

# Study & Evaluation Scheme

of

## Doctor of Medicine MD (Physiology) 2011-12



TEERTHANKER MAHAVEER MEDICAL COLLEGE & RESEARCH CENTRE  
**TEERTHANKER MAHAVEER UNIVERSITY**  
Delhi Road, Moradabad, Uttar Pradesh-244001  
Website: [www.tmu.ac.in](http://www.tmu.ac.in)

# **P.G. Curriculum M.D. Physiology**

## **Index**

1. Goal
2. Objectives
3. Syllabus
4. Teaching Program
5. Posting
6. Thesis
7. Assessment
8. Job Responsibilities
9. Suggested Books

# **P.G. Curriculum**

## **M.D. Physiology**

The infrastructure and faculty of the department of Physiology will be as per MCI guidelines.

### **1. Goals;**

The goal of MD Course in Physiology is produce a competent physiologist and a good medical teacher who:

- ❖ Is able to demonstrate comprehensive understanding of physiology as well as that of applied disciplines;
- ❖ Has acquired skills in effective teaching and communicating with medical and paramedical students;
- ❖ Is oriented to principles of research methodology and is thus able to plan and conduct research effectively;
- ❖ Is able to plan educational programmes in physiology utilizing modern methods of teaching and evolution;
- ❖ Is able to organize and equip physiology labs.

### **2. Objectives**

At the end of MD Course in Physiology, the student should be able to:

- ❖ Demonstrate Comprehensive understanding of the structure, function and development of human body as related to physiology, all the factors which might disturb these, mechanism of such disturbances and the disorders of structure and function;
- ❖ Critically evaluate the impact of recent information on the genesis of current concepts related to various topics of physiology;
- ❖ Recapitulate the information imparted to the UG students in physiology;
- ❖ Perform and critically evaluate the practical exercise done by UG students;
- ❖ Demonstrate competence in basic concepts of research methodology, effectively use the statistical methods and write a scientific paper on the lines accepted by standard scientific journals;
- ❖ Design, fabricate and use indigenous gadgets for experimental purposes;
- ❖ Demonstrate familiarity with the principles of medical education;
- ❖ Draw out meaningful curricula for teaching medical and paramedical courses;
- ❖ Organize the labs for various practical exercises, substitute and fabricate some of the simpler equipment for teaching purpose;
- ❖ Handle and order for stores, draw up lists of equipment required to equip physiology labs;
- ❖ Develop skills as a self directed learner, recognize continuing educational needs; use appropriate learning resources and critically analyze relevant published literature;
- ❖ Organize and supervise the desired managerial and leadership skills;
- ❖ Function as a productive member of team engaged in research and education.

# 3.Syllabus

## 3.1. Theory

### ❖ General and Cellular

#### Physiology

- General functional organization of human body
- Cell-organelles and their functions.
- Cell to cell and local communications, Transport across cell membrane
- Body fluid compartments : Define and explain
- Homeostasis : Definition, maintenance, control of internal environment, different regulatory systems in homeostasis.
- Principles of control systems :
- General characteristics and components of biological control system.
  - ❖ Concept of negative and positive feedback
  - ❖ Correction, error and feedback gain
  - ❖ Hormonal control mechanism : Definition of hormones, receptors and target cells. Role of hormones in homeostasis.
  - ❖ Neural control of mechanism : Role in homeostasis.
- Technology : Stimulus, excitability, conductivity, contractility, refractory period, chronaxie, rheobase, summation etc,
- Receptor generator potential, properties and transduction
- Synapses ultrastructure, properties, synaptic plasticity, neurotransmitters and mode of transmission.

### ❖ Nerve and muscle physiology

- Structure and functions of a neuron and neuroglia.
- Nerve fibre types, function and nerve injury.
- Molecular basis of resting membrane and action potential, compound action potential, Recording.
- Structure and transmission across neuro-muscular junction.
- Neuro-muscular blocking agents.
- Pathophysiology of Myasthenia gravis and other applied aspects of NM junction.
- Types and structure of muscle fibers.
- Action potential in different muscle types.
- Molecular basis of muscle contraction.
- Muscular changes during exercise.
- Energy sources and metabolism in muscle.
- Properties of excitable tissue.
- EMG.

### ❖ Autonomic nervous system

- Anatomical organization of nervous system :
- Functional organization of nervous system : Divisions, distribution and functions.
- Higher control of autonomic nervous system.
- Physiological role of autonomic nervous system.
- Pharmacology of autonomic nervous system.

### ❖ Blood, reticulo-endothelial and immune system

- Blood as a body fluid : Composition and functions of blood.
- Plasma: Normal constituents.

- Plasma Proteins : Types, concentrations, properties and functions.
- Blood cells : Types, distribution and overview of haematopoiesis.
  - ❖ Erythrocytes – morphology, functions, fate, normal count, PCV, ESR, Fragility, haemolysis.
  - ❖ Erythropoiesis definition, stages and regulating factors.
  - ❖ Blood indices and their clinical usefulness.
  - ❖ Anaemias and polycythemia
  - ❖ Leukocytes classification, morphology, normal counts, functions, development and related applied aspects.
  - ❖ Platelets morphology, functions, development and related applied aspects.
- Blood groups: Agglutinogens and agglutinins, landsteiner's law, ABO and Rh group, minor blood groups
- Blood transfusion relation of blood groups, indications, hazards and storage of blood, inheritance, hemolytic disease of the new born.
- Haemostasis : Physiology of coagulation, tests for clotting, clot retraction, and anticoagulation, Bleeding and coagulation disorders.
- Reticuloendothelial system: Functions of spleen and lymph nodes.
- Lymph and tissue fluids : Formation and functions.
- Immunity and its disorders.
  
- ❖ **Respiratory system:**
  - Functional anatomy of respiratory system
  - Mechanics of breathing : Movements of thoracic cage during respiration, muscles involved and their nerve supply, intrapleural and pulmonary pressure and volume changes, pressure-volume inter-relationships, lung compliance – surfactant, airway resistance, work of breathing.
  - Spirometry, lung volumes & capacities : Definitions, normal values, significance and special features.
  - Pulmonary gas exchange : Alveolar-capillary membranes, diffusion capacities,
  - partial pressure gradients and factors influencing diffusion of gases, measurement of diffusion capacity using carbon monoxide.
  - Applied physiology shunt and alveolar-capillary block
  - Ventilation perfusion ratio and its importance in respiratory diseases.
  - Gas Transport
    - ❖ Oxygen transport – factors influencing the combination of haemoglobin with oxygen, oxygen dissociation curve- plotting, features, physiological advantage of its shape, factors affecting its shift and Bohr's effect.
    - ❖ Carbon dioxide transport – tissue uptake, carriage in blood and release at the lungs importance of red blood cell, chloride shift, role in acid base balance, Haldane effect.
  - Regulation of respiration : Neural control – medulla, pons and vagus
  - Chemo-receptors: peripheral and central, chemical and non-chemical influences on respiration, integrated responses.
  - Respiration in unusual environments : High altitude hypoxia and space flight
  - Deep sea diving: nitrogen narcosis, Hyperbaric oxygen and oxygen toxicity.
  - Abnormal breathing : Apnoea, hyperpnoea, tachypnoea, dyspnoea, Chyne- stokes breathing and Biot's breathing- definition, features and physiological basis.
  - Hypoxia, cyanosis.
  - Artificial respiration: Definition, types, principles, indications, advantages and disadvantages.
  - Pulmonary function tests

- Pulmonary abnormalities.

#### ❖ **Cardiovascular system :**

- Heart as a mechanical pump : Design of systemic and pulmonary circulation.
- Introduction of the venous pressure, flow and resistance. Types of blood vessels and their functions.
- Properties of myocardial cells : Site of generation of cardiac impulse- pace maker tissue.
- Mechanisms of spontaneous generation of impulses.
- Specialized conducting system and its importance
- Electrical properties of working myocardial cells.
- Molecular basis of contraction and excitation contraction coupling (in brief)
- All or none phenomenon, length-tension relationship.
- Frank-Starling Law, neural influences.
- Effect of ions and chemical on myocardial contractility.
- Cardiac cycle : Mechanical and electrical events, pressure volume relationship
- Electrocardiography : Definition, uses, principle, waves and their explanations.
- ECG recording techniques
- Cardiac arrhythmias and their ECG interpretation
- Cardiac output : Definition, normal values and variations, major determinants of cardiac output and regulation, Heart-lung preparation – measurement of cardiac output, Fick's principle and its application, indicator dye methods of measurement, Regulation of heart rate and stroke volume.
- Haemodynamics : Definition of terms- pressure, flow, resistance, velocity etc.
- Laminar and turbulent flow, Poiseuille law, factors affecting blood flow and resistance, critical closing pressure
- Various types of circulation, local regulation of blood flow to tissues.
- Arterial Blood Pressure : Definition, normal value, variations, measurement, mean arterial pressure (MAP) and its determinants.
- Short term reflex control: baroreceptors and their significance. Mechanism of reflex control and its limitations.
- Long term control: renal body fluid – pressure control mechanism, hypertension.
- Regional circulation : Coronary, cerebral, cutaneous, splanchnic, skeletal muscle and foetal. Normal values, special features and regulation.
- Cardiovascular changes during exercise.
- Cardiac failure, circulatory shock.

#### ❖ **Gastrointestinal system :**

- Introduction to gastrointestinal Physiology : Functions of GI System – individual parts. Innervation of the gut, regulation of GI functions – general overview.
- Oral Cavity : Mastication and digestion in mouth and its importance.
- Salivary secretion: mechanism, composition, functions and regulation.
- Physiology of deglutition : Definition, stages and neural control and applied aspects.
- Stomach : Overview of functions
  - ❖ Physiology of gastric secretion – mechanism, composition, function and control.
  - ❖ Experimental procedures to elucidate and phases of gastric secretion.
  - ❖ Gastric motility – characteristics and control, gastric emptying and antral pump mechanism, peptic ulcer.
- Pancreatic secretions: Composition, mechanism, functions and control.
- Small intestine : Secretion, movement and control.

- Large intestine : Functions, secretions, movements.
- Gastrointestinal hormones and their role in secretomotor functions of the gut.
- Defaecation : Mechanism and control.
- Physiology of vomiting, diarrhoea, constipation.
- Digestion and absorption.
- Nutrition and vitamins.
- ❖ **Hepatobiliary system :**
  - Liver : Functions
  - Entero hepatic circulation
  - Bile formation, secretion, regulation and jaundice
  - Physiological basis of liver function tests
  - Gall bladder: Functions, Mechanism and regulation of gall bladder contraction, applied aspects and Oral cholecystography
- ❖ **The Body Fluids and Renal Physiology**
  - Body fluid compartments and its regulation.
  - Renal circulation.
  - Urine formation involving processes of filtration, tubular reabsorption, secretion and concentration.
  - Water diuresis and osmotic diuresis.
  - Regulation of acid base balance.
  - Structure and function of a Juxta glomerular apparatus.
  - Renal mechanisms for the control of volume, blood pressure and ionic composition.
  - Innervations of bladder, micturition and abnormalities of micturition.
  - Artificial kidney, dialysis and renal transplantation.
  - Renal Function test.
  - Diuretics, Renal failure
- ❖ **Endocrinology**
  - General Endocrinology
  - Mechanism of action and Regulation of hormones
  - Physiological actions and applied aspects of pituitary gland, Thyroid gland, Parathyroid gland, Adrenal gland, Pancreas and hypothalamus, Growth Hormone.
  - Estimation and assessment of Hormones.
  - Pineal gland and local hormones.
- ❖ **Reproductive System**
  - Introduction : Sexual differentiation and development.
  - Male reproductive system :
    - ❖ Primary and accessory organs and their functions.
    - ❖ Spermatogenesis and its regulation
    - ❖ Testosterone- secretion, transport, metabolism, mechanism and physiological actions
    - ❖ Control of testicular function – feedback mechanism and abnormalities.
  - Female reproductive system :
    - ❖ Physiology of menstrual cycle :
    - ❖ Ovarian cycle, Uterine cycle, vaginal and cervical cycle
    - ❖ Physiology of ovulation and its detection
    - ❖ Ovarian hormones – Estrogen and progesterone – physiological actions and mechanism of action
    - ❖ Control of ovarian function: feedback mechanism, menopause and abnormalities.

- ❖ Physiology of fertilization and implantation.
- ❖ Physiology of pregnancy : Endocrine changes, foeto-placental unit, changes in mother during pregnancy, tests for pregnancy
- ❖ Physiology of parturition : Role of oxytocin
- ❖ Physiology of lactation : Role of oxytocin and prolactin
- ❖ Infertility, contraception
  
- ❖ **Growth, Development and Genetics**
  - Growth and development : Definition
    - ❖ Physical growth – prenatal & postnatal period, pubertal growth, skeletal age and physical maturity
    - ❖ Organ growth – differential growth of specific organs and tissues (Brain, head, lymphoid tissue, visceral and reproductive organs at various ages)
    - ❖ Growth spurts in human's life-infancy and late puberty.
    - ❖ Growth rates in boys and girls, mental growth and factors influencing growth- genetic, nutritional and hormonal
  - Disorders of normal growth
  - Abnormalities of foetal and postnatal growth
  - Hereditary short stature.
  - Physiology of ageing :
    - ❖ Changes in various systems and mechanisms involved
    - ❖ Factors affecting ageing.
  - Apoptosis.
  - Genetic control of protein synthesis, genetic code and regulation of gene expression, cell cycle and its regulation.
  - Applied genetics
  
- ❖ **Integumentary System**
  - Skin : Functions
  - Sweat glands : Types, secretion and functions.
  - Thermoregulation : Mechanism, receptors
    - ❖ Hypothalamic thermostat
    - ❖ Acclimatization
    - ❖ Disorders of thermoregulation
  
- ❖ **Metabolism**
  - Carbohydrate, protein and lipid metabolism, Energetics and metabolic rate, obesity and starvation.
  
- ❖ **Central Nervous System :**
  - Introduction : Organization of the nervous system
    - ❖ The structural and functional unit of nervous system.
    - ❖ Neurons – types, functional components and morphology
  - Neuroglia – types, morphology, functions and classification of nerves
  - Signal transmission in the nervous system :
  - Graded potential – definition, characteristics and physiological significance
    - ❖ Resting membrane potential – ionic basis
    - ❖ Action potential – definition
    - ❖ Ionic basis for electrical, chemical and excitability changes
    - ❖ Propagation, mechanism and factors influencing the same.
  - Response of neurons and nerve fibers to injury
    - ❖ Types of injuries.



- ❖ Types of changes – Wallerian degeneration and regeneration
- ❖ Factors influencing regeneration
- Microenvironment of the neuron: CSF-composition, formation & circulation, Blood brain barrier and its importance
- Synapse : Definition and types, structure, mechanism of transmission and properties
- Sensory receptors : Definition, classification and properties
- Reflexes : Definition and classification
  - ❖ Reflex arc and stretch reflex
  - ❖ Properties of reflexes and their clinical significance.
- Somato-sensory system :
  - ❖ Classification and characteristics of difference sensations
  - ❖ Sensory pathways and regulation at the higher level
  - ❖ Physiology of pain including referred pain
- Control of posture and movement
  - ❖ General Principles of organisation of motor control
  - ❖ Effects of complete transection and hemisection of spinal cord
  - ❖ Descending pathways involved in motor control
  - ❖ Corticospinal (pyramidal) system and
  - ❖ Corticobulbar (extrapyramidal) system
  - ❖ Cortex, basal ganglia and cerebellum- motor control and their disorders
- Reticular formation : Definition, connections and functions
- Physiological basis of consciousness and sleep
- EEG : Evoked potentials and their clinical significance.
- Hypothalamus : Components, connections and functions
- Thalamus : Components, connections, functions, thalamic syndrome
- Limbic system : Components, connections and functions
- Frontal. Parietal, occipital and temporal lobe: components, connections, functions and effects of lesions
- Higher cortical functions :
  - Learning, memory, judgement, language and speech.
- ❖ **Special Senses**
- Visual system :
  - ❖ Structure of eye and overview of functions
  - ❖ Structure and function of cornea
  - ❖ Aqueous humor – formation, circulation and drainage
  - ❖ Intraocular pressure and functions
  - ❖ Optics of vision – image forming mechanism
  - ❖ Pupil and its functions
  - ❖ Light reflex and accommodation
  - ❖ Binocular and monocular vision
  - ❖ Common errors of refraction
  - ❖ Visual acuity and visual fields – clinical importance
  - ❖ Ophthalmoscopy, retinoscopy and perimetry
  - ❖ Photoreceptors – distribution, visual pigments and their functions
  - ❖ Light and dark adaptation : photopic and scotopic vision
  - ❖ Visual pathway – transduction, transmission, synaptic modulation and visual cortex.
  - ❖ Effects of transection of visual pathway at various levels.
  - ❖ Eye movements – neurophysiological basis of fixation of gaze and conjugate movements.
  - ❖ Physiology of colour vision – theories and electrophysiological aspects

- ❖ Colour blindness – classification and tests.
- ❖ Auditory system:
  - ❖ Functional anatomy of ear and general properties of sound
  - ❖ External ear – functions
  - ❖ Middle ear – functions of tympanic membrane and ossicles,
  - ❖ Mechanism of sound transmission, impedance matching, function of eustachian tube.
  - ❖ Internal ear – structure and function of cochlea, sound transduction, electrical potentials from cochlea, pitch and intensity discrimination.
  - ❖ Auditory pathway – receptive fields and tonotopic maps, binaural interactions, nerve pathway from the cochlea to the auditory cortex.
  - ❖ Organization of auditory cortex and functions, sound localization
  - ❖ Deafness : types, tests to diagnose deafness (practicals)
  - ❖ Audiometry and its clinical applications.
  - ❖ The Vestibular System : Structure of labyrinth
    - Vestibular transduction – response to rotational and linear acceleration.
    - Central vestibular pathway
    - Vestibulo-ocular reflex and its clinical importance
    - Clinical tests for vestibular integrity, disorders of labyrinth
- The Olfactory System : Location of receptors and pathways, physiology of olfaction and disorders of olfactory sensation.
- The Gustatory System : Location of receptors and pathways, physiology of gustation and disorders of gustatory sensation.

## 3.2. Practical

- ❖ Hematology - all UG practical, TEC, RC, TPL, Arneeth count and BM examination
- ❖ Amphibian- all UG frog's muscle and heart (isolated and intact)
- ❖ Human Experiments- all system, ergography, EMG, ECG, BMR, EEG, AFT, Evoked potential, tests of physical fitness (bicycle ergometer )
- ❖ Mammalian Experiments – rabbit's heart and ileum

## 4. Teaching Program

### 4.1. General Principles

Acquisition of practical competencies being the keystone of postgraduate medical education, postgraduate training is skills oriented. Learning in postgraduate program is essentially self-directed and primarily emanating from clinical and academic work. The formal sessions are merely meant to supplement this core effort.

### 4.2. Teaching Sessions

Teaching sessions will be held in the form of seminars, journals clubs, microteaching, tutorials & discussions.

### 4.3. Teaching Schedule:

The suggested teaching schedule of the department is as follows :

- |   |                    |
|---|--------------------|
| 1. Library day/Thesis work  | <b>Once a week</b> |
| 2. Seminar/Journal Club/Microteaching   | <b>Once a week</b> |
| 3. Practical on systems   | <b>Once a week</b> |
| 4. Tutorial/Discussion/Formal PG teaching   | <b>Once a week</b> |
| 5. Intradepartmental meet (with all the faculty and demonstrators to discuss weekly teaching schedule discuss any of problem faced).  | <b>Once a week</b> |
| 6. Central session (held in hospital auditorium regarding various topics like CPC, guest lectures, students seminars, grand round, sessions on basic sciences, biostatistics, research methodology, teaching methodology, health economics, medical ethics and legal issues). | <b>Once a Week</b> |

In addition, PG students also attend daily theory classes as per UG teaching schedule.

### 5. Posting :

The postgraduate student will rotate through allied clinical departments such as Biochemistry, Pathology, Transfusion Medicine, General Medicine, Pulmonary Medicine, Cardiology, Neurology, Endocrinology and Nephrology.

### 6.Thesis

- 6.1 Every candidate shall carry out work on an assigned research project under the guidance or recognized postgraduate teacher; the project shall be written and submitted in the form of a Thesis .

- 6.2 Every candidate shall submit thesis plan to the university within the time frame set by university.
- 6.3 Thesis shall be submitted to the University six months before the commencement of theory examination i.e. May/June session, 30<sup>th</sup> Nov of the proceeding year of examination and for Nov/Dec session 31<sup>st</sup> May of the year of examination.
- 6.4 The student will identify a relevant question; (ii) conduct critical review of literature; (iii) formulate a hypothesis; (iv) determine the most suitable study design; (v) state the objectives of the study; (vi) prepare a study protocol; (vii) undertake a study according to the protocol; (viii) analyze & interpret research data, and draw conclusions; (ix) write a Thesis.

## 7. Assessment

All the PG residents are to be assessed daily for their academic activities and also periodically.

### 7.1. General Principles

- ❖ The assessment is valid, objective and reliable.
- ❖ It covers cognitive, psychomotor & affective domains.
- ❖ Formative, continuing and summative (final) assessment is also conducted in theory as well as practical's / clinical. In addition, Thesis is also assessed separately.

### 7.2 Formative Assessment

The formative assessment is continues as well as end-of-term. The former based on the feedback from the senior residents and the consultants concerned. End-of-term assessment is held at the end of each semester (up to the 5<sup>th</sup> semester). Formative assessment will not count towards pass/fail at the end of the program, but will provide feedback to the candidate.

### 7.3 Summative Assessment

- Ratio of marks in theory and practical's will be equal.
- The pass percentage will be 50%.
- Candidate will have to pass theory and practical examination separately.

#### A. Theory Examination (Total = 400)

Paper Marks	Title
<b>Paper 1:</b> 100	History & General Physiology
<b>Paper 2:</b> 100	Systemic Physiology - I

**Paper 3:** Systemic Physiology-II  
100

**Paper 4:** Applied and Recent Advances in Physiology  
100

**B. Practical Examination and Viva Voce (Total = 400)**

- Two long exercise (Mammalian/human)  
200
- Two short exercises (Hematology/Microteaching)  
100
- Oral  
100

**8. Job Responsibilities:**

**For Teaching**

- Should be able to take a class using audiovisual aids right from blackboard & chalk to that with laptop & multimedia session.
- Should be able to make short lectures under senior teachers supervision.
- Should have learnt to make Power Point Presentation.
- Should have learnt to make multiple-choice questions.
- Must attend all undergraduate theory and practical classes. They must play an active role in table teaching in all practical's classes.

**For Research work**

- Should have skill to look up reference from journals and present seminars.
- Should have computers skills.
- Will be expected to be familiar with standards methods of preparing a bibliography and for preparing manuscripts and illustrations for publication.

**9. Suggested Books-**

**Core Books:**

- ❖ Text book of Medical Physiology by Guyton & Hall
- ❖ Review of Medical Physiology by William F. Ganong
- ❖ Understandings of medical Physiology by Bijlani.

**Reference books:**

- ❖ Human physiology by Vander Sherman
- ❖ Physiological basis of medical practice by best & Taylor
- ❖ Bern & Levy Physiology
- ❖ Human Anatomy & Physiology By Elaine N. Marieb.
- ❖ Principles of Medical Physiology By Sircar
- ❖ Text book of Medical Physiology By Indu Khurana
- ❖ Fundamental of Anatomy & Physiology by Martini.

**Journals:**

- ❖ Annual Review of Physiology.
- ❖ Indian Journal of Physiology & Pharmacology
- ❖ Journal of Applied Physiology
- ❖ Physiology reviews.