

SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH

TAMAKA, KOLAR-563 103, KARNATAKA

M.B.B.S. Degree Course

(Phase-I Physiology subject)

REVISED CURRICULUM

2019-20

PHYSIOLOGY

****Medical Council of India, Competency based Undergraduate curriculum for the Indian Medical Graduate, 2018. Vol. 1**

GOAL:

The Goal of teaching Undergraduate students in Physiology is to make them understand the Physiological Principles and normal Homeostatic Mechanisms of normal Human body so that he/she can understand the Disease pattern better.

COURSE OUTCOME:

At the end of I MBBS Phase I, a medical student, in Physiology should be able to :

1. Elucidate the functions of organ systems in normal subject
2. Explain the various regulatory mechanisms and their integration in maintenance of Homeostasis.
3. Describe the mechanism of altered physiology on exposure to stress.
4. Apply the principles of physiology in understanding disease process.
5. Compare the normal and abnormal data & interpret the same to assess health status.
6. Comprehend basics of Reproductive physiology as relevant to National Family Welfare Programme.
7. Perform basic laboratory investigations relevant for a rural setup.
8. Demonstrate compassionate approach while examining subjects.

COURSE CONTENTS :

PY 1.1- number of the competency as represented in the MCI curriculum booklet ** where first two alphabets PY represents subject Physiology and number following alphabet reflects topic number.

SL. NO.	COMPETENCIES	CORE	NON CORE	HOURS
1	General Physiology (PY 1.1-1.9) Structure and functions of a mammalian cell; Principles of Homeostasis, Intercellular communication; Apoptosis; Transport mechanisms across cell membranes; Fluid compartments of the body; pH & Buffer systems in the body; Evaluation of functions of the cells and products in Clinical care and research.	√ √ √ √ √		(8 hrs)
2	Hematology: (PY 2.1 - 2.13) (16 hrs) Components of blood: formation, regulation and functions; plasma proteins – origin, types, variations and functions; Hemoglobin- synthesis, variants, functions and its breakdown & Jaundice; Blood indices; Anemia and its classification; Hemostasis: mechanism, regulation & disorders Anticoagulants; Blood groups, blood banking and transfusion; Immunity: types, mechanism & regulation; ESR; Lymph-composition, circulation and functions – Autoimmune disorders	√ √ √ √ √ √ √ √ √	√ √	16 hrs
3	Nerve & Muscle Physiology: (PY 3.1 - 3.18) (10hrs) Neuron and neuroglia: structures, types, functions; Resting membrane potential; Action potential in nerve, skeletal & smooth muscle; Nerve fibres: classification, functions & properties; nerve injuries, degeneration and regeneration in peripheral nerve; Neuromuscular junction: structure, transmission of impulses, neuro-muscular blocking agents, Myasthenia gravis; Muscle fibres: structure, types & functions; Muscle contraction; molecular basis (skeletal, smooth), Isotonic Vs. Isometric, Energy sources and metabolism, gradation of muscle activity; muscle dystrophy, Myopathies; Strength-duration curve	√ √ √ √ √ √ √ √ √ √ √ √		10 hrs

4	<p>Gastrointestinal Physiology: (PY 4.1 - 4.10) (10hrs) Functional anatomy and broad functions of digestive system, enteric nervous system; GI Secretions- composition, mechanism of secretion, functions, and regulation of saliva, gastric, pancreatic, intestinal juices and bile secretion; GI movements- types, regulation, functions, reflexes; role of dietary fibres; Digestion and absorption of nutrients; GI hormones- source, 67 regulation, functions; Gut-brain axis; structure and functions of liver and gall bladder; gastric function tests, pancreatic exocrine function tests & liver function tests, Pathophysiology - Achalasia cardia, peptic ulcer, gastro oesophageal reflux disease, Vomiting, diarrhoea, constipation, Adynamic ileus, Hirschsprung's disease.</p>	√ √ √ √ √ √ √ √ √ √ √ √ √ √	√ √ √	10 hrs
5	<p>Cardiovascular Physiology: (PY 5.1 - 5.16) (25hrs) Functional anatomy of heart; Pacemaker tissue and conducting system-generation, conduction of cardiac impulse; Properties of cardiac muscle; Cardiac cycle; ECG- recording, normal ECG, uses, cardiac axis, Abnormal ECG in common arrhythmias, changes with hypertrophy & MI; Haemodynamics; Heart rate-factors affecting, regulation; Cardiac output- factors, regulation, measurement; Blood pressure- components, determinants, factors, regulation and applied aspect, Regional circulation- autoregulation, microcirculation, lymphatic circulation, coronary, cerebral, capillary, skin, fetal, pulmonary and splanchnic circulation; Pathophysiology- shock, syncope, heart failure & coronary artery disease</p>	√ √ √ √ √ √ √ √ √ √ √ √		25 hrs
6	<p>Respiratory Physiology: (PY 6.1-6.10) (12hrs) Functional anatomy of respiratory tract, dead space; Mechanics of respiration; Pressure volume changes during ventilation; Lung volume and capacities; Alveolar surface tension; Compliance; Airway resistance; alveolar ventilation, V/P ratio; Diffusion capacity of lungs; Transport of respiratory gases- Oxygen and Carbon dioxide; Neural and chemical regulation of respiration; Physiology of high altitude and deep sea diving;</p>	√ √	√	12 hrs

	Principles of artificial respiration, oxygen therapy; Patho-physiology of dyspnoea, hypoxia, cyanosis, asphyxia, – drowning, periodic breathing; Lung function tests & its clinical significance		√ √	
7	Renal Physiology: (PY 7.1 - 7.9) (10hrs) Structure and functions of kidney & juxta glomerular apparatus, role of renin-angiotensin system ; Renal blood flow; Mechanism of urine formation, concentration and diluting mechanism; Concept and significance of ‘clearance’ tests; Renal regulation of fluid and electrolytes & acid-base balance; Structure and innervation of urinary bladder, physiology of micturition, cytometry, and its abnormalities; Artificial kidney(dialysis) and renal transplantation; Renal Function Tests	√ √ √ √ √ √ √ √ √ √ √		10 hrs
8	Endocrine Physiology: (PY 8.1 - 8.6) (16 hrs) Mechanism of action of steroid, protein and amine hormones; Synthesis, secretion, transport, physiological actions, regulation and effect of altered (hypo and hyper) secretion of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas and hypothalamus; Physiology of bone and calcium metabolism; Physiology of growth; Physiology of Thymus & Pineal Gland; Hormone function tests ; Obesity & metabolic syndrome; Stress response	√ √ √ √ √ √	√ √ √	16hrs
9	Reproductive Physiology: (PY 9.1 - 9.12) (10hrs) Sex determination; sex differentiation and their abnormalities; Puberty: onset, progression, stages; early and delayed puberty; Male reproductive system: functions of testis, spermatogenesis and its regulation, Cryptorchidism ; Female reproductive system: functions of ovary and its control, menstrual cycle: Hormonal, uterine and ovarian changes; Tests for ovulation; Physiological effects of sex hormones; Contraceptive methods for male and female; Effects of removal of gonads on physiological functions; Physiology of pregnancy, fetoplacental unit, pregnancy tests, parturition & lactation; Semen analysis; Causes and principles of management of infertility; Hormonal changes and their effects	√ √ √ √ √ √ √ √ √ √ √ √ √	√	10 hrs

	during perimenopause and menopause; Psychological and psychiatric disturbances associated with reproductive physiology.			
10	<p>Neurophysiology: (PY 10.1 - 10.20) (37 hrs) Organization of nervous system; Sensory system: types, functions and properties of synapse, receptors, reflex; Somatic sensations & sensory tracts; Physiology of pain; Motor system: organization, motor tracts, mechanism of maintenance of tone, control of voluntary movements ; Posture and equilibrium & vestibular apparatus; Reticular activating system, Autonomic nervous system ; Spinal cord: functional organization and lesions ; Formation, circulation and function of CSF; Blood brain barrier; Neurotransmitters. Organization, connections and functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities; Higher mental functions ; Physiology of sleep, memory, learning and speech and their disorders; EEG. Special senses- Smell and taste sensation and their abnormalities; Functional anatomy of ear and auditory pathways & physiology of hearing, Deafness, hearing tests; Functional anatomy of eye, Image formation, Visual pathway and its lesions, Physiology of vision including acuity of vision, colour vision, field of vision, refractive errors, physiology of pupil; light reflex, accommodation reflex, dark and light adaptation; Auditory & visual evoked potentials</p>	<p>√ √ √ √ √ √ √ √ √ √</p>		37hrs
11	<p>Integrated Physiology: (PY 11.1 - 11.14) (6 hrs) Temperature regulation: mechanism, adaptation to altered temperature (heat and cold environment), mechanism of fever, cold injuries and heat stroke; Exercise- cardiorespiratory and metabolic adjustments during exercise (isotonic and isometric), exercise in heat and cold, physical training effects; Physiological consequences of sedentary lifestyle; Brain death; Physiology of Infancy*; Physiology of aging-free radicals and antioxidants*; Physiology of meditation*.</p>	<p>√ √ √</p>	√	6 hrs

PRACTICALS:

The entire practical have been categorized as ‘Procedures’ and ‘Demonstrations’. The procedures are to be performed by the students during practical classes to acquire skills. Some of these would be included in the practical during University examination. Those categorized as “Demonstrations” are to be shown to students during practical classes. However, these Demonstrations would not be included in the university examinations, but questions based on these would be given in the form of data, charts, problems and case – histories, for interpretation by students.

HAEMATOLOGY

Sl.No.	CONTENTS	Skill tested
1.	Compound Microscope	DOAP
2.	Packed cell volume - Demonstration	Demonstration
3.	Erythrocyte sedimentation rate - Demonstration	Demonstration
4.	Estimation of Haemoglobin concentration	DOAP
5.	Haemocytometer	DOAP
6.	Total RBC count	DOAP
7.	Reticulocyte count	Demonstration
8.	Total Leucocyte count	DOAP
9.	Osmotic fragility	Demonstration
10.	Peripheral smear	DOAP
11.	Differential Leucocyte count	DOAP
12.	Absolute eosinophil count	DOAP
13.	Determination of bleeding time	DOAP
14.	Determination of clotting time	DOAP
15.	Platelet count demonstration	Demonstration
16.	Determination of blood groups	DOAP

HUMAN EXPERIMENTS

Sl.No.	CONTENTS	Skill
1.	Mossos's Ergograph	DOAP
2.	Spirometry	DOAP
3.	Demonstration of computerised spirometry	DOAP
4.	Peak Flow Meter	DOAP
5.	Demonstration of Electrocardiography	Demonstration
6.	Anthropometry	DOAP
7.	Demonstrate Harvard Step test	DOAP
8.	Record Arterial pulse tracing using finger plethysmography	Demonstration
9.	Clinical examination of radial pulse	DOAP
10.	Measurement of Blood Pressure	DOAP
11.	Effect of Posture on Blood Pressure	DOAP
12.	Effect of exercise on pulse & Blood Pressure	DOAP
13.	cardiovascular autonomic function tests	Demonstration
14.	Demonstrate Basic Life Support in a simulated environment	Demonstration

CLINICAL EXAMINATION

Sl.No.	CONTENTS	Skill
1	Clinical Examination of Cardiovascular System	DOAP
2	Clinical examination of Respiratory System	DOAP
3	Clinical examination of Sensory system	DOAP
4	Clinical examination of Motor system	DOAP
5	Clinical Examination of Reflexes	DOAP
6	Clinical Examination of Cranial Nerves	DOAP
7	Clinical Examination of Abdomen	DOAP

AMPHIBIAN EXPERIMENTS

Sl.No.	CONTENTS	SKILL
1	Study of apparatus	Interpretation of graphs
2	Gastrocnemius muscle sciatic nerve preparation	Interpretation of graphs
3	Recording of simple muscle twitch (smt)	Interpretation of graphs
4	Effect of strength of stimuli	Interpretation of graphs
5	Effect of repeated stimuli - fatigue	Interpretation of graphs
6	Effect of temperature on muscle contraction	Interpretation of graphs
7	Velocity of nerve impulse	Interpretation of graphs
8	Effect of two successive stimuli	Interpretation of graphs
9	Genesis of tetanus	Interpretation of graphs
10	Effect of preload and after load on muscle contraction and	Interpretation of graphs
11	Normal cardiogram of frog	Interpretation of graphs
12	Effect of temperature on normal cardiogram of frog	Interpretation of graphs
13	Effect of stannius ligature	Interpretation of graphs
14	Properties of cardiac muscle – i	Interpretation of graphs
15	Properties of cardiac muscle – ii	Interpretation of graphs
16	Long refractory period	Interpretation of graphs
17	Effect of vagal stimulation	Interpretation of graphs
18	Effect of ions on isolated frog's heart	Interpretation of graphs
19	Effect of drugs on isolated frog's heart	Interpretation of graphs

Teaching Learning Methodology: Computer Assisted Learning

SKILL CERTIFICATION:

List and number of sessions for skill certification:

	Topic	Number required to Certify as per MCI
PY5.12	Record blood pressure & pulse at rest and in different grades of exercise and postures in a volunteer or simulated environment	1 each x 3
PY6.9	Demonstrate the correct clinical examination of the respiratory system in a normal volunteer or simulated environment	1
PY 10.11	Demonstrate the correct clinical examination of the nervous system: Higher functions, sensory system, motor system, reflexes, cranial nerves in a normal volunteer or simulated environment	1 each (total 5)
PY 10.20	Demonstrate (i) Testing of visual acuity, colour and field of vision and (ii) hearing (iii) Testing for smell and (iv) taste sensation in volunteer / simulated environment	1 each (total 4)

****Learners must have completed the required certifiable competencies for that phase of training to be eligible for appearing at the final university examination of that subject.**

EARLY CLINICAL EXPOSURE:

*****Medical Council of India. Early Clinical Exposure for the Undergraduate Medical Education Training Program, 2019: pp 1-43.**

Clinical visits: 12 hours

Basic science correlations: 18 hours

Discussion based on case vignettes, graphs, clinical videos, patient in classroom setting, etc linked to various systems in physiology.

	Topic	Setting
1.	Anaemia	classroom
2.	Anthropometry for nutritional Assessment	Hospital
3.	Parkinson's signs & symptoms	classroom
4.	Refractive errors	classroom
5.	Renal Dialysis	Hospital

6.	Cerebellar dysfunction	classroom
7.	Thyroid Dysfunction	Hospital
8.	Cognition & its Assessment	classroom
9.	COPD	Hospital
10.	Cushing's syndrome	classroom

***ECE assessment should be included subject-wise

LOG BOOK:

Logbook helps the student in maintaining a record of:

- Foundation Course,
- Reflections on Early Clinical Exposure,
- Periodic assessment tests
- Certifiable skills
- Self-directed learning,
- Reflections of AETCOM module
- Feedback.

****Learners must update the log book appropriate for that phase of training to be eligible for appearing at the final university examination of that subject.**

Aligned and Integrated topics(AITO)

******Medical Council of India. Alignment and Integration Module for Undergraduate Medical Education Program, 2019: pp 1- 34**

- Anemia
- Jaundice
- Diabetes
- Thyroid Diseases
- Nutrition
- Febrile Illness
- Tuberculosis
- Malaria
- Diarrhoea
- Ischemic Heart Disease
- Polycystic Ovarian Syndrome

******Assessment for AITo will be subject based.**

AETCOM:

*******“Medical Council of India, Attitude, Ethics and Communication (AETCOM) Competencies” for the Indian Medical Graduate 2018**

First two modules of the AETCOM as prescribed in the MCI AETCOM booklet will be conducted as given below:

1. Module 1.1: What does it mean to be a doctor?

Competencies addressed:

The student should be able to:	Level
1. Enumerate and describe professional qualities and roles of a physician	KH
2. Describe and discuss the commitment to lifelong learning as an important part of physician growth	KH
3. Describe and discuss the role of a physician in health care system	KH
4. Identify and discuss physician’s role and responsibility to society and the community that she/ he serves	KH

2. Module 1.2: What does it mean to be a patient?

Competencies addressed

The student should be able to:	Level
1. Enumerate and describe professional qualities and roles of a physician	KH
2. Demonstrate empathy in patient encounters	SH

*******There should be at least one short question from AETCOM in each subject**

TEACHING HOURS AND METHODS :

1. Total Number of Hrs : 525 :

Theory Didactic Lectures	160 Hrs.
SGT/practicals/tutorials/integrated learning	310 Hrs
SDL	25 Hrs.
Total	495 Hrs
Early clinical exposure	30 Hrs
Grand total	525 hrs

2. System wise distribution of Teaching Hours :

Sl. No.	System	No. of Hrs.
1	General Physiology (PY 1.1-1.9)	08
2	Hematology: (PY 2.1 - 2.13) (16 hrs)	16
3	Nerve & Muscle Physiology: (PY 3.1 - 3.18) (10hrs)	10
4	Gastrointestinal Physiology: (PY 4.1 - 4.10) (10hrs)	10
5	Cardiovascular Physiology: (PY 5.1 - 5.16) (25hrs)	25
6	Respiratory Physiology: (PY 6.1-6.10) (12hrs)	12
7	Renal Physiology: (PY 7.1 - 7.9) (10hrs)	10
8	Endocrine Physiology: (PY 8.1 - 8.6) (16 hrs)	16
9	Reproductive Physiology: (PY 9.1 - 9.12) (10hrs)	10
10	Neurophysiology: (PY 10.1 - 10.20) (37 hrs)	37
11	Integrated Physiology: (PY 11.1 - 11.14) (6 hrs)	06

Classes may be coordinated and integrated with relevant departments on various topics as scheduled below.

3. TEACHING LEARNING METHODS:

- Didactic lectures
- Structured interactive sessions
- Small group discussion
- Team Based learning
- Problem based learning
- Focused group discussion (FGD) for Poor performers
- Practical including demonstrations

- Problem based exercises.
- Computer assisted learning
- Written case scenario
- Self-directed learning
- Integrated teaching at horizontal & vertical levels
- E-modules

4. METHODS OF ASSESSMENT:

- Modified essay question
- Short notes questions.
- MCQs
- Problem solving exercises
- OSPE
- OSCE
- Open Book tests
- Readiness Assessment test
- Records Review
- Microscopic examination
- Quiz
- Assignment
- Oral Viva Voce

5. LEARNING RESOURCE MATERIALS:

- Text books
- Reference books
- Practical note books
- Internet resources
- Video films etc.

6. LIST OF e-MODULES:

- Action potentials of nerve, muscle
- Transport across cell membrane
- Types of blood cells
- Transmission across neuromuscular junction
- Conduction system of heart
- ECG : Normal and abnormal

SCHEME OF EXAMINATION

*******Medical Council of India. Competency Based Assessment Module for Undergraduate Medical Education Training program, 2019: pp 1-30.**

Eligibility to appear for university examinations:

a. Attendance:

Attendance requirements are 75% in theory and 80% in practical for eligibility to appear for the university examinations

b. Internal assessment :

Student must secure at least 50% marks of the total marks (combined in theory and practical; not less than 40 % marks in theory and practical separately) assigned for internal assessment in a Physiology in order to be eligible for appearing at the final University examination.

Scheme for calculation of internal assessment: Total marks-80

Theory (maximum marks)	Marks	Practicals	Marks
		Practical & viva	30*
Theory written paper	30*	Logbook +record	05
Formative Assessment(Quiz,PAT,PCT, seminar,foundation course)	10	Professionalism	05
Total	40		40

Please note:

*Prior to submission to the University, the marks for each of the three internal examination theory assessments must be calculated out of 30 marks, regardless of the maximum marks.

-Only the final marks out of 40 needs to be submitted to the University, separately for Theory and practical for each internal assessment.

Theory: 40 Marks

Minimum of three internal assessments (IA) will be conducted at the end of each Block with other departments for 100 marks. Average of the best of the Three IA marks is taken into consideration for calculating the final internal assessment marks.

Marks obtained by continuous Assessment tests like Quiz, PAT, PCT, seminar will be considered for theory internal marks

Type of Questions	Number of questions	Marks for each question	Total
MCQ's	20	1	20
Long Essay	Case based-1 Normal-1	10	20
Short Essay	6	5	30
Short Answer	10	3	30
Total marks			100

Note:

- **The third internal examination is the preliminary examination which will be conducted on the lines of the university examination.**
- **Internal assessment will include questions from Early Clinical exposure, AITO, AETCOM.**
- **20% of the Internal assessment will be by MCQ's**

Practical/Viva: 40 Marks

Three practical assessments in the form of OSPE and OSCE will be conducted along with the Theory Internal Assessments. Average of best of three will be taken. Record maintenance & logbook assessed will be added to practicals. Professionalism will be a separate assessment & marks is considered for practical's.

Certifiable skills: will be evaluated as per checklist & certificate of accomplishment is awarded which is mandatory to take-up university exam.

University examination

A. Theory : 200 Marks

There shall be two theory papers of 100 marks each and duration of each paper will be of 3 hours. The pattern of questions would be of three types.

Note:

Type of Questions	Number of questions	Marks for each question	Total
Long Essay	2	10	20
Short Essay	10	5	50
Short Answer	10	3	30
Total marks			100

Distribution of chapters and suggested marks in parenthesis for Paper I and Paper II in Physiology for University examination are as follows

Paper-I

General Physiology (5) Blood (20), cardiovascular system (25), Respiratory system (20), gastrointestinal system (15), renal system (15).

1 long essay must be from CVS & 1 from RS & 1 from blood

Paper-II

Endocrine (30), Special senses (15), Reproduction (10), Central Nervous System (30), Nerve & muscle physiology (10), Integrated Physiology (5)

1 long essay must be from endocrines & 1 from CNS

*The topics assigned to the different papers are generally evaluated under those sections. However a strict division of the subject may not be possible and some overlapping of topics is inevitable. Students should be prepared to answer overlapping topics.

B. Practical: 80 Marks

There shall be two practical sessions, Practical I and II, each carrying 40 marks, each practical will be of 2 hrs, duration. The distribution of content and marks for the practical would be:

<u>Practical I:OSCE</u>	<u>40 marks</u>
<u>Clinical:</u>	
CVS/Per Abdomen	10 marks
RS	10 marks
CNS/special senses	10 marks
<u>Human experiments:</u>	10 marks
<u>Practical II:(OSPE)</u>	<u>40 marks</u>
Hematology	<u>20 marks</u>
Amphibian	<u>10marks</u>
Cases/problems	<u>10marks</u>

C. Viva-Voce Examination: 20 Marks

The viva-voce examination shall carry 20 marks and all examiners will conduct the examination.

Portions of Paper I	10 Marks
Portions of Paper II	10 Marks

SCHEME OF MARKS DISTRIBUTION

Total Marks	380
<u>University Examination :</u>	
Theory	
Paper – I	100
Paper – II	100
<u>University Examination :</u>	

Practical	80
Vivavoce	20
Internal Assessment	40
Internal Assessment	
Theory	40
Practical/viva	40

Criteria for passing university examination

- The student must **secure at least 40% marks in each of the two theory papers** with **minimum 50% of marks in aggregate** (both papers together) to pass.
- The marks obtained in the viva examination will be added to the practical marks.
- The student **must secure a minimum of 50% of marks in aggregate in the viva and practical examination** (both combined) to pass.
- Students must secure at least 50% marks of the total marks (combined in theory & practical) assigned for Internal assessment to be declared successful at the final university examination of that subject.
- A **maximum number of four permissible attempts** would be available to clear the first Professional University examination, whereby the **first Professional course** will have to be **cleared** within **4 years of admission** to the said course. Partial attendance at any University examination shall be counted as an availed attempt.
- There shall be **one main examination** in an academic year and a **supplementary** to be held **not later than 90 days** after the declaration of the results of the main examination.

RECOMMENED TEXT BOOKS AND REFERENCE BOOKS

The list of books under the section Reference books are categorized under three levels of difficulty – level one being the easiest. The books under level one are meant to provide an overall. Simple but comprehensive account of physiology. Books at level two can be considered as alternative textbooks and some of them are excellent books for further reading. Level three books are really meant for purposes of reference during advanced study in any special area of Physiology.

REFERENCE BOOKS:

Recommended Books (Latest Editions):

Sl.No.	Title
1	GUYTON (Arthur C), Text of Medical Physiology. Recent edn., Prism Publishers, Bangalore.
2	GANONG (William F), Review of Medical Physiology, Recent edn., Appleton and

3	Essentials of Medical Physiology Paperback – 2014 by A.B.S. Mahapatra (Author)
4	Textbook of Medical Physiology, 2e [Print Replica] Kindle Edition by Venkatesh D., Sudhakar H.H. (Author)
5	Comprehensive Textbook Of Medical Physiology by G K Pal, Pravati Pal, et al. 1 January 2019 VANDER et al. Human Physiology, recent edn.
6	Chatterjee's Human Physiology 11E V1 Paperback – 31 Jan 2016 by C.C.Chatterjee (Author)
7	CHAUDHURI (Sujith K), Concise Medical Physiology, New Central Books, Calcutta.
8	Textbook of Physiology (Set of 2 Volumes) (2018-19 Session) Paperback – 2019 by A K Jain (Author)
9.	Textbook of Medical Physiology by Elsevier India; 2 edition by Indu Khurana and Aarushi Khurana.

Practical Physiology:

There is no one text book on experimental physiology and that may be recommended with impunity. However, there is certainly no need for an undergraduate medical student to invest in one. Some useful books to refer to are:

1	Ghai . A textbook of practical physiology
2	McLeod, Clinical Examination
3	Hutchison & Hunter, Clinical Methods
4	AK Jain-manual of practical physiology
5	PravathiPal- Manual of practical Physiology
6	Chatterjee's Manual of practical physiology