

# ALL INDIA INSTITUTE OF MEDICAL SCIENCES



(AIIMS), Bibinagar



Hyderabad Metropolitan Region,  
Telangana.

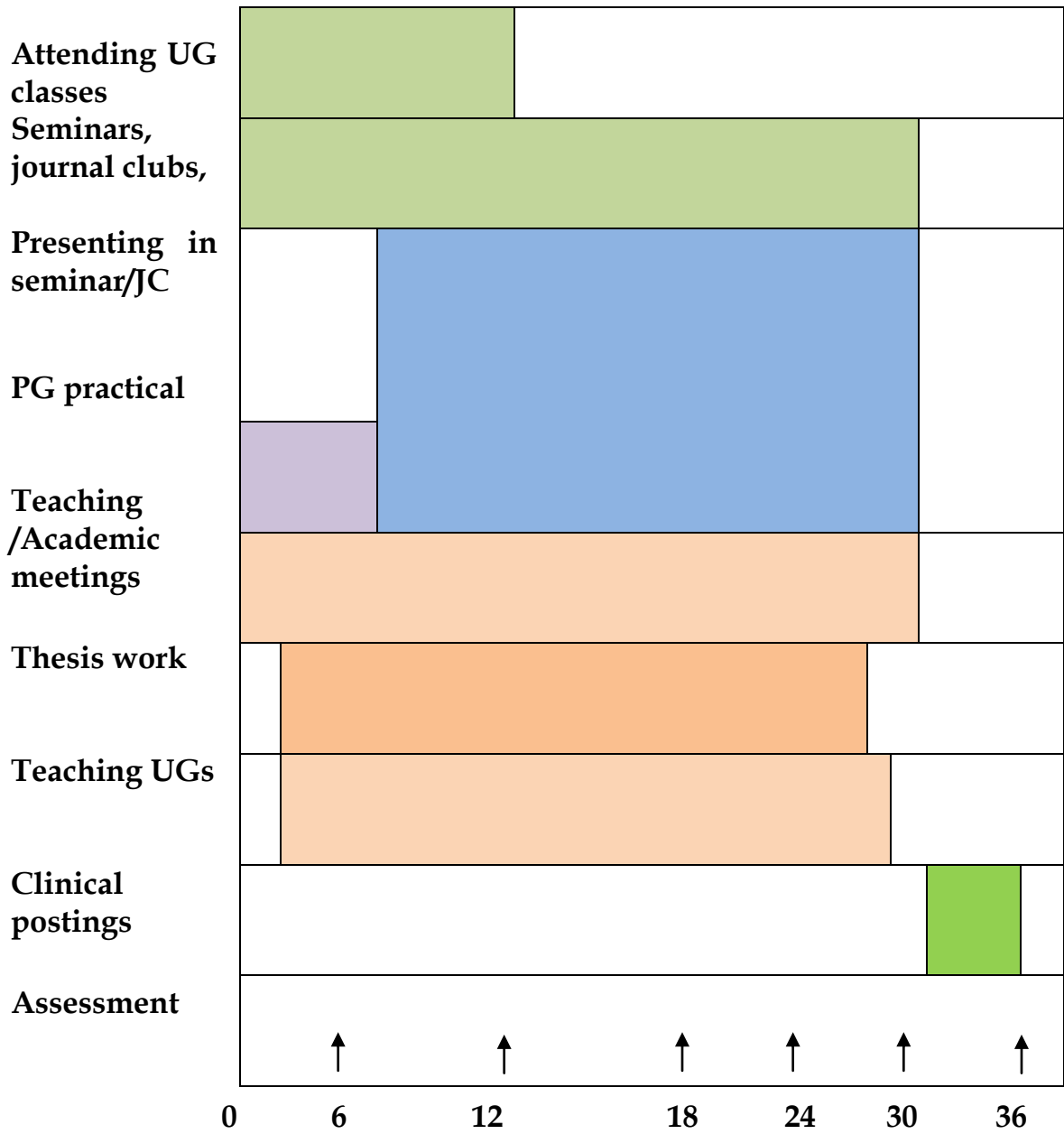
**Department of Physiology**

**PG Curriculum**

**For**

**M.D in Physiology**

**Gantt chart for activities:**





## **M.D. in PHYSIOLOGY**

### **Preamble:**

The primary aim of our institute is to develop patterns of teaching in postgraduate medical education in all the branches so as to demonstrate a high standard of medical education to all. This educational experience is imparted in an atmosphere of research.

The purpose of postgraduate teaching is to render specialist who shall provide high quality health care and take forward the basis of science through research and skills training. The purpose of the training in Physiology is to produce experts with necessary knowledge, skills and attitude to impart education and to carry out research in Physiology and shall be able to serve the community as competent physiologists and render appropriate advice and service to the clinicians as and when it is required.

The objective of this document is to provide teachers and learners illustrative guidelines to achieve defined outcomes through various teaching-learning activities along with assessment.

### **Goal:**

The goal of the training is to prepare postgraduate student, develop and encourage self directed learning for a life time by self-motivation; to acquire necessary knowledge of functions of various body systems, to facilitate understanding of the physiological basis of health and disease; to develop relevant skills and appropriate attitude to impart education and to carry out research in Physiology along with other interdisciplinary faculties and serve as competent Applied Physiologist so as to render appropriate advice and service to the clinician.



### **Outcome:**

At the end of the M.D Physiology course, the student should be able to independently perform the tests and interpret the results to correlate clinically and simultaneously incorporate their use in research and academia. These are enlisted as follows:

#### A. Cognitive domain:

- i. Should be able to explain functions of various organs along with their regulations.
- ii. Should be able to comprehend, elucidate, justify various fundamentals of varied responses, pathogenesis of diseases and its management.
- iii. Application of knowledge

#### B. Affective domain

- i. Should be able to perform tests empathically

#### C. Psychomotor domain

- i. Should be able to perform the tests/practicals effectively

### **Skills required: Should have/ be able to do**

1. Good and clear communication, Ethics and Attitude
2. General examination and Clinical Examination of all systems inpatient.
3. Acquire knowledge and be able to interpret data
  - a) ECG
  - b) EEG, EMG, NCV, ENMG, Evoked potential and other Neuro-diagnostic tests
  - c) Spirometry and PFT



### Teaching learning Activities:

1. Seminars, symposia, panel discussion of suitable topics moderated by teachers.
2. Small group discussion.
3. Dissertation work presentation.
4. Attend & participate in CME, conferences, workshops
5. Rotation in various Clinical Departments

### Systems involved:

#### Semester I

##### *a. General & Cellular Physiology*

- \_ Cell as the living unit of the body
- \_ The internal environment
- \_ Homeostasis
- \_ Control systems
- \_ Organization of a cell
- \_ Physical structure of a cell
- \_ Transport across cell membranes
- \_ Functional systems in the cells
- \_ Genetic code, its expression, and regulation of gene expression
- \_ Cell cycle and its regulation

##### *b. Hematology*

- \_ Erythrocytes
  - erythropoiesis
  - structure & function of RBCs
  - formation of hemoglobin
  - destruction & fate of RBCs
  - anemias
  - polycythemias



## Leucocytes

- general characteristics
- genesis & life span of WBCs
- classification & functions of each type of WBC

— leukopenia

— leukemias

\_ Blood groups

— classification

— antigenicity

— agglutination

— blood typing

— principles of transfusion medicine

\_ Hemostasis

— components of hemostasis

— mechanisms of coagulation

— coagulation tests

— anticoagulants

\_ Immunity

— Innate immunity

— Acquired immunity

— Allergy, hypersensitivity and immunodeficiency

— Psychoneuroimmunology

## *c. Renal Physiology & Fluid Balance*

\_ Body fluid compartments

\_ Water balance; regulation of fluid balance

\_ Urine formation

\_ Regulation of extracellular sodium & osmolarity



- \_ Renal mechanisms for the control of blood volume, blood pressure & ionic composition
- \_ Regulation of acid-base balance
- \_ Micturition
- \_ Diuretics
- \_ Renal failure

## **Semester II**

### *a. Cardio-vascular Physiology*

- \_ Properties of cardiac muscle
- \_ Cardiac cycle
- \_ Heart as a pump
- \_ Cardiac output
- \_ Nutrition & metabolism of heart
- \_ Specialized tissues of the heart
- \_ Generation & conduction of cardiac impulse
- \_ Control of excitation & conduction
- \_ Electrocardiogram
- \_ Arrhythmias
- \_ Principles of Hemodynamics
- \_ Neurohumoral regulation of cardiovascular function
- \_ Microcirculation & lymphatic system
- \_ Regional circulations
- \_ Cardiac failure
- \_ Circulatory shock

### *b. Respiration*

- \_ Functional anatomy of respiratory system
- \_ Pulmonary ventilation
- \_ Alveolar ventilation





- \_ Mechanics of respiration
- \_ Pulmonary circulation
- \_ Pleural fluid
- \_ Lung edema
- \_ Principles of gas exchange
- \_ Oxygen & carbon-dioxide transport
- \_ Regulation of respiration
- \_ Hypoxia
- \_ Oxygen therapy & toxicity
- \_ Artificial respiration
- \_ Environmental Physiology
- c. Physiology of hot environment*
- \_ Physiology of cold environment
- \_ High altitude
- \_ Aviation physiology
- \_ Space physiology
- \_ Deep sea diving & hyperbaric conditions

### **Semester III**

#### *a. Nerve & Muscle Physiology*

- \_ Resting membrane potential
- \_ Action potential
- \_ Classification of nerve fibres
- \_ Nerve conduction
- \_ Degeneration and regeneration in nerves

#### Functional anatomy of skeletal muscle

- \_ Neuro-muscular transmission and blockers
- \_ Excitation-contraction coupling
- \_ Mechanisms of muscle contraction



\_ Smooth muscle

*b. General, Sensory & Motor Physiology*

\_ General design of nervous system

\_ Interneuronal communication

\_ Classification of somatic senses

\_ Sensory receptors

\_ Sensory transduction

\_ Information processing

\_ Dorsal column & medial lemniscal system

\_ Thalamus

\_ Somatosensory cortex

\_ Somatosensory association areas

\_ Pain

\_ Organization of spinal cord for motor function

\_ Reflexes & reflex arc

\_ Brain stem & cortical control of motor function

\_ Cerebellum

\_ Basal ganglia

\_ Maintenance of posture and equilibrium

\_ Motor cortex

*c. Special Senses*

\_ Optics of vision

\_ Receptors & neural functions of retina

\_ Colour vision

\_ Perimetry

\_ Visual pathways

\_ Cortical visual function

\_ Functions of external and middle ear



- \_ Cochlea
- \_ Semicircular canals
- \_ Auditory pathways
- \_ Cortical auditory function
- \_ Deafness & hearing aids
- \_ Primary taste sensations
- \_ Taste buds

Transduction & transmission of taste signals

- \_ Perception of taste
- \_ Peripheral olfactory mechanisms
- \_ Olfactory pathways
- \_ Olfactory perception

*d. Limbic System and Higher Nervous System*

- \_ Autonomic nervous system
- \_ Limbic system and hypothalamus
- \_ EEG
- \_ Sleep
- \_ Emotions & Behaviour
- \_ Learning & Memory
- \_ Yoga

## **Semester IV**

*a. Nutrition & Metabolism*

- \_ Carbohydrates
- \_ Fats
- \_ Proteins
- \_ Minerals
- \_ Vitamins
- \_ Dietary fibre



- \_ Recommended Dietary Allowances
- \_ Balanced diet
- \_ Diet for infants, children, pregnant & lactating mothers, and the elderly
- \_ Energy metabolism
- \_ Obesity & Starvation

### **Semester V**

#### *b. Gastro-intestinal System*

- \_ General principles of G-I function
- \_ Mastication & swallowing
- \_ Esophageal motility
- \_ Salivary secretion
- \_ Gastric mucosal barrier
- \_ Pancreatic & biliary secretion
- \_ Gastrointestinal motility
- \_ Digestion & absorption
- \_ Functions of Colon
- \_ Pathophysiology of peptic ulcer and diarrheal disease

#### Liver functions

#### *c. Endocrines & Reproduction*

- \_ Classification of Hormones
- \_ Mechanism of Hormone action
- \_ Measurement of hormones in Blood
- \_ Endocrine functions of the hypothalamus
- \_ Pituitary
- \_ Thyroid
- \_ Adrenals
- \_ The endocrine pancreas
- \_ Pathophysiology of diabetes



- \_ Parathyroid, calcitonin, Vit D & calcium metabolism
- \_ Pineal gland
- \_ Testosterone & male sex hormones
- \_ Spermatogenesis
- \_ Hyper & hypogonadism
- \_ Menstrual cycle
- \_ Female sex hormones
- \_ Pregnancy & Lactation
- \_ Functions of Placenta
- \_ Parturition
- \_ Lactation

### **Semester VI**

Apart from the above topics in general and systemic physiology, the students are introduced to:

1. Biophysics
2. Biochemistry
3. Biostatistics
4. Molecular Biology
5. Medical Education
6. History of Medicine

Cardiovascular System

Respiratory System

Central Nervous System

Renal Physiology



**Various Clinical Physiology Labs and their Specific Learning Objectives are listed below:**

**1. Assessment of Cardiovascular Autonomic Function**

**Specific Learning Objectives**

1. Heart rate variability

1. State the physiological basis of heart rate variability
2. Physiological factors that affect heart rate variability
3. Enumerate the equipment that is required for estimating heart rate variability
4. Describe the procedure of conduct of each of the tests in prescribed manner
5. State the instructions that are given to subject to be done a day prior to the conduct of the test
6. Precautions that must be taken during the conduct of the tests
7. Enumerate and state the physiological meaning of the various time domain and frequency domain parameters obtained as part of estimating heart rate variability
8. Enumerate various algorithms that are used for the estimating heart rate variability
9. State the normal values of each of parameters obtained
10. Interpret the results of test in terms of normal or abnormal
11. Relate the tests to sympathetic/parasympathetic component of the cardiovascular autonomic control.
12. State the disorders in which heart rate variability is affect
13. State the diagnostic/prognostic value of heart rate variability in clinical disorders

**2. Basic cardiovascular autonomic test**



1. Enumerate the tests that are included in the Ewing's battery of tests of autonomic function
2. State the basic physiology and neural pathways underlying each of the tests
3. Enumerate the equipment that is required for the conduct of each of the tests
4. Describe the procedure of conduct of each of the tests in prescribed manner
5. State the instructions that are given to subject to be done a day prior to the conduct of the test
6. Precautions that must be taken during the conduct of the tests
7. Measure/calculate the values obtained in the each of the tests
8. State the normal values of each of the test
9. Interpret the results of each of test in terms of normal/borderline or abnormal
10. Relate the tests to sympathetic/parasympathetic component of the cardiovascular autonomic control.
11. State the disorders in which cardiovascular autonomic function is altered
12. State the diagnostic/prognostic value of heart rate variability in clinical disorders
13. State the effect of various factors like age, physical activity etc on each of the tests.

## **2. Assessment of Vascular function**

### **Specific Learning Objectives**

1. Enumerate various techniques that are employed for the assessment of vascular function



2. State the physiological basis and technical principles underlying each of these techniques
3. Enumerate the equipment that is required for performing each of the measurement
4. Relate each of the measured parameter to the different physiological components of the vascular function
5. State the precautions that must be taken during conduct of each of these tests
6. Describe the procedure of conduct of each of the tests in prescribed manner
7. State the normal values of each of the measurements
8. State the physiological factors that affect the measured parameters
9. State the diagnostic and prognostic importance of each of the measured parameters

### **3. Assessment of Cognitive Function Testing and Neuroelectrodiagnostic techniques**

#### **Specific Learning Objectives**

1. Deciding which cognitive function tests to assess based on the objectives of the study
2. Designing the test: software based scripting of the test
3. Conduction of the test
4. Recording, analysis and interpretation of the test
5. Conduct and analysis of the following cognitive function tests:
  - (i) Sternberg test
  - (ii) Stroop test
  - (iii) Picture and word memory test
  - (iv) Visuo-spatial working memory test





## 6. Conduction of the Neuroelectrodiagnostic test

- a. Nerve conduction study
- b. Electromyography (EMG)
- c. Visual evoked potential (VEP)
- d. Brainstem auditory evoked potential (BAEP)
- e. Somato- sensory evoked potential (SEP)
- f. Motor evoked potential (MEP)
- g. Electroencephalography (EEG)
- h. Electrooculography (EOG)
- i. Electronystagmography (ENG)

## 7. Recording, analysis and interpretation of the Neuroelectrodiagnostic test

### **4. Assessment of Cognitive Function Testing**

#### **Specific Learning Objectives**

1. Application of 128 electrode net on a subject
2. Setting of EEG acquisition parameters in the netstation
3. Recording of 128 channel EEG
4. Pre-processing of EEG data
5. Use of EEG analysis softwares including Matlab, EEG lab & Cartool
6. EEG analysis using including:
  - (a) Fast-Fourier Transformation (FFT) based frequency spectral analysis
  - (b) Wavelet transformation based Joint Time-Frequency Analysis (JTFA) –  
Temporal and frequency bands are analyzed simultaneously in the EEG signals.
  - (c) Source Localization



(d) Microstates analysis

## **5. Pain assessment in humans and animals**

### **Specific Learning Objectives**

1. Define pain and nociception.
2. Describe the pain pathways and state the neural mechanisms for modulation of pain.
3. Perform various pain assessment procedures (tail flick latency, hotplate test, formalin test and von Frey test) in rats.
4. Record temporal summation to assess descending facilitatory system in rats.
5. Record nociceptive flexion reflex and pain score by visual analog scale in a human subject.
6. Assess efficacy of endogenous analgesic system in humans.
7. Analyze and interpret the results obtained in both humans and rats.
8. State and follow the precautions in lieu of ethical constraints.

## **6. Whole night polysomnography**

### **Specific Learning Objectives**

1. Artifact free recording and monitoring of whole night polysomnography in human subject.
2. Scoring of sleep stages, arousals, respiratory events, cardiac events and movements.
3. PAP therapy

## **7. Yoga and Meditation**

### **Specific Learning Objective**

1. Demonstrate effects of Yoga and meditation on brain functions.



## **8. Pulmonary Function Testing**

### **Specific Learning Objective**

1. Definitions of spirometric values
2. Knowledge of anatomy, physiology and pathophysiology required for spirometry
3. Spirometry equipment including strengths and weaknesses, pitfalls and influencing factors to reference values
4. Indications and contraindications of spirometry testing
5. How to perform quality spirometry and recognition of poor quality manoeuvres
6. How to interpret spirometry tests
7. Quality assurance, including ability to correctly describe, document, and ensure quality standards and practice



### **Assessment:**

**Formative:** Continual medical knowledge, patient care, procedural and academic skills, self-directed learning and ability to practice.

1. Journals / recent advances
2. Patient based - Lab recordings and reporting
3. Self-directed learning
4. Objective structured clinical examination
5. Direct observed assessment of procedures
6. Intradepartmental and interdepartmental learning activities

### **Summative:**

1. Dissertation work presentation
2. Paper Publications
3. Examination –Theory & practicals

### **Theory Examination**

The examinations shall be organised on the basis of ‘Grading’ or ‘Marking system’ to evaluate and to certify post graduate student's level of knowledge, skill and competence at the end of the training. Obtaining a minimum of 50% marks in ‘Theory’ as well as ‘Practical’ separately shall be mandatory for passing examination as a whole. The examination for M.D./ MS shall be held at the end of 3rd academic year. An academic term shall mean six month's training period.

There should be 4 theory papers:

**Paper I:** General Physiology including history of Physiology

**Paper II:** Systemic Physiology (system providing transport, nutrition and energy)

**Paper III:** Systemic Physiology (system concerned with regulation, neural control and procreation)

**Paper IV:** Applied Physiology including recent advances



Theory Pattern for Pre- Professional and Professional Examination is as follows:

<i>Pre-Professional and Professional Examination</i>	<i>Theory Examination</i> <i>100 marks each (3 hours)</i>		<i>Practical Examination (280 marks+120 Marks Viva)</i>	
Paper I	100 marks	<i>Day 1</i>	Day 1	280 marks
Paper II	100 marks	<i>Day 2</i>		
Paper III	100 marks	<i>Day 3</i>	Day 2	120 Marks
Paper IV	100 marks	<i>Day 4</i>		
<b>Total</b>	<b>400 Marks</b>		<b>Total</b>	<b>400Marks</b>

Practical Pattern for Pre- Professional and Professional Examination is as follows:

<b>Practical Examination</b>	Headings	No. of questions	Each Q. Marks	Total Marks
<b>Day 1</b>				
OSPE 1	Stations (Other department postings).	<b>6</b>	<b>5</b>	<b>30</b>
OSPE 2	Cased based Haematology practical.	<b>2</b> (1 Long + 1 Short)	<b>35 + 15</b>	<b>50</b>
OSCE 3	Clinical case presentation.	<b>1</b>	<b>80</b>	<b>80</b>
OSPE 4	Clinical Physiology practical	<b>1</b>	<b>80</b>	<b>80</b>
OSPE 5	Viva on Amphibian & Mammalian Experiments.	<b>4</b>	<b>10</b>	<b>40</b>



<b>Total</b>	<b>280</b>
<b>Day 2</b>	
Microteaching /Pedagogy.	<b>20</b>
Grand viva including the following components: <input type="checkbox"/> Thesis (PPT presentation). <input type="checkbox"/> Discussion of physiology theory. <input type="checkbox"/> Teaching methodologies. <input type="checkbox"/> Contribution of scientists <input type="checkbox"/> Journals (Indian/Foreign). <input type="checkbox"/> Recent research advances.	<b>100</b>
<b>Total</b>	<b>120</b>
<b>Grand total</b>	<b>400</b>

### **Practical and oral examination**

Practical examination should be spread over two days and include the following components:

1. Objective Structured Practical Exam (OSPE)/ Spotters (OSCE 1)
2. Performing and reporting two special laboratory investigations (OSCE 2)
3. Problem solving exercises pertaining to Clinical Physiology (OSCE 3, 4)
4. Two animal experiments (one long and one short) illustrating mechanisms, physiological concepts and their applications to humans. It is advisable to use simulated experiments for this purpose. (OSCE 5)
5. Two human experiments (one long and one short), dealing with clinical physiology as would have significant bearing on human health and patient care. (OSCE 5)
6. Micro-teaching session for assessing communication skills. (Day 2)

Viva-voce examination should include the following components:



- (i) Theoretical discussion (General and systemic Physiology)
- (ii) Teaching techniques
- (iii) Thesis
- (iv) Eminent Physiologists (Foreign/Indian)
- (v) Journals (Indian/Foreign)
- (vi) Recent advances



## Recommended books:

### Textbooks:

- Guyton and Hall Textbook of Medical Physiology - Hall John E
- Ganong's Review of Medical Physiology- Barrett Kim E, Barman SM
- Berne and Levy Physiology- Koeppen Bruce M, Stanton Bruce
- Physiological basis of medical practice- Best and Taylor
- Comprehensive Textbook of Medical Physiology- G K Pal
- Textbook of Practical Physiology by Dr G K Pal and Dr Pravati Pal
- Hutchison's Clinical Methods: An integrated approach to Clinical Practice
- Textbook of Practical Physiology: by Dr Ranade
- Vander's Human Physiology: The mechanism of body function- Eric P. Widmaier, Hershel Raff, Kevin T. Strang
- Medical Physiology: A cellular and molecular approach- Boron Walter F, B Emile
- Keel, Samson and Wright's Applied Physiology.
- Understanding physiology, Dr. RL Bijlani

## Reference Books System-wise

### Blood:

- Williams Haematology by Kenneth Kaushansky
- Wintrobe's Clinical Hematology by John P. Greer
- Wintrobe's – Clinical Hematology

### Nerve Muscle:

- Cellular Physiology of Nerve and Muscle by Gary G. Matthews





- Essential of exercise physiology by William D. McArdle. Frank I Katch

### **Cardiovascular Physiology:**

- Levick's Introduction to cardiovascular Physiology
- Mosby physiology monograph series-Cardiovascular Physiology
- The ECG made easy by John Hampton

### **Respiratory Physiology:**

- Respiratory physiology, the essentials by Au John B West
- Pulmonary Physiology and Patho-physiology: An Integrated, Case-Based Approach by Au John B West
- J.E. Cotes- Respiratory Physiology

### **Endocrine Physiology:**

- Williams Textbook of Endocrinology

### **Gastrointestinal System:**

- Yamada's Textbook of Gastroenterology

### **Renal Physiology:**

- Vander's renal physiology

### **Central Nervous System:**

- Principles of neural science by Eric Kandel
- Clinical Neuroanatomy by Richard S. Snell
- Neurophysiology : A Conceptual Approach by Roger Carpenter
- Clinical neurophysiology by Jun Kimura

### **Clinical Examination:**

- Macleod's Clinical Examination
- Bates' Guide to Physical Examination and History Taking

### **Clinical Neurophysiology:**

- Mishra uk, Kalita J- Clinical neurophysiology



- Niedermeyer's EEG – Basic principles, Clinical application, and related fields

### **Experimental Physiology**

- D.T. Harris – Experimental Physiology

### **Medical Education:**

- Basics In Medical Education by Zubair Amin
- Principles Of Medical Education by Tejinder Singh

### **Research Methodology:**

- Research methodology methods and techniques by C R Kothari

### **Miscellaneous:**

- Harrison's Principles of Internal medicine
- Davidson's Principles and Practice of Medicine, International Edition
- Harpers Illustrated Biochemistry

### **Journals Recommended:**

- American Journal of Applied Physiology.
- Annual Review of Physiology.
- Advances in Physiological education and Recent advances in Physiology
- Journal of Physiology (British pub.)
- Indian Journal of Physiologists and Pharmacologists
- Journal of Experimental Physiology
- Indian Journal of Medical Research
- Acta Physiologica Scandivinia
- Indian J of Chest diseases and allied sciences.
- Journal of sports physiology.
- Fundament of Exercise testing: WHO publications.



- Brain
- Nature
- Lancet
- News in Physiological Sciences
- Physiological Reviews.
- The New England Journal of Medicine.

**Periodicals:**

- Annual Review of Physiology.
- Annual Review of Neuroscience.