CURRICULUM OF HUMAN PHYSIOLOGY FOR MEDICAL STUDENTS

PHYSIOLOGY

1. VISION / GOAL

The broad goal of the teaching of undergraduate students in Physiology aims at providing the student comprehensive knowledge of the normal functions of the organ systems of the body to facilitate an understanding of the physiological basis of health and disease. Simultaneously focus is to inculcate requisite skills, attitudes, values and responsiveness, so that they may function appropriately and effectively as a physician of first contact of the community while being globally relevant.

2. LEARNING OBJECTIVE(overall)

Demonstrate knowledge of normal human structure, function and development from a molecular, cellular, biologic, clinical, behavioral and social perspective so that he becomes capable of fulfilling his various roles of an Indian Medical Graduate as a clinician, leader, communicator, lifelong learner and professional,

3. COMPETENCIES

(a) Knowledge /Cognitive Domain

At the end of the course the learner shall be able to:

1) Understand and explain the physiological functioning of all the organ systems and their interactions for well coordinated total body function.
2) Assess the relative contribution of each organ system to the maintenance of the milieu interior.
3) Explain various regulatory mechanisms and their integration.
4) Elucidate the physiological aspects of growth and development.
5) Describe the physiological response and adaptations to environment stresses and during disease processes.
6) List the physiological principles underlying, pathogenesis and treatment of disease.
7) Understand reproductive physiology and differences in sexual development.
8)Describe the various function tests for assessing the functioning of various organ systems.

Course content: see Appendix I

(https://www.nmc.org.in/information-desk/for-colleges/ug-curriculum)

(b) Skills/ Psychomotor Domain

At the end of the course the learner shall be able to perform and interpret following skills:

1) Conduct experiments designed for study of physiological phenomena.
2) Interpret experimental / investigative data to assess health status.
3) Distinguish between normal and abnormal data derived as a result of tests which he/she has performed and observed in the laboratory.
4) Understand basic laboratory investigations relevant for a rural set up.
5)Able to perform a physical examination and perform diagnostic maneuvers

(List of Experiments/Investigation: Appendix I)

(c) Communication Domain

1) Communicate effectively with peers, students and teachers in various teaching-learning activities.
2) Demonstrate the use of verbal and non-verbal empathetic communication techniques while communicating with patients and/or caregivers.

(d) Attitude Domain

1) Demonstrate respect for inherent dignity and autonomy of patients and their caregivers
2) Due respect in handling human body parts and gender issues that could arise during clinical examination
3) Appreciate the issues of equity and social accountability while exposing students to early clinical exposure
4) Demonstrate respect for diversity and professional behavior
5) Demonstrate ability to recognize and manage ethical and professional conflicts.

4. COURSE

Course content: see Appendix 1

General Physiology

PY1.1 Describe the structure and functions of a mammalian cell
PY1.2 Describe and discuss the principles of homeostasis
PY1.3 Describe intercellular communication
PY1.4 Describe apoptosis – programmed cell death
PY1.5 Describe and discuss transport mechanisms across cell membranes
PY1.6 Describe the fluid compartments of the body, its ionic composition & measurements
PY1.7 Describe the concept of pH & Buffer systems in the body
PY1.8 Describe and discuss the molecular basis of resting membrane potential and action potential in excitable tissue
PY1.9 Demonstrate the ability to describe and discuss the methods used to demonstrate the functions of the cells and its products, its communications and their applications in Clinical care and research.

Haematology

PY 2.1Describe the composition and functions of blood components
PY2.2 Discuss the origin, forms, variations and functions of plasma proteins
PY2.3 Describe and discuss the synthesis and functions of Haemoglobin and explain its breakdown. Describe variants of haemoglobin
PY2.4 Describe RBC formation (erythropoiesis & its regulation) and its functions

PY2.5 Describe different types of anaemias & Jaundice
PY2.6 Describe WBC formation (granulopoiesis) and its regulation
PY2.7 Describe the formation of platelets, functions and variations.
PY2.8 Describe the physiological basis of hemostasis and, anticoagulants. Describe bleeding & clotting disorders (Hemophilia, purpura)
PY2.9 Describe different blood groups and discuss the clinical importance of blood grouping, blood banking and transfusion
PY2.10 Define and classify different types of immunity. Describe the development of immunity and its regulation
PY2.11 Estimate Hb, RBC, TLC, RBC indices, DLC, Blood groups, BT/CT
PY2.12 Describe test for ESR, Osmotic fragility, Hematocrit. Note the findings and interpret the test results etc
PY 2.13 Describe steps for reticulocyte and platelet count

Nerve and Muscle Physiology

PY3.1 Describe the structure and functions of a neuron and neuroglia; Discuss Nerve Growth Factor & other growth factors/cytokines
PY3.2 Describe the types, functions & properties of nerve fibers
PY3.3 Describe the degeneration and regeneration in peripheral
PY3.4 Describe the structure of neuro-muscular junction and transmission of impulses
PY3.5 Discuss the action of neuro-muscular blocking agents
PY3.6 Describe the pathophysiology of Myasthenia gravis
PY3.7 Describe the different types of muscle fibres and their structure
PY3.8 Describe action potential and its properties in different muscle types (skeletal & smooth)
PY3.9 Describe the molecular basis of muscle contraction in skeletal and in smooth muscles
PY3.10 Describe the mode of muscle contraction (isometric and isotonic)
PY3.11 Explain energy source and muscle metabolism
PY3.12 Explain the gradation of muscular activity
PY3.13 Describe muscular dystrophy:
PY3.14 Perform Ergography
PY3.15 Demonstrate effect of mild, moderate and severe exercise and record changes in cardiorespiratory parameters
PY3.16 Demonstrate Harvard Step test and describe the impact on induced physiologic parameters in a simulated environment
PY3.17 Describe Strength-duration curve
PY3.18 Observe with Computer assisted learning (i) amphibian nerve -muscle experiments (ii) amphibian cardiac experiments

Gastrointestinal Physiology

PY4.1 Describe the structure and functions of digestive system
PY4.2 Describe the composition, mechanism of secretion, functions, and regulation of saliva, gastric, pancreatic, intestinal juices and bile secretion
PY4.3 Describe GIT movements, regulation and functions. Describe defecation reflex. Explain role of dietary fibre.
PY4.4 Describe the physiology of digestion and absorption of nutrients. Describe the source of GIT hormones, their regulation and functions
PY4.6 Describe the Gut-Brain Axis
PY4.7 Describe & discuss the structure and functions of liver and gall bladder
PY4.8 Describe & discuss gastric function tests, pancreatic exocrine function tests & liver function tests

PY4.9 Discuss the physiology aspects of: peptic ulcer, gastrooesophageal reflux disease, vomiting, diarrhoea, constipation, Adynamic ileus, Hirschsprung's disease
PY4.10 Demonstrate the correct clinical examination of the abdomen in a normal volunteer or simulated environment

Cardiovascular Physiology

PY5.1 Describe the functional anatomy of heart including chambers, sounds; and Pacemaker tissue and conducting system.
PY5.2 Describe the properties of cardiac muscle including its morphology, electrical, mechanical and metabolic functions
PY5.3 Discuss the events occurring during the cardiac cycle
PY5.4 Describe generation, conduction of cardiac impulse
PY5.5 Describe the physiology of electrocardiogram (E.C.G), its applications and the cardiac axis
PY5.6 Describe abnormal ECG, arrythmias, heart block and myocardial Infarction
PY5.7 Describe and discuss haemodynamics of circulatory system
PY5.8 Describe and discuss local and systemic cardiovascular regulatory mechanisms
PY5.9 Describe the factors affecting heart rate, regulation of cardiac output & blood pressure
PY5.10 Describe & discuss regional circulation including microcirculation, lymphatic circulation, coronary, cerebral, capillary, skin, foetal, pulmonary and splanchnic circulation
PY5.11 Describe the patho-physiology of shock, syncope and heart failure
PY5.12 Record blood pressure & pulse at rest and in different grades of exercise and postures in a volunteer or simulated environment
PY5.13 Record and interpret normal ECG in a volunteer or simulated environment
PY5.14 Observe cardiovascular autonomic function tests in a volunteer or simulated environment
PY5.15 Demonstrate the correct clinical examination of the cardiovascular system in a normal volunteer or simulated environment
PY5.16 Record Arterial pulse tracing using finger plethysmography in a volunteer or simulated environment

Respiratory Physiology

PY6.1 Describe the functional anatomy of respiratory tract
PY6.2 Describe the mechanics of normal respiration, pressure changes during ventilation, lung volume and capacities, alveolar surface tension, compliance, airway resistance, ventilation, V/P ratio, diffusion capacity of lungs
PY6.3 Describe and discuss the transport of respiratory gases: Oxygen and Carbon dioxide
PY6.4 Describe and discuss the physiology of high altitude and deep sea diving
PY6.5 Describe and discuss the principles of artificial respiration, oxygen therapy, acclimatization and decompression sickness.
PY6.6 Describe and discuss the pathophysiology of dyspnoea, hypoxia, cyanosis asphyxia; drowning, periodic breathing
PY6.7 Describe and discuss lung function tests & their clinical significance
PY6.8 Demonstrate the correct technique to perform & interpret Spirometry

PY6.9 Demonstrate the correct clinical examination of the respiratory system in a normal volunteer or simulated environment
PY6.10 Demonstrate the correct technique to perform measurement of peak expiratory flow rate in a normal volunteer or simulated environment

Renal Physiology

PY7.1 Describe structure and function of kidney
PY7.2 Describe the structure and functions of juxta glomerular apparatus and role of renin-angiotensin system
PY7.3 Describe the mechanism of urine formation involving processes of filtration, tubular reabsorption & secretion; concentration and diluting mechanism
PY7.4 Describe & discuss the significance & implication of Renal clearance
PY7.5 Describe the renal regulation of fluid and electrolytes & acid-base balance
PY7.6 Describe the innervations of urinary bladder, physiology of micturition and its abnormalities
PY7.7 Describe artificial kidney, dialysis and renal transplantation
PY7.8 Describe & discuss Renal Function Tests
PY7.9 Describe cystometry and discuss the normal cystometrogram

Endocrine Physiology

PY8.1 Describe the physiology of bone and calcium metabolism
PY8.2 Describe the 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
PY8.3 Describe the physiology of Thymus & Pineal Gland
PY8.4 Describe function tests: Thyroid gland; Adrenal cortex, Adrenal medulla and pancreas
PY8.5 Describe the metabolic and endocrine consequences of obesity & metabolic syndrome, Stress response. Outline the psychiatry component pertaining to metabolic syndrome.
PY8.6 Describe & differentiate the mechanism of action of steroid, protein and amine hormones

Reproductive Physiology

PY9.1 Describe and discuss sex determination; sex differentiation and their abnormities and outline psychiatry and practical implication of sex determination.
PY9.2 Describe and discuss puberty: onset, progression, stages; early and delayed puberty and outline adolescent clinical and psychological association.
PY9.3 Describe male reproductive system: functions of testis and control of spermatogenesis & factors modifying it and outline its association with psychiatric illness
PY9.4 Describe female reproductive system: (a) functions of ovary and its control; (b) menstrual cycle - hormonal, uterine and ovarian changes
PY9.5 Describe and discuss the physiological effects of sex hormones
PY9.6 Enumerate the contraceptive methods for male and female. Discuss their advantages & disadvantages
PY9.7 Describe and discuss the effects of removal of gonads on physiological functions
PY9.8 Describe and discuss the physiology of pregnancy, parturition & lactation and outline the psychology and psychiatry-disorders associated with it.

PY9.9 Interpret a normal semen analysis report including (a) sperm count, (b) sperm morphology and (c) sperm motility, as per WHO guidelines and discuss the results
PY9.10 Discuss the physiological basis of various pregnancy tests
PY9.11 Discuss the hormonal changes and their effects during perimenopause and menopause
PY9.12 Discuss the common causes of infertility in a couple and role of IVF in managing a case of infertility.

Neurophysiology

PY10.1 Describe and discuss the organization of nervous system
PY10.2 Describe and discuss the functions and properties of synapse, reflex, receptors
PY10.3 Describe and discuss somatic sensations & sensory tracts
PY10.4 Describe and discuss motor tracts, mechanism of maintenance of tone, control of body movements, posture and equilibrium & vestibular apparatus
PY10.5 Describe and discuss structure and functions of reticular activating system, autonomic nervous system (ANS)
PY10.6 Describe and discuss Spinal cord, its functions, lesion & sensory disturbances
PY10.7 Describe and discuss functions of cerebral cortex, basal ganglia, thalamus, hypothalamus, cerebellum and limbic system and their abnormalities
PY10.8 Describe and discuss behavioural and EEG characteristics during sleep and mechanism responsible for its production
PY10.9 Describe and discuss the physiological basis of memory, learning and speech
PY10.10 Describe and discuss chemical transmission in the nervous system. (Outline the psychiatry element).
PY10.11 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
PY10.12 Identify normal EEG forms S S Y Small group teaching OSPE/Viva voce Psychiatry
PY10.13 Describe and discuss perception of smell and taste sensation
PY10.14 Describe and discuss patho-physiology of altered smell and taste sensation
PY10.15 Describe and discuss functional anatomy of ear and auditory pathways & physiology of hearing
PY10.16 Describe and discuss pathophysiology of deafness. Describe hearing tests
PY10.17 Describe and discuss functional anatomy of eye, physiology of image formation, physiology of vision including colour vision, refractive errors, colour blindness, physiology of pupil and light Reflex
PY10.18 Describe and discuss the physiological basis of lesion in visual pathway
PY10.19 Describe and discuss auditory & visual evoke potentials
PY10.20 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

Integrated Physiology

PY11.1 Describe and discuss mechanism of temperature regulation
PY11.2 Describe and discuss adaptation to altered temperature (heat and cold)
PY11.3 Describe and discuss mechanism of fever, cold injuries and heatstroke

PY11.4 Describe and discuss cardio-respiratory and metabolic adjustments during exercise; physical training effects
PY11.5 Describe and discuss physiological consequences of sedentary lifestyle
PY11.6 Describe physiology of Infancy
PY11.7 Describe and discuss physiology of aging; free radicals and antioxidants
PY11.8 Discuss & compare cardio-respiratory changes in exercise (isometric and isotonic) with that in the resting state and under different environmental conditions (heat and cold)
PY11.9 Interpret growth charts
PY11.10 Interpret anthropometric assessment of infants
PY11.11 Discuss the concept, criteria for diagnosis of Brain death and its implications
PY11.12 Discuss the physiological effects of meditation
PY11.13 Obtain history and perform general examination in the volunteer /simulated environment
PY11.14 Demonstrate Basic Life Support in a simulated environment

5. TEACHING LEARNING METHODS

- Interactive lectures
- DOAP (Demonstration-Observation - Assistance- Performance) Sessions: Hematology experiments, Human experiments including Clinical examination, Computer assisted learning of frog and mammalian experiments, Demonstration of some human experiments
- Small Group Discussions
- Student seminars
- Graphs and charts to be made in the departments to teach different principles of physiology, as well as pathophysiology, and to provide problem-solving exercises.
- Early Clinical Exposure
- Self Directed Learning

Integration

Efforts are to be made to encourage integrated teaching between medical subjects. At the end of this teaching the student shall acquire an Integrated knowledge of organ structure, physiological and biochemical function, its regulatory mechanisms, its pathophysiology and principles of management.

AETCOM Modules

AETCOM (Attitude, Ethics & Communication) modules for the first year would be taught through various teaching learning methodologies and would also be assessed.

6. ASSESSMENT

a) Formative Assessment: Formative assessment shall be done periodically throughout the course.

i) Log Book: Log book is to be maintained to record all activities like seminar, symposia, early clinical exposure, AETCOM modules and other academic activities.It has to be submitted to the department regularly and would be assessed regularly.

ii) **Certifiable competencies:**Achievement of certifiable competencies would also be recorded in logbooks. The student must have completed the required certifiable competencies and completed the log book to be eligible for appearing at the final university examination.

b) Internal Assessment:

i) No less than three internal assessment exams shall be conducted during the course.

ii) Up To twenty percent IA marks (Theory and Practical) would be from Log book assessment.

iii) 50%combined in theory and practical (not less than 40% in each) for eligibility for appearing for University Examinations.

c) Summative Assessment:

University (Professional) examination: Will have Theory, viva and practical examinations.

i) <u>THEORY PAPERS</u>

There shall be two theory papers. The student must secure at least 40% marks in each of the papers with minimum 50% of marks in aggregate (both papers together) to pass.

Each paper shall be of 03 hours duration and 100 marks.

<u>THEORY PAPER - PHYSIOLOGY</u>

PAPER – I (100 Marks)

Topics:
Blood, CVS, Respiration, Kidney, GIT including Nutrition, and Integrated Physiology

PAPER – II (100 Marks)

Topics:
Gen Physiology, Nerve – Muscle Physiology, CNS, Special Senses, Endocrines, Reproduction and Integrated Physiology

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THEORY QUESTION PAPER FORMAT
(Applicable for Paper- I and Paper-II)

Part I

Q 1. Objective Type Questions including MCQs 10*2=20

Part II

Q 2a. Long structure question / Problem based question 10

Q2b.Physiological / Clinical significance 4*2.5 = 10

Q 3. Write Short Notes 4*5= 20

Part III

Q4 a. Long structure question / Problem based question 10

Q4 b. Explain the following: 4*2.5 = 10

Q5. Describe Briefly / Short notes 4*5 = 20

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ii) PRACTICALS & VIVA

1. Spotting/OSPE	10 marks
2. Problem solving exercise	10 marks
3. Graph and charts (including those pertaining to Amphibian nerve muscle and heart experiments)	05 marks
4. Human Experiment	15 marks
5. Haematology	15 marks
6. Clinical Exercise	10 marks
7. Practical record book	05 marks
Total	**70 marks**
VIVA	**30 marks**
Grand Total	**100 marks**

Note:

Internal Assessment: 50% combined in theory and practical (not less than 40% in each) for eligibility for appearing for University Examinations

University Examination: Mandatory 50% marks in theory and practical
(theory=theory paper(s)only)(practical= practical/clinical + viva)

Internal assessment marks are not to be added to marks of the University examinations and should be shown separately in the grade card.

A candidate obtaining 75 % marks in theory plus practicals shall be declared to have passed the subjects with Honors.

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.

7. RECOMMENDED READING

(A) TEXT
(B) **S**

1. Guyton & Hall Textbook of Medical Physiology, Second South Asia Edition- Elsevier
2. Comprehensive Textbook of Medical Physiology- G K Pal – Second Edition- Jaypee Brothers
3. Textbook of Physiology latest Ed. - A. K. Jain- Avichal
4. Understanding Physiology by Dr. R.L. Bijlani
5. Medical Physiology by Indu Khurana
6. Human Physiology latest Ed C C Chatterjee

(B) REFERENCE BOOKS

1. Ganong's Review of Medical Physiology, latest Ed. Lange Publisher
2. Lippincott's Illustrated Reviews, latest Ed. Preston & Wilson, Wolter Kluver
3. Objective Structured Practical Examination in Physiology, Aarti Sood Mahajan,Jaypee Brothers Medical Publishers (P) Ltd

(C) PRACTICAL BOOKS

1. Manual of Practical Physiology For M.B.B.S. latest Ed. – A. K. Jain Arya publications
2. Practical Physiology – V.P.Varshney & Mona Bedi – Jaypee Brothers
3. Textbook of Practical Physiology latest Ed. – G K Pal-University Press
4. Ghai's Textbook of Practical Physiology 9th Ed

(D) CLINICAL EXAMINATION

1. Bates' Guide to Physical examination and History Taking - Uzma Firdaus- Wolters Kluwer
2. Hutchinson's Clinical Methods.
3. Macleod's Clinical Examination latest ed

(E) AETCOM

Jonsen AR, Siegler M, Winslade WJ. *Clinical Ethics: A Practical Approach to Ethical Decisions in Clinical Medicine*. latest Edition. New York: McGraw-Hill, Inc., 2015

Timms O. *Biomedical Ethics*. latest Edition. Elsevier India, 2019