M.Sc. in Medical Physiology 2 Years (4 Semesters)

Overview: The **M.Sc. in Medical Physiology** is a postgraduate program focused on the study of the functions and mechanisms of the human body, with an emphasis on clinical applications. Physiology is essential for understanding how the body's systems operate under normal conditions and how they adapt to disease or injury. The program combines theoretical knowledge with practical training, preparing students for careers in healthcare, research, medical education, and clinical applications. This degree is designed for students who are interested in pursuing advanced careers in medical physiology, clinical research, or teaching in medical schools.

The curriculum integrates core physiological concepts with clinical and experimental research methodologies, enabling students to contribute to improving patient care, advancing healthcare practices, and contributing to the overall understanding of human physiology.

Affiliated Institution: School of Medical Sciences and Technology, Malla Reddy Vishwavidyapeeth (Deemed to be University) ****** The minimum eligibility for M.Sc. in Medical Physiology is a pass in B.Sc with at least 50% marks in qualifying exam.

Key Highlights:

- **Comprehensive Understanding of Human Physiology**: The program offers an in-depth exploration of human physiological processes, from cellular mechanisms to systemic interactions.
- **Clinical Relevance**: Focus on the application of physiological knowledge to clinical scenarios, such as understanding disease mechanisms, diagnostic techniques, and therapeutic strategies.
- **Hands-on Laboratory Experience**: Students engage in laboratory experiments to study physiological processes and understand the role of various systems (nervous, cardiovascular, respiratory, etc.).
- **Research Opportunities**: The program encourages research, particularly in areas like disease pathophysiology, pharmacology, and physiology-based medical innovations.
- **Advanced Technology Integration**: Students are introduced to modern tools used in physiological research, such as electrophysiology, medical imaging, and biomarkers.
- **Cross-disciplinary Knowledge**: The curriculum often includes modules that integrate physiology with other disciplines such as biochemistry, pharmacology, anatomy, and biophysics.

Course Curriculum:

The M.Sc. in Medical Physiology is typically a two-year program with a balance of lectures, laboratory work, and independent research projects.

Year 1:

Core Modules:

- **Basic Medical Physiology**: Study of the foundational physiological concepts, including cell physiology, bioenergetics, and homeostasis.
- **Cardiovascular Physiology**: Detailed study of the heart and circulatory system, including the regulation of blood pressure, cardiac function, and vascular health.
- **Neurophysiology**: Examination of the nervous system, including the physiology of the brain, spinal cord, sensory systems, and neural signaling.
- **Respiratory Physiology**: Study of pulmonary function, gas exchange, regulation of breathing, and respiratory pathophysiology.
- **Renal Physiology**: Understanding kidney function, water-electrolyte balance, and renal regulation mechanisms.
- **Endocrine Physiology**: Focus on the role of hormones in regulating various physiological processes, including metabolism, growth, and reproduction.

Practical Training:

- Laboratory work focused on experimental techniques used to measure physiological functions (e.g., blood pressure, heart rate, respiration, etc.).
- Use of physiological recording equipment, such as ECG, EMG, and spirometers, to study human physiology.
- Research-based assignments that introduce students to experimental physiology and data analysis.

Year 2:

Advanced Modules:

- **Pathophysiology**: Explore the changes in normal physiological processes that occur in diseases such as diabetes, hypertension, and heart disease.
- **Medical Pharmacology and Physiology**: Study the interaction between drugs and physiological systems, focusing on the impact of pharmacological agents on human health.
- **Exercise Physiology**: Learn about the physiological responses to physical activity and exercise, including adaptations at the cardiovascular, muscular, and metabolic levels.
- **Physiological Research Methods**: In-depth exploration of experimental techniques used in physiological research, including imaging methods and statistical analysis.
- **Biochemistry in Physiology**: Study how biochemical processes are related to normal physiological function and their alteration in disease states.
- **Clinical Physiology and Diagnostic Techniques**: Apply physiological principles to clinical settings, including the use of diagnostic tools such as electrocardiograms (ECG), pulmonary function tests (PFTs), and blood gas analysis.

Research Project/Dissertation:

- In the second year, students will conduct independent research on a topic related to medical physiology. This research can focus on a particular physiological system, disease model, or experimental technique.
- The project culminates in a dissertation that presents original research findings, contributing to the field of medical physiology.

Career and Academic Opportunities:

Career Opportunities:

Graduates of the M.Sc. in Medical Physiology are well-equipped for careers in healthcare, research, education, and industry. Potential career paths include:

- **Clinical Physiologist**: Work in hospitals or clinics, providing physiological assessments, diagnostic support, and advising healthcare professionals.
- **Medical Researcher**: Conduct research in academic institutions, hospitals, or pharmaceutical companies, studying disease mechanisms, new treatments, or physiological innovations.
- **Health and Wellness Expert**: Apply knowledge of physiology to guide health, fitness, and wellness programs, particularly in exercise physiology or sports medicine.
- **Medical Educator**: Teach physiology at medical schools, nursing programs, and healthcare institutions, training future medical professionals.
- **Clinical Trial Specialist**: Work with pharmaceutical companies to design and oversee clinical trials that test new drugs and treatments, using physiological data to monitor health outcomes.
- **Healthcare Consultant**: Advise healthcare organizations on improving patient care, treatment protocols, and the application of physiological principles in practice.

Academic Opportunities:

Graduates of the M.Sc. in Medical Physiology can pursue advanced degrees in related fields, including:

- **Ph.D. in Physiology or Biomedical Sciences**: Specialize in a particular area of physiology (e.g., neurophysiology, cardiovascular physiology) and contribute to cutting-edge research.
- **M.D. (Doctor of Medicine)**: Some graduates may choose to pursue a medical degree, using their strong foundation in physiology to advance to clinical practice.

Research Prospects:

- **Disease Mechanisms and Physiology**: Investigate the physiological changes associated with chronic diseases like cardiovascular disease, diabetes, and neurodegenerative disorders.
- **Clinical Physiology and Diagnostics**: Conduct research to improve diagnostic tools and methods used in healthcare, focusing on the integration of physiology and technology.
- **Exercise and Performance Physiology**: Study the physiological effects of exercise and physical performance, particularly in athletes or individuals with chronic conditions.
- **Pharmacological Physiology**: Explore how drugs and therapies interact with physiological systems, aiming to develop new treatments for diseases.

Professional Opportunities:

- **Certified Clinical Physiologist**: Certification in clinical physiology may be required for some job roles, particularly in clinical settings.
- **Professional Memberships**: Graduates can join professional organizations such as the **American Physiological Society (APS)** or the **European Society of Physiology (EP)**, which offer networking, research collaboration, and career development opportunities.
- **Medical Technology and Equipment**: Opportunities exist in the development and application of medical devices and technologies that monitor or influence physiological parameters.

Higher Education and Research Prospects:

- **Ph.D. in Medical Physiology**: Graduates can continue their academic journey by pursuing a doctoral program to conduct advanced research in physiological sciences.
- **Postdoctoral Research**: Graduates may choose to undertake postdoctoral research, contributing to specialized fields like cardiovascular physiology, neurophysiology, or exercise science.
- **Medical Specializations**: Graduates may choose to pursue a medical degree (M.D.) to become specialized practitioners in fields such as cardiology, endocrinology, or neurology, where a deep understanding of physiology is essential.

Conclusion:

The **M.Sc. in Medical Physiology** is a valuable program for those interested in the intricate workings of the human body and its application in clinical settings. The program provides a robust foundation in physiological sciences and is ideal for students aiming for careers in healthcare, research, medical education, or clinical practice.

Graduates of this program are well-positioned to contribute to improving patient care, advancing medical research, and teaching the next generation of healthcare professionals. With strong career prospects in research, healthcare, and education, an M.Sc. in Medical Physiology offers a versatile and rewarding path for those passionate about understanding the mechanisms that govern human health and disease.

Labs

1. General Physiology Lab

- **Basic Equipment:**
  - ✓ Compound and phase-contrast microscopes
  - ✓ pH meters, digital weighing balances
  - ✓ Water baths, incubators, centrifuges
  - ✓ Spectrophotometer (UV-Vis)
- **Hematology & Blood Analysis:**
  - ✓ Hemocytometers for RBC/WBC counting
  - ✓ Microhematocrit centrifuge

- ✓ Blood grouping and cross-matching kits
- ✓ Automated cell counters

2. Cardiovascular Physiology Lab

- ➢ **Blood Pressure & Heart Function:**
  - ✓ Digital sphygmomanometers
  - ✓ ECG machines (12-lead ECG)
  - ✓ Phonocardiography (heart sounds recording)
  - ✓ Doppler ultrasound for vascular studies
- ➢ **Autonomic Nervous System Function:**
  - ✓ Tilt table for orthostatic response testing
  - ✓ Handgrip dynamometer for autonomic reflex testing
  - ✓ Cold pressor test setup

3. Neurophysiology & Electrophysiology Lab

- ➢ **Neural Activity Studies:**
  - ✓ EEG (Electroencephalography)
  - ✓ EMG (Electromyography)
  - ✓ Nerve conduction velocity (NCV) testing equipment
  - ✓ Evoked potential recording systems
- ➢ **Cognitive & Behavioral Testing:**
  - ✓ Reaction time apparatus
  - ✓ Memory and cognition assessment tools
  - ✓ Computerized neurocognitive assessment software

4. Pulmonary & Respiratory Physiology Lab

- ➢ **Lung Function Tests:**
  - ✓ Spirometers (digital & manual)
  - ✓ Peak flow meters for asthma studies
  - ✓ Gas analyzers for oxygen and CO_2 measurements
  - ✓ Body plethysmograph for lung volume assessment

5. Exercise Physiology & Metabolism Lab

- ➢ **Cardio-Respiratory Fitness Assessment:**
  - ✓ Treadmills and cycle ergometers
  - ✓ VO_2 max analyzers for aerobic capacity measurement
  - ✓ Pulse oximeters and lactate analyzers

- **Metabolic Studies:**
  - ✓ Indirect calorimetry for energy expenditure
  - ✓ Glucose tolerance test (GTT) setup
  - ✓ Resting metabolic rate (RMR) measuring systems

6. Endocrinology & Reproductive Physiology Lab

- **Hormonal Assays:**
  - ELISA kits for thyroid, insulin, cortisol testing
  - RIA (Radioimmunoassay) setup
  - Chemiluminescence analyzers for hormone studies
- ✓ **Reproductive Physiology Studies:**
  - ✓ Semen analysis microscopes
  - ✓ Hormonal assay kits for reproductive hormones
  - ✓ Ovulation detection kits

7. Gastrointestinal & Renal Physiology Lab

- **GI Function Testing:**
  - ✓ Gastrointestinal motility studies (electrogastrography)
  - ✓ pH and acid secretion analysis
  - ✓ Urea breath test for H. pylori detection
- **Renal Function Studies:**
  - ✓ Urinalysis kits for kidney function testing
  - ✓ Creatinine clearance test setup
  - ✓ Water balance and electrolyte analyzers

8. Molecular & Cellular Physiology Lab

- **Molecular Biology Techniques:**
  - ✓ PCR and RT-PCR for gene expression studies
  - ✓ Western blotting for protein analysis
  - ✓ Flow cytometry for cell studies
- **Cell Culture & Histology:**
  - ✓ Tissue culture facilities with CO_2 incubators
  - ✓ Immunohistochemistry and fluorescence microscopy
  - ✓ Confocal microscopy for cell imaging

9. Bioinformatics & Computational Physiology Lab

- **Data Analysis & Modeling:**

- MATLAB, SPSS for statistical analysis
- Signal processing software for physiological data
- Computational models for cardiovascular and neural physiology

PROGRAM OUTCOMES (POs)

PO	Program Outcomes
PO-1	**Advanced Human Physiology-** Gain in-depth knowledge of organ system functions, cellular physiology, and homeostasis mechanisms.
PO-2	**Clinical & Applied Physiology-** Understand the physiological basis of diseases, diagnostic tests, and therapeutic interventions.
PO-3	**Neurophysiology & Endocrinology-** Study the nervous and endocrine system functions, their regulatory mechanisms, and related disorders.
PO-4	**Cardiovascular & Respiratory Physiology-** Explore the physiological principles of circulation, cardiac function, pulmonary gas exchange, and related pathophysiology.
PO-5	**Renal & Gastrointestinal Physiology-** Learn the mechanisms of fluid balance, electrolyte regulation, digestion, and absorption.
PO-6	**Exercise & Environmental Physiology-** Analyze the impact of physical activity, stress, and environmental factors on human physiology.
PO-7	**Research Methodology & Experimental Physiology-** Develop hands-on skills in physiological experiments, electrophysiology, and data analysis.
PO-8	**Teaching & Scientific Communication-**Enhance abilities in medical education, research writing, and presentation of physiological concepts.

COURSE STRUCTURE – M.Sc. Medical Physiology

SEMESTER – I

Sl. No.	Broad Category	Course Code	Name of the Subject/Practical	Contact hours/week			Credits
				L	T	P	
1.	Major (Core)	MSMPY101	General Physiology & Homeostasis	2	1	0	3
2.		MSMPY102	Neurophysiology	2	1	0	3
3.		MSMPY103	Blood & Immunophysiology	2	0	2	3
4.		MSMPY104	Cardiovascular Physiology	2	1	0	3
5.	**Minor** Select any two minor courses, each worth 3 credits, for a maximum of 6 credits per semester	MSMPY105	1. Respiratory Physiology 2. Renal & Acid-Base Physiology 3. Clinical Autonomic Nervous System Physiology	2	0	2	6
			4. Stress & Neuroendocrine Physiology 5. Research Methodology & Biostatistics	2	0	2	
6.	**Skill Enhancement Courses**	MSMPY106	1. Physiological Laboratory Techniques	0	0	2	2
			2. Clinical & Experimental Hematology	0	0	2	
			Total	12	3	10	**20**
Total Contact Hours				**25**			

Course outcome for the major courses in M.Sc. Medical Physiology

Course Name	Course Outcomes
General Physiology & Homeostasis	- Understand the fundamental principles of human physiology, including cell structure, function, and signaling. - Explain the concept of homeostasis and regulatory mechanisms involved in maintaining internal balance. - Analyze physiological responses to stress, temperature regulation, and acid-base balance. - Evaluate the integration of organ systems in maintaining homeostasis under normal and pathological conditions. - Apply physiological principles to clinical and research settings.
Neurophysiology	- Understand the structure and function of the nervous system, including neurons, synapses, and neurotransmitters. - Explain the electrophysiological basis of nerve conduction, reflexes, and sensory processing. - Analyze motor control, autonomic nervous system regulation, and higher brain functions. - Evaluate the pathophysiology of neurological disorders such as Parkinson's disease, epilepsy, and stroke. - Apply neurophysiological techniques in clinical diagnostics, such as EEG and nerve conduction studies.
Blood & Immunophysiology	- Understand the composition and functions of blood, including hematopoiesis, clotting mechanisms, and blood groups. - Explain the physiological and molecular mechanisms of immune responses. - Analyze disorders related to blood, such as anemia, clotting disorders, and leukemia. - Evaluate the role of the immune system in infection, inflammation, and autoimmune diseases. - Apply knowledge of hematology and immunophysiology in clinical diagnostics and therapeutic interventions.
Cardiovascular Physiology	- Understand the structure and function of the heart, blood vessels, and circulatory system. - Explain cardiac electrophysiology, cardiac cycle, and hemodynamic principles. - Analyze the regulation of blood pressure, circulation, and responses to exercise and stress. - Evaluate the pathophysiology of cardiovascular diseases such as hypertension, heart failure, and arrhythmias . - Apply cardiovascular physiological concepts in diagnostic techniques like ECG, echocardiography, and blood flow measurements.

Course outcome for the minor courses in M.Sc. Medical Physiology

Course Name	Course Outcomes
Respiratory Physiology	- Understand the mechanics of breathing, gas exchange, and transport of oxygen and carbon dioxide. - Explain the regulation of respiration by neural and chemical mechanisms. - Analyze lung function tests and their clinical significance in respiratory disorders. - Evaluate the impact of conditions like asthma, COPD, and pulmonary hypertension on respiratory physiology. - Apply knowledge of respiratory physiology in critical care and pulmonary rehabilitation.
Renal & Acid-Base Physiology	- Understand the structure and function of the kidneys in fluid and electrolyte balance. - Explain renal mechanisms of filtration, reabsorption, and excretion. - Analyze the regulation of acid-base balance and its physiological significance. - Evaluate renal pathophysiology in conditions like kidney failure, hypertension, and metabolic acidosis. - Apply renal physiology concepts in nephrology and clinical diagnostics.
Clinical Autonomic Nervous System Physiology	- Understand the structure and function of the autonomic nervous system (ANS). - Explain the role of the sympathetic and parasympathetic nervous systems in physiological regulation. - Analyze autonomic function tests and their application in diagnosing ANS disorders. - Evaluate the impact of autonomic dysfunction in diseases like hypertension, diabetes, and neurodegenerative disorders. - Apply ANS physiology in clinical scenarios, including autonomic neuropathy and heart rate variability studies.
Stress & Neuroendocrine Physiology	- Understand the physiological response to stress and the role of the hypothalamic-pituitary-adrenal (HPA) axis. - Explain the neuroendocrine regulation of hormones in response to physical and psychological stress. - Analyze the effects of chronic stress on metabolism, immune function, and mental health. - Evaluate stress-related disorders such as anxiety, depression, and adrenal insufficiency. - Apply knowledge of neuroendocrine physiology in therapeutic interventions for stress management.
Research Methodology & Biostatistics	- Understand the principles of scientific research, study design, and hypothesis testing. - Apply statistical methods to analyze physiological data and interpret research findings. - Develop skills in literature review, data presentation, and scientific writing. - Evaluate the ethical considerations in human and animal research. - Apply biostatistical tools to evidence-based physiological research and clinical trials.

M.Sc. in Medical Physiology – Course Structure & Syllabus

Course Duration: 2 Years (4 Semesters)

Total Credits: 80–100

Total Teaching & Training Hours: ~3,600

Total Teaching Hours Distribution

- **Theory Classes:** ~1,200–1,500 hours
- **Practical & Laboratory Training:** ~800–1,000 hours
- **Clinical Internship & Hands-on Training:** ~800–1,000 hours
- **Research Project & Dissertation:** ~300–500 hours

Assessment Methods

Assessment Component	Weightage (%)	Details
Continuous Internal Assessment (CIA)	**40%**	Includes internal exams, assignments, presentations, case studies, and practical performance
End-Semester Examination (ESE)	**60%**	Divided into theory (40%) and practical (20%)
Mid-Semester Exams	**20%** (Part of CIA)	Two internal tests per semester
Assignments & Case Studies	**5%** (Part of CIA)	Research-based assignments, literature reviews, clinical case reports
Seminars & Presentations	**5%** (Part of CIA)	Oral/poster presentations on diabetes management
Practical Performance & Clinical Evaluation	**5%** (Part of CIA)	Skill-based assessments in labs/hospitals
Attendance & Participation	**5%** (Part of CIA)	Regularity in theory & practical sessions
Theory Examination (Final)	**40%** (Part of ESE)	Structured written paper covering subject knowledge
Practical Examination (Final)	**20%** (Part of ESE)	Includes viva, skill demonstration, case handling
Dissertation/Research Project	**Mandatory**	Evaluated in the final year by internal & external examiners
Clinical Internship/Training	**Pass/Fail**	Logbook-based evaluation with hospital mentor review

Marking System & Grading

Marks (%)	Grade	Grade Point (GPA/CGPA Equivalent)	Classification
90 - 100	O (Outstanding)	10	First Class with Distinction
80 - 89	A+ (Excellent)	9	First Class with Distinction
70 - 79	A (Very Good)	8	First Class
60 - 69	B+ (Good)	7	First Class
50 - 59	B (Satisfactory)	6	Second Class
<50 (Fail)	F (Fail)	0	Fail (Re-exam Required)

Pass Criteria:

- **Minimum 50% marks in each subject** (Theory & Practical separately).
- **Aggregate of 55% required for progression** to the next semester.
- **No more than two backlogs** allowed for promotion to the final year.

Exam Pattern for Theory & Practical

A. Theory Examination Pattern

Total Marks: 100 (Converted to 40% for End-Semester Assessment)
Duration: 3 Hours

Section	Question Type	No. of Questions	Marks per Question	Total Marks
Section A	Short Answer Type (SAQ)	10 (Attempt all)	2	20
Section B	Long Answer Type (LAQ)	5 (Attempt any 4)	10	40
Section C	Case-Based/Clinical Scenario	3 (Attempt any 2)	15	30
Section D	MCQs/Objective Type	10 (Compulsory)	1	10
Total				**100**

Weightage:

- Systemic & Applied Physiology – 40%
- Neurophysiology & Cardiovascular Physiology – 30%
- Research & Case Studies in Physiology – 20%
- Clinical & Experimental Techniques in Physiology – 10%

Passing Criteria: Minimum **50% (50/100 marks)**

B. Practical Examination Pattern

Total Marks: 100 (Converted to 20% for End-Semester Assessment)
Duration: 4–6 Hours

Component	Marks Distribution
Clinical Case Presentation & Physiological Assessment	30
OSCE (Objective Structured Clinical Examination) – Skill Demonstration	25
Human Physiology Experiments & Functional Tests	20
Lab-Based Examination (Cardiovascular, Respiratory, Neuromuscular, Endocrine Assessments)	15
Record Work (Logbook & Assignments)	10
Total	**100**

OSCE (Skill-based Assessment) includes stations on:

- Cardiovascular System Assessment (Blood Pressure, ECG Interpretation)
- Pulmonary Function Testing (Spirometry, Peak Flow Meter)
- Neuromuscular System Evaluation (EMG, Reflex Testing)
- Endocrine & Metabolic Assessments (Glucose Tolerance Test, Thyroid Function Tests)

Passing Criteria: Minimum 50% (50/100 marks) in practicals.

Recommended Books & E-Resources

Textbooks

- **"Ganong's Review of Medical Physiology"** – Kim E. Barrett
- **"Guyton and Hall Textbook of Medical Physiology"** – John E. Hall
- **"Berne & Levy Physiology"** – Bruce M. Koeppen
- **"Best & Taylor's Physiological Basis of Medical Practice"** – O.P. Tandon

E-Resources & Journals

- **Journal of Applied Physiology**
- **American Journal of Physiology**
- **European Journal of Clinical Physiology**
- **National Center for Biotechnology Information (NCBI) Physiology Database**

Career Opportunities after M.Sc. in Medical Physiology

- **Clinical Physiologist** in Hospitals & Diagnostic Labs
- **Biomedical Research Scientist** in Universities & Research Centers
- **Exercise Physiologist** in Sports & Rehabilitation Medicine
- **Medical Educator** in Medical & Allied Health Sciences
- **Neurophysiology Specialist** in Neurology & Electrophysiology Labs