



छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHUJI MAHARAJ UNIVERSITY, KANPUR

(पूर्ववर्ती कानपुर विश्वविद्यालय कानपुर)

Formerly Kanpur University, Kanpur – 208024

A Documentary Support

*For*

*Metric No. – 1.1.1*

**Programme Outcomes & Course Outcomes**

*Under the*

**Criteria - I**

**(Curriculum Design and Development)**

**Key Indicator - 1.1**

*In*

**Metric No. – 1.1.1**

**B.Sc. Medical Laboratory Technology**

  
Co-ordinator  
Internal Quality Assurance Cell  
CSJM University, Kanpur

  
(Registrar)  
C.S.J.M. University  
Kanpur  
REGISTRAR  
C.S.J.M. UNIVERSITY  
KANPUR

**School of Health Sciences**  
**CSJM University, Kanpur**

**Ordinance & Syllabus**  
**for**  
**B.Sc. in Medical Laboratory Technology**  
**(B.Sc.-MLT)**  
**Academic Programme**

**Ordinance according to**  
**NEP-2020**

**Duration: 3 years & 6 Months**  
**(Six Semesters & 6 Months Internship)**

*Ram Lal Sharma*

*Veer*

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*Manish Kumar*

*Digvijay*

# **B.Sc.-Medical Laboratory Technology**

## **ORDINANCE**

### **Chapter**

#### **"A"**

#### **About Medical Laboratory Technology**

Medical Laboratory Technology deals with all the clinical laboratory investigations on clinical samples for laboratory diagnosis of various diseases. Blood, tissue and body fluids are analyzed and examined for various types of foreign organisms and abnormalities. This information is then used by the medical team to make decisions regarding a patient's medical care. 85% of all medical decisions are based on the results of clinical laboratory investigation reports. Medical Laboratory Technology is an important subject in the field of Medicine. In each system of Medicine, diagnosis of disease is a primary step because no treatment is possible without a proper diagnosis. It is the Medical Laboratory Technocrat, who performs this important task by various scientific tools and techniques. In today's modern world of technology, the diagnosis, treatment & prognosis of various diseases depends upon the results of investigations carried out in a clinical laboratory. Thus, these professionals play a key role in the field of health care. Medical Laboratory Technology has played a significant role in the advancement in the field of Medicine, especially in past few decades. As modern medicine becomes more of a team effort, the Medical Laboratory Technologist is an important member and integral part of the medical team.

1. B.Sc.-Medical Laboratory Technology degree will be under the **faculty of Medicine** of C.S.J.M. University, Kanpur.

2. **Duration of Course :**

- B.Sc.-Medical Laboratory Technology course will be a full time course.
- Duration will be Three years (06 Semesters) followed by compulsory 06 months internship.

3. **No. of Seats :**

Total no. of Students to this course **shall be 90.**

4. **Admission.**

**Eligibility Criteria:**

For admission in this course candidate has to pass 10 + 2 or its equivalent examination in Science (Biology) conducted by any Board or University incorporated by law and recognized by this University with minimum 50% marks in aggregate in Physics, Chemistry & Biology (relaxation of 5% marks for SC/ST student).

**Mode of Admission:**

As per the University Norms.

5. **Medium of instruction:**

English shall be the medium of instruction in the class and in the University examination.

6. **Method of Teaching:**

The method of teaching adopted shall be a combination of lectures, demonstrations and practicals by the full time faculty, visiting or part time or guest faculty.

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**7. Examination:**

- As per the University norms

**Duration of Examination:**

- Each theory paper shall be of three-hours duration OR as per the University norms.

**8. Attendance to appear in the end semester examination :**

The permission to appear in end semester examination shall be granted to such candidate only who have fulfill the condition of 75% attendance in each subject separately in theory and practical as per the university rule.

Regarding attendance requirements students will have to fulfill the condition of 75% attendance. 15% relaxation in attendance, in exceptional circumstances can be made by the Vice Chancellor on the recommendation of the Director/Coordinator/Head of the Institute/Department.

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## Learning Objectives

1. Proficiently perform a full range of clinical laboratory tests.
2. Develop and evaluate test systems and interpretive algorithms.
3. Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information.

## Programme outcome

This profession holds so much importance-

Medical Laboratory Professionals (Medical Laboratory Technologist) work in all areas of a clinical laboratory including blood banking, clinical bio-chemistry, haematology, immunology, histopathology and medical microbiology.

They perform a full range of laboratory tests – from simple prenatal blood tests, to more complex tests to uncover diseases such as HIV/AIDS, diabetes, and cancer. They are also responsible for confirming the accuracy of test results, and reporting laboratory findings. The information obtained from a Medical Laboratory Scientist helps the physician influence the medical treatment a patient will receive. Medical Laboratory Scientists operate complex electronic equipment, computers and precision instruments costing millions of dollars. Medical Laboratory Professionals analyze human fluid samples using techniques available to the clinical laboratory, such as manual white blood cell differentials, bone marrow counts, analysis via microscopy, and advanced analytical equipment. They help physicians in choosing the correct laboratory tests and ensure proper collection methods. They receive patient specimens, analyze and interpret them, and report results. Medical Laboratory Professionals must recognize anomalies in their test results and know how to correct problems with the instrumentation. They monitor, screen, and troubleshoot analyzers featuring the latest technology available in the market. They perform equipment validations, calibrations, quality controls, —STAT' or run-by-run assessment, statistical control of observed data, and recording of normal operations. To maintain the integrity of the laboratory process, medical laboratory scientists recognize factors that could introduce error and reject contaminated or substandard specimens, as well as investigate discrepant results. Common tests performed by Medical Laboratory Professionals are complete blood count (CBC), comprehensive metabolic panel (CMP), electrolyte panel, liver function tests (LFT), renal function tests (RFT), thyroid function test (TFT), urinalysis, coagulation profile, lipid profile, blood type, semen analysis (for fertility and post-vasectomy studies), serological studies and routine cultures. In some facilities that have few phlebotomists, or none at all, (such as in rural areas) Medical Laboratory Professionals may perform phlebotomy on patients, as this skill is part of their clinical training. The practical experience required to obtain a Bachelor's degree in Medical Laboratory Technology gives these professionals a unique understanding of the inter-relationship between microbiological and chemical testing and the resulting clinical manifestations in clinical, scientific and industrial settings.

## Programme Specific Outcome

On completion of this course, the students will be able to:

- Collection and receiving of specimens (infectious samples i.e. blood, urine, stool, sputum, pus, semen, tissues and body fluids) for various biochemical, pathological, microbiological, haematological and blood bank investigations, etc.
- To perform and validate various investigations for the purpose of differential diagnosis
- Calibration and standardization of glassware's and other laboratory equipment
- Standardization and selection of test analytical procedures
- Maintenance of supplies of laboratory reagents / diagnostic kits
- Evaluation of reagents and diagnostic kit for diagnostic suitability
- Maintenance of quality control for reliability of laboratory reports
- Preparation of chemical and biological reagents
- Supervision, organization of work and personnel management
- Maintenance of records and preparation of statistics

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- They look for bacteria, parasites, and other microorganisms; analyze the biochemical content of fluids; match blood for transfusions; and test for drug levels in the blood to show how a patient is responding to treatment
- Technologists also prepare specimens for examination, count cells, and look for abnormal cells in blood and body fluids
- They use automated equipment and computerized instruments capable of performing a number of tests simultaneously, as well as microscopes, cell counters, and other sophisticated laboratory equipment.
- Then they analyze the results and relay them to physicians
- With increasing automation and the use of computer technology, the work of Technologists has become less hands-on and more analytical
- The complexity of tests performed, the level of judgment needed, and the amount of responsibility workers assume depend largely on the amount of education and experience they possess
- They make cultures of body fluid and tissue samples, to determine the presence of bacteria, fungi, parasites, viruses or other microorganisms
- Clinical laboratory technologists analyze samples for chemical content or a chemical reaction and determine concentrations of compounds such as blood glucose and cholesterol, enzymes and hormones levels
- They also type and cross match blood samples for transfusions. Clinical laboratory staff evaluate test results, develop and modify procedures, and establish and monitor programs, to ensure the accuracy of tests. Senior technologists supervise junior laboratory technologists.
- Medical Laboratory Tech. staffs in small laboratories perform many types of tests, whereas those in large laboratories generally specialize
- Laboratory Technology staff prepare specimens and analyze the chemical, hormonal and enzyme contents of body fluids
- They also examine and identify bacteria and other microorganisms
- In blood bank or Immuno-Haematology, technologists collect, type and cross match blood and prepare its components for transfusions. They also analyze the blood for safe and infection free transfusion (Like HIV, Hepatitis, Syphilis, TPHA, Malaria Parasite etc.)
- In Immunology, technologists examine elements of the human immune system and its response to foreign bodies
- In Molecular Biology, technologists perform complex protein and nucleic acid testing on human cell samples

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## SCHEME OF EXAMINATION

### B.Sc. in Medical Laboratory Technology First Semester University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	General Pathology	MLT-101	75	25	100	75	25	100	200
2	Fundamentals of Anatomy & Physiology-I	MLT-102	75	25	100	75	25	100	200
3	Basics of Biochemistry	MLT-103	75	25	100	75	25	100	200
4	General Microbiology	MLT-104	75	25	100	75	25	100	200
Grand Total									800

### B.Sc. in Medical Laboratory Technology Second Semester University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Hematology	MLT-201	75	25	100	75	25	100	200
2	Fundamentals of Anatomy & Physiology-II	MLT-202	75	25	100	75	25	100	200
3	Medical Biochemistry	MLT-203	75	25	100	75	25	100	200
4	Introduction to Patient safety	MLT-204	75	25	100	-	-	-	100
Grand Total									700

### B.Sc. in Medical Laboratory Technology Third Semester University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Blood Bank Procedures-I	MLT-301	75	25	100	75	25	100	200
2	Endocrinology	MLT-302	75	25	100	75	25	100	200
3	Clinical Biochemistry-I	MLT-303	75	25	100	75	25	100	200
4.	Immunology & Serology	MLT-304	75	25	100	75	25	100	200
Grand Total									800

### B.Sc. in Medical Laboratory Technology Fourth Semester University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Blood Bank Procedures-II	MLT-401	75	25	100	75	25	100	200
2	Tumor and Cancer Markers	MLT-402	75	25	100	75	25	100	200
3	Clinical Biochemistry-II	MLT-403	75	25	100	75	25	100	200
4.	Parasitology	MLT-404	75	25	100	75	25	100	200
Grand Total									800

### B.Sc. in Medical Laboratory Technology Fifth Semester University Examination

S. No.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Analytical Biochemistry	MLT-501	75	25	100	75	25	100	200
2	Systemic Bacteriology	MLT-502	75	25	100	75	25	100	200
3.	Quality Laboratory Management	MLT-503	75	25	100	75	25	100	200
4	Histopathology & Cytology Techniques (Elective)	MLT-504	75	25	100	75	25	100	200
	Applied Microbiology (Elective)	BMM-504							
									800

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## B.Sc. in Medical Laboratory Technology Sixth Semester University Examination

S. No	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1	Mycology	MLT-601	75	25	100	75	25	100	200
2	Automation	MLT-602	75	25	100	75	25	100	200
3	Coagulation Studies	MLT-603	75	25	100	75	25	100	200
4.	Virology	MLT-604	75	25	100	75	25	100	200
<b>Grand Total</b>									<b>800</b>

### INTERNAL ASSESSMENT

- It will be for theory and practical both.
- It will be done through the whole semester.
- Candidate must obtain at least 40% marks in theory and practicals separately in internal assessment to be eligible for the semester university examination.

- **Internal assessment (Theory)** will be done as follows:

- Mid-term/ class test etc. = 10 marks
  - Assignments/Project/Quiz/ Presentations etc. = 10 marks
  - Attendance = 05 marks
- Total = 25 marks**

- **Internal assessment (Practical)** will be done as follows:

- Laboratory Manual/Assignments/Class test etc. = 10 marks
  - Day to day performance/continuous evaluation/record etc = 10 marks
  - Attendance = 05 marks
- Total = 25 marks**

### CRITERIA FOR PASSING

- As per the University Norms.

### DIVISION:

- As per the University Norms.

### INTERNSHIP

- A candidate will have to undergo internship for a period of six calendar months in a medical college/hospital equipped with modern pathology laboratory facility or in a fully equipped pathology laboratory, which fulfills the norms decided by the University.

### DEGREE:

- The degree of B.Sc. in Medical Laboratory Technology (B.Sc.-MLT) course of the University shall be conferred on the candidates, who have pursued the prescribed course of study for not less than six semesters and have passed examinations as prescribed under the relevant scheme and completed 6 months of compulsory rotatory internship.

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## COURSE OF STUDY

### B.Sc. in Medical Laboratory Technology First Semester (First Year)

S.No.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	General Pathology	MLT-101	40	40	80	4
2	Fundamentals of Anatomy & Physiology-I	MLT-102	60	60	120	6
3	Basics of Biochemistry	MLT-103	60	60	120	6
4	General Microbiology	MLT-104	40	40	80	4
5.	Sample Collection Training*			80	80	4
				<b>Total</b>	<b>480</b>	<b>24</b>

\*Not included for university examination.

### B.Sc. in Medical Laboratory Technology Second Semester (First Year)

S.No.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	Hematology	MLT-201	60	60	120	6
2	Fundamentals of Anatomy & Physiology-II	MLT-202	60	60	120	6
3	Medical Biochemistry	MLT-203	40	40	80	4
4	Introduction to Patient safety	MLT-204	80	-	80	4
5	Sample collection training*			80	80	4
				<b>Total</b>	<b>480</b>	<b>24</b>

\*Not included for university examination.

### B.Sc. in Medical Laboratory Technology Third Semester (Second Year)

S.No.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	Blood Bank Procedures-I	MLT-301	40	40	80	4
2	Endocrinology	MLT-302	60	60	120	6
3	Clinical Biochemistry-I	MLT-303	40	40	80	4
4	Immunology & Serology	MLT-304	60	60	120	6
5	Clinical Training/ Seminar/ Presentations/Camps*			80	80	4
				<b>Total</b>	<b>480</b>	<b>24</b>

\*Not included for university examination.

### B.Sc. in Medical Laboratory Technology Fourth Semester (Second Year)

S.N o.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	Blood Bank Procedures-II	MLT-401	40	40	80	4
2	Tumor & Cancer Markers	MLT-402	60	60	120	6
3	Clinical Biochemistry-II	MLT-403	40	40	80	4
4	Parasitology	MLT-404	60	60	120	6
5	Clinical Training (in a medical college/100 bedded hospital with well-equipped pathology laboratory for at least one month)*			140	140	6
				<b>Total</b>	<b>540</b>	<b>26</b>

\*Not included for university examination.

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### B.Sc. in Medical Laboratory Technology Fifth Semester (Third Year)

S.No.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	Analytical Biochemistry	MLT-501	60	60	120	6
2	Systemic Bacteriology	MLT-502	40	40	80	4
3	Quality Laboratory Management	MLT-503	60	60	120	6
4.	Histopathology & Cytology Techniques (Elective)	MLT-504	40	40	80	4
	Applied Microbiology (Elective)	BMM-504				
5	<b>Clinical Training/ Seminar/ Presentations/Camps*</b>			80	80	4
				<b>Total</b>	<b>480</b>	<b>24</b>

\*Not included for university examination.

### B.Sc. in Medical Laboratory Technology Sixth Semester (Third Year)

S.No.	Subjects	Subject Code	Minimum Teaching hours			Credit Hours
			Theory	Practical	Total	
1	<b>Mycology</b>	MLT-601	60	60	120	6
2	<b>Automation</b>	MLT-602	60	60	120	6
3	<b>Coagulation Studies</b>	MLT-603	40	40	80	4
4	<b>Virology</b>	MLT-604	40	40	80	4
5	<b>Clinical Training</b> (in a medical college/100 bedded hospital with well-equipped pathology laboratory for at least one month)*			140	140	6
				<b>Total</b>	<b>540</b>	<b>26</b>

\*Not included for university examination.

#### INTERNSHIP

- There shall be six months of Internship after the final semester examination for candidates declared to have passed the examination in all the subjects.
- During the internship candidate shall have to work full time average 7 hours per day (each working day) for 6 Calendar months.
- Each candidate is allowed maximum of 6 holidays during entire Internship Program and in case of any exigencies during which the candidate remains absent for a period more than 6 days, he/she will have to work for the extra days during which the candidate has remained absent.
- The Internship should be rotatory and cover Haematology, Histology & Cytology, Biochemistry, Microbiology, Endocrinology & Automation sections of Pathology laboratory.
- Based on the attendance and work done during posting the Director/Principal/ head of institution/department shall issue '**Certificate of Satisfactory Completion**' of training following which the University shall award the B.Sc. in Medical Laboratory Technology Degree or declare the candidate eligible for the same.
- **No candidate shall be awarded degree without successfully completing six months' internship.**
- Institution, shall have to satisfy itself that satisfactory infrastructure facilities of Pathology Laboratory exist in the Institute / Hospital where the internship training has to be undertaken. Following parameters / guidelines have been suggested:
  - a. It is mandatory for the Institution to have its own well equipped and modern pathology laboratory.
  - b. Senior Pathologist should manage the pathology laboratory in the Institutes/Hospitals.
- Teaching Institute's Director / Principal/ Head can at his/her discretion may grant NOC to the students to do the Internship at the place of his/her choice provided the concerned Hospital/Pathology Laboratory fully satisfies the above criteria. For the purpose of granting NOC the candidate shall have to submit to the Institution the status of Pathology Laboratory services available at the place where he/she intends to do his Internship.

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# **B.Sc. in Medical Laboratory Technology- First Semester**

## **GENERAL PATHOLOGY**

**Subject Code: MLT-101**

**Min. Hrs - Theory: 40 Hrs. & Practical: 40 Hrs.**

### **Course Outcomes:**

- To provide general insight into the history and basics of General Pathology.
- To Impart knowledge about general outline of pathology.
- To provide brief knowledge about basic procedure done in pathology laboratory.

### **THEORY**

#### **1. Cell Injury and Cellular Adaptations.**

- a) Normal Cell
- b) Cell Injury- types of cell injury, etiology of cell injury, morphology of cell injury, cellular swelling.
- c) Cell death: types- autolysis, necrosis, apoptosis & gangrene.
- d) Cellular adaptations-atrophy, hypertrophy, hyperplasia & dysplasia.

#### **2. Inflammation**

- a) Acute inflammation - vascular event, cellular event, inflammatory cells.
- b) Chronic Inflammation - general features, granulomatous inflammation, tuberculoma.

#### **3. Hemodynamic Disorders:**

Edema, hyperemia, congestion, hemorrhage, circulatory disturbances, thrombosis, ischemia & infarction.

#### **4. Neoplasia:**

Definition, how does it differ from hyperplasia, Feature of Benign Tumor and Malignant Tumor  
difference between benign tumor and malignant tumor.

#### **5. Healing**

Definition, different phases of healing, factors influencing wound healing.

### **PRACTICAL**

1. Components & setting of the Compound microscope.
2. Focusing of object.
3. Use of low & high power objectives of microscope.
4. Use of oil immersion lens.
5. Care and Maintenance of the microscope.
6. Different types microscopy
  - Dark field microscopy
  - Fluorescence Microscopy
7. Electron Microscopy in brief.

### **Text Books**

1. Robbins and Cortran, (2020), Pathologic Basis of Disease, First Vol., 10th Ed., South Asia.
2. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
3. Harsh Mohan, (2018), Harshmohan Text Book of Pathology, 8<sup>th</sup> Ed., J.P. Brothers.
4. Kumar, V., Abbas, A. K., & Aster, J. C. (2017). Robbins Basic Pathology (10th ed.). Elsevier - Health Sciences Division.

### **Reference Books**

1. S. Kim. Suvarna, Christopher, Lyton and John D. Bancroft, (2019), Bancroft's Theory and Practice of Histological Techniques, 8<sup>th</sup> Ed., Elsevier.
2. CFA Culling, (2013), Handbook of Histopathological and Histochemical Techniques, 3<sup>rd</sup> Ed., Elsevier.
3. Campbell James Todd, (2016), Tood-Sandford-Davidsohn Clinical Diagnosis and Management by Laboratory Methods, 16<sup>th</sup> Ed., Saunders.

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# B.Sc. in Medical Laboratory Technology- First Semester

## FUNDAMENTALS OF ANATOMY & PHYSIOLOGY-I

Subject Code: MLT-102

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- Students will be able to learn the terminology of the subject.
- To Provide basic knowledge of cells, tissues, blood and to understand anatomy and physiology of human body.
- This subject will develop an understanding of the structure and function of organs and organ systems in normal human body.

### THEORY

#### Anatomy

##### 1. General Anatomy

- Introduction & Subdivisions of Anatomy
- Anatomical Nomenclature planes, Positions, Body Parts & Movements.
- Cell - structure & function
- Tissue
  - Epithelium
  - Connective
  - Sclerous
  - Muscular
  - Nervous
- Lymphatic System

#### Physiology

##### 1. Cell : Structure & function

##### 2. Blood

- Blood cells
- Haemoglobin
- Blood groups
- Coagulation Factors
- Anaemia & Immunoglobulins

##### 3. Cardiovascular system

Heart rate, cardiac cycle, cardiac output, blood pressure, hypertension, radial pulse

##### 4. Respiratory System

- Ventilation
- Functions
- Lungs Volumes and capacities

##### 5. Gastrointestinal System

Process of digestion in various parts

### PRACTICAL

#### Anatomy

- Identification and description of all anatomical structures.
- The learning of Anatomy by demonstration only through dissected parts, slides, models, charts etc.

#### Physiology

- Measurement of pulse, blood pressure.
- Elicitation of Reflexes & jerks.
- Identification of blood cells by study of peripheral blood smear.

#### Text Books

- Rizzo, Donald C. (2015). *Fundamentals of Anatomy and Physiology*. 4th ed. Florence, AL: Cengage Learning.
- B.D. Chaurasiya (2022). *Human Anatomy*, 9<sup>th</sup> Ed., CBS Publication.

#### Reference Books

- Gray, Henry. (2013). *Grays Anatomy*. London, England: Arcturus Publishing.
- Hall, J. E. (2015). *Guyton and hall textbook of medical physiology* (13th ed.). W B Saunders.
- Moore, K. L., Dalley, A. F., & Agur, A. (2017). *Clinically oriented anatomy* (8th ed.). Lippincott Williams and Wilkins.

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# B.Sc. in Medical Laboratory Technology- First Semester

## BASICS OF BIOCHEMISTRY

Subject Code: MLT-103

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To provide general insight and basic knowledge of basics of biochemistry.
- The students will be given the basic of knowledge of chemistry and metabolism of various metabolites.

### THEORY

#### 1. Chemistry of carbohydrates & their related metabolism -

Introduction, definition, classification, biomedical importance & properties.

Brief outline of metabolism:

Glycogenesis & glycogenolysis (in brief), Glycolysis, citric acid cycle & its significance, HMP shunt & Gluconeogenesis (in brief), regulation of blood glucose level.

#### 2. Amino acids - Definition, classification, essential & non-essential amino acids.

#### 3. Chemistry of Proteins & their related metabolism -

Introduction, definition, classification, biomedical importance.

Metabolism:

Transformation, Decarboxylation, Ammonia formation & transport, Urea cycle, metabolic disorders in urea cycle, catabolism of amino acids especially Phenylalanine, Tyrosine & Tryptophan, Creatine, Creatinine, Proteinuria.

### PRACTICAL

#### 1- Introduction

Aim, basis, interpretation, safety in clinical biochemistry Laboratory

#### 2- Laboratory organization

Instruments, glassware, sample collection & specimen labeling, routine tests, anticoagulants, reagents, cleaning of glassware, isotonic solution, standardization of methods, preparation of solution & interpretation of result, normal values.

#### 3- Uses, Care, Principle and Maintenance of various instruments of the laboratory.

#### 4- Identification of Carbohydrates (qualitative tests).

#### 5- Identification of Proteins (qualitative test).

### Text Books

1. V.N. Raje (2018). Biochemistry and Clinical Pathology, 3<sup>rd</sup> Ed., CBS Publication.
2. Dr. S.K. Gupta (2019). Text book of Medical Biochemistry, 2<sup>nd</sup> Ed., APC Publisher.
3. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
4. DM Vasudevan (2023). Text Book of Biochemistry for Medical Students, 10<sup>th</sup> Ed., Jaypee Publisher.
5. M.N. Chatterjea and Rana Shinde (2018). Textbook of Medical Biochemistry, 8<sup>th</sup> Ed., Jaypee Publisher.

### Reference Books

1. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry*, 7th ed., W.H. Freeman.
2. Voet, D., Voet, J. G., & Pratt, C. W. (2016). *Fundamentals of biochemistry*, (5th ed.). John Wiley & Sons.

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# B.Sc. in Medical Laboratory Technology- First Semester

## GENERAL MICROBIOLOGY

Subject Code: MLT-104

Min. Hrs - Theory: 40 Hrs. & Practical: 40 Hrs.

### Course Outcomes:

- To provide knowledge of various microorganisms and their role in human life and the role of Sterilization and disinfection processes.

### THEORY

- General characters and classification of Bacteria.**
- Characteristics of Bacteria**  
**Morphology-** Shape, Capsule, Flagella, Inclusion, Granule, Spore.
- Growth and Maintenance of Microbes**  
Bacterial division, Batch Culture, Continuous culture, bacterial growth- total count, viable count, bacterial nutrition, oxygen requirement, CO<sub>2</sub> requirement, temperature, pH, light.
- Sterilization and Disinfection.**  
Physical agents- Sunlight, Temperature less than 100°C, Temperature at 100°C, steam at atmospheric pressure and steam under pressure, irradiation, filtration.  
Chemical Agents- Alcohol, aldehyde, Dyes, Halogens, Phenols, Ethylene oxide.
- Culture Media**  
Definition, uses, basic requirements, classification, Agar, Peptone, Transport Media, Sugar Media, Anaerobic Media, Containers of Media, Forms of Media
- Staining Methods**  
Simple, Grams staining, Ziehl-Neelsen staining or AFB staining, Negative Impregnation
- Collection and Transportation of Specimen**  
General Principles, Containers, Rejection, Samples- Urine, Faeces, Sputum, Pus, Body fluids, Swab, Blood.
- Care and Handling of Laboratory Animals**  
Fluid, Diet, Cleanliness, Cages, ventilation, Temperature, Humidity, handling of Animals, Prevention of disease.
- Disposal of Laboratory/Hospital Waste**  
Non-infectious waste, Infected sharp waste disposal, infected non-sharp waste disposal.

### PRACTICAL

- Preparation of swabs/sterile tubes & bottles.
- Preparation of smear.
- Staining.: Gram & Ziehl -Neelsen staining.
- Identification of Culture media.
- Identification of instruments.
- Identification of common microbes.

### Text Books

- Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
- Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
- Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of diagnostic microbiology (5th ed.). Saunders.
- D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.

### References Books

- Stefan (2020), Jawetz Melnick Adelbergs Medical Microbiology, 28<sup>th</sup> Ed., MacGraw Hill.
- Robbins and Cortran, (2020), Pathologic Basis of Disease, First Vol., 10th Ed., South Asia.
- Sastry Apurba S, (2021), Essentials of Medical Microbiology, 3<sup>rd</sup> Ed., Jay Pee Publishers.

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## **B.Sc. in Medical Laboratory Technology- First Semester**

### **SAMPLE COLLECTION TRAINING**

**Practical: 80 Hrs.**

The students will get training of Specimen collection in any Pathology lab/ OPD/ Hospital.

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# B.Sc. in Medical Laboratory Technology- Second Semester

## HEMATOLOGY

**Subject Code: MLT-201**

**Min. Hrs. - Theory :60 Hrs. & Practical: 60 Hrs.**

### Course Outcomes:

- To prepare the students for understanding of composition of blood.
- Students will learn basic haematological techniques. Students must be able to collect, preserve and process blood samples.
- Students will be able to perform routine investigations in clinical hematology laboratories.

### **THEORY**

1. Haematopoiesis
2. **Structure of RBC & WBC:** Structure of RBC & WBC variation in size and shape Leukocyte classification Romanowsky's stains.
3. **Basic Haematological Techniques:** Characteristics of good technician, Preparation of specimen collection material, Lab request form, Specimen rejection criteria for blood specimen, Hemolysis of blood.
4. **Basic steps for drawing a blood specimen by venepuncture,** Complications of venepuncture., Patient after care, Arterial Puncture, Collection by skin puncture (Capillary Blood).
5. **Blood Samples Processing:** Separation of serum, Separation of plasma, Changes in blood on keeping, Maintenance of specimen identification, Transport of the specimen., Effect of storage on Blood Cell Morphology
6. **Universal Precautions:** Principle, Modes of Specific Protection, Needle stick Injury.
7. **Haematological Disorders**
  - a) Classification of Anemia: Definition & Classification (Morphological and etiological), Pathogenesis
  - b) Iron Deficiency Anemia: Distribution of body Iron, Iron Absorption, causes of iron deficiency, lab findings.
  - c) Megaloblastic Anemia: Causes, Lab findings.
  - d) Haemolytic Anemia: Definition, causes, classification & lab findings.
  - e) Sickle cell Anemia: Sickle cell trait, Pathogenesis Clinical Features, laboratory investigations
8. **Bone Marrow:** Cell composition of normal adult Bone marrow, Aspiration, Indication, Preparation & Staining, Special Stain for Bone Marrow -Periodic Acid Schiff, Sudan Black, Myeloperoxidase.
9. **Leukaemia:** Classification, Blood picture, Differentiation of Blast cells.
10. Principle of Flow Cytometry.

### **PRACTICAL**

- |  |  |
|--|--|
| 1. Basic requirements for hematology laboratory. | 13. Determination of PCV by Wintrob's.   |
| 2. Glass wares for Hematology.                   | 14. Erythrocyte Indices- MCV, MCH, MCHC. |
| 3. Equipments for Hematology.                    | 15. Reticulocyte Count.                  |
| 4. Anticoagulant vial preparation.               | 16. Absolute Eosinophil Count.           |
| 5. Complete Blood Counts.                        | 17. Morphology of Red Blood Cells.       |
| 6. Determination of Hemoglobin.                  |  |
| 7. RBC Count by Hemocytometers.                  |  |
| 8. TLC by Hemocytometer.                         |  |
| 9. Differential Leukocyte count.                 |  |
| 10. Determination of Platelet Count.             |  |
| 11. Determination of ESR by Wintrob's.           |  |
| 12. Determination of ESR by Westergren's method. |  |

### Text Books

1. Harsh Mohan, (2018), Harshmohan Text Book of Pathology, 8<sup>th</sup> Ed., J.P. Brothers.
2. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
3. Ghai's (2022). Ghai's Text Book of Practical Physiology, 10<sup>th</sup> Ed., J.P. Brothers.

### References Books

1. Robbins and Cotran, (2020), Pathologic Basis of Disease, First Vol., 10th Ed., South Asia.
2. Ronald Hoffman and Edward J. Benz Jr. (2018). Hematology Basic Principles and Practices, 6<sup>th</sup> Ed., Elsevier.
3. Jacqueline H., Carr Bernadette, F Radak (2013). Clinical Hematology Atlas, 3<sup>rd</sup> Ed., Saunders.

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# B.Sc. in Medical Laboratory Technology- Second Semester

## FUNDAMENTALS OF ANATOMY & PHYSIOLOGY-II

Subject Code: MLT-202

Min. Hrs. - Theory :60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To provide knowledge about terminology and comprehensive knowledge of Human Anatomy & Physiology.

### THEORY

#### Anatomy

##### 1. Systemic

Basic Features of:

- Cardiovascular system
- Respiratory system
- Digestive system
- Excretory system
- Genital (Male & Female) system
- Nervous system

#### Physiology

##### 1. Endocrinology

- List of Endocrine Glands
- Hormones: Their secretion and functions (in brief)

##### 2. Excretion system

- Structure of nephron
- Urine formation

##### 3. Central Nervous System

- Parts
- Sliding Filament Theory
- Neuro Muscular Junction
- Wallerian Degeneration
- Motor Nervous system
  - Upper motor neuron system
  - Lower motor neuron system

##### f) Sensory nervous system

- Sympathetic Nervous system
- Parasympathetic nervous system

##### 4. Skin - Function & Structure

##### 5. Muscular System

Classification of muscles & their functions

##### 6. Special Senses - Eye & ear (in brief)

7. Reproductive System – Structure & Function of male & female reproductive organs, menstruation, puberty, menopause, fertilization & Development of fertilized ovum, placenta & its function.

### PRACTICAL

#### Anatomy

- Demonstration of skeleton - articulated and disarticulated.
- Demonstration of dissected parts (upper extremity, lower extremity, thoracic & abdominal viscera, face and brain).

#### Physiology

- Measurement of pulse, blood pressure.
- Elicitation of Reflexes & jerks.
- Identification of blood cells by study of peripheral blood smear.

#### Text Books

- B.D. Chaurasiya (2022). Human Anatomy, 9<sup>th</sup> Ed., CBS Publication.
- Rizzo, Donald C. (2015). *Fundamentals of Anatomy and Physiology*. 4th ed. Florence, AL: Cengage Learning.
- Ghai's (2022). Ghai's Text Book of Practical Physiology, 10<sup>th</sup> Ed., J.P. Brothers.

#### Reference Books

- Gray, Henry. (2013). *Grays Anatomy*. London, England: Arcturus Publishing.
- Hall, J. E. (2015). *Guyton and hall textbook of medical physiology* (13th ed.). W B Saunders.
- Moore, K. L., Dalley, A. F., & Agur, A. (2017). *Clinically oriented anatomy* (8th ed.). Lippincott Williams and Wilkins.

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# B.Sc. in Medical Laboratory Technology- Second Semester

## MEDICAL BIOCHEMISTRY

**Subject Code: MLT-203**

**Min. Hrs. - Theory :40 Hrs. & Practical: 40 Hrs.**

### Course Outcomes:

- To train students in both theoretical and practical in the field of medical biochemistry.

### THEORY

#### 1. **Chemistry of Lipids & their related metabolism -**

Introduction, definition, classification, biomedical importance, essential fatty acids.

Brief out line of metabolism:

Beta oxidation of fatty acids, fatty liver, Ketosis, Cholesterol & it's clinical significance, Lipoproteins in the blood composition & their functions in brief, Atherosclerosis.

#### 2. **Enzymes -**

Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes - Creatinine kinase, Alkaline phosphatase, Acid phosphatase, LDH, SGOT, SGPT, Amylase, Lipase, Carbonic anhydrase etc.

#### 3. **Acid base balance concepts & disorders -** pH, Buffers, Acidosis, Alkalosis

#### 4. **Hyperglycemia & hypoglycemia -**

Diabetes mellitus - definition, types, features, gestation diabetes mellitus, glucose tolerance test, Glycosylated hemoglobin, glycosurias, Hypoglycemia & its causes

### PRACTICAL

- 1- To study general properties of the enzyme (Urease) & Achromatic time of Salivary amylase.
- 2- Urine analysis – normal & abnormal constituents of urine.
- 3- CSF & Semen Analysis - Gross & Microscopic.
- 4- Centrifugation: Principle, types & applications.
- 5- Chromatography: Definition, types, RF value, description of paper chromatography & applications.

### Text Books

1. DM Vasudevan (2023). Text Book of Biochemistry for Medical Students, 10<sup>th</sup> Ed., Jaypee Publisher.
2. Dinesh Puri (2010). Textbook of Medical Biochemistry, 2<sup>nd</sup> Ed., Elsevier.
3. V.N. Raje (2018). Biochemistry and Clinical Pathology, 3<sup>rd</sup> Ed., CBS Publication.
4. Dr. S.K. Gupta (2019). Text book of Medical Biochemistry, 2<sup>nd</sup> Ed., APC Publisher.
5. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
6. M.N. Chatterjea and Rana Shinde (2018). Textbook of Medical Biochemistry, 8<sup>th</sup> Ed., Jaypee Publisher.

### Reference Books

1. Voet, D., Voet, J. G., & Pratt, C. W. (2016). Fundamentals of biochemistry, (5th ed.). John Wiley & Sons.
2. Nelson, D. L., & Cox, M. M. (2017). *Lehninger principles of biochemistry*, 7th ed., W.H. Freeman.

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# B.Sc. in Medical Laboratory Technology- Second Semester

## INTRODUCTION TO PATIENT SAFETY

Subject Code: MLT-204

Min. Hrs. - Theory: 80 Hrs.

### Course Outcomes:

- To provide knowledge to students to understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system.
- To sensitize students in basic emergency care, Infection prevention & control with knowledge of Bio-medical waste management.

### THEORY

#### 1. Quality assurance and management -

- a. Concepts of Quality of Care
- b. Quality Improvement Approaches
- c. Standards and Norms
- d. Quality Improvement Tools
- e. Introduction to NABH guidelines in brief.

**2. Bio medical waste management and environment safety-** The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:

- a. Definition of Biomedical Waste
- b. Waste minimization
- c. BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
- d. Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
- e. BMW Management & methods of disinfection
- f. Modern technology for handling BMW
- g. Use of Personal protective equipment (PPE) and Monitoring & controlling of cross infection (Protective devices)

**3. Infection prevention and control -** The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –

- a. Evidence-based infection control principles and practices such as sterilization, disinfection
- b. Hospital acquired infections – Factors influencing infection, susceptible patients, Hospital Environment, Therapeutic Procedures, Drug Resistance, Transfusion, Advances in medical progress, sources of infection-exogenous/endogenous.
- c. Microorganism-Modes of transmission, Hospital infections and causative organisms.
- d. Urinary Tract Infection, Respiratory infection, Wound and Skin sepsis, Bacterimia, septicaemia.
- e. Diagnosis and control.
- f. Prevention
- g. Infection Control Policy

#### 4. Antibiotic Resistance-

- a. History of Antibiotics
- b. Mechanism of action of antibiotics- interference with cell wall synthesis, action on cytoplasmic membrane, inhibiting protein synthesis, inhibitors of transcription, inhibitors of translation, inhibiting DNA function, metabolic antagonist.
- c. Anti-microbial drugs – Penicillin, Cephalosporin, Aminoglycosides, Tetracycline, Macrolides, Clindamycin, Lincomycin, Vancomycin, Quinolones, Sulphonamides.
- d. Antitubercular drugs, metronidazole
- e. Antibiotic resistance
- f. Mechanism- permeability, production of enzymes, structural target, altered metabolic pathway.
- g. Genetic basis of resistance-chromosomal and extra chromosomal.

**5. Disaster preparedness and management-** The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-

- a. Fundamentals of emergency management,
- b. Psychological impact management,
- c. Resource management,
- d. Preparedness and risk reduction,

### Text Books

1. Liam Donaldson, Walter Ricciardi (2021). Textbook of Patient Safety and Clinical Risk Management, Springer.
2. Gridhar J Gyani, Alexander Thomas (2017). Handbook of Healthcare Quality & Patient Safety, Jaypee Brothers.

### Reference Books

1. Ronda G Hughes, PhD, MHS, RN. (2008). Patient Safety and Quality, 8th Ed., Agency for Healthcare Research and Quality (US).
2. Stefan (2020), Jawetz Melnick Adelbergs Medical Microbiology, 28<sup>th</sup> Ed., MacGraw Hill.
3. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of diagnostic microbiology (5th ed.). Saunders.
4. Avedis Donabedian (2003). An Introduction to Quality Assurance in Health Care, 1<sup>st</sup> Ed.

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## **B.Sc. in Medical Laboratory Technology- Second Semester**

### **SAMPLE COLLECTION TRAINING**

**Practical: 80 Hrs.**

The students will get training of Specimen collection in any Pathology lab/ OPD/ Hospital.

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# B.Sc. in Medical Laboratory Technology-Third Semester

## BLOOD BANK PROCEDURES-I

Subject Code: MLT-301

Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.

### Course Outcomes:

- The subject will provide detailed knowledge about Blood Bank Procedure.
- The students will be able to perform all procedures of blood banking.
- The students will be able to maintain blood bank records & issue blood.

### THEORY

#### 1. Blood Grouping

- Introduction
- Human Blood Group system
- ABO Subgroups
- Red Cell Antigen
- Natural Antibodies
- Rh System
- Rh Antigens & Rh Antibodies
- Hemolytic Disease of Newborn & Prevention
- Principal of Blood grouping, antigen-antibody reaction.
- Agglutination, Hemagglutination, Condition required for antigen antibody reaction.
- Blood grouping techniques, Cell grouping, Serum grouping.
- Methods for ABO grouping. Slide & Tube Method, Cell grouping, Serum grouping, Rh grouping by slide & tube method.
- Difficulties in ABO grouping.
- Rouleaux formation, how it interfere with Blood grouping.
- Auto agglutinins.
- Antiserum used in ABO test procedures, Anti –A, Anti-B Anti- AB Antiserum.
- Inheritance of the Blood groups.
- Control, A&B Cells preparation, Auto control.
- Medical applications of Blood groups.

#### 2. Blood Collection

- Blood collection packs.
- Anticoagulants.
- Taking & giving sets in Blood transfusion.
- Techniques of collecting blood from a doctor.
- Instructions given to the donor after blood donation.
- Adverse donor reaction.

#### 3. Blood Donation

- Introduction
- Blood donor requirements
- Criteria for selection & rejection
- Medical history & personal details
- Self-exclusion.
- Health checks before donating blood.
- Screening for TTI.

#### 4. Testing Donor Blood

- Screening donor's blood for infectious agents - HIV, HCV, HBV, Treponema palladium, Plasmodium, HTLV.
- Bacterially contaminated Blood.

#### 5. Blood Donor Records

- Blood donation record book.
- Recording results.
- Blood donor card.

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## 6. Storage & Transport

- Storage of blood.
- Changes in blood after storage.
- Gas refrigerator.
- Lay out of a blood bank refrigerator
- Transportation.

### PRACTICAL

- Blood grouping & Cross Matching
- Coomb's Test – Direct and Indirect

### Text Books

1. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications.
2. Sood Ramnik, (2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications.

### Reference Books

1. G.P. Saluja & G.L. Singar (2014). Standard Operating Procedures & Regulatory Guidelines, 1<sup>st</sup> Ed., Jaypee Publications.
2. Ochei J & Kolhatkar A (2000), Medical Laboratory Science: Theory & Practice, 3rd edition, McGraw Hill Education.
3. Mukherjee .L.K(2017), Medical Laboratory Technology, Vol.1-3,3rd edition, Tata McGraw Hill
4. Wintrobe's Clinical Hematology,(2014),13th edition, Lippincott Williams & Wilkins

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# B.Sc. in Medical Laboratory Technology-Third Semester

## ENDOCRINOLOGY

Subject Code: MLT-302

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To provide knowledge about hormones.

### THEORY

1. Introduction
2. Difference between hormones and enzymes.
3. Classification of hormones.
4. Regulation and general mechanism of action of hormones.
5. Pituitary gland & hypothalamus
6. Hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Leuteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotrophic hormone (ACTH)
7. Hormones of neurohypophysis- Oxytocin, Antidiuretic hormone (ADH)
8. Hormones of the Thyroid gland- chemistry and normal physiology, Thyroid disorders-goiter, myxedema, autoimmune thyroiditis, tumors of the thyroid gland, hyperthyroidism, Graves' disease, Calcitonin, Parathyroid Hormone (PTH)
9. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addison's disease, Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
10. Adrenal medulla-metabolism of catecholamines
11. Hormones of the gonads -  
Testosterone, Estrogens, Progesterone, their synthesis and functions.  
Human Chorionic Gonadotropin (HCG), hormone, menstrual cycle, Menopause
12. Hormone of pancreas - Insulin- its metabolic effects on carbohydrates, fats & protein, control of insulin secretion, Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin.
13. Hormone of kidney - Renin

### PRACTICALS

1. Estimation of T3
2. Estimation of T4
3. Estimation of TSH
4. Estimation of FSH
5. Estimation of LH
6. Estimation of hCG
7. Estimation of Cortisol
8. Estimation of Progesterone
9. Estimation of Testosterone
10. Others

### Text Books

1. D M Vasudevan, (2011), Text book of Medical Biochemistry, 6th edition Jaypee Publishers
2. M N Chatterjea & Rana Shinde, (2012), Text book of Medical Biochemistry, 8th edition, Jaypee Publications

### Reference Books

1. Singh & Sahni, (2008), Introductory Practical Biochemistry, 2nd edition, Alpha science
2. Lehninger, (2013), Principles of Biochemistry, 6th edition, W H Freeman
3. Teitz, (2007), Fundamentals of Clinical Chemistry, 6th edition, Elsevier Publications
4. Bishop (2013), Clinical Chemistry, 7th edition, Wiley Publications

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# **B.Sc. in Medical Laboratory Technology-Third Semester**

## **CLINICAL BIOCHEMISTRY-I**

**Subject Code: MLT-303**

**Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.**

### **Course Outcomes:**

- To identify the indications for basic procedures and perform them in appropriate manner.
- Subject will provide complete procedural knowledge used in Clinical Biochemistry.

### **THEORY**

- 1- Photometry-  
Definition, laws of photometry, absorbance, transmittance, absorption maxima, instruments, parts of photometer, types of photometry—colorimetry, spectrophotometry, flame photometry, fluorometry, choice of appropriate filter, measurements of solution, calculation of formula, applications.
- 2- Water & Mineral Metabolism-  
Distribution of fluids in the body, ECF & ICF, water metabolism, dehydration, mineral metabolism, macronutrients (principal mineral elements) & trace elements.
- 3- Liver Functions & their Assessment-  
Based on: 1- Carbohydrate metabolism 2-Protein metabolism 3- Lipid metabolism 4-Measurements of serum enzyme levels 4-Bile pigment metabolism, Jaundice, its types and their biochemical findings.
- 4- Renal Function Tests-  
Various Tests, GFR & Clearance
- 5- Immunodiffusion Techniques, Radioimmunoassay & ELISA-  
Principles & Applications.
- 6- Electrophoresis -  
Principle, Types & Applications.

### **PRACTICAL**

**(By Colorimeter / Spectrophotometer)**

1. Blood urea estimation
2. Serum creatinine estimation
3. Serum uric acid estimation
4. Serum total protein estimation
5. Serum albumin estimation
6. Serum globulin estimation
7. Serum Bilirubin total estimation
8. Serum Bilirubin direct estimation
9. Serum GOT (AST) estimation
10. Serum GPT (ALT) estimation
11. Alkaline phosphatase estimation
12. Acid phosphatase estimation

### **Text Books**

1. D M Vasudevan, (2011), Text book of Medical Biochemistry, 6th edition Jaypee Publishers
2. M N Chatterjea & Rana Shinde, (2012), Text book of Medical Biochemistry, 8th edition, Jaypee Publications

### **Reference Books**

1. Singh & Sahni, (2008), Introductory Practical Biochemistry, 2nd edition, Alpha science
2. Lehninger, (2013), Principles of Biochemistry, 6th edition, W H Freeman
3. U Satyanarayan, (2008), Essentials of Biochemistry, 2nd edition, Standard Publishers

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# B.Sc. in Medical Laboratory Technology-Third Semester

## IMMUNOLOGY & SEROLOGY

Subject Code: MLT-304

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To provide knowledge about Immune reactions, response etc.

### THEORY

1. Immunity
  - Definition and classification
  - General Principles of Innate & Acquired Immunity.
2. Immune Response
  - Humoral immunity & cell mediated immunity.
3. Antigen
  - Definition, classes, properties.
4. Antibodies/Immunoglobulins - Definition, Properties, Sub types of Immunoglobulins
5. Antigen/Ab Reaction/Serological Refractions.
6. Features of antigen/antibody Reaction-
  - Precipitation
  - Agglutination
  - Complement fixation test
  - Neutralization
  - Opsonization
  - Immune adherence
  - Immuno fluorescence
  - Immuno electron microscopic test
7. Structure and functions of Immune System
  - Parts of Immune system
  - T/B cells, other cells & their functions
8. Hyper sensitivity Reactions
  - General Principles of different types of hypersensitive reactions i.e., type 1, 2, 3, 4.
  - Auto immune disorders
9. ELISA
10. Vaccination
  - Schedule & Vaccines

### PRACTICAL

- WIDAL Test
- VDRL Test
- RA Test
- CRP Test

### Text Books

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
3. D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.

### Reference Books

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Sastry Apurba S, (2021), Essentials of Medical Microbiology, 3<sup>rd</sup> Ed., Jay Pee Publishers.

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## **B.Sc. in Medical Laboratory Technology- Third Semester**

### **CLINICAL TRAINING/ SEMINAR/ PRESENTATIONS/ CAMPS**

**Practical: 80 Hrs.**

The students will get training any Hospital/ Well equipped Pathology or in medical checkup camps.

They will do presentations and participate in Seminars related to their subjects.

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# B.Sc. in Medical Laboratory Technology- Fourth Semester

## BLOOD BANK PROCEDURE-II

Subject Code: MLT-401

Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.

### Course Outcomes:

- The subject will provide detailed knowledge about Blood Bank Procedures.
- The students will be able to perform all procedures of blood banking.
- The students will be able to maintain blood bank records & issue blood.

### THEORY

#### 1. Maintenance of Blood Bank Records

- Blood bank temperature sheet.
- Blood bank stock sheet.
- Blood transfusion request form.

#### 2. Compatibility Testing

- Purpose
- Single tube compatibility techniques using AHG reagent.
- Emergency compatibility testing.
- Difficulties in cross matching.
- Labeling & Issuing cross- matched blood.

#### 3. Blood Components

- Collection of blood components for fractional transfusion.
- Platelets packed Red Cell, Platelet rich Plasma, Platelets concentrate.
- Preparation of concentrated (packed) Red cells.
- Techniques of preparation.

#### 4. Blood Transfusion

- Principal & Practice of blood Transfusion.
- Blood Transfusion service at District level.
- Guide lines for the use of Blood, Appropriate use of Blood, Quality Assurance.
- Antilogous Blood Transfusion practices.
- Objectives of Quality Assurance in Blood Transfusion services, Standard operating procedures for usage, donation & storage of blood, screening of donor, compatibility testing, safety, procurement of supplies.

#### 5. Blood Transfusion Reactions

- Investigation of a Transfusion reaction.
- Hemolytic transfusion reaction.
- Actions to take when transfusion reaction occurs.

### PRACTICAL

- Blood grouping & Cross Matching
- Visit to Blood Bank
- Training of blood collection in blood donation camps

### Text Books

1. Godkar.B. Praful,(2016) Textbook of MLT,3rd edition,Bhalani Publications
2. Singh Tejinder,(2014),Atlas & Textbook of Haematology,3rd edition,Avichal Publications
3. Sood Ramnik,(2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications

### Reference Books:

1. Ochei J & Kolhatkar A(2000),Medical Laboratory Science: Theory & Practice, 3rd edition, Mcgraw Hill Education.
2. G.P. Saluja & G.L. Singar (2014). Standard Operating Procedures & Regulatory Guidelines, 1<sup>st</sup> Ed., Jaypee Publications.
3. Mukherjee .L.K(2017), Medical Laboratory Technology,Vol.1-3,3rd edition, Tata Mcgraw Hill

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# B.Sc. in Medical Laboratory Technology- Fourth Semester

## TUMOR AND CANCER MARKERS

**Subject Code: MLT-402**

**Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.**

### Course Outcomes:

To provide knowledge about tumor markers and their assessment.

### THEORY

1. Introduction.
2. The Carcinogens-definition.
3. Oncogene-definition-  
Mechanism of action of Oncogenes (outline).
4. Characteristics of growing tumor cells-general and morphological changes, biochemical changes.
5. Tumor Markers-  
Introduction and definition
6. Clinical applications of tumor markers.
7. Enzymes as tumor markers, Alkaline Phosphatase (ALP), Creatine kinase (CK), Lactate dehydrogenase (LDH), Prostatic acid phosphatase (PAP), Prostate specific antigens (PSA).
8. Hormones as tumor markers (introduction of each type in brief).
9. Oncofetal antigens.
10. Alpha feto protein (AFP)
11. Carcino embryonic antigen (CEA)
12. Squamous cell carcinoma (SCC) antigen.
13. Carbohydrate markers (brief introduction of each type)  
CA 15-3, CA 125
14. Blood group antigen (brief introduction of each type)  
CA 19-9, CA 50, CA 72-4, CA 242
15. Bladder cancer markers (introduction in brief) -  
Bladder tumor antigen (BTA)
16. Fibrin- Fibrinogen degradation product (FDP).
17. Nuclear matrix protein (NMP22).
18. Biomarkers still in research (introduction in brief)-  
Telomeres, TRAP assay, hyaluronic acid and Hyaluronidase

### PRACTICAL

1. Estimation of Alpha feto proteins (AFP)
2. Estimation of Carcino embryonic antigen (CEA)
3. Estimation of CA- 125
4. Estimation of Prostate specific antigen (PSA)
5. Others

### **Other Elisa Tests**

1. Test for HIV
2. Test for Hepatitis B (HBsAg)
3. Test for Hepatitis (HCV)
4. Malaria antigen
5. Others

### Text Books

1. Sood Ramnik, (2015), Text book of Medical Laboratory Technology, 2nd edition, Jaypee Publications.
2. Godkar. B. Praful, (2016) Textbook of MLT, 3rd edition, Bhalani Publications

### Reference Books

1. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
2. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology. 11th edition Wiley-Blackwell Scientific Publication, Oxford.
3. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.
4. Murphy K, Travers P, Walport M. (2008). Janeway's Immunobiology. 7th edition Garland Science Publishers, New York.
5. Peakman M, and Vergani D. (2009). Basic and Clinical Immunology. 2nd edition Churchill Livingstone Publishers, Edinburgh.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

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# **B.Sc. in Medical Laboratory Technology- Fourth Semester**

## **CLINICAL BIOCHEMISTRY-II**

**Subject Code: MLT-403**

**Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.**

### **Course Outcomes:**

- Pertains knowledge regarding how to analyze various clinical samples for estimation of clinical biochemistry.
- To provide knowledge about advance instrumentation and procedural knowledge of clinical biochemistry.

### **THEORY**

- 1- Polymerase Chain Reaction -  
Principle & Applications
- 2- Autoanalyzer -  
Principle & Applications
- 3- Vitamins-  
Fat & water soluble vitamins, sources, requirement, deficiency disorders & biochemical functions.
- 4- Cardiac Profile -  
In brief Hypertension, Angina, Myocardial Infarction, Pattern of Cardiac Enzymes in heart diseases
- 5- Different methods of Glucose Estimation-  
Principle advantage and disadvantage of different methods
- 6- Different methods of Cholesterol Estimation-  
Principle, advantage and disadvantage of different methods.

### **PRACTICAL**

**(By Colorimeter / Spectrophotometer)**

1. Blood Glucose Estimation
2. Serum amylase estimation
3. Total cholesterol estimation
4. HDL cholesterol (direct) estimation.
5. LDL cholesterol (direct) estimation
6. Triglyceride estimation
7. Serum sodium estimation
8. Serum potassium estimation
9. Serum chloride estimation
10. CK-NAC estimation
11. Other Tests

### **Text Books**

1. D M Vasudevan, (2011), Text book of Medical Biochemistry, 6th edition Jaypee Publishers
2. M N Chatterjea & Rana Shinde, (2012), Text book of Medical Biochemistry, 8th edition, Jaypee Publications
3. Godkar.B. Praful, (2016) Textbook of MLT, 3rd edition, Bhalani Publications

### **Reference Books**

1. Singh & Sahni, (2008), Introductory Practical Biochemistry, 2nd edition, Alpha science
2. Lehninger, (2013), Principles of Biochemistry, 6th edition, W H Freeman
3. U Satyanarayan, (2008), Essentials of Biochemistry, 2nd edition, Standard Publishers

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# B.Sc. in Medical Laboratory Technology- Fourth Semester

## PARASITOLOGY

Subject Code: MLT- 404

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To provide brief knowledge of parasites involved in human infections.
- To understand the life cycle and lab diagnosis of various important human parasites.

### THEORY

1. Definition - parasitism, HOST, Vectors etc.
2. Classification of Parasites.
3. Phylum Protozoa- general pathogenic and non-pathogenic protozoa.
4. Phylum Nematelminths/Round worms (Nematoda) .
5. Phylum Platyhelminths - class-Cestoda, class-Trematoda.
6. Lab diagnosis of parasitic infections.

### Protozoa :

- i. Intestinal Amoebae
  - a. E. Histolytica : Life cycle, Morphology, Disease & Lab Diagnosis
  - b. E. coli : Life cycle, Morphology, Disease & Lab Diagnosis
- ii. Flagellates of intestine/genitalia
  - a. Giardia lamblia : Life cycle, Morphology, Disease & Lab Diagnosis
  - b. Trichomonas vaginalis : Life cycle, Morphology, Disease & Lab Diagnosis
- iii. Malarial Parasite
  - a. Plasmodium vivax : Life cycle, Morphology, disease & lab diagnosis
  - b. Differences between P. vivax, P. malaria, P. falciparum & P. ovale.

### Nematodes :

Intestinal Nematodes :

- a. Ascaris: Life cycle, Morphology, disease & lab diagnosis
- b. Brief discussion about Enterobius vermicularis (Thread worm) and Ancylostoma duodenale (Hook worm)

Tissue Nematodes:

W. Bancrofti - Life cycle, Morphology, Disease & Lab Diagnosis

### Phylum Platyhelminths

- a. Cestodes - T. solium, T. saginata & E. granulosus. (in brief)
- b. Trematodes - S. haematobium & F. hepatica (in brief)

### PRACTICAL

- Stool examination.
- Identification of different ova & cysts in stool samples.

### Text Books

1. Sougata Ghosh (2021). Paniker Textbook of Medical Parasitology, 9<sup>th</sup> Ed., Jaypee Brothers.
2. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
3. D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.

### Reference Books

1. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013). Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
2. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier
3. Willey JM, Sherwood LM, and Woolverton C.J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.

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## **B.Sc. in Medical Laboratory Technology- Fourth Semester**

### **CLINICAL TRAINING**

**Min. Hrs.-140 Hrs**

Clinical training of students will be provided in a medical college/100 bedded hospital with well-equipped pathology laboratory for at least one month.

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# B.Sc. in Medical Laboratory Technology, Fifth Semester

## ANALYTICAL BIOCHEMISTRY

Subject Code: MLT- 501

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- The students will learn how to analyze various clinical patients' samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers.
- Syllabus are made to learn the techniques of collection of clinical samples and their processing along with recording of data.
- Provide basic knowledge of clinical biochemistry and metabolism various metabolites involved in different diseases.

### THEORY

- **Method of estimation and assessment for**
  - Glucose tolerance test
  - Insulin tolerance test
  - Xylose excretion test.
- **Gastric analysis.**
- **Clearance test for renal function**
- **Qualitative test for:** Urobilinogens, Barbiturates
- **Qualitative analysis of Renal calculi.**
- **Chemical examination of Cerebrospinal fluid.**
- **Brief knowledge about rapid techniques in clinical biochemistry**

### PRACTICAL

#### Clinical Biochemistry

(By Semi autoanalyzer / Fully automated analyzer)

1. Estimation of Cholesterol
2. Estimation of HDL Cholesterol
3. Estimation of LDL Cholesterol
4. Estimation of Triglycerides
5. Estimation of LDH
6. Estimation of Glucose
7. Estimation of Bilirubin (Total, Direct, Total + Direct)
8. Estimation of SGPT
9. Estimation of SGOT
10. Estimation of Acid Phosphatase
11. Estimation of Alkaline Phosphatase
12. Estimation of Iron
13. Estimation of Creatinine
14. Estimation of Urea
15. Estimation of Uric acid
16. Estimation of CK-MB
17. Estimation of CK-NAC
18. Estimation of Chlorides
19. Estimation of Sodium
20. Estimation of Potassium
21. Estimation of Hexagon Troponin+
22. Estimation of Phosphorus
23. Estimation of TIBC
24. Estimation of Albumin
25. Estimation of Calcium
26. Estimation of Hemoglobin
27. Estimation of Magnesium
28. Estimation of Blood Urea Nitrogen
29. Others

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### **Text Books**

1. D M Vasudevan, (2011), Text book of Medical Biochemistry, 6th edition Jaypee Publishers
2. M N Chatterjea & Rana Shinde, (2012), Text book of Medical Biochemistry, 8th edition, Jaypee Publications
3. Godkar. B. Praful, (2016) Textbook of MLT, 3rd edition, Bhalani Publications

### **Reference Books**

1. Singh & Sahni, (2008), Introductory Practical Biochemistry, 2nd edition, Alpha science
2. Lehninger, (2013), Principles of Biochemistry, 6th edition, W H Freeman
3. U Satyanarayan, (2008), Essentials of Biochemistry, 2nd edition, Standard Publishers

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# B.Sc. in Medical Laboratory Technology- Fifth Semester

## SYSTEMIC BACTERIOLOGY

Subject Code: MLT- 502

Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.

### Course Outcomes:

- To provide information about the different type of bacterial culture procedures and test used for identification of medically important bacteria.
- To identify the indications for basic procedures, culture media and their preparations.

### THEORY

#### Study of -

Staphylococcus, Streptococcus, Pneumococcus, Neisseria gonorrhoea, Neisseria meningitis, Corynebacterium diphtheriae, Mycobacterium, Clostridium, E.coli, Klebsiella, Salmonella, Proteus, Pseudomonas, Vibrio & Spirochaetes with reference to their:

- Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & lab diagnosis.

### PRACTICAL

1. Culture Techniques
2. Composition of culture media
3. Preparation of media
4. Identification of media & their uses
5. Culture methods & identification of common bacteria on media.
6. Antibiotic sensitivity testing.

### Text Books

1. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication
2. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
3. D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.

### Reference Books

1. Sastry Apurba S, (2021), Essentials of Medical Microbiology, 3<sup>rd</sup> Ed., Jay Pee Publishers.
2. Brooks G.F., Carroll K.C., Butel J.S., Morse S.A. and Mietzner, T.A. (2013)
3. Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication
4. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.

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# B.Sc. in Medical Laboratory Technology- Fifth Semester

## QUALITY LABORATORY MANAGEMENT

Subject Code: MLT- 503

Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.

### Course Outcomes:

- To demonstrate distinctive, meritorious and high quality practice that leads to excellence.
- To demonstrate the quality of being assumable for all actions to service users.

### THEORY

1. Introduction to Quality control
2. Total quality management framework
3. Quality laboratory processes, Quality assurance, Quality assessment, Quality control, Quality planning and Quality improvement
4. Costs of conformance and non-conformance, appraisal costs, prevention costs
5. Internal quality control, basic steps, sources of error and their correction methods, CAPA - corrective action & preventive action
6. Sources of variation in laboratory results
7. Quality control charts, Levy- Jennings and Cusum charts
8. External quality control
9. Quality control programme, intrinsic and extrinsic and random errors
10. Current trends in laboratory accreditation, ISO certificate, West guard Rules
11. Demonstration of various methods of quality control.

### PRACTICAL

- Sample accountability-
  - Labeling of sample
  - Making entries in Laboratory records
- Reporting results-
  - Basic format of a test report
  - Release of examination results
  - Alteration in reports
- Calibration and Validation of Clinical Laboratory instruments
- Ethics in medical laboratory practice in relation to the following:
  - Pre-Examination procedures
  - Examination procedures
    - -Reporting of results
  - Preserving medical records
- Access to medical laboratory records 8. Audit in a Medical Laboratory – Documentation

### Text Books

1. Godkar.B. Praful,(2016) Textbook of MLT,3rd edition,Bhalani Publications 2.
2. Sood Ramnik, (2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications

### Reference Books

1. Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications
2. Bishop(2013),Clinical Chemistry,7th edition, Wiley Publications.
3. Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22nd edition, Elsevier

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# B.Sc. in Medical Laboratory Technology- Fifth Semester

## HISTOPATHOLOGY & CYTOLOGY TECHNIQUES

**Subject Code: MLT- 504 (Elective)**

**Min. Hrs. - Theory: 40 Hrs., Practical: 40 Hrs.**

### Course Outcomes:

- To provide knowledge about Histopathology.
- To provide knowledge of slide preparation and staining of various cytological specimen.
- To train students in testing of various histological specimen in addition to microtomy.

### THEORY

1. Introduction to Histopathology, exfoliative Cytology.
2. Basic steps for Tissue Processing- Fixing, Embedding, Microtomy, Staining, Mounting, methods of decalcifications.
3. Laboratory requirements for Histopathology & Cytology - Chemicals & Reagents
4. Equipments - Microscope, Microtome -Types, Uses, Parts, different types of microtome knives, care & maintenance. Automated tissue processor - components, working & precautions during use, Tissue floating bath.
5. Staining Methods -
  - a. Hematoxylin & Eosin stain, Hematoxylin - Types, methods of preparation, staining, Eosin - Method of preparation.
  - b. Reticulin stain
  - c. PAP staining- components & methods.
6. Museum Techniques
  - a. The mounting of pathological specimens - Introduction., Preparation of specimen, Fixation of specimen- Kaiserling solution-1 & Kaiserling solution-2
  - b. Precaution taken for the Fixation of Specimens.
  - c. Storage of Specimens.
  - d. Mounting of Museum Specimens.
  - e. Routine Mounting of Specimens.
  - f. Filling and Scaling.

### PRACTICAL

1. Parts of microtome
2. Tissue processing
3. H & E staining
4. PAP staining.
5. Automation in tissue processing.
6. Setting up of histopathology lab.

### Text Books

1. Harshmohan (2017), Textbook of Pathology, 7th edition, Jaypee Publications
2. Godkar.B. Praful,(2016) Textbook of MLT, 3rd edition,Bhalani Publications

### Reference Books

1. Bancroft's Theory and Practice of Histological Techniques, 7th Edition, Elsevier Publications.
2. C F A Culling,(1974), Handbook of Histopathological and Histochemical Techniques: Including Museum Techniques,3rd edition, Butterworths Publishers

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## **B.Sc. in Medical Microbiology- Fifth Semester**

### **APPLIED MICROBIOLOGY**

**Subject Code: BMM- 504 (Elective)**

**Min. Hrs. - Theory: 40 Hrs., Practical: 40 Hrs.**

#### **Course Outcomes:**

- To provide knowledge about various clinical diseases and their patterns.
- To provide knowledge about various organism responsible for causing them.
- To provide knowledge about the changing trends of various organisms worldwide.

#### **THEORY**

1. Urinary tract infections
2. Nosocomial infections/Health Care Associated Infections
3. Pyrexia of unknown origin
4. Immunization

#### **PRACTICAL**

1. Assignment of Microbiology
2. Antimicrobial sensitivity testing
3. Slit smear preparation
4. Culture & sensitivity, inoculation techniques of different specimens
5. Others

#### **Text Books**

1. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
2. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
3. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of diagnostic microbiology (5th ed.). Saunders.
4. D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.

#### **References Books**

1. Stefan (2020), Jawetz Melnick Adelbergs Medical Microbiology, 28<sup>th</sup> Ed., MacGraw Hill.
2. Sastry Apurba S, (2021), Essentials of Medical Microbiology, 3<sup>rd</sup> Ed., Jay Pee Publishers.
3. Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
4. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.
5. Willey JM, Sherwood LM, and Woolverton C.J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.

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## **B.Sc. in Medical Laboratory Technology- Fifth Semester**

### **CLINICAL TRAINING/ SEMINAR/ PRESENTATIONS/ CAMPS**

**Practical: 80 Hrs.**

The students will get training any Hospital/ Well equipped Pathology or in medical checkup camps.

They will do presentations and participate in Seminars related to their subjects.

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# **B.Sc. in Medical Laboratory Technology- Sixth Semester**

## **MYCOLOGY**

**Subject Code: MLT- 601**

**Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.**

### **Course Outcomes:**

- To provide brief introduction of general characteristics of medically important fungi.
- To provide laboratory diagnosis of various medically important fungi.
- To provide complete procedural investigation procedures of fungi causing human diseases.

### **THEORY**

- Morphology and Structure of fungi
- Classification of fungi
- Nutrition and cultivation of fungus
- Cutaneous & Sub cutaneous and Systemic Mycosis (in brief)
- Lab diagnosis of fungal Infections
- Opportunistic fungal infections

### **PRACTICAL**

1. Culture Media used for fungus.
2. Fungal culture
3. Methods of lab diagnosis.

### **Text Books**

1. D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.
2. Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
3. Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
4. Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of diagnostic microbiology (5th ed.). Saunders.

### **References Books**

1. Goering R., Dockrell H., Zuckerman M. and Wakelin D. (2007) Mims' Medical Microbiology. 4th edition. Elsevier.
2. Stefan (2020), Jawetz Melnick Adelbergs Medical Microbiology, 28<sup>th</sup> Ed., MacGraw Hill.
3. Sastry Apurba S, (2021), Essentials of Medical Microbiology, 3<sup>rd</sup> Ed., Jay Pee Publishers.
4. Adelberg's Medical Microbiology. 26th edition. McGraw Hill Publication.
5. Willey JM, Sherwood LM, and Woolverton C.J. (2013) Prescott, Harley and Klein's Microbiology. 9th edition. McGraw Hill Higher Education.

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# **B.Sc. in Medical Laboratory Technology- Sixth Semester**

## **AUTOMATION**

**Subject Code: MLT- 602**

**Min. Hrs. - Theory: 60 Hrs. & Practical: 60 Hrs.**

### **Course Outcomes:**

- To provide brief knowledge (both theoretical and practical) about handling of diagnostic instruments.
- To make aware to students about latest technology used for various investigations.

### **THEORY**

1. Automation - Introduction, meaning, advantages, history
2. Continuous flow analyzers
3. Single channel continuous flow analyzers-advantages, disadvantages
4. Multi-channel flow analyzers
5. Discrete auto analyzers - basic features, types, semi-automated, fully automated
6. Batch analyzers
7. Random access analyzers (RAA)
8. Component steps in fully automated analyzers
9. Auto analyzers based on immunoassay techniques, Micro particle enzyme immunoassay (MEIA)
10. Various random access analyzers - Hitachi- 704, BM/Hitachi - 717
11. Centrifugal analyzers, ASCA
12. Dry chemistry analyzers
13. Dimension RxL clinical chemistry system
14. The Heterogeneous Immunoassay module components
15. Beckman Array 360 system
16. Mini Vidas analyzers
17. Immulite automated immunoassay analyzers
18. Latest trends in Automation, Biochips, Lab on a chip (LoC), Nanosensors- advantages and disadvantages.

### **PRACTICAL**

**Demonstration of working on various latest equipments.**

**Various Experiments using ELISA/ Semi Auto Analyser/ Fully Automatic Analyser/ Mini Vidas/ D-10/ PCR etc.**

#### **Estimation of Hormones-**

1. Estimation of T3
2. Estimation of T4
3. Estimation of TSH
4. Estimation of FSH
5. Estimation of LH
6. Estimation of hCG
7. Estimation of Cortisol
8. Estimation of Progesterone
9. Estimation of Testosterone
10. Others

#### **Estimation of HBA1c**

#### **Estimation of Vitamin D**

#### **Estimation of tumor and cancer markers**

1. Estimation of Alpha fetoproteins (AFP)
2. Estimation of Carcino embryonic antigen (CEA)
3. Estimation of CA -125
4. Estimation of Prostate specific antigen (PSA)

#### **Estimation of Serum Calcium, Serum Potassium, Serum Magnesium & Others.**

### **Text Books**

1. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications.
2. Sood Ramnik, (2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications.

### **Reference Books**

1. Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications.
2. Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22nd edition, Elsevier.
3. Singh & Sahni,(2008),Introductory Practical Biochemistry,2nd edition, Alpha science.
4. Lehninger,(2013),Principles of Biochemistry,6th edition, W H Freeman.

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# **B.Sc. in Medical Laboratory Technology- Sixth Semester**

## **COAGULATION STUDIES**

**Subject Code: MLT- 603**

**Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.**

### **Course Outcomes:**

- To provide brief introduction of coagulation system and factors involved in coagulation.
- To provide knowledge about diagnosis of coagulation factors deficiencies.

### **THEORY**

1. Hemostasis - Definition, Basic concept and principle, Basic steps involved in Hemostasis.
2. Coagulation -
  - a. Basic Physiology, coagulation factors.
  - b. Mechanism of blood coagulation.
  - c. Extrinsic Pathway.
  - d. Intrinsic Pathway.
  - e. Regulators of blood coagulation.
3. Testing of blood coagulation -
  - a. Bleeding Time, Duke's method.
  - b. Clotting Time- Capillary tube method & Lee white's method.
  - c. PT, aPTT, TT
  - d. Clot retraction time
  - e. Determination of fibrinogen.
4. Quality Assurance for routine Hemostasis Laboratory-
  - a. Introduction.
  - b. Sample collection technique (Phelbotomy)
  - c. Sample preparation, Anticoagulant used, Importance of use of Sodium Citrate.
5. Role in Diseases, Bleeding disorders-
  - a. Platelet disorder - Thrombocytopenias - causes including aplastic anemia.
  - b. D I C
  - c. I T P
  - d. Hemophilia

### **PRACTICAL**

1. Precautions to prevent hemolysis
2. Storage of blood specimens
3. Bleeding time & clotting time estimation
4. Prothrombin time estimation
5. aPTT (activated partial thromboplastin time) estimation.
6. Clot retraction time.

### **Text Books**

1. Godkar.B. Praful, (2016) Textbook of MLT,3rd edition, Bhalani Publications.
2. Sood Ramnik, (2015), Text book of Medical Laboratory Technology,2nd edition, Jaypee Publications.

### **Reference Books**

1. Wintrobe's Clinical Hematology,(2014),13th edition, Lippincott Williams & Wilkins.
2. De Gruchy's Clinical Haematology in Medical Practice,(2012),Sixth edition, Wiley Publications.
3. Dacie & Lewis Practical Hematology, (2011),11th edition, Elsevier Publications.
4. R N Makroo, (2009),Compendium of Transfusion medicine,2nd edition, Career Publications

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# **B.Sc. in Medical Laboratory Technology- Sixth Semester**

## **VIROLOGY**

**Subject Code: MLT- 604**

**Min. Hrs. - Theory: 40 Hrs. & Practical: 40 Hrs.**

### **Course Outcomes:**

- To impart basic knowledge of disease causing viruses.
- To provide brief introduction of diagnostics procedures of disease causing viruses.

### **THEORY**

- General characters of viruses
- Classification of viruses
- Lab diagnosis of viral infections
- Cultivation of viruses
- Bacteriophages.
- Retro viruses - HIV, Hepatitis virus, Pox virus,
- Picorna virus - Polio
- Orthomyxo virus - Influenza
- Arbo virus - Chikungunya, Dengue
- Herpes and Adeno virus

### **PRACTICAL**

- Methods of lab diagnosis of different virus.

### **Text Books**

- D.R. Arora (2020). Text Book of Microbiology, 6<sup>th</sup> Ed., CBS Publishers.
- Ananthanarayan R. and Paniker C.K.J. (2009) Textbook of Microbiology. 8th edition, University Press Publication.
- Praful B. Godkar & Darshan P. Godkar (2014). Text Book of Medical Laboratory Technology, Clinical Laboratory Science & Molecular Diagnosis, 3<sup>rd</sup> Ed., Bhalani Publishing House.
- Mahon, C. R., Lehman, D. C., & Manuselis, G. (2014). Textbook of diagnostic microbiology (5th ed.). Saunders.

### **References Books**

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*Ram Lal Sharma*

*Vesth*

*Munish Kumar*

*Digvijay*

## **B.Sc. in Medical Laboratory Technology- Sixth Semester**

### **CLINICAL TRAINING**

**Min. Hrs.-140 Hrs.**

Clinical training of students will be provided in a medical college/100 bedded hospital with well-equipped pathology laboratory for at least one month.

Ram Lal'shore

Vesth

Munish Kestop

Digvijay