AMRITA SCHOOL OF MEDICINE
DEPARTMENT OF PHYSIOLOGY

PROGRAM
MD PHYSIOLOGY
(Revised with effect from 2015-2016 onwards)
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GOAL
The goal of postgraduate Medical education in Physiology shall be to produce competent medical teachers who shall –
1. Perform the professional obligations ethically and in keeping with the objectives of National Health Policy.
2. Have acquired the basic skills in teaching medical and para medical students.
3. Be aware of the contemporary advances and developments in Physiology.
4. Have acquired a spirit of scientific enquiry and are oriented to the principles of research methodology.

OBJECTIVES
The candidate, upon successfully qualifying in MD Physiology examination, should be-
1. A competent Physiologist
2. Able to effectively teach medical and paramedical students the basic physiological mechanisms of human body with reference to their implications in the pathogenesis of diseases (patho physiology) and the physiological basis of their management.
3. Able to conduct such clinical/experimental research as would have significant bearing on human health and patient care and also able to publish research papers.
4. Acquire skills in conducting collaborative research in the field of Physiology and allied sciences.
5. Able to demonstrate to the students that the knowledge of physiology can be used in a variety of clinical settings to solve diagnostic and therapeutic problems.
6. Encourage students to participate in workshops/seminars/journal clubs/demonstrations in allied departments to acquire skills for collaborative research.

PROGRAM OUTCOMES
PO1 Possess comprehensive knowledge of the normal functions of all organ systems of the body
PO2 Possess an understanding of the physiological basis of health and disease.
PO3 Understanding of the basic biophysical principles involved in functioning of body organs in normal and diseased conditions
PO4 Ability to explain the normal functioning of all organ systems in human body and its alterations in diseased state, correlating the same with classical clinical features and outline the basic principles of management.

PO5 Ability to perform detailed clinical examination of each system in a systematic manner and interpret the findings.

PO6 Ability to perform all basic haematology laboratory tests and interpret the results and outline the possible causes for the abnormal results.

PO7 Demonstrate high level critical thinking skills and applying acquired knowledge in solving problems.

PO8 Ability to ask correct research questions and design and conduct research work and publish

**PROGRAM SPECIFIC OUTCOMES**

PSO1 Ability to explain functional anatomy of all organs and organ systems, specific function of each and the role of homeostasis.

PSO2 Knowledge of the interactions of different organ system for well-coordinated total body functions (maintenance of milieu interior)

PSO3 Ability to outline the basic physiological responses and adaptations to changes in external and internal environment.

PSO4 Ability to record, analyze and interpret human physiology experiments like BP, ECG, Spirogram, Audiogram, Stethography, Perimetry, Physiograph and interpret basic abnormalities.

PSO5 Ability to perform technical aspects of all lab tests in hematology and principles underlying the test.

PSO6 Ability to draw and explain amphibian skeletal and cardiac muscle graph

**SYLLABUS - THEORY**

**I. General Physiology**

General and Cellular Basis of Human Physiology
Organisation of body fluids.
Functional morphology of cell
Transport across cell membrane & capillary wall
Intercellular communications
Genetics and Gene therapy
Homeostasis, Bio electric potentials

2. Haematology

Composition & functions of blood, functions of plasma proteins.
The functional basis of different formed elements of blood. Elaborate on the current concepts of hemopoiesis, abnormalities in the RBC function with the functional basis of anaemias, the abnormalities in WBC, the basis of the various types of immunological responses in the human body and the mechanisms of regulation of immune responses, abnormalities in platelet functions, haemostatic mechanisms in health and disease.
Current trends in the classification of various blood groups & physiological considerations in blood transfusion
Blood volume.
Lymph & tissue fluid.

3. Nerve Muscle Physiology

Major historical landmarks in the development of current concepts of nerve muscle physiology.
Nerve Cells- Structure, properties and function, Classification of fibre types
Bioelectric potentials, CRO
Nerve degeneration & regeneration
Mixed Nerve – properties
Synapse – properties and functions
Neuroglia
Skeletal muscle- Physiological anatomy of skeletal muscle, Molecular mechanism of muscle contraction, types of contraction, length tension relationship.
Electrical Phenomena & ionic fluxes, energy sources and metabolism
Properties of muscle in intact organism
Motor unit, effects of denervation, EMG and its applications.
Cardiac muscle – Functional anatomy, electrical properties, mechanical properties, length tension relationship. Conducting system of heart and its electrical properties
Smooth muscle – Morphology, Types, electrical & mechanical properties, control of smooth muscle contraction, length - tension relationship, plasticity.
Neuromuscular Physiology, diseases affecting neuromuscular junction.

4. Nervous System

Importance of evolution and development
The contributions of neurophysiologists who have led to the development of the present status of neurophysiology
Various methods used for the study of neurophysiology
Organisation of the nervous system

Sensory System
- Receptors, Pathways, thalamus, cortical Sensory areas.
- Important abnormalities of pain & other somatic sensation.

Motor System
- Motor functions of spinal cord and spinal cord reflexes
- Cortical and brainstem control of motor function
- Cerebellum. Basal ganglia and overall motor control
- Cerebral cortex, Motor & Sensory dysfunction at different levels.
- Vestibular apparatus and equilibrium, posture & movement

Neurotransmitters

Autonomic Nervous System
Hypothalamus, Limbic System
Speech, Memory, Learning, Behaviour, Conditioned reflexes.
Sleep and electrical activities of brain

Cerebrospinal fluid

5. Special Senses

Olfaction, Gustation, Vision, Audition.

6. Cardiovascular System

Organisation of CVS, Origin and spread of cardiac impulse
Cardiac Cycle – Normal electrical and mechanical events & their abnormalities.
Cardiac output, Haemodynamics
Blood pressure & its regulation.
Regional circulation including lymphatic circulation, foetal circulation.
Shock, cardiopulmonary adjustments in health and disease.
Basic principles in the assessment of CVS function.

7. Respiratory System

Functional Anatomy of Respiratory System
Respiratory movements & muscles involved in it. Bronchial tone.
Mechanics of Pulmonary Ventilation - Spirometry - Lung volumes & capacities.
Pressures during the breathing cycle, elastic properties of lung, compliance of lung & chest wall, alveolar surface tension, work of breathing, airway resistance.
Ventilation & Perfusion, Pulmonary Ventilation, Alveolar ventilation, Dead space, Pulmonary blood flow, Ventilation Perfusion Ratio.
Composition of respiratory gases.
Respiratory Membrane, Physics of Diffusion.
Transport of Gases - Transport of Oxygen, Oxygen Dissociation curve and factors affecting it. Carbon dioxide transport, CO₂ dissociation curve
Myoglobin & foetal haemoglobin
Regulation of respiration
Respiratory adjustments in health & disease – Including high altitude Physiology & Acclimatisation
O₂ therapy, Use of Ventilators, artificial respiration.

8. Environmental Physiology

Thermo regulatory mechanism in the body and their behaviors in acute & chronic thermal stress.
Effects of exposure to hypo & hyperbaric environment
Acclimatization process
Effects of ‘G’ forces
Mechanism related to biological rhythm & their role in normal state of body function.
Effect of different types of environmental pollutants on the body.
9. Gastro Intestinal System
Nutrition & metabolism, energy balance
Functional anatomy of GIT
Secretions of GIT and associated glands and their regulation
Movements of GIT
Digestion and Absorption
Describe the basis of evaluation of metabolic functions in health and disease with special reference to liver function tests.
Gastro intestinal hormones, disorders of gastrointestinal function.

10. Endocrinology
Synthesis & secretion, transport, metabolism, mode of action and estimation of various hormones secreted by the endocrine glands.
The neurohumoral mechanisms involved in regulation of hormonal secretions and their mechanism of action at cellular level.
Changes that occur in body as a result of hypo and hyper function of different glands and their hormonal interactions correlating with the function tests.
Bone physiology and calcium metabolism
Endocrine functions of other organs.
Growth, development and ageing.

11. Reproductive System
Development and functions of gonads
Sex differentiation and their abnormalities
Male reproductive system
Female reproductive system
Puberty, Menopause
Pregnancy, Lactation, Contraception
Infertility & its management

12. Excretory System
Functional anatomy of kidney and the basic principles involved in the secretory and excretory function of kidney.
Evaluate the role of kidney in fluid and electrolyte homeostasis & acid - base balance.
The physiological basis of evaluation of renal functions in health and disease.
Principles of dialysis.
Physiological basis of diuretic action
Renal transplantation.
Skin & temperature regulation

SYLLABUS - PRACTICAL

1. Haematology
   Haemocytometry - Counts of various cells in the blood i.e. RBC, WBC, eosinophils, platelets and reticulocytes.
   Make, stain & report on a peripheral smear & do differential count of WBCs
   Haemoglobinometry, PCV, ESR, Blood Indices.
   Blood grouping – ABO & Rh typing
   Determination of bleeding time & clotting time
   Haemolysis & fragility tests (Demonstration only)

2. Nerve Muscle Physiology
   All the laboratory exercises done by undergraduate students in nerve muscle
   Physiology – Skeletal muscle, cardiac muscle & smooth muscle (Graph discussion)
   Ergography
   EMG & Nerve conduction studies (Demonstration only)

3. Nervous system & Special senses
   Examination of higher functions
   Examination of sensory system
   Examination of motor system
   Examination of cranial nerves
   Examination of reflexes
   Examination of nervous system in a patient with nervous system disorder & interpret the data obtained.
   EEG (Demonstration only)
   Perimetry
   Tests for hearing & deafness interpretation

4. Cardiovascular system
   Examination of cardiovascular system in a normal person.
   Determination of arterial blood pressure & its variation with posture & exercise
Recording of arterial pulse using physiograph
Recording of normal ECG in 12 leads
Echocardiography & treadmill test (Demonstration only)

5. Respiratory system
Examination of respiratory system in a normal person.
Recording of respiratory movements – normal & after exercise, using
stethograph & Spirometer & interpretation of data obtained.
Peak expiratory flow meter studies

6. Endocrinology & Reproduction (Chart discussion only)
Evaluation of a patient with endocrine disorder
Determination of ovulation time by basal body temperature chart, cervical smear &
vaginal smear
Pregnancy diagnostic tests – Immunological test (Demonstration only)

COURSES

Course I General Physiology, Haematology, Cardiovascular System (MDPY1)
CO1: Describe the structure of cell membrane with reference to ion channels. Ho-
meostasis, Transport across cell membrane and Bioelectric potentials
CO2: Discuss the Body fluid compartments, Homeostasis, Plasma proteins, RBC,
WBC, Platelets, Coagulation of Blood, Blood Group, Lymph and Tissue fluid.
CO3: Describe Functional anatomy of heart and blood vessels, Properties of Cardiac
muscle, Cardiac cycle, Normal ECG, Cardiac output, Haemodynamics. Blood pres-
sure, Regional circulation, Shock.
CO4: Should be able to perform common hematological tests and interpret the results

General Physiology

General and Cellular Basis of Human Physiology
Organisation of body fluids.
Functional morphology of cell
Transport across cell membrane & capillary wall
Intercellular communications
Genetics and Gene therapy
Homeostasis, Bio electric potentials

Haematology

Composition & functions of blood, functions of plasma proteins. The functional basis of different formed elements of blood. Elaborate on the current concepts of hemopoiesis, abnormalities in the RBC function with the functional basis of anaemias, the abnormalities in WBC, the basis of the various types of immunological responses in the human body and the mechanisms of regulation of immune responses, abnormalities in platelet functions, haemostatic mechanisms in health and disease.

Current trends in the classification of various blood groups & physiological considerations in blood transfusion
Blood volume.
Fluid dynamics in blood vessels
Lymph & tissue fluid.

Cardiovascular System

Organisation of CVS, Origin and spread of cardiac impulse
Cardiac Cycle – Normal electrical and mechanical events & their abnormalities.
Cardiac output, Haemodynamics
Blood pressure and stroke volume
Blood pressure & its regulation.
Renal control of blood pressure
Regional circulation including lymphatic circulation, foetal circulation.
Shock, cardiopulmonary adjustments in health and disease.

Basic principles in the assessment of CVS function.

Course II Physiology of Respiration, Renal Physiology, Skin & Temperature Regulation, Principles of Biophysics as applied to Physiology (MDPY2)
CO1: Explain Mechanism of Breathing, surfactant. Ventilation, Pulmonary Circulation, Transport of gases, Regulation of respiration, Hypoxia, exercise, artificial respiration-

CO2: Should be able to perform common human physiology experiments and interpret the results

CO3: Should be able to draw amphibian skeletal and cardiac muscle graphs and discuss the physiological basis

Excretory System

Functional anatomy of kidney and the basic principles involved in the secretory and excretory function of kidney.
Evaluate the role of kidney in fluid and electrolyte homeostasis & acid-base balance.
The physiological basis of evaluation of renal functions in health and disease.
Principles of dialysis.
Physiological basis of diuretic action
Renal transplantation.

Skin & temperature regulation

Respiratory System

Functional Anatomy of Respiratory System
Respiratory movements & muscles involved in it. Bronchial tone.

Mechanics of Pulmonary Ventilation - Spirometry - Lung volumes & capacities.
Pressures during the breathing cycle, elastic properties of lung, compliance of lung & chest wall, alveolar surface tension, work of breathing, airway resistance.
Ventilation & Perfusion, Pulmonary Ventilation, Alveolar ventilation, Dead space, Pulmonary blood flow, Ventilation Perfusion Ratio.
Low VQ ratio and its clinical importance
Composition of respiratory gases.
Respiratory Membrane, Physics of Diffusion.

Transport of Gases - Transport of Oxygen, Oxygen Dissociation curve and factors affecting it. Carbondioxide transport, CO₂ dissociation curve

Surface tension and surfactants
Myoglobin & foetal haemoglobin
Regulation of respiration
Respiratory adjustments in health & disease – Including high altitude Physiology & Acclimatisation
Pathophysiology of Bend
**O₂ therapy, Use of Ventilators, artificial respiration.**

**Course III Nervous System, Special Senses, Muscle & Nerve Physiology (MD-PY3)**
CO1: Discuss the classification of muscles-Morphology of skeletal muscle, Mechanisms of muscle contraction
CO3: Discuss organisation of nervous system and functions. Synapse, Reflex action.
Sensory system, Motor System, and higher functions of brain
CO4: Describe the physiology of vision, audition, smell and taste

**Nerve Muscle Physiology**

**Major historical landmarks in the development of current concepts of nerve muscle physiology.**
Nerve Cells- Structure, properties and function, Classification of fibre types
Bioelectric potentials, CRO
Nerve degeneration & regeneration
Mixed Nerve – properties
Synapse – properties and functions
Neuroglia
Skeletal muscle- Physiological anatomy of skeletal muscle, Molecular mechanism of muscle contraction, types of contraction, length tension relationship.

**Electrical Phenomena & ionic fluxes, energy sources and metabolism**
**Properties of muscle in intact organism**
Motor unit, effects of denervation, EMG and its applications.
Cardiac muscle – Functional anatomy, electrical properties, mechanical properties, length tension relationship. Conducting system of heart and its electrical properties 
Smooth muscle – Morphology, Types, electrical & mechanical properties, control of smooth muscle contraction, length - tension relationship, plasticity.
Neuromuscular Physiology, diseases affecting neuromuscular junction.

**Nervous System**

Importance of evolution and development
The contributions of neurophysiologists who have led to the development of the present status of neurophysiology

**Various methods used for the study of neurophysiology**

Organisation of the nervous system

**Sensory System**
- Receptors, Pathways, thalamus, cortical Sensory areas.
- Important abnormalities of pain & other somatic sensation.

**Motor System**
- Motor functions of spinal cord and spinal cord reflexes
- Cortical and brainstem control of motor function
- Cerebellum, Basal ganglia and overall motor control
- Cerebral cortex, Motor & Sensory dysfunction at different levels.
- Vestibular apparatus and equilibrium, posture & movement

**Autonomic Nervous System**

**Hypothalamus, Limbic System**

Speech, Memory, Learning, Behaviour, Conditioned reflexes.

Sleep and electrical activities of brain

Cerebrospinal fluid

**Special Senses**

Olfaction, Gustation, Vision, Audition.

**Course IV Gastro Intestinal System, Endocrine System, Reproductive System, Recent Advances in Physiology (MDPY4)**

CO1: Discuss the secretory and motor functions of gastrointestinal tract
CO2: Explain the role of kidney in formation of urine, regulation of pH and body fluid volume and also clinical implications
CO3: Describe the mechanism of action, functions and abnormalities in secretion of endocrine glands
CO4: Should be able to perform clinical examination of various systems
CO5: Describe the development of male and female characteristics, hormonal changes, menstrual cycle, fertilization, pregnancy and contraceptive methods.

**Gastro Intestinal System**
Nutrition & metabolism, energy balance
Functional anatomy of GIT

**Secretions of GIT and associated glands and their regulation**
Movements of GIT
Digestion and Absorption
Describe the basis of evaluation of metabolic functions in health and disease with special reference to liver function tests.

**Gastro intestinal hormones, disorders of gastrointestinal function.**

**Endocrinology**
Synthesis & secretion, transport, metabolism, mode of action and estimation of various hormones secreted by the endocrine glands.
The neurohumoral mechanisms involved in regulation of hormonal secretions and their mechanism of action at cellular level.
Changes that occur in body as a result of hypo and hyper function of different glands and their hormonal interactions correlating with the function tests.
Bone physiology and calcium metabolism
Endocrine functions of other organs.
Growth, development and ageing.

**Reproductive System**
Development and functions of gonads

**Sex differentiation and their abnormalities**
Male reproductive system
Female reproductive system
Puberty, Menopause
Pregnancy, Lactation, Contraception
Infertility & its management

Course V Soft Skills (MDPY5) - Elective
CO1 Awareness about different study designs, sample size calculation, different methods of hypothesis testing and clinical trials. Proficiency in conducting a research.
CO2 Proficiency in different aspects of medical ethics and etiquette. Awareness about the responsibilities of being a part of a team/department.
CO3 Proficiency in teaching and the use of various teaching aids.
CO4: Ability to work as the member of a team.

TEXTBOOKS RECOMMENDED

1. Prescribed Books -

3. Understanding Medical Physiology: R.L. Bijalani- Jaypee Brothers
5. Text book of Practical Physiology: Ghai

2. Reference Books –

2. Physiology: Berne & Levy
5. Williams Text book of Endocrinology
6. Clinical Haematology: Wintrobe’s
7. De Gruchy’s Clinical Haematology in Medical Practice
RESEARCH

Each candidate has to work on a particular topic for thesis, submission of which shall be as per University regulations. The thesis should be brief, clear and focus on the relevance of the topic & should be under the following sub-headings

1. Title
2. Introduction
3. Review of literature
4. Materials & methods
5. Observations
6. Discussion
7. Summary & conclusion
8. Bibliography
9. Appendix – tools used for data collection like questionnaire etc

It should be submitted to the University at least 3 months before commencement of final University examination.

LOG BOOK & RECORD BOOK –

Candidate has to maintain a journal, duly certified by the teacher, in which all the practicals done by him/her are recorded

Candidate will also maintain work diary/log book & record his/her participation in all day to day training programs conducted by the department. Attendance in CME’s, conferences, seminars & other academic programs are to be entered in this.

The journal & logbook must be scrutinized & certified by the Head of the department.

TEACHING OF UG STUDENTS –

During training period, the candidate should actively involve themselves in teaching programs for undergraduates, both theory & practicals

ADMINISTRATION –
They should be able to organise the laboratories for the conduction of various practic-
als.
Handle and order equipment for the stores, draw up lists of equipments required to equip any section of physiology.

TEACHING-LEARNING METHODOLOGY –
Group Discussions
Attending Lectures/Demonstration
Conducting / Attending seminars & Journal clubs
Conducting / Attending Practical demonstrations for UG students and Paramedicals
Practical exercises
Microteaching sessions

EXAMINATION PATTERN

Theory - 4 papers – 100 marks each Total - 400 marks

Topic distribution for theory -
   Paper I - General Physiology, Haematology, Cardiovascular system
   Paper II - Physiology of Respiration, Renal Physiology, Skin & temperature Regulation, Principles of Biophysics as applied to Physiology
   Paper III - Nervous system, Special senses, Muscle & nerve Physiology
   Paper IV– Gastro intestinal Physiology, Endocrine system, Reproductive system, Recent advances in Physiology

Question paper pattern -
Each paper - 3 Hours duration
Essay 2 x 20 = 40marks
Short Essays 5 X 10 = 50 marks
Short notes 2 X 5 = 10 marks
Total 100 marks
## Practical exam –

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<th>Day 1</th>
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<td>OSPE</td>
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<tr>
<td>Clinical Examination of subject provided</td>
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<td>Hematology</td>
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<td>Human Physiology</td>
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<td>Graph Discussion (Amphibian &amp; Mammalian)</td>
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<td>Chart discussion (Clinical Cases, Interpretation of data, Charts etc)</td>
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**Day 2**

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<td>Micro Teaching</td>
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A candidate securing separate minimum of 50 % in theory and practical is eligible to pass the examination. Those securing 75% and above are eligible for distinction.
MD Physiology examination
Model Question Paper
Paper I
General Physiology, Haematology & Cardiovascular system

Max marks 100

Draw neatly labeled diagrams wherever necessary. Leave first page blank for mark distribution

I. Describe the blood supply of heart. Give an account of the pathophysiology of ischaemic heart disease

(10+10=20 marks)

II. Discuss the indications for transfusion of blood and blood products. Explain the signs and symptoms of mismatched blood transfusion, giving their physiological basis.

(10+10=20 marks)

III. Discuss the following -
A. Compensatory mechanisms during hypovolemic shock
B. Clinical applications of bioelectric potentials
C. Active transport across cell membrane & their inhibitors
D. Role of lymphocytes in immune mechanism
E. Regulation of heart rate

(10 marks X5=50 marks)

IV. Write briefly on -
A. Osmosis
B. Functions of platelets

(5 marks X2=10 marks)

..............................
I. Explain the mechanism of oxygen transport to tissues. Explain the various causes of hypoxia. What is oxygen toxicity?

(10 + 6 + 4 = 20 marks)

II. Describe the mechanism and significance of renal H\(^+\) ion secretion and buffer systems in renal tubular fluid.

(20 marks)

III. Discuss the following -
A. Renal function tests & their clinical significance
B. Role of skin in body temperature regulation
C. Acclimatization to high altitude
D. La Place’s law as applied to pulmonary and renal function
E. Ventilatory responses to PO\(_2\), PCO\(_2\) & pH changes & their interrelationship

(10 marks X 5 = 50 marks)

IV. Write briefly on -
A. Physiological applications of Donnan’s membrane equilibrium
B. Ventilation perfusion ratio & its significance

(5 marks X 2 = 10 marks)

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MD Physiology examination

Model Question Paper
Paper III

Max marks 100

Draw neatly labeled diagrams wherever necessary. Leave first page blank for mark distribution

I. Describe the physiology of maintenance of muscle tone and its alterations in Pyramidal & extra pyramidal diseases. (10+10=20 marks)

II. Describe the mechanism of secretion, circulation and re absorption of aqueous humor. How is normal intra ocular pressure maintained? What is glaucoma? (10+5+5=20 marks)

III. Discuss the following
   A. Drugs acting on neuro-muscular junction and the mechanism of action of each
   B. Synaptic plasticity
   C. Role of internal ear in detection and differentiation of sound
   D. Formation, circulation, absorption and functions of cerebrospinal fluid
   E. Features of hemisection of spinal cord and their physiological basis (10 marks x5=50 marks)

IV. Write briefly on
   A. Mechanism of contraction of smooth muscle
   B. Signal transduction in taste buds (5marksx2=10marks)
MD Physiology examination

Model Question Paper

Paper IV

Endocrinology, Reproduction, GIT & Recent advances

Max marks 100

Time 3 hours

Draw neatly labeled diagrams wherever necessary. Leave first page blank for mark distribution

I Discuss the physiological role of hormones secreted by adrenal cortex. Write a note on diagnosis & management of Addison’s disease

(15+5=20 marks)

II Describe the endocrine & exocrine functions of pancreas. What are the effects of dysfunction of pancreas?

(10+10=20 marks)

III Discuss the following –

A Describe the physiological processes leading to ovulation. Add a note on tests for ovulation & their significance

B Outline the events occurring during digestion and absorption of fat in GIT

C Discuss the systemic actions and regulation of secretion of thyroid hormones

D Describe gametogenesis in male & its regulation
E Explain the physiology of deglutition. Outline the causes of dysphagia

(10 marks each x 5 = 50)

IV Write briefly on –

A In Vitro fertilization (IVF)

B Prostaglandins

(5 marks each x 2 = 10)