the newborn.

Lymph: Lymph nodes and channels, capillaries and their permeability, rate of lymph flow. Composition and function, effect of interstitial fluid on lymph flow.

Cerebrospinal Fluid: Formation, flow, pressure, absorption and function. Brain edema, blood brain barrier and blood CSF barrier.

Sweat: Glands, formation, volume regulation.

Ocular fluids: Overview, production and turnover of Tears, Aqueous and Vitreous humor.

Synovial fluid: Composition and regulation of volume and function.

Body Cavity Fluids: Overview of Pleural, Pericardial fluid, peritoneal fluid and surfactant.

Practicals:

1. To determine the packed cell volume (PCV) or Hematocrit ratio by Wintrobe's method.
2. Determination of erythrocyte count in a sample of blood.
3. Determination of absolute red cell Indices by calculations.
4. Determination of blood groups

5. Estimation of hemoglobin concentration by Sahli's method.
6. To determine the erythrocyte sedimentation rate (ESR) by Westergren's method.
7. Determination of total leukocyte count in a sample of blood.
8. Determination of differential leukocytes count.
9. Determination of platelet count.
10. Determination of bleeding time and clotting time.

Recommended Books:

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology, 12th ed; W. B Saunders, 2011 (Recommended textbook).
- Pallister, C., Blood Physiology and Pathophysiology. Butterworth — Heinemann Ltd.,1994.
- Schmaier A. H. and Petruzelli L. M., Hematology: Lippincott Williams and Wilkins, 2003.
- Talib V. H. and Khurana S. K., Hematology For students (Clinical and Practical Approach). CBS Publishers and Distributors, 1995.
- Ogsten, D., The Physiology of Hemostasis: Biddies Ltd, Guildford and King's Lynn,1983.
- Ganong, W. F., Review of Medical Physiology: International ed. McGraw-Hill. 2005.

CCE-421	Civics and Community Engagement	2 (2-0)
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Relevant to Concerned Department

QTR-421	Quantitative Reasoning I	3 (3-0)
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Relevant to Concerned Department

ENG-322	Expository Writing	3 (3-0)
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Relevant to Concerned Department

ISL-321/322	Pakistan Studies	2 (2-0)
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Relevant to Concerned Department

Semester 3

PHS-401	Physiology of Digestion and Metabolism	3 (2-1)
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Course Vision:

- To understand the organization of gastrointestinal system with respect to its functions.
- To understand the role of liver, gall bladder and pancreas in secretion, storage and release of chemical substances for digestion.

- To provide understanding of different segments of GIT with respect to processing of food, digestion, absorption, their secretions and excretion.

Course Contents:

Digestion:

Introduction: An overview of Gastrointestinal system, general organization, autonomic supply, chemical mediators.

Mouth: Anatomy, mastication. Structure and function of salivary glands, composition and regulation of salivary secretions.

Esophagus: Esophageal secretions, esophageal peristalsis, swallowing, lower sphincter control.

Stomach: Structure and innervation, gastric glands and their secretions, composition and regulation of gastric secretions, gastric motility.

Pancreas: Functional anatomy, composition, mechanism and regulation of pancreatic secretion, cellular mechanism of secretion, cholecystokinin and acetylcholine as pancreatic exocrine secretion mediators.

Liver and Gall Bladder: Structure and function, composition of bile. Mechanism and control of bile secretion. Transport and storage of Bile. Enterohepatic circulation. Gall stone.

Small Intestine: Epithelial cells, intestinal glands. Motility and intestinal reflex. Assimilation: Digestion and absorption of Carbohydrates, Proteins, Fats, Iron and Electrolytes.

Large Intestine: Structure and motility, Electrolyte transport, Microflora, Defecation reflex.

Gastroenteropancreatic Hormones: Gastric, pancreatic, duodenal hormones and their roles in digestion.

Physiology of Gastrointestinal Disorders

Metabolism:

Metabolism of Carbohydrates

Metabolism of Fats

Metabolism of Proteins

Practical:

1. To observe the digestive organs in a dissected animal model (Frog, Uromastix, Rabbit)
2. To study the histology of digestive organs by slides and charts.
3. To determine the composition and normal physical and chemical properties of saliva.
4. To find the effect of substrate concentration on enzyme activity.
5. To observe the protein digestion by the action of pepsin.
6. To observe the effect of Renin on milk protein.
7. To observe the effect of Pancreatin on carbohydrate digestion.
8. To study the action of Bile on fat digestion

Books Recommended:

- Guyton, A. C. and Hall, J. E. Text book of Medical Physiology. 12th ed. W.B Saunder. 2010.
- Human Physiology: An Integrated Approach, 4th Edition by Dee Unglaub Silverthorn (2010).
- Johnson, L. R. and Gerwin, T. A. Gastrointestinal Physiology. Mosby Inc., 2001

PHS-403	Physiology of Respiratory System	3 (2-1)
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Objectives:

- To understand the role of respiratory passages in conditioning of air, speech and resonance.
- To understand the mechanism of respiration.
- To understand the exchange and transport of respiratory gases
- To understand the nervous and chemical/humoral regulation of respiration.

Course Contents:

Introduction: Anatomical and physical relationship, lung volumes and capacities.

Functions of Respiratory Passages: Air-conditioning, speech and resonance,

Respiratory Mechanism: Muscles of respiration, pressure, compliance and elasticity. Surface tension, surfactants. Work of breathing. Ventilation-Perfusion Relationship: Oxygen transport from air to tissue, Hypo and Hyperventilation, Respiratory quotient, Ventilation-perfusion ratio.

Respiratory Pigments: Hemoglobin, hemerythrin, chlorocrourin.

Transport of Respiratory Gases: Henry's law, Dalton's law, oxygen and carbon dioxide dissociation curves and factors affecting, Bohr and Haldane effect, Hypoxia, hypercapnia, cyanosis.

Acid-Base Status: Respiratory and metabolic, acidosis and Alkalosis.

Control of Respiration: Nervous and Chemical/humoral control during normal quiet breathing and stress.

Practical:

1. To record and relate the changes in circumference of chest (normal and maximal breathing) with activity of respiratory muscles.
2. To obtain a graphical record of normal respiration.
3. To study the effect of exercise on respiration.
4. To observe the effect of deglutition on respiration.
5. To observe the effect of rebreathing of expired air on respiratory rate.
6. To observe the effect of voluntary apnea on normal respiration.
7. To observe the effect of mental stress on respiration.

8. To measure/calculate the lung volumes and capacities by spirometer/vitalograph
9. To determine the oxygen consumption of cockroach per hour by potometer.
10. To determine respiratory gases in expired air by Douglas Bag method.

Recommended Books:

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 12th ed. W. B. Saunders, 2005. (Recommended Textbook).
- West, J. B. Respiratory Physiology; The essentials. 7th ed., Williams and Wilkins, London, 2005.
- Davis, A. The Respiratory System, Basic Science and Clinical conditions. Churchill Livingstone, London. 2003.
- Levitzky, M. G. Pulmonary physiology, 6th ed., McGraw-Hill, New York, 2003.
- Leff, L. A. and Schumacker, P. T. Respiratory Physiology, Basic and Application. W. B. Saunders Company, London, 1993.
- Stuch, N. C. Basic Respiratory Physiology. Churchill Livingstone, London, 1991.
- Mines, A. H. Respiratory Physiology. 2nd ed., Raven Press, New York, 1986.

PHS-407	Renal Physiology	3 (2-1)
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Objectives:

- To understand the filtration function of glomerulus and its relationship with renal blood flow.
- To understand the mechanism of early and late filtrate processing.
- To know the mechanism for the formation of dilute and concentrated urine.
- To understand the endocrine function of kidney.
- To interpret the renal function tests in health and disease.

Course Contents:

Introduction: Structural and functional characteristics of nephrons.

Fluid Dynamics: Filtration process, Glomerular filtrate, composition and factors affecting filtration function.

Renal Blood Flow and Glomerular filtration Rate: Control and regulation of flow rate. Tubuloglomerular feedback.

Renal Clearance: Para-amino hippuric acid and Inulin based estimation of Glomerular filtration rate and renal blood flow.

Renal Tubular Functions: Reabsorption and secretion in the proximal tubule, Loop of Henle, Juxtaglomerular apparatus, distal tubules, Collecting ducts, mechanisms of dilution and concentration of urine (Counter-current system and role of vasa recta).

Renal Regulation: Body fluids Osmolarity, Volume, pH, and electrolytes. Respiratory

and metabolic acidosis/alkalosis.

Dialysis: Principle, basic mechanism.

Practicals:

1. To study various procedures for collection and preservation of urine specimens for urinalysis.
2. To determine the physical and chemical properties of urine.
3. Spectrophotometric examination of the urine sample (Ascorbic acid, Iron, Glucose, Uric acid, Proteins).
4. To determine blood urea and creatinine.
5. To observe the effects of diuretics on urinary volume and pH in animal models.
6. Determination of threshold time for micturition using diuretics on animal model.
7. Microscopic examination of urinary sediments.
8. Preparation of slide to study the animal kidney histology.

Recommended Books:

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 12th ed. W. B Saunder. 2005. (Recommended Textbook).
- Vander's Renal Physiology (LANGE Physiology Series) by Douglas Eaton, John Pooler and Arthur J. Vander. 2002.
- Lote, C. J. Principles of Renal Physiology, 3rd ed., Chapman and Hall, London, 1994.
- Berliner, C. W. and. Giebisch, G. H. Renal Physiology. American Physiological Society, Bethesda. 1987.
- Valtin, H. Renal Function: Mechanisms Preserving Fluid and Solute Balance in Health. Little Brown and Company, Boston, 1973.
- Pitts, R. F. Physiology of Kidney and Body Fluids, An Introductory Text. Year Book Medical Publisher, Chicago. 1964.

GSC-321	The Science of Global Challenges	3 (3-0)
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Relevant to Concerned Department

QTR-422	Quantitative Reasoning II	3 (3-0)
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Relevant to Concerned Department

ICT-321 Applications of Information and Communication Technologies	3 (3-0)
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Relevant to Concerned Department

Semester 4

Course Vision:

To understand

- Organization and components of cardiovascular system
- Excitability and contractility in heart with respect to its role in pumping of blood in circulatory system.
- Various phases of the cardiac cycle along with variation in blood volume and pressures in ventricles aorta and atria.
- ECG with respect to its recording and analysis for cardiac functions.
- The regulation of cardiac activity and blood pressure in arterial tree.
- Role of vascular bed and importance of coronary circulation.

Course Contents:

Introduction: Organization of circulatory system

Structure of Heart: Specialized cells and functional anatomy of heart Electrical Properties of Heart: Pace makers, mechanism of self-excitation, rhythmicity, types of cardiac potentials and excitation of ventricular fibers

Cardiac Cycle: Cardiac cycle and output, atria as primer pump, Ventricle as pump work output of heart and pressure volume curves ECG and its Analysis: characteristics of normal ECG; methods of recording, ECG leads, principles of vectorial analysis of normal ECG. Electrical analysis of ventricular QRS, abnormal voltages of QRS (causes)

Regulation of Cardiac Activity: Control of rhythmicity by autonomic innervations, myocardial performance and its neural and hormonal control Vascular Bed: Arrangements of vessels, routes from arterial to venous system, volume of blood in different vessels. architecture of the terminal vascular bed, volume distension, mean velocity of flow. circulation time and flow in capillaries. measurement and meaning of circulation time, shunts and AV-Anastomoses

Blood Vessels: Elastic nature of vessels (Hooke's and Laplace Law).

The Arterial System: Arterial blood pressure, relationship between flow and pressure in capillaries, importance of transmural pressures, Pressure gradients, viscosity and blood flow, peripheral resistance, regulation of blood pressure Control of Cardiac Output: Relationship between cardiac output and venous return, influence of various factors

Coronary Circulation: Functional anatomy of coronary vessels, Factors influencing coronary blood flow. Cutaneous, Skeletal muscle, Cerebral, Pulmonary, Special Circulation: Renal and splanchnic circulation, Peripheral circulation and Intrinsic and extrinsic control of peripheral blood flow and its control central and peripheral factors (Exercise and Hemorrhage)

Practical:

1. To record normal cardiogram and observe the effect of temperature on

frog's heart

2. Effect of Stannius ligature on the heart of frog/uromastix
3. To observe the effect of Vagal stimulation on heart
4. To observe the effect of various factors (1) posture, (2) breath holding, (3) exercise, (4) over ventilation and (5) stress on blood pressure
5. To record and study ECG
6. To evaluate the cardiac efficiency after exercise by scoring chart.

Books Recommended:

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 12th ed. W. B. Saunders, 2010.
- Richard E. Klabunde. 2006. Cardiovascular Physiology Concepts. Lippincott Williams & Wilkins
- **Mohrman, D. E. and Heller, L. J., Cardiovascular Physiology. McGraw Hill, Boston, 2002.**

PHS-404	Nerve and Muscle Physiology	3 (2-1)
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Objectives:

To understand the:

- Significance of nerve-muscle relation with respect to their role in various systems of human body.
- Types of neurons, nerves & muscles with respect to their gross & ultrastructures and physiological functions.
- Classification of nerves & skeletal muscles with respect to their functions.
- Excitability, contractility & mechanics of skeletal, cardiac and smooth muscles & their importance.

Course Contents:

Introduction: Significance of nerve-muscle physiology related to various systems (CVS, Respiration and Special senses) Characteristics of nerve & muscle, functions and types.

Neuron & synapse: Classification, structure & functions of neurons, synapse and synaptic transmission, role of neurotransmitters. Classification of nerves.

Skeletal Muscle: Gross Structure, Covering, Connective tissue layer, Aponeurosis, tendon sheath. Classification: On the basis of direction, location, origin, insertion, Color,

Fiber types, nerve and blood supply to muscle and various actions. Skeletal muscle **Movements:** muscular actions; individual and group, role of skeleton and muscle in various movements, Neuromuscular Junction: Motor unit, and mechanism of impulse transmission through NMJ, Synthesis of neurotransmitter and its secretion. Electrical **activity:** Resting membrane potential, Ionic channels, conductance and generation of action potential. Microanatomy: Sarcolemma,

Sarcoplasm, Nuclei, Sarcoplasmic Reticulum, Mitochondria, Transverse tubules, Myoglobin, Myofilaments, Molecular structure of contractile proteins, Excitation contraction coupling. Mechanism of **Contraction**: Theories of contraction (Sliding filament, ratchet) and their molecular aspects. Muscle Mechanics: Twitch, tetanus, summation, staircase, fatigue, isotonic and isometric contraction, tone. Relationships: Length Tension, force velocity & strength duration relationships. Muscle heat: efficiency of muscle, sources of energy, Location and function of Muscle proprioceptors.

Smooth Muscles: Microanatomy: Sarcoplasm, Mitochondria, Caveolea, sub surface, cisterns, Sarcolemma, cell to cell contacts, cyto-skeleton, dense bodies, intermediate filaments, myofilaments, classification, excitation, contraction and regulation, Neuronal and hormonal influence, excitation and inhibition at NMJ, electrical activity (membrane & action potentials), E-C coupling, contractile process & its regulation (latch mechanism).

Cardiac Muscles: Microanatomy, Fiber types, Mechanism of excitation and contraction, types of action potential.

Practical:

1. To dissect out nerve and muscle from Frog's leg and fixation for recording of muscle mechanics (Twitch & summation).
2. To study the ultra-structure & functions of neuron, synapse using illustrated charts and multimedia presentation.
3. To record the effect of tetanization on muscle contractility.
4. To record the effect of repeated direct and indirect stimulation on the muscle to observe its transmission & contraction fatigue.
5. To record the Staircase effect in muscle contraction
6. Experiment to demonstrate muscle tone, tension, isometric and isotonic contractions and fatigue in human muscles.
7. To demonstrate the preparation of isolated intestinal strip and its use for the recording of rhythmic activity on kymograph/chart recorder/power lab.
8. To demonstrate the rhythmic contraction and relaxation in isolated heart of mammal using kymograph/power lab/chart recorder.
9. To record EMG during voluntary contraction of human muscle.
10. To determine the work performed by human muscles, using an Ergograph.

Recommended Books:

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology, 12th ed. W. B. Saunders, 2005 (Recommended Textbook).
- Richard D. Keynes, David J. Aidley & Christopher L. H, Huang. Nerve & Muscle, Cambridge, 2011

- Berney, R. M. and Levy, M. N. Physiology. Mosby Air book, 1992.
- Berney, R. M. and Levy, M. N. The Structure and Function of Muscle. Academic Press, 1968.
- West, J. B. Physiological Basis of Medical Practice. Williams and Wilkins. 1990.

PHS-406	Homeostasis	2 (2-0)
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Course Vision:

- To study homeostatic mechanisms of the body.

Course Contents:

Physiological homeostasis, homeostasis of organism water regulation, sugar homeostasis, temperature regulations, other mechanisms of homeostasis, changes in internal environment, costs and benefits of homeostasis, endocrine system and homeostasis, feedback circuits.

Books Recommended:

- Lauralee Sherwood's. Human Physiology: From Cells To Systems 5th Ed. (2011)
- Medical Physiology (2008) By Walter F. Boron, Emile L. Boulpaep.
- Ezeilo, G. C., Text book of Physiology. Oxford University Press, New Delhi, 2002.
- Campbell, N.A., Reece, J.B., Mitchell, L.G., Biology, 7th ed: Benjamin/Cummings, Menlo Park, 2005.

PHS-410	General Immunology	3 (2-1)
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Course Vision:

- Basic Concepts of Immunology
- Types of Immunity
- Immune Mediators

Course Contents:

Introduction to immune system: Adaptive and innate immunity, cells and organs of immune system, soluble mediators of immunity, antigens, immune responses, inflammation, defenses against intracellular and extracellular pathogens, immunopathology, vaccination.

Cells, tissues and organs of immune system: Cells of innate and adaptive immune system, lymphoid tissue and lymphocytes traffic.

Cell migration and inflammation: Mechanism and pattern of cell migration, complement.

Antibodies: Immunoglobulins, interaction of antibodies with antigens, function of antibodies, antibodies diversity, immunoglobulins gene recombinations, somatic mutations.

T-cell receptors and major histocompatibility molecules complex: T-cells receptors, genes of T-cell antigen receptors, Major histocompatibility complex molecules (MCH), interaction of MCH molecules with antigenic peptides, interaction of T-cells receptors with MCH and antigens.

Antigen presentation: Antigen presenting cells, antigen processing and presentation, T-cell activation.

Cytokines: Cytokines and cytokines receptors families, cytokine production by T-cells subset.

Cell cooperation in antibody response: Development of B-cells, activation of B-cells by T-dependent

Immunological techniques

Practical:

1. Identification of blood cells and their functions in immunological processes.
2. Experiments in antigen-antibody interactions: precipitation reactions; hemagglutination etc.
3. Preparation of various immunogens
4. Demonstrations of immunoassays
5. Protocols and demonstrations of immunoblotting and immunoprecipitation.
6. Protocols of monoclonal antibody production.

Books Recommended:

- Thomas J. Kindt, Barbara A. Osborne, Richard A. Goldsby. Kuby Immunology, 6 th ed. W. H. Freeman, 2006.
- Kindt, T.J., Osborne, B.A. and Goldsby, R.A. Immunology, W.H. Freeman and Co Ltd., London, 2006.
- Goldsby, R.A., Kindt, T. J., Osborne, B.A. and Kuby, J. Immunology, W.H. Freeman and Co Ltd., London, 2006.

ENP-422	Entrepreneurship	2 (2-0)
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Relevant to Concerned Department

Semester 5

PHS-501	Neurophysiology	4 (3-1)
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Course Vision:

- To inculcate understanding for the role of neuron as functional unit in neural activities.
- To provide understanding of electrical transmission and their pathways in spinal cord and brain.
- To give understanding of various levels of brain with respect to their individual role in motor control and their integration for somatic, vegetative and behavioral activities.

Course Contents:

Neural functions and Pathways: Anatomical and Physiological methods for the identification of neuronal functions and their pathways.

Communication within neurons: Flow of electrical currents along nerves and in electrical analog models of nerve cell membrane.

Threshold properties: Refractory period, accommodation, all or none law, Neural codes, initiation of impulse

Communication between neurons: Electrical transmission, Types of channels.

Receptor adaptation: Function of adaptation. Synaptic and neuromuscular transmission

Local Motor Control: Motor Neurons, descending pathways, Sensory feedback from muscles; spindle reflexes, the servo hypothesis

Control of Posture: The importance of Support, Role of Brain Stem,

Higher functions: cerebral cortex; Integration between different cortices

Global Motor Control: Motor cortex, Corticospinal concept.

Basal ganglia: Functions and clinical conditions Physiology of Autonomic Nervous System, Sympathetic and parasympathetic control, Autonomic reflexes Neurotransmitters, Types; Cholinergic and Adrenergic Receptors, Denervation hypersensitivity.

Recognition and Memory: Types of learning, central circuits of learning, Role of cerebellum in learning.

Hypothalamus limbic system: Motivation, Emotion, Hypothalamus, Sleep and cortical arousal, EEG and its clinical use, Limbic system, role of amygdala and Hippocampus.

Practical:

1. To calculate the conduction velocity of sciatic nerve in frog by the help of recorded twitches on kymograph.
2. Demonstration of various tendon reflexes in human being.
3. Demonstration of various common (daily use) examples for the understanding of spinal reflexes in human subjects.
4. Demonstration of the principle and use of an oscilloscope in various neurophysiological studies.
5. Recording of an action potential from Frog/Uromastix sciatic nerve on physiograph by using extracellular electrodes.
6. To observe the neurophysiological influence of vagus nerve on heart activity(Uromastix/Rabbit/Frog)
7. Elicitation of spinal reflexes in Frog.
8. Effect of strychnine on spinal reflexes in Frog.
9. Effect of acid treatment to observe withdrawal reflexes in frog.
10. Demonstration of the recording of an action potential from sciatic nerve bundle by using intracellular glass capillary microelectrode.

Books Recommended:

- Ray, Soumya S. Neuroscience. 3rd Edition, Sinauer Associates Inc., Maryland, 2008.
- Allan Siegel, Hriday N. Sapru, Essential Neuroscience. Lippincott Williams & Wilkins, 2006.

- Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 12th ed; W.B Saunders Co. 2005.
- Carpenter, R.H.S. Neurophysiology. 4th ed; Oxford University Press, Oxford. 2002.

Objectives:

- To understand the synthesis, secretion and function of hormones.
- To understand the mechanism of action of hormone on target tissue.
- To explain the biosynthesis, actions and regulation of secretion of hormones of pituitary, thyroid, parathyroid, pancreas, adrenal cortex, adrenal medulla, gonadal hormones.
- To understand the function of hormones secreted from non-endocrine organs.

Course Contents:

Introduction: Endocrine Glands, Functional anatomy of different endocrine glands, General account of chemical nature and biosynthesis of hormones, Transport of hormones to the site of action

Mechanism of Hormone Action: Hormonal signaling and its role in coordination of molecular, cellular and tissue functions; conceptual account of different types of signaling and transductions,

Hormone Functions: physiological actions of the hormones of hypothalamus, pituitary, thyroid, parathyroid, endocrine pancreas, adrenal cortex, adrenal medulla, gonads, corpus luteum, pineal, thymus. Endocrine secretions of heart, kidney and adipose tissue.

Invertebrate hormones. Hormones involved in molting and metamorphosis.

Control of Hormonal Secretion: Negative and positive feedback regulation.

Practicals:

1. To demonstrate the position of various endocrine glands
2. Experiments to reveal the roles of endocrine glands and their hormones in physiological functions
3. The effect of insulin on glycemic level.
4. To determine the random and fasting blood glucose level.
5. To perform oral glucose tolerance test in human/animals.
6. To determine the effect of cortisol on biochemical parameters (glucose/protein)
7. To determine the effect of MSH on skin pigmentation.

Recommended Books:

Greenspan, F. S. and Strewler, G. J. Basic and Clinical Endocrinology. Prentice-Hall, New York, 2004. (Recommended Textbook).

Guyton, A. C. and Hall, J. E. Textbook of Medical Physiology. 12th ed. W. B Saunder, 2005.

Molina, P. E. Endocrine Physiology. McGraw-Hill, Boston, 2003.

Kacsoh, B.. Endocrine Physiology. McGraw-Hill, Boston. 2000.

Wilson, J. D., Foster, D. W., Larsen, P. R and Kronenberg, H. Williams Textbook of Endocrinology. W. B. Saunders, Philadelphia. 2002.

Ganong, W. F. Review of Medical Physiology. 24th ed. McGraw-Hill. 2005.

Gerald D. Tharp, David A. Woodman Experiments in physiology. 10th Edition.

PHS-505	General and Systemic Pharmacology	4 (3-1)
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Theory:

General Pharmacology: Sources of drugs, Mechanism of action of drug, Absorption, Distribution, Metabolism and Elimination of drugs, Untoward effects of drugs, Drug receptor interaction and its characterization, Drug interaction and its clinical significance; Drug residues, **General classification of drugs:** Antibiotics, antiprotozoal, anthelmintic, antiviral, and antifungal drugs.

Systemic Pharmacology: Drugs acting on Central Nervous System, Preanesthetic medication, Inhalant General anesthetics, Intravenous anesthetics, Hypnotics, Sedatives and analgesics., Anticonvulsants, Tranquilizers and CNS stimulants, Local anesthesia, Intraspinal and epidural anesthesia, Neuromuscular-blocking agents, Anti-cancerous chemotherapy, Autonomic drugs , Pharmacology of Autocoids, Antipyretics and analgesics, Antiinflammatory drugs, Drugs acting on gastrointestinal tract, Drugs acting on respiratory system, Drugs acting on urinary system, Diuretics and antidiuretics, Drugs acting on cardiovascular system, Drugs acting on fluids and electrolyte balance, Endocrine pharmacology, Nutritional pharmacology, Drugs acting locally on skin, Drugs acting locally on mucus membranes.

Practical:

Weights and measures, Medical prescription, Pharmaceutical calculations, Partition coefficient of drugs, Formulations; external and internal dosage forms, Techniques of drug administration in experimental modals, Demonstration of Pharmacokinetic experiments, Identification of various drugs, Preparation of ointments, Preparation of liniments , Preparation of tinctures, Experiments on drug antagonism and synergism, Drug assays, Acute toxicity study, Strychnine poisoning and its antidotes.

Books Recommended:

1. Hardman, J.G., L.E. Limbird, et al., 2005. Goodman and Gillman pharmacology basis of therapeutics, 11th Ed., McGraw-Hill, New York.
2. Katzung, B.G. 2009. Basic and Clinical Pharmacology. 11th Ed., McGraw hill, New York, U.S.A.
3. Richard A. Harvey., 2011. Pharmacology (Lippincott Illustrated Reviews Series), 5th Ed., LWW, U.S.A.

4. Bennett P.N. 2012. Clinical Pharmacology. 11th Ed., Churchill Livingstone, U.S.A.
5. Foreman, J.C., T. Johansen and A.J. Gibb, 2009. Textbook of Receptor Pharmacology, 3rd Ed. CRC Press, USA, UK and Canada.

PHS-507	Principles of Human Nutrition	3 (3-0)
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Course Vision:

- To understand the basic needs of human nutrition and balanced diet

Course Contents:

Introduction: definitions, food, nutrients, diet, balanced diet, food groups, food guide pyramid, meal planning. Eating food: smell, taste, satiety.

Water: functions, sources, regulation in body, dietary requirements, content in food.

Carbohydrates: types, role in body, dietary fiber, sweeteners, dietary requirements, content in food.

Fats and oils: types, functions, dietary requirements, content in food, fat substitutes.

Proteins: amino acids, protein synthesis, classification, functions, quality of proteins, dietary requirements, content in foods. **Vitamins:** classification, role in body, content in food. **Mineral elements:** types, requirements, sources, functions.

Digestion: alimentary tract, digestive juices, secretions.

Absorption and metabolism of nutrients: carbohydrates, protein, lipids.

Nutrient and dietary deficiency disorders: malnutrition, obesity, coronary diseases, diabetes, lactose and gluten intolerance, dental caries – symptoms, causes, prevention.

Books Recommended

Geissler, C. and Powers, H. 2010. Human nutrition. Churchill Livingstone, London, UK.

Awan, J.A. 2007. Elements of food and nutrition. Unitech Communications, Faisalabad- Pakistan.

Semester 6

PHS-504	Reproductive Physiology	3 (2-1)
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Objectives:

- To know the hypothalamic control and role of FSH and LH in relations of gonadal hormones.
- To understand the stages of spermatogenesis and functions of testosterone.
- To know the phases of ovarian and uterine cycles and their correlation.
- To understand the process of fertilization, Implantation, placental function,
- To understand the process of parturition and lactation.

Introduction: Gender; identity and sexuality, role of gonadotrophic hormones in puberty and maturation of hypothalamic-pituitary gonadal axis. Reproductive states in aging.

Male Reproductive System: Hormones of testis their functions, spermatogenesis and their hormonal regulation.

Female Reproductive System: Hormones of the ovaries; Ovarian cycle, endometrial cycle; Amenorrhea, dysmenorrhea, post menopausal syndrome.

Pregnancy, Parturition and Lactation: Coitus and fertilization, Implantation, Maternal recognition of pregnancy, response and maintenance. Placental functions, Development of breast and lactation, stages of parturition.

Regulation of Reproductive hormones: Testosterone, estrogen, progesterone, HCG, somatomammotropin, oxytocin, prolactin etc.

Fertility and infertility: Azospermia, Oligospermia, impotency. polycystic ovaries, Hormonal deficiency.

Practical:

1. To study the histology of male and female reproductive organs with the help of models/3D animation/slides.
2. Study of female reproductive cycle through vaginal smear in mice.
3. To observe the morphology of spermatogenic cells in testicular tissue.
4. To observe the motility of sperms.
5. To study different stages of the estrous cycle.
6. The study the Influence of gonadectomy on the target tissue in animal model.
7. To perform pregnancy test through strip method in urine.
8. To determine the metabolic pattern (BMR, BBT) in different stages of menstrual /estrous cycle.

Recommended Books:

Greenspan, F. S. and Stewler, G. J. Basic and Clinical Endocrinology. Prentice-Hall, New York. 2001. (Recommended Textbook)

Knobil, I. and Neill, J. The Physiology of Reproduction. Raven Press, New York, 2005.

Molina, P. E. Endocrine Physiology. McGraw-Hill, Boston, 2003.

Wilson, J. D., Foster, D. W., Larsen, PR and Kronenberg, H. Williams Textbook of Endocrinology. W. B. Saunders, Philadelphia, 2002.

Kacsoh, B. Endocrine Physiology. McGraw-Hill, Boston. 2000.

Objectives:

- To provide understanding of various sensory apparatus, their location, structure and functions.
- To inculcate the understanding of various sensory modalities their transduction, transmission and sensations.

- To understand the pathways for the transmission of sensory signals from sense organs towards brain with respect to excitation and inhibition.
- To study molecular mechanisms in generation of receptor potentials.

Introduction: Receptors and sensations, sensory coding, transduction, types of receptors, mechanism of sensory adaptation, somatic and special senses.

Somatic Sensations: Pain; types, receptors, transmission of signal to CNS and causes of pain, Headache and thermal sensations.

Tactile Sensation: Sensory modalities, types of receptors and central projections, neural responses from smaller afferents, receptive fields, lateral inhibition, central responses.

Proprioception: Muscle spindle; Golgi tendon organ, ultra structure and function, vestibular apparatus; ultra-structure and function.

Gustation: Primary sensations of taste, threshold for tastes, taste buds and their functions, transmission of taste signals, transduction mechanism and taste preference.

Olfaction: Olfactory cells; structure, mechanism of excitation and adaptation, central olfactory projections and psychophysics of smell, transduction mechanisms and olfactory pathway.

Visual System: Optics of vision: Physical principles of optics; refraction of light and application of refractive principles to lenses, optics of eye; mechanism of accommodation, image formation. Eye, photoreceptor and neural function of retina; photochemistry of vision and color vision mechanisms of adaptation and visual acuity and factors affecting visual acuity, visual pathways; function of lateral geniculate nucleus and visual cortex, fields of vision and eye movements and their control, visual localization and, autonomic control of accommodation and pupillary aperture.

Auditory System: Structure of ear (external, middle and internal), nature of sound and sound spectra, Fourier analysis by cochlea and responses from auditory fibers, spatial localization of sound and determination of loudness, Impedance matching, functional organization of central auditory pathways.

Practicals:

1. Study of pupillary, cutaneous and kinaesthetic reflexes in human.
2. Determination of visual acuity of human subject by using Snellen's and Jagger's eyes chart.
3. Determination of visual field by perimetry.
4. To assess the colour vision by wooltest and Ishihara chart.
5. To locate Gustoreceptors present on human tongue by using chemical methods.
6. Determination of hearing ability of human subject by using air conduction, bone conduction and sound perception methods.
7. To observe various physiological phenomenon's related with the focusing of light on the retina of human eye in a simulated model.

8. Locate and plot the boundary of the blind spot of eye using the computer-simulated program.
9. To distinguish the different odors by examining various samples.
10. Experiments related to sensory adaptations.

Recommended Books:

Guyton, A. C. and Hall, J. E Textbook of Medical Physiology. W. B. Saunders Co., 2005.

(Recommended Textbook).

Carpenter, R. H. S. Neurophysiology, Oxford University Press, 2000.

Ganong. Review of Medical Physiology

Berne, R. M. and Levy, M. N. Physiology. Mosby Yearbook, 1992.

PHS-508	Comparative Physiology	3 (2-1)
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Course Vision:

- To acquire a comparative knowledge of various important systems in different vertebrates.
- To understand the functional diversity and phylogeny.
- To understand the differences in energy production, utilization and its uses in various functions.

Course Contents:

Introduction: Theme, diversity and phylogeny

Circulatory system: Open and closed circulation, comparative functional heart morphology Neurogenic and myogenic heart, cardiovascular response to extreme environmental condition, regulation of circulatory system.

Respiration: Comparative respiratory system morphology and pigments Gas exchange and distribution, diving bradycardia response Regulation and adaptation to extreme environmental conditions.

Body fluids: Osmoregulation, osmoregulators and osmoconformers Osmoregulation in aquatic and terrestrial environment.

Energy: Acquiring energy, feeding methods, Nutritional requirements and adaptation of alimentary system, ruminant digestion, Energetics of different modes of locomotion (swimming, flying, running), Biological rhythm: Rhythms in different groups.

Temperature: Thermal biology, Physiological classification using thermal biology, temperature compensations in ecto-, endo- and hetrotherms.

Nervous system: A comparative overview of neuronal structure, function and organization.

Sensory reception: Comparative aspects of general, chemo-, mechano-, thermo- and photo-reception.

Glands and Hormones: comparative aspects of hormonal responses in various groups.

Practical:

1. To compare the differences in the respiratory structures in different species.
2. To record the differences in the contractile activity of the gastrocnemius muscles of a reptile, amphibian and mammal.
3. To compare the differences in the locomotory behaviour of mammals and reptiles with respect to the role of their skeletal muscles.
4. To compare cardiac rate and force among different vertebrates.
5. To compare the adaptations in the digestive tracts of various vertebrates.

Books Recommended:

Kenneth V. Kardong. Vertebrates: Comparative Anatomy, Function, Evolution, 6th Ed. (2011). Amazon, USA.

Comparative Physiology, Natural Animal Models And Clinical Medicine By Michael A Singer. 2007. World Scientific. Canada.

Randell, D., Burggen, W. and French, K. Eckert Animal Physiology. 5th ed, W. H. Freeman and Co. New York, 2002.

BCH-608	Clinical Biochemistry	3 (2-1)
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Relevant to Concerned Department

BIT-405	Introduction to Biotechnology	3 (2-1)
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Relevant to Concerned Department

SAT-507	Biostatistics	3 (3-0)
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Relevant to Concerned Department

Semester 7

PHS-601	Electrophysiology	3 (2-1)
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Objectives:

- To understand the basis of electrical activity produced in human body.
- To provide the knowledge of equipment's used in electrical recordings.
- To provide an understanding of various methods required for electrical recordings; by using different types of excitable tissues/cells.

Introduction: Concepts of Electricity: electric charge, electric field, electric current & Ohm's law, direct, alternating, and pulsed current.

Physiology of Excitable Cells: Passive Electrical Properties of Membranes: Resistance & Capacitance. Action Potentials: generation, propagation, stimulation by depolarizing agents, perfusion and gating. Voltage Clamp: rationale and methods, separation of currents, conductance changes, reconstruction of the action potential. Effect of Fiber **Geometry:** cable properties of elongated cells, determinants of conduction velocity, velocity vs. diameter, extra-cellular stimulation and recording.

Voltage Gated Channels: Na Channels: pore and selectivity, pharmacology of Na channels, gating in Na channels, the Na channel protein. Ca Channels: gating and action potentials, selectivity and block. K Channels: diversity in gating, conductance, selectivity, and block.

Receptor Mechanism: Receptors as transducers, Differential sensitivity of receptors, properties of generator potentials in different receptors, site and generation of action potential. Receptor adaptation, spike discharge, Intensity-frequency relationship and information coding mechanism of repetitive firing, Discharge of tonic & phasic receptors.

Instrumentation: Characteristics and Components of Electrotherapeutic Stimulation Systems: signal generator, types of stimulators, stimulation electrodes (placement, orientation, size and shape). Characteristics and Components of devices used in electrophysiology: extra-cellular recording technique, surface and subcutaneous electrodes.

Electrical Stimulation of Muscles; Technique and applications: Muscle Plasticity in response to Electrical Stimulation, Instrumentation for Neuromuscular Electrical Stimulation (NMES), NMES to augment Strength and Endurance, Functional Neuromuscular Electrical Stimulation, Precautions and Contraindication for NMES.

Electromyography: Introduction, Nerve Stimulation Unit, Nerve Stimulation Studies; definitions of terms, procedures, sensory, latency, H-reflex, F-wave M response, NMJ studies. Needle electromyography: technique, sites for testing, normal and abnormal potentials. Electro diagnosis: technique, normal and abnormal potentials, artifacts and source of errors.

Electroencephalography: Physiological basis of EEG, Technical requirement for EEG and its basic, Normal EEG pattern, Activation method, Spikes and sharp waves, slow activity, cerebral death studies, neonatal EEG.

Polysomnography: Physiological basis of sleep & sleep disorders, Technical aspects and Interpretation of polysomnography.

Practical:

1. To record resting membrane potential from isolated animal muscle or nerve fiber using glass capillary microelectrode on oscilloscope or power lab.
2. To understand the biophysical & cable properties of membrane using its electrical model through multimedia presentation.
3. To record action potential using extracellular electrodes from an isolated sciatic nerve of frog/rabbit/Uromastix using chart recorder or power lab.

4. To demonstrate the use of voltage clamp technique, its main equipment, and accessories using multimedia presentation.
5. To record the sodium and potassium currents using respective channel blockers (tetrodotoxin & tetra ethyl ammonium ions) through Voltage clamp technique in an electrophysiology lab or through multimedia presentation.
6. To explain the types of micropipette and their use in voltage clamping and recordings of electrical potentials from individual ionic channels, use of channel blockers; in electrophysiology lab or through multimedia presentation.
7. To understand the differences between fast adapting (Paccinian Corpuscle) and slow adapting (Muscle Spindle) receptors using multimedia presentation.
8. To demonstrate the use of electrotherapeutic stimulation devices in physiotherapy in an electrotherapy lab or through multimedia presentation.
9. To demonstrate the use of NMES devices for the recording of nerve conduction velocities, H-reflex, F-wave, M-response and electromyography (surface/needle) in a neurology laboratory.
10. To demonstrate the use of electroencephalograph for the recording of various EEG waves and their clinical importance/application with respect to sleep studies.

Recommended Books:

Clinical Electrophysiology, Lynn Synder & Andrew J. Robbins, Williams & Wilkins, 1989. (Recommended Textbook).

Manual of Electroneuromyography, (2nd ed.), Hyman L. & Joel Brumlik, Harper & Row, 1976.

Practical Electromyography, (2nd Ed.), Ernest W. Johnson, Williams & Wilkins, 1988

Textbook of Physiology: Excitable Cells & Neurophysiology (21st ed.), Patton, Fuchs, Hille, Scher, Steiner, W.B Saunders, 1989

Textbook of Medical Physiology, (10th ed.), C. Guyton & J. E. Hall, W. B Saunders, 2000.

PHS-603	Physiology of Health, Fitness and Exercise	3 (2-1)
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Objectives:

- To understand the importance of exercise and balanced nutrition.
- To correlate exercise with energy production and consumption.
- To understand the effect of exercise in different physiological conditions.

Introduction: The basis of human performance, macro and micronutrients.

Bioenergetics: Biological energy transformation, Mechanisms of energy transfers in body during rest and exercise, energy expenditure during walking, jogging, running and swimming, individual differences in energy requirements.

Energy Metabolism: Rest-to-exercise transition, metabolic responses, factors governing fuel selection.

Regulations during Exercise: Respiration and acid base balance, Circulatory, muscular and endocrine adaptation. Temperature regulation.

Energy Enhancement: Training for anaerobic and aerobic power, muscle strength and training; Special aids for training to enhance performance. Exercise performance and environmental stress. Exercise at high altitude, thermal stress, stress in diving and microgravity. Effects of overweight and obesity on performance and weight control.

Practical:

1. Epidemiological surveys related to pattern of health and disease
2. Designing exercise and nutrition program.
3. Experiments to evaluate cardiorespiratory fitness.
4. Health estimation parameters in; games, strenuous exercise, climbing, swimming and jogging.
5. To measure body mass index.

Recommended Books:

- McArdle, W. D., Katch, F. I. and Katch, V. L. Exercise Physiology: Energy, Nutrition and Human Performance. Lippincott Williams and Wilkins, Baltimore. 2001. (Recommended Textbook).
- Powers, S. K. and Howley, E. T. Theory and applications to fitness and Performance. Brown and Benchmark. 1997.

PHS-607

Pathophysiology

3 (2-1)

Objectives:

- To understand the physiological basis of different pathological disorders.

Introduction: Basic concepts of pathophysiology. Phenomena of alterations in human physiologic function and the resulting human response. Molecular basis of Pathophysiology. The disease process.

Disorders of Blood: Red and White Blood Cells Disorders, Disorders of Coagulation. Disorders of, Inflammation and the Immune Response, Hypersensitivity Disorders and Immune Deficiencies.

Cardiovascular Disorders: An overview on ischemic, valvular and congenital disorders. Hypertension and cardiac failure and shock.

Gastrointestinal Disorders: Disorders of GIT motility: diarrhea, constipation, intestinal obstruction, irritable bowel syndrome. Peptic ulcer disease. Vomiting & nausea.

Disorders of liver & gall bladder: Hepatitis, gallstones, jaundice, cirrhosis.

Respiratory Disorders : Obstructive and restrictive lung diseases.

Renal Disorders: Urinary tract infections, renal calculi. Renal failure, glomerulonephritis, nephrotic syndrome.

Musculoskeletal Disorders: Muscular dystrophies, kyphosis, scoliosis.

Nervous Disorders: Functional abnormalities of higher nervous system. Headache, migraine and sleep disorders. Cerebrovascular accidents and paralysis.

Skin Disorders: Dermatitis, eczema, acne, keratosis, vitiligo, skin burns.

Practical:

1. An overview of collection, handling and preservation of pathological samples.
2. Comparison of health and disease states of different body tissues and organs with the help of slides or charts.
3. Liver function test of pathological samples.
4. Renal function test for pathological sample.
5. Detection of abnormal constituents of Urine.
6. To determine (quantitative) blood urea nitrogen in the provided pathological sample for the detection of Uremia.
7. To understand X-ray, MRI, ultrasonographic reports.

Recommended Books:

Robbins Basic Pathology. 7th Ed., Vinay Kumar, Ramzi's Cotran, Stanley L Robbins. W. B Saunders USA, 2003. (Recommended Textbook).

Essentials of Pathophysiology. 3rd edition. Carol Porth, Kathryn J., Gaspard and Kim A., RN Noble. Lippincott.

Review of Medical Physiology 22nd Ed., William F. Ganong. Mc Graw-Hill. USA. 2005

General and Systemic Pathology. 2nd ed., J. C. E. Underwood. Churchill Livingstone UK.1998.

Cecil Essential of Medicine. 6th ed., Thomas A. Andreoli, Charles C. J. Carpenter, Robber C. Griggs, Joseph Loscalzo. Saunders NOIDA U.P. 2004

Davidson's Principles and Practice of Medicine.18th Ed., Christopher Haslett, Edwin R. Chilvers, John A. A. Hunter, Nicholas A. Boon. Churchill Livingstone Press. UK. 2001.

PHS-609	Research Methods in Biosciences	3 (3-0)
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- Introduction to Research
- Types of Research
- Introduction to qualitative research: Sampling and data collection in qualitative research. Analysis
- Introduction to quantitative research: Sampling, data collection and analysis
- How to make a research question
- Choosing the best methodology: Validity, Variable, control and experimental groups, Blinding, confounding variables
- Writing literature Review
- Writing Research Proposal

- Statistical Analysis
- Thesis Writing: Research Question, Literature Review, Methodology, Findings, Further Research
- Paper Refunding
- Working on an oral presentation

PHS-613

Biomedical Laboratory Diagnostics

3 (1-2)

Course Vision:

- To provide an understanding of clinical aspects of major disorders and basic concepts of diagnostic techniques.
- To develop a plan for the diagnosis, treatment and prevention of the clinical disorders.

Course Contents:

- Introduction to clinical Physiology and diagnostic approach
- Clinical guidelines for diagnosis, clinical features and diagnosis of cardiovascular diseases (e.g., hypertension, heart failure), pathophysiology and diagnosis of asthma, chronic obstructive pulmonary disease, pulmonary fibrosis, pneumonia, clinical aspects of renal diseases (e.g acute kidney injury, chronic kidney disease), sign, symptoms and lab test, diagnosis and clinical aspects of gastrointestinal disorders (e.g., peptic ulcer disease, inflammatory bowel disease), neurological disorders (e.g., stroke, multiple sclerosis), clinical features and diagnosis of developmental and genetic disorders, musculoskeletal disorders (e.g., osteoporosis, myopathies), metabolic disorders and diagnostics.
- Aging and senescence, hyper function & hypofunction of the glands; altered tissue response, tumors & other causes of endocrine disorders. approach to the patient with endocrine disease: general & special features of endocrine illness: history, sign, symptoms and lab tests, etiology & clinical features of hypothalamic disorders. hypopituitarism; hyperpituitarism: acromegaly & gigantism, hyperprolactinemia. disorders due to alteration in gonadotropins and corticotropin secretion, diabetes insipidus, syndrome of inappropriate secretion of ADH, adverse effects of iodide, goitrogens; euthyroidism, nontoxic goiter. hyperthyroidism; effects of thyrotoxicosis, Grave's disease, hypothyroidism: myxedema and cretinism, thyroiditis, thyroid cancer; thyroid hormone resistance syndromes.
- Andrology, gynecology and infertility
- Infectious disease diagnostics
- Clinical biochemistry

- Introduction to internal medicine and intensive care
- Prevalence, methods of determination of obesity, causes, endocrine & metabolic consequences of obesity.

Practical:

- To record and study ECG.
- Phlebotomy and preservation of blood sample, to determine complete blood count.
- To study various procedures for collection and preservation of urine specimens for urinalysis.
- Spectrophotometric examination of the urine and blood sample (Ascorbic acid, Iron, Glucose, Uric acid, Proteins).
- To determine blood urea and creatinine.
- To measure/calculate the lung volumes and capacities by spirometer/vitalograph.
- Study of endocrine glands in different pathological states with the help of prepared slides.
- Approach to the patient with different diseases: group discussion on case studies.
- To perform an impaired glucose tolerance test in humans.
- To determine the parameters of obesity, body mass index, waist hip ratio, skin fold thickness.
- To determine the markers of bone formation (serum alkaline phosphatase) and bone resorption (serum and urinary calcium and hydroxy proline) in patients with bone disorders such as osteoporosis & others.
- X-rays and ultrasonography.

Recommended Books:

- Endocrinology: Basic and Clinical Principles, 2nd Edition. Robert K. G. de Groot, Shlomo Melmed, and Kenneth S. Polonsky. Cambridge University Press. 2023.
- Endocrinology and Metabolism: Principles and Practice, 2nd Ed. Lisa M. Hark and Joseph L. Fins. Springer. 2022.
- Pathophysiology: A Clinical Approach, 5th Edition. E. L. Frizell, R. J. Bailey, and A. L. Carr. McGraw-Hill Education. 2023.
- Principles and Practice of Medicine, 20th Ed. William E. Stoney, C. J. McMahon, and P. H. Thorpe. Elsevier. 2022.

Semester 8

INT-631	Internship	3 (0-3)
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PHS-634	Seminar	1 (0-1)
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