

Human Physiology including Biophysics

Learning Objectives

At the end, a medical student, in Physiology should be able to understand

1. Functions of organ systems in a normal subject
2. Various regulatory mechanisms and their integration in maintenance of homeostasis
3. Altered physiology on exposure to stress, during disease process to diagnose and manage it relevant to other specialties.
4. Compare the normal and abnormal data; interpret the same to assess health status.
5. Reproductive physiology as relevant to National Family Welfare programme.
6. Basic laboratory investigations relevant for a rural setup
7. Concept of professionalism.
8. Approaches to the patient with humanity and compassion.

Course contents

Course contents	Must know	Desirable to know
General Physiology		
– Principles of homeostasis	+	
– Structure of cell membrane	+	
– Transport mechanisms	+	
– Intercellular communications	+	
– Fluid compartments of the body.	+	
– Cell and cell organelles	+	
– Apoptosis & Aging.		+
– Genetics Overview		+
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Blood		
- Composition and functions of blood	+	
– RBC- formation, function and anemia's	+	
– WBC- formation, functions and Leukemia's	+	
– Hemoglobin- synthesis and functions		+
– Jaundice & Hemoglobinopathies	+	
– Platelets & Plasma Proteins	+	
– Blood groups- basis of blood grouping, clinical importance, blood banking and transfusion	+	
– Haemostasis, anticoagulants		
– Immunity	+	
– Autoimmune disorders		

-	+	
Muscle and nerve physiology		+
- Structure and functions of a neuron and neuralgia	+	
- Nerve Fibre types & Function	+	
- Molecular basis of resting membrane and action potential, compound action potential	+	+
- Transmission of nerve impulse	+	
- Structure and transmission across neuro-muscular junction	+	
- Neuro-muscular blocking agents	+	
- Pathophysiology of Myasthenia gravis	+	
- Types and structure of muscle fibers	+	
- Action potential in different muscle types	+	
- Molecular basis of muscle contraction	+	
- Muscular changes during exercise	+	
- Energy sources & Metabolism in muscle	+	
- Properties of excitable tissue.	+	
Renal system		
- Structure and function of nephron	+	
- Renal circulation and kidney function	+	
- Urine formation involving processes of filtration, tubular absorption, secretion and concentration	+	
- Water diuresis and osmotic diuresis	+	
- Acidification of urine	+	
- Structure and function of a Juxta glomerular apparatus	+	
- Role of renin-angiotensin system	+	
- Fluid and electrolyte balance and its regulation	+	
- Innervations of bladder, micturition, abnormalities of micturition	+	
- Artificial kidney, dialysis and renal transplantation	+	
- Renal Function Test	+	
- Diuretics	+	+
• Digestive system		
- Basic structure of Digestive system	+	
- functions of		
• Salivary secretion		
• Gastric secretion		
• Pancreatic secretion		+
• Intestinal secretion		
• Bile		
• Gastro-intestinal hormones-source, regulation and functions	+	
• Gastro-intestinal movements	+	
	+	

<ul style="list-style-type: none"> • Pathophysiology of peptic ulcer, Gastro-oesophageal reflux disease, vomiting, diarrhoea, constipation • Liver & Bile 	+	
<ul style="list-style-type: none"> • Endocrinology <ul style="list-style-type: none"> - Gen Endocrinology, Mechanism of action of hormones - Regulation of various Imp hormones, - Physiological actions and effect of altered secretion of Pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas and hypothalamus , Growth Hormone Estimation and assessment of Hormones Pineal gland and local hormones 	+	+
<ul style="list-style-type: none"> • Reproductive system <ul style="list-style-type: none"> - Sex differentiation and aberration - Functions of testis & ovary - Spermatogenesis & factors influencing it - Menstrual cycle-hormonal, uterine and ovarian changes - Physiological changes during pregnancy and lactation - Puberty - Physiological effect of sex hormones - Pregnancy, Foeto placental unit , pregnancy tests - Menopause - Contraceptive methods (male and female methods) - Infertility 	+	+
<ul style="list-style-type: none"> • Cardiovascular system <ul style="list-style-type: none"> - - Properties of cardiac muscle - Conducting system of heart - Cardiac cycle & Heart sounds - Cardiac output & Measurement, Regulation - Haemodynamics of circulatory system - Regulation of heart rate and blood pressure and cardiac output - Electrocardiogram-physiological basis and applications. - Regional circulation-coronary, cerebral, capillary, foetal and pulmonary circulation,Muscle , skin and splanchnic - Pathophysiology of shock, coronary artery disease, hypertension - Cardio-pulmonary resuscitation - Abnormal ECG 	+	+
	+	

<ul style="list-style-type: none"> • Respiratory system <ul style="list-style-type: none"> – Functional anatomy, Non respiratory functions of lung – Mechanics of normal respiration, Compliance, work of breathing, airway resistance – Pressure changes during Respiratory cycle – Regulation of respiration – Transport of respiratory gases, Gas exchange – Lung function test-clinical significance – Principles of artificial respiration, oxygen therapy, acclimatization to high altitude and decompression sickness. – Pathophysiology –hypoxia, cyanosis and asphyxia. – Environmental physiology 	+	
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<ul style="list-style-type: none"> • Central nervous system <ul style="list-style-type: none"> – Organization of nervous system – Functions and properties of synapse, reflex, receptors. – Functions of cortex, sensory and motor pathways , basal ganglia, thalamus, hypothalamus, cerebellum and limbic system. – Structure and function of reticular activating system, autonomic nervous system – Mechanism of maintenance of tone, posture and equilibrium-vestibular apparatus – Higher functions (Memory, Learning, Speech) – Pathophysiology of Parkinsonism, section of spinal cord. – EEG and Sleep – Pain and referred pain – Regional circulation and CSF 	+	
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<ul style="list-style-type: none"> • Special senses <ul style="list-style-type: none"> – Functional anatomy of eye – Physiology of image formation, colour vision, refractive errors Visual reflexes-pupillary and light reflex – Effect of lesion for visual pathway – Pathophysiology of blindness – Functional anatomy ear – Mechanism of hearing – Pathophysiology of deafness – Perception of smell and taste sensation – Pathophysiology of altered smell and taste sensation – Auditory & visual evoke potential 	+	
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<ul style="list-style-type: none"> • Skin and body temperature regulation <ul style="list-style-type: none"> – Mechanism of temperature regulation 	+	
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Adaptation to Extreme temperature (heat and cold) Mechanism of fever, cold injuries and heat stroke.		
Physiology of growth Regulation of body pH		
Physiology of sports, exercise, yoga and meditation, Cardio-respiratory and metabolic adjustments Physiological effects of yoga and meditation		

Skills (Practicals)

A medical student, in Physiology, must be able to perform and interpret following skills:

Skill	Able to perform independently	Able to perform under guidance	Assist	Observe
Haematology				
Microscope and its parts	+			
RBC count	+			
WBC count	+			
Differential WBC count	+			
Hb estimation	+			
Eosinophil count	+			
Platelet count	+			
Clotting and bleeding time				
Blood grouping and cross matching		+		
Interpret peripheral smear – identify abnormality and anaemia	+			
Calculate various blood indices				+
Osmotic fragility test		+		
Reticulocyte count	+			
Platelet count				
Muscle and nerve physiology				
Properties of nerve and muscle to demonstrated by computer based modules				+
Mossos ergography	+			
	+			

Reproductive system	+			
Pregnancy test				+
Cardiovascular system				
History taking				
Examine peripheral arterial pulse	+			
Record arterial blood pressure using sphygmomanometer , Posttute , excercise	+	+		+
Record ECG, identify normal waves, intervals and pick up abnormalities	+			
Locate the apex beat				
Auscultate the areas of heart, appreciate heart sound, pickup abnormal sounds				
Echocardiography	+			
Respiratory system	+			
Perform spirometry (computer spirometer, if available) and interpret the recording to appreciate restrictive and obstructive airway diseases	+			
Locate the position of trachea and appreciate its deviation in disease				+
Percuss lung fields to appreciate the change in note in disease				
Auscultate lung fields appreciate the normal breath sound and pickup adventitious sounds	+			
	+			
Cardio-pulmonary resuscitation Stethography	+			
	+			
Nervous system				
Examination of Sensory system (touch, pain, pressure and temperature)	+			
Examination of motor system (nutrition, tone, power and co-ordination)				+
Examination of superficial and deep reflexes				

Examination of cranial nerves (sensory and motor division)	+			
Examination of autonomic nervous system	+			
	+			
	+			
EEG, EMG and nerve conduction studies	+		+	
			+	
			+	
Special senses				
Acuity of vision (near and distant vision)				
Colour vision				
Field of vision	+			
Tests for hearing				
Test for smell and taste				
Principle of ophthalmoscopy				
Optometry				
Audiometry				
Body temperature and metabolism				
Recording body temperature in different location				

METHOD OF ASSESSMENT:

- Modified essay question
- Microscopic examination
- Short answer questions
- MCQs
- Problem solving exercises
- OSPE,
- Records Review.
- Checklist,
- Oral Viva Voce

TEACHING LEARNING METHODS:

- Structured interactive sessions
- Small group discussion
- Focused group discussion (FGD)
- Practical including demonstrations
- Problem based exercises
- Skill labs
- Video clips
- Written case scenario
- Self learning tools
- Interactive learning
- e-modules

TIME OF EVALUATION:

There should be regular formative assessment. Formative assessment, day-to-day performance should be given greater importance. Examination of Physiology should be at the end of 2nd semester and formative assessment in middle of 1st and 2nd semester and summative assessment at the end of 2nd semester.

LEARNING RESOURCE MATERIALS

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

Topic for integrated teaching:

- 1. Digestive system**
- 2. Endocrinology**
- 3. Hematology and immunology**
- 4. Central Nervous system**
- 5. Special senses**
- 6. Renal system**
- 7. Respiratory system**
- 8. Cardiovascular system**
- 9. Reproductive system**
- 10. Musculoskeletal system**

List of e-modules

- 1. Action potentials of nerve, muscle**
- 2. Transport across cell membrane**
- 3. Types of blood cells**
- 4. Transmission across neuromuscular junction**
- 5. conduction system of heart**
- 6. ECG: Normal and abnormal**

Scheme of marks distribution

Formative assessment 20% (Total marks)

Summative assessment 80% (Total marks)

Theory 50%

Practical 50%

Marks distribution

Total 400 marks

Theory

Paper I 100 marks

Paper II 100 marks

(Each paper will have section A and B)

Section A - MCQ 30 marks

Section B Structure short answer questions
And one LQ 70 marks

Theory Internal Assessment 40 marks

Practicals & orals

Summative assessment 120 marks

Practical Internal Assessment 40 marks

Paper I

General Physiology 8 marks

Blood 20 marks

Cardio-vascular system 24 marks

Respiratory system 20 marks

Digestive system 16 marks

Renal system 12 marks

Paper II

Endocrinology 20 marks

Reproductive system	16 marks
Central Nervous system	28 marks
Special senses	16 marks
Nerve and muscle physiology	14 marks
Skin and body temperature & Exercise physiology	06 marks

SUGGESTIVE TEXTBOOKS OF PHYSIOLOGY

1. Review of Medical Physiology by W F Ganong
2. Textbook of Medical Physiology by Guyton
3. Textbook of Medical Physiology by A K Jain
4. Textbook of Medical Physiology by Beerne and Levy
5. Textbook of Medical Physiology by Best and Taylor
6. [Undrstanding medical physiology – R.L.Bijlani](#)
7. [Textbook of physiology – Vander etal](#)
8. [Textbook of physiology—Chuadhri](#)

[Suggestive practical books](#)

1. [Practical physiology by Ghai](#)
2. [Practical physiology by pravati pal](#)
3. [Practical physiology by A.K.Jain](#)