CURRICULUM

4 YEARS DEGREE PROGRAMME
IN
MEDICAL LABORATORY TECHNOLOGY
B.Sc. (HONS.)

Institute of Allied Health Sciences
Rawalpindi Medical University

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LEARNING OUTCOMES

Following competencies will be expected from a student completing 4 years degree course in Medical Laboratory Technology. The student should be able to:

- Learn and apply the practical theory (new techniques and procedures) of the laboratory directly to workplace settings
- Demonstrate knowledge of medical terminology with special emphasis on writing and understanding the laboratory reports.
- Select and use appropriate, safe and effective tools to solve a variety of problems pertaining to collecting, transporting, handling and conducting tests on laboratory samples
- Demonstrate knowledge of utilizing and performing corrective and preventative maintenance on a variety of instruments and sensitive (automated) equipment.
- Relate laboratory results to common disease process and draw and defend reasonable conclusions with proper satisfaction of the patients and their concerns.
- Perform and monitor quality control within predetermined limits in the laboratory.
- Help in the upgrading and expansion of the equipment and management of other supplies used in the laboratory.

NOMENCLATURE AND DURATION

NOMENCLATURE:

The name of the degree programme shall be B.Sc Medical Laboratory Technology.

COURSE TITLE:

B.Sc Medical Laboratory Technology

TRAINING CENTERS:

Departments of Pathology accredited by RMU for this training in the affiliated institutes of the Rawalpindi Medical University, Rawalpindi.

COURSE DURATION:

Four years

COURSE SCHEME

The training is spread over four years with a specific component for each year of training.

FIRST YEAR

Theoretical component:

1. Basic Anatomy & Histology
2. Basic Physiology
3. Basic Biochemistry
4. General Pathology
5. Behavioural Sciences
6. Islamiyat
7. Pakistan studies
8. Computer Education

Practical component:

Hands-on training in basic techniques related to the discipline

SECOND YEAR

Theoretical component:

1. Haematology and Blood Banking
2. Histopathology and Cytopathology

Practical component:

Hands-on training in laboratory techniques in above mentioned disciplines.

THIRD YEAR

Theoretical component:

1. Microbiology
2. Chemical Pathology
3. Immunology & Serology

Practical component:

Hands-on training in laboratory techniques in above mentioned disciplines.

FOURTH YEAR

Theoretical component:

1. **Elective Subjects:**
    - Immunohematology
    - Advanced Clinical Chemistry
    - Clinical Microbiology
    - Advanced Clinical Immunology
    - Medical Genetics
    - Molecular Biology

2. **Biostatistics and Research Methodology (Compulsory)**

Practical component:

- Advanced lab training related to elective subjects
- Research assignments related to elective subjects

TRAINING AS TRAINERS

The students during final year of the programme will be involved actively in the teaching & training of the junior classes i.e. 1st year & 2nd year so that the seniors become mentors for the juniors. These educational activities will be carried out under the direction and supervision of a faculty member.

METHODS OF INSTRUCTIONS

As a policy, active participation of the students will be encouraged. Following teaching modalities will be employed:

- Large group teachings (lectures)
- Small group teachings
- Seminar presentations
- Assignments
- Skills teachings
- Self directed learning

SKILLS TO BE LEARNT DURING MEDICAL LABORATORY TECHNOLOGY COURSE

- Demonstrate complete knowledge of all simple and advanced laboratory procedures
- Ability to preserve, process and manipulate all types of biological samples in the laboratory
- Using techniques appropriate for the tissue, produce sections (slides) for microscopic examination. This includes fixation, trimming tissues, dehydration, microtomy, and staining.
- Perform special stains on tissues and other biological samples when requested by the Pathologist.
- Using a cryostat, produce slides from frozen tissues for examination by fluorescent antibody and other techniques.
- Label slides with appropriate case number or other identification and match slides with lab unit paperwork for delivery to pathologists.
- Maintenance and use of microscopes
- Demonstrate knowledge of medical terminology with special emphasis on writing and understanding the laboratory reports.
- Maintain necropsy room supplies.
- Clean and disinfect necropsy room and equipment.
- Maintenance of work records, tissue storage, up-to-date methodology and miscellaneous duties.
- Attend continuing education programs as funding and work load permits.
- Assist in the preparation of cost accounting for histotechnology procedures.
- Complete work in compliance with the quality assurance policies and procedures.
- Maintenance of stock solutions, controls and equipment.
- Ability to learn and master the operation of automated laboratory equipment.
- The ability to trouble-shoot problems related to laboratory equipment.
- Ability to communicate effectively both verbally and in writing.
- Basic computer skills and knowledge of the Microsoft Office Suite.
- Knowledge of record keeping.
- The ability to analyze and modify the laboratory techniques according to the circumstances.

EXAMINATIONS

ASSESSMENT

It will consist of action and the professional growth oriented student-centered integrated assessment, with additional components of the internal assessment & summative assessment.

STUDENT-CENTERED INTEGRATED ASSESSMENT

It views students as decision makers in need of information about their own performance. Integrated assessment is meant to student's responsibility to decide what to evaluate as well as how to evaluate, it encourages students to "own" the evaluation and to use it as a basis for self-improvement. Therefore, it tends to be growth oriented, student controlled, collaborative, dynamic, contextualized, flexible and action oriented.

It will be based on,

- Self assessment by the students
- Peer assessment
- Internal assessment by the faculty

SELF ASSESSMENT BY THE STUDENTS

Each student will be provided with a predesigned self assessment form to evaluate his/her level of comfort and competency in dealing with different types of education related situations. It will be the responsibility of the student to correctly identify his/her areas of weakness and to take appropriate measures to address to these weaknesses.

PEER ASSESSMENT

The students will be expected to evaluate their peers after the monthly small group meetings. These should be followed by a constructive feedback according to the prescribed guidelines and should be non-judgmental in nature. This will enable students to become good mentors in the future.

INTERNAL ASSESSMENT BY THE FACULTY

The internal assessment by the faculty will translate into additional scores for the students to be added in theory paper marks & will be based on the following parameters:

- Punctuality & Attendance
- General conduct
- Scores of Regularly conducted class tests & Sendup examinations

SUMMATIVE ASSESSMENT

It will be carried out at the end of the programme to empirically evaluate the cognitive, psychomotor and the affective domains in order to award the degree after successful completion of the course.

First Professional B.Sc Medical Laboratory Technology Examination

Total Marks = 400 Pass Marks= 50%

Paper	Subjects	
Paper-I	**Basic Anatomy & Physiology**	
	Theory	90 Marks
	Internal Assessment	10 Marks
		(05 + 05 in each Subject)
		Total Marks=100
Paper-II	**Basic Biochemistry & General Pathology**	
	Theory	90 Marks
	Internal Assessment	10 Marks
		(05 + 05 in each Subject)
		Total Marks=100
Paper-III	**Islamic Studies / Ethics & Pakistan Studies**	
	Theory	90 Marks
	Internal Assessment	10 Marks
	(06 marks in Islamic Studies/Ethics04 marks in Pakistan Studies)	
		Total Marks=100
Paper-IV	**Behavioural Sciences & Computer Education**	
	Theory	90 Marks
	Internal Assessment	10 Marks
		(05 + 05 in each Subject)
		Total Marks=100

FIRST PROFESSIONAL EXAMINATION

OUTLINE OF TESTS

The First Professional examination shall be held at the end of first academic year (nine months of teaching) and every candidate shall be required to take examination in the following subjects.

A candidate to pass in a subject shall have to obtain a minimum of 50% of total marks of each part of the subject separately. The minimum number of marks required to pass the examination for Islamic Studies/Ethics & Pakistan Studies shall be thirty-three percent (33%) in each paper separately and thirty three percent (33%) in aggregate.

Paper-I Basic Anatomy & Physiology = 100 marks

The examination in the subject of Basic Anatomy & Physiology shall consist of one Theory Paper of three hours duration and of maximum 90 marks. Internal Assessment will be of 10 marks.

Section I : Basic Anatomy = 50 Marks

There will be 45 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Section - II: Basic Physiology = 50 marks

There will be 45 MCQs and each question will carry 01 mark Internal Assessment will be of 05 marks

Paper-II Basic Biochemistry & General Pathology = 100marks

The examination in the subject of Basic Biochemistry & General Pathology shall consist of one Theory Paper of three hours duration and of maximum 90 marks. Internal Assessment will be of 10 marks. There will be two sections in this paper.

Section - I: Basic Biochemistry = 50marks

There will be 45 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Section - II: General Pathology = 50marks

There will be 45 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Paper-III Islamic Studies / Ethics & Pakistan Studies =100 marks

The examination shall consist of one Theory Paper of 60+40=100 marks and 3 hours duration.

Section-I : Islamic Studies/Ethics =60 marks.

This section shall have question on Islamic Studies in case Muslim candidates and on Ethics in case of non-Muslim. There shall be 3 questions in this section of Theory and there will be no choice.

Each question shall carry 18 marks.

Internal Assessment will be of 06 marks.

Section-II : Pakistan Studies = 40 marks

This section shall have 3 questions on Pakistan Studies and there will be no choice. Each question shall carry 12 marks.

Internal Assessment will be of 04 marks.

Paper-IV Behavioural Sciences & Computer Education= 100 marks

The examination in the paper of Behavioural Sciences& Computer Education shall consist of one Theory Paper of 90 marks and three hours duration. Internal Assessment will be of 10 marks.

Section I : Behavioural Sciences = 50 marks

There will be 45 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Section - II: Computer Education = 50 marks

There will be 45 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Second Professional B.Sc Medical Laboratory Technology Examination

Total Marks = 400 Pass Marks= 50%

Paper-I **Hematology & Blood Banking**

Theory	90 Marks
Internal Assessment	10 Marks
Practical & Oral	90 Marks
Internal Assessment	10 Marks
	Total Marks=200

Paper-II **Histopathology & Cytopathology**

Theory	90 Marks
Internal Assessment	10 Marks
Practical & Oral	90 Marks
Internal Assessment	10 Marks
	Total Marks=200

SECOND PROFESSIONAL EXAMINATION

OUTLINE OF TESTS

The Second Professional Examination shall be held at the end of second year and shall consist of the following subjects:

Paper-I:Haematology and Blood Banking **Total Marks : 200**

Written paper:

The examination in the subject of Haematology and Blood Banking shall consist of one written paper of three hours duration and of maximum 90 marks. Internal Assessment shall be of 10 Marks

The written paper will consist of two sections as detailed below.

Section I : Haematology = 80 marks

There will be 8 short essay questions from the subject of Haematology and there will be no choice. Each short essay question will carry 5 marks.

There will be 40 MCQs and each question will carry 01 mark.

Section - II: Blood Banking = 20 marks

There will be 2 short essay questions from the subject of Blood Banking and there will be no choice. Each short essay question will carry 5 marks.

There will be 10 MCQs and each question will carry 01 mark.

Oral/ Practical Examination in the subject of Haematology and Blood Banking will consist of maximum 90 marks. Internal Assessment shall be of 10 Marks

Paper-II: Histopathology & Cytopathology **Total Marks : 200**

Written paper:

The examination in the subject of Histopathology and Cytopathology shall consist of one written paper of three hours duration and of maximum 90 marks. Internal Assessment shall be of 10 Marks

The written paper will consist of two sections as detailed below.

Section I : Histopathology = 80 marks

There will be 8 short essay questions from the subject of Histopathology and there will be no choice. Each short essay question will carry 5 marks.

There will be 40 MCQs and each question will carry 01 mark.

Section - II: Cytopathology = 20 marks

There will be 2 short essay questions from the subject of Cytopathology and there will be no choice. Each short essay question will carry 5 marks.

There will be 10 MCQs and each question will carry 01 mark.

Oral/ Practical Examination in the subject of Histopathology and Cytopathology will consist of maximum 90 marks. Internal Assessment shall be of 10 Marks.

Third Professional B.Sc. Medical Laboratory Technology Examination

Total Marks = 600 Pass Marks= 50%

Paper-I **Chemical Pathology**

Theory	90 Marks
Internal Assessment	10 Marks
Practical & Oral	90 Marks
Internal Assessment	10 Marks
	Total Marks=200

Paper-II **Microbiology Including Parasitology**

Theory	90 Marks
Internal Assessment	10 Marks
Practical & Oral	90 Marks
Internal Assessment	10 Marks
	Total Marks=200

Paper-III **Immunology & Serology**

Theory	90 Marks
Internal Assessment	10 Marks
Practical & Oral	90 Marks
Internal Assessment	10 Marks
	Total Marks=200

THIRD PROFESSIONAL EXAMINATION

OUTLINE OF TESTS

The Third Professional Examination shall be held at the end of third year and shall consist of the following subjects:

Paper-I:Haematology and Blood Banking **Total Marks : 200**

Written paper:

The examination in the subject of Chemical Pathology shall consist of one theory paper of three hours duration and of maximum 90 marks.

There will be 09 short essay questions from the subject of Chemical Pathology and there will be no choice. Each short essay question will carry 05 marks.

There will be 45 MCQs and each question will carry 01 mark.

Practical & Oral Examination in the subject of Chemical Pathology will consist of maximum 90 marks. Internal Assessment shall be of 10 Marks.

Paper-II: Microbiology including Parasitology Total Marks : 200

Written paper:

The examination in the subject of Microbiology shall consist of one theory paper of three hours duration and of maximum 90 marks.

There will be 09 short essay questions from the subject of Microbiology and there will be no choice. Each short essay question will carry 05 marks.

There will be 45 MCQs and each question will carry 01 mark.

Practical & Oral Examination in the subject of Microbiology will consist of maximum 90 marks. Internal Assessment shall be of 10 Marks.

Paper-III: Immunology and Serology Total Marks : 200

Written paper:

The examination in the subject of Immunology and Serology shall consist of one Theory paper of three hours duration and of maximum 90 marks. Internal Assessment shall be of 10 Marks. There will be two sections of the paper.

Section I : Immunology = 50 marks

There will be 05 short essay questions from the subject of Immunology and there will be no choice. Each short essay question will carry 05 marks.

There will be 20 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Section - II: Serology = 50 marks

There will be 05 short essay questions from the subject of Serology and there will be no choice. Each short essay question will carry 05 marks.

There will be 20 MCQs and each question will carry 01 mark.

Internal Assessment will be of 05 marks.

Practical & Oral Examination in the subject of Immunology & Serology will consist of maximum 90 marks. Internal Assessment shall be of 10 Marks.

Final Professional B.Sc. Medical Laboratory Technology Examination

Total Marks = 500 Pass Marks= 50%

Paper-I	**Medical Statistics & Research Methods**	
	Theory	90 Marks
	Internal Assessment	10 Marks
	Research Paper	90 Marks
	Internal Assessment	10 Marks
		Total Marks=200
Paper-II	**Elective Subject**	
	Theory	90 Marks
	Internal Assessment	10 Marks
	Practical & Oral	180 Marks
	Internal Assessment	20 Marks
		Total Marks=300

FINAL PROFESSIONAL EXAMINATION

OUTLINE OF TESTS

The Final Professional Examination shall be held at the end of fourth year and shall consist of the following subjects:

Paper I: Medical Statistics and Research Methods Total Marks= 200

The examination in the subject of Medical Statistics and Research Methods shall consist of one Theory Paper of three hours duration and of maximum 90 marks. Internal Assessment shall be of 10 Marks.

There will be 09 short essay questions from the subject of Medical Statistics and Research Methods and there will be no choice. Each short essay question will carry 05 marks.

There will be 45 MCQs and each question will carry 01 mark.

Oral Examination in the research report will be of maximum 90 marks.

Internal Assessment shall be of 10 Marks.

Paper II: Elective Subject Total Marks= 300

The examination in the Elective Subject shall consist of one Theory Paper of three hours duration and of maximum 90 marks. Internal Assessment shall be of 10 Marks.

There will be 09 short essay questions from the Elective Subject and there will be no choice. Each short essay question will carry 05 marks.

There will be 45 MCQs and each question will carry 01 mark.

Practical & Oral Examination in the Elective Subject will consist of maximum 180 marks. Internal Assessment shall be of 20 Marks.

CURRICULUM & SYLLABI

First Professional B.Sc. Medical Laboratory Technology Examination

Paper – I : BASIC ANATOMY, HISTOLOGY & PHYSIOLOGY

Theory Marks:	90
Internal Assessment:	10
Total Marks:	100
Pass Marks:	50%
Total study hours:	200

SYLLABI AND COURSE OF READING:

Note: Syllabi and course of reading is divided into two parts. 100 hours will be allocated for Sec I and 100 hours will be allocated for the Sec II. Question paper will carry 45 theory marks for each part.

Section- I

BASIC ANATOMY & HISTOLOGY

Introduction regarding

- Anatomical Nomenclature
- Life span of a human being
- Structural and functional organization
- Terminology and body plan
- Systematic Anatomy
- Basic organization of the body
- Histology of the anatomical structures being studied

Skin

- The structure of the hypodermis, dermis. and epidermis.
- Superficial fascia and deep fascia

The Musculoskeletal System:

- Components of the Skeletal System
- Description of Axial & Appendicular Skeleton
- The process of bone ossification. Growth, Remodeling and repair
- Main features of the skull including all views
- Shape and regions of vertebral column
- Important features of the regional vertebrae

- Bones of the thoracic cage, including the types of ribs.
- The bones of the pectoral girdle and upper limb
- The bones of the pelvic girdle and lower limb
- Various types of joints and types of joint movement
- connective tissue, components of the connective tissue matrix
- Description of skeletal muscle, smooth muscle and cardiac muscle
- Origin, insertion. synergist, antagonist and prime mover.
- The movements of the arm, forearm and hand and the involved muscle groups
- Muscles of the trunk and the actions they accomplish.
- Movements of the thigh, leg and foot with involved muscle groups

The Nervous System

- Division of the Nervous System and the characteristics of each.
    - Central Nervous System
    - Peripheral Nervous System
    - Autonomic Nervous System
    - Special Senses
- Anatomical pathways and description of:
    - Olfactory system— olfactory neurons
    - Hearing and Balance , structure of the outer middle and inner ear
    - Taste — taste bud.
    - Visual — chambers of the eye and structure of the rods and cones
    - The structure of a neuron, nerve, nerve tract, nucleus, and ganglion.
    - The components of a reflex arc and synapse
    - The three meningeal layers surrounding the central nervous system,
    - Cerebrospinal fluid and its circulation.
    - List the various cranial nerves
    - Various lobes of the brain and the cerebellum

The Cardiovascular System

- Anatomy of the Heart— the size, shape and location of the heart and Chambers, valves and their locations
- The location of the coronary arteries
- The structure of the conduction system of the heart.
- Pulmonary and systemic circulation
- The structure of arteries, capillaries and veins.
- Major arteries and veins and the body areas, they supply
- Lymphatic system tonsils, lymph nodes, the spleen and the thymus.

Respiratory System

- The anatomy of the respiratory passages, beginning at the nose and ending with the alveoli.
- The lobes of the lungs and the membranes that cover the lungs
- Pleural cavity
- The muscles of contraction of respiration

The Digestive System

- The structure of the organs that make up the digestive tract and their relations to other organs in thoracic and abdominal cavity
- Blood supply of the organs of the GI tract
- Important secretory glands, the liver and pancreas (both exocrine and endocrine components).

Genito-Urinary System

- The structures and organs of the urinary system and its relations with other organs
- The structure of the nephron
- Formation of Sex Cells
- Organs of the Male Reproductive System
- Organs of the Female Reproductive System

Section- II

BASIC PHYSIOLOGY

Introduction To The Human Physiology

- Functional organization---relationship between structure and function of the human body
- Homeostasis - its importance-- negative and positive feedback mechanism

Integumentary System

- Functions of the skin, hair, glands and nails
- Body temperature and its regulation

The Musculoskeletal System:

- Functions of the bones and muscles
- Functional characteristics of Skeletal Muscle, Smooth Muscle and Cardiac Muscle
- The events of muscle contraction and relaxation in response to an action potential in a motor neuron.
- Distinguish between aerobic and anaerobic muscle contraction.
- Muscle hypertrophy and atrophy

The Nervous System:

- Functions of the central nervous system,
- The functional areas of the cerebral cortex and their interactions.
- functions of the parts of the brainstem diencephalons, basal nuclei. Limbic system. And cerebellum.
- functions of various cranial nerves.
- Functions of the somatic motor nervous system
- Functions of the autonomic nervous system
- The function of neurons, neuroglial cells and their components.
- Resting membrane potential and an action potential.

- The function of a synapse and reflex arc
- The functions of the specialized sense organs
- Eye— physiology of site, accommodation, optic nerve and optic chiasma
- Ear— functions of the internal, middle and external ear
- Physiology of the hearing and balance
- Smell: physiology of olfactory nerve
- Taste: physiology of taste
- Location of the taste buds physiology of speech

The Endocrine System

- Functions of the Endocrine System
- Chemical Signals, receptors and hormones
- The Endocrine Glands and their Hormones
- Other Hormones

Blood

- Composition of Blood and Plasma
- Functions of Blood
- Formed Elements
- Stages of cell development
- Blood grouping
- Coagulation mechanism

The Cardiovascular system

- Functions of the Heart
- Electrical Activity of the Heart origin and propagation of cardiac impulse
- Phases of the Cardiac Cycle
- Heart Sounds
- Regulation of Heart Functions— intrinsic and extrinsic
- Functions of the Peripheral Circulation
- The Physiology of Circulation
- Pulmonary Circulation
- Systemic Circulation
- Arteries
- Veins
- Local Control of Blood Vessels
- Nervous Control of Blood Vessels
- Regulation of Arterial Pressure
- The function of Lymphatic System, tonsils, lymph nodes, the spleen and the thymus.

Respiratory System

- Functions of the Respiratory System beginning at the nose and ending with the alveoli.
- Ventilation and Lung Volumes
- Gas Exchange and gas transport in the blood
- Rhythmic Ventilation

The Digestive System

- Functions of each organ of the Digestive System including major salivary glands
- Movements and Secretions in each organ of the Digestive System and their regulation
- Physiology of Digestion, Absorption, and Transport

Genito-Urinary System

- Urine Production, Urine Movement
- Regulation of Urine Concentration and Volume
- Body Fluid Compartments
- Regulation of Extracellular Fluid Composition
- Regulation of Acid-Base Balance
- Physiology of Male Reproductive system—spermatogenesis and reproductive glands, hormones and their regulations
- Physiology of Female Reproductive system— ovulation, hormones and their regulations

Immunity

- Define immunity, Innate Immunity, Adaptive Immunity
- Antigens and Antibodies
- Primary and secondary responses to an antigen
- Antibody-mediated immunity and cell-mediated immunity
- Role of lymphocyte in immunity regulation

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Paper – II : BASIC BIOCHEMISTRY & GENERAL PATHOLOGY

Theory Marks:	90
Internal Assessment:	10
Total Marks:	100
Pass Marks:	50%
Total study hours:	200

SYLLABI AND COURSE OF READING:

Note: Syllabi and course of reading is divided into two parts. 100 hours will be allocated for Sec I and 100 hours will be allocated for the Sec II. Question paper will carry 45 theory marks for each part.

Section- I

BASIC BIOCHEMISTRY

Physiochemical Principles

- Hydrogen ion conc. and pH notation
- Acidity & Alkalinity
- Indicators & Buffer solutions
- PH and its determination
- The colloidal state
- Absorption
- Structure and function of cell membrane and movement of materials across cell membrane
- Osmosis & Osmotic pressure
- Surface tension
- Viscosity

Carbohydrates

- Introduction and classification of carbohydrates
- Some important monosaccharides, disaccharides and polysaccharides
- Regulation of blood glucose level
- Definition and end products of
    a. Glycolysis
    b. Citric acid cycle
    c. Glycogenolysis
    d. Glycogenesis
    e. Gluconeogenesis

Proteins and Amino Acids

- Introduction, importance, classification and properties of proteins

- Entry of amino acids into cells and peptide linkage
- Special sources of proteins

Lipids

- Introduction, Classification and Function of lipids
- Biosynthesis of fatty acids, natural fats or triglycerides
- Fatty acid oxidation

Vitamins and Minerals

- Classification of vitamins
- Fat soluble vitamins and Water soluble vitamins
- Deficiency effects

Enzymes

- Introduction, Classification Chemical nature and properties of enzymes
- The mechanism of enzyme reactions
- Factors affecting the enzyme activity
- Important coenzymes and their actions
- Regulatory enzymes

Nutrition and Dietetics

- Balanced diet
- Role of carbohydrates, fats and proteins, their dietary sources and uses in the body
- Quantitative and qualitative daily requirements of carbohydrates, fats, proteins, vitamins and minerals

Section- II

GENERAL PATHOLOGY

- **Cell injury and death:**
  - Causes of cell injury
  - Necrosis & gangrene
  - Apoptosis
  - Subcellular responses
- **Cell adaptations:**
  - Hyperplasia
  - Hypertrophy
  - Atrophy
  - Metaplasia
  - Pigmentation
  - Calcification
  - Fatty change
  - Intracellular accumulation

- **Inflammation:**
    - **a. Acute inflammation**
        - i. Vascular events
        - ii. Cellular events
        - iii. Chemical mediators
    - **b. Chronic inflammation**
        - i. General
        - ii. Granulomatous
    - **c. Morphologic patterns of acute and chronic inflammation**
- **Healing and repair:**
    - a. Normal controls
    - b. Repair by connective tissue
    - c. Wound healing
- **Haemodynamic disorders**
    - a. Edema
    - b. Hyperemia / congestion
    - c. Hemorrhage
    - d. Thrombosis
    - e. Embolism
    - f. Infarction
    - g. Shock
- **Diseases of immunity**
    - a. General features
    - b. Hypersensitivity reactions
    - c. Immune deficiencies
    - d. Autoimmunity
    - e. Amyloidosis
- **Neoplasia:**
    - a. Nomenclature
    - b. Molecular basis
    - c. Carcinogenic agents
    - d. Clinical aspects

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Paper – III : ISLAMIC STUDIES & PAKISTAN STUDIES

Theory Marks:	100
Total Marks:	100
Pass Marks:	50%
Total study hours:	150

SYLLABI AND COURSE OF READING:

Note: Syllabi and course of reading is divided into two parts. 100 hours will be allocated for Sec I and 50 hours will be allocated for the Sec II. Question paper will carry 60 marks for Islamic Studies & 40 marks for each Pakistan Studies.

Section- I

ISLAMIC STUDIES

Introduction to Quranic Studies

1) Basic Concepts of Quran
2) History of Quran
3) Uloom-ul -Quran

Study of Selected Text of Holy Quran

1) Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
2) Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
3) Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
4) Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
5) Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)

Seerat of Holy Prophet (S.A.W) I

1) Life of Muhammad Bin Abdullah (Before Prophet Hood)
2) Life of Holy Prophet (S.A.W) in Makkah
3) Important Lessons Derived from the life of Holy Prophet in Makkah

Seerat of Holy Prophet (S.A.W) II

1) Life of Holy Prophet (S.A.W) in Madina
2) Important Events of Life Holy Prophet in Madina
3) Important Lessons Derived from the life of Holy Prophet in Madina

Introduction To Sunnah

1) Basic Concepts of Hadith
2) History of Hadith
3) Kinds of Hadith
4) Uloom–ul-Hadith
5) Sunnah & Hadith
6) Legal Position of Sunnah

Selected Study from Text of Hadith

Islamic Culture & Civilization

1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture& Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

Political System of Islam

1) Basic Concepts of Islamic Political System
2) Islamic Concept of Sovereignty
3) Basic Institutions of Govt. in Islam

Islamic History

1) Period of Khlaft-E-Rashida
2) Period of Ummayyads
3) Period of Abbasids

Social System of Islam

1) Basic Concepts of Social System of Islam
2) Elements of Family
3) Ethical Values of Islam

Section- II

PAKISTAN STUDIES

1. Historical Perspective

a. Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-i-Azam Muhammad Ali Jinnah.
b. Factors leading to Muslim separatism
c. People and Land
    i. Indus Civilization
    ii. Muslim advent
    iii. Location and geo-physical features.

2. Government and Politics in Pakistan

Political and constitutional phases:

a. 1947-58
b. 1958-71

c. 1971-77
d. 1977-88
e. 1988-99
f. 1999 onward

3. Contemporary Pakistan

a. Economic institutions and issues
b. Society and social structure
c. Ethnicity
d. Foreign policy of Pakistan and challenges
e. Futuristic outlook of Pakistan

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Paper – IV : BEHAVIORAL SCIENCES & COMPUTER EDUCATION

Theory Marks:	90
Internal Assessment	10 (5 marks for each subject)
Total Marks:	100
Pass Marks:	50%
Total study hours:	200

SYLLABI AND COURSE OF READING:

Note: Syllabi and course of reading is divided into two parts. 100 hours will be allocated for Sec I and 100 hours will be allocated for the Sec II. Question paper will carry 45 marks for Behavioural Sciences & 45 marks for Computer Education.

Section- I

BEHAVIORAL SCIENCES

1. **Introduction to Behavioural Sciences and its importance in health.**
   - Bio-Psycho-Social Model of Health Care and the Systems Approach
   - Normality vs Abnormality
   - Importance of Behavioural sciences in health
   - Desirable Attitudes in Health Professionals
2. **Understanding Behaviour**

   Sensation and sense organs
   - Describe sensation, sense organs/special organs

   Perception
   - Define perception, what factors affecting perception

   Attention and concentration
   - Define attention and concentration. What factors affecting them

   Memory
   - Define memory and describe its stages, types and methods to improving it

   Thinking
   - Define thinking; describe its types and theories What is cognition and levels of cognition?
   - Discuss problem solving and decision making strategies

   Communication
   - Define communication. What are types, modes and factors affecting it. Describe ways to recognize non-verbal cues. Characteristics of a good communicator
3. **Individual Differences**
   - **Personality**

- Define personality. What factors affect personality development? How personality can be assessed? Influence of personality in determining reactions during health, disease, hospitalization, stress

- **Intelligence.**
  - Define intelligence and the various types of intelligence.
  - What factors affect it and how it can be assessed?
- **Emotions**
  - Define emotions. What are the various types of emotions?
  - Emotional Quotient (EQ)- concept & utility
- **Motivation**
  - Define motivation and what are the types of motivation?

4. **Learning**
   - Define learning, Principles of learning, modern methods and styles of learning, types of learners, Strategies to improve learning skills
5. **Stress and Stressors**
   - Define and classify stress and stressors Relationship of stress and stressors with illness
6. **Life Events**
   - Concept of life events and their relationship with stress and illness
7. **Stress Management**
   - What is coping skills
   - What is conflict and frustration?
   - What is concept of adjustment and maladjustment?
8. **Interviewing / Psychosocial History Taking**
   - Define, types of interview and listening Skills of interviewing and listening
9. **Allied Health Ethics-Hippocratic oath**
   - Do's and Don'ts
   - What is the concept of Allied Health ethics?
10. **Culture and Allied Health practice**
    - Concept of group, its dynamics
    - Attitude, value, belief, myths, social class, stigma, sick role and illness, health belief models
11. **Psychological reactions**
    - Grief and bereavement, Family and illness Dealing with difficult patients
    - What are the psychosocial aspects of illness, hospitalization, rape, torture, terminal illness, death and dying?
    - Psychosocial issues in Emergency Departments, Intensive Care and Coronary Care Units, Operating Theatres, Cancer wards, Transplant Units, Anaesthesia
12. **Breaking Bad News**
    - Introduction, Models, Methods, Death of the patient, abnormal baby, intractable illness
13. **Pain, Sleep, Consciousness**
    - Concept of pain.
    - Physiology of pain,
    - Altered states of consciousness.
14. **Communication Skills**

- Counseling,
- Crisis Intervention Conflict Resolution
- Principles of effective communication, active listening, the art of questioning The art of listening.
- Good and bad listener.
- Counseling: Scope, Indications and Contraindications,
- Steps, Do's and Don'ts, How to deal with real life crisis and conflict situations in health settings

Section- II

COMPUTER EDUCATION

Introduction To Computers

- Usage and functionality of computers
- Limitations of Computers
- Classification of Computers
- Basic Components of Computers
- Hardware
- Software
    - System Software
    - Application Software
- Equipment's/devices in Personal computer system
- Input devices
- Output devices
- Storage devices
- The processor
- Microsoft Windows
    - Introduction to MS-Windows
    - Arranging, Moving and Resizing Windows.
    - Identifying the components of desktop.
    - Moving, Changing and Closing Windows.
    - Crating, Opening and Deleting items and folders.
    - Working with My Computer
    - Deleting and Resume Print Jobs.
    - Using Control Panel
    - Working with Accessories.
- Microsoft Office
    - Different routine operations in

        Microsoft Word
        Microsoft Excel
        Microsoft Power Point

- Internet and Email
    - Introduction To Outlook Express
    - Using Internet Explore

Second Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT: HEMATOLOGY & BLOOD BANKING

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	200
Practical hours:	400
Total study hours:	600

SECTION I :

HEMATOLOGY

1. **Introduction to Haematology**
   - Review of vascular system and Blood Constituents.
   - Methods for Securing Blood.
   - Method for securing Bone Marrow.

2. **Origin and Development of Blood cells, Maturation of Erythrocytes and erythrocyte count.**
   - Blood formation:
   - Intrauterine.
   - Extrauterine.

- Factors which govern Haematopoiesis.
- Principles of Normal cell Maturation.
  - Erythrocytes:-
    a) Definition.
    b) Maturation.
    c) Factors required for erythropoiesis.
- Enumeration of Erythrocytes:
  - General principles of count.
  - The hemocytometer.
  - The red cell diluting pipette.
  - Diluting fluids.
  - Sources of error.
  - Normal Values.
- Haemoglobin:
  - Definitions of terms.
  - Chemistry of Haemoglobin.
  - Metabolism.
  - Compounds of Haemoglobin.
  - Haemoglobinometery.
- Haematocrit, Erythrocyte Sedimentation Rate:
  - Haematocrit.

a) Definition and principle of test procedures:
1.Micro 2. Macro.
b) Sources of Error.
c) Normal Values.
d) Significance of abnormal findings.
e) Correlation of Haemoglobin, Haematocrit, and Erythrocyte Count.

- Erythrocyte Sedimentation Rate:
  - Principle of Test Procedures
  - Methods
  - Sources of Error.
  - Normal Values.
  - Significance of Abnormal Values.
- Maturation of Leukocytes, Leukocyte Count.
  - Introduction:
    a) Definition.
    b) Origin.
    c) Functions and biological Properties.
  - Maturation of Granulocytic Series.
    Criteria for identifying cells and description of cells.
- Maturation of Lymphocytic Series.
- Maturation of Monocytic Series.
- Enumeration of Leukocytes:
  - General Principle of haemocytometer method.
  - The Haemocytometer.
  - Diluting Fluids.
  - Sources of Error.
  - Normal Values.
- Maturation of Thrombocytes, Preparation of Blood Smears and Differential Blood Count.
  - Maturation of Thrombocytes:
  - Description of Cells.
  - Preparation of Blood Smears.
  - Preparation of various types of blood smears.
  - Fixation.
  - Staining.
    a) Types of Stains.
    b) Criteria for good smear stained by Wright's method.
    c) Sources of error.
  - Examination of stained smears:
    a) Define differential Count.
    b) Observation of Erythrocytes.
    c) Number of Platelet estimated.
    d) Tabulation of Leukocytes.
    e) Classification of leukocytes and normal values:- Arneth Count.
- Total Eosinophil Count and Cerebrospinal fluid count:
  - Functions of Eosinophils.
  - Significance of increased and decreased values.
  - Principle of the staining method for total eosinophil count.
  - Equipment used in eosinophil count.
  - Haemocytometer.

- Normal Values for the method used.

- Cerebrospinal fluid:
  - Definition.
  - Sources.
  - Functions.
  - Collection:- The Lumbar puncture.
  - Laboratory studies.
    - Necessity of maintaining sterility.
    - Necessity of immediate examination.
    - Gross Observation.
  - Cytologic studies.
    - Principle of the cell count.
    - Normal values and significance abnormal findings.

- Pathology of Erythrocytic series, Including abnormal Haemoglobin syndromes and Indices.
  - Brief review of maturation of erythrocytes and haemoglobin metabolism.
  - The Indices.
  - Abnormal Forms:
    a) Abnormalities on shape
    b) Abnormal inclusions.
    c) Variation in haemoglobin content and staining properties.
    d) Diagnosis and differential diagnosis of
      - Iron deficiency anaemia, megaloblastic anemia, hemolytic anemias, sideroblastic anemia, thalassemias, sickle cell anaemias, aplastic anaemias.
      - Polycythemias

- Reticulocyte Count, Fragility of Erythrocytes, Sickle cell studies:
  1. Reticulocyte Counts:
  - Method of smear making for reticulocyte count
  - Normal values for adults and infants.
  - Means of demonstrating reticulocytes
  - Principle of the staining reaction
  - Sources of error.
  2. Fragility of Erythrocytes:
  - General Considerations
  - Response of the erythrocytes to the Hypertonic and Hypotonic solutions.
  - Determination of fragility of erythrocytes:
    Effect of small variations in shape and size of erythrocytes on the fragility.
  3. Sickle Cell studies:
  - Principle of tests for sickle cell studies
  - Laboratory Diagnosis.
    1. Sealed whole blood method.
    2. Sodium metabisulfite method

- Thrombocytes, Homeostasis, and Blood Coagulation:
  1. Thrombocytes:
  - Physical properties
  - Review of Maturation
  - Functions
  - Enumeration of Platelets
  2. Haemostasis:
  - Haemorrhage

- Hemophilia
- Von Willebrand Disease
- Disorders of platelets
- Investigations
- Coagulation studies
- Thrombosis
- Hereditary thrombophilia
- Acquired thrombophilia
- Disseminated Intravascular Coagulation (DIC)

- Special stains in Haematology:
    1. Peroxidase stain
    2. Sudan Black B
    3. Periodic Acid Schiff (PAS) Stain
    4. Feulgan reaction
    5. Histochemical techniques for alkaline phosphatase
    6. Miscellaneous stains used in Haematology:
        a) Giemsa.
        b) Prussian blue reaction
- L.E Phenomenon and continuation of Bone Marrow study.
    - L. E phenomenon and techniques of L.E cells preparation.
    - Bone Marrow Examination
        a) Bone marrow aspiration and trephine biopsy.
        b) Bone marrow differential count.
- Acute Lymphoblastic Leukemia (ALL)
- Chronic Lymphoblastic Leukemia (CLL)
- Acute Myeloid Leukemia (AML)
- Chronic Myeloid Leukemia (CML)
- Myeloproliferative disorders (MPD)
- Myelodysplastic syndrome (MDS)
- Lymphomas
- Bone Marrow Failure Syndromes

SECTION II:

BLOOD BANKING

History of Blood Transfusion Antigen Antibody theory:

1. Antigen
2. Antibody

Immunization Classification of Antibodies:

1. Precipitin
2. Lysin
3. Agglutinin
4. Complete/Bivalent

Antiglobulin test Blood groups ABO systems:

1. Agglutinogen - definition
2. Agglutinin - definition
3. Landsteiner's Postulates
4. Sub groups of "A" and "B"

5. Techniques for blood grouping-slide test
6. Techniques for reverse blood grouping-tube test.
7. Sources of error, controls in blood bank, general.

Low tittered groups "O" blood Rh - Hr Typing: Agglutinogen Agglutinin theory:

1. Agglutinogen definition
2. Agglutinin definition
3. Cause of sensitization to the Rh - Hr factor
4. Techniques for Rh typing

Sources of error Controls Cross Matching procedures:

1. Purpose of crossmatch
2. Methods of cross-matching
3. Cross-matching problems
    - Rouleaux
    - Cold Agglutinins
    - Hyperproteinemia and hyperglobulinemia Other Blood Group Systems

Transfusion reactions Antiglobulin tests:

1. Direct Coomb's
2. Indirect Coomb's
3. Sources of error, controls Rh Antibody tests
    - Screening tests using a cell panel:
        a) Slide test
        b) Tube test
    - Titrations

Erythroblastosis Foetalis:

- Causes:
    - Due to Rh incompatibility
    - Methods of testing
    - Due to ABO incompatibility
    - Methods of testing

Second Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT: HISTOPATHOLOGY & CYTOLOGY

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	200
Practical hours:	400
Total study hours:	600

SECTION I :

HISTOPATHOLOGY

- **Microscope**
  - Brief history of microscopy
  - Parts of a microscope
  - Types of microscope. Classification and their uses.
  - Nature of light, Concepts of amplitude, Wavelength and Phase.
  - Perception of color and brightness.
  - Refraction, formation of images.
  - Merits and Demerits of achromatic and apochromatic objectives.
  - Immersion objectives.
  - Specification of objective magnification, focal length, tube length, resolution, numerical aperture etc. Calculation of the resolution and magnification
  - Care and Cleaning of the Microscope
- **Introduction to common Histological Techniques:**
  - Examination of fresh material. Supravital staining. Examination of fixed material.
  - Fixation:
  - The purpose of fixation, common fixative used for the histological techniques.
  - The Paraffin method of sectioning tissue:
  - Advantages and disadvantages of the paraffin method. Dehydration of tissues. Clearing of tissues Infiltration with paraffin. Paraffin block making. Section cutting with a rotary microtome. Fixing paraffin section to slides.
  - Microtome and Microtome Knives:
  - Grinding and stooping of microtome knives.
  - Cleaning and lubrication of the microtome.
  - The Freezing Method of Sectioning:
  - Advantages and disadvantages of freezing method.
  - Common techniques of freezing tissues.
  - Cutting sections with a freezing microtome.

- **Stains:**
    - Object of staining.
    - Classification of stains.
    - Acids and basic dyes.
    - Basophilic and acidophilic tissue components.
    - Routine Haematoxyline-Eosin Staining Of Paraffin Sections
    - The procedure of haematoxyline-eosin staining and mounting sections.
    - The relation of various steps in this procedure.
    - Special Staining Techniques
    - GMS, Mucicarmine and Alcian Blue.
    - Stains for Connective Tissue Elements
    - Mallory's connective tissue stain.
    - Aldehyde fuchsin and Verhoffs stain for elastic fibers
    - Gordon + Sweet stain for reticular fibres
    - Toluidine blue staining of mast cells
    - Von- Geison, Masson's Trichome
- **Stains for Nervous Tissues:**
    - Nissel Stain. Stains for myelin.
- **Histochemical demonstration of lipids:**
    - Choice of fixative.
    - Choice of sectioning Technique.
    - Sudan Black B Stain.
    - Staining for frozen section.
- **Histochemical demonstration of glycogen:**
    - Choice of fixative and sectioning
    - Best's Carmine staining for paraffin sections.
- **Demonstration of:**
    - Calcium, Iron, Melanin, Muscle Tissue PTAH, Amyloid Material, Mucinous Material
- **The PAS Technique:**
    - The Schiff reaction.
    - Significance of the Schiff reaction.
    - Procedure of the PAS staining.
- **Special Gross Anatomical Techniques**
- **Preserving and mounting gross anatomical specimen:**
    - Preservative fluids: Kaiserling Solution I & II.
    - Mounting specimens in fluid media.
    - Mountings specimens in plastics
- **Immunohistochemistry**
    - Introduction and significance
    - Methods of Immunohistochemistry: Direct and Indirect
    - PAP / Avidin Biotin method
    - Steps involved in Immunohistochemistry (starting from dewaxing to the final chromogen application)
    - Significance of interpretation of the results: scoring/ staining intensity
    - Antigen retrieval methods

- Types of fixatives, buffering media, enzyme labels and chromogens used in Immunohistochemistry.
- List of commonly used tumor markers in different diseases and their clinical utility.

- **Biopsy and types of biopsies**
  - Merits and demerits of different types of biopsies
- **Fixation methods with salient gross and microscopic morphological changes in common diseases of:**
  - Gastrointestinal Tract
  - Genitourinary System (Male and Female)
  - Respiratory tract
  - Brain and spinal cord
  - Skin and subcutaneous tissues
  - Heart and blood vessels
  - Lymphatic system including tonsils, lymph nodes, the spleen and thymus

SECTION II :

CYTOLOGY

- Cell and its structure, classification of cells and tissues.
- Basic principles of exfoliative cytology
- Exfoliation, sites from which exfoliated cells can be obtained and methods for obtaining them.

Pathologic processes affecting cell morphologies:

- Inflammation, Repair and regeneration, benign and malignant tumors. o Female genital tract.
- Methods for obtaining smears and their fixation
- Pap's and Giemsa's staining
- Normal cells of female genital tract
- Abnormal cells other than malignant cells
- Diagnosis of carcinoma of male genital tract. o Respiratory tract:
- Method for obtaining smears and their fixation o Cytologic techniques for
- Urinary tract
- G.I. tract
- Circulating blood and aspirating smears. o Immunocytochemistry
- Introduction and significance
- Methods of Immunocytochemistry: Direct and Indirect
- PAP / Avidin Biotin method
- Steps involved in Immunocytochemistry (starting from fixation to the final chromogen application)
- Antigen retrieval methods
- Types of buffering media, enzyme labels and chromogens used in Immunocytochemistry

Third Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT:

CHEMICAL PATHOLOGY

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	100
Practical hours:	200
Total study hours:	300

Course Outlines:

- Chemical Changes in Gastrointestinal tract:
- Digestion and digestive enzymes, their control and mechanism of secretion, bile Absorption of water, Minerals, Fats, Carbohydrate and proteins.

Urine:

- Composition of glomerular filtrate and change which occur in the tubules, normal urine, physical properties, and composition, pathological constituents and their determination, kidney function tests.

Minerals:

- Metabolism of Na, Ca, P, Fe, Cu, and Co, Electrolyte balance and imbalance.

Water Balance:

- Distribution of body fluids, were intake and output, dehydration and edema.

Hormones:

- Parathyroid effects on Ca and phosphorus metabolism, Thyroid functions and chemistry, effects of hormones at metabolism.

Quantitative Analysis of Urine:

- Amino acids, Bence-Jones proteins, Calcium, Coproporphyrins, creatinine, galactose, phosphates, nitrogen, PH, specific gravity, Ca, p, Oxalates and urates. Determination of
    - Urea (qualitative and Quantitative) pathological Constituents:
    - Sugar, Albumin, Ketone bodies, Blood, Bile pigments.

Renal function tests

- Renal function tests used in clinical investigation.
    - Inulin and Creatinine clearance (GFR).
    - Para-aminohippurate clearance (renal plasma flow).

- Maximum rate of tubular excretion of P-amino-hippurate (Tr-PAH) (measures excretory function of renal tubules).
- Maximum rate of reabsorption of glucose (Tmg) (measures reabsorption function of renal tubules).

- Classification of Renal Function Tests.
- Classification of renal function tests used in clinical assessment of renal function.
    - Blood urea nitrogen.
    - Serum Urea.
    - The phenolsulfonphthalein (PSP) test.
    - Serum creatinine
    - Creatinine Clearance
    - Serum Uric Acid
    - Electrolytes

Bile Pigments and Urobilinogen in urine

- Two types of bile pigments and their characteristics.
- Constituents and derivation of bile which appear in the urine.
- Derivation of Bile in urine.
- Routine screen test for bilirubin.

  Methods:-
    - Foam test,
    - Harrison Fouchet method,
    - Harrison's spot test,
    - Icto test (Ames company),
    - Observant for standing of element of urine sediment.
- Determination of Urobilin in urine.
- Determination of urobilinogen in the urine.
- Semi quantitative methods of Watson or of Wallace and Diamond.

Haemoglobin, Myoglobin and Haemosiderin in Urine :

- Haematuria.
- Detection of Haemoglobin in urine.
    - Spectroscopic examination.
    - Benzidines test.
    - Guaiac test.
    - Tablet test.
- Myoglobinuria.

  Differentiation or separation from Haemoglobin.
    - spectroscopic examination.
    - spectrophotometry.
    - Precipitation by 80% saturated ammonium sulfate.
- Haemosiderin:
    - Prussian blue reaction.

Other chemical tests :

- Indicanuria: Obermayer's test.
- Porphyrinuria :
    - Identification of Porphobilinogen.
    - Identification of uroporphyrins.
    - Identification of coproporphyrins: Method of Schwitz, Zeir and Watson.

- Melanin:
    - Ferric chloride test.
    - Bromine Water test.
    - Method of Blackberg and Wagner.
    - The Thormahlen test.
- Chlorides:
    - Frantus test.
    - Method of Schales and Schales.
- Phenylketonuria:
    - Ferric Chloride test.
    - Phenistix.
- Metabolites of Salicylate and PAS:
    - Screening test for Salicylates and PAS.
        i) Ferric Chloride ii) Phenistix.

Urinary Calculi:

- Observations to be made of gross appearance.
- Reagents and Scheme for detection.

Lipid Profile
Liver Function Tests
Cardiac Profile
Hormones:

- Parathyroid effects on Ca and Phosphorus
- Thyroid Functions and Chemistry
- Insulin effects on Glucose metabolism, secretion, structure. Hyperglycemia, Diabetes Mellitus. Antagonistic hormones
- Male and Female sex hormones. (Testicular/ Ovarian/ Placental Hormones). Synthesis, secretion, actions, metabolism. A little information about Amenorrhea, Oligomenorrhoea, Hirsutism, Virilism, Spermatogenesis, Ovulation, Climacteric.
- Anterior and Posterior pituitary hormones, hypothalamic hormones. Positive and negative feedback.
- Adrenal Glands. Hormones of the adrenal medulla and cortex. Hypo and Hyper secretion. Cushing's syndrome. Addison's disease. Pheochromocytoma.

Practical:

- Quantitative Analysis of Blood:
    - Use of the visual colorimeter and photoelectric colorimeters, instruction on calculation of the concentration of the substances determined. The following blood analytical procedures will be taught.
    - Creatinine, Fatty acids, Phosphates, iron, plasma protein, calcium, Cholesterol, Glucose, Urea.

Third Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT:

MICROBIOLOGY INCLUDING PARASITOLOGY

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	100
Practical hours:	200
Total study hours:	300

Course Outlines:

Introduction to microbiology.

- Interaction between host and infectious agent
- Purpose of infectious agent in nature
- What is the virulence role of environment in infection?
- Gram positive cocci. Taxonomy. General characteristics.
- Clinical significance of bacteria.
- Isolation and identification of bacteria.
- Staphylococci and related gram positive cocci.
- Streptococci. Enterococci. Enterobacteriaceae: Escherichieae. Edwardsielleae, Salmonelleae, Citrobacteriaceae, Klebsielleae, Proteacae. Yersinieae, Erwinieae.
- The Non-fermentative gram negative bacilli.
- Curved gram-negative bacilli. o Vibrionaceae and campylobactericaeae.
- Fastidious gram negative bacilli
- Hemophilus. sp. Actino bacillus sp. Pasteurella. Brucella species. Bartonella. sp. Bordetella sp. Legionella. Neisseria species and moraxella catarrhalis.
- Aerobic and gram positive bacilli. Listeria monocytogenes.
- Corynebacterium. sp. Gardnerella vaginalis. Lactobacillus sp.
- Aerobic actinomycetes. Nocardia
- Streptomycetes.
- The Anaerobic bacteria, Anaerobic. non. Spore forming gram positive bacilli.
- Clostridum species.
- Mycoplasmas and Ureaplasmas.
- Mycobacteria.
- Spirochetal infections: Treponema. Borrelia, Leptospira, Spirilla

Mycology:

- Clinical categorization of fungal infections. Laboratory approach to diagnosis of fungal infection. Identification of dermatophytes.
- Laboratory identification of yeast.

Parasitology:

- Clinical manifestations of parasitic disease. Life cycle. Prevention.

- Collection. Transport of specimen and its identification in laboratory.
- Intestinal Protozoa. Amoeba. Flagellates. Ciliates. Nematodes. Cestodes Trematodes. Blood and tissues parasites.

Virology:

- Introduction. Clinical manifestation of viral infection.
- Diagnosis of viral infection. o Infections with Chlamydia species.
- Infections with Rickettsia. Coxiella. Ehrlichia and anaplasma.

Sterilization & Disinfection

- **Laboratory Exercises:**
    - Each lecture will be followed by two hour practical class where the student will apply their theoretical knowledge in the understanding of related microbiological investigations, which have been proved useful for the diagnosis of human diseases.
    - During the other laboratory sessions, the students will be engaged in the preparation of media, the sterilization of glass ware, Antigens, Antibodies, Vaccines - haemolysin, permanent slides, laboratory reagents and also to assisting postgraduate students in the isolation of micro - organisms from clinical materials.

Third Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT:

IMMUNOLOGY & SEROLOGY

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	100
Practical hours:	200
Total study hours:	300

Sec –I IMMUNOLOGY

- **General Immunology**
- Innate and adaptive immunity
- Antigen and antigenecity
- Antibodies and immunoglobulins
- Cell mediated and humoral immunity
- Immune system
- Hypersensitivity
- Autoimmunity
- Immune mediated diseases
- Immunization
- Immune deficiency
- **Immunological Techniques**
    - General considerations
    - Agglutination reactions
    - Precipitation reactions
    - Immunodiffusion techniques:
    - Double diffusion
    - Single radial immunodiffusion.
    - Immunoelectrophoresis
    - Complement Fixation test
    - Immunoflourescence : Direct & Indirect
    - Enzyme Immunoassay (EIA)
- **Immunochemical Techniques:**
    - Quantitation of IgG, IgA, IgM, IgD, and IgE in serum and other body fluids
    - Immunoelectrophoretic analysis of serum immunoglobulin abnormalities Detection/quantitation of Bence-Jones protein in the urine
    - Cryoglobulin determination and analysis
    - Tests for circulating immune complexes by immunochemical methods

- Immunochemical and electrophoretic analysis of CSF
- Measurement of overall complement function
- Total haemolytic and alternative pathway titrations of complement components (especially C3, C4, Factor Band C1 esterase inhibitor)
- Electrophoretic examination for altered complement components
- Other serum protein determinations including acute phase proteins (CRP etc.), Carcinoembryonic antigen, a-fetoprotein and protein clearance ratios
- Pregnancy tests on urine.

- **Immunohistological Tests:**
  - Detection of antigens, antibodies, Immunoglobulins and complement components deposited in pathological lesions, particularly in the kidney and skin
  - Characterization of plasma cells and lymphocyte types in relevant tissue biopsies, using immunofluorescent and enzyme-labelled techniques.

Sec -II SEROLOGY

- Introduction of immune system
- Antigens, definition types examples
- Anti-bodies definition, types functions, structures
- Antigen anti-body reactions
- Serological Techniques
- Tests for circulating antibodies to autoantigens in tissue sections by indirect immunofluorescence and enzyme-labelled techniques
- Tests for antibodies to other autoantigens by agglutination, precipitation, complement fixation and radioimmunoassay
- Tests for antibodies to non-microbial environment and food allergens
- Tests for antibodies to selected microbiological antigens
- Tissue Typing For HLA-Antigens: Serological And DNA Based
- Principles of QUALITY CONTROL and the use of reference preparations as laboratory standards
- Antigen-Antibody reaction techniques
- ELISA Technique
- Widal test
- Typhidot test
- Brucella Agglutination test.
- Antistreptolysin O titre.
- Bacterial Haemagglutination test.
- Paul Bunnel reaction.
- RA Factor Test
- CRP test.
- RPR test
- VDRL test.
- Complement fixation test
- PCR

Final Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT:

MEDICAL STATISTICS & RESEARCH METHODOLOGY

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	100
Practical hours:	200
Total study hours:	300

Contents of The Course:

- **Introduction of Statistics**: Statistical data condensation of data, presentation of data by graphs, health related data, rates and their relative importance, presentation of quantitative data.
- **Sampling:** The concept of sampling, types and methods of drawing ideal sample, sampling distribution of sample mean, error of sampling, standard error, chi square, T-test and their uses in health.
- **Central Tendency:** Concepts of central tendency, mean, median & mode and their value in health, percentiles, measure of dispersion, coefficient of variation and skewness, normal distribution, range, standard deviation and relative deviation.
- **Hypothesis:** Concepts of hypothesis testing, null & alternative hypothesis, two types of errors, acceptance & rejection regions, tow sided & one sided tests, general steps in hypothesis testing, test about means, confidence interval for mean, meaning of significance in statistical procedures and methods of inferential statistics.
- **Regression & Correlation:** Scatter diagram, straight line regression model, method of least squares, sample correlation coefficient, inference about regression coefficient and correlation coefficient.
- **Introduction to Research:** The question of legitimate knowledge, knowledge & decision making, the scientific method, quantitative vs qualitative research, application of scientific method, positivistic vs naturalistic paradigm.
- **Classification of Research:** Basic vs applied research, evaluation research, research & development (R&D), action research.
- **Selection & Formulation of a Problem:** From generic to a specific program, program statement, getting an access to primary and secondary resources, note taking and information to management, Review of related literature, questions and/or hypothesis of the study.
- **Development of a Research Plan:** The ethical, legal and professional obligations, the rational of the study, the research plan, evaluation of a research plan.

- **Selection of sample:** sample & population, basic considerations in sampling, random sampling, stratified random sampling cluster sampling, systematic sampling determination of sample size, elimination of sampling bias.
- **Instrumentation and Data Collection:** Tests and scales, objectivity and standardization, types of tests and scales, validity and reliability of an instrument, assessment of validity and reliability, development of tests/scale.
- **Data Analysis & Interpretation:** Preparing data analysis, types of measurement scales, descriptive statistics inferential statistics, using computer for data analysis.
- **Preparation of a Research Report:** Format & style, citation, references & bibliography writing theses, dissertations & journal articles.
- Student will prepare a research report regarding the selected elective subject under the guidance of the approved supervisor for the elective subject.
- The research report will be submitted in the final year examination.

Final Professional B.Sc. Medical Laboratory Technology Examination

SUBJECT:

IMMUNOHEMATOLOGY (BLOOD BANKING)

Theory Marks:	90
Practical Marks	90
Internal Assessment	20
Total Marks:	200
Pass Marks:	50%
Theory hours:	100
Practical hours:	200
Total study hours:	300

Course Outline:

- **Blood Components and Therapy**
  - Blood processing equipment.
  - Preparation and uses of Specific Blood Components
    - Whole blood
    - Red cell concentrate
    - Fresh frozen plasma
    - Platelet concentrate
    - Cryoprecipitate
    - Cryosupernatent
    - Granulocyte concentrate
    - Albumin-plasma protein fraction
    - Factor VIII concentrate
    - Factor IX complex
    - Immune Serum Globulin (ISG)
    - Rh Immune Globulin

- **Autologous Blood Transfusion**
    - Pre-operative autologous blood donations (PABD)
    - Acute normovolemic hypodilution (ANH)
    - Intra operative blood salvage
    - Post-operative blood salvage

- **ABO and Other Major Blood Group Systems**
  - Antigen
  - Antibody characteristics
  - Significance of transfusion
  - Significance of hemolytic disease of the newborn
  - Features & Practical Applications
    - MNS

        - P
        - Kell
        - Duffy
        - Lewis
        - Kidd
        - Lutheran
- **Discrepancies in ABO/D Grouping**
    - False-Positive Reactions
        - Rouleaux
        - Cold Agglutination & Cold Reacting Autoantibodies
        - T-Activation / Polyagglutination
        - Acquired B
        - Potentiators
        - Contaminating Antibodies
    - False-Negative Reactions
        - Reagent-Loss of Potency
        - Failure to add reagent
        - Failure to Identify Lysis
        - Mixed Field Appearance
        - D-Variant Phenotype
- **Incompatibilities**
    - Dealing with incompatibilities effectively and efficiently
    - Antibodies to high incidence antigens
    - Cold agglutinins
    - Hemolytic anemias
- **Antiglobulin Test**
    - Direct
    - Indirect
- **Tests for Screening & Detection of Atypical Antibodies**
    - Screening tests using a cell panel
    - Titrations
    - Adsorption & elution techniques
- **Blood Donor Selection**
    - Recruitment of voluntary non-renumerated donors
    - Transfusion transmissible infections
    - Testing strategies
        - HIV
        - HBV
        - HVC
        - Syphilis
- **Haemopoietic stem cells collection and storage**
    - Requirements & procedures
- **Irradiation of blood products**
    - Indications
        - Definite & Possible
- **Quality Control**
    - Critical control points

    - Reagent controls
    - Random quality control
    - Overview of Waste Management
- **Apheresis**
    - Types
    - Clinical applications
- **Record Keeping**
    - Repeat blood orders
    - Transplantation leading to change of blood type
    - Retention of specimens and transfused units
- **Transfusion Reactions & Hemovigilance**
    - Transfusion Reactions
    - Investigations related to transfusion
- **Practical Training**
    - Research assignment related to elective subject.