

**REVISED CURRICULUM
OF
PHYSIOLOGY**

Curriculum Development Project
Sponsored by
Ministry of Science and Technology
Islamabad



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2002

CURRICULUM DIVISION, UGC

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*Composed by **Ghafoor Ahmad**, UGC, Regional Centre, Lahore*

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed University Grants Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the 44th Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The National Curriculum Revision Committee on Physiology in its meeting held in May, 2002 at the U.G.C. Regional Centre, Lahore finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
ADVISER (C&T)

May, 2002

INTRODUCTION

A meeting of National Curriculum Revision Committee in Physiology to prepare the curriculum was held from January 2-4th, 2002 at UGC, Regional Centre Lahore. The following attended:

1. Prof. Dr. Masood Qureshi
Department of Physiology
University of Karachi, Karachi. Convener
2. Dr. Maqsood Ahmad
Associate Professor,
Department of Physiology
B. Z. University, Multan. Member
3. Prof. Dr. M. Shoaib Akhtar
Deptt. of Physiology & Pharmacology
University of Agriculture, Faisalabad. Member
4. Mr. Zakirullah
Gomal University, D.I. Khan Member
5. Dr. S. A. Malik
Quaid-e-Azam University,
Islamabad. Member
6. Mrs. Tasneem Farasat,
Department of Physiology
Lahore College for Women, Lahore. Member
7. Mr. Tahir Umar
Assistant Professor,
Government College, Lahore. Member
8. Ms. Saleema Bashir
Govt. Kinnaird College, Lahore. Member
9. Mr. Zahid H. Sididqui
Govt. F.C. College, Lahore. Member

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|----|---|------------------|
| 4. | Mr. Zakirullah
Gomal University,
D.I. Khan | Member |
| 5. | Dr. S. A. Malik
Quaid-e-Azam University,
Islamabad. | Member |
| 6. | Mrs. Tasneem Farasat,
Department of Physiology
Lahore College for Women, Lahore. | Member |
| 7. | Mr. Tahir Umar
Assistant Professor,
Government College, Lahore. | Member |
| 8. | Ms. Saleema Bashir
Govt. Kinnaird College, Lahore. | Member |
| 9. | Prof. Dr. M. Shoaib Akhtar
Deptt. of Physiology & Pharmacology
University of Agriculture, Faisalabad. | Member/Secretary |

Mr. Tahir Ali Shah, Assistant Director Curriculum (S &T), University Grants Commission, Islamabad coordinated the committee.

Prof. Dr. Masood Qureshi, University of Karachi, Dr. Fazal Subhan, Director/Principal Scientific Officer, Public Health Division, (NIH), Islamabad and Mr. Zahid H. Sididqui, F.C. College, Lahore could not attend the meeting.

Meeting started with recitation of versus from the Holy Quran.

Mr. Muhammad Riaz Cheema welcomed the members of the committee on behalf of Chairman, UGC. The Director explained to the committee that only framework of the curriculum was drafted in the preliminary meeting of the committee on 2-4th January, 2002 while outlines of courses were to be provided by Prof. A. M. Cheema,

Secretary of the NCRC. Despite best efforts it was received on 19th May, 2002, therefore, it could not be circulated among the members of the committee for taking their comments.

Prof. Dr. Ghulam Mustafa Seehar also sent his draft curriculum through curriculum Division, Islamabad. He again updated the same, which was put in the folders for consideration by the committee.

The Director requested the members to visit the local publishers for addition of latest editions in the curriculum.

In the absence of Dr. Masood Qureshi, the committee unanimously appointed Prof. Dr. A. Majeed Cheema, University of the Punjab, Lahore as Convener and Prof. Dr. M. Shoaib Akhtar, University of Agriculture, Faisalabad as Secretary of the NCRC in the final meeting then the regular agenda was taken by the committee. The committee finalized the scheme of studies and detail of courses for B.Sc(Hons) Three years degree, M.Sc. (One Year), B. Sc. (Pass) Two Years, M.Sc. (Two Years), M. Phil. and Physiology courses for B. Pharmacy students as under.

**SCHEME OF STUDIES
FOR
B. Sc. Honours Three Years Degree Course**

Eligibility: Higher Secondary School Certificate
(Pre-Medical/Pre-Engineering)

Year 1 Semester-I

English Language	2
Pakistan Studies	2
Mathematics/Biology	2
Fundamentals of Physiology	3
Lab Fundamental of Physiology	1
Minor Subject 1 Course	2
Lab Subject 1 Course	1
Minor Subject 2 Course	2
Lab Subject 2 Course	1
	Sub Total: 16

Semester-II

English Language	2
Islamiyat	2
Prokaryotic Physiology	2
Lab Prokaryotic Physiology	1
Plant Physiology	2
Lab Plant Physiology	1
Minor Subject 1 Course	2
Lab. Subject 1 Course	1
Minor Subject 2 Course	2
Lab Subject 2 Course	1
	Sub Total: 16

Year 2 Semester-III

Biostatistics	2
Neuroanatomy	2
Neurophysiology	2
Sensory Physiology	2
Lab Neurophysiology	2
Minor Subject 1 Course	2
Lab Subject 1 Course	1
Minor Subject 2 Course	2
Lab Subject 2 Course	1
	Sub Total: 16

Semester-IV

Musculoskeletal System	2
Lab Musculoskeletal System	1
Cardiovascular System	3
Lab Cardiovascular System	1
Pulmonary System	2
Lab Pulmonary System	1
Minor Subject 1 Course	2
Lab Subject 1 Course	1
Minor Subject 2 Course	2
Lab Subject 2 Course	1

Sub Total: 16

Year 3 Semester-V

Gastroenteropancreatic System	2
Lab Gastroenteropancreatic System	1
Excretory System	2
Acid Base Balance	2
Lab Excretory System & Acid Base Balance	1
Endocrine System	3
Lab Endocrine System	1
Reproductive & Developmental Physiology	2
Lab Reproductive & Developmental Physiology	1
Fundamental of Pharmacology	2
Lab Fundamental of Pharmacology	1

Sub Total: 18

Semester-VI

Bioinformatics & Computer Application	2
Environmental Physiology	2
Lab Environmental Physiology	1
Physiology of Health Fitness & Exercise	2
Lab Physiology of Health Fitness & Exercise	1
Molecular Genetics	2
Toxicology & Radiation Biology	2
Physiological Techniques	2
Behavioural Physiology	2
Pathological Physiology	2

Sub Total: 18

Grant Total: 100

Minor Subjects: Minor subject of Biochemistry is mandatory.
Other Minor Subjects may be chosen from the following or other available subjects.

- Microbiology
- Genetics
- Biotechnology
- Pharmacology
- Biophysics
- Immunology
- Toxicology
- Zoology
- Parasitology
- Pathology
- Marine Biology
- Fish Physiology
- Livestock Physiology

DETAIL OF COURSES

YEAR 1

SEMESTER I

ENGLISH LANGUAGE (2 Credit Hours).

PAKISTAN STUDIES (2 Credit hours)

MATHEMATICS/ BIOLOGY (2 credit hours)

Introduction to science of biology.

Chemical basis of life: Carbon & molecular diversity; Structure and function of macromolecules (carbohydrates, lipids, proteins and nucleic acids); Overview of metabolism (glycolysis, Krebs's cycle, electron transport chain).

The cell: Cellular diversity Cell organelles (Endoplasmic Reticulum, Ribosomes, The Golgi's apparatus, Lyso-somes, Vacuoles, Chloroplast, Mitochondria, Microfilaments, Cilia and flagella); Membranes and functions Transport of molecules across membranes; The nucleus; Cell reproduction.

The continuity of life: Mitosis and meiosis. Introductory account of mechanism of inheritance: Mendelian laws of inheritance.

Mechanism of evolution: Brief concept of Lamarkism, Darwinism and recent concept.

Biological diversity: Major groups of plants and animals. 1. Viruses and prokaryotes 2. The protist 3. The fungi . 4. The seedless plants 5. The seed plants. The animal kingdom: acoelomates, proto-stomes, and deuterostomes.

Plant form and function: Structure, growth, transport, nutrition, reproduction and development. Control systems in plants.

Animal form and function: Structure and function in nutrition, circulation, gas exchange, defense system, homeostasis, nervous system, chemical signals, reproduction and development.

Ecological considerations: Ecosystem components with distribution and adaptation of organisms.

Book recommended:

Biology 2002 Campbell, N. A. The Benjamin/Cummings Publishing Company, Inc. Menlo Park, California, USA

FUNDAMENTALS OF PHYSIOLOGY (3 Credit hours)

Status of physiology in life sciences.

The relationship of physiology with other allied disciplines.

The disciplines in physiology.

The significance of study of physiology.

The central theme of study of physiology: Structure and function, Adaptation, acclimatization, homeostasis, feed back systems, conformity and regulation.

Information and literature of physiology.

Experimentation in physiology.

The excitable systems: Nerve and muscle; general concepts of ionic basis of excitability of membranes; chemical basis of communication among cells, synaptic transmission. **Chemical communication and hormones.**

Receptors for signaling transduction of cellular responses.

Movement and locomotory system: Muscle, cilia, flagella, motor proteins in locomotion and their interaction.

The systems of nutrition, circulation and respiration in transfer of carbon chain and transfer of chemical energy from outer environment to cell. The elimination of waste by excretion.

The interaction of organism with environment: The sustainability of organisms in varied osmorgulatory and temperature conditions.

Coordination of function by neuronal and chemical regulation.

Gender interactions and reproduction for continuity of species.

Diversity in function and evolutionary perspectives.

LAB FUNDAMENTALS OF PHYSIOLOGY (1 Credit hour)

Experiments demonstrating excitability of tissues, communication among cells. membrane transduction, carbon flow in nutrition, circulation and respiration. Interactions among systems and environments and diversity of functions.

Books recommended:

Eckert Animal Physiology. Mechanisms and adaptations. 2002. Randall, D., Burggren, W. and French, K. W. H. Freeman and Company, New York.

Textbook of Medical Physiology. 2001. Guyton, A. C. and Hall, J. E. W. B. Saunders Company, Philadelphia.

Review of Medical Physiology. 2001. Ganong, W. F. Prentice-Hall International Inc. New Delhi.

Principles of Physiology. 2000. Berne, R. M. and Levy, M.N. Mobsy, St Louis.

MINOR SUBJECT 1 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 1 COURSE (1 Credit Hour)

MINOR SUBJECT 2 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 2 COURSE (1 Credit Hour)

Total Credits of Semester I = 16

SEMESTER II

ENGLISH LANGUAGE (2 Credit hours)

ISLAMIAT (2 Credit hours)

PROKARYOTIC PHYSIOLOGY (2 credit hours)

Properties and behavior of bacteria with respect to their chemical and physical requirements for sustainability and reproduction.

Metabolic pathways

Protein export

Chemiosmosis and multiple transport system.

Functions of bacterial membrane and antibiotic resistance mechanism.

Principles of enzyme action.

Fermentation respiration.

Novel bacteria pathways and biotransformation.

Status and nature of virus in life system.

Multiplication, lysogeny, episomy, and transducing bacteriophages, Interference with viral multiplication.

LAB PROKARYOTIC PHYSIOLOGY (1 credit hours)

Bacterial culture, Experiments to explore applied aspects of microbial physiology and identification of bacteria.

Book/s Recommended:

The Physiology and Biochemistry of Prokaryotes. 1999. White, D. Oxford University Press, Oxford.

Microbial Physiology and Metabolism. 1999. Caldwell, D. R. Star Bop. Co.

Elements of Microbiology. Pelczar, M. J., and Chan, E. C. S. 1981. McGraw-hill book Company, Aukland.
Advances in Microbial Physiology. [David W. Tempest](#). 1994. Academic Press, Inc.

PLANT PHYSIOLOGY (2 credit hours)

Introduction: The Organization of Plants and Plant Cells.

Plants, water and minerals: Plant Cells and Water, Water Relations of the Whole Plant, Plants and Inorganic Nutrients, Roots, Soils, and Nutrient Uptake, Plants and Nitrogen.

Plants, energy, and carbon: Light and Pigments: An Introduction to Photobiology, Leaves and Photosynthesis, Bioenergetics and the Light-Dependent Reactions of Photosynthesis, Photosynthesis: Carbon Metabolism, Translocation and Distribution of Photoassimilates, Cellular Respiration: Retrieving the Energy in Photoassimilates, Carbon Assimilation and Productivity, Molecules and Metabolism.

Regulation of plant development: Patterns in Plant Development, The Role of Hormones in Plant Development, Biochemistry and Mode of Action of Hormones, Photomorphogenesis--Responding to Light, Plant Movements--Orientation in Space, Measuring Time: Photoperiodism and Rhythmic Phenomena, Temperature and Plant Development.

Stress physiology and biotechnology: The Physiology of Plants under Stress, Plant Physiology and Biotechnology.

LAB PLANT PHYSIOLOGY (1 credit hour)

Experiments to study various physiological phenomena in the plants.

Book Recommended:

Introduction to Plant Physiology, 1998. [Hopkins](#), W.G. John Wiley and Sons, New York.

MINOR SUBJECT 1 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 1 COURSE (1 Credit Hour)

MINOR SUBJECT 2 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 2 COURSE (1 Credit Hour)

Total Credits of Semester II = 16

YEAR 2

SEMESTER III

BIOSTATISTICS

(2 Credit Hours)

Introduction: Scientific Method; The Aims of Medicine, Science, and Engineering; The Roles of Models and Data; Deterministic and Statistical Models; Probability Theory and Computer Simulation; Definition: Monte Carlo simulation.

Classes of models and statistical inference: Statistical Models - the Frequency Interpretation; Some Useful Statistical Models; Narrowing Down the Class of Potential Models.

Sampling and descriptive statistics: Representative and Random Samples; Descriptive Statistics of Location; Descriptive Statistics of Variability; Other Descriptive Statistics.

Survey of basic probability: Introduction; Probability and its Basic Rules; Discrete Uniform Models and Counting; Conditional Probability; Statistical Independence; Systematic Approach to Probability Problems; Random Variables, Expectation and Variance; The Central Limit Theorem and its applications.

Introduction to statistical estimation: Methods of Estimation; Distribution of Sample Percentiles; Adequacy of Estimators; Confidence Limits and Confidence Intervals; Confidence Limits and Interval for Binomial; Comparing Estimators; The Bootstrap.

Testing hypotheses: Introduction; Some Commonly Used Statistical Tests; Types I and II Errors and (Discriminating) Power; The Simulation Approach to Estimating Power; Some Final Issues and Comments.

Basic regression and analysis of variance: Introduction; Simple Linear Regression; Multiple Linear Regression; The Analysis of Variance.

Books Recommended

Basic & Clinical Biostatistics, 2000. [Dawson](#), B.K. McGraw-Hill Professional Publishing.

Basic Statistical Methods and Models for the Sciences, 2001. [Rosenblatt](#), J. Chapman & Hall.

NEUROANATOMY

(2 Credit Hours)

Introduction and overview.
Cells of the nervous system.
Peripheral nervous system.
Autonomic nervous system.
Coverings of the central nervous system.
Ventricular system and cerebrospinal fluid.
Blood supply of central nervous system.
Spinal cord. Brain stem.
Cranial nerves and cranial nerve nuclei.
Cerebellum.
Thalamus.
Cerebral hemisphere and cerebral cortex.
Corpus striatum.
Visual system.
Hypothalamus, limbic system and olfactory system.

Book/s Recommended:

Neuroanatomy. 2000. Crossman, R and Neary, D. Churchill Livingstone, London.

NEUROPHYSIOLOGY

(2 credit hours)

Neural Mechanisms.

Communication Within Neurones: The flow of electrical current along nerves. The dependence of potential on ionic permeabilities. The dependence of ionic permeability on potential. Conduction velocity. Threshold properties. Neural codes.

Communication Between Neurones: Common features of all neurons. Sensory receptors. Synaptic transmission.

Motor Functions.

Types of Motor Control: Difficulties in studying motor systems. Motor control and feedback. The hierarchy of control.

Local Motor Control: Motor neurons, Descending pathways, Sensory feedback from muscles.

The Control of Posture: The importance of support, Vestibular contribution to posture, Visual contributions to posture, Neck reflexes, Posture as a whole.

Global Motor Control: Motor cortex, Cerebellum, Basal ganglia.

Higher Functions.

Recognition and Memory Cerebral Cortex: Prefrontal cortex, Parietal cortex, Temporal lobe.

Motivation And Behaviour: Motivation, Emotion, The hypothalamus, Sleep and cortical arousal, A Last look at the brain, Index.

LAB NEUROPHYSIOLOGY (1 credit hour)

Study of membrane potentials. Study of conduction velocity in the nerves. Experiments to study sensory and motor functions in animal models. Experiments to study behaviour in animals.

Book/s Recommended

Neurophysiology, 2002. [Carpenter](#), R.H.S., Oxford University Press., Oxford.

Neurophysiology, 2002. Blankenship. Mosby, Year Book. St. Louis, USA.

Neuroanatomy and Neurophysiology: A Review, 2002. [Jonathan, S.C.](#) (Editor [Robert L. MacDonald](#)). Thieme Medical Pub.

SENSORY PHYSIOLOGY (2 credit hours)

Sensory Functions: Skin sense. Sensory modalities. Types of receptor. Central projections. Neural responses. Central responses. Pain.

Proprioception: Muscle proprioceptors. Joint receptors. Conscious proprioception. The vestibular apparatus.

Hearing: The nature of sound. Sound spectra. The structure of the ear. Fourier analysis by the cochlea. Responses from auditory fibres. Spatial localization of sound. Central pathways and responses.

Vision: Light and dark. Image-forming by the eye. The retina. Retinal interneurons. Mechanisms of adaptation. Visual acuity. Visual form recognition. Colour vision. Visual localization. Visual proprioception.

Smell and Taste: Smell, Taste.

LAB SENSORY PHYSIOLOGY (1 credit hour)

Experiments to study cutaneous receptor sensitivity. Study of proprioception. Experiments related to hearing, visions, smell and taste.

Book/s Recommended:

Fundamentals of Sensory Physiology, 1986. Edited by [Schmidt](#), R.F., Translated by [M. A. Biederman-Thorson](#). Springer-Verlag, New York.

Neurophysiology, 2002. [Carpenter](#), R.H.S., Oxford University Press., Oxford.

Neurophysiology, 2002. Blankenship. Mosby, Year Book. St. Louis, USA.

MINOR SUBJECT 1 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 1 COURSE (1 Credit Hour)

MINOR SUBJECT 2 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 2 COURSE (1 Credit Hour)

Total Credits of Semester III = 16

SEMESTER IV

MUSCULOSKELETAL SYSTEM (2 credit hours)

The Human Machine: Elementary Mechanics, Force and Mechanics, Forms of Motion, Kinematics, Kinetics, Chapter, The Musculoskeletal System, Unicellular and Multicellular Organisms, Cellular Organization in Multicellular Organisms, Musculoskeletal System Structure, Musculoskeletal System Function.

Functional Anatomy of the Muscular and Skeletal Systems: The Skeleton, Composition and Function of the Skeleton, Terminology, The Axial Skeleton, The Appendicular Skeleton.

Connective Tissues: Functions of Connective Tissues, Ordinary Connective Tissues, Cartilage, Bone, The Articular System, Structural Classification of Joints, Joint Movements, The Stability-Flexibility Classification of Joints, Synovial Joint Classification, Flexibility, Stability, and Laxity in Synovial Joints, Chapter 6 Joints of the Axial Skeleton, The Joints Between the Vertebrae, Degeneration and Damage in the Vertebral Column, Normal Shape of the Vertebral Column, Abnormal Curvature of the Vertebral Column, Joints of the Pelvis: Sacroiliac Articulations and Pubic Symphysis. **Joints of the Appendicular Skeleton:** Joints and Joint Complexes, Shoulder Complex, Elbow Complex, Wrist Complex, Hip Joint, Knee Complex, Ankle Complex.

The Neuromuscular System: The Nervous System, Skeletal Muscle Structure, Muscle Fiber Structure and Function, Kinesthetic Sense and Proprioception, Mechanical Characteristics of Muscle-Tendon Units, Muscle Architecture and Function, Stretch-Shorten Cycle.

Forces in Muscles and Joints: Force Vectors, Lever Systems in the Musculoskeletal System, Swing and Stabilization Components of Muscle Force.

Musculoskeletal Response and Adaptation to Loading: Mechanical Characteristics of Musculoskeletal Components, Stress-Strain Relationships in Solids, Viscosity and Viscoelasticity, Active and Passive Loading.

Structural Adaptation of the Musculoskeletal System: Adaptation, Biopositive and Bionegative Effects of Loading, Response and Adaptation of Musculoskeletal Components to Loading.

Etiology of Musculoskeletal Disorders and Injuries: Kinetic Chain, Compensatory Movements, Risk Factors, References, Index, About the Author.

LAB MUSCULOSKELETAL SYSTEM (1 credit hour)

Study of the functional anatomy of muscle and skeletal system in human model and in animals. Experiments on neuromuscular conduction. Study of interaction of muscle and skeleton specifically at the joints.

Book/s Recommended

The Musculoskeletal System, 2001. [Sambrook](#), P. (Editor), [Leslie, MD Schrieber](#) (Editor), [Thomas Taylor](#), [Leslie Schrieber](#), [Tom Taylor](#), [Andrew Ellis](#). Churchill Livingstone.

Structure and Function of the Musculoskeletal System, 1999. [Watkins](#), J. Human Kinetics Pub.

CARDIOVASCULAR SYSTEM (3 credit hours)

Electrical activity of heart: Cardiac potentials, conduction of cardiac fibres, pace makers, electrocardiography, clinical features of ECG.

The Cardiac pump: Functional anatomy of heart, cardiac chambers and valves, cardiac cycle, cardiac output.

Regulation of heart beat: Control by autonomic nerve, myocardial performance and its nervous and humoral regulation.

Haemodynamics: Relationship between blood pressure and flow, resistance to flow.

The atrial system: Arterial elasticity, arterial blood pressure.

Microcirculation and Lymphatics: Functional anatomy, endothelium in regulation and transcapillary exchange, lymphatic return.

Peripheral circulation and Control: Intrinsic and extrinsic control of peripheral blood flow and balance between these factors regulation.

Control of cardiac output: Relationship between cardiac output and venous return and influence of various factor.

Coronary circulation: Functional anatomy of coronary vessels, its regulation by various factors, coronary collateral vessels.

Special circulation: Cutaneous, skeletal muscle, cerebral, pulmonary, renal and splanchnic circulations.

Interplay of central and peripheral factors in control of circulation: Exercise effect and hemorrhage.

LAB CARDIOVASCULAR SYSTEM (1 credit hour)

Experiments on various models to understand the concepts included in the theory course

Books Recommended:

Textbook of Medical Physiology. 2001. Guyton, A. C. and Hall, J. E.. W. B. Saunders Company, Philadelphia.

Cardiovascular Physiology, 2002. [Mohrman](#), D.E. and [Heller](#), L.J. McGraw Hill Text, Boston.

Cardiovascular Physiology, 2001. [Robert, M., Md Berne](#), [Matthew N., MD Levy](#), [Matthew N. Levy](#). Mosby, Inc., St. Louis, USA.

PULMONARY SYSTEM (2 credit hours)

Pulmonary Physiology: Structure and Function of the Upper Airways, Structure of the Lungs, Blood-Tissue Exchange in the Pulmonary Circulation, Partial Pressure and Diffusion of Blood Gases, Respiratory Compliance, Respiratory Muscles, Respiratory Pressures and Flows, Spirometry and Lung Volumes, The Work of Breathing, Blood-Gas Transport in the Lung, Oxygen-Hemoglobin

Binding, The Transport of Carbon Dioxide, Regulation of Pulmonary Blood Flow, Relationship of Alveolar, Ventilation to Pulmonary Perfusion, Acid-Base Relationships, Acid-Base Homeostasis.

Regulation of Pulmonary Function: Models of Respiratory Control, Respiratory Mechanoreceptors, Respiratory Chemoreceptors, Adaptive Control of Respiration.

Selected Pathophysiology of the Pulmonary System: Types of Hypoxia, Abnormal Respiratory Control Patterns, Artificial Ventilation, Chronic Obstructive Pulmonary Disease, Restrictive Lung Diseases, Congestive Heart Failure.

LAB PULMONARY SYSTEM (1 credit hour)

Experiments in respiratory mechanisms with emphasis on the concepts in theory course.

Reference Books

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J. E. W. B. Saunders Company, Philadelphia.

Pulmonary Physiology, 2002. [Levitky](#), M.G. and [Levitky](#), M.G. McGraw Hill Text, Boston.

Pulmonary System, 2001. [Grossbach](#), I. Lippincott Williams & Wilkins Publishers.

MINOR SUBJECT 1 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 1 COURSE (1 Credit Hour)

MINOR SUBJECT 2 COURSE (2 Credit Hours)

LAB MINOR SUBJECT 2 COURSE (1 Credit Hour)

Total Credits of Semester IV = 16

YEAR 3

SEMESTER V

GASTROENTEROPANCREATIC SYSTEM (2 credit hours)

Functional anatomy of gastroenteropancreatic system.

GIT segments secretion: Salivary gastric pancreatic and bile fluid secretions.

The Control of secretions: Nervous and hormonal controls of GIT secretions.

Digestion: Digestion of different nutrients, avian digestion, rumen digestion.

Absorption: Absorption of nutrients, the factors influencing the components of nutrients.

Splanchnic circulations: Alteration in circulation during absorption.

Motility: Esophageal peristalsis, motility of small and large intestine.

Regulation of motility: Regulation by peptide hormones and autonomic nervous system.

Special features of GIT: Swallowing, gastric emptying, antiperistalsis, colic pains.

Large intestine secretions: Diarrhea and constipation.

LAB GASTROENTEROPANCREATIC SYSTEM (1 credit hour)

The experiments related to the regulations of digestive secretions, nutrients absorptions and GIT motility and the factors affecting these mechanisms.

Reference Books

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J.E. W.B. Saunders Company, Philadelphia.

Gastrointestinal physiology, 2001. Jhonson, L.R. and Gerwin, T.A. Mosby Inc., St. Louis, USA.

EXCRETORY SYSTEMS (2 credit hours)

Renal Functions, Anatomy, and Basic Processes: Anatomy of the Kidneys and Urinary System, Blood Supply to the Nephrons, Categories of Nephrons, Juxtaglomerular Apparatus.

Glomerular Filtration: Intrarenal Chemical Messengers, Renal Blood Flow and Glomerular Filtration, Flow, Resistance, and Pressure in the Kidneys. Formation of Glomerular Filtrate and Direct Determinants of GFR.

Autoregulation of renal function: The factors in autoregulation: Renal Sympathetic, Angiotensin II, Intrarenal Baroreceptors, Prostaglandins and other factors.

Renal Clearance: Definition of Clearance, Plasma Creatinine and Urea Concentrations.

Reabsorption and Secretion: Transport Mechanisms in Reabsorption. Transport Mechanisms in Tubular Secretion. Bidirectional Transport. Regulation of Membrane Channels and Transporters. Renal Handling of Organic Substances. Active Proximal Reabsorption of Organic Nutrients: Glucose, Amino Acids, etc. Proteins and Peptides. Urea. Active Proximal Secretion of Organic Anions. Urate. Active Proximal Secretion of Organic Cations. Passive Reabsorption or Secretion of Weak Organic Acids and Bases. Basic Renal Processes for Sodium, Chloride, and Water. Sodium, Chloride and Water Reabsorption.

Countercurrent Multiplier System: The Role of Interstitial Urea in Balancing Collecting-Duct Urea. Countercurrent Exchange: Vasa Recta.

Control of Sodium Excretion: Regulation of Plasma Volume and Osmolarity. Control of GFR in Response to Changes in Body Sodium Content and Extracellular Volume. Control of Tubular Sodium Reabsorption. Glomerulotubular Balance. Aldosterone. Control of Aldosterone Secretion. Peritubular-Capillary Starling Factors and the Role of Renal Interstitial Hydraulic Pressure. Direct Tubular Effects of Renal Sympathetic Nerves. Direct Tubular Effects of Angiotensin II. Pressure Natriuresis. Atrial Natriuretic Factor (ANF). Antidiuretic Hormone. Other Hormones.

Control of Water Excretion: Baroreceptor Control of ADH Secretion. Osmoreceptor Control of ADH Secretion. Thirst and Salt Appetite. Renal Regulation of Potassium Balance. Regulation of Internal Potassium Distribution. Basic Renal Mechanisms. Mechanism of Potassium Secretion in the Cortical Collecting Duct. Homeostatic Control of Potassium Secretion by the Cortical Collecting Duct. Potassium Secretion and Fluid Delivery.

The Cortical Collecting Duct: Effects of Diuretics. ADH and Water Diuresis.

Comparative aspects of nitrogen excretion: The nature of excretory products in different animals and their relationship with availability of water.

ACID BASE BALANCE

(2 credit hours)

The Effects of Acid-Base Changes on Potassium Secretion, Renal Regulation of Hydrogen-Ion Balance, Bicarbonate Excretion, Bicarbonate Filtration and Reabsorption, Bicarbonate Secretion, Addition of New Bicarbonate to the Blood, (Renal Excretion of

Hydrogen ions), Hydrogen-Ion Secretion and Excretion on Urinary Buffers, Phosphate and Organic Acids as Buffers, Qualitative Integration of Bicarbonate Reabsorption and Hydrogen-Ion Excretion on Nonbicarbonate Buffers, Glutamine Catabolism and NH_4^+ Excretion, Quantitation of Renal Acid-Base Compensation, Homeostatic Control of Renal Acid-Base, Compensation, Control of Renal Glutamine Metabolism and NH_4^+ Excretion, Control of Tubular Hydrogen-Ion Secretion, Control of Bicarbonate Secretion, Specific Categories of Acid-Base Disorders, Renal Compensation for Respiratory Acidosis and Alkalosis, Renal Compensation for Metabolic Acidosis and Alkalosis, Factors Causing the Kidneys to Generate or Maintain a Metabolic Alkalosis, Influence of Extracellular-Volume, Contraction, Influence of Chloride Depletion, Influence of Aldosterone Excess and, Potassium Depletion, Regulation of Calcium and Phosphate Balance, Objectives, Effector Sites for Calcium Homeostasis, Gastrointestinal Tract, Kidneys, Bone, Hormonal Control of Effector Sites, Parathyroid Hormone, 1,25-dihydroxyvitamin D3, Calcitonin, Other Hormones, Overview of Renal Phosphate Handling.

LAB EXCRETORY SYSTEM AND ACID-BASE BALANCE

(1 credit hour)

Experiments related to excretory functional mechanisms and acid-base balance concerning the concepts in theory courses.

Reference Books

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J. E. W.B. Saunders Company, Philadelphia.

Excretory System, 1994. [Silverstein](#), A., [Silverstein](#), V.B. and [Silverstein](#), R. Twenty-first Century Books.

Renal Physiology, 2002. [Navar](#), [Vander](#), A.J. McGraw-Hill, Boston.

ENDOCRINE SYSTEM

(3 credit hours)

Functional anatomy of different endocrine glands:

Endocrine system in homeostasis:

Hormonal signaling: Hormonal signaling in coordination of molecular, cellular and tissue functions

General account of chemical nature and biosynthesis of hormones:

Transport of hormones to the site of action:

Mechanisms of hormones action: Protein and peptide hormones, steroid hormones, thyroid hormones, conceptual account of different types of signaling and transductions.

Control systems: Feedback mechanisms in hormonal homeostasis.

Hypothalamohypophyseal system: The hormones and their physiological actions of hypothalamus, anterior pituitary and posterior pituitary, their control.

Thyroid gland: Biosynthesis, physiological actions and control of hormones.

Endocrine pancreas: The principal hormones of insulin and glucagon: Their physiological action and control.

Adrenal cortex: Physiological actions and control of hormones.

Adrenal medulla: Physiological actions and control of hormones.

Other endocrine mechanisms: Accounts of pineal gland hormones, thymus hormones, atrial natriuretic hormone and hormones related to blood formation.

Clinical aspects: A brief account among different endocrine glands of their clinical manifestations.

LAB ENDOCRINE SYSTEM

(1 credit hour)

Experiments in understanding the roles of endocrine glands and their hormones in physiological functions.

Reference Books

Basic and Clinical Endocrinology, 2001. Greenspan, F.S. and Strewler, G.J. Prentice-Hall International Inc.

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

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

REPRODUCTIVE AND DEVELOPMENTAL PHYSIOLOGY

(2 credit hours)

Sex: Gender, its identity and sexuality.

Reproductive messengers: Gonadotrophic hormones, somatomammotrophic polypeptides, cytokines, steroids and other such hormones.

Mechanism of action: Gonadotrophic and steroid hormones.

Testicular functions: Hormones, spermatogenesis and endocrine factors regulating it.

Ovarian function: Hormones, folliculogenesis and endocrine factors regulating it.

Puberty and maturation of hypothalamic-pituitary gonadal axis:

Coitus and fertilization:

Implantation:

Maternal recognition in support of pregnancy:

Fetus and its preparation for birth:

Parturition:

Lactation and maternal behaviour:

Fertility and antifertility:

LAB REPRODUCTIVE AND DEVELOPMENTAL PHYSIOLOGY

(1 credit hour)

Study of the female cycle. Effects of hormones on cycle activity. Influences of gonadectomy on the targets. Metabolism pattern in different reproductive states.

Reference Books

Essential Reproduction, 2000. Johnson, M.H. and Everitt, B.J. Blackwell Science Ltd.

Basic and Clinical Endocrinology, 2001. Greenspan, F.S. and Strewler, G.J. Prentice-Hall International Inc.

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

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

Basic and Clinical Endocrinology. Greenspan, F. S. and Strewler, G. J. 2001 Edition. Prentice-Hall International Inc.

Williams Textbook of Endocrinology. Wilson, J. D., Foster, D. W., Larsen, P. R. and Kronenberg, H. 1998 Edition. W. B. Saunders, Philadelphia.

FUNDAMENTALS OF PHARMACOLOGY (2 Credit hours)

Introduction: Definition Of Pharmacology; Pharmaceutical terms used in medical practice; Drugs and drug use with ancient history; Pharmacokinetics and pharmacodynamics; Drug receptor interaction and physical interaction of drug and receptor; Drugs and cell membrane; Routes of drug administration (with advantages and disadvantages); Factors influencing drug absorption and drug action in man; Drug toxicity and dose related toxicity (with drug abuse and

drug dependence); Therapeutic index; Official Books (Pharmacopoeia); Factors affecting drug distribution (or causes); Psology

Various Groups of Drugs Used in Clinical Practice with Special Emphasis on:Classification; History, Source and Chemistry; Pharmacokinetics; Mode of action; Clinical uses; Untowards effects/Toxicity; Dosages; Antidotes

Haematinics

Anti coagulants

Vitamins

Norcotic and non norcotic analgesics

Antiseptics and disinfectants

Histamines and antihistamines

Anti cancer drugs

Anti-biotics

Diuretics

Antacid

Laxative/purgatives

Ematics and antiemetics

LAB FUNDAMENTALS OF PHARMACOLOGY (1 Credit Hour)

Experiments related to the concepts in theory cours.

Books Recommended:

The Pharmacological Basis of Therapeutics, 2001. Hardman, J.G. and Limbird, L.E. (eds.). Goodman & Gilman's. McGraw-Hill Professional Publishing.

Pharmacology: Examination & Board Review,1996. [Katzung](#), B.G., [Trevor](#), A.J. and [Trevor](#), A.G. McGraw-Hill Professional Publishing.

Pharmacology, 2001. [Rang](#), H.P., [Dale](#), M.M., [Ritter](#), J.M. and [Gardner](#), P. Churchill Livingstone.

Total Credits of Semester V = 18

SEMESTER VI

BIOINFORMATICS AND COMPUTER APPLICATIONS

(2 Credit Hours)

ENVIRONMENTAL PHYSIOLOGY

(2 credit hours)

Basic principles in environmental physiology: Nature and levels of adaptation and mechanisms of adaptations.

Osmoregulation: Water, ion and osmotic balance in animals with reference to osmoregulation and excretion, control of osmoregulation.

Energy supply: Energy budgets in animals inhabiting varied environment.

Respiratory and circulatory adaptations: Ventilating structures and associated circulatory adaptations in animals inhabiting different environment.

Temperature and its effects: Biochemical and physiological effects of temperature, temperature classification of organisms particularly animals, mechanisms of heat production, heat dissipation and heat conservations for temperature relations.

Coping with different environments: Osmotic, thermal, respiratory, sensory and reproductive adaptations in organisms inhabiting marine, shorelines and estuaries, freshwater, special aquatic habitats, terrestrial life, extreme terrestrial habitats and parasitic habitats.

LAB ENVIRONMENTAL PHYSIOLOGY (1 credit hour)

Experiment to demonstrate the adaptations in varied conditions of oxygen and water availability and temperature.

Reference Books

Environmental physiology of animals, 2000. Willmer, P., Stone, G. and Johnston, I. Blackwell Science Ltd.

Animal Physiology. Adaptations and Environment. Schmidt-Neilsen, K., 1998 Edition. Cambridge University Press, Cambridge.

Eckert Animal Physiology. Mechanisms and adaptations. Randall, D., Burggren, W. and French, K. 1998 Edition. W. H. Freeman and Company, New York.

Comparative Animal Physiology. Withers, P. C. 1992 Edition. Saunders College Publishing.

PHYSIOLOGY OF HEALTH, FITNESS AND EXERCISE

(2 credit hours)

Nutrition: The base for human performance. Macro and micro nutrients.

Energy for physical activity: Mechanisms of energy transfers in body. Energy transfer in exercise, energy expenditure during rest and physical activity, Energy expenditure during walking, jogging, running and swimming; Individual differences in energy requirements.

Systems for energy delivery and utilization: Pulmonary functions in energy delivery; Cardiovascular system and its regulation and integration in energy delivery; Skeletal muscles in energy utilization.

Endocrine systems and exercise: Acute and chronic responses in exercise.

Enhancement of energy capacity: Training for anaerobic and aerobic power, muscle strength during training, special aids to exercise training and performance.

Exercise performance and environmental stress: Exercise in high altitude, thermal stress, in diving and microgravity.

Body composition, energy balance and weight control: Over-weight obesity and weight control.

Exercise in special population: In pregnancy, aged persons, cardiovascular patients, asthmatic and other pulmonary disease patients, and cancer patients.

LAB PHYSIOLOGY OF HEALTH, FITNESS AND EXERCISE

(1 credit hour)

Epidemiological surveys related to pattern of health and disease, Designing exercise programs. Designing nutrition programs, Experiments to evaluate cardiorespiratory fitness.

Reference books

McArdle, W. D. Katch, F. I. and Katch, V. L. 2001. Exercise Physiology: Energy, Nutrition and Human Performance. 5th Edition. Lippincott Williams and Wilkins, Baltimore, USA.

Powers, S.K. and Howley, E. T. 1997. Theory and Applications to Fitness and Performance. 3rd Edition. Brown and Benchmark Publishers.

MOLECULAR GENETICS

(2 Credit Hours)

Introduction.

What is DNA?

Genes

Genome structure

Transcription and RNA

Translation and genetic code

Control of gene expression

Inheritance

Mapping of genes

Gel electrophoresis and blotting

Gene cloning and gene libraries

Polymerase chain reaction (PCR)

Sequencing and sequence analysis

The future of molecular genetics: biotechnology, transgenic and gene therapy.

Books Recommended:

Molecular Genetics, 1999. [Hancock](#), J.T. Arnold, Edward.

BMS Explained: Molecular Genetics, 1999. [Hancock](#), J.T. Oxford University Press, Oxford.

TOXICOLOGY AND RADIATION BIOLOGY

(2 Credit hours)

Toxicology

General Principles of Toxicology;

Disposition of Toxicants.

Non-Organ Directed Toxicity.

Target Organ Toxicity.

Toxic Agents.

Environmental Toxicology.

Applications of Toxicology.

Brief account of cellular and molecular mechanisms in toxicology.

Books Recommended:

Casarett & Doull's Toxicology: The Basic Science of Poisons, 2001. [Casarett, L.J.](#), [Curtis D., Klaassen, C. D.](#) (Editors), [Doull, J.](#) and [Klaassen, C.D.](#) McGraw-Hill Professional Publishing, New York.
Comprehensive Toxicology : Cellular and Molecular Toxicology, 2002. [Vanden Heuvel, J.P.](#), [Perdew, G.H.](#) and [Mattes, W.B.](#) (eds.). Pergamon Press, New York.

Radiation Biology

Basic physics; Cell survival; Repair of sublethal damage and the dose-rate effect;

Effects of radiation on chromosomes; Radiation carcinogenesis; Radiation biology of tumor subpopulations; The effect of radiations on developmental processes; The effects of radiation on the cellular components of the immune system; Acute radiation syndromes; Applications of radiation biology in nuclear medicine; Implications of radiobiology of clinical radiation therapy; The application of particle beams to radiation therapy.

Books Recommended:

Radiation Biology, 1982. [Pizzarello, D.J.](#) C R C Press Reprints.
Radiation Biology and Protection, 2001. [Forshier, S.](#) Delmar Learning.

PHYSIOLOGICAL TECHNIQUES (2 credit hours)

Physiographic techniques: Experiments on nerve and muscle excitability.

Electrocardiographic and myographic studies: Experiments on muscle and cardiac activity.

Molecular techniques: Use of microelectrodes and micropipettes in experiments for membrane potentials; Tracing molecules with radioisotopes and monoclonal antibodies.

Cellular techniques: Structural analysis of cells; Light microscopy, Electron microscopy, Cell culture.

Biochemical Analysis: Spectrophotometry, Chromatography, Electrophoresis, Southern, Northern and Western blotting.

Immunological Techniques: Enzyme-linked immunosorbent assay, Radioimmunoassay.

Immunofluorescence techniques.

References Books

Current Methods in Muscle Physiology : Advantages, Problems, and Limitations (Oxford Science Publications), 1998. Sugi, H. (Editor). International Union of Physiological Sciences. Oxford University Press, Oxford.

Methods in Cardiac Electrophysiology, 1998. Pugsley, M.K. and Walker, M.J. (Editors). CRC Press, New York.

Principles of physiological Measurement, 1986. Cameron, J.N. Academic Press, New York.

BEHAVIOURAL PHYSIOLOGY (2 credit hours)

Introduction: Understanding Human Consciousness: A Physiological Approach; The Nature of Physiological Psychology; Natural Selection and Evolution; Ethical Issues in Research with Animals; Careers in Neuroscience; Strategies for Learning.

Structure and Functions of Cells of the Nervous System: Cells of the Nervous System; Communication within a Neuron; Communication between Neurons.

Structure of the Nervous System: Basic Features of the Nervous System; The Central Nervous System; The Peripheral Nervous System.

Psychopharmacology: Principles of Psychopharmacology; Sites of Drug Action; Neurotransmitters and Neuromodulators.

Methods and Strategies of Research: Experimental Ablation; Recording and Stimulating Neural Activity; Neurochemical Methods; Genetic Methods.

Vision: The Stimulus; Anatomy of the Visual System; Coding of Visual Information in the Retina; Analysis of Visual Information: Role of the Striate Cortex; Analysis of Visual Information: Role of the Visual Association Cortex.

Audition, the Body Senses, and the Chemical Senses: Audition; Vestibular System; Somatosenses; Gustation; Olfaction; Perception of Specific Odors.

Control of Movement: Muscles; Reflex Control of Movement; Control of Movement by the Brain.

Sleep and Biological Rhythms: A Physiological and Behavioral Description; Why Do We Sleep?; Physiological Mechanisms of Sleep and Waking; Disorders of Sleep; Biological Clocks.

Reproduction Behavior: Sexual Development; Hormonal Control of Sexual Behavior; Neural Control of Sexual Behavior; Parental Behavior.

Emotion: Emotions as Response Patterns; Expression and Recognition of Emotions; Feelings of Emotions; Aggressive Behavior.

Ingestive Behavior: Drinking: The Nature of Physiological Regulatory Mechanisms; Drinking and Salt Appetite; Brain Mechanisms of Thirst and Salt Appetite; Mechanisms of Satiety.

Ingestive Behavior: Eating: Some Facts about Metabolism; What Starts a Meal?; What Stops a Meal?; Brain Mechanisms; Eating Disorders.

Learning and Memory: Basic Mechanisms: The Nature of Learning; Learning and Synaptic Plasticity; Perceptual Learning; Classical Conditioning; Instrumental Conditioning and Motor Learning.

Relational Learning and Amnesia: Human Anterograde Amnesia; Relational Learning in Laboratory Animals.

Human Communication: Speech Production and Comprehension; Brain Mechanisms; Disorders of Reading and Writing.

Schizophrenia and the Affective Disorders: Schizophrenia; Major Affective Disorders.

Anxiety Disorders, Autistic Disorder, and Stress Disorders: Anxiety Disorders; Autistic Disorder; Stress Disorders.

Drug Abuse: Common Features of Addiction; Commonly Abused Drugs; Heredity and Drug Abuse; Therapy for Drug Abuse.

Reference Books

Physiology of Behavior, 2000. Neil R. Allyn & Bacon.

PATHO-PHYSIOLOGY

(2 credit hours)

Central concepts of pathophysiology

Cells And Tissues: The Cell 1 Cellular Biology; Altered Cellular and Tissue Biology; The Cellular Environment -- Fluids and Electrolytes, Acids and Bases

Genes and Gene-Environment Interaction: 4 Genes and Genetic Diseases; Genes, Environment, and Common Diseases.

Mechanisms of Self-Defense: Immunity; Inflammation; Infection and Alterations in Immunity and Inflammation; Stress and Disease.

Cellular Proliferation – Cancer: Tumor Biology; Tumor Invasion and Metastasis; Cancer in Children.

Pathophysiologic Alterations -- Organs And Systems

The Neurologic System: Structure and Function of the Neurologic System; Pain, Temperature Regulation, Sleep, and Sensory Function; Concepts of Neurologic Dysfunction; Alterations of Neurologic Function; Neurobiology of Schizophrenia, Mood Disorders, and Anxiety Disorders; Alterations of Neurologic Function in Children.

The Endocrine System: Mechanisms of Hormonal Regulation; Alterations of Hormonal Regulation.

The Reproductive Systems: Structure and Function of the Reproductive Systems; Alterations of the Reproductive Systems; Sexually Transmitted Infections.

The Hematologic System: Structure and Function of the Hematologic System; Alterations of Erythrocyte Function; Alterations of Leukocyte, Lymphoid, and Hemostatic Function; Alterations of Hematologic Function in Children.

The Cardiovascular and Lymphatic Systems: Structure and Function of the Cardiovascular and Lymphatic Systems; Alterations of Cardiovascular Function; Alterations of Cardiovascular Function in Children.

The Pulmonary System: Structure and Function of the Pulmonary System; Alterations of Pulmonary System; Alterations of Pulmonary System in Children.

The Renal and Urologic System: Structure and Function of the Renal and Urologic Systems; Alterations of Renal and Urinary Tract Function; Alterations of Renal and Urinary Tract Function in Children.

The Digestive System: Structure and Function of the Digestive System; Alterations of Digestive Function; Alterations of Digestive Function in Children.

The Musculoskeletal System: Structure and Function of the Musculoskeletal System; Alterations of Musculoskeletal Function; Alterations of Musculoskeletal Function in Children.

The Integumentary System: Structure, Function, and Disorders of the Integument; Alterations of Integument in Children.

Multiple Interacting Systems: Shock, Multiple Organ Dysfunction Syndrome, and Burns in Adults; Shock, Multiple Organ Dysfunction Syndrome, and Burns in Children.

Reference Book

Pathophysiology: The Biologic Basis for Disease in Adults & Children, 2001. [Kathryn, L. McCance](#), [Huether](#), S.E. Mosby, St. Louis, USA.

Pathophysiology: Biological & Behavioral Perspectives, 2002. Banasik, J.L., Lee-Ellen C. Copstead. Amazon.com, Inc. or its affiliates

Total Credits of Semester VI = 18

M.Sc. (Physiology) One Year Degree Course

Eligibility: B.Sc. (Hons.) Physiology

SEMESTER I

Contemporary Physiology	3
*Specialization Course-I	2
Lab Specialization Course-I	1
* Specialization Course-II	2
Lab Specialization Course-II	1
* Specialization Course-III	2
Lab Specialization Course-III	1
* Specialization Course-IV	2
Lab Specialization Course-IV	1

SEMESTER II

Electrophysiology	3
Specialization Course-V	2
Lab Specialization Course-V	1
Thesis**	9

*Special Group: A few of specializations are mentioned. Different institutions may have others depending upon the availability of expertise.

Endocrinology-I	Molecular Endocrinology	2+1
Endocrinology-II	Clinical Endocrinology	2+1
Endocrinology-III	Comparative Endocrinology	2+1
Endocrinology-IV	Reproductive Endocrinology	2+1
Endocrinology-V	Environmental Endocrinology	2+1

Neurophysiology-I
Neurophysiology-II
Neurophysiology-III
Neurophysiology-IV
Neurophysiology-V

Environmental Physiology-I
Environmental Physiology-II
Environmental Physiology-III
Environmental Physiology-IV
Environmental Physiology-V

Reproduction-I
Reproduction-II
Reproduction-III
Reproduction-IV
Reproduction-V

**Thesis work and allocation of topic and literature survey will be started in third semester.

CONTEMPORARY PHYSIOLOGY

Contemporary studies in excitability tissues.
Contemporary studies in neurophysiology.
Contemporary studies in endocrinology.
Contemporary studies in myology.
Contemporary studies in pulmonary physiology.
Contemporary studies in cardiovascular physiology.
Contemporary studies in excretory physiology and acid base balance.
Contemporary studies in gastroenteropancreatic physiology.
Contemporary studies in reproduction.
Contemporary studies in osmoregulation.
Contemporary studies in temperature relations.

LAB CONTEMPORARY PHYSIOLOGY (1 credit hour)

Design experiments based on the concepts in theory course.

Books Recommended

Search for latest books for the above mentioned contemporary studies from internet database.

ELECTRO PHYSIOLOGY (3 credit hours)

- A) **Introduction:** Resting Potential; Action Potential; Voltage Clamp; Neurophysiological Properties of Neurons; Synaptic Potentials.

- B) **The Cuing of Attention to Visual Field Locations:** Analysis with ERP Recordings; Selective Visual Attention:

Selective Cuing, Selective Cognitive; Processing, and Selective Response Processing; Orienting Attention in the Visual Fields; An Electrophysiological Analysis; The Order of Global- and Local-Level Information Processing; Electrophysiological Evidence for Parallel Perceptual Processes; Event-Related Potentials and Stimulus Repetition in Direct and Indirect Tests of Memory; Slow Potentials During Long-Term Memory Retrieval; Event-Related Potentials Dissociate Immediate and Delayed Memory; What Is Who Violating? A Reconsideration of Linguistic Violations in Light of Event-Related Brain Potentials; ERP Negativities During Syntactic Processing of Written Words; ERP Mapping: A Tool for Assessing Language Disorders?; Threshold Variations in Cortical Cell Assemblies and Behavior; The Influence of Hand Movements on Cortical Negative; DC Potentials; Principles of Electrogenesis of Slow Field Potentials in the Brain; The Neural Substrates of Cognitive Event-Related Potentials; A Review of Animal Models of P3; Theta and Delta Responses in Cognitive Event-Related Potential Paradigms and Their Possible Psychophysiological Correlates; Magnetoencephalography in the Study of Human Brain Functions; Keyword Index.

- C) **Electricity and Electrophysiology:** Molecular Physiology of Cardiac Ion Channels; The Cardiac Action Potential; Propagation through Cardiac Muscle; Neurohumoral Modulation of Cardiac Electrophysiologic Properties; Pharmacological Modulation of Cardiac Electrophysiologic Properties; Electrophysiologic Abnormalities in Hypertrophies, Failed or Infarcted Hearts; Synthesis of the Cardiac Purkinje-Fiber Action Potential Using a Computer Model; User Manual for the Computer Model of Purkinje Action Potential.

LAB ELECTROPHYSIOLOGY

(1 credit hour)

Experiments based on the concepts related to the study in theory course.

Books Recommended:

New Developments in Cardiac Pacing and Electrophysiology, 2002. [Ovsyshcher](#), I.E.

Futura Pub Co.

An Introduction to Cardiac Electrophysiology, 2000. [Zara](#), A. (Editor), [Michael R. Rose](#) (Editor), [Antonio Zaza](#) (Editor), [Michael Rosen](#) (Editor). Dunitz Martin Ltd.

Experimental Animal Physiology. A Contemporary Systems Approach, 1996. [Ottis](#), K.

Cognitive Electrophysiology, 1994. [Heinze](#), H.J., [Munte](#), T.F. and [Mangun](#), G.R. (Editors). Springer Verlag.

Electrophysiology of the Neuron : An Interactive Tutorial/Book and MacIntosh Disk, 1994. [Huguenard](#), J., [Gordon M. Shepherd](#), [David A. McCormick](#). Oxford University Press.

Specialization Courses

Endocrinology-I	Molecular Endocrinology	2+1
Endocrinology-II	Clinical Endocrinology	2+1
Endocrinology-III	Comparative Endocrinology	2+1
Endocrinology-IV	Reproductive Endocrinology	2+1
Endocrinology-V	Environmental Endocrinology	2+1

ENDOCRINOLOGY-I: MOLECULAR ENDOCRINOLOGY**Principles of Molecular Endocrinology.**

Biosynthetic pathways: Biosynthetic pathways of various hormones of endocrine glands and tissues.

Mechanisms of hormones: Hormones that act as transcription-regulatory factors, hormones that act at the cell surface, the transduction pathways from membranes to manifestation of response.

Transport of hormones: Molecular aspects of transport of the hormones.

Physiological responses: Molecular aspects of the physiological actions of the hormones of different endocrine glands.

Hormonal interactions: Biochemical targets in hormonal interactions.

LAB MOLECULAR ENDOCRINOLOGY

Experiments related to the concepts in the above theory course.

ENDOCRINOLOGY-II: CLINICAL ENDOCRINOLOGY

Clinical aspects:

Pituitary glands: Gigantism, acromegaly, dwarfism, hyperprolactinemia, alteration in gonadotrophic and corticotrophic releases; Diabetes insipidus.

Thyroid glands: Endemic goiter, myxedema, cretinism, Grave's disease, Hashimoto disease, other immunological crises with the gland.

Parathyroid glands: Clinical aspects related to hypercalcemia and hypocalcemia.

Endocrine pancreas: Diabetes mellitus, disorder of hypoglycemia.

Adrenal cortex: Cushing's syndrome, Addison disease, Hirsutism.

Adrenal medulla: Excess releases of catecholamine.

Gonads: Various anomalies of testes and ovaries leading to various clinical indispositions.

Hormones associated syndromes: Endocrine hypertension, Obesity, Anorexia nervosa, Bulimia nervosa, Disorders of vasodilator hormones.

Hormones in malignancy: Breast and prostate cancer.

Hormonal manifestations of malignancy:

ENDOCRINOLOGY-III: COMPARATIVE ENDOCRINOLOGY

Endocrine mechanisms in invertebrates: Neurosecretion, endocrine tissue and glands in lower invertebrates, annelids, mollusks, crustaceans and insects.

Evolutionary aspects of endocrine glands in lower chordates.

Comparative aspects of endocrine mechanisms in vertebrates: Evolutionary development in the position of endocrine glands in different vertebrates, diversity in the role of endocrine glands in different vertebrates.

Molecular comparative aspects: Evolution in the role of various hormones in different vertebrates such as of growth hormones, prolactin, vasopressin, thyroid hormones, insulin.

ENDOCRINOLOGY-IV: REPRODUCTIVE ENDOCRINOLOGY

Sex differentiation: The role of H-Y antigen, various endocrine and paracrine mechanisms in the development of different segments of female and male reproductive tract.

Folliculogenesis: Advance studies in ovulatory mechanism and quota of ova to be ovulated.

Spermatogenesis: Molecular mechanisms in spermatogenesis and factors influencing it.

Hypothalmo-pituitary-gonadal axis: Various feedback interactions.

Gonadotrophins: Biosynthesis and release regulating mechanisms.

Reproductive rhythms: Ultradian, infradian and other rhythms in reproduction.

Implantation.

Pregnancy maintenance.

Parturition.

Lactation.

Antifertility mechanisms.

ENDOCRINOLOGY-V: ENVIRONMENTAL ENDOCRINOLOGY

Principles in environmental endocrinology.

Environment and thyroid: Iodine in environment and its influences on thyroid functions, plant products influencing thyroid functions such as goitrogens in *Brassica* spp., drug influencing thyroid functions, environmental radiations affecting thyroid.

Environment and reproduction: Various pesticides manifesting astrogenic effects in aquatic vertebrates and through food chains the terrestrial vertebrates including human, plant products affecting reproduction such as gossypol in cotton seed oils.

Stress and adrenal cortex: Adaptation of adrenal cortex in social and environmental stresses.

Aging: Hormone status in aging and environmental supplementations from food and water.

Reference Books

Williams Text Book of Endocrinology, 2002. Wilson, J. D., Foster, D. W., Kronenberg, H. M. and Larson, P. R. (eds). W. B. Saunders Company, Philadelphia

Endocrinology, 2001. DeGroot, L. J. and Jameson, J.L. (eds). W.B. Saunders, Philadelphia.

Endocrine Physiology, 2000. Kacsoh, B. McGraw Hill Co., Inc.

Comparative endocrinology, 1997. Bentley, P.J. Springer-Verlag, New York.

Molecular endocrinology, 1994. Bolander, F.F. Academic Press, Inc.

B. Sc. Pass Course (Two Years Degree Course)
(Annual System)

Physiology as an elective subject of the three, as requirement for the Degree

Paper-A:	Principles of Physiology	
	Theory	45 Marks
	Practical	15 marks
Paper-B:	Physiological System	
	Theory	50 Marks
	Practical	20 Marks
Paper-C:	Integrative Physiology	
	Theory	50 Marks
	Practical	20 Marks
	Total:	200 Marks

PAPER A (THEORY)

(45 Marks)

Principles of Physiology

Status of physiology in life sciences.

The relationship of physiology with other allied disciplines.

The disciplines in physiology.

The significance of study of physiology.

The central theme of study of physiology: Structure and function, Adaptation, acclimatization, homeostasis, feed back systems, conformity and regulation.

Information and literature of physiology.

Experimentation in physiology.

Membrane potentials: Cellular membranes and transmembrane transport of solutes and water. Ionic equilibria and resting membrane potentials. Generation and conduction of action potentials.

Synaptic transmission: Various synaptic mechanisms, neurotransmitters

Membrane receptors: Second messengers and signal transduction pathways.

PRINCIPAL OF PHYSIOLOGY (PRACTICAL) (15 Marks)

Experiments demonstrating excitability of tissues, communication among cells. membrane transduction, carbon flow in nutrition, circulation and respiration. Interactions among systems and environments and diversity of functions.

PAPER B

PHYSIOLOGICAL SYSTEMS (THEORY) (55Marks)

Cardiovascular system: Blood and hemostasis, Electrical activity of the heart, Cardiac pump, Regulation of the heartbeat, Hemodynamics, Arterial system, Microcirculation and lymphatics, Peripheral circulation and its control, Control of cardiac output, Special circulation.

Respiratory system: Overview of respiratory system, Mechanical aspects of breathing, Pulmonary and bronchial circulation, Transport of oxygen and carbon dioxide between the lungs and the cells, Control of breathing.

Gastrointestinal system: Motility of gastrointestinal tract and its local, nervous and hormonal control, Gastrointestinal secretions and their regulation, Digestion and absorption in the gastrointestinal tract.

Renal system: Elements of renal function, Solute and water transport along the nephron, Tubular function, Control of body fluid volume and osmolality, Potassium, calcium and phosphate homeostasis, Role of kidneys in acid-base balance.

PHYSIOLOGICAL SYSTEMS (PRACTICAL) (20 Marks)

Experiments based on the functional aspects of circulatory, respiratory, excretory, nutritive and osmoregulatory systems.

PAPER C

INTEGRATIVE PHYSIOLOGY (THEORY) (55 Marks)

Nervous system: Cellular organization, general sensory system, Special senses, Motor system, Autonomic nervous system and its control, Higher functions of the nervous system.

Endocrine system: General principles of endocrine physiology, Whole body metabolism,. Hormones of pancreatic islets, Endocrine regulation of the metabolism of calcium and phosphate, pituitary gland, Thyroid gland, Adrenal cortex, Adrenal medulla, overview of reproductive functions, Male reproduction, Female reproduction.

Neuroendocrine system: Hypothalamus and other neuroendocrine mechanisms.

Muscle: Molecular basis of contraction, Muscles acting on the skeleton, Muscles in the walls of hollow organs.

INTEGRATIVE PHYSIOLOGY (PRACTICAL) (20 Marks)

Experiments related to nervous system, endocrine system and muscular system.

Book recommended:

Eckert Animal Physiology. Mechanisms and adaptations. 2002. Randall, D., Burggren, W. and French, K. W. H. Freeman and Company, New York.

Textbook of Medical Physiology. 2001. Guyton, A. C. and Hall, J. E. W. B. Saunders Company, Philadelphia.

Review of Medical Physiology. 2001. Ganong, W. F. Prentice-Hall International Inc. New Delhi.

Principles of Physiology. 2000. Berne, R. M. and Levy, M.N. Mobsy, St Louis.

M.Sc. Physiology – Two Year Degree Course

Eligibility: B.Sc. with Biosciences subject to the approval of the Equivalence Committee

Year 1 Semester-I

Physiology of Excitable Cells	2
Lab Physiology of Excitable Cells	1
Cardiovascular-Pulmonary Physiology	2
Lab Cardiovascular-Pulmonary Physiology	1
Excretory, Acid Base Balance & GIT Physiology	2
Lab Excretory, Acid Base Balance & GIT Physiology	1
Endocrine & Reproductive Physiology	2
Lab Endocrine & Reproductive Physiology	1
Fundamental of Pharmacology	2
Lab Fundamental of Pharmacology	1

Sub Total: 15

Semester-II

Bioinformatics & Computer Application	2
Environmental Physiology	2
Lab Environmental Physiology	1
Physiology of Health Fitness & Exercise	2
Lab Physiology of Health Fitness & Exercise	1
Molecular Genetics	2
Toxicology & Radiation Biology	2
Physiological Techniques	2
Behavioural Physiology	2
Pathological Physiology	2

Sub Total: 18

Year 2 Semester-III

Contemporary Physiology	3
Specialization course-I	2
Lab Specialization course-I	1
Specialization course-II	2
Lab Specialization course-II	1
Specialization course-III	2
Lab specialization course-III	1
Specialization course-IV	2
Lab Specialization course-IV	1

Sub Total: 15

Semester-IV

Electrophysiology	3
Specialization Course-V	2
Lab Specialization Course-V	1
Thesis	9

Sub Total: 15

Grand Total: 63**YEAR 1****SEMESTER I****PHYSIOLOGY OF EXCITABLE CELLS (2 credit hours)*****NEUROPHYSIOLOGY*****Neural Mechanisms.**

Communication Within Neurones: The flow of electrical current along nerves. The dependence of potential on ionic permeabilities. The dependence of ionic permeability on potential. Conduction velocity. Threshold properties. Neural codes.

Communication Between Neurones: Common features of all neurons. Sensory receptors. Synaptic transmission.

Motor Functions.

Types of Motor Control: Difficulties in studying motor systems. Motor control and feedback. The hierarchy of control.

Local Motor Control: Motor neurons, Descending pathways, Sensory feedback from muscles.

The Control of Posture: The importance of support, Vestibular contribution to posture, Visual contributions to posture, Neck reflexes, Posture as a whole.

Global Motor Control: Motor cortex, Cerebellum, Basal ganglia.

Higher Functions.

Recognition and Memory Cerebral Cortex: Prefrontal cortex, Parietal cortex, Temporal lobe.

Motivation And Behaviour: Motivation, Emotion, The hypothalamus, Sleep and cortical arousal, A Last look at the brain, Index.

Sensory Functions: Skin sense. Sensory modalities. Types of receptor. Central projections. Neural responses. Central responses. Pain.

Proprioception: Muscle proprioceptors. Joint receptors. Conscious proprioception. The vestibular apparatus.

Hearing: The nature of sound. Sound spectra. The structure of the ear. Fourier analysis by the cochlea. Responses from auditory fibres. Spatial localization of sound. Central pathways and responses.

Vision: Light and dark. Image-forming by the eye. The retina. Retinal interneurons. Mechanisms of adaptation. Visual acuity. Visual form recognition. Colour vision. Visual localization. Visual proprioception.

Smell and Taste: Smell, Taste.

MUSCULOSKELETAL SYSTEM

The Human Machine: Elementary Mechanics, Force and Mechanics, Forms of Motion, Kinematics, Kinetics, Chapter, The Musculoskeletal System, Unicellular and Multicellular Organisms, Cellular Organization in Multicellular Organisms, Musculoskeletal System Structure, Musculoskeletal System Function.

Functional Anatomy of the Muscular and Skeletal Systems: The Skeleton, Composition and Function of the Skeleton, Terminology, The Axial Skeleton, The Appendicular Skeleton.

Connective Tissues: Functions of Connective Tissues, Ordinary Connective Tissues, Cartilage, Bone, The Articular System, Structural Classification of Joints, Joint Movements, The Stability-Flexibility Classification of Joints, Synovial Joint Classification, Flexibility, Stability, and Laxity in Synovial Joints, Chapter 6 Joints of the Axial Skeleton, The Joints Between the Vertebrae, Degeneration and Damage in the Vertebral Column, Normal Shape of the Vertebral Column, Abnormal Curvature of the Vertebral Column, Joints of the Pelvis: Sacroiliac Articulations and Pubic Symphysis. **Joints of the Appendicular Skeleton:** Joints and Joint Complexes, Shoulder Complex, Elbow Complex, Wrist Complex, Hip Joint, Knee Complex, Ankle Complex.

The Neuromuscular System: The Nervous System, Skeletal Muscle Structure, Muscle Fiber Structure and Function, Kinesthetic Sense and Proprioception, Mechanical Characteristics of Muscle-Tendon Units, Muscle Architecture and Function, Stretch-Shorten Cycle.

Forces in Muscles and Joints: Force Vectors, Lever Systems in the Musculoskeletal System, Swing and Stabilization Components of Muscle Force.

Musculoskeletal Response and Adaptation to Loading: Mechanical Characteristics of Musculoskeletal Components, Stress-

Strain Relationships in Solids, Viscosity and Viscoelasticity, Active and Passive Loading.

Structural Adaptation of the Musculoskeletal System: Adaptation, Biopositive and Bionegative Effects of Loading, Response and Adaptation of Musculoskeletal Components to Loading.

Etiology of Musculoskeletal Disorders and Injuries: Kinetic Chain, Compensatory Movements, Risk Factors, References, Index, About the Author.

LAB PHYSIOLOGY OF EXCITABLE CELLS (1 credit hour)

Study of membrane potentials. Study of conduction velocity in the nerves. Experiments to study sensory and motor functions in animal models. Experiments to study behaviour in animals.

Experiments to study cutaneous receptor sensitivity. Study of proprioception. Experiments related to hearing, visions, smell and taste.

Study of the functional anatomy of muscle and skeletal system in human model and in animals. Experiments on neuromuscular conduction. Study of interaction of muscle and skeleton specifically at the joints.

Book/s Recommended

Neurophysiology, 2002. [Carpenter](#), R.H.S., Oxford University Press., Oxford.

Neurophysiology, 2002. Blankenship. Mosby, Year Book. St. Louis, USA.

Neuroanatomy and Neurophysiology: A Review, 2002. [Jonathan S.C.](#) (Editor [Robert L. MacDonald](#)). Thieme Medical Pub.

Fundamentals of Sensory Physiology, 1986. Edited by [Schmidt](#), R.F., Translated by [M. A. Biederman-Thorson](#). Springer-Verlag, New York.

Neurophysiology, 2002. [Carpenter](#), R.H.S., Oxford University Press., Oxford.

Neurophysiology, 2002. Blankenship. Mosby, Year Book. St. Louis, USA.

The Musculoskeletal System, 2001. [Sambrook](#), P. (Editor), [Leslie MD Schrieber](#) (Editor), [Thomas Taylor](#), [Leslie Schrieber](#), [Tom Taylor](#), [Andrew Ellis](#). Churchill Livingstone.

Structure and Function of the Musculoskeletal System, 1999. [Watkins](#), J. Human Kinetics Pub.

CARDIOVASCULAR-PULMONARY PHYSIOLOGY(3 credit hours)

Electrical activity of heart: Cardiac potentials, conduction of cardiac fibres, pace makers, electrocardiography, clinical features of ECG.

The Cardiac pump: Functional anatomy of heart, cardiac chambers and valves, cardiac cycle, cardiac output.

Regulation of heart beat: Control by autonomic nerve, myocardial performance and its nervous and humoral regulation.

Haemodynamics: Relationship between blood pressure and flow, resistance to flow.

The atrial system: Arterial elasticity, arterial blood pressure.

Microcirculation and Lymphatics: Functional anatomy, endothelium in regulation and transcapillary exchange, lymphatic return.

Peripheral circulation and Control: Intrinsic and extrinsic control of peripheral blood flow and balance between these factors regulation.

Control of cardiac output: Relationship between cardiac output and venous return and influence of various factor.

Coronary circulation: Functional anatomy of coronary vessels, its regulation by various factors, coronary collateral vessels.

Special circulation: Cutaneous, skeletal muscle, cerebral, pulmonary, renal and splanchnic circulations.

Interplay of central and peripheral factors in control of circulation: Exercise effect and hemorrhage.

Pulmonary Physiology: Structure and Function of the Upper Airways, Structure of the Lungs, Blood-Tissue Exchange in the Pulmonary Circulation, Partial Pressure and Diffusion of Blood Gases, Respiratory Compliance, Respiratory Muscles, Respiratory Pressures and Flows, Spirometry and Lung Volumes, The Work of Breathing, Blood-Gas Transport in the Lung, Oxygen-Hemoglobin Binding, The Transport of Carbon Dioxide, Regulation of Pulmonary Blood Flow, Relationship of Alveolar, Ventilation to Pulmonary Perfusion, Acid-Base Relationships, Acid-Base Homeostasis.

Regulation of Pulmonary Function: Models of Respiratory Control, Respiratory Mechanoreceptors, Respiratory Chemoreceptors, Adaptive Control of Respiration.

Selected Pathophysiology of the Pulmonary System: Types of Hypoxia, Abnormal Respiratory Control Patterns, Artificial Ventilation,

Chronic Obstructive Pulmonary Disease, Restrictive Lung Diseases, Congestive Heart Failure.

LAB CARDIOVASCULAR-PULMONARY PHYSIOLOGY

(1 credit hour)

Experiments on various models to understand the concepts included in the theory course

Experiments in respiratory mechanisms with emphasis on the concepts in theory course.

Books Recommended:

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J. E.. W. B. Saunders Company, Philadelphia.

Cardiovascular Physiology, 2002. [Mohrman](#), D.E. and [Heller](#), L.J. McGraw Hill Text, Boston.

Cardiovascular Physiology, 2001. [Robert, M., Md Berne](#), [Matthew N., MD Levy](#), [Matthew N. Levy](#). Mosby, Inc., St. Louis, USA.

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J. E. W. B. Saunders Company, Philadelphia.

Pulmonary Physiology, 2002. [Levitky](#), M.G. and [Levitky](#), M.G. McGraw Hill Text, Boston.

Pulmonary System, 2001. [Grossbach](#), I. Lippincott Williams & Wilkins Publishers.

EXCRETORY, ACID BASE BALANCE AND GIT PHYSIOLOGY

(2 credit hours)

GASTROENTEROPANCREATIC

Functional anatomy of gastroenteropancreatic system.

GIT segments secretion: Salivary gastric pancreatic and bile fluid secretions.

The Control of secretions: Nervous and hormonal controls of GIT secretions.

Digestion: Digestion of different nutrients, avian digestion, rumen digestion.

Absorption: Absorption of nutrients, the factors influencing the components of nutrients.

Splanchnic circulations: Alteration in circulation during absorption.

Motility: Esophageal peristalsis, motility of small and large intestine.

Regulation of motility: Regulation by peptide hormones and autonomic nervous system.

Special features of GIT: Swallowing, gastric emptying, antiperistalsis, colic pains.

Large intestine secretions: Diarrhea and constipation.

EXCRETORY

Renal Functions, Anatomy, and Basic Processes: Anatomy of the Kidneys and Urinary System, Blood Supply to the Nephrons, Categories of Nephrons, Juxtaglomerular Apparatus.

Glomerular Filtration: Intrarenal Chemical Messengers, Renal Blood Flow and Glomerular Filtration, Flow, Resistance, and Pressure in the Kidneys. Formation of Glomerular Filtrate and Direct Determinants of GFR.

Autoregulation of renal function: The factors in autoregulation: Renal Sympathetic, Angiotensin II, Intrarenal Baroreceptors, Prostaglandins and other factors.

Renal Clearance: Definition of Clearance, Plasma Creatinine and Urea Concentrations.

Reabsorption and Secretion: Transport Mechanisms in Reabsorption. Transport Mechanisms in Tubular Secretion. Bidirectional Transport. Regulation of Membrane Channels and Transporters. Renal Handling of Organic Substances. Active Proximal Reabsorption of Organic Nutrients: Glucose, Amino Acids, etc. Proteins and Peptides. Urea. Active Proximal Secretion of Organic Anions. Urate. Active Proximal Secretion of Organic Cations. Passive Reabsorption or Secretion of Weak Organic Acids and Bases. Basic Renal Processes for Sodium, Chloride, and Water. Sodium, Chloride and Water Reabsorption.

Countercurrent Multiplier System: The Role of Interstitial Urea in Balancing Collecting-Duct Urea. Countercurrent Exchange: Vasa Recta.

Control of Sodium Excretion: Regulation of Plasma Volume and Osmolarity. Control of GFR in Response to Changes in Body Sodium Content and Extracellular Volume. Control of Tubular Sodium Reabsorption. Glomerulotubular Balance. Aldosterone. Control of Aldosterone Secretion. Peritubular-Capillary Starling Factors and the Role of Renal Interstitial Hydraulic Pressure. Direct Tubular Effects of Renal Sympathetic Nerves. Direct Tubular Effects of Angiotensin II. Pressure Natriuresis. Atrial Natriuretic Factor (ANF). Antidiuretic Hormone. Other Hormones.

Control of Water Excretion: Baroreceptor Control of ADH Secretion. Osmoreceptor Control of ADH Secretion. Thirst and Salt Appetite. Renal Regulation of Potassium Balance. Regulation of

Internal Potassium Distribution. Basic Renal Mechanisms. Mechanism of Potassium Secretion in the Cortical Collecting Duct. Homeostatic Control of Potassium Secretion by the Cortical Collecting Duct. Potassium Secretion and Fluid Delivery.

The Cortical Collecting Duct: Effects of Diuretics. ADH and Water Diuresis.

Comparative aspects of nitrogen excretion: The nature of excretory products in different animals and their relationship with availability of water.

ACID BASE BALANCE

The Effects of Acid-Base Changes on Potassium Secretion, Renal Regulation of Hydrogen-Ion Balance, Bicarbonate Excretion, Bicarbonate Filtration and Reabsorption, Bicarbonate Secretion, Addition of New Bicarbonate to the Blood, (Renal Excretion of Hydrogen Ions), Hydrogen-Ion Secretion and Excretion on Urinary Buffers, Phosphate and Organic Acids as Buffers, Qualitative Integration of Bicarbonate Reabsorption and Hydrogen-Ion Excretion on Nonbicarbonate Buffers, Glutamine Catabolism and NH_4^+ Excretion, Quantitation of Renal Acid-Base Compensation, Homeostatic Control of Renal Acid-Base, Compensation, Control of Renal Glutamine Metabolism and NH_4^+ Excretion, Control of Tubular Hydrogen-Ion Secretion, Control of Bicarbonate Secretion, Specific Categories of Acid-Base Disorders, Renal Compensation for Respiratory Acidosis and Alkalosis, Renal Compensation for Metabolic Acidosis and Alkalosis, Factors Causing the Kidneys to Generate or Maintain a Metabolic Alkalosis, Influence of Extracellular-Volume, Contraction, Influence of Chloride Depletion, Influence of Aldosterone Excess and, Potassium Depletion, Regulation of Calcium and Phosphate Balance, Objectives, Effector Sites for Calcium Homeostasis, Gastrointestinal Tract, Kidneys, Bone, Hormonal Control of Effector Sites, Parathyroid Hormone, 1,25-dihydroxyvitamin D₃, Calcitonin, Other Hormones, Overview of Renal Phosphate Handling.

LAB EXCRETORY, ACID BASE BALANCE AND GIT

PHYSIOLOGY

(1 credit hour)

The experiments related to the regulations of digestive secretions, nutrients absorptions and GIT motility and the factors affecting these mechanisms.

Experiments related to excretory functional mechanisms and acid-base balance concerning the concepts in theory courses.

Reference Books

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J.E. W.B. Saunders Company, Philadelphia.

Gastrointestinal physiology, 2001. Jhonson, L.R. and Gerwin, T.A. Mosby Inc., St. Louis, USA.

Textbook of Medical Physiology, 2001. Guyton, A. C. and Hall, J. E. W.B. Saunders Company, Philadelphia.

Excretory System, 1994. [Silverstein](#), A., [Silverstein](#), V.B. and [Silverstein](#), R. Twenty-first Century Books.

Renal Physiology, 2002. [Navar](#), [Vander](#), A.J. McGraw-Hill, Boston.

ENDOCRINE AND REPRODUCTIVE PHYSIOLOGY

(3 credit hours)

ENDOCRINE

Functional anatomy of different endocrine glands:

Endocrine system in homeostasis:

Hormonal signaling: Hormonal signaling in coordination of molecular, cellular and tissue functions

General account of chemical nature and biosynthesis of hormones:

Transport of hormones to the site of action:

Mechanisms of hormones action: Protein and peptide hormones, steroid hormones, thyroid hormones, conceptual account of different types of signaling and transductions.

Control systems: Feedback mechanisms in hormonal homeostasis.

Hypothalamohypophyseal system: The hormones and their physiological actions of hypothalamus, anterior pituitary and posterior pituitary, their control.

Thyroid gland: Biosynthesis, physiological actions and control of hormones.

Endocrine pancreas: The principal hormones of insulin and glucagon: Their physiological action and control.

Adrenal cortex: Physiological actions and control of hormones.

Adrenal medulla: Physiological actions and control of hormones.

Other endocrine mechanisms: Accounts of pineal gland hormones, thymus hormones, atrial natriuretic hormone and hormones related to blood formation.

Clinical aspects: A brief account among different endocrine glands of their clinical manifestations.

REPRODUCTIVE AND DEVELOPMENTAL PHYSIOLOGY

Sex: Gender, its identity and sexuality.

Reproductive messengers: Gonadotrophic hormones, somatomammotrophic polypeptides, cytokines, steroids and other such hormones.

Mechanism of action: Gonadotrophic and steroid hormones.

Testicular functions: Hormones, spermatogenesis and endocrine factors regulating it.

Ovarian function: Hormones, folliculogenesis and endocrine factors regulating it.

Puberty and maturation of hypothalamic-pituitary gonadal axis:

Coitus and fertilization:

Implantation:

Maternal recognition in support of pregnancy:

Fetus and its preparation for birth:

Parturition:

Lactation and maternal behaviour:

Fertility and antifertility:

LAB ENDOCRINE AND REPRODUCTIVE PHYSIOLOGY

(1 credit hour)

Experiments in understanding the roles of endocrine glands and their hormones in physiological functions.

Study of the female cycle. Effects of hormones on cycle activity.

Influences of gonadectomy on the targets. Metabolism pattern in different reproductive states.

Reference Books

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

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

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

Basic and Clinical Endocrinology, 2001. Greenspan, F.S. and Strewler, G.J. Prentice-Hall International Inc.

Basic and Clinical Endocrinology, 2001. Greenspan, F.S. and Strewler, G.J. Prentice-Hall International Inc.

Basic and Clinical Endocrinology. 2001. Greenspan, F. S. and Strewler, G. J.. Prentice-Hall International Inc. Boston.

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

Essential Reproduction, 2000. Johnson, M.H. and Everitt, B.J. Blackwell Science Ltd.

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

FUNDAMENTALS OF PHARMACOLOGY

(2 Credit hours)

Introduction: Definition Of Pharmacology; Pharmaceutical terms used in medical practice; Drugs and drug use with ancient history; Pharmacokinetics and pharmacodynamics; Drug receptor interaction and physical interaction of drug and receptor; Drugs and cell membrane; Routes of drug administration (with advantages and disadvantages); Factors influencing drug absorption and drug action in man; Drug toxicity and dose related toxicity (with drug abuse and drug dependence); Therapeutic index; Official Books (Pharmacopoeia); Factors affecting drug distribution (or causes); Psology

Various Groups of Drugs Used in Clinical Practice with Special Emphasis on: Classification; History, Source and Chemistry; Pharmacokinetics; Mode of action; Clinical uses; Untowards effects/Toxicity; Dosages; Antidotes

Haematinics

Anti coagulants

Vitamins

Norcotic and non norcotic analgesics

Antiseptics and disinfectants

Histamines and antihistamines

Anti cancer drugs

Anti-biotics

Diuretics

Antacid

Laxative/purgatives

Ematics and antiemetics

LAB FUNDAMENTALS OF PHARMACOLOGY (1 Credit Hour)

Experiments related to the concepts in theory courses.

Books Recommended:

The Pharmacological Basis of Therapeutics, 2001. Hardman, J.G. and Limbird, L.E. (eds.). Goodman & Gilman's. McGraw-Hill Professional Publishing.

Pharmacology: Examination & Board Review, 1996. [Katzung](#), B.G., [Trevor](#), A.J. and [Trevor](#), A.G. McGraw-Hill Professional Publishing.

Pharmacology, 2001. [Rang](#), H.P., [Dale](#), M.M., [Ritter](#), J.M. and [Gardner](#), P. Churchill Livingstone.

Total Credits of Semester V = 18

SEMESTER II

BIOINFORMATICS AND COMPUTER APPLICATIONS

(2 Credit Hours)

ENVIRONMENTAL PHYSIOLOGY

(2 credit hours)

Basic principles in environmental physiology: Nature and levels of adaptation and mechanisms of adaptations.

Osmoregulation: Water, ion and osmotic balance in animals with reference to osmoregulation and excretion, control of osmoregulation.

Energy supply: Energy budgets in animals inhabiting varied environment.

Respiratory and circulatory adaptations: Ventilating structures and associated circulatory adaptations in animals inhabiting different environment.

Temperature and its effects: Biochemical and physiological effects of temperature, temperature classification of organisms particularly animals, mechanisms of heat production, heat dissipation and heat conservations for temperature relations.

Coping with different environments: Osmotic, thermal, respiratory, sensory and reproductive adaptations in organisms inhabiting marine, shorelines and estuaries, freshwater, special aquatic

habitats, terrestrial life, extreme terrestrial habitats and parasitic habitats.

LAB ENVIRONMENTAL PHYSIOLOGY (1 credit hour)

Experiment to demonstrate the adaptations in varied conditions of oxygen and water availability and temperature.

Reference Books

Environmental physiology of animals, 2000. Willmer, P., Stone, G. and Johnston, I. Blackwell Science Ltd.

Animal Physiology. Adaptations and Environment. Schmidt-Neilsen, K., 1998 Edition. Cambridge University Press, Cambridge.

Eckert Animal Physiology. Mechanisms and adaptations. Randall, D., Burggren, W. and French, K. 1998 Edition. W. H. Freeman and Company, New York.

Comparative Animal Physiology. Withers, P. C. 1992 Edition. Saunders College Publishing.

PHYSIOLOGY OF HEALTH, FITNESS AND EXERCISE (2 credit hours)

Nutrition: The base for human performance. Macro and micro nutrients.

Energy for physical activity: Mechanisms of energy transfers in body. Energy transfer in exercise, energy expenditure during rest and physical activity, Energy expenditure during walking, jogging, running and swimming; Individual differences in energy requirements.

Systems for energy delivery and utilization

n: Pulmonary functions in energy delivery; Cardiovascular system and its regulation and integration in energy delivery; Skeletal muscles in energy utilization.

Endocrine systems and exercise: Acute and chronic responses in exercise.

Enhancement of energy capacity: Training for anaerobic and aerobic power, muscle strength during training, special aids to exercise training and performance.

Exercise performance and environmental stress: Exercise in high altitude, thermal stress, in diving and microgravity.

Body composition, energy balance and weight control: Over-weight obesity and weight control.

Exercise in special population: In pregnancy, aged persons, cardiovascular patients, asthmatic and other pulmonary disease patients, and cancer patients.

LAB PHYSIOLOGY OF HEALTH, FITNESS AND EXERCISE

(1 credit hour)

Epidemiological surveys related to pattern of health and disease, Designing exercise programs. Designing nutrition programs, Experiments to evaluate cardiorespiratory fitness.

Reference books

Powers, S.K. and Howley, E. T. 1997. Theory and Applications to Fitness and Performance. 3rd Edition. Brown and Benchmark Publishers.

McArdle, W. D. Katch, F. I. and Katch, V. L. 2001. Exercise Physiology: Energy, Nutrition and Human Performance. 5th Edition. Lippincott Williams and Wilkins, Baltimore, USA.

MOLECULAR GENETICS

(2 Credit Hours)

Introduction.

What is DNA?

Genes

Genome structure

Transcription and RNA

Translation and genetic code

Control of gene expression

Inheritance

Mapping of genes

Gel electrophoresis and blotting

Gene cloning and gene libraries

Polymerase chain reaction (PCR)

Sequencing and sequence analysis

The future of molecular genetics: biotechnology, transgenics and gene therapy.

Books Recommended:

Molecular Genetics, 1999. [Hancock](#), J.T. Arnold, Edward.

BMS Explained: Molecular Genetics, 1999. [Hancock](#), J.T. Oxford University Press, Oxford.

TOXICOLOGY AND RADIATION BIOLOGY (2 Credit hours)

Toxicology

General Principles of Toxicology;
Disposition of Toxicants.
Non-Organ Directed Toxicity.
Target Organ Toxicity.
Toxic Agents.
Environmental Toxicology.
Applications of Toxicology.
Brief account of cellular and molecular mechanisms in toxicology.

Books Recommended:

Casarett & Doull's Toxicology: The Basic Science of Poisons, 2001. [Casarett, L.J.](#), [Curtis D., Klaassen, C. D.](#) (Editors), [Doull, J.](#) and [Klaassen, C.D.](#) McGraw-Hill Professional Publishing, New York.
Comprehensive Toxicology : Cellular and Molecular Toxicology, 2002. [Vanden Heuvel, J.P.](#), [Perdew, G.H.](#) and [Mattes, W.B.](#) (eds.). Pergamon Press, New York.

Radiation Biology

Basic physics; Cell survival; Repair of sublethal damage and the dose-rate effect;
Effects of radiation on chromosomes; Radiation carcinogenesis; Radiation biology of tumor subpopulations; The effect of radiations on developmental processes; The effects of radiation on the cellular components of the immune system; Acute radiation syndromes; Applications of radiation biology in nuclear medicine; Implications of radiobiology of clinical radiation therapy; The application of particle beams to radiation therapy.

Books Recommended:

Radiation Biology, 1982. [Pizzarello, D.J.](#) C R C Press Reprints.
Radiation Biology and Protection, 2001. [Forshier, S.](#) Delmar Learning.

PHYSIOLOGICAL TECHNIQUES (2 credit hours)

Physiographic techniques: Experiments on nerve and muscle excitability.

Electrocardiographic and myographic studies: Experiments on muscle and cardiac activity.

Molecular techniques: Use of microelectrodes and micropipettes in experiments for membrane potentials; Tracing molecules with radioisotopes and monoclonal antibodies.

Cellular techniques: Structural analysis of cells; Light microscopy, Electron microscopy, Cell culture.

Biochemical Analysis: Spectrophotometry, Chromatography, Electrophoresis, Southern, Northern and Western blotting.

Immunological Techniques: Enzyme-linked immunosorbent assay, Radioimmunoassay.

Immunofluorescence techniques.

References Books

Current Methods in Muscle Physiology : Advantages, Problems, and Limitations (Oxford Science Publications), 1998. Sugi, H. (Editor). International Union of Physiological Sciences. Oxford University Press, Oxford.

Methods in Cardiac Electrophysiology, 1998. Pugsley, M.K. and Walker, M.J. (Editors). CRC Press, New York.

Principles of physiological Measurement, 1986. Cameron, J.N. Academic Press, New York.

BEHAVIOURAL PHYSIOLOGY (2 credit hours)

Introduction: Understanding Human Consciousness: A Physiological Approach; The Nature of Physiological Psychology; Natural Selection and Evolution; Ethical Issues in Research with Animals; Careers in Neuroscience; Strategies for Learning.

Structure and Functions of Cells of the Nervous System: Cells of the Nervous System; Communication within a Neuron; Communication between Neurons.

Structure of the Nervous System: Basic Features of the Nervous System; The Central Nervous System; The Peripheral Nervous System.

Psychopharmacology: Principles of Psychopharmacology; Sites of Drug Action; Neurotransmitters and Neuromodulators.

Methods and Strategies of Research: Experimental Ablation; Recording and Stimulating Neural Activity; Neurochemical Methods; Genetic Methods.

Vision: The Stimulus; Anatomy of the Visual System; Coding of Visual Information in the Retina; Analysis of Visual Information: Role of the Striate Cortex; Analysis of Visual Information: Role of the Visual Association Cortex.

Audition, the Body Senses, and the Chemical Senses: Audition; Vestibular System; Somatosenses; Gustation; Olfaction; Perception of Specific Odors.

Control of Movement: Muscles; Reflex Control of Movement; Control of Movement by the Brain.

Sleep and Biological Rhythms: A Physiological and Behavioral Description; Why Do We Sleep?; Physiological Mechanisms of Sleep and Waking; Disorders of Sleep; Biological Clocks.

Reproduction Behavior: Sexual Development; Hormonal Control of Sexual Behavior; Neural Control of Sexual Behavior; Parental Behavior.

Emotion: Emotions as Response Patterns; Expression and Recognition of Emotions; Feelings of Emotions; Aggressive Behavior.

Ingestive Behavior: Drinking: The Nature of Physiological Regulatory Mechanisms; Drinking and Salt Appetite; Brain Mechanisms of Thirst and Salt Appetite; Mechanisms of Satiety.

Ingestive Behavior: Eating: Some Facts about Metabolism; What Starts a Meal?; What Stops a Meal?; Brain Mechanisms; Eating Disorders.

Learning and Memory: Basic Mechanisms: The Nature of Learning; Learning and Synaptic Plasticity; Perceptual Learning; Classical Conditioning; Instrumental Conditioning and Motor Learning.

Relational Learning and Amnesia: Human Anterograde Amnesia; Relational Learning in Laboratory Animals.

Human Communication: Speech Production and Comprehension; Brain Mechanisms; Disorders of Reading and Writing.

Schizophrenia and the Affective Disorders: Schizophrenia; Major Affective Disorders.

Anxiety Disorders, Autistic Disorder, and Stress Disorders: Anxiety Disorders; Autistic Disorder; Stress Disorders.

Drug Abuse: Common Features of Addiction; Commonly Abused Drugs; Heredity and Drug Abuse; Therapy for Drug Abuse.

Reference Books

Physiology of Behavior, 2000. Neil R. Allyn & Bacon.

PATHO-PHYSIOLOGY

(2 credit hours)

Central concepts of pathophysiology

Cells And Tissues: The Cell 1 Cellular Biology; Altered Cellular and Tissue Biology; The Cellular Environment -- Fluids and Electrolytes, Acids and Bases

Genes and Gene-Environment Interaction: 4 Genes and Genetic Diseases; Genes, Environment, and Common Diseases.

Mechanisms of Self-Defense: Immunity; Inflammation; Infection and Alterations in Immunity and Inflammation; Stress and Disease.

Cellular Proliferation – Cancer: Tumor Biology; Tumor Invasion and Metastasis; Cancer in Children.

Pathophysiologic Alterations -- Organs And Systems

The Neurologic System: Structure and Function of the Neurologic System; Pain, Temperature Regulation, Sleep, and Sensory Function; Concepts of Neurologic Dysfunction; Alterations of Neurologic Function; Neurobiology of Schizophrenia, Mood Disorders, and Anxiety Disorders; Alterations of Neurologic Function in Children.

The Endocrine System: Mechanisms of Hormonal Regulation; Alterations of Hormonal Regulation.

The Reproductive Systems: Structure and Function of the Reproductive Systems; Alterations of the Reproductive Systems; Sexually Transmitted Infections.

The Hematologic System: Structure and Function of the Hematologic System; Alterations of Erythrocyte Function; Alterations of Leukocyte, Lymphoid, and Hemostatic Function; Alterations of Hematologic Function in Children.

The Cardiovascular and Lymphatic Systems: Structure and Function of the Cardiovascular and Lymphatic Systems; Alterations of Cardiovascular Function; Alterations of Cardiovascular Function in Children.

The Pulmonary System: Structure and Function of the Pulmonary System; Alterations of Pulmonary System; Alterations of Pulmonary System in Children.

The Renal and Urologic System: Structure and Function of the Renal and Urologic Systems; Alterations of Renal and Urinary Tract Function; Alterations of Renal and Urinary Tract Function in Children.

The Digestive System: Structure and Function of the Digestive System; Alterations of Digestive Function; Alterations of Digestive Function in Children.

The Musculoskeletal System: Structure and Function of the Musculoskeletal System; Alterations of Musculoskeletal Function; Alterations of Musculoskeletal Function in Children.

The Integumentary System: Structure, Function, and Disorders of the Integument; Alterations of Integument in Children.

Multiple Interacting Systems: Shock, Multiple Organ Dysfunction Syndrome, and Burns in Adults; Shock, Multiple Organ Dysfunction Syndrome, and Burns in Children.

Reference Books

Pathophysiology: Biological & Behavioral Perspectives, 2002. Banasik, J.L., Lee-Ellen C. Copstead. Amazon.com, Inc. or its affiliates

Pathophysiology: The Biologic Basis for Disease in Adults & Children, 2001. [Kathryn, L. McCance](#), [Huether](#), S.E. Mosby, St. Louis, USA.

Total Credits of Semester VI = 18

YEAR 2

SEMESTER III

CONTEMPORARY PHYSIOLOGY (3 credit hours)

Contemporary studies in excitability tissues.

Contemporary studies in neurophysiology.

Contemporary studies in endocrinology.

Contemporary studies in myology.

Contemporary studies in pulmonary physiology.

Contemporary studies in cardiovascular physiology.

Contemporary studies in excretory physiology and acid base balance.

Contemporary studies in gastroenteropancreatic physiology.

Contemporary studies in reproduction.

Contemporary studies in osmoregulation.

Contemporary studies in temperature relations.

LAB CONTEMPORARY PHYSIOLOGY (1 credit hour)

Design experiments based on the concepts in theory course.

Books Recommended

Search for latest books for the above mentioned contemporary studies from internet database.

*Specialization course-I	2
Lab Specialization course-I	1
*Specialization course-II	2
Lab Specialization course-II	1
*Specialization course-III	2
Lab specialization course-III	1
*Specialization course-IV	2
Lab Specialization course-IV	1

SEMESTER IV

ELECTRO PHYSIOLOGY (3 credit hours)

- A) **Introduction:** Resting Potential; Action Potential; Voltage Clamp; Neurophysiological Properties of Neurons; Synaptic Potentials.
- B) **The Cuing of Attention to Visual Field Locations:** Analysis with ERP Recordings; Selective Visual Attention: Selective Cuing, Selective Cognitive; Processing, and Selective Response Processing; Orienting Attention in the Visual Fields; An Electrophysiological Analysis; The Order of Global- and Local-Level Information Processing; Electrophysiological Evidence for Parallel Perceptual Processes; Event-Related Potentials and Stimulus Repetition in Direct and Indirect Tests of Memory; Slow Potentials During Long-Term Memory Retrieval; Event-Related Potentials Dissociate Immediate and Delayed Memory; What Is Who Violating? A Reconsideration of Linguistic Violations in Light of Event-Related Brain Potentials; ERP Negativities During Syntactic Processing of Written Words; ERP Mapping: A Tool for Assessing Language Disorders?; Threshold Variations in Cortical Cell

Assemblies and Behavior; The Influence of Hand Movements on Cortical Negative; DC Potentials; Principles of Electrogenesis of Slow Field Potentials in the Brain; The Neural Substrates of Cognitive Event-Related Potentials; A Review of Animal Models of P3; Theta and Delta Responses in Cognitive Event-Related Potential Paradigms and Their Possible Psychophysiological Correlates; Magnetoencephalography in the Study of Human Brain Functions; Keyword Index.

- C) **Electricity and Electrophysiology:** Molecular Physiology of Cardiac Ion Channels; The Cardiac Action Potential; Propagation through Cardiac Muscle; Neurohumoral Modulation of Cardiac Electrophysiologic Properties; Pharmacological Modulation of Cardiac Electrophysiologic Properties; Electrophysiologic Abnormalities in Hypertrophies, Failed or Infarcted Hearts; Synthesis of the Cardiac Purkinje-Fiber Action Potential Using a Computer Model; User Manual for the Computer Model of Purkinje Action Potential.

LAB ELECTROPHYSIOLOGY

(1 credit hour)

Experiments based on the concepts related to the study in theory course.

Books Recommended:

Experimental Animal Physiology. A Contemporary Systems Approach, 1996. [Ottis](#), K.

New Developments in Cardiac Pacing and Electrophysiology, 2002. [Ovsyshcher](#), I.E.

Futura Pub Co.

Cognitive Electrophysiology, 1994. [Heinze](#), H.J., [Munte](#), T.F. and Mangun, G.R. (Editors). Springer Verlag.

Electrophysiology of the Neuron : An Interactive Tutorial/Book and MacIntosh Disk, 1994. [Huguenard](#), J., [Gordon M. Shepherd](#), [David A. McCormick](#). Oxford University Press.

An Introduction to Cardiac Electrophysiology, 2000. [Zara](#), A. (Editor), [Michael R. Rose](#) (Editor), [Antonio Zaza](#) (Editor), [Michael Rosen](#) (Editor). Dunitz Martin Ltd.

*Specialization Course-V	2
Lab Specialization Course-V	1
**Thesis	9

*A few of specializations are mentioned above. Different institutions may have others depending upon the availability of expertise.

*Special Group: A few of specializations are mentioned. Different institutions may have others depending upon the availability of expertise.

Specialization Courses

Endocrinology-I	Molecular Endocrinology	2+1
Endocrinology-II	Clinical Endocrinology	2+1
Endocrinology-III	Comparative Endocrinology	2+1
Endocrinology-IV	Reproductive Endocrinology	2+1
Endocrinology-V	Environmental Endocrinology	2+1

ENDOCRINOLOGY-I: MOLECULAR ENDOCRINOLOGY

Principles of Molecular Endocrinology.

Biosynthetic pathways: Biosynthetic pathways of various hormones of endocrine glands and tissues.

Mechanisms of hormones: Hormones that act as transcription-regulatory factors, hormones that act at the cell surface, the transduction pathways from membranes to manifestation of response.

Transport of hormones: Molecular aspects of transport of the hormones.

Physiological responses: Molecular aspects of the physiological actions of the hormones of different endocrine glands.

Hormonal interactions: Biochemical targets in hormonal interactions.

LAB MOLECULAR ENDOCRINOLOGY

Experiments related to the concepts in the above theory course.

ENDOCRINOLOGY-II: CLINICAL ENDOCRINOLOGY

Clinical aspects:

Pituitary glands: Gigantism, acromegaly, dwarfism, hyperprolactinemia, alteration in gonadotrophic and corticotrophic releases; Diabetes insipidus.

Thyroid glands: Endemic goiter, myxedema, cretinism, Grave's disease, Hashimoto disease, other immunological crises with the gland.

Parathyroid glands: Clinical aspects related to hypercalcemia and hypocalcemia.

Endocrine pancreas: Diabetes mellitus, disorder of hypoglycemia.

Adrenal cortex: Cushing's syndrome, Addison disease, Hirsutism.

Adrenal medulla: Excess releases of catecholamine.

Gonads: Various anomalies of testes and ovaries leading to various clinical indispositions.

Hormones associated syndromes: Endocrine hypertension, Obesity, Anorexia nervosa, Bulimia nervosa, Disorders of vasodilator hormones.

Hormones in malignancy: Breast and prostate cancer.

Hormonal manifestations of malignancy:

ENDOCRINOLOGY-III: COMPARATIVE ENDOCRINOLOGY

Endocrine mechanisms in invertebrates: Neurosecretion, endocrine tissue and glands in lower invertebrates, annelids, mollusks, crustaceans and insects.

Evolutionary aspects of endocrine glands in lower chordates.

Comparative aspects of endocrine mechanisms in vertebrates: Evolutionary development in the position of endocrine glands in different vertebrates, diversity in the role of endocrine glands in different vertebrates.

Molecular comparative aspects: Evolution in the role of various hormones in different vertebrates such as of growth hormones, prolactin, vasopressin, thyroid hormones, insulin.

ENDOCRINOLOGY-IV: REPRODUCTIVE ENDOCRINOLOGY

Sex differentiation: The role of H-Y antigen, various endocrine and paracrine mechanisms in the development of different segments of female and male reproductive tract.

Folliculogenesis: Advance studies in ovulatory mechanism and quota of ova to be ovulated.

Spermatogenesis: Molecular mechanisms in spermatogenesis and factors influencing it.

Hypothalmo-pituitary-gonadal axis: Various feedback interactions.

Gonadotrophins: Biosynthesis and release regulating mechanisms.

Reproductive rhythms: Ultradian, infradian and other rhythms in reproduction.

Implantation.

Pregnancy maintenance.

Parturition.

Lactation.

Antifertility mechanisms.

ENDOCRINOLOGY-V: ENVIRONMENTAL ENDOCRINOLOGY

Principles in environmental endocrinology.

Environment and thyroid: Iodine in environment and its influences on thyroid functions, plant products influencing thyroid functions such as goitrogens in *Brassica* spp., drug influencing thyroid functions, environmental radiations affecting thyroid.

Environment and reproduction: Various pesticides manifesting estrogenic effects in aquatic vertebrates and through food chains the terrestrial vertebrates including human, plant products affecting reproduction such as gossypol in cotton seed oils.

Stress and adrenal cortex: Adaptation of adrenal cortex in social and environmental stresses.

Aging: Hormone status in aging and environmental supplementations from food and water.

Reference Books

Williams Text Book of Endocrinology, 2002. Wilson, J. D., Foster, D. W., Kronenberg, H. M. and Larson, P. R. (eds). W. B. Saunders Company, Philadelphia

Endocrinology, 2001. DeGroot, L. J. and Jameson, J.L. (eds). W.B. Saunders, Philadelphia.

Endocrine Physiology, 2000. Kacsoh, B. McGraw Hill Co., Inc.

Comparative endocrinology, 1997. Bentley, P.J. Springer-Verlag, New York.

Molecular endocrinology, 1994. Bolander, F.F. Academic Press, Inc.

Neurophysiology-I

Neurophysiology-II

Neurophysiology-III

Neurophysiology-IV

Neurophysiology-V

Environmental Physiology-I
Environmental Physiology-II
Environmental Physiology-III
Environmental Physiology-IV
Environmental Physiology-V

Reproduction-I
Reproduction-II
Reproduction-III
Reproduction-IV
Reproduction-V

**Thesis work and allocation of topic and literature survey will be started in third semester.

M.Phil (2 years)
Ph.D. 3-4 years

Eligibility: M.Sc. Physiology or related disciplines subject to approval of Equivalence Committee.

Course work requirements: 24 credit hours.

In M.Phil:		Total 60 Credits	
Year I	Semester-I		
	Course-I	3+1	
	Course-II	3+1	
	Course-III	3+1	
	Semester-II		
	Course-IV	3+1	
	Course-V	3+1	
	Course-VI	3+1	
		Total: 24 credits	
Year-2	Semester III and IV	Research Work	36 credits

In Ph.D.

Six courses of 24 credits may be taught in 2-3 semesters.
The rest of weightage is of Research Work.

A few of the courses are listed. Different institution may add courses according to their expertise.

Principles and Methods in Physiology	3+1
Physiology of Excitable Cells	3+1
Physiological Systems	3+1
Endocrine Physiology	3+1
Exercise Physiology	3+1
Physiology of Health, Fitness and Performance	3+1
Molecular & Clinical Endocrinology	3+1
Molecular Physiology	3+1
Diabetology	3+1
Thyroidology	3+1
Term paper in Physiology/Endocrinology	3
Seminar in Physiology/Endocrinology	2

PHYSIOLOGY FOR B. PHARMACY DEGREE

Year-1:	A course: Human Anatomy & Physiology	
	Theory	100 Marks
	Practical	100 Marks
Year-2:	A course: Human Anatomy & Physiology	
	Theory	100 Marks
	Practical	100 Marks
	Total:	400 Marks

PAPER I: ANATOMY AND PHYSIOLOGY-I (THEORY-I)

Cell

Cell Structures.

Membrane Structure: Membrane lipid, protein and carbohydrate; Membrane Transport; Passive Movement Across the Membranes, Simple Diffusion, Facilitated Diffusion, Osmosis, Filtration, Dialysis; Active Movement Across Membranes; Active Transport; Ingestion by the cell; Endocytosis; Pinocytosis and Phagocytosis; Exocytosis such as release of neurotransmitter from the vesicle; Transmembrane signaling in special reference to chemical messengers, such as neurotransmitters, hormones etc.; Receptor Operated ion channels; Receptor activated enzyme systems;

Cytoplasm: Cytosol; Organelles: Cytoskeleton, Microvilli, Ribosomes, Endoplasmic reticulum, Golgi apparatus, Lysosomes, Mitochondria, Nucleus, The Genes, Genetic Code, Transcription, Translation, Cell Division and cell differentiation apoptosis, necrosis; Cancer

Tissues:

Epithelial; Connective; Muscle; Nervous; Hypertrophy, Atrophy, Metaplasia etc

Nerve & Muscle:

Structure of The Nerve Cell; Structure of the nerve cell (Heading); Functional classification of nerve; General Structure of Neurons; Associated cells of the Nervous System; Neuroglia; Associated Cells of the Central Nervous System; Associated Cells of the Peripheral Nervous System; Degeneration and Regeneration of nerve Fiber; Regeneration in the Central Nervous System.

Neurophysiology: Membrane Potentials and Action Potentials; Basic Physics of Membrane Potential of nerve; Resting membrane potential of nerve; Nerve Action Potential; Propagation of Action Potential; Conduction of the nerve impulse, the action potential; Compound action potential; The Nerve Endings; Synaptotagmin and Synapsin-I; Types of synapse; Synaptic functions; Neuroeffector functions; Neurotransmitters, Neuroactive Peptides, Neuromodulators (choline esters, Monoamines, Amino acids etc.) and how do they produce different physiological effects.

Muscles: Classification; Structure and functions of skeletal Muscles; Nerve and Blood Vessels; Microanatomy of skeletal Muscles; T-Tubules and the sarcoplasmic reticulum; Myofibrils and Microfilaments; Sarcomere organization; Thin and Thick filaments; Sliding Filaments.

Control of Muscle fiber contraction: Structure of neuromuscular junction; Function of neuromuscular junction; Transmission of impulses from nerve to skeletal muscle and mechanism of its contraction; Drugs that effect the transmission at the neuromuscular junction; Muscle Mechanics – Complete and incomplete tetanus; Muscle Fatigue; Smooth Muscle – Structure, location, contraction and excitation of Smooth Muscle

Nervous System:

Anatomy of Central Nervous System; Structural Organization of Brain; Meninges, Ventricles and CSF, Blood Brain Barrier

Forebrain: Cerebrum; Learning and Memory; sleep and Dreams; Diencephalon; Thalamus; Hypothalamus;

Midbrain: Colliculi , Red nuclens; Substantia nigra;

Hindbrain: Medulla Oblongata; Pons; Cerebellum

Physiological and anatomical abnormalities: Alzheimers; Cerebral Palsy; Cerebrovascular Accident (CVA); Epilepsy; Headache, Pain, Thermal Sensation; Parkinsons Disease; Encephalitis

The Spinal Cord and Spinal Nerves: The Cord Reflexes; Ascending Tracts; Descending Tracts; Physiological and Anatomical Abnormalities such as spinal cord injury, poliomyelitis.

Autonomic Nervous System

Physiological and Anatomical Consideration: General Organization: Physiologic Anatomy of Sympathetic and parasympathetic Nervous System; Basic Characteristics of Sympathetic and Parasympathetic Function; Cholinergic and Adrenergic Fibers – Secretion of Acetylcholine or Noradrenaline;

Receptors on the Effector Organs; Excitatory and Inhibitory Actions of Sympathetic and Parasympathetic Stimulation; Effects of Sympathetic and Parasympathetic Stimulation on Specific Organs;

The Endocrine System: Function of the Adrenal Medullae; Sympathetic and Parasympathetic “Tone” Autonomic Reflexes; “Alarm” or “Stress” Response of the Sympathetic Nervous System; Medullary, Pontine, and Mesencephalic Control of the Autonomic Nervous System; Pharmacology of the Autonomic Nervous system; Sympathomimetic Drugs: Cholinergic Drugs; Sympatholytic and Parasympatholytic Drugs.

Sensory Physiology

Touch, smell, taste, vision, equilibrium and hearing

Endocrine System

Endocrine Glands and Hormones:

Structure and Function; Chemical Classification of Hormones; Prohormones and Prehormones; Common Aspects of Neural and Endocrine; Regulation; Hormone Interactions; Effects of Hormone Concentrations; Tissue Response; Mechanisms of Hormone Action; Hormones That Bind to Nuclear Receptor Proteins; Hormones That Use Second Messengers of Pituitary, Adrenal, Thyroid and Parathyroid, Pancreas and Other Endocrine Glands, Autocrine and Paracrine Regulation

The Reproductive System

Physiologic anatomy of male sexual organs; Spermatogenesis and its abnormalities; Male sex hormones and its functions; Abnormalities of male sexual function; Physiologic anatomy of female sexual organs; Female hormonal system; Ovarian cycle and its phases Functions of ovarian hormones; Abnormalities of secretion by the ovaries.

PAPER II: ANATOMY AND PHYSIOLOGY-I (PRACTICAL-I)

Histological Study of: Epithelial, Connective, Skeletal, Nervous tissues; Cerebrum; Hypothalamus; Spinal cord; Pituitary (Anterior and posterior); Thyroid; Parathyroid; Adrenal gland; Pancreas; Thymus; Testis; Ovaries

Gastrocnemius – sciatic Nerve Muscle preparation of frog.

Recording of simple muscle twitch and the effect of temperature, load, tetanic, fatigue, local anesthetics, cations, on nerve muscle preparation;

Demonstration of loss and regain (Sleeping time) of righting reflex.

**Tractions Test demonstration in mice (use of various sedatives)
Cumulative scoring of Leptazole induced convulsions in mice/rat**

PAPER III: ANATOMY AND PHYSIOLOGY-II (THEORY-II)

Blood

Heart and Circulation; Functions and Components of the circulatory System; Functions of the Circulatory System; Major Components of the circulatory System; Histological structure of cardiac muscle

Composition of the Blood

Plasma; The Formed Elements of Blood; Hamatopoiesis; Red Blood Cell Antigens and Blood groups; Blood Clotting; Dissolution of Clots, WBCs, Platalets.

Acid Base Balance of the Blood

Structure of the Heart: Pulmonary and Systemic Ciruclations; Atrioventricular and Semilunar Valves.

Cardiac Cycle and Heart Sounds: Pressure Changes during the Cardiac Cycle; Heart Sounds, Heart Murmers.

Electrical Activity of the heart and Electrocardiogram: Determination, Clinical significance etc.

Blood Vessels: Arteries; Capillaries; Veins

Arteriosclerosis and Cardiac Arrhythmias: Arteriosclerosis; Arrhythmias Detected by the Electrocardiogram (ECG).

Cardiac Output: Regulation of Cardiac Rate; Regulation of Stroke Volume; Venous Return

Blood Volume: Exchange of Fluid between Capillaries and Tissues; Regulation of Blood Volume by the Kidneys

Vascular Resistance to Blood Flow: Physical Laws Describing Blood Flow; Extrinsic Regulation of Blood Flow; Paracrine Regulation of Blood Flow; Intrinsic Regulation of Blood Flow.

Blood Flow to the Heart and Skeletal Muscles: Aerobic Requirements of the heart; Regulations of Coronary blood Flow; Regulation of Blood Flow through Skeletal Muscles; Circulatory Changes during Exercise

Blood Flow to the Brain and Skin: Cerebral Circulation; Cutaneous Blood Flow

Blood Pressure: Baroreceptor Reflex; Chemoreceptor Reflexes; Measurement of Blood Pressure; Pulse Pressure and Mean Arterial Pressure, Regulation of B.P.

Hypertension, Shock, and Congestive Heart Failure: Hypertension; Circulatory Shock; Congestive Heart Failure

The Lymphatic System

Lymph: Composition and cells

Lymphatic Capillaries and other Vessels: Circulation of lymph

Lymph Nodes

Tonsils

Spleen, Thymus Gland

Aggregated Lymph Nodules

Inflammation Response: Phagocytosis

The Immune System

Defense Mechanisms: Nonspecific Immunity; Specific Immunity; Lymphocytes

Functions of B Lymphocytes: Antibodies; The Complement System; Local Inflammation

Active and Passive Immunity: Active Immunity and the Clonal Selection Theory; Passive Immunity; Monoclonal Antibodies

Functions of T Lymphocytes: Thymus; Killer, Helper, and Suppressor; T Lymphocytes; Interactions between Antigen Presenting Cells and T Lymphocytes; Immunological Tolerance

Tumor Immunology: Immunotherapy for Cancer; Natural Killer Cells; Effects of Aging and Stress

Diseases Caused by the Immune System: Autoimmunity; Immune Complex Diseases; Allergy

The Urinary System

Components and Functional Anatomy of the Kidneys: Location and External Anatomy; Internal Anatomy; Blood Supply; Lymphatic; Nerve Supply; The Nephron; Glomerular (Bowman's) capsule ; Proximal convoluted tubule; Loop of the nephron (Loop of Henle); Distal convoluted tubule; Collecting duct; Juxtaglomerular apparatus

Physiology of the Kidneys

Glomerular Filtration: Mechanics of Glomerular filtration; Glomerular filtration rate; Factors affecting the Glomerular filtration rate

Tubular Re-Absorption: Transport mechanisms of tubular reabsorption

Tubular Secretion: Potassium-ion Secretion; Hydrogen-ion secretion; Plasma Clearance; Countercurrent Concentration of Urine;

Acid Base Regulation; Development of Kidney Function; Use of Diuretics

Physiological And Anatomical Abnormalities: Acute and Chronic Renal Failure etc; Infection of the urinary Tract; Congenital Abnormalities of the Urinary System.

The Respiratory System

Respiratory Tract: Nose, Pharynx, Larynx, Structure; Sound Production; Trachea; Lungs, The Respiratory Tree; Alveoli; Alveolar surface tension; Lungs: Lobes and Pleurae; Nerve and Blood Supply.

Mechanics of Breathing: Boyle's Law; Muscular control of Breathing; Amounts of Air in the Lungs

Factors Affecting Gas Movement and Solubility: Dalton's law Partial Pressure; Solubility of Gases; Pressure and solubility: Henry's Law; Diffusion of Gases.

Gas Transport: External Respiration; Internal Respiration; Transport of Oxygen in the Blood; Transport of Carbon Dioxide in the Blood; Carbon Monoxide and Hemoglobin

Neurochemical Control of Breathing: Medullary Rhythmicity Area; Apneustic and Pneumotaxic Areas of the pons; Chemical controls; Sensors and reflexes

Other Activities of the Respiratory System: Physiological and Anatomical Abnormalities; Rhinitis; Laryngitis; Asthma; Hay Fever; Emphysema; Pneumonia; Tuberculosis; Lung Cancer

The Digestive System

Structures: Basic Functions; Tissue Structure

Mouth: Lips and Cheeks; Teeth and Gums; Chewing

Tongue: Palate; Salivary Glands; Saliva and its functions; Control of Salivary secretion

Pharynx and Esophagus: Pharynx; Esophagus; Swallowing (Deglutition)

Abdominal Cavity and Peritoneum Stomach: Anatomy of the Stomach; Functions of the stomach; Digestive Movements within the stomach; Regulation of gastric emptying; Secretion of gastric juices

Small Intestine: Anatomy of the Small Intestine; Duodenum; Jejunum and ileum; Adaptations of the mucous of the small intestine; Cell types in the small intestine; Functions of the Small Intestine; Digestive movements of the small intestine; Digestive enzymes in the small intestine; Absorption from the Small Intestine; Carbohydrates; Proteins; Lipids; Water; Other substances

Pancreas as a Digestive Organ Liver as a Digestive Organ: Anatomy of the Liver; Vessels of the liver; Microscopic anatomy of

the liver; Functions of the Liver; Storage functions of the liver; Secretion of bile; Large Intestine; Anatomy of the Large Intestine; External anatomy of the large intestine; Microscopic anatomy of the large intestine; Rectum Anal Canal, and Anus; Functions of the large Intestine; Bacterial activity; Formation of feces; Movements of the large intestine and defecation

Physiological and anatomical abnormalities: Constipation and Diarrhea; Peptic Ulcers; Vomiting; Cirrhosis of liver; Hepatitis; Jaundice

The Integumentary System

Skin: Epidermis; Stratum corneum; Stratum lucidum; Stratum granulosum; Stratum spinosum; Stratum basale; Dermis; Papillary layer; Reticular layer; Hypodermis

Functions of the Skin: Protection, synthesis, sensory receptors; Temperature regulation; How a Wound Heals; Glands of the Skin; Sweat Glands; Sebaceous (Oil) Glands

Body Temperature, Temperature Regulation, And Fever

Normal Body Temperature: Body Temperature is controlled by balancing heat production against heat loss; Heat Production; Heat Loss; Regulation of Body Temperature, Role of the hypothalamus; Neuronal Effector Mechanisms That Decrease or Increase Body Temperature; Concept of a "Set-Point" for Temperature Control; Behavioral Control of Body Temperature; Local Skin Temperature Reflexes; Abnormalities of Body Temperature Regulation; Fever; Use of antipyretics

Exposure of the Body to Extreme Cold;

Skeletal System

Structure of Bone: Bone Development and Growth; Remodeling and Homeostatic Mechanisms; An overview of the skeleton; The Axial Division; The Skull; The Neck and Trunk; The Appendicular division; The upper Limb; The Lower Limb; Articulations; Integration with other systems

PAPER IV: ANATOMY AND PHYSIOLOGY-II (PRACTICAL-II)

Histological Study of : Cardiac Muscle, Smooth muscle, skeletal muscle, stomach, intestine, colon, liver, kidney, artery, vein, trachea, lung, epiglottis etc.

Effect of temp, adrenaline, acetylcholine on frog's heart.

Determination of blood groups, ESR, Hemoglobin conc, Blood volume, RBCs count, WBCs count, DLC, Bleeding time clotting

time, Haematocrit, Prothronbin time, platelet count; Recording of human blood pressure. Effect of exercise on BP and respiration rate. Determination of Tidal volume Total lung capacity etc. Effect of adrenaline on blood sugar (use of glucometer) Identification and labeling and drawing of human skeleton.

Books Recommended

Guyton and Hall. Text Book of Medical Physiology.

Carola and Harley. Human Anatomy and Physiology.

Stuart Ira Fox. Human Physiology.

Fredesie H. Martini and F Bartholomew. Essentials of Anatomy and Physiology.

Netter. Atlas of Human Anatomy.

Elaine Maries. Human Anatomy and Physiology.

Gerard Tortora. Principle of Anatomy and Physiology.

Fred E. D. Amour. Manual for Laboratory Work in Mammalian Physiology.

RECOMMENDATIONS

1. The expertise available in various disciplines of physiology in other areas like health, medicine and live stock industry and veterinary medicine be also consulted for future consideration
2. To approach regularly authorities/organizations responsible for upgradation of curriculum of physiology and where this subject is being taught like PMDC, PARC and private medical and agricultural universities, to revise their physiology curriculum for their respective degree such as MBBS, DVM B. Pharmacy, Nursing, Physiotherapy etc.
3. Physiology as an elective subject at B.Sc. pass course be inducted.
4. To make necessary arrangements for introducing/strengthening teaching of physiology at secondary and higher secondary levels for the awareness and also of public interest in health fitness.
5. To strengthen human resources developing in the teaching of physiological disciplines. Workshop/seminar/refresher courses on recent advances be arranged at a university where most of expertise are available.
6. Two papers of 200 marks each (100 theory + 100 practicals) during the two years be incorporated for the B. Pharmacy degree programme.
7. To promote writing of monographs and lab exercise note books on various disciplines of physiology at all levels the incentives be provided to physiologists.
8. Candidates holding M.Sc.(Physiology) degree need to be appointed through P.S.C. to teach the subject at Secondary and higher secondary level.

The meeting ended with a vote of thanks to the chair.

-sd-

(Prof. Dr. Abdul Majeed Cheema)
Convener

-sd-

(Prof. Dr. M. Shoaib Akhtar)
Secretary

