

PHYSIOLOGY — M D

OBJECTIVES

The M.D. (Physiology) program has the following broad and intermediate objectives:

Broad Objectives

The candidate qualifying for the award of M.D. (Physiology) should be able to:

1. demonstrate comprehensive understanding of physiology as well as that of the applied disciplines;
2. demonstrate adequate knowledge of the current developments in medical sciences as related to physiology;
3. teach undergraduates and postgraduates in physiology;
4. plan and conduct research;
5. plan educational programs in physiology utilizing modern methods of teaching and evaluation; and
6. organize and equip physiology laboratories.

Intermediate Objectives

The candidate qualifying for the award of M.D. (Physiology) should be able to:

1. demonstrate comprehensive understanding of the structure, function and development of the human body as related to physiology, all the factors which might disturb these, mechanisms of such disturbances and the disorders of structure and function, which may result from the disturbances;
2. critically evaluate the impact of the recent information on the genesis of current concepts related to various topics of physiology;
3. recapitulate the information imparted to the undergraduate students in physiology;
4. perform and critically evaluate the practical exercises done by undergraduate students;
5. identify a research problem which could be basic, fundamental or applied in nature; define the objectives of the problem and give a fair assessment as to what is expected to be achieved at the completion of the project; design and carry out technical procedures required for the study; record accurately and systematically the observations and analyze them objectively; effectively

- use statistical methods for analyzing the data; interpret the observations in the light of existing knowledge and highlight in what way his observations have advanced scientific knowledge; write a scientific paper on the lines accepted by standard scientific journals;
6. design, fabricate and use indigenous gadgets for experimental purposes;
 7. demonstrate familiarity with the principles of medical education including definitions of objectives, curriculum construction, merits and merits of various tools used in the teaching-learning process; use of learning aids and learning settings, and methods of evaluation;
 8. share learning experiences with the undergraduate and postgraduate students using appropriate pedagogical skills and methods;
 9. draw out meaningful curricula for teaching medical and paramedical courses; give lucid, interactive lectures, presenting the information in a logical, simple and comprehensive manner; generate interest and curiosity amongst the students during lectures; give practical demonstrations;
 10. organize the laboratories for various practical exercises, substitute and fabricate some of the simpler equipment for teaching purposes; and
 11. handle and order for stores, draw up lists of equipment required to equip physiology laboratories

TEACHING PROGRAMME

To achieve the above objectives in three years, we have the following structured programme.

Semester 1

1. Orientation to the department
2. Choosing the subject of thesis and guide
3. Writing the protocol
4. Recapitulation of undergraduate physiology through attending UG lectures

Semester 2

1. Physiology: theory & practical
2. Thesis work
3. Recapitulation of undergraduate physiology through attending UG lectures

Semester 3

1. Physiology: theory & practical
2. Thesis work

Semester 4

1. Physiology: theory & practical
2. Thesis work

Semester 5

1. Physiology: theory & practical
2. Submission of thesis

Semester 6

1. Clinical posting

Physiology: Theory & Practical

The theory and practical syllabus is completed in four semesters. The department conducts the semester-wise programme in a cyclic fashion so that no matter at what point a student joins the programme, he completes the course in two years. The semester-wise programme is as follows:

- I.
 - a. General & Cellular Physiology
 - b. Hematology
 - c. Renal Physiology & Fluid Balance
- II.
 - a. Cardio-vascular Physiology
 - b. Respiration
 - c. Environmental Physiology
- III.
 - a. Nerve & Muscle Physiology
 - b. General, Sensory & Motor Physiology
 - c. Special Senses
 - d. Limbic System and Higher Nervous System
- IV.
 - a. Nutrition & Metabolism
 - b. Gastro-intestinal System
 - c. Endocrines & Reproduction

Themes and Topics

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

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

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

The above topics are covered through a mix of self-learning and structured program. The structured program consists of:

1. Seminars every Saturday

The seminars are on a topic belonging to a system scheduled for the semester. The topic is presented in depth appropriate for postgraduates by one of the M.D. or M.Sc. students and moderated by a faculty member.

The seminars represent only a small and somewhat arbitrary selection of topics. They are not intended to cover an entire system. Their aims are to:

- a. introduce the system

- b. tune the students to the system
- c. cover recent advances
- d. give students practice in the art of oral presentation

2. Journal clubs and Faculty presentations, every Tuesday

The journal clubs are on an article belonging to a system scheduled for the semester. The article is presented by an M.D./M.Sc./Ph.D. student or senior demonstrator, and moderated by a faculty member. The aims of journal clubs are to:

- a. highlight recent advances
- b. discuss classical papers
- c. inculcate the faculty of critical appreciation of a research article
- d. give students and senior demonstrators practice in the art of oral presentation

Faculty presentations are usually on:

- a. medical education
- b. research methodology
- c. an area of research in which the faculty member is involved

3. Practicals

About 8-10 practical exercises are conducted every semester exclusively for M.D. (and M.Sc.) students on systems scheduled for the semester. The results obtained in these exercises are presented in teaching meetings (see below).

Besides specially designed P.G. practicals, M.D. students perform all undergraduate practicals, and also teach some of these practicals to the undergraduates.

4. Teaching meetings, every Saturday

Since M.D. students are also junior demonstrators, they are actively involved in teaching undergraduates. In the teaching meetings, the forthcoming practical exercises are discussed, and feedback on recently held exercises is obtained. These discussions are designed to improve the performance of M.D. students in teaching and related administrative responsibilities. In addition, teaching meetings are also utilized for discussion of P.G. practicals, research protocols of new P.G. students, presentation of thesis work by P.G. students prior to submission of the thesis, and any other items of interest to the teaching and research staff of the department.

5. Clinical postings

During their last semester, M.D. students are posted for two weeks each in the Departments of Medicine, Cardiology, Gastroenterology, Neurology, Endocrinology and Nephrology, and in Dr. R.P. Centre for Ophthalmic Sciences. In these postings, the students attend ward rounds and also observe the work going on in clinical physiology laboratories associated with these departments, e.g. the pulmonary function test lab, cardiac catheterization lab, and radioimmunoassay lab. The aim of these postings is to:

- a. provide the students concrete living examples of the application of physiology in diagnosis and management of disease, and to
- b. illustrate through some living examples how knowledge of physiology may grow through observations made on patients.

ASSESSMENT

In the first five semesters, an end-semester theory, practical and oral examination is conducted by the department on the systems scheduled for the semester, and a record of the internal assessment maintained. In the last (6th) semester, the students take the final M.D. examination conducted by the examination section.

SUMMARY

A summary of the M.D. (Physiology) program has been given in Fig. 1.

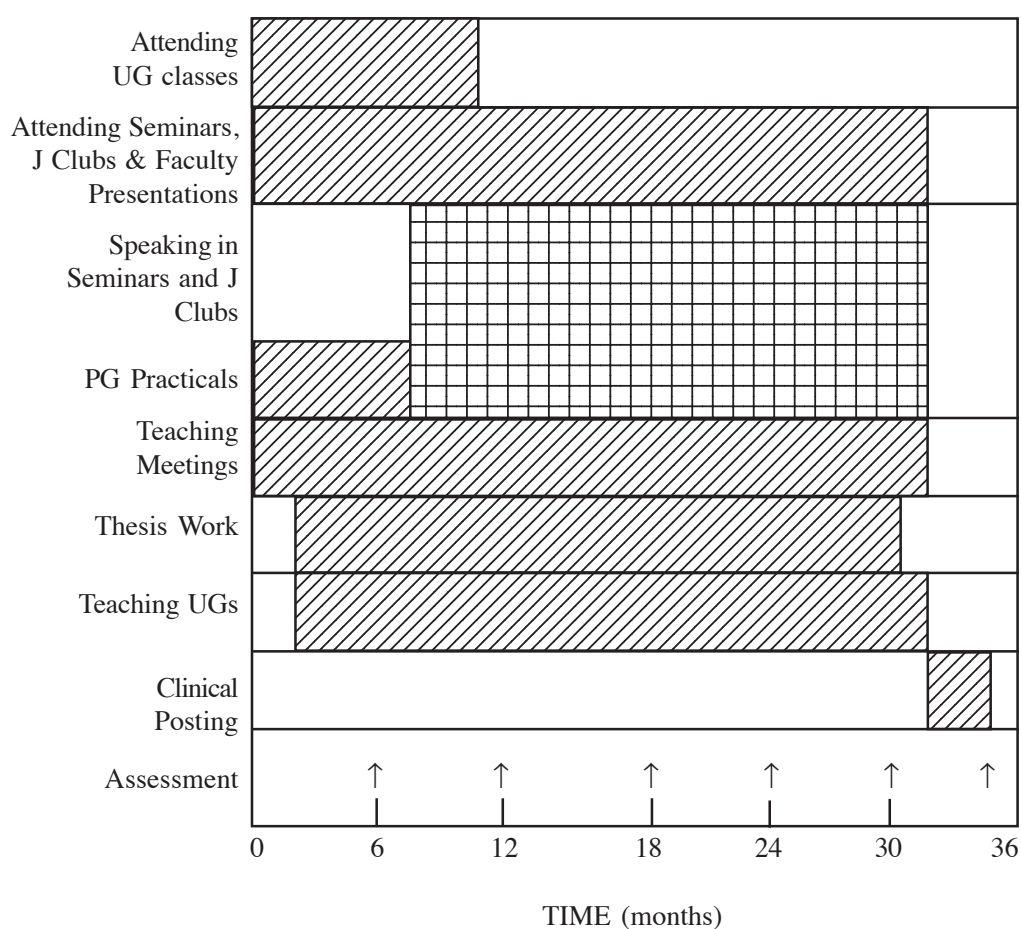


Fig.1. The M D (Physiology) program of AIIMS. The cross-hatched area is the 4-semester period during which one cycle of general and systemic physiology is completed. Light arrows, internal (formative) assessment; heavy arrow, final (summative) assessment.