M. Sc. Medical Anatomy

M.Sc. MEDICAL ANATOMY

1. PREAMBLE

M.Sc. Medical Anatomy will be an intensive three years (Six Semesters) course primarily for graduates in the biological sciences, which should facilitate them for teaching and research in health education sciences. The focus during the training programme will be to equip the candidate with adequate skills and also to be productive in promoting the professional career in research or into the Ph.D. programme.

2. OBJECTIVES

At the end of the course the post graduate student in Anatomy will be able to:-

a) Identify and know the anatomy of all the structures of the human body.

b) Identify the organs and tissues under the microscope.

c) Demonstrate knowledge of basic principles and development of the organs and systems.

d) Explain the developmental basis of the major variations and abnormalities.

e) Carryout relevant research

3. DURATION

Full time : Three year course:- Six semesters

1st & 2nd Semester subjects a) Anatomy b) Physiology c) Biochemistry.

3rd to 6th Semester – Anatomy.

4. ELIGIBILITY

B. Sc graduates of Biological Sciences or Life Sciences

5. COURSE CONTENT UNIT- WISE

The course consists of a programme of lectures, tutorials and practical classes for the 1st & 2nd semester mainly on Anatomy, Physiology and Basic Biochemistry. At the end of each semester the students take up a University Examination of Theory, Viva and Practical. The third to sixth semester will be devoted to Department of Anatomy mainly focused on Anatomy proper, and the students are involved in seminars, journal clubs and practical classes. At the end of each semester the student will appear for University Examination. Every post graduate student pursuing M.Sc. Medical Anatomy is required to carry out work on selected Research project under the guidance of P.G. teacher and the Research work done shall be submitted in the form of dissertation in the 6th semester.

Semester I
ANATOMY THEORY

Code Theory Paper I : ANA-T01

Practical : ANA-P01

COURSE CONTENTS

ANATOMY THEORY ANA-T01

General Anatomy Overview

™ Introduction to Anatomy and Anatomical terms

™ Basic principles of tissues, Human cell & types of cells.

™ Skin	:	Thick Skin & Thin Skin
™ Fascia	:	Superficial Fascia & Deep Fascia
™ Connective tissue	:	Types of connective tissue Cells of connective tissue Loose areolar tissue White fibrous tissue Adipose tissue Collagen fibres Reticular fibres Elastic fibres
™ Cartilage	:	Types of cartilage : White fibro cartilage, Elastic cartilage and Hyaline cartilage
™ Bones	:	Long bones, Short bones, Short long bones, Pneumatic bones, Sesamoid bones, Compact bone & Spongy Bone
™ Joints	:	General classification of Joints –Fibrous Cartilagenous, Synovial

™ Muscles : Skeletal Muscles, Cardiac Muscles, Smooth muscles

™ Nervous tissue : Neurons & Nerve fibres.
Introduction to
Central and Peripheral Nervous system
Autonomic nervous system in brief
-Sympathetic nervous system
-Parasympathetic nervous system

™ Blood vessels : Arteries , Veins, Capillaries and Sinusoids

™ Lymphatic system : Types of lymphocytes,
Circulation of lymph
Cysterna chyli
Lymphoid tissues

General Histology-

™ Introduction to Histology and Microscopes

™ Epithelium : Simple epithelium
Pseudostrafied epithelium
Stratified epithelium

™ Connective tissue : Cells of connective tissue
Loose areolar tissue
White fibrous tissue
Adipose tissue
Collagen fibres
Reticular fibres
Elastic fibres

™ Cartilages : Hyaline cartilage
Elastic cartilage
White fibro cartilage.

™ Bone : Cells of bone
Compact bone
Spongy bone

™ Nervous tissue	:	Neurons & types Nerve fibres Ganglia :- Spinal ganglion, Autonomic ganglion
™ Muscle	:	Cardiac Muscle Skeletal Muscle Smooth Muscle
™ Vascular system	:	Large sized artery Medium sized artery Large sized vein Medium sized vein
™ Lymphatic system	:	Thymus, Lymph nodes, Spleen, Palatine tonsil
™ Skin & Appendages	:	Thick skin & Thin skin

General Embryology-

- Cell division
- Gametogenesis
- Ovarian cycle and Uterine/ Menstrual cycle
- Fertilization, Cleavage, Blastocyst, Implantation
- Formation of fetal membranes, Chorion, Amnion, Chorionic villi, Placenta and Umbilical cord
- Phases of embryonic development, Primitive streak, Notochord ,Bilaminar germ disc, Trilaminar germ disc
- Formation and Fate of germ layers and Derivatives
- Folding of embryo
- Formation of body cavities

ANATOMY PRACTICALS : **ANA-P01**

- Gross anatomy :
- Osteology: spotters Identification of Bones of Axial and Appendicular skeleton identify parts of bones
- Types of Joints with examples.
- General Embryology models for spotters & discussion
- Histology :

General Histology slides for spotters and discussion

Semester II

ANATOMY THEORY

Code Theory Paper I : ANA-T02

Practical : ANA-P02

COURSE CONTENTS

ANATOMY THEORY: ANA-T02

Gross Anatomy Overview

Basic overview of the Gross Anatomy and Applied Anatomy and Systemic Histology of all related organs of the following systems

- **Gastrointestinal System:** Introduction, Digestive Tract with all related organs, Major Digestive Glands.
- **Respiratory System :-** Introduction, Components of Respiratory System, Conducting & Respiratory portions of the Respiratory system, Lungs
- **Cardio-vascular system:-** Introduction, Functions of CVS, Components of CVS, Anastomosis, Circulation of Blood.
- **Genitourinary system:-** Introduction, Kidney, Ureters, Urinary bladder, Urethra, Male reproductive system, Female reproductive system
- **Nervous System:** Introduction, Subdivision of Nervous System, structural organization of Nervous System, Nerve Fibres, Autonomic Nervous system.
- **Endocrine System:** Introduction, Components of Endocrine system, scattered masses of endocrine cells in exocrine glands, Diffuse neuroendocrine cells

  Lymphatic System : Lymph-nodes, thoracic duct & spleen.

ANATOMY PRACTICALS : ANA-P02

- **Gross Anatomy:** Demonstration of all important Prosected organs of Gastro-intestinal, Respiratory, Cardio-vascular, Genito-urinary, Nervous, Endocrine systems, Lymphatic System.
- **Systemic Histology slides:** Gastro-intestinal, Respiratory, Cardio-vascular, Genito-urinary, Nervous, Endocrine systems, Lymphatic System.

Semester III
ANATOMY THEORY

Code Theory Paper I : ANA-T03
Paper II : ANA-T04
Practical : ANA-P03

COURSE CONTENTS

GROSS ANATOMY

Paper 1: **ANA-T03**

UPPER LIMB: Detailed region wise Gross Anatomy of Upper limb

LOWER LIMB: Detailed region wise Gross Anatomy of Lower limb

Paper 2: **ANA-T04**

Systemic Histology-

- Cardiovascular system: Cardiac muscle and Blood vessels
- Digestive system and Pancreas
- Hepatobiliary system
- Renal system
- Respiratory system

- Endocrine system
- Male reproductive system
- Female reproductive system
- Central nervous system
- Special senses: eye and ear

Systemic Embryology :

Development of

- Pharyngeal apparatus
- Aortic Arches
- Gastrointestinal system, and related glands
- Hepato biliary system
- Renal system
- Cardio Vascular system
- Respiratory system
- Endocrine system
- Male Reproductive system
- Female Reproductive system,
- Central Nervous System

COURSE 3: ANATOMY PRACTICALS : ANA-P03

GROSS ANATOMY PRACTICALS

Upper limb:

- Dissection and prosection of upper limb
- Osteology of all upper limb bones
- Surface anatomy of upper limb and
- Radiology of upper limb

Lower limb:

- Dissection and prosection of lower limb
- Osteology of all lower limb bones
- Surface anatomy of lower limb and

- Radiology of lower limb
- **Systemic Embryology models for spotters & discussion**

HISTOLOGY PRACTICALS :

systemic histology slides for spotters and discussion.

Biostatistics Research Methodology & Biomedical Ethics	6 hrs/week
Synopsis writing and submission	4hrs/week
Seminar/Journal Club on Anatomy topics	2hrs/week
Microteaching sessions	2hrs/week
Posting to Basic Science Research Lab	2hrs/week

Semester IV
ANATOMY THEORY

Code Theory Paper I : ANA-T05
Paper II : ANA-T06
Practical : ANA-P04

COURSE CONTENTS

PAPER 1 : ANA-T05

1 THORAX

- Thorax : Thoracic Wall- Typical intercostal space & its contents.
- Mediastinum - Superior mediastinum, Inferior mediastinum
- Pleura -Visceral & parietal layers, Pleural cavity
- Lungs - External features , nerve supply & blood supply, Broncho pulmonary segments & its applied aspects
- Pericardium: Fibrous pericardium and Serous pericardium
- Heart: External features of Heart in detail. Details of interior of chambers of heart, atria, ventricles, blood supply, nerve supply & applied aspects
- Great vessels: Arch of aorta, Pulmonary trunk, Superior vena cava, Inferior vena cava
- Oesophagus: Parts, features, blood supply, nerve supply & applied aspects
- Trachea: Parts, features, blood supply, nerve supply & applied aspects
- Osteology: Typical & Atypical thoracic vertebrae, Typical & Atypical Ribs, Sternum

2. ABDOMEN AND PELVIS:

- Anterior abdominal wall: Muscles of Anterior abdominal wall, Rectus sheath boundaries, contents, formation & applied aspects.

- External Genitalia: Males —— Penis ,scrotum, testis,

  Females — Vagina, Clitoris

- Abdominal Cavity: Peritoneal cavity in general, Peritoneal folds & Ligaments, Omentum, Pouches of peritoneum, Pouch of douglas, Subdiaphragmatic recesses, Hepatorenal pouch, Paracolic gutters, Supracolic & infracolic compartments & applied aspects.

- Abdominal Viscera: Stomach, Spleen, Liver, Pancreas, Kidney & Ureter.

  Small intestine— Duodenum, Jejunum, Ileum.

  Large intestine — General Features, Appendix & ceacum.

  Blood supply of Gut.

  Applied aspects.

- Diaphragm: Attachments, Minor & major openings, nerve supply, blood supply & applied aspects

- Perineum: Superficial perineal pouch, Deep perineal pouch, Male perineum, female perineum, Ischiorectal fossa with its boundaries, contents & applied aspects.

- Vessels & nerves: Abdominal aorta & its branches, Common iliac artery & its branches in detail, Lumbar plexus.

- Urinary system: Kidney, Ureter, Urinary bladder, Urethra.

- Pelvis: Pelvic diaphragm,Ovary, Uterus— parts, features, position, supports , blood supply & nerve supply.

- Rectum and Anal canal in detail with applied aspects.

- Osteology: Typical & Atypical lumbar Vertebra, Sacrum, Male & Female bony pelvis.

PAPER 2 : **ANA-T06**

SYSTEMIC HISTOLOGY: all systemic histology slides

- Cardiovascular system Blood vessels and cardiac muscle

- Digestive system and Pancreas
- Hepatobiliary system
- Renal system
- Respiratory system
- Endocrine system
- Male reproductive system
- Female reproductive system
- Central nervous system
- Special senses: eye and ear

SYSTEMIC EMBRYOLOGY: Pharyngeal arches and Aortic Arches , Gastrointestinal system and related glands, Hepatobiliary system, Renal system, Cardio vascular system, Respiratory system, Male reproductive system , Female reproductive system.

Genetics: Basics of Cytogenetics, Modes of inheritance, Chromosomes, Karyotyping, Mutations, Chromosomal aberrations: Numerical and Structural. Clinical genetics: Syndromes, Genetic counselling , Prenatal diagnosis, Gene therapy.

ANATOMY PRACTICALS: ANA-P04

Gross anatomy:

- Dissection and prosection of Thorax and Thoracic viscera inculding Radiology, Osteology and Surface anatomy
- Dissection and prosection of Abdomen and Pelvis, with all viscera including Radiology, Osteology and Surface anatomy

Systemic Histology : all systemic histology slides

EMBRYOLOGY MODELS: systemic embryology models

- **Dissertation work** **12 hours/week**
- **Seminar / Journal club & Pedagogy training** **6 hours/week**
- **Microteaching** **2 hours/week**

Semester V
ANATOMY THEORY

Code Theory Paper I : ANA-T07
Paper II : ANA-T08
Practical : ANA-P05

COURSE CONTENTS

ANATOMY THEORY :

PAPER 1: ANA-T07

Gross Anatomy of Head and Neck:

Scalp Layers, nerve supply, blood supply & applied aspects.

Temporal & infra temporal regions –

Muscles of Mastication, Mandibular nerve, Maxillary artery, Otic ganglion, Pterygo-palatine ganglion, Temporo - mandibular joint.

A) Triangles of Neck :

Boundaries,contents & applied aspects of

- Anterior Triangle
- Submental triangle
- Diagastric triangle
- Muscular triangle
- Carotid triangle
- Posterior Triangle of Neck : Boundaries, contents & applied aspects.

B) Cranial Cavity :

- Meningis: Dura mater, Arachnoid mater

  Pia mater

- Dural venous Sinuses.
- All Cranial Nerves in detail.

C) Orbit & its contents :

- Eyeball and Extra ocular muscles
- Oculomotor nerve.
- Abducent nerve.
- Trochlear nerve.
- Optic nerve.
- Lacrimal gland.

D) Deep dissection of Neck :

- Thyroid gland.
- Trachea.
- Oesophagus.

E) Submandibular region :

- Submandibular gland
- Sub lingual gland.
- Suprahyoid muscles.
- Extrinsic group muscles of tongue.
- Submandibular ganglion.

F) Parotid region :

- Parotid gland anatomy
- Extra cranial course of facial nerve.

G) Nasal cavity :

- Medial wall of nose
- Lateral wall of nose.
- Paranasal air sinuses.

H) Larynx :

- Cartilages
- Interior of larynx
- Muscles of larynx.
- Blood supply and nerve supply
- Applied aspects.

I) Pharynx :

- Nasopharynx
- Oropharynx
- Laryngopharynx.
- Muscles of pharynx.
- Blood supply and nerve supply
- Applied aspects.

J) Tongue :

- External features
- Extrinsic Muscles
- Intrinsic Muscles
- Blood supply & nerve supply
- Applied aspects.

K) Palate :

- Muscles of soft palate
- Blood supply & nerve supply
- Development of palate
- Applied aspects

L) Ear :

- External ear
- Internal ear
- Middle ear
- Boundaries and Contents
- Blood supply & nerve supply
- Applied aspects

M) Eye ball :

- External features
- Layers
- Blood supply, nerve supply and Applied aspects

<u>PAPER 2 :</u> **ANA-T08**

HISTOLOGY Pertaining Head and Neck :

- Oral cavity-Tongue, tooth, salivary gland
- Thyroid gland
- Pituitary gland
- Thymus gland
- Eye (Cornea and Retina)
- Ear (organ of corti)

EMBRYOLOGY Pertaining Head and Neck :

Development of

- Pharyngeal apparatus
- Aortic arches,
- Tongue, tooth, salivary glands
- Face
- Thyroid gland
- Pituitary gland
- Thymus gland
- Eyeball
- Ear
- Skull

HISTOLOGICAL TECHNIQUES :

- Preparation of tissues
- Fixation
- Embedding
- Paraffin block making
- Microtomes
- Section cutting
- Staining techniques.

ANATOMY PRACTICALS : **ANA-P05**

GROSS ANATOMY : Dissection and prosection of Head and Neck **Osteology** of Head & Neck :

- Skull
- Norma frontalis

- Norma lateralis
- Norma basalis
- Norma occipitalis
- Norma verticalis.
- Cranial fossae
- Mandible
- Hyoid bone
- Typical & Atypical cervical vertebrae
- Foetal skull

Radiology of Head and Neck

Surface Anatomy of Head and Neck

EMBRYOLOGY MODELS of Head and Neck

- **Dissertation work** **12 hours/week**
- **Seminar / Journal club & Pedagogy training** **6 hours/week**
- **Microteaching** **2 hours/week**

Semester VI
ANATOMY THEORY

Code Theory Paper I : ANA-T09
Paper II : ANA-T10
Practical : ANA-P06

COURSE CONTENTS

ANATOMY THEORY

PAPER 1 : Neuroanatomy ANA-T09

1. Detailed Neuroanatomy of Neuron structure, Synapse, Neuroglia, Brief knowledge of techniques used in study of Neuro Anatomy, Receptors, Neuro muscular junctions.
   - Detailed study of Spinal cord, Brain stem, Cerebrum, Cerebellum, Diencephalon, Basal ganglia, Olfactory and Limbic system. Forebrain, Midbrain, Hindbrain including external features, Internal structures connections, Functions, Fibres etc.
   - Ventricles and circulation of Cerebrospinal fluid.
   - Related Applied anatomy of all structures
   - Visual pathway, Cranial nerves including cranial nerve nuclei, Autonomic nervous system.
   - Blood supply of Central Nervous System.

Recent advances in Clinical and Radiological anatomy

PAPER 2 : ANA-T10

Basics of Embalming and Museum techniques

Plastination: Posthumous Preservation of whole Human body as well as parts of Human body & posthumous preservation of Foetuses.

Histology of Nervous system:

Peripheral nerve, Ganglia,Cerebrum,

Cerebellum, Pituitary gland, Spinal cord

Embryology of Nervous System : Notochord, Neurulation, neural crest cells, Development of Central Nervous system and related structures, pituitary gland

Practicals: **ANA-P06**

- Dissection and prosection of Brain and Brain stem, Spinal cord, Cranial nerves
- Osteology of skull
- Histology Slides : Peripheral nerve, Ganglia ,Cerebrum, Cerebellum, Pituitary gland, Spinal cord
- Radiology
- Embryology Models : Development of Central Nervous system and related structures, pituitary gland
- Related surface marking

Completion of writing and Submission of Dissertation	12 hours/week
Seminar, Journal Club / Pedagogy	6 hours/week
Microteaching	2 hours/week

Attendance & monitoring progress :

It is required to maintain an attendance of 80% in both theory & practicals separately and it is mandatory to attend all the Internal Exams to be eligible for appearing University Examinations.

Course centric Activities :

Microteaching & pedagogy sessions will be provided to improve teaching skills and Research methodology & biostatistics postings to improve the Research capability for the M.Sc. students.

Seminars & Journal club activities will be conducted to improve subject knowledge.

Dissertation :

Dissertation review meetings will be conducted every month for reporting about the progress of dissertation work by the student and necessary guidance will be provided.

1st Semester & 2nd Semester

Theory Scheme of Examination.

Sl.no	Theory	Subjects	Theory Max. + IA + Viva Voce	Max. Marks Theory (Total)	Max. Marks Practical	Grand Total
1	Paper-I	Anatomy	80 + 20 + 30	130	70	200

Type of questions and distribution of marks for Theory Examination –Anatomy

Type of questions	Number of questions	Marks for each question	Total
Long Essay	02	10	20
Short Essay	09	05	45
Short Answer	05	03	15
Total			**80**

Note: Internal Assessment 20 marks add to the theory paper

1st Semester Practical -70 Marks

Type of Questions	Practical Marks
Histology	40 Marks
Gross Anatomy	10 Marks
Total	50 Marks
Internal Assessment Marks (15 + 5 Marks Record)	**20 Marks**
Grand Total	**70 Marks**

2nd Semester Practical -70 Marks

Type of Questions	Practical Marks
Histology	30 Marks
Gross Anatomy	20 Marks
Total	50 Marks
Internal Assessment Marks (15 + 5 Marks Record)	**20 Marks**
Grand Total	**70 Marks**

SCHEME OF EXAMINATION -

For 3rd , 4th ,5th & 6th Semester:

Theory (02 Papers each of 100 Marks)

Type of Questions	Pattern	Marks
Paper I		
i) Long Essay Questions =	20 Marks x 2	40 Marks
ii) Short Essay Questions	06 Marks x 10	60 Marks.
	TOTAL	100 Marks
Paper II		
i) Long Essay Questions =	20 Marks x 2	40 Marks
ii) Short Essay Questions	06 Marks x 10	60 Marks.
	TOTAL	100 Marks
	Total Theory	200
	Viva Voce	30 Marks
	Internal Assessment Marks	20 Marks
	Grand Total	**250** Marks

Practical 3rd , 4th ,5th &6th Semester

Type of Questions	**Practical Marks**
Gross Anatomy	50 Marks
Histology	30 Marks
Total	80 Marks
Internal Assessment Marks (15 + 5 Marks Record)	20 Marks
Grand Total	**100 Marks**

Criteria for Pass I Semester to VI Semester in Anatomy Subject.

For declaration of pass in any subject in the University examination, a candidate shall pass both in Theory and Practical examinations components separately as stipulated below.

The Theory component consists of marks obtained in University Written paper(s) and Viva-Voce examination. For a pass in theory, a candidate shall secure not less than 50% marks in aggregate i.e marks obtained in written examination, viva-voce & Theory Internal Assessment marks added together. For a pass in practical examination, a candidate shall secure not less than 50% marks in aggregate, i.e marks obtained in

university practical examination and Practical Internal Assessment marks added together .

A candidate not securing 50% marks in aggregate in Theory or Practical examination in any of the subject shall be declared to have failed in that subject and is required to appear for both Theory and Practical again in the subsequent examination in that subject.

Scheme of Examination.

Candidates will be allowed to appear for examination only if attendance (minimum 75%) is satisfactory and dissertation is accepted.

Carry Over System (ATKT):

At any given point of time a candidate shall have subjects pending to clear of only previous semester in addition to the subjects of the current semester that he/she is appearing for example

- If the candidate has not cleared I semester, he/she can appear for semester II and pending subjects of semester I simultaneously.
- For appearing for semester III he/she should have cleared semester I and can appear for papers pending from semester II along with semester III subjects.
- For appearing for semester IV he/she should have cleared semester II and can appear for papers pending from semester III along with semester IV subjects.
- For appearing for semester V he/she should have cleared semester III and can appear for papers pending from semester IV along with semester V subjects.
- For appearing for semester VI he/she should have cleared semester IV and can appear for papers pending from semester V along with semester VI subjects.

Declaration of Class:

a) A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secure 75% of marks or more of

grand total marks prescribed will be declared to have passed the examination with distinction.

b) A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secured 65% of marks or more but less than 75% of grand total marks prescribed will be declared to have passed the examination in First Class.

c) A candidate passing the university examination in more than one attempt shall be placed in Pass class irrespective of the percentage of marks secured by him/her in the examination.

TEXT BOOKS			
1.	Cunningham's Manual of Practical Anatomy: Vol. I, II, III	6.	General Anatomy by Daksha Dixit / B.D. Chaurasia
2.	Human Anatomy Vol. I, II, & III by Datta A.K./ Inderbir Singh/Vishram Singh/Govind Raju	7.	Embryology by – Daksha Dixit/Inderbir Singh
3	Di.fiore's Atlas of Histology	8.	Neuro Anatomy by Inderbir Singh/ Datta A. K. / Krishna Garg
4	Histology by Gunasegaran/Inderbir Singh	9.	Living & Radiological Anatomy by A. Halim
5	A Regional Atlas of Human Body	10.	Human Genetics by Bhatnagar/ Gangane

VIII. RECOMMENDED JOURNALS:

Sl. No.	Name of the Journal
1.	CLINICAL ANATOMY
2.	JOURNAL OF ANATOMICAL SOCIETY OF INDIA
3.	JOURNAL OF ANATOMY
4.	ACTA ANATOMICA
5.	AMERICAN JOURNAL OF ANATOMY
6.	AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY
7.	JOURNAL OF MORPHOLOGY, EMBRYOLOGY
8.	ANATOMICAL RECORD
9.	ANNUAL REVIEW OF GENETICS
10.	AMERICAN JOURNAL OF MEDICAL GENETICS

Recommended additional Text & Reference Books (Latest editions)

1. Lee McGregor's Synopsis of Surgical Anatomy by Decker GAG, dU Plessis DJ.

2. MooreK.L. Clinically Oriented Anatomy 5 Ed. 2006.

3. Vertebrates Comparative Anatomy 3/e. 2002.

4. Netter Atlas of Human Anatomy 4/e 2006

Histology:

1. Ross et al. Histology A text & Atlas with correlated cell & Molecular Biology.

2. Basic Histology text & Atlas .By Jenqueira.

Embryology :

1. Moore & Persaud .The Developing Human.

M. Sc. Medical Physiology

M.Sc. MEDICAL PHYSIOLOGY

PREAMBLE :

M.Sc. Medical Physiology will be an intensive three years (Six Semesters) course primarily for graduates in the Biological Sciences, which should facilitate them for teaching and research in health education sciences. The focus during the training programme will be to equip the candidate with adequate skills and also to be productive in promoting the professional career in research or in to the Ph.D programme.

OBJECTIVES :

At the end of the course a post graduate student in Physiology should be able to: -

1. Develop skills and understand general and systemic Physiology.
2. To understand physiological basis of health and disease affecting various organ systems.
3. Select and use appropriate teaching techniques and resources.
4. Carryout relevant research.
5. Function as an effective member of teaching team or research team.

DURATION:-

Full time three year course.

1st & 2ndSemester subjects – a) Anatomy b) Physiology c) Biochemistry.

3rd to 6th Semester – Physiology.

ELIGIBILITY :-

B.Sc. graduates of Biological Sciences or Life Sciences

COURSE CONTENTS UNIT WISE:-

The course consists of a programme of lectures, tutorials and practical classes for the 1st & 2nd semester mainly on Anatomy, Physiology and Basic Biochemistry. At the end of each semester the students will appear for University Examination. The second to sixth semester will be devoted at Department of Physiology mainly focused on proper Physiology and are involved in seminars, journal club and practical classes. At the end of every semester the students will appean for university exam in theory, practical & viva voce every candidate is required to carry out worth on selected research project under guidence of recognised P.G. teacher & shall be submitted in form of dissertation in 6th semester.

Semester I

Physiology Theory

PHYIT01 General Physiology, Nerve Muscle Physiology, Blood & Lymph, Respiratory System, Cardiovascular System

PHYIP01 Physiology Practical

PHYIT01

GENERAL PHYSIOLOGY

Homeostasis –definition & feedback mechanisms, Cell organelles, Structure of cell membrane, Transport Mechanisms- active and passive transport, intercellular communications Body fluids –compartments & measurement

NERVE MUSCLE PHYSIOLOGY

Types of neurons & neuroglia

Classification of nerve fibers

Properties of nerve fiber, RMP monophasic action potential & its ionic basis

Muscles- Structure &Types, sarcomere, strength duration curve.

Properties of skeletal muscle

NMJ Structure & Transmission of impulse across the NMJ.

Excitation contraction coupling, Mechanism of contraction and its molecular basis.

BLOOD AND LYMPH

Composition and functions of blood, Plasma Proteins- Types, Normal Values, Functions.

Red blood cells- Morphology, functions. Normal values, variations and life span. Erythropoiesis- Stages, factors and regulation.

RBC indices. PCV, ESR –definition & normal values

Hemoglobin – Types, Functions, physiological variation, fate of Hb, Definition & types of Jaundice

Anemia - Definition types and general features.

Leucocytes –Morphology of different types of leucocytes, functions, variations.

Platelets –Morphology, functions, normal values, variations.

Hemostasis and blood coagulation – definition, clotting factors, mechanism of clotting, anticoagulants, Hemophilia & Purpura.

Blood groups – ABO system and Rh system & Rh incompatibility

Blood transfusion – indications, types & reactions.

RESPIRATORY SYSTEM

Functional anatomy of respiratory tract.

Mechanism of ventilation - Pressure & volume changes, Definition & normal value of compliance. Surfactant – Source, chemical nature, functions, Lung volumes and capacities - definition, normal values.

Oxygen Transport – O_2 Hb dissociation curve & factors affecting it CO_2 transport – Chloride Shift, Haldane effect

Regulation of respiration – Organization of respiratory centers. Neural regulation & chemical regulation.

Hypoxia- Definition, types & characteristic features changes in high altitude & dysbarism, Artificial respiration

CARDIO VASCULAR SYSTEM

Functional anatomy of heart, blood vessels.

Conducting system, Properties of cardiac muscle, neat labelled diagram of normal ECG, Cardiac cycle – Phases & pressure, volume changes. Cardiac output – definition, factors affecting, Method of determination, regulation. Blood pressure & it's regulation

Semester I

Physiology Practical

PHYIP01

Practical : 60 Hours

I. Hematology

1. Estimation of Hemoglobin
2. Study of haemocytometer and determination of red blood cell count
3. Blood indices.
4. Study of the Microscope
5. Erythrocyte sedimentation rate & packed cell volume. (Demonstration)
6. Osmotic fragility (Demonstration)
7. Determination of blood group
8. Determination of White Blood cell count.
9. Preparation and staining of a peripheral smear; differential leucocyte count.
10. Bleeding time & Clotting time.

II. Human Physiology Experiments

1. Examination of arterial pulse
2. Recording of normal blood pressure
3. Recording of normal spirogram
4. Artificial respiration

III. Interpretation of charts, problems & case histories

Semester II

Physiology Theory

PHYIIT02 Gastro Intestinal System, Renal System, Reproductive System, Endocrinology, Special Senses, Nervous System

PHYIIP02 Physiology Practical

PHYIIT02
GASTRO INTESTINAL TRACT
Functional Anatomy of GI tract.
Salivary secretion. Composition of saliva, functions
Gastric secretion- Composition, Mechanism of secretion of HCl, functions of gastric juice & Regulation of gastric secretion
Pancreas- composition and functions
Liver and gall bladder - Composition, function
Small Intestine - Composition and functions
Function of large intestine.
Gastro intestinal movements – Deglutition, Movements of small & large intestine

RENAL SYSTEM
Physiological Anatomy – Types of Nephron & JG apparatus
Glomerular filtration rate: Definition, normal value, factors affecting it
Innervation of urinary bladder, Micturition reflex
Artificial Kidney

REPRODUCTIVE SYSTEM
Physiological anatomy of female and male reproductive organs
Female reproductive system - Menstrual cycle, Functions of ovary, Action of estrogen and progesterone,
Tests for ovulation
Male reproductive system- Spermatogenesis, Semen
Contraceptive methods - Classification

ENDOCRINOLOGY

Pituitary hormones- actions, Applied aspects: Signs and symptoms of Gigantism, Acromegaly and Dwarfism

Thyroid hormones- Biosynthesis, actions, Applied aspects: Signs and symptoms of Myxedema, Cretinism and Grave's disease

Calcium homeostasis

Actions of Insulin, Diabetes Mellitus – Signs & Symptoms

Adrenal hormones- Names and their actions, Applied aspects: Signs and symptoms of Cushing's syndrome and Addison's disease

SPECIAL SENSE

Smell: Receptors and olfactory pathway

Taste: Structure of taste bud. Basic taste modalities Taste pathway

Ear- Functional Anatomy

Functions of middle ear, Structure of organ of corti, auditory pathway, Deafness – Types, Tuning fork tests and its interpretation

Eye- Physiological Anatomy, Image formation, Structure of photoreceptors, Functions of aqueous humour. Visual pathway, light reflexes and accommodation reflexes, Common errors of refraction colour vision and colour blindness

NERVOUS SYSTEM -

Organization of CNS

Synapse- definition, types of synapse, steps of synaptic transmission.

Receptors- definition & classification

Reflexes – Definition, classification& reflex arc

Description of posterior column tract, lateral spinothalamic tract, Ventral spinothalamic tract

Description of pyramidal tract.

Signs of upper motor neuron and lower motor neuron lesion

Naming the extrapyramidal tracts and their functions

Autonomic Nervous System- Division & functions

CSF & Blood Brain Barrier

Semester II

Physiology Practical

PHYIIP02

PRACTICALS -60 Hours

CLINICAL EXAMINATION .

1. General physical examination
2. Introduction to clinical examination
3. Clinical examination of cranial nerves –I,II (Acuity of vison & color vision) III,IV,VI& VIII
4. Interpretation of charts, problems & case histories.

Semester III

Physiology Theory

PHYIIIT03 **Paper I**- General &Molecular Physiology, Blood and Lymph, Human Immune System

PHYIIIT04 **Paper II**- Cardiovascular System, Hemodynamics of Blood flow

PHYIIIP03 Physiology Practical

PAPER I

PHYIIIT03

General &Molecular Physiology

Cell and its organelles. Structure of cell membrane. Second messengers. Intercellular communications. Transport across cell membrane. Homeostasis. Body fluids – compartments, composition and measurement. Oedema and its causes.Replacement of body fluid loss. Apoptosis

Chromosome structure and organization: Structure and function of DNA, RNA.

Genes: General consideration, Protein synthesis-DNA Replication, Transcription, Translation, Gene expression & Regulation of gene expression.

Blood and Lymph

Composition and functions of blood. Plasma Proteins. Cellular elements of blood – formation, regulation, morphology, functions and variations. Blood indices, PCV, ESR. Haemoglobin – Structure, synthesis, functions & catabolism. Jaundice. Anemia – definition, types & features. Haemostasis. Fibrinolytic system. Anticoagulants. Bleeding disorders. Blood groups. Rh incompatibility. Blood transfusion and storage. Lymph – composition, circulation and functions.

Human Immune System

1. Definition and Classification, Immunoglobulin-Structure and Types
2. Mechanisms of immune responses-Humoral and Cell-mediated
3. Complement System, Major Histocompatibility Complex (MHC)

PAPER II

PHYIIIT04

Cardiovascular System

Functional anatomy of heart and conducting system. Properties of cardiac muscle. Cardiac cycle. ECG – principles, normal and abnormal ECG. Cardiac output – regulation and measurement. Heart rate. Blood pressure – definition and regulation. Cardiovascular changes during exercise. Regional circulations – microcirculation, coronary, cerebral, cutaneous and fetal circulation. Pathophysiology of Shock.

Hemodynamics of Blood flow- Functional morphology of various types of blood vessels, Flow, Pressure, Resistance, Blood flow measurement, Laminar and turbulent flow, Reynolds' number, Bernoulli and Poiseuille's equations and their application

Physiology Practical

PHYIIIP03

Practicals-60 Hours

1. Preparation of Blood Smear and Determination of Differential Leucocyte Count
2. Absolute Eosinophil Count
3. Platelet Count
4. Reticulocyte Count
5. Recording of BP – Effect of Posture & Exercise
6. Clinical examination of radial pulse

7. Recording and interpretation of ECG and calculation of Heart rate
8. Clinical examination of CVS
9. Interpretation of charts problems case histories.

- Biostatistics -90 Hours
- Research Methodology & Biomedical Ethics
- Synopsis writing and submission -60 Hours
- Seminar/Journal Club on Physiological topic -30 Hours
- Microteaching sessions -30 Hours
- Posting to Basic Science Research Lab -30 Hours

Semester IV

Physiology Theory

PHYIVT05 **Paper I**- Respiratory System, Environmental Physiology, Exercise Physiology

PHYIVT06 **Paper II**- Gastrointestinal Tract, Nutrition, Renal system

PHYIVP04 Physiology Practical

PAPER I

PHYIVT05

Respiratory System

Functional anatomy of respiratory tract. Pulmonary blood flow.

Mechanics of Respiration: Mechanism of ventilation,Pressure & volume changes, Compliance, Airway resistance, Work done during breathing, Surfactant–source, chemical nature and functions, Dead space, Alveolar ventilation, Ventilation-perfusion ratio, Diffusion capacity of lungs, Lung volumes and capacities–definition, normal values, determination and significance.

OxygenTransport–O_2-Hb dissociation curve and factors affecting it.

CO_2transport–CO_2dissociation curve, Chloride Shift, Haldaneeffect.

Regulation of respiration– organization of respiratory centers, neural regulation and chemical regulation. Respiratory acidosis and alkalosis. Periodic breathing. Hypoxia-definition, types, effects & treatment. Oxygen therapy. Dyspnea. Asphyxia. Cyanosis. Artificial Respiration. Respiratory adjustments during muscular exercise.

Environmental Physiology: High Altitude, Space and Deep Sea Physiology

Exercise Physiology

Exercise: Types and Gradings

Physiological Responses to Exercise- Neuromuscular, Cardiovascular, Respiratory, Metabolic, Water and Electrolyte, Endocrine

Physiology of Fitness and Health , Physiology of Training

Benefits of exercise in Health and Disease

PAPER II

PHYIVT06

Gastrointestinal Tract

Functional anatomy. Smooth muscle – structure and mechanism of contraction. composition, secretion, functions and regulation– salivary glands, stomach, pancreas, small intestine and large intestine. Functions of liver and gall bladder. Liverfunction Tests. Bile secretion and its regulation. Gastrointestinal movements and applied aspects. GI hormones. Digestion and absorption of food. Pathophysiology of Peptic ulcer, Achalasia, Hirschsprung's disease

Nutrition: Nutritional needs of the Body, Balanced Diet, Recommended Dietary Allowances

Renal system

Functional anatomy of kidney. Renal blood flow. Juxtaglomerular apparatus. Mechanism of urine formation. Counter-current mechanism. Role of kidney in water and electrolyte balance. Acidification of urine. Diuretics. Kidney function tests. Structure and innervations of bladder. Physiology of Micturition. Cystometrogram. Disorders of micturition. Principles of artificial kidney. Acid Base Balance, Regulation of extra cellular volume

PHYSIOLOGY PRACTICAL

PHYIVP04

Practical60 Hours

1. Clinical Examination of Respiratory System
2. Cardiovascular fitness tests – Harvard step tests
3. VO2 Max and MET calculation- Demonstration

4. Autonomic Function Tests- Demonstration
5. To Record- Pulmonary function tests by Computerized Spirometry, FEV1, PEFR – Wright's peak flow meter
6. Stethography
7. Clinical Examination of Abdomen
8. Interpretation of charts problems case histories.

- Seminar/Journal Club & Pedagogy Training - 90 Hours
- Microteaching -30 Hours

Semester V

Physiology Theory

PHYVT07 **Paper I-**Endocrinology, Stress physiology, Chronophysiology

PHYVT08 **Paper II**- Reproductive System, Special Senses

PHYVP05 Physiology Practical

PAPER I

PHYVT07

Endocrinology

Introduction and general principles of endocrinology. Hormones – types, mechanism of action, synthesis, secretion, regulation and actions of anterior, posterior pituitary, thyroid, parathyroid, adrenal gland, and endocrine pancreas. Calcium Homeostasis. Physiology of growth. Minor endocrine glands – pineal body, heart and kidney. Local hormones

Applied endocrinology- Hypothyroidism-Cretinism and Myxedema, Grave's Disease, Goitre, Thyroid Function Tests, Tetany, Hyperparathyroidism, Rickets, Osteoporosis, Osteomalacia

Diabetes Mellitus-Classification, Pathophysiology and Treatment,

Gigantism, Acromegaly, Dwarfism, Panhypopituitarism, Diabetes Insipidus, Cushing's Syndrome, Addison's Disease, Hyperaldosteronism, Adrenal Virilism, Pheochromocytoma

Stress physiology:

- Types of Stress.
- Physiology of stress and stress relieving mechanisms
- Neuroendocrine response to Stress
- Effect of stress on physical health

- STRESS Adaptation Syndrome
- Stress management

Chronophysiology

Physiology of Growth & Development: General growth curve, Infancy,adolescent growth spurt, Neural growth curve, Lymphoid growth curve, Factors affecting growth, Physiology of behavioural development- Milestones

Physiology of Ageing- Theories

PAPER II

PHYVT08

Reproductive System

Sex determination and differentiation. Puberty.

Male Reproductive System: Physiological anatomy. Spermatogenesis and regulation.Semen and its analysis. Testicular hormones.

Female Reproductive System: Physiological anatomy.Oogenesis. Ovarian hormones.Menstrual cycle – changes in ovary, uterus, cervix, vagina and hormonal regulation. Ovulation and its detection. Fertilization. Implantation. Pregnancy – physiological changes and nutritional needs of mother. Pregnancy tests. Placenta. Fetoplacental unit. Parturition. Lactation. Composition of breast milk. Physiology of newborn.

Contraception: Physiological basis of contraception in males and females.

Special Senses

Eye: Functional anatomy of eye. Optics and Image forming mechanisms. Photochemistry of vision. Neurophysiology of vision. Errors of refraction. Visual pathway and lesions. Acuity of vision. Field of vision. Colour vision. Pupillary reflexes. Accommodation. Dark adaptation. Nutritional deficiency– Night blindness.

Ear: Functional anatomy. Auditory receptors and pathway. Physics of sound. Role of tympanic membrane, middle ear and cochlea in hearing. Electrophysiology of hearing. Deafness and its causes.Tuning fork tests and its interpretation. Principles of audiometry,

Taste and Smell: Modalities, receptors, transduction, pathway and applied aspects.

PHYSIOLOGY PRACTICAL

PHYVP05

Practical-60 Hours

1. Clinical Examination of I, II , III, IV, VI & VIII cranial nerve
2. Perimetry
3. Interpretation of charts problems case histories.

- Seminar/Journal Club & Pedagogy Training -90 Hours
- Microteaching- 30 Hours

Semester VI

Physiology Theory

PHYVIT09 **Paper I-**Nerve and Muscle, Nervous System-Part I

PHYVIT10 **Paper II**- Nervous System-Part II, Higher Functions of the Brain, Comparative Physiology, Physiology of Yoga and Meditation.

PHYVIP06 Physiology Practical

Paper I

PHYVIT09

Nerve and Muscle

Nerve fibers – classification, properties and functions. Membrane potentials. Degeneration and regeneration in nerves. Muscles –classification and properties. Molecular basis and mechanism of muscle contraction. Thermal and chemical changes during muscle contraction. Oxygen debt. Neuromuscular transmission. Neuromuscular blocking drugs. Neuromuscular disorders – Myasthenia gravis.

Nervous System-Part I

Organization of the nervous system

CNS-Brain & Spinal Cord

Cerebral Hemisphere – Lobes, areas & functions

Formation, circulation and functions of CSF. Blood brain barrier.

Peripheral Nervous System- Somatic &Autonomic nervous system.

Central neurotransmitters

Synapse- Definition, Structure, Classification, Steps of synaptic transmission, Electrical events, properties of synapse

Receptors- Definition, Structure, Classification, Electrical events, properties of receptors

Reflexes- Definition, Reflex arc, Classification & properties

Monosynaptic reflex- Stretch reflex, muscle spindle, regulation & muscle tone

Polysynaptic reflex – Withdrawal reflex

PAPER II

PHYVIT10

Nervous System-Part II

Motor and sensory systems and their lesions. Spinal Cord Lesions

Vestibular apparatus.

Control of Body Movements and Posture.

Reticular system in brain stem.

Basal ganglia.

Cerebellum.

Limbic system.

CNS disorders – Alzheimer's disease, Parkinsonism, Syringomyelia and Tabes dorsalis.

Higher Functions of the Brain

Memory and Learning: Classification and Physiological Basis

- Sleep and Consciousness**:** Physiological Basis for sleep and wakeful cycle, REM and Non REM sleep, Disorders of Sleep
- Functions of Neo-cortex: Physiology of Language, speech and disorders
- Behavior and Emotions: Limbic functions, Sexual Behavior
- Hypothalamus and Thalamus.

Comparative Physiology –CVS, Respiratory System & Renal system

Physiology of Yoga and Meditation

Physiological Effects of Yoga &Meditation.Yoga in Health & Diseases

PHYSIOLOGY PRACTICAL

PHYVIP06

PRACTICAL-60Hours

1. Examination of Sensory System.
2. Examination of Motor System.
3. Examination of Reflexes.
4. Examination of Cranial Nerves –V, VII, IX, X, XI & XII
5. Mosso'sergography- at normal condition, after venous occlusion and arterial occlusion
6. Interpretation of charts problems case histories.

- Seminar/Journal Club & Pedagogy Training -90 Hours
- Microteaching - 30 Hours
- Dissertation work from III – VI semester - 500 Hours

1st semester & 2nd Semester

Scheme of Examination

Sl.no	Theory	Subjects	Theory Max. + IA + Viva Voce	Max.Marks Theory (Total)	Max. Marks Practical	Grand Total
1	Paper-II	Physiology	80 + 20 + 30	130	70	200

Type of questions and distribution of marks for Theory examination –Physiology

Type of questions	Number of questions	Marks for each question	Total
Long Essay	02	10	20
Short Essay	09	05	45
Short Answer	05	03	15
Total			**80**

Note: Internal Assessment 20 marks add to the theory paper

Practical -70 Marks

Type of Questions	Practical Marks
Major Experiments	30 Marks
Minor Experiments	20 Marks
Total	50 Marks
Internal Assessment Marks (15 + 5 marks Record)	**20 Marks**
Grand Total	**70 Marks**

SCHEME OF EXAMINATION

For 3rd, 4th, 5th & 6th Semester:

Theory (02 Papers each of 100 Marks)

Type of Questions	Pattern	Marks
Paper I		
i) Long Essay Questions =	20 Marks x 2	40 Marks
ii) Short Essay Questions	06 Marks x 10	60 Marks.
	TOTAL	**100 Marks**
Paper II		
i) Long Essay Questions =	20 Marks x 2	40 Marks
ii) Short Essay Questions	06 Marks x 10	60 Marks.
	TOTAL	**100 Marks**
	Total Theory	200
	Viva Voce	30 Marks
	Internal Assessment Marks	20 Marks
	Grand Total	**250 Marks**

Practical – 100 Marks

Type of Questions	Practical Marks
Major	50 Marks
Minor	30 Marks
Total	80 Marks
Internal Assessment Marks (15 + 5 marks Record)	20 Marks
Grand Total	**100 Marks**

Criteria for Pass I Semester to VI Semester in Physiology Subject.

For declaration of pass in any subject in the University examination, a candidate shall pass both in Theory and Practical examinations components separately as stipulated below.

The Theory component consists of marks obtained in University Written paper(s) and Viva-Voce examination. For a pass in theory, a candidate shall secure not less than 50% marks in aggregate i.e marks obtained in written examination, viva-voce & Theory Internal Assessment marks added together. For a pass in practical examination, a candidate shall secure not less than 50% marks in aggregate, i.e marks obtained in

university practical examination and Practical Internal Assessment marks added together .

A candidate not securing 50% marks in aggregate in Theory or Practical examination in any of the subject shall be declared to have failed in that subject and is required to appear for both Theory and Practical again in the subsequent examination in that subject.

Scheme of Examination.

Candidates will be allowed to appear for examination only if attendance (minimum 75%) are satisfactory and dissertation is accepted.

Carry Over System (ATKT):

At any given point of time a candidate shall have subjects pending to clear of only previous semester in addition to the subjects of the current semester that he/she is appearing for example

- If the candidate has not cleared I semester, he/she can appear for semester II and pending subjects of semester I simultaneously.
- For appearing for semester III he/she should have clear semester I and can appear for papers pending from semester II along with semester III subjects.
- For appearing for semester IV he/she should have clear semester II and can appear for papers pending from semester III along with semester IV subjects.
- For appearing for semester V he/she should have clear semester III and can appear for papers pending from semester IV along with semester V subjects.
- For appearing for semester VI he/she should have clear semester IV and can appear for papers pending from semester V along with semester VI subjects.

Declaration of Class:

a) A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secure 75% of marks or more of grand total marks prescribed will be declared to have passed the examination with **Distinction.**

b) A candidate having appeared in all the subjects in the same examination and passed that examination in the first attempt and secured 65% of marks or more but less than 75% of grand total marks prescribed will be declared to have passed the examination in **First Class.**

c) A candidate passing the university examination in more than one attempt shall be placed in **Pass class** irrespective of the percentage of marks secured by him/her in the examination.

Recommended Books (Latest Editions)

Sl. No	Title	Author	Publications
1	Text of medical physiology	Guyton A.C	Prism Publishers
2	Review medical physiology	Ganong W.F	Appleton and Lange
3	Text book of medical physiology	Jain A.K	Avichal Publishing Company
4	Text book of medical physiology	Pal G.K	Ahuja Jaypee Publishers
5	Manual of Practical physiology	Jain A.K	Arys Publishers
6	A Text book of Practical physiology	Ghai C.L	Jaypee Brothers
7	Hutchison's clinical methods	Hunter Bomford	Bailliere Tindal
8	Clinical physiology	Campbell J.M	ELBS
9	Physiology	Berne R.M & Levy M.N	Mosby Publication

M. Sc. Medical Biochemistry

M.Sc. MEDICAL BIOCHEMISTRY

1. PREAMBLE :

M.Sc.Medical Biochemistry will be an intensive three years (six semesters) course primarily for graduates in the biological sciences, which should facilitate them for teaching and research in health education sciences. The focus during the training programme will be to equip the candidate with adequate skills and also to be productive in promoting the professional career in research or in to the Ph.D programme.

2. OBJECTIVES :

i) Teaching and working in the field of medical biochemistry with understanding of both theory and laboratory practice.

ii) Understand the principles of the analytical techniques used in a Clinical Biochemistry department.

iii) Understand the procedures used to set-up, assess and maintain the quality of laboratory analysis.

iv) Understand the physiological and pathological processes affecting biochemical investigations.

v) Understand the use of clinical biochemistry results in the diagnosis and management of common medical disorders.

vi) Be able to communicate his/her knowledge to colleagues and clinicians.

vii) Have initiative to, systematically conduct research, solve problems on the basis of scientific processes, make independent decisions and express opinions with logics and possibilities.

viii) Appropriately putting knowledge of biochemistry into use in an enhancement or application, especially in the field of medicine and public health,

ix) Publicizing new knowledge and findings, and giving advice about medical biochemistry with clarification and accuracy.

3. QUALIFICATION FOR ADMISSION

A candidate for admission to M.Sc. (Medical Biochemistry) Course should have passed B.Sc. Chemistry or B.Sc. (MLT) or B.Sc. Life Sciences full time degree in any recognized University.

4. DURATION OF THE COURSE

The M.Sc. (Medical Biochemistry) is a full time 3 years course

1st Sem. And 2nd Sem. a) Anatomy b) Physiology c) Biochemistry

3rd to 6th Semester – Biochemistry.

5. COURSE CONTENT UNIT WISE

The course consists of programme of lectures, tutorials, and practical classes for the 1st and 2nd semester of mainly on Anatomy, Physiology and Basic Biochemistry. At the end of each semester the students take up a University Exam of Theory, Viva and Practical. The third to sixth semester will be devoted at Dept. of Biochemistry mainly focused on proper Biochemistry and are involved in seminars, journal club and practical classes. At the end of every semester the students will take up the Theory, Viva and Practical exam. Every candidate is required to carry out work on selected research project under the guidance of a recognized post graduate teacher. The results of such work shall be submitted in the form of Dissertation in the 6th semester.

Semester I

M.Sc. Medical Biochemistry Theory

Code: **BCHMT01** General Biochemistry

BCHMP01 Biochemistry Practical

1. **Introduction and Scope ofBiochemistry.**
2. **Biomolecules, forces that stabilize the biomolecules, Principles of Thermodynamics and Donnan membrane equilibrium.**
3. **Cell and subcellular structures:**

Mitochondria, Endoplasmic Reticulum, Golgi complex, Peroxisomes, Lysosome, Ribosome, Nucleolus, Centrosome, chromosomes, Nucleosomes, Histones.

4. **Biological membranes:**

Membranes Structure; composition of Cell Membrane-Fluid Mosaic Model, specialised membrane structures.

Transport across biological membranes: Passive diffusion, Facilitated diffusion, Ion

channels,Ligand gated channels,Voltage gated channels, Ionophores, Active transport, Uniport, Symport, Antiport, Exocytosis, Endocytosis, Pinocytosis, Phagocytosis.

5. **pH and buffers:**

Definition of Acids, Bases, Buffers, pH, pH of biological fluids, Henderson-Hasselbalch equation: Derivation and Applications.

6. **Chemistry of Carbohydrates:**

Definition, functions and classification of Carbohydrates.

Monosaccharides: Glucose, Fructose, Mannose, Galactose, Properties & Reactions of Monosaccharides

Disaccharides: Sucrose, Lactose, Maltose.

Polysaccharides: Chemistry and Functions of Homopolysaccharides and Heteropolysaccharides/ Mucopolysaccharides.

7. **ChemistryofAminoAcids,PeptidesandProteins**

Definition and Classification of amino acids, properties of amino acids. Properties and formation of Peptide bond. Color reactions of amino acids. Definition, Classification and properties of proteins. Structural organization of proteins and its determination. Primary structure of insulin and Structure-function relationship. Biologically important peptides.

8. **Chemistry ofLipids.**

Definition, classification and functions of lipids.

Classification of fatty acids, properties of fatty acids, essential fatty acids. Triglycerides: properties and its reactions.

Phospholipids, Glycolipids and Lipoproteins: Classification and its functions. Derived Lipids: Steroids and cholesterol.

9. **Chemistry of NucleicAcids.**

Definition of nucleosides, nucleotides and nucleic acids. Nucleotides: Structure, nomenclature and functions of nucleotides.

DNA: Structure of DNA (Watson and Crick Model), chargaff's rule, Organization of DNA, Genes and chromosomes.

RNA: Types and functions of RNA.

10. **Enzymes:**

Definition and IUBMB Classification of enzymes. Holoenzyme, Apoenzyme, coenzymes.

11. **Vitamins:**

Chemistry, sources, RDA, functions and deficiency manifestations of Vitamins.

Fat Soluble Vitamins: Vitamin A, Vitamin D, Vitamin E, VitaminK. Hypervitaminosis.

Water Soluble Vitamins: Vitamin C, Thiamine (B1), Riboflavin (B2), Niacin (B3), Pyridoxine (B6), Folic acid, Vitamin B12.

Semester I

Biochemistry Practicals

BCHMP01

Practicals:60Hrs

1. Reactions of Monosaccharides : Glucose and fructose
2. Reactions of Disaccharides :Lactose,maltose and sucrose
3. Reactions of Polysaccharides : Starch
4. Identification of unknown carbohydrate
5. Precipitation and coagulation reactions of proteins
6. Colour reactions of proteins
7. Reactions of Albumin and Casein
8. Biochemically important substances
9. Identification of unknown solution.

Semester II

M.Sc. Medical Biochemistry Theory

Code: **BCHMT02** Basic Metabolism

BCHMP02 Biochemistry Practical

1. **DIGESTION, ABSORPTION & RELATED DISORDERS:**

- ❖ Carbohydrates
- ❖ Lipids
- ❖ Proteins

2. **CARBOHYDRATE METABOLISM:**

❖ Glycolysis, Gluconeogenesis, Citric acid cycle:

- Definition, location, reactions with enzymes, energetics and regulation.
- Glycolysis: BPG Shunt
- Gluconeogenesis: Cori's Cycle and Glucose alanine cycle.
- Citric acid cycle: amphibolic nature of the cycle, anaplerotic reactions.

❖ Blood Glucose homeostasis: Regulation, normal levels of Fasting, random and postprandial blood sugar.

❖ Diabetes Mellitus- Definition, Classification, Biochemical Derangements, Glucose ToleranceTest.

3. **LIPIDMETABOLISM:**

❖ Beta Oxidation of fatty acids and Ketone body metabolism:

- Definition, location, reactions with enzymes,energetics and regulation.
- Ketone Bodies: Normal serum levels, ketonemia, ketonuria and ketosis.

4. PROTEIN AND AMINO ACID METABOLISM

- General reactions of amino acids: Transamination,Nonoxidative and Oxidative deamination
- Formation and transport of ammonia
- Disposal of ammonia (Ureacycle)
- Hyperammonemias

5. Minerals

- Sources, RDA, Functions and deficiency manifestations of Calcium, Phosphorus, Iron, Zinc, Copper, Iodine, Selenium and Fluoride.

6. Nutritionandenergymetabolism

- Calorific value and nutritional importance of Carbohydrates, Lipids, Proteins and Dietaryfibers.
- BMR (Basal Metabolic Rate)
  - Definition, Normal values and Factors affecting BMR.

Semester II

Biochemistry Practicals

BCHMP02

Practicals: 60 Hrs

1. Analysis of Urine-Normal and abnormal constituents.
2. Spectroscopic examination of Hemoglobin derivates.
3. Estimation of blood glucose by GOD POD method
4. Estimation of total protein and A/G ratio by Biuret method
5. Estimation of urea by DAM method
6. Standered operating procedure of colorimeter and spectrophotometer. (Measurement of region of maximal absorption of a coloured solution)
7. Demonstration of Electrophoresis and chromatography.
8. Case reports –OGTT and ketoacidosis.

Semester III

M.Sc Medical Biochemistry Theory

Code:	BCHMT03- Paper I-	**Enzymology and Biology of Free Radicals and Antioxidants:**
	BCHMT04-Paper II-	**Nutrition**
	BCHMP03	Biochemistry Practical

Paper I

BCHMT03

Enzymology: General Concepts and Enzyme Kinetics

Classification, Enzyme structure, Co-enzymes, Active center

Mechanism of action of enzymes: Lock and key model, induced fit theory, substrate strain theory, covalent catalysis, acid base catalysis and entropy effect.

Enzyme Kinetics:

Factors affecting enzyme activity: concentration of enzyme, substrate, product, effect of temperature and pH. Michaelis constant, double reciprocal plot.

Enzyme regulation:

Competitive inhibition, Noncompetitive inhibition and uncompetitive inhibition. Allosteric inhibition, Key enzymes, Feedback inhibition, Covalent modification, Repression, Induction, zymogen activation, Specificity of enzymes, Iso-enzymes.

Clinical Enzymology and Biomarkers

Enzyme units, Plasma specific and non-specific enzymes, enzymes of clinical significance, enzymes as therapeutic agents, enzymes as laboratory reagents, non-protein enzymes, immobilized enzymes.

Biology of Free Radicals and Antioxidants

Free radicals, Reactive oxygen species, Generation, Damage, Free radical scavenger systems, Inflammation, role of free radicals in Respiratory diseases, Retrolental fibroplasia, Reperfusion injury, Atherosclerosis, Skin diseases, Age-related diseases. Lipid peroxidation, Initiation, propagation and termination phases, Preventive anti-oxidants, Chain breaking anti- oxidants, Total Antioxidant capacity

Paper II

BCHMT04

Principles of Nutrition

Calorific value of foods, respiratory quotient, Basic Metabolic Rate-definition, normal values, factors affecting BMR and measurement of BMR. Specific dynamic action, nutritional importance of carbohydrates, dietary fibre lipids and proteins, Nitrogen balance, biological value of proteins, net protein utilization, mixed diet, Balanced Diet. Principles of Diet prescription for healthy individuals. Specialized diets-Diabetic, diet for hypertension, diet in renal and liver diseases. Diet prescription for obesity and under nutrition. Total parenteral nutrition.

Vitamins: -Fat Soluble Vitamins (A, D, E, K)

Chemistry, sources, RDA, biochemical functions and deficiency manifestations, and metabolism of fat soluble vitamins.

Vitamin A: Role in vision, Vitamin D,Vitamin E, VitaminK.

Water Soluble Vitamins

Thiamine(B1), Beriberi, Riboflavin(B2), Niacin, Pyridoxine(B6), Pantothenic acid, Acetyl CoA, Succinyl CoA, Biotin, Folic acid, Folate antagonists, Folate trap, Vitamin B12, Choline, Inositol, Ascorbic acid (Vitamin C), Scurvy.

Mineral Metabolism and Abnormalities

Calcium, Homeostasis, Parathyroid hormone, Calcitonin, Hypercalcemia, Hypocalcemia, Bone metabolism; Markers of bone metabolism;

Phosphorus, Magnesium, Sulphur, Iron, Absorption, Iron deficiency, Hemochromatosis, Copper, Ceruloplasmin, Iodine, Zinc, Fluoride, Selenium, Manganese, Molybdenum,Cobalt, Nickel, Chromium, Lithium.

Nutritional value of different foods Nutrition in health and diseases

Protein energy malnutrition (PEM), Marasmus, Kwashiorkor, Obesity.

Prescription of diet.

Special diets: Mediterranean diet, Diabetic diet, Diet for renal disease, Diet for liver disease.

Food exchange system, Glycemic index, Total parenteral nutrition

Research Methodology and Biomedical ethics- 30(2 hours/week)

Tutorials -60 (4 Hours /Week)

Synopsis writing and submission -60 (4 Hours / week)

Seminar / Journal presentation - 60(4 Hours / Week)

Postings to Basic Research Lab -60 (4 Hours /Week)

Semester III

Biochemistry Practicals

BCHMP03

Biochemistry Practicals -90(6 Hours /Week)

Equipment and Instrumentation

Principles, SOPs, Types and Application of the following Instruments and Equipment's

- Weighing Balances, Centrifuges, Hot air Ovens,
- Incubators, Water Baths, colorimeter,
- Spectro photometer, Flame Photometer, pH meter, Distillation plants
- Automatic dispensers and Diluters.

Calculation of Normality, Molarity and preparation of Normal and Molar solutions, Preparation of Buffers, Factors affecting enzyme activity (temperature and pH)

Standardisation and Estimation of AST, ALT, ALP, ACP and Amylase

IV Semester

M.Sc Medical Biochemistry Theory

Code:	BCHMT05- Paper I-	**Metabolism I**
	BCHMT06-Paper II-	**Metabolism II**
	BCHMP04	Biochemistry Practical

Paper I

BCHMT05

Overview of Metabolism

Experimental approach to study of metabolism,Tissue culture, Radioisotope tracers, Metabolic profile in organs, Brain, Skeletal muscle, Cardiac muscle, Adipose tissue, Liver, Metabolic adaptations during starvation.

Major Metabolic Pathways of Glucose

Digestion and absorption of carbohydrates, Glucose transporters, Regulation of blood sugar Glycolysis, Gluconeogenesis, Citric acid cycle: Definition, location, reactions with enzymes, energetics and regulation.

Glycolysis: BPG Shunt

Gluconeogenesis: Cori's Cycle and Glucose alanine cycle Glycogen metabolism:

Glycogenolysis, Glycogen synthesis, Glycogen storage diseases.

Citric acid cycle: amphibolic nature of the cycle, anaplerotic reactions

Minor Metabolic Pathways of Carbohydrates

Hexose monophosphate shunt pathway: Definition, location, reactions with enzymes, energetics and regulation, Glucose-6-phosphate dehydrogenase deficiency

Glucuronic acid pathway, Essential pentosuria, Polyol pathway, Fructose metabolism, Hereditary fructose intolerance, Fructosuria,

Galactose metabolism, Galactosemia. Metabolism of alcohol.

Amino sugars, Glycoproteins, Proteoglycans, Blood group substances,

Mucopolysaccharidoses.

Inborn errors associated with carbohydrate metabolism.

General Amino Acid Metabolism

Digestion of proteins, Absorption of aminoacids, Meister cycle, Intracellular protein degradation, Cathepsins, Ubiquitin pathway, Proteosomes, Inter-organ transport of amino acids, Glucose Alanine cycle;

Catabolism of amino acids, Formation of ammonia, Transamination, Oxidative deamination, Nonoxidative deamination, Disposal of ammonia (Urea cycle) Disorders of urea cycle, Hepatic coma, Blood urea.

One carbon compounds, Generation and utilization of one carbon groups.

Simple, Hydroxy and Sulfur Containing Amino Acids Glycine, Creatine, Creatinine, Primary hyperoxaluria Serine, Serine choline glycine cycle, Selenocysteine, Alanine, Glucose alanine cycle, Beta alanine, Threonine, Methionine, Transmethylation reactions, Cysteine, Glutathione, Sulphur, Cystinuria, Homocystinurias, Cystathioninuria.

Acidic, Basic and Branched Chain Amino Acids

Glutamic acid, GABA, Glutamine, Aspartic acid, Asparagine, dicarboxylic amino aciduria Lysine, Arginine,Nitric Oxide, Ornithine, Polyamine synthesis

Valine, Leucine, Isoleucine, Maple syrup urine disease, Isovaleric aciduria, Histidine, Histamine

Aromatic Amino Acids and Amino Acidurias

Phenylalanine, Tyrosine, Melanin, Catecholamines, Phenylketonuria, Alkaptonuria, Albinism, Tryptophan, Nicotinic acid pathway, Serotonin, Melatonin, Indican, Hartnup's disease, Proline, Inter-relation of amino acids; Amino acidurias

Citric Acid Cycle

Citric acid cycle reactions, Significance of TCA cycle, Amphibolic role, Anaplerotic role, Regulation.

Biological Oxidation and Electron Transport Chain

Primary, secondary and tertiary metabolism, Redox potential, Biological oxidation, Oxidases, Cytochrome oxidase, Dehydrogenases, NAD+, FAD, Cytochromes, Oxygenases, High energy compounds, Organization of electron transport chain, NADH shuttle, Malate aspartate shuttle, Flow of electrons, Oxidative phosphorylation,

Chemi-osmotic theory, ATP synthase, Inhibitors of ATP synthesis, Uncouplers of oxidative phosphorylation, Ionophores.

Paper II

BCHMT06

Metabolism of Lipids

Digestion and absorption of fat

Beta oxidation- Definition, location, reactions with enzymes, energetics and regulation.

Oxidation of odd chain fatty acids, Alpha oxidation, Omega oxidation, Organic acidurias

Denovo synthesis of fatty acids-Definition, location, reactions with enzymes, energetics and regulation.

Metabolism of triglycerides

Metabolism of adipose tissue, Hormone sensitive lipase, Liver adipose tissue axis. Fatty liver, Lipotropic factors.

Ketone bodies - Ketogenesis, Ketolysis, Ketosis.

Cholesterol and Lipoproteins

Steroids, Structure of cholesterol, Metabolism of cholesterol, Formation of bile acids

Plasma lipids, Transport of lipids, Lipoproteins, Apolipoproteins,Chylomicrons,VLDL, LDL, HDL, Reverse cholesterol transport, Lp(a), Free fatty acid, Non-esterified fatty acids.

MCFA, PUFA, Prostaglandins and Compound Lipids

Digestion of medium chain fatty acids, Monounsaturated fatty acids, Beta oxidation of unsaturated fatty acids.

Polyunsaturated fatty acids, Desaturation of fatty acids. Eicosanoids, Prostaglandins, Leukotrienes.

Synthesis of Compound Lipids. Lipid storage diseases.

Nucleotides; Chemistry and Metabolism

Purine bases, Pyrimidine bases, Nucleosides, Nucleotides

Biosynthesis of purine nucleotides, Salvage pathway, Regulation of synthesis, Degradation of purines, Uric acid, Gout, Secondary hyperuricemia, Lesch-Nyhan syndrome.

Synthesis of pyrimidine nucleotide, Regulation, Oroticaciduria , Degradation of pyrimidine.

Integration of Metabolism: Metabolism during starvation and in well fed state.

Detoxification and Biotransformation of Xenobiotics

Phase one reactions, Oxidative reactions, Reductive reactions, Hydrolysis, Phase two reactions, Conjugation, Phase three reactions.

Good laboratory practices-30(2Hrs/Week)

Tutorials -60(4 Hours /Week)

Hospital posting-60 (4 Hours /Week)

Dissertation Work-60 (4 Hours /Week)

Seminar / Journal Club-60 (4 Hours /Week)

Semester IV

Biochemistry Practicals

BCHMP04

Biochemistry Practicals -90(6 Hours /Week)

Standardisation and Estimation: Glucose, Urea, Uric acid , Creatinine, Cholesterol, Total protein, Albumin, Bilirubin, Calcium, Phosphorus, Ascorbic acid.

V Semester

M.Sc. Medical Biochemistry Theory

Code:	BCHMT07- Paper I-	**Molecular Biology and Techniques**
	BCHMT08-Paper II-	**Applications of Bio-informatics and Nanotechnology**
	BCHMP05	Biochemistry Practical

Paper I

BCHMT07

Deoxyribo Nucleic Acid (DNA): Structure and Replication

Structure of DNA, Watson-Crick model, Supercoiling of DNA, Nucleoproteins, Chromosomes.

Replication of DNA, Meselson-Stahl experiment, DNA polymerases, Replisome, Primosome, Okazaki fragments.

Repair mechanisms, Diseases associated with repair mechanisms, Xerodermapigmentosum, Telomeres, Telomerase, Inhibitors of DNA replication.

Transcription

Ribonucleic acid: Differences between DNA and RNA, types of RNA

Transcription, Transcription signals, Initiation of transcription, Elongation of transcription, Termination of transcription, Post-transcriptional processing.

Spliceosomes, Ribozymes, Introns and exons, Reverse transcriptase

Genetic code: Features of Genetic Code and Wobble hypothesis.

Translation: Initiation of translation, Elongation of translation, Termination of translation, Protein targetting, Post-translational processing, Protein folding, Chaperones, Heat shock proteins, Inhibitors of protein synthesis, Antibiotics,

Mitochondrial DNA and RNA, Genomics and proteomics, Micro RNA, interfering RNA, RNA silencing; Antisense therapy.

Inheritance, Mutations and Regulation of Gene Expression

Principles of heredity, Dominant inheritance, Recessive inheritance, X-linked inheritance, Population genetics, Chromosomal recombination, Genetic loci on chromosome

Mutations:

Point mutation, Termination codon mutation, Frame shift mutation, Conditional mutation, Ame's test, Mutagens, Site directed mutagenesis.

Cell cycle, Check points, Oncosuppressor proteins, Rb protein, p53, Apoptosis, Caspase activation cascade.

Regulation of gene expression:

Operon concept, Repression, Derepression, Lac operon, Gene rearrangement, Hormone response elements; Gene amplifications, Gene switching, Viruses, Antiviral agents: Lysogeny, Transduction, Epigenetic modifications.

Recombinant DNA Technology and Gene Therapy

Application of recombinant DNA technology, Restriction endonucleases, Restriction map, cDNA, Vectors, Plasmids, Cosmids, Homopolymer tailing, Chimeric molecules, Cloning,Transfection, Selection, Expression vectors, Genetherapy. Vectors forgene therapy, Retroviruses, Adenoviruses, Plasmidliposome complex, Stemcells.

Molecular Diagnostics

Gene library, Linkage analysis, Microsatellite markers, Human Genome Project

Blotting Techniques:

Types and In-situ hybridization.

Animal cloning, Molecular cloning in clinical diagnosis and management DNA finger printing, Restriction fragment length polymorphism (RFLP)

Polymerase chain reaction (PCR) : Types and Applications

Mutation detection Techniques :

Single Strand Conformation Polymorphism (SSCP), Heteroduplex Analysis, Conformation Sensitive Gel Electrophoresis (CSGE), Protein Truncation Test (PTT), Denaturing High Performance Liquid Chromatography (DHPLC)

Transgenesis: Transgenic animals and their protein products

DNA sequencing: Maxam Gilbert Technique, Dideoxynucleotide Method, Automated DNA sequencing and Microarray

Paper II

BCHMT08

Blood constituents and Endocrinology

Hemoglobin (Structure, Oxygen and Carbon Dioxide, Transport, Abnormal Hemoglobins)

Structure of hemoglobin, Transport of gases, Oxygen dissociation curve, Hemoglobin interaction, Effect of 2,3-BPG, Isohydric transport of carbon dioxide, Chloride shift, Fetal hemoglobin (HbF) ,Hemoglobin derivatives, Carboxy hemoglobin, Met-hemoglobin, Hemoglobin variants, Sickle cell hemoglobin (HbS), Thalassemias, Myoglobin, Anemias.

Heme Synthesis and Breakdown

Structure of heme, Biosynthesis of heme, Porphyrias. Catabolism of heme Plasma bilirubin, Hyperbilirubinemias, Congenital hyperbilirubinemia

Jaundice: Hemolytic jaundice, Hepatocellular jaundice, Obstructive jaundice, Differential diagnosis of jaundice.

Plasma Proteins

Serum electrophoretic pattern in normal and abnormal states, Albumin, Transport proteins.Acute phase proteins and Negative acute phase protein.

Clotting factors, Anticoagulants, Fibrinolysis, Hemophilia.

Immunochemistry

Immune response, Effector mechanisms, Cell mediated immunity, Humoral immunity

Immunoglobulins-Structure, Variabilityand Classes of immunoglobulins, Isotypes, allotypes, ideotypes, Complement system, Multiple myeloma, Plasmacytoma, Bence-Jones Proteinuria, Macroglobulinemia,

Hypergamma-globulinemia, Hereditary angio neurotic edema.

Immunodeficiency states, Molecular mechanisms of antibody production, Transposition of genes, Somaticrecombination. Molecular structure of antigens, HLA antigens, Cytokines, Lymphokines.

Mechanisms of Action of Hormones

G proteins, Cyclic AMP, Protein kinases, Phosphatidyl inositol biphosphate, Inositol triphosphate, Diacyl glycerol, Cyclic GMP, Steroid receptors, Insulin Signaling pathway, mTOR, Jak-STAT pathway, NFkB

Hypothalamic and Pituitary Hormones

Anti-diuretichormone, Oxytocin, Hypothalamic releasing factors, Growth hormone, Adrenocorticotropic hormone, Endorphins, Glycoprotein hormones, Thyroid stimulating hormone, Gonadotropins.

Steroid Hormones

Adrenal cortical hormones, Synthesis of steroid hormones,17-ketosteroids, Assessment of glucocorticoid secretion, Assessment of mineralo corticoid function, Adrenal hyperfunction, Adrenal hypofunction, Primary hyperaldosteronism, Adrenogenital syndrome, Ovarian hormones, Testicular hormones.

Thyroid Hormones

Thyroid hormones, Synthesis, Secretion, Mechanism of action, Metabolic effects, Assessment of thyroid function, Hyperthyroidism, Hypothyroidism.

Signal Molecules and Growth Factors

Adiponectin, Cadherins C-Jun, EGFR, Erythropoietin, ERK, Gastrin, GSK3, HSP,HIF, ICAM, IGF, IGFR, IR, IRS, Interferons, JNKs, MMP, Osteocalcin, Osteoprotogerin, p38, p53, Pancreatic polypeptide, PDGF, ProteinC, Rb,, Secretin, Selectins, STAT, TGF, TNF,

Biochemistry of AIDS andHIV

Transmission,Natural course of the disease, Laboratory analysis, Virus, Replication, HIV genes and gene products, Immunology of AIDS, Anti-HIV drugs,Protection.

Biostatistics-30(2 Hours /Week)

Tutorials - 60 (4 Hours /Week)

Dissertation work-60 (4 Hours /Week)

Seminar/Journal presentations30 (2 Hours /Week)

Hospital Lab Postings-90 (6 Hours /Week)

Semester V

Biochemistry Practicals

BCHMP05

Biochemistry Practicals-90 (6Hrs/Week)

- Isolation of DNA
- Electrophoretic separation of Plasma proteins
- Tests for Inborn Errors of Metabolism:

  Qualitative: DNPH, Benedict's Test, Ferricchloride test, Methyl malonic acid test, Nitrosonapthol test, spot test and CPC test for mucopolysaccharidoses,

  Test for sulfhydryl compounds, Paper and Thin Layer Chromatography.

Semester VI

M.Sc. Medical Biochemistry Theory

Code:	BCHMT09- Paper I-	**Clinical and Diagnostic Biochemistry: Part I**
	BCHMT10-Paper II-	**Clinical and Diagnostic Biochemistry: Part II**
	BCHMP06	Biochemistry Practical

Paper I

BCHMT09

Acid-Base Balance and pH

Acids and bases, Henderson-Hasselbalch equation, Buffers, Buffer capacity, Buffers of body fluids, Respiratory regulation of pH, Renal regulation of pH, Titratable acid, Cellular buffers, Disturbances in acid base balance, Anion gap, Metabolic acidosis, Metabolic alkalosis, Respiratory acidosis, Respiratory alkalosis.

Electrolyte and Water Balance

Body water compartments, Donnan membrane equilibrium, Osmolality, Electrolyte concentration of body fluid compartments, Regulation of sodium and water balance, Renin-angiotensin system, Assessment, Disturbances, Isotonic contraction, Hypotonic contraction, Hypertonic contraction, Isotonic expansion,

Hypotonic expansion, Hypertonic expansion; Clinical applications of Sodium, Potassium, Chloride, Hypernatremia, Hyponatremia, Hypokalemia, Hyperkalemia, Hyperchloremia, Hypochloremia.

Body Fluids (Milk, CSF, Amniotic Fluid)

Milk, Colostrum, Aqueous humor, Cerebrospinal fluid, Amniotic fluid, Assessment of fetal maturity.

Tissue Proteins in Health and Disease

Collagen, Elastin, Keratins, Contractile proteins, Actin, Myosin, Troponin, Muscle contraction, Calmodulin, Micro filaments, Micro tubules, Lens proteins; Prions, Human prion diseases, Biochemistry of aging, Alzheimer's disease.

Liver Function Tests

Tests for liver function, Serumbilirubin, Classification of jaundice, Bile acids and bile salts, Tests based on the metabolic capacity of the liver, Tests based on synthetic function, Serum enzymes as markers of hepatobiliary diseases,

Kidney Function Tests

Formation of urine, Functions of the tubules, Renal threshold, Tubular maximum, Abnormal constituents of urine, Proteinuria, Reducing sugars, Clearance tests, Inulin clearance, Creatinine clearance test, Cystatin C, Urea clearance test, Tests for tubular function, Osmolality, Acidification test

Gastric Function tests and Thyroid function test.

Gastric function, Hydrochloric acid secretion, Assessment of free and total acidity **Pancreatic function tests:** Pancreatic enzymes, secretin –cholecystokinin test **Cardiovascular Diseases and Hyperlipidemias**

Lipidprofile, Hyperlipidemias, Atherosclerosis and CAD: Risk factors and Prevention of atherosclerosis, Hypolipoproteinemias, Hyperlipoproteinemias (Fredericksons classification).

Prenatal diagnosis; AFP, hCG, uE3, DIA, PAPP-A; Newborn screening; Investigations for Metabolic disorders.

Paper II

BCHMT10

Quality control

Accuracy, Precision, Specificity, Sensitivity, Limits of errors allowable in the laboratory, Percentage error.

Automation in Clinical Laboratory Kit Validation

Dry Chemistry analysis

General Techniques for Separation, Purification and Quantitation

Electrophoresis, PAGE, Immuno-electrophoresis, High voltage electrophoresis, Capillary electrophoresis, Chromatography (adsorption, partition, ion exchange, gel

filtration, affinity),HPLC, Ultracentrifugation, Determination of molecular weight of proteins, Radio immunoassay, ELISA test, pHmeter, Colorimeter, Spectrophotometer, Flame photometer, Auto analysers, Dry chemistry systems, Ion selective electrodes, Tandem mass spectroscopy, Fluorescent activated cell sorter.

Immunological Techniques

RIA, ELISA, Hybridoma technology and Monoclonal antibodies.

Biochemistry of Cancer

Etiology, Chemical carcinogens, Antimutagens, Oncogenic viruses ,Oncogenes, Proto oncogene, Antioncogenes, Oncosuppressor genes, Growth factors, Tumour kinetics, Doubling time, Contact inhibition, Anchorage dependence, Apoptosis, Oncofetal antigens, Tumor markers, Alpha fetoprotein, Carcinoembryonic antigen, Tissue polypeptide antigen, Prostate specific antigen, Other tumor markers, Anticancer drugs, Drug resistance.

Neurobiology:

Neuron, Neurotransmitters, Neurodegenerative disorders: Parkinsons's disease, Alzheimer's disease.

Applications of Isotopes in Medicine

Subatomic particles, Valency, Isotopes, Radioactive decay, Alpha, Beta, Gamma radiations, Half-life, Units of radioactivity, Research applications, Diagnostic applications,Teletherapy, Radiosensitivity, Fractionation of doses, Biological effects of radiation,Radiation protection.

Environmental Pollution and Heavy Metal Poisons

Corrosives and irritants, Organic irritant poisons, Neurotoxins, Heavy metal poisons, Lead, Mercury, Aluminium, Arsenic, Pesticides and insecticides, Organophosphorus compounds, Industrial hazards, Airpollutants, Sulphurdioxide,Toxic substances in food stuffs, Lathyrism.

Tutorials- 60 hours (4 Hours /Week)

Dissertation work-90 (6 Hours/Week)

Seminar/Journal Club / Pedagogy-60 (4 Hours /Week

Lab Posting- 60 hours (4 Hours /Week)

Semester VI

Biochemistry Practicals

BCHMP06

Biochemistry Practicals-90 (9 Hours /Week)

Advanced Techniques in Biochemistry:

- Demonstration of PCR,HPLC.
- Automation.
- Liver panel.
- Renal panel.
- Diabetic panel.
- Analysis of urine: Normal and Abnormal constituents.
- Kit Validation.
- CSF Analysis.
- Estimation of Malondialdehyde, SOD,Glutathione peroxidase, Vit C, Total Antioxidant Capacity.

1st Semester & 2nd Semester

Scheme of Examination :

SL No.	Theory	Subjects	Theory Max. + IA + Viva Voce	Max.Marks Theory (Total)	Max. Marks Practical	Grand Total
1	Paper 1	Anatomy	80 + 20 + 30	130	70	200
2	Paper 2	Physiology	80 + 20 + 30	130	70	200
3	Paper 3	Biochemistry	80 + 20 + 30	130	70	200

Type of question and distribution of marks for theory examination –Anatomy, Physiology and Biochemistry

Type of questions	Number of questions	Marks for each question	Total
Long Essay	02	10	20
Short Essay	09	05	45
Short Answer	05	03	15
Total			80

Note: Internal Assessment 20 Marks add to the theory paper

Practical -70 Marks

Type of Question

Type of Questions	Practical Marks
Major Experiments	30 Marks
Minor Experiments	20 Marks
Total	50 Marks
Internal Assessment Marks (15 + 5 marks Records)	20 Marks
Grand Total	**70 Marks**

Scheme of Examination

For 3rd,4th ,5th& 6th Semester

(Anatomy, Physiology, Biochemistry &Microbiology)

(Theory (02 Papers each of 100 Marks)

Theory	Pattern	Marks
Paper I		
i) Long Essay Questions =	20X2	40Marks
ii) Short Essay Questions	6X10	60 Marks
TOTAL		100 Marks
Paper II		
i) Long Essay Questions =	20X2	40Marks
ii) Short Essay Questions	6X10	60 Marks
TOTAL		100 Marks
	Total Theory	200
	Viva Voce	30
	Internal Assessment Marks	20
	Grand Total	250 Marks

Note:10 % of weightage should be given to Biostatistics, Research Methodology and Bioethics in the 3rd Semester Final theory exam of Anatomy, Physiology,Biochemistry and Microbiology.(Max .of 10 Marks can be allotted out of 80 theory marks)

Practical -100 Marks

Type of Questions	**Practical Marks**
Major	50 Marks
Minor	30 Marks
Total	80 Marks
Internal Assessment Marks (15 + 5 Marks Record)	20 Marks
Grand Total	100 Marks

PG BIOCHEMISTRY REFERENCE TEXT BOOKS

SL NO	AUTHOR	TITLE	PUBLISHER
1.	MURRAY	HARPER'S ILLUSTRATED BIOCHEMISTRY	JAYPEE
2.	MICHAEL BISHOP	CLINICAL CHEMISTRY	WOLTERS KLUWER/LIPPINCOTT WILLIAMS &WILKINS
3.	DENISE R FERRIER	LIPPINCOTT'S ILLUSTRARTED REVIEWS:BIOCHEMISTRY	WOLTERS KLUWER/LIPPINCOTT WILLIAMS &WILKINS
4.	VOET	PRINCIPLES OF BIOCHEMISTRY	JOHN WILEY & SONS
5.	CARL BURTIS ADWAL. ASHWOOD DAVID BRUNS	TEITZ TEXTBOOK OF CLINICAL CHEMISTRY AND MOLECULAR DIAGNOSTICS	ELSEVIER
6.	DEVLIN	TEXTBOOK OF BIOCHEMISTRY-CLINICAL CORELATION	JOHN WILEY & SONS
7.	PANINI	MEDICAL BIOCHEMISTRY-AN ILLUSTRATED REVIEW	THIEME
8.	RANJANA CHAWLA	PRACTICAL CLINICAL BIOCHEMISTRY	JAYPEE
9.	SANKAR KUMAR GHOSH SENTHIL KUMAR P NAGARAJAN	PRINCIPLES AND METHODS OF MOLECULAR BIOLOGY-A PRACTICAL APPROACH	PANIMA PUBLISHING CORPORATION
10	VASUDEVAN	TEXT BOOK OF BIOCHEMISTRY FOR MEDICAL STUDENTS	JAYPEE
11	DINESH PURI	TEXT BOOK OF BIOCHEMISTRY	ELSEVIER
12	SATYANARAYANA	BIOCHEMISTRY	ELSEVIER
13	BHAGVAN	ESSENTIALS OF MEDICAL BIOCHEMISTRY	VIKAS MEDICAL BOOK HOUSE

M. Sc. Medical Microbiology

M.Sc. MEDICAL MICROBIOLOGY

PREAMBLE:

M.Sc.Medical Microbiology will be an intensive three years (six semesters) course primarily for graduates in the biological sciences, which should facilitate them for teaching and research in health education sciences. The focus during the training programme will be to equip the candidate with adequate skills and also to be productive in promoting the professional career in research or in to the Ph.D programme.

OBJECTIVES:

A candidate upon successfully qualifying in M.Sc – Microbiology examinations should be able to -

1. Be competent in microbiological techniques.
2. Practice good laboratory techniques in hospital and in the community in the fields of Bacteriology, Virology, Mycology, Parasitology & Immunology.
3. Conduct experimental research having a significant bearing on human health.
4. Plan, execute, analyze & present the research work in medical microbiology.
5. Interact with allied Department by rendering services to advanced laboratory investigations.
6. Acquire skills in conducting collaborative research in the field of Microbiology and Allied Sciences.
7. Demonstrate to the students how the knowledge of Microbiology can be used in variety of clinical settings to solve diagnostic problems.

DURATION:

Duration- 3 years.

1st & 2nd semester, Rotational postings in Anatomy, Physiology, Biochemistry & 20 Theory classes in General Microbiology.

M.Sc. Microbiology students will be trained along with the MSc Anatomy, Physiology and Biochemistry students in their 1st & 2nd semester.

Second to Sixth Semester training will be in Microbiology.

ELIGIBILITY:

Candidates with the degree of B.Sc. Microbiology with minimum of 60 % of marks.

SCOPE FOR FUTURE:

After completion of M.Sc Degree they are eligible to undertake scientific work in various Institutes and Industries, Laboratory technical work in Hospitals, appointment in Dental Colleges, Allied Science Colleges, Nursing Colleges, Physiotherapy Colleges as Teaching Faculty.

The course consists of a programme of lectures, tutorials, and practical classes for the 1st & 2nd semester mainly on Anatomy, Physiology and Basic Biochemistry and 20 lectures on Basic Microbiology. At the end of each semester the students take up a University Exam of Theory, Viva and Practical. The second to sixth semester will be devoted at Dept of Microbiology mainly focused on Microbiology and are involved in seminars, journal club and practical classes. At the end of Third year the students will take up the Theory, Viva and Practical Exam in Microbiology.

Department of Microbiology

SEMESTER III

COURSE CONTENT

Theory Lectures	Topics
Paper- I	**General Bacteriology:** History of Microbiology, Morphology of bacteria Microscopy Physiology of the bacteria Sterilization and Disinfection Culture media,Methods of identification of bacteria, Bacterial Taxonomy and Genetics .
Paper -II	**Immunology:** Infection, Normal immune system. Innate immunity, Antigens, Immunoglobulins, Complement. Antigen-Antibody reactions, Cell mediated and Humoral immunity. Hypersensitivity, Immunodeficiency diseases, Auto-immunity. Immune tolerance, Immunology of transplantation, Tumour immunology. Prophylaxis and immunotherapy. Measurement of immunity. Immunohematology.

Practicals	Topics
	General Bacteriology and Immunology 1.Microscopy-Types of microscopes, maintenance 2.Sterilization techniques Sterilization of instruments, media, endoscopes, surface disinfection and sterilization, chemical sterilization, OT sterilization, newer techniques in sterilization. 3.Preparation of various stains 4.Culture media preparation and uses 5.Inoculation of culture media 6.Processing protocols of various samples 7.Principals and procedures of various diagnostic serological tests 8.Antigen extraction techniques 9.Molecular techniques 10.Preparation of antibiotic solution 11.Performing and interpreting Antibiotic sensitivity testing 12.Quality assurance in microbiology

SEMESTER IV

COURSE CONTENT

Theory Lectures	Topics
Paper- I	**GPC- Gram Positive Cocci, GNC - Gram Negative Cocci, GPB- Gram Positive Bacilli** Staphylococcus and Micrococcus. Streptococcus, Neisseria, Branhamella, & Moraxella, Clostridia, Mycobacteria, Corynebacteria , Bacillus, Actinomyces, Nocardia, Actinobacillus.
Paper -11	**All GNB: Gram Negative Bacilli** E.Coli, Klebsiella, Citrobacter,Proteus, Salmonella & Shigella Vibrios, Aeromonas, Plesiomonas, Campylobacter , Spirillum. Haemophilus, Bordetella, Pasteurella, Francisella, Brucella, Pseudomonas. Spirochaetes, Chlamydiae. Rickettsiae , Non sporing Anaerobes, Mycoplsama, Ureaplasma, Acholeplasma, Erysipelothrix , Listeria, Chromobacterium, Flavobacterium, Acinetobacter& Alkaligens.

Practical's	Topics
	GPC- Gram Positive Cocci; GNC - Gram Negative Cocci; GPB- Gram Positive Bacilli and All GNB- Gram Negative Bacilli 1.Biochemical reaction principles and performing various tests 2.Processing protocol of various samples 3.Isolation and Identification of bacteria to species level 4.Performing and interpretation of diagnostics 5.Designing of serological tests 6.Performing antibiotic sensitivity testing 7.Good laboratory practices

SEMESTER V

COURSE CONTENT

Theory Lectures	Topics
Paper- I	**General Virology** Morphology, Cultivation techniques, Replication, Classification of viruses, Bacteriophage, Laboratory diagnosis of viral infections. **DNA Viruses** Herpetoviridae, Poxviridae, Adenoviridae, Papovaviridae. Parvoviridae **RNA Viruses;** Picornaviridae, Myxoviridae, Arboviridae, Retroviridae, Hepatitis, Oncogenic, Slow, Teratogenic Viruses. **Miscellaneous Viruses**.
Paper -11	**Mycology** Classification & Morphology and Reproduction in fungi Contaminant and opportunistic fungi. Superficial mycotic infections. Subcutaneous mycotic infections. Systemic mycotic infections. Mycotoxins & Antifungal agents

Practicals	Topics
	Virology and Mycology 1.Viral serological techniques 2.Identification protocols of virus 3.Staining techniques used in diagnosis of -Viral infection -Fungal infection 4.Identification protocols of fungi 5.Antifungal susceptibility testing

SEMESTER VI

COURSE CONTENT

Theory Lectures	Topics
Paper- I	**Protozoology** Entamoeba, Free living Amoebae, Giardia, Trichomonas, Leishmania, Trypanosoma, Plasmodia, Toxoplasma, Sarcocystis, Cryptosporidia, Cylospora, Isospora, Babesia, Balantidium &Other protozoa **Applied Microbiology** Recent Advances in Microbiology Biomedical waste Management Air sampling Water testing Food testing
Paper -11	**Helminthology** **Cestode:** Diphyllobothrium, Taenia, Echinococus, Hymeonolepis, Dipylidium, Multiceps **Trematode:** Schistosoma, Fasciola, Gastrodiscoides, Paragonimus, Clonarchis, Opisthorchis, **Nematodes :** Trichuris, Trichinella, Strongyloides, Ancylostoma, Ascaris, Enterobius, Filarial worms, Dracunculus & Other parasites

Practicals	Topics
	<u>Parasitology</u> 1.Stool sample Examination-Wet mount -Staining techniques 2.Peripheral smear preparation and staining for parasitic infestations. 3.Stool concentration techniques. 4.Collection of sample for various parasitic infestation 5.Recent diagnostic techniques in diagnostic parasitology 6.Air sampling 7.Water sampling 8.Food testing

Semester III [One day]

Practical – 100 Marks

Types of Questions	Marks
Spotters	10
Gram Stain	15
Special stain	10
Media Pouring	15
Inoculation techniques	15
Serology	15
Total	80
Internal Assessment Marks [15 + 5 Marks Record]	100

Semester IV [Two day]

Practical – 100 Marks

Types of Questions	Marks
Spotters	10
Pure Culture	25
Sample inoculation and interpretation	25
Serological tests and interpretation	20
Total	80
Internal Assessment Marks [15 + 5 Marks Record]	20
Grand Total	**100**

Semester V [One day]

Practical – 100 Marks

Types of Questions	Marks
Spotters	10
Viral Serology	25
Mycology Exercise	25
Slides	20
Total	80
Internal Assessment Marks [15 + 5 Marks Record]	20
Grand Total	**100**

Semester VI [One day]

Practical – 100 Marks

Types of Questions	Marks
Spotters	10
Stool Examination and Concentration techniques	25
Demonstration of Hemoparasites	25
Wet mount preparation and Staining	10
Occult Blood test	10
Total	80
Internal Assessment Marks [15 + 5 Marks Record]	20
Grand Total	**100**

Scheme of Examination

Existing		
Types of Questions	**Pattern**	**Marks**
Paper I	–	–
i) Long Essay Questions	20x2	40 Marks
ii) Short Essay Questions	6x10	60 Marks
	Total	**100 Marks**
Paper II		
i) Long Essay Questions	20x2	40 Marks
ii) Short Essay Questions	6x10	60 Marks
	Total	**100 Marks**
	Total Theory	200 Marks
	Viva Voce	30 Marks
	Internal Assessment Marks	20 Marks
	Grand Total	**250 Marks**

SEMESTER III

Intensive Course in Research Methodology & Biostatistics Weekly schedule for Regular students

Objective: The Intensive Course is designed to gain specialized knowledge and skills required to design, monitor and manage research in Medical and Allied fields. Intensive Course in Research Methodology and Biostatistics covers syllabi of Applied Statistics of Medical UG/PGs.

Furthermore, the syllabus of Intensive Course is made keeping in mind Ph. D. Entrance Examinations of various Universities.

Topic	Contents
Basic Statistical Methods (18L + 12P)	✓ Application & Uses in Medical Research ✓ Methods of Presentation, Measures of Central Tendency ✓ Measures of Dispersion, ✓ Concepts of Probability Theory ✓ Theoretical Distributions ✓ Correlation and Regression for Qualitative and Quantitative ✓ Vital Statistics
Inferential Statistics (16L + 14P)	✓ Sampling Techniques, Study Designs ✓ Concepts & Methods for calculating Sample Size ✓ Parametric & Non Parametric Tests ✓ Assessment of Diagnostic Tests
Thesis Components(5L + 10P)	✓ Thesis Structure/ Critical Review for Consistency ✓ Topic-Title (Review for need and sample size) ✓ Research TitleConsistency with Objectives ✓ Standard Operating Procedures (SOP) & ✓ Expected Outcome/s and Statistical Analysis ✓ Writing Research Article/Dissertation /Thesis
Preparation of Data and Analysis Using EXCEL & SPSS (8L + 7P)	✓ EXCEL & SPSS – Managing Data Files & Analysis ✓ Cleaning and Editing of Data

Note: Laptop is mandatory for the Participants.

Course Duration

Full Time: The course is 3 Weeks, 5 days a Week, 9 am to 5 pm.

Part Time: The course is 5 Weeks, 5 days a week (Monday to Friday) 2 to 5pm.

Scheme of Examination

- On the last day of the course, Examination comprising one Theory and one Practical of three hours duration each will be arranged.
- Full time participants will be assessed on each Monday as feedback, and the marks obtained will be treated as Internal Assessment.
- Part Time Course Students will be assessed on 3rd and 5th Monday for Internal Assessment.
- Interested participants can complete their practical assignments and research during the course or thereafter.

Eligibility

- Faculty, Scholars, UG & PG students from Health, Medicine and Allied disciplines interested in research, or preparing for competitive examination will be eligible.
- Maximum intake is 30 on First Come First Served basis.

The Certificates will be with grades

Grade	Marks in Assessments
A	≥75% marks
B	60% but less than 75%
C	50% but less than 60%

Participants with < 50% marks will have to appear for examination with the subsequent batch, to become eligible for Certificate.

Fees for the course

- No fee for Ph.D. Scholars and PG & UG students deputed by Constituent Units of the KAHER, as part of regular University Curriculum, if the attendance is 100%. However, Rs. 2,000/- as a refundable deposit has to be made. For the absentees Rs. 500/- per day will be deducted from the refundable deposit of Rs. 2,000/-.
- For other than KAHER deemed to be University participants, the fee for the course is Rs. 6,500/-.

SEMESTER IV

Basic Science Research Center (BSRC) Posting

Observationof the working of the following lab instruments

1) Ph meter
2) Electrophoresis
3) PCR
4) Tissue culture lab

   Co2 incubator

   Cryo preservation
5) Microbiology lab
6) Centrifugation

SEMESTER V

ART OF SCIENTIFIC WRITING

Where to submit a scientific paper?

Deciding on authorship

Determining the journal requirements

English language, Abbreviations and Acronyms in Medical Writing

Composing the title and abstract

Writing the keywords

Writing the introduction

Writing the materials and methods

Interpretation and use of statistics in publication

Preparing effective tables

Preparing effective illustrations

Writing the results

Writing the discussion and conclusion

How to write a case report?

How to write a letter to the editor?

Dealing with journal reviewers

SEMESTER VI

COMPUTER SKILLS

Fundamentals of Computers-I

1. **Introduction to computer:** introduction, characteristics of computer, blockdiagram of computer, generations of computer, computer languages.

a. **Input output devices:** input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems)

b. **Processor and memory:** The Central Processing Unit (CPU) and main memory.

c. **Storage Devices:** sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

2. **Introduction to MS-Word:** introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spellchecking, printing the document file, creating and editing of table and mail merge.

3. **Introduction to Excel:** introduction, about worksheet, entering information, saving work books and formatting, printing the worksheet, creating graphs.

4. **Introduction to power-point:** introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

5. **Introduction of Operating System:** introduction, operating system concepts, types of operating system

a. **Introduction to MS-DOS:** History of DOS, features of MS-DOS, MS-DOS Commands (internal and external).

b. **Introduction of windows:** History, features, desktop, taskbar, icons on the desktop, operationwith folder, creating shortcuts, operation with windows (opening, closing, moving,resizing, minimizing and maximizing, etc.).

6. **Computer networks:** introduction, types of network (LAN, MAN, WAN, Internet,Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components ofnetwork.

7. **Internet and its Applications:** definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.

- Search Strategies
- Email and Email etiquette

8. **Introduction to installation of different software and introduction about different software related to MLS.**

Practicals:

Learning to use MS Office: MS WORD, MS EXCEL & MS Power Point and Internet