PROFORMA FOR POST-GRADUATE CURRICULUM

DEPARTMENT OF: PHYSIOLOGY

1. Programme Objectives: -

   **Introduction** -

   Aim - The purpose of this programme is to standardize Physiology teaching at Post-graduate level through out of the country so that it will benefit in achieving a competent physiologist. A good medical teacher in Physiology practicing the required skills of teaching, uniformity in undergraduate teaching. Thus the training in MD Physiology should be distinctive from that in M.Sc., Ph.D.(Physiology), where the approach to the subject is primarily experimental.

2. **Specific learning Objectives:**-
   (i) Cognitive Domain  
   (ii) Psychomotor Domain  
   (iii) Affective Domain

- A candidate upon successfully qualifying in the MD (Physiology) examinations should be able to understand and deal with all aspects of general and systemic physiology.
- Effectively teach undergraduate medical, paramedical and all other basic science students, the basic physiological mechanisms of human body, with reference to their implications in the pathogenesis of diseases (pathophysiology) affecting various organ systems and the physiological basis of their management.
- Select and use appropriate teaching techniques and resources.
- Must be able to demonstrate to the students how the knowledge of physiology can effectively be used in a variety of clinical settings to solve diagnostic and therapeutic problems.
- Critically evaluate published journal literature.
- Effectively use the library facilities including computer, CD ROM and internet research.
- Conduct relevant clinical/experimental research as would have significant bearing on human health and patient care.
- Function as an effective member of a teaching or research team.
- Acquire skills in conducting collaborative research in the field of physiology and allied sciences.
- Interact with the allied departments by rendering services in advanced laboratory investigations.

3. **Post graduate Training:**-

   Based on the available facilities, department can prepare a list of Post-graduate experiments pertaining to basic and applied physiology. Active learning should form the mainstay of postgraduate training. There should be lectures for post-graduates (at
least 20 per year), along with seminars, symposia, group-discussions, Journal clubs. The post-graduate students should regularly attend the ward rounds of various clinical departments and select cases of interest for discussion with the physiology faculty. They should render special investigative services in their respective are of specialization. Each college should have a Medical Education Unit to generate teaching resource material for UG and evolving of problem solving modules.

1) **Duration of course**: Three years
2) **Eligibility**: After completion of MBBS
3) **Selection**: Entrance Exam (Delhi PG exam, All India PG Exam.)
4) **Training Programme**: Post-graduate students should be trained according to the syllabus of theory, practicals. Also they should be imparted in Physiology research. The training programme should consist of lectures, practicals, seminars, journal club and group discussions.
5) **Scope of Training and General Acquaintance**: The post-graduate students should be able to teach Under-graduate students of Physiology and conduct research independently so as to help in the advancement of medical science (preventive, diagnostic and therapeutic)

4. **Course Content:-**

I. **Knowledge:**

a. General and Cellular Physiology
   - Cell as the living unit of the body
   - The internal environment
   - Homeostasis
   - Control system
   - Organization 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 and function of RBCs
     - Formation of hemoglobin
     - Destruction and fate of RBCs
     - Anemias
     - Polycythemias
   - Leucocytes
     - General characteristics
- Genesis and life span of WBCs
- Classification and functions of each type of WBC
- Leucopenia
- Leukemias
- Blood Groups
  - Classification
  - Antigenicity
  - Agglutination
  - Blood typing
  - Principles of transfusion medicine
- Hemostasis
  - Components of hemostasis
  - Mechanism of coagulation
  - Coagulation tests
  - Anticoagulants
- Immunity
  - Innate immunity
  - Acquired immunity
  - Allergy, hypersensitivity and immunodeficiency

C. Renal Physiology and fluid Balance

- Body fluid compartments
- Water balance: regulation of fluid balance
- Urine formation
- Regulation of extracellular sodium and osmolarity
- Renal mechanisms for the control of blood volume, blood pressure and ionic composition
- Regulation of acid-base balance
- Micturition
- Diuretics
- Renal failure and Kidney Function Tests

D. Cardio-vascular Physiology

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

e. Respiration

- Functional anatomy of respiratory system
- Pulmonary ventilation
- Alveolar ventilation
- Mechanics of respiration
- Pulmonary circulation
- Pleural fluid
- Lung edema
- Principles of gas exchange
- Oxygen and carbon-dioxide transport
- Regulation of respiration
- Hypoxia
- Oxygen therapy and toxicity
- Artificial respiration
- Environmental Physiology

f. Physiology of hot environment

- Physiology of cold environment
- High altitude
- Aviation physiology
- Space physiology
- Deep sea diving and hyperbaric conditions

g. Nerve and Muscle Physiology

- Resting membrane potential
- Action potential
- Classification of nerve fibres
- Nerve conduction
- Degeneration and regeneration in nerves
- Functional anatomy of skeletal muscle
o Neuro-muscular transmission and blockers
  o Excitation-contraction coupling
  o Mechanisms of muscle contraction
  o Smooth muscle

h. General, Sensory and Motor Physiology
  o General design of nervous system
  o Interneuronal communication
  o Classification of somatic senses
  o Sensory receptors
  o Sensory transduction
  o Information processing
  o Dorsal column and medial lemniscal system
  o Thalamus
  o Somatosensory cortex
  o Somatosensory association areas
  o Pain
  o Organization of spinal cord for motor function
  o Cerebellum
  o Basal ganglia
  o Maintenance of posture and equilibrium
  o Motor cortex

i. Special Senses
  o Optics of vision
  o Receptors and neural functions of retina
  o Colour vision
  o Perimetry
  o Visual pathways
  o Cortical visual function
  o Functions of external and middle ear
  o Cochlea
  o Semicircular canals
  o Auditory pathways
  o Cortical auditory function
  o Deafness and hearing aids
  o Primary taste sensations
  o Taste buds
  o Transduction and transmission of taste signals
  o Perception of taste
  o Peripheral olfactory mechanisms
o Olfactory pathways
o Olfactory perception

j. Limbic System and Higher Nervous System

o Autonomic nervous system
o Limbic system and hypothalamus
o EEG
o Sleep
o Emotions and behavior
o Learning and memory
o Yoga

k. Nutrition and metabolism

o Carbohydrates
o Fats
o Proteins
o Minerals
o Vitamins
o Dietary fibre
o Recommended dietary allowances
o Balanced diet
o Diet for infants, children, pregnant and lactating mothers, and the elderly
o Energy metabolism
o Obesity and starvation

l. Gastro-intestinal system

o General principles of GI function
o Mastication and swallowing
o Esophageal motility
o Salivary secretion
o Gastric mucosal barrier
o Pancreatic and biliary secretion
o Gastrointestinal motility
o Digestion and absorption
o Functions of colon
o Pathophysiology of peptic ulcer and diarrheal disease
o Liver functions

m. Endocrines and Reproduction

o Classification of hormones
Mechanism of hormone action
- Measurement of hormones in blood
- Endocrine function of the hypothalamus
- Pituitary
- Thyroid
- Adrenals
- The endocrine pancreas
- Pathophysiology of diabetes
- Parathyroid, calcitonin, Vit D and calcium metabolism
- Pineal gland
- Testosterone and male sex hormones
- Spermatogenesis
- Hyper and hypogonadism
- Menstrual cycle
- Female sex hormones
- Pregnancy and lactation
- Functions of placenta
- Parturition
- Lactation

**Syllabus for practical training**

**HEMATOLOGY EXPERIMENTS.**

- Estimation of hemoglobin
- Determination of Total Erythrocyte (RBC) Count.
- Determination of RBC Indices (Blood standards)
- Determination of Total Leucocytes (WBC) count : TLC
- Preparation of a peripheral blood Smear and Determination of Differential Leukocyte Count : DLC.
- Determination of Arneth Count.
- Determination of Bleeding Time (BT) and clotting time (CT).
- Determination of Blood Groups (A,B,O and Rh system)
- Determination of specific Gravity of Blood.
- Determination of Erythrocyte Sedimentation Rate (ESR) and Packed cell volume (PCV).
- Determination of Osmotic Fragility of Red Blood Cells.
- Determination of Platelet Count.
- Determination of Reticulocyte Count.
- Determination of Absolute Eosinophil Count.
- Study of Haemopoietic Cells Present in the Bone Marrow.

**ANIMAL EXPERIMENTS.**

a. Amphibian (Frog) Experiments.
- Effect of temperature on simple muscle twitch
- Effect of two successive stimuli (of same strength)
- Effect of increasing strength of stimuli.
- Effect of increasing frequency of stimuli (genesis of tetanus)
- Effect of free load and after load.
- Effect of repeated stimuli (study of phenomenon of fatigue).
- Determination of conduction velocity of sciatica nerve and effect of variables on it.

b. Mammalian Experiments (Dog/Rabbit)

- General Management of mammalian experiments.
- Perfusion of isolated mammalian heart and study the effects of drugs and ions.
- Recording of isolated intestinal movement and tone and effect of drugs and ions.

III. Human Physiology

A. Clinical Physiology
1. Elementary principles of clinical examination
2. General Physical examination.
3. General principles of inspection/palpation/percussion/auscultation

B. Nerve Muscle Physiology

1. Ergography and hand grip spring Dynamography – study of phenomenon of human fatigue.
2. Recording of electromyography (EMG)

C. Cardiovascular system (CVS)

1. Clinical examination of CVS
2. Examination of arterial and venous pulses.
3. Measurements of arterial blood pressure.
4. Recording of 12 lead electrocardiography (ECG) and its interpretation.

D. Respiratory system

1. Clinical examination of respiratory system
2. Stethography – study of respiratory movements and effect of various factors.
3. Assessment of ventilatory functions – vitalography
5. Measurement of BMR.
6. Cardio pulmonary cerebral resuscitation and artificial respiration.
E. **Abdominal system:** Clinical examination of Abdomen.

F. **Reproductive system**

1. Determination of Ovulation time by basal body temperature chart, cervical smear and vaginal smear
2. Semen analysis: Sperm count and motility

G. **Nervous system including special senses.**

1. Clinical examination of the nervous system and its physiological basis
2. Examination of higher mental functions.
3. Examination of cranial nerves.
4. Examination of sensory system
5. Examination of motor system including reflexes
6. Clinical examination of special senses:
   (i) Smell and Taste
   (ii) Test of hearing to deafness
   (iii) Ophthalmology:
   (a) Clinical examination of the eye and papillary reflex
   (b) Visual acuity
   (c) Perimetery – mapping out of visual field and blind spot
   (d) Accommodation
   (e) Fundoscopy
   (f) Colour vision and colour blindness
7. Reaction (visual and auditory) and reflex time
8. Electroencephalography (EEG)
9. Autonomic NS (ANS) Testing
10. Neuro – electro diagnostic techniques:
    (i) Nerve conduction study
    (ii) Visual evoked potential (VEP)
    (iii) Brainstem auditory evoked potential (BAEP)
    (iv) Somato sensory evoked potential (SEP)
    (v) Motor evoked potential (MEP)

**Others:** Tests for physical fitness: Cardio-respiratory responses to steady state exercise using, lab Harvard step test; Bicycle Ergometry; treadmill test for determination of V\textsubscript{O2} max.

II. **Skills:** The Laboratory should be involved in active research in one or more well defined fields.

**Clinical Neurophysiology Laboratory**

1. Electroencephalography
2. Evoked potential recording
3. Electromyography
4. Nerve conduction studies
5. Autonomic nervous system (ANS) testing.

**Cardio-respiratory laboratory**

1. Electrocardiography and Hotler
2. Pulse plethysmograph
3. GSR recorder
4. Blood-gas analyzer
5. Computerized multifunctional spirometer with graphic displays for usual lung volumes and capacities measurement.
6. Equipment for measuring pulmonary diffusion capacity and FRC
7. Measurement of Basal metabolic rate (BMR)

**Exercise Physiology Laboratory**

1. Bicycle ergometer
2. Two step test exerciser
3. Tread Mill

**Metabolic/Endocrinology/Reproductive Bio-medicine laboratory**

This laboratory will perform various tests pertaining to Gastrointestinal, renal, metabolic, endocrinial and reproductive bio-medicine.

1. Spectrophotometer
2. pH meter
3. ELISA reader/washer
4. Luminometer
5. Semi-qutoanalyzer

5. **Evaluation:-**

I. **Internal (Formative) Assessment**: PG should be assessed regularly by theory and practical exam., seminar presentation, micro-teaching and viva-voce. The internal assessment (100 marks for theory and 100 marks for practicals) should be added to the University assessment.

II. **University (Summative) Assessment**
The post-graduate examinations should be in 4 parts:

- Thesis, to be submitted by each candidate at least 6 months before the date of commencement of the theory examination.
There should be 4 theory papers:

**Paper-I** General Physiology including History of Physiology.
- Physiology of cell; various cellular mechanisms. Genetic control mechanisms.
- Various principles of physics and physical chemistry involved in physiological phenomenon, e.g. haemodynamics, bio-electrical potentials, body fluids, methods of measurements.
- Interaction of human body in ambient environment including high altitude and deep sea.
- Sports physiology.
- Yoga and meditation.
- History of physiology

**Paper II** Systemic Physiology (system providing transport, nutrition and energy) including comparative physiology
- Blood and immunity
- Cardiovascular system.
- Respiratory system.
- Gastro intestinal tract (GIT) and dietary requirements.
- Excretion, pH, water and electrolyte balance.
- Comparative physiology.

**Paper III** Systemic Physiology (system concerned with procreation, regulation and neural control).
- Reproduction and family planning/foetal and neonatal physiology.
- Nerve-muscle physiology including muscle mechanics.
- Endocrine physiology.
- Nervous system (Central, peripheral and autonomic)
- Special senses.

**Paper IV** Applied Physiology including recent advances
- Patho-Physiology pertaining to systemic physiology,
- Physiological basis of various Evaluation Tests.
- Biostatistics, Biophysics, Biochemistry; Micro anatomy,
- Recent advances,
- Growth and development including ageing.

**Practicals:**
Should be spread over 2 days and include the following components:
1. Spotting.
2. Problem solving exercises pertaining to clinical physiology.
3. Performing and reporting two special laboratory investigations.
4. Two animal experiments (one long and one short) illustrating mechanisms, physiological concepts and their applications to humans.
5. Two human experiments (One long and one short), dealing with clinical physiology as would have significant bearing on human health and patient care.
6. Micro-teaching session for assessing communications skills.
7. Viva-voce should include the following components:
   - Text discussion general and systemic physiology
   - Teaching techniques
   - Thesis
   - Scientists contribution to Physiology (Foreign / Indian).
   - Research advances.

I. Theory
1. Four theory papers each of 03 hours duration (100 marks each with minimum of 3 questions) 400
2. Internal Assessment 100
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Total Theory 500  
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II. Practical
1. Spotting (2x10=20)
2. Problem solving (10x2=20)
3. Two special investigation (15x2=30)
4. Two long experiments
   (one each animal and human)(60x2=120)
5. Two short experiments
   (one each animal and human)(30x2=60)
6. Micro teaching (50)
7. Viva voce (100) 400
8. Internal assessment 100
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Total Practical 500  
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Note:
1. Minimum of 50% marks in theory and 50% in practicals including viva voce are required to declare pass in the subject.
2. a candidate obtaining ≥ 80% marks separately in theory and practicals including viva voce will be declared to have passed the subject with honors.
SUGGESTIONS MADE BY MEDICAL COLLEGES UNDER DELHI UNIVERSITY FOR UG/PG COURSES (PHYSIOLOGY).

PG CURRICULUM

A. PG curriculum should include the entire UG curriculum.
B. In each of the topics, PG should be up to date with recent advances.
C. Research methodology and biostatistics must be made a part of the curriculum.
D. Maintenance of practical file should be compulsory.
E. PG should be assessed during their 3 years of MD. PGs should attend all UG lectures, practicals, tutorials and give exams.
F. Multi-disciplinary seminars for PGs of Pre/Para and clinical subjects should be incorporated in the academic calendar.
G. The final theory exam (MD Final) should have structured long questions designed to evaluate the understanding of the subject by post graduates.
H. The final practical exam should include spotting.
I. A log book should be maintained by the PG students and it should be evaluated at the time of final examination.
J. There should be regular classes in the statistic at least in the first year of PG. It is recommended that rather than a continuous schedule these classes should be spread out over a period of six to nine months so that the students are in continuing with the concepts rather than just being taught at one time.
K. The postgraduate student should at least be posted in the departments of Biochemistry, Pathology, Medicine, Gynae & Obst. & Pediatrics on rotation basis for a particular period of time and clinical case presentation should be introduced. The student should be able to explain the physiological basis of various signs and symptoms and biochemical derangements pertaining to various organ systems.

UG Curriculum

A. Duration of the course should be at least 15 months.
B. The final practical university exam (1st professional MBBS) should include spotting.
C. In the pattern of theory examinations definitions, normal values and MCQs are not to be included instead the Final University exam (1st Professional MBBS) should have structured long questions.
D. Few topics on yoga, sports, exercise, neonatal, Physiology should have detailed lectures and practical training exercises.
RECOMMENDED BOOKS

1. Keel, Samson and Wright’s Applied Physiology.
2. Best and Taylor – Physiological Basis for Medical Practice.
5. Text books of Physiology Vol I & II Dr. A.K. Jain.
6. Manual of practical physiology, Dr. AK Jain.
7. Understanding physiology, Dr. RL Bijlani.
13. JE Cotes – Respiratory Physiology.
14. DT Harris – Experimental Physiology.
15. Wintrobe’s – Clinical Haematology.

JOURNALS

3. Advances in Physiological education and Recent advances in Physiology.
4. Journal of Physiology (British pub.)
7. Indian Journal of Medical Research.
10. J sports physiology.