



छत्रपति शाहू जी महाराज विश्वविद्यालय, कानपुर

CHHATRAPATI SHAHU JI 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

M.Sc. MLT Clinical Biochemistry


Co-ordinator

Internal Quality Assurance Cell
CSJM University, Kanpur


(Registrar)

C.S.J.M. University
Kanpur

REGISTRAR
C.S.J.M. UNIVERSITY
KANPUR

Ordinance & Syllabus

For

M.Sc. – MLT Academic Programme

Specialization/Discipline:

Clinical Biochemistry

**Ordinance According to
NEP-2020**

**Duration:
2 years (4 Semesters)**

Master of Science - Medical Laboratory Technology (M.Sc.-MLT)

1. M.Sc. MLT degree will be under the faculty of Medicine of C.S.J.M. University, Kanpur in the department of Medical Laboratory Technology.

2. **Duration of Course:**

- M.Sc. MLT course will be a full-time course.
- Duration will be two years (Four Semesters).
This course shall be divided into four semester examinations namely MSc in Medical Laboratory Technology I & II Semester (First Academic Year), & III & IV Semester (Second Academic Year) .

3. **Specialization/Discipline**

There shall be following specialization/discipline:

- **M.Sc. MLT in Clinical Biochemistry**
- **M.Sc. MLT in Medical Microbiology & Immunology**
- **M.Sc. MLT in Pathology**

4. **Seats:**

Specialization/ Discipline	No. of Seats
M.Sc. MLT in Clinical Biochemistry	10
M.Sc. MLT in Medical Microbiology & Immunology	10
M.Sc. MLT in Pathology	10

5. **Admission:**

Eligibility:

The students who have passed B.Sc.-MLT (B.Sc.-Medical Laboratory Technology) Course from any recognized Institutions/University with minimum of 55% marks (50% for SC/ST)

Mode of Admission:

As per the University Norms.

6. **Medium of Instruction**

English shall be the medium of instruction for all the subjects of study and for examination of the course.

7. **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.

8. **Examination:**

As per the University norms.

Duration of examination:

As per the University norms.

9. **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.

M.Sc. – Medical Laboratory Technology (MLT)

Clinical Biochemistry

Program outcome

At the end of the course the student should be able to:

- Supervise/Perform routine Clinical Biochemistry laboratory testing.
- Provide Medical laboratory services in all types of clinical laboratories from Primary healthcare laboratory to Tertiary health care institution in the fields of Bacteriology, Immunology, Mycology, Parasitology and Virology.
- Make specimen-oriented decision on predetermined criteria including working knowledge of critical values.
- Communicate with other members of healthcare team, customers and patients in an effective manner.
- Process information and ensure quality control as appropriate to routine laboratory.
- Train students in routine/special laboratory procedure.
- Upgrade knowledge and skills in a changing healthcare scenario.
- Should know the logical interpretation of clinical lab investigations.
- Should be capable to extrapolate data acquired.
- Should be capable of supervise / guide the staff working on automated machine.
- Should be capable of teaching, proposing/executing research project.

Program Specific outcome

- Proficiently supervise and perform full range of clinical Biochemistry laboratory tests.
- Develop and evaluate test systems and interpretive algorithms.
- Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information.
- To teach under graduate students and develop/guide research projects.
- Faculty development in Medical Laboratory Technology (MLT).

"B"
Regulations : Scheme of Examination

M.Sc.-MLT (Clinical Biochemistry)

First Semester University Examination

S. N o.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1.	Medical Biochemistry	MMLT-101CB	75	25	100	75	25	100	200
2.	Clinical Pathology & Immunopathology	MMLT-102CB	75	25	100	75	25	100	200
3.	General Microbiology	MMLT-103CB	75	25	100	75	25	100	200
4.	Research Methodology	MMLT-104CB	75	25	100	-	-	-	100
Grand Total									700

Second Semester University Examination

S. N o.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1.	Medical Laboratory Management	MMLT-201CB	75	25	100	75	25	100	200
2.	Blood grouping and Immunology	MMLT-202CB	75	25	100	75	25	100	200
3.	Biomedical Techniques	MMLT-203CB	75	25	100	75	25	100	200
4.	Biostatistics	MMLT-204CB	75	25	100				100
Grand Total									700

Third Semester University Examination

S. N o.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1.	Clinical Biochemistry	MMLT-301CB	75	25	100	75	25	100	200
2.	Endocrinology	MMLT-302CB	75	25	100	75	25	100	200
3.	Tumour and Cancer Marker	MMLT-303CB	75	75	100	75	25	100	200
Grand Total									600

Fourth Semester University Examination

S. N o.	Subjects	Subject code	THEORY MARKS			PRACTICAL MARKS			Total marks
			Theory Paper	Internal Assessment	Total	Practical	Internal Assessment	Total	
1.	Applied Biochemistry	MMLT-401CB	75	25	100	75	25	100	200
2.	Automation	MMLT-402CB	75	25	100	75	25	100	200
3.	Dissertation	MMLT-403CB							300
Grand Total									700

SCHEME OF EXAMINATION

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:

- a) Seminars/Symposia/Journal club/Assignment/
Clinical presentation = 10 marks
- b) Mid-term examination = 10 marks
- c) Attendance/Teaching Skills = 05 marks

Total = 25 marks

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

- a) Lab work Presentation /Clinical Lab Practices/Clinical Training = 10 marks
- b) Practical Training Skills/ Continuous evaluation = 10 marks
- c) Laboratory Manual/Attendance = 05 marks

Total = 25 marks

- Internal assessment of subjects without practical will be done as:

- a) Assignments/ Projects/ class test/ Presentations = 10 marks
- b) Mid Term examination = 10 marks
- c) Attendance/Teaching Skills = 05 marks

Total = 25 marks

Criteria for Passing

- As per University norms.

Maximum duration for completion for course

- A candidate shall complete the course within four years from date of admission failing which the candidate will be discharged.

Division:

- As per the University norms.

Degree:

- The degree of M.Sc.-MLT course of the University shall be conferred according to specialization/discipline on the candidates who have pursued the prescribed course of study for not less than two academic years and have passed examinations as prescribed under the relevant scheme.

Monitoring Progress of Studies

It is essential to monitor the learning progress of each candidate through continuous appraisal and regular internal assessment. It not only also helps teachers to evaluate students, but also students to evaluate themselves. The monitoring be done by the faculty members of the department based on participation of students in various teaching / learning activities.

(a) Seminar

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars in a semester (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

(b) Clinical Lab Practices

Post graduate students must do:

- Sample collection, storages & analysis of every sample given to them for various parameters.
- They should know proper laboratory management.
- They should work on every instrument according to their specialization.
- Maintenance and care of the instrument of the laboratory.
- They will do hospital/laboratory/blood bank postings for training & skill development.

(c) Teaching Skills

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

(d) Journal Review Meeting (Journal Club):

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

(e) Work diary / Log Book

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted by the student.

(f) Mid Term Examination/Class Test/Assignments

There will be mid-term examination/class tests/ assignments in every semester. Various class test may be taken by the department and assignments may be given to students on various topics. Marks of these will be included in every semester.

(g) Records

Records, log books and marks obtained in mid-term examination/class tests/ assignments will be maintained by the Head of the Department/Teacher of the concerned subject.

Dissertation

Every candidate pursuing M.Sc.-MLT degree course is required to carry out research work on a selected research project under the guidance of a recognized postgraduate teacher. The results of such a work shall be submitted in the form of dissertation. Topic for dissertation shall be assigned by the guide.

If the subject of Thesis entails collaboration with other departments or specialties, the collaborative portion of the work will be supervised by Co-Guide, designated by the University Institute of Health Sciences in consultation with the Guide. Where a Co-Guide is involved, the Thesis will be certified jointly by the Guide & Co-guide.

Every candidate shall submit synopsis to the University in the prescribed Performa containing particulars of proposed dissertation work, within 6 months from the date of commencement of the course on or before the dates notified by the university. The synopsis shall be sent through the proper channel. Such synopsis will be reviewed and the university will register the dissertation topic.

No change in the dissertation topic or guide shall be made without prior approval of the university. Guide will be only a facilitator, advisor of the concept and hold responsible in correctly directing the candidate in the methodology and not responsible for the outcome and results.

The dissertation should be written under the following headings.

1. Introduction
2. Aims or objectives of study
3. Review of literature
4. Material and methods
5. Results
6. Discussion
7. Conclusion
8. References
9. Master and Chart & Table (If Applicable)
10. Annexure (If Applicable)

The written text of dissertation/ research project shall not be less than 50 pages and shall not exceed 125 pages excluding references, tables, questionnaires and other annexure. It should be neatly typed in double line spacing on one side of bond paper (A4 size, 8.27" x 11.69") and bound properly. Spiral binding should be avoided. A declaration by the candidate for having done the work himself should also be included, and the guide, head of the department and Director/Coordinator of the institute shall certify the dissertation/ research project.

Every candidate is required to give power point presentation before final submission of dissertation. Four copies of Dissertation/research project shall be submitted to the university, through proper channel, along with a soft copy (CD), 2 months before the final examination. It shall be assessed by two examiners appointed by the university, one internal and one external. There will be a power point open presentation of the submitted dissertation as per the schedule given by the university. This presentation shall be jointly evaluated by external and internal examiner as per the criteria given below:

Objective(s) of the work done	50 Marks
Methodology adopted	100 Marks
Result and Discussion	100 Marks
Conclusion & outcome	50 Marks
Total	300 Marks

To pass in the dissertation a student must secure 150 marks.

If the student failed to secure the minimum passing marks he will resubmit the dissertation 1½ month before the supplementary exam.

Guide

I. Eligibility to be a guide

- (a) Full time faculty involved in teaching in the same department/institute or in the colleges or institution where he or she is working.
- (b) Academic qualification and teaching/professional experience for each branch

For M.Sc.-MLT in Clinical Biochemistry

- MBBS, MD (Medical Biochemistry)/MBBS, M.Sc. (Medical/Clinical Biochemistry with 02 years teaching/professional experience.
Or
MBBS, Ph.D. (Faculty of Medicine) with 2 years teaching/professional experience in related subject.
Or
MBBS/Ph.D.(Life Science) with 5 years teaching experience in related subject.
Or
M.Sc. (Medical/Clinical Biochemistry) or M.Sc.-MLT in Clinical Biochemistry with 05 years of teaching experience after the postgraduate qualification in a teaching institute.

The Vice Chancellor of the University can appoint a person as a guide whom he/she considers suitable.

II. Age of Guide

The age of guide should not exceed 62 years or as per university norms.

III. Guide student ratio

1: 5

A recognized guide shall supervise dissertation work of not more than 5 students per academic year.

IV. Change of Guide

In the event of registered guide leaving the department/institute or in the event of death of guide, guide may be change with prior permission from the university.

COURSE OF STUDY

Specialization- Clinical Biochemistry

M.Sc.-MLT (Clinical Biochemistry) First Semester University Examination

S. No.	Subjects	Subject code	Teaching Hours			Credit
			Theory	Practical	Total	
1.	Medical Biochemistry	MMLT-101CB	60	60	120	06
2.	Clinical Pathology & Immunopathology	MMLT-102CB	60	60	120	06
3.	General Microbiology	MMLT-103CB	60	60	120	06
4.	Research Methodology	MMLT-104CB	80		80	04
5.	Dissertation				40	02
6.	Teaching Skills/Seminars/Symposia/ Journal Club etc. *				80	02
Total					560	26

* Not Included in University Exam. Included in the Internal Marks.

M.Sc.-MLT (Clinical Biochemistry) Second Semester University Examination

S. No.	Subjects	Subject code	Teaching Hours			Credit
			Theory	Practical	Total	
1.	Medical Laboratory Management	MMLT-201CB	60	60	120	06
2.	Blood grouping & Immunology	MMLT-202CB	60	60	120	06
3.	Biomedical Techniques	MMLT-203CB	60	60	120	06
4.	Biostatistics	MMLT-204CB	80		80	04
5.	Dissertation				40	02
6.	Teaching Skills/Seminars/Symposia/ Journal Club etc. *				80	02
7.	Clinical Lab Practices* OR Clinical Training* (in a medical college/100 bedded hospital with well-equipped Pathology/ Clinical Biochemistry/ Microbiology Laboratory for at least one month)				120	02
Total					680	28

* Not Included in University Exam. Included in the Internal Marks.

M.Sc.-MLT (Clinical Biochemistry) Third Semester University Examination

S. No.	Subjects	Subject code	Teaching Hours			Credit
			Theory	Practical	Total	
1.	Clinical Biochemistry	MMLT-301CB	80	80	160	08
2.	Endocrinology	MMLT-302CB	60	60	120	06
3.	Tumour and Cancer Marker	MMLT-303CB	60	60	120	06
4.	Dissertation				40	02
5.	Teaching Skills/Seminars/Symposia/ Journal Club etc. *				80	02
6.	Clinical Training/ Camps*				180	02
Total					700	26

* Not Included in University Exam. Included in the Internal Marks.

M.Sc.-MLT (Clinical Biochemistry)
Fourth Semester University Examination

S. No.	Subjects	Subject code	Teaching Hours			Credit
			Theory	Practical	Total	
1.	Applied Biochemistry	MMLT-401CB	80	80	160	08
2.	Automation	MMLT-402CB	80	80	160	08
3.	Dissertation	MMLT-403CB			120	06
4.	Teaching Skills/Seminars/Symposia/ Journal Club etc. *				100	02
5.	Clinical Lab Practices* OR Clinical Training* (in a medical college/100 bedded hospital with well-equipped Pathology/ Clinical Biochemistry/ Microbiology Laboratory for at least one month)				180	02
Total					720	26

* Not Included in University Exam. Included in the Internal Marks.

Syllabus

M.Sc.-MLT –Semester-I for all Specialization

MEDICAL BIOCHEMISTRY

Subject Code: MMLT-101CB

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

Course Outcomes

- To provide brief knowledge of biochemical metabolites.
- To impart knowledge about methods of qualitative and quantitative analysis of biomolecules.

THEORY

1. Carbohydrates

- Definition, Function, Classification, Isomerism & Properties of Monosaccharides, Disaccharides Polysaccharides
- Metabolism-Utilization of Glucose, Glycogenesis (in brief), Glycogenolysis (in brief), Glycolysis, Citric Acid Cycle, Gluconeogenesis(in brief), HMP Shunt(in brief), Regulation of Blood Glucose level

2.-Amino Acids

- Definition, Classification & functions
- Properties

3.- Proteins-

- Definition, classification, functions
- Structural Organization-Primary, Secondary, Tertiary & Quaternary
- Metabolism- Catabolism of Amino Acid Nitrogen, Synthesis of Urea- Transamination, Oxidative deamination, Ammonia formation & Transport, Urea Cycle, Metabolic Disorders in Urea Cycle,
- Essential and non-essential amino acids
- Creatine & Creatinine, Proteinuria

4.-Lipids

- Definition, classification, biomedical importance, Lipoproteins in the blood composition & their functions in brief,
- Metabolism- Beta oxidation of fatty acids, fatty liver, Ketosis, Cholesterol & it's clinical significance. Atherosclerosis. essential fatty acids

5.- Enzymes

- Introduction, definition, classification, coenzymes, isoenzymes, properties, factors affecting enzyme action, enzyme inhibition, diagnostic value of serum enzymes,

6- Hyperglycemia & hypoglycemia –

- Hyperglycemia, Diabetes mellitus - definition, types, features, gestation diabetes mellitus, glucose tolerance test, Glycosylated hemoglobin, glycosurias,
- Glucose Tolerance test, Insulin Tolerance Test
- Hypoglycemia & its causes

7- Bilirubin General types and Jaundice

- Liver Function Test
 - i) Bilirubin estimation
 - ii) Alkaline phosphates and acid phosphates estimation
 - iii) SGOT, SGPT Estimation

8- Xylose absorption test

9- Analysis of calculi

11-Cerebrospinal fluid analysis

- Composition and function of CSF

- Clinical significance of CSF analysis
- Estimation of sugar and proteins in CSF

10- Urine chemistry

- Physical and Chemical examination of Urine samples. Qualitative tests for inorganic urinary ingredients
- Common qualitative and quantitative tests of urine
- Automation in Urine chemistry

11- Renal Function tests-

Functions of Kidney

GFR

Various Renal Function tests

12- Blood gases and pH, carboxyhemoglobin, CO, Met Hb, O₂ saturation

13- Blood collection procedures- theory of anticoagulation.

14- Bio-Medical waste: Types, potential risks and their safe management.

PRACTICAL

- 1- Identification of Carbohydrates (qualitative tests).
- 3- Identification of Proteins (qualitative tests).
- 4- To study general properties of the enzyme (Urease) & Achromatic time of Salivary amylase.
- 5- Urine analysis –abnormal constituents of urine.
- 6- Biochemical examination of CSF.
- 7- Estimation of blood sugar by Folin wu method & Glucose Oxidase Method
- 8- Estimation of blood urea.
- 9- Estimation of blood uric acid.
- 10- Estimation of serum creatinine
- 11- Estimation of total serum protein
- 12- Estimation of Cholesterol/HDL/LDL Cholesterol by enzymatic method.
- 13- Estimation of Serum Triglyceride
- 14- Estimation of Serum Bilirubin- total & direct
- 15- Estimation of Alkaline & Acid Phosphatase
- 16- Estimation of SGOT, SGPT, GGTP
- 17- Estimation of serum – total protein
- 18- Estimation of serum Globulin
- 19- Estimation of serum – Albumin
- 20- Estimation of Serum Amylase
- 21- Estimation of common parameters in urine through use of strips.

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
4. Sood Ramnik, (2015), Text book of Medical Laboratory Technology, 2nd 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.
1. G.P. Saluja & G.L. Singar (2014). Standard Operating Procedures & Regulatory Guidelines, 1st 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.

M.Sc.-MLT –Semester-I for all Specialization

CLINICAL PATHOLOGY & IMMUNOPATHOLOGY

Subject Code: MMLT-102 CB

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

Course Outcomes

- To provide complete knowledge of collection, transportation and processing of various clinical pathology specimens.
- To provide complete knowledge of investigative & diagnostic procedure involved in clinical pathology.
- To provide brief knowledge of immunohematological diseases.

THEORY

A. CLINICAL PATHOLOGY

1. Collection, transport, preservation and processing of various clinical specimens
2. Urine examination- microscopic.
3. Test for haemosiderin pigment.
4. Stool examination
 - Collection of specimen of faeces
 - Macroscopic (Naked eye) inspection
 - Concentration method, Flotation method.
 - Microscopic examination
 - Chemical examination
 - Strip method
 - Test for Occult blood – Benzidine Test
6. Sputum examination –
 - collection of specimen
 - Physical examination
 - Microscopic – Gram's stain, Ziehl Neelsen stain for AFB
 - Chemical examination
7. Gastric analysis
Indications, contra indications. Method of collection. Fasting gastric juice – Macroscopic and microscopic examination.
 - Fractional test meal
 - Augmented Histamine test
 - Hollander's test
8. Cerebrospinal fluid analysis
Method of obtaining CSF, indications, contra indications.
Examination of CSF:
 - Physical examination
 - Biochemical examination
 - Microscopic examination
 - a. Cytological examination
 - b. Bacteriological examination
- 9- Semen Analysis- Gross & Microscopic
9. Body fluids
Microscopic examination of Pleural, Pericardial, synovial, ascitic and peritoneal fluid.
10. Pregnancy Test- Method, interpretation.

B. IMMUNOPATHOLOGY

1. Mechanism of Ab-mediated inactivation: direct and indirect
e.g. Diabetes mellitus, Thyroid diseases, Pernicious anemia, Polyendocrinopathy, Infertility, Haemophilia, Myasthenia gravis, Anti-idiotypes and diseases.
2. Immune deficiency disorders
3. Immunohaematologic diseases: Transfusion reactions, erythroblastosis foetals, warm-antibody diseases, cold antibody diseases, drug and hemolytic diseases, agranulocytosis, thrombocytopenic purpura, immune suppression cytotoxic antibodies in vitro.
4. Immune complex reactions: arthus reaction, serum sickness, evaluation of circulating immune complexes.
5. Connective tissue diseases: Arteritis, SLE, Dermatomyositis, Rheumatic fever, Rheumatoid arthritis, Progressive systemic sclerosis.
6. Atopic anaphylactic reactions: reaginic antibody, anaphylaxis, atopic allergy – factors involved, asthma, hay fever, food allergy, insect allergy, atopic eczema, delayed hypersensitivity reactions, contact dermatitis, viral infections, graft rejection.
7. Autoallergic diseases: encephalomyelitis, multiple sclerosis, orchitis, thyroiditis, sjogren's syndrome.
8. Granulomatous reactions: Infectious diseases like Tuberculosis, Leprosy.
9. Immunomodulators
10. Autoimmune diseases
11. Immunology of AIDS.

PRACTICAL

A. Clinical Pathology

1. Urine examination - microscopic.
Urine Test for haemosiderin pigment.
2. Stool examination –
 - i. Macroscopic examination
 - ii. Concentration method, Flotation method.
 - iii. Microscopic examination
 - iv. Benzidine Test- for occult blood
3. Sputum examination - Macroscopic, Microscopic and AFB Staining
4. Examination of Cerebrospinal fluid (CSF) and body fluids.
5. Pregnancy Test
6. Examination of Semen-Microscopic.

B. Immunopathology

1. Serological tests (Screening & diagnostic) used in different pathological conditions.
2. Delayed type hypersensitivity testing.
3. Histocompatibility testing
4. Coomb's test – Direct & Indirect
5. Setting up of Immuno histochemistry lab.
6. Other tests

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, 3rd Ed., Bhalani Publishing House.
3. D.R. Arora (2020). Text Book of Microbiology, 6th 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, 3rd Ed., Jay Pee Publishers.

M.Sc.-MLT –Semester-I for all Specialization

GENERAL MICROBIOLOGY

Subject Code: MMLT-103 CB

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

Course Outcomes

- To provide supportive clinical care and uses of relative investigations.
- To identify the indicators of basic procedures and perform them in appropriate manner.

THEORY

(A) General Microbiology

- Classification of microorganism –Prokaryotes and Eukaryotes
- Microscope – Light/Dark field microscope/ phase contrast /fluorescence/Electron
- Staining Methods: Sample, Stain, Negative staining, Gram's Stain, principle, Modification of Gram's Staining. Acid fast stain, Modifications, Interpretation, About Stain.
- Morphology of Bacteria – Shape, Cell wall, Gram positive cell wall, Gram negative cell wall, Cell membrane. Cytoplasm, Cell wall, Appendages – Capsule, Flagella, Fimbriae/pilli.
- Bacterial spore
- Bacterial growth and nutrition- Growth requirement, sources, environmental factors affecting growth.
- Bacterial count
- Bacterial growth curve, Lag phase, log phase, stationary factors, affecting growth of bacteria – oxygen carbon dioxide, temperature, pH, Light, Osmotic effect.

(B) Sterilization and disinfection: Physical agents – drying heat, dry heat, flaming, incineration, moist heat, filtration, radiation, ionizing radiation, non-ionizing radiation.
Chemical agents of sterilization – Alcohol, Aldehydes. Phenols, halogens, Iodine, Chlorine, Oxidizing agents, heavy metals, surface active agents. Cationic, Anionic. Dyes – Aniline, Phenol, Coefficient (Rideal Walker Test).

(C) Culture media and Methods

Constituents of culture media, meat extract, yeast extract. Agar types of culture Media-Liquids Semi solid, solid, Peptone water, nutrient, broth, nutrient, Agar basal media, Enriched media, Blood Agar, Chocolate Agar Loeffler's serum slop, Blood Culture Media.
Enrichment broth selective media, transport media, differential media, MacConkey Agar, CLED Agar, Anaerobic culture method.

Culture Method : Streak culture, Lawn or carpet culture, Stroke culture, Stab culture, liquid culture, pour plate culture.

Anaerobic culture methods : Anoxomat, McIntosh & Fild's Anaerobic Jar, Gaspak system

D) General Principles in Microbiology

1. Collection and handling of various samples.
2. Antimicrobial sensitivity and assay.
3. Lab animals handling and care
4. Laboratory Safety

PRACTICAL

- Culture media preparation and composition -Nutrient Agar, MacConkey, CLED, Sabourauds etc.
- Gram's staining of different specimens like pus, sputum, urine, CSF, endometrial tissue, pleural fluid
- AFB staining of different specimens like sputum, pus, pleural fluid, endometrial tissue.
- Antibiotic sensitivity testing
- Identification of various bacteria on various culture media.

Text Books

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

References Books

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

M.Sc.-MLT –Semester-I for all Specialization

RESEARCH METHODOLOGY

Subject Code: MMLT-104 CB
Theory- Min. Hrs -: 80 Hrs.

Course Outcomes

- Understand the basic principles of research and methods applied to draw inferences from the research findings.
- To be made aware of the need of biostatistics and understanding of data and sampling methods in labs.

THEORY

Research Methodology

1. Research in Medical Laboratory Technology

- Introduction
- Research for Laboratory Technician: Why? How? And When?
- Research – Definition, concept, purpose, approaches
- Internet sites

2. Research Fundamentals

- Define measurement
- Measurement framework
- Scales of measurement
- Pilot Study
- Types of variables
- Reliability & Validity
- Drawing Tables, graphs, master chart etc

3. Writing a Research Proposal, Critiquing a research article

- Defining a problem
- Review of Literature
- Formulating a question, Operational Definition
- Inclusion & Exclusion criteria
- Forming groups
- Data collection & analysis
- Results, Interpretation, conclusion, discussion
- Informed Consent
- Limitations

4. Research Design

- Principle of Designing
- Design, instrumentation & analysis for qualitative research
- Design, instrumentation & analysis for quantitative research
- Design, instrumentation & analysis for quasi-experimental research
- Design models utilized

5. Research Ethics

- Importance of Ethics in Research
- Main ethical issues in human subjects' research
- Main ethical principles that govern research with human subjects
- Components of an ethically valid informed consent for research

Textbooks:

1. B.L Agarwal, (2012), Basic statistics, New Age International Publication.

Reference:

1. Sundarrao, (2002), Introduction to biostatistics and Research Methodology, 1st Ed. CBS.
2. C.R Kothari, (2014) Research methodology, 3rd Ed., New Age international publication.

M.Sc.-MLT –Semester-I for all Specialization

DISSERTATION

Min. Hrs -: 40 Hrs.

Students will prepare their synopsis for dissertation in consultation with their guides.

Performa for synopsis:

1. Introduction
2. Aims and Objectives
3. Review of Literature
4. Methodology or Material and Methods
5. References

Note:

1. The copies of synopsis must be in bound properly.
2. The candidate have to submit 4 copies of synopsis.
3. Colour scheme for synopsis will be white.
4. Text writing
Paper to be used – A4 size (Bond Paper)
Printing – One side
Font - Title – 18 Pt. Bold
Heading – 16 Pt. Bold.
Sub Heading – 14 Pt. Bold
Running text (English) -12 Pt. – Times New Roman
Running Text (Hindi) 14 Pt. (CG12, Krutidev 10)
Spacing : Double
Margin : Left – 4 Cm, Top, Bottom, Right – 2.5 Cm.
Page Numbering– Properly numbered

5. Writing Reference

Should be numbered consecutively in the order in which they are first mentioned in the text (not in alphabetic order). Identify references in text, tables and legends by Arabic numerals in superscript. References cited only in tables or figure legends should be numbered in accordance with the sequence established by the first identification in the text of the particular table or figure.

Journal Articles

Shashi A, Jain SK and Pandey M: *In-vitro* evaluation of antilthiatic activity of seeds of *Dolichos biflorus* and roots of *Asparagus racemosus* . International Journal of Plant Sciences 2008; 1:67-71.

A Book

Kalia AN: A Text Book of Industrial Pharmacognosy. CBS Publishers & Distributors, First Edition 2005.

A Chapter in a Book

Nadkarni KM: Indian Materia Medica. Popular Prakashan, Mumbai, Edition 3, Vol. I, 2000: 242-246.

M.Sc.-MLT –Semester-I for all Specialization

TEACHING SKILLS/SEMINARS/ SEMINARS/ SYMPOSIA/ JOURNAL CLUB ETC. Min. Hrs -: 80 Hrs.

(a) Teaching Skills

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

(b) Seminar

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

(c) Journal Review Meeting (Journal Club):

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

(d) Work diary / Log Book

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted the student.

M.Sc.-MLT –Semester-II for all Specialization

MEDICAL LABORATORY MANAGEMENT

Subject Code: MMLT-201 CB

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

Course Outcomes

- To be made aware of basic ethics, good lab practices including awareness/safety in a clinical laboratory.
- To understand sample accountability, quality management system, biomedical waste management.
- To know calibration and validation of clinical laboratory instruments, laboratory information system (LIS), Hospital information system (HIS) and financial management.

THEORY

1. Preparation of operating budgets

General aspects of financial management of laboratories

2. Cost-analysis (tests and instruments); justification of providing new services or rejecting existing ones; lease and purchase decision analysis; delegation of budget responsibilities, work load statistics.

3. Laboratory design

Designing laboratories for different types and sizes of institutions: selection of equipment and systems for the laboratory, concepts of workstation consolidation, workflow analysis, concepts in laboratory automation (sample transportation systems, modular systems, robotics).

4. Laboratory safety

Fire, chemical, radiation and infection control

(Body substance precautions), hazardous waste and transport of hazardous materials.

5. Training of technical staff

Familiarity is needed with the syllabi of various training programs; knowledge of the teaching requirements and level of knowledge technical staff; understanding of qualifications of technologists trained in other countries.

6. Maintenance of records

Procedure manuals, ward manuals, quality control programs, patient data retrieval.

7. Personnel management

Personnel policy manual; job descriptions; labor, supervision relations; conducting job interviews; motivation, recognizing job distress syndrome; delegation to a laboratory manager.

8. Hospital organization

Interactions between the laboratory service and the rest of the hospital.

9. Professional ethics.

10. Quality assurance;

Total quality management; development and monitoring of performance indicators.

11. Public relations:

hospital and community.

12. Basic clinical epidemiology

13. Laboratory Data Processing

14. General principles of methods for reduction of data into forms suitable for electronic data handling systems (computerized accessioning functions, sample identification and tracking (e.g. bar code systems), result reporting, storage and retrieval, electronic data transfer).

15. Use of computers in quality control and management

Use of computers for calculating analytical results (eg. non-linear functions).

16. General aspects of system design

Central vs. stand-alone systems, host computers and equipment interfaces.

17. Laboratory information systems (LIS), Hospital information systems (HIS).

18. Personal computer use

Word processing, spreadsheets, data-base, graphics, statistics, presentations, email, internet. Security of data storage and transmission.

19. Data base structures and data mining.

20. Appropriate access control to patient information.

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. 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.

M.Sc.-MLT –Semester-II for all Specialization

BLOOD GROUPING & IMMUNOLOGY

Subject Code: MMLT-202 CB

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

Course Outcomes

- This syllabus provide knowledge about Blood grouping and cross matching.
- Students will be able to perform blood group testing and cross matching.
- To make aware of basic aspects of immunity, antigens, antibodies.
- To make use of immunological diagnosis in patient disease finding.

THEORY

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, Haemagglutination, 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 interferes 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.

CROSS MATCHING

- Purpose
- Major and Minor cross matching
- Different types of Major & Minor tests
- Difficulties in cross matching

Immunity-Innate Immunity, Acquired Immunity and Miscellaneous Immunity-Concepts of specificity and memory, Basic properties of innate immune cells, Basic properties of adaptive immune cells.

Physiochemical properties of innate immunity-Physiological barriers, Anatomical barriers, Phagocytic/endocytic barriers, Inflammatory barriers, Immune Response -Humoral & Cell mediated.

Antigens and Immunogens - Complete antigens, Heptane, Factors affecting antigens, Classes of antigens, Immunoglobulins (Igs), Types of Immunoglobulins, Properties of Immunoglobulins, Abnormal Immunoglobulins, Monoclonal antibodies

Antigen/Antibody reactions-Precipitation, Agglutination, Compliment fixation test, Neutralization test, Immunofluorescence, Radioimmuno assay, ELISA, Rapid tests, Chemiluminisence linked Immunoassay, Immuno electron microscopy, Immunoblotting, Applications of antigens/antibody reactions.

Compliment system pathway

Immunological mechanism in health system - Lymphoid system, MHC Complex

PRACTICAL

1. Blood grouping.
2. Rh grouping & Rh typing (slide & tube method)
 - Du Testing
 - Rh – antibody titration
3. Compatibility Testing
 - Selection of blood
 - Crossmatching Technique – Major, Minor, Saline, Albumin, Coomb's, Emergency and Special conditions.
4. Rapid plasma Reagin Tests
5. Rheumatoid arthritis factors
6. C reactive protein test
7. ELISA
8. Antistreptolysin-O

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, 1st 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
5. Abbas AK, Lichtman AH, Pillai S. (2007). Cellular and Molecular Immunology. 6th edition Saunders Publication, Philadelphia.
6. Delves P, Martin S, Burton D, Roitt IM. (2006). Roitt's Essential Immunology.11th edition Wiley-Blackwell Scientific Publication, Oxford.
7. Goldsby RA, Kindt TJ, Osborne BA. (2007). Kuby's Immunology. 6th edition W.H. Freeman and Company, New York.

M.Sc.-MLT –Semester-II for all Specialization

BIOMEDICAL TECHNIQUES

Subject Code: MMLT-203 CB

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

Course Outcome

- To make aware of different biomedical techniques and their uses.

THEORY

1. Methods of qualitative analysis of biomolecules:
Principles, experimental procedures and application of chromatography – paper, thin-layer, ion exchange, affinity, gel filtration, gas-liquid and HPLC. Principles, procedures and application of Electrophoresis – paper, polyacrylamide gel, agarose gel, capillary and cellulose acetate.
2. Quantitative methods:
Principles and applications of Photometry, Spectrophotometry, flurometry, ion selective procedures, flame photometry, atomic absorption spectrometry. Ion selective electrodes and their applications in Medicine.
3. Centrifugation Techniques –
Principle and technique of preparative and analytical centrifugation, differential centrifugation, density gradient centrifugation, ultra-centrifuge and its application.
4. Radio Isotopes:
Detection and measurement of radioactive isotopes, application of isotopes in research and clinical bio-cemistry, Radioactive emissions, radiation-matter interaction, radiation dose.
5. Cell Fractionation, Biochemical activities of different fractions, marker enzymes.
6. Bioenergetics and Biological oxidation:
Concept of free energy change, high energy compounds, ATP generation, redox Potential Assessment, Electron transport chain, oxidative phosphorylation, inhibitors, Uncouplers, ionophores.
7. Purification of enzymes from cells, characterization and Internal Assessment of purity, purification of proteins.

PRACTICAL

1. Chromatography: paper, thin layer, gel, ion-exchange, demonstration of HPLC and GLC
2. Photometry, spectrophotometry, atomic absorption spectrophotometry
3. Electrophoresis: slide gel, PAGE, Agarose gel, Native, SDS PAGE of Blood Sample. (Demo only)
4. Cell fractionation – methods
5. Estimation of Inorganic phosphorous
6. Estimation of Serum Calcium
7. Estimation of LDH
8. Estimation of CK Nac
9. Estimation of CK MB
10. Estimation of Sodium
11. Estimation of Potassium
12. Estimation of Phosphorus
13. Estimation of TIBC
14. Estimation of Hemoglobin
15. Other tests

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.
5. Wilson & Walker, Practical Biochemistry,2nd edition.

M.Sc.-MLT –Semester-II for all Specialization

BIOSTATISTICS

Subject Code: MMLT-204 CB

Theory- Min. Hrs -: 80 Hrs.

Course Outcomes

- To know the basic knowledge of Biostatistics and their use in data analysis.
- To evaluate patient data.

THEORY

1. Biostatistics

- Introduction
- Definition
- Types
- Application

2. Data

- Definition
- Types
- Presentation
- Collection methods

3. Measures of central value

- Arithmetic mean, median, mode. Relationship between them
- Partitioned values- Quartiles, Deciles, Percentiles
- Graphical determination

4. Measures of Dispersion

- Range
- Mean Deviation
- Standard Deviation

5. Normal Distribution Curve

- Properties of normal distribution
- Standard normal distribution
- Transformation of normal random variables.
- Inverse transformation
- Normal approximation of Bioaxial distribution.

6. Correlation analysis

- Bivariate distribution:
- Scatter Diagram
- Coefficient of correlation
- Calculation & interpretation of correlational coefficient
- T-test, Z-test, P-value

7. Regression analysis

- Lines of regression
- Calculation of Regression coefficient
- Sampling distribution
- Standard error
- Types I & II error

9. Probability (in Brief)

10. Hypothesis Testing

- Null Hypothesis
- Alternative hypothesis
- Acceptance & rejection of null Hypothesis
- Level of significance

11. Parametric & non parametric tests

- Chi square test
- Mann-Whitney U test
- Wilcoxon Signed test
- Kruskal-Wallis test
- Friednam test
- T-test/student T test
- Analysis of variance

Textbooks:

1. B.L Agarwal, (2012), Basic statistics, New Age International Publication.

Reference:

1. Sundarrao, (2002), Introduction to biostatistics and Research Methodology, 1st Ed. CBS.
2. C.R Kothari, (2014) Research methodology, 3rd Ed., New Age international publication.

M.Sc.-MLT –Semester-II for all Specialization

DISSERTATION

Min. Hrs -: 40 Hrs.

Students will do the research work for their dissertation as per the synopsis.

TEACHING SKILLS/SEMINARS / SYMPOSIA/ JOURNAL CLUB ETC.

Min. Hrs -: 80 Hrs.

(a) Teaching Skills

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

(b) Seminar

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

(c) Journal Review Meeting (Journal Club):

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

(d) Work diary / Log Book

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted by the candidate by the student.

M.Sc.-MLT –Semester-II for all Specialization

CLINICAL LAB PRACTICES OR CLINICAL TRAINING*

Min. Hrs -: 120 Hrs.

Clinical Lab Practices

Post graduate students must do:

- Sample collection, storages & analysis of every sample given to them for various parameters.
- They should know proper laboratory management.
- They should work on every instrument according to their specialization.
- Maintenance and care of the instrument of the laboratory.
- They will do hospital/laboratory/blood bank postings for training & skill development.

OR

Clinical Training

The students will get their clinical training in a medical college / 100 bedded hospital with well-equipped Pathology/ Clinical Biochemistry/ Medical Microbiology Laboratory.

M.Sc.-MLT (CLINICAL BIOCHEMISTRY)

Semester-III

CLINICAL BIOCHEMISTRY

Subject Code: MMLT-301CB

Theory- Min. Hrs :- 80 Hrs., Practical- Min. Hrs :- 80 Hrs.,

Course Outcome

- The students will get knowledge about Vitamins, minerals and various investigations.

THEORY

1. Glycated Hemoglobin
-Introduction, Importance
Test for HBA1c Estimation
- 2-Clinical features and laboratory findings in disorders of the plasma proteins; acute phase proteins. Causes of hypoalbuminemia; hypo- and hyperglobulinemias.
3. Lipid profile, Separation of lipoproteins
4. NUCLEIC ACIDS
 - Nucleotides and their bases, DNA, RNA, High energy compounds.
 - Major roles of purines and pyrimidines, synthesis of pyrimidines, pyrimidine salvage, catabolism of pyrimidines, synthesis of purines, purine salvage, catabolism of purines, Gout.
5. VITAMINS
 - Fat- & water-soluble vitamins, sources, requirement, deficiency disorders & biochemical functions.
6. ENERGY METABOLISM AND NUTRITION
 - Food calories, RQ, BMR, RDA, SDA, calorie requirements, proteins in nutrition, fats in nutrition, carbohydrates in nutrition, fibers in nutrition, protein –energy malnutrition, starvation, diet for normal adults, pregnant women, children, etc.
7. MINERAL METABOLISM AND ITS DISORDERS.
 - Macronutrients (Principal mineral elements), Micronutrients-Sodium and potassium, chlorine, calcium and phosphorus, magnesium, sulfur metabolism, Iron, copper, Zinc, Manganese, Molybdenum, Cobalt, Selenium, Iodine, Fluorine, chromium, Water Balance.

PRACTICAL

Clinical Biochemistry Practical

Estimation of blood urea.
Estimation of blood uric acid.
Estimation of serum creatinine.
Estimation of total serum protein.
Estimation of Inorganic phosphorous.
Estimation of Cholesterol/HDL/LDL Cholesterol.
Estimation of Serum Triglyceride
Estimation of Serum Calcium
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

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

M.Sc.-MLT (CLINICAL BIOCHEMISTRY)

Semester-III

Endocrinology

Subject Code: MMLT-302CB

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

Course Outcomes

- To correlate hormones with clinical disorders.
- To provide complete information regarding diagnostics procedures related to hormone testing.

THEORY

ENDOCRINOLOGY

1. Introduction
2. Difference between hormones and enzymes.
3. Classification of hormones.
4. Neurotransmitter families
5. Hormones receptors
6. Regular and general mechanism of hormone, Signal transductions.
7. Regulation and general mechanism of action of hormones.
8. Pituitary gland & hypothalamus and its hormones.
9. Hormones of the Anterior Pituitary- Growth hormone, Prolactin, Gonadotropin, Follicle Stimulating hormone, Luteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotrophic hormone (ACTH)
10. Hormones of posterior pituitary (neurohypophysis)- Oxytocin, Antidiuretic hormone (ADH)
11. 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)
12. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addison's disease, Glucocorticoids & functions, Mineralocorticoids & functions, Cortisol & functions, Cushing's syndrome, Conn's syndrome.
13. Adrenal medulla-metabolism of catecholamines
14. Hormones of the gonads -
Testosterone, Estrogens, Progesterone, their synthesis and functions.
Human Chorionic Gonadotropin (HCG), hormone, menstrual cycle, Menopause
15. Gastrointestinal hormones.
16. Hormone of pancreas - Insulin- its metabolic effects on carbohydrates, fats & protein, control of insulin secretion, Insulin like growth factor, Glucagon- functions, metabolic effects, blood glucose regulation, Diabetes Mellitus, Somatostatin.
17. Hormone of kidney - Renin

ASSESSMENT OF THYROID FUNCTION

- The structure, biosynthesis, secretion, and metabolism of thyroid hormones (thyroxine (T_4), triiodothyronine(T_3), and reverse T_3 (rT_3)). Thyroid physiology and control of thyroid function (thyrotropin-releasing hormone (TRH) and thyrotropin (TSH)).
- The common causes of hypothyroidism and hyperthyroidism
- The laboratory tests for evaluation of thyroid disorders and be able to interpret these analytes in their clinical context with an appreciation for the euthyroid sick state.
- Current analytical methodologies for thyroid testing (TSH methods : 1st-, 2nd-, and 3rd-generation assays; isotopic and non-isotopic methods; T_4 ; free T_3 methods; T-uptake methods; TSH suppression and stimulation tests).

PRACTICAL

ENDOCRINOLOGY

1. Estimation of T_3
2. Estimation of T_4
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. 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,Jayppe 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.

M.Sc.-MLT – (Clinical Biochemistry)
Semester-III
Tumor & Cancer Markers
Subject Code: MMLT-303CB
Theory- Min. Hrs -: 60 Hrs., Practical- Min. Hrs -: 60 Hrs.,

Course Outcome

- To provide knowledge about Tumor & cancer markers.

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-
Definition, Classification, Biochemistry and distribution of tumor markers both protein and carbohydrate.
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).
9. Oncofetal antigens.
10. Alpha feto protein (AFP)
11. Carcino embryonic antigen (CEA)
12. Squamous cell carcinoma (SCC) antigen.
13. Carbohydrate markers (introduction of each type)
CA 15-3, CA 125
14. Blood group antigen (introduction of each type)
CA 19-9, CA 50, CA 72-4, CA 242
15. Bladder cancer markers (introduction) -
Bladder tumor antigen (BTA)
16. Fibrin- Fibrinogen degradation product (FDP).
17. Nuclear matrix protein (NMP22).
18. Biomarkers still in research (introduction)-
Telomeres, TRAP assay, hyaluronic acid and Hyaluronidase
19. Limitations of laboratory assessment various tumor markers and the factors affecting the results of different analytical procedure.
20. The conceptual basis of assays used to screen for malignancy include Bayes theorem.
21. Recent developments in identifying proteomic patterns for cancer detection.
22. Free radicals and Antioxidants

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. Estimation of CA-153
6. Other tests

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, Edinberg.
6. Richard C and Geiffrey S. (2009). Immunology. 6th edition. Wiley Blackwell Publication.

Semester-III

Common to all specialization/discipline

DISSERTATION

Min. Hrs -: 40 Hrs.

Students will do the research work for their dissertation as per the synopsis.

TEACHING SKILLS/SEMINARS / SYMPOSIA/ JOURNAL CLUB ETC.

Min. Hrs -: 80 Hrs.

(a) Teaching Skills

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

(b) Seminar

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

(c) Journal Review Meeting (Journal Club):

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

(d) Work diary / Log Book

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted by the candidate by the student.

Semester-III
Common to all Specialization/Discipline

CLINICAL TRAINING/ CAMPS

Min. Hrs -: 180 Hrs.

The students will get their clinical training in a medical college / 100 bedded hospital with well-equipped Pathology/ Clinical Biochemistry/ Medical Microbiology Laboratory.

They will participate in various medical camps.

M.Sc.-MLT – (Clinical Biochemistry)

Semester-IV

APPLIED BIOCHEMISTRY

Subject Code: MMLT-401CB

Theory- Min. Hrs -: 80 Hrs., Practical- Min. Hrs -: 80 Hrs.,

Course Outcome

- To provide brief knowledge about applied clinical biochemistry.

THEORY

1- Inborn errors of Metabolism

Hereditary anemia, carbohydrate metabolism, lipid metabolism, protein metabolism, nucleic acid metabolism

2- Detoxification

Oxidation, Reduction, Hydrolysis, Conjugation

3- Toxicants in food

Naturally occurring toxicants, Fungal Contamination, Toxic effects of some metals and chemicals

4- Cardiac Profile

Major manifestation of heart disease, Ischemic Heart disease, Angina pectoris, Myocardial Infarction, Hypertension,

5- The chemistry of respiration-

Diffusion of gases in lungs, Transport of oxygen by the blood, Factors affecting dissociation of oxyhemoglobin, cacarboxy hemoglobin, the transport of CO₂ in the blood, buffer systems of the blood, chloride shift, Acid-base balance, Hypoxia

6- Recombinant DNA Technology

Introduction, Biological Importance, Restriction enzymes, DNA Cloning, Polymerase chain reaction, Prenatal Diagnosis, Practical application of Recombinant DNA Technology, Its use in molecular analysis of disease. Restriction fragment Length Polymorphism(RFLP), Gene therapy, Glossary, Clinical aspects

7- Biochemical & Genetic Basis of disease

Introduction, Biochemical standpoint, The major classes of genetic diseases, Pathologic consequences of genetic diseases, Gene therapy

8- The Human Genome project

Principal methods adopted to identify & isolate normal and disease genes, Major finding reported in the rough drafts of the human genome, Major classes of proteins encoded by human genes, Implications for proteomics, biotechnology and bioinformatics, Implications for medicine

PRACTICAL

- | | |
|--|------------------------------------|
| • Estimation of blood sugar | • Estimation of SGOT, SGPT, GGT |
| • Estimation of HbA1c | • Estimation of Serum Amylase |
| • Estimation of blood urea. | • Estimation of LDH |
| • Estimation of blood uric acid. | • Estimation of CK Nac |
| • Estimation of serum creatinine. | • Estimation of CK MB |
| • Estimation of Blood Urea Nitrogen | • Estimation of Sodium |
| • Estimation of Serum Bilirubin- total & direct | • Estimation of Potassium |
| • Estimation of total serum protein. | • Estimation of Phosphorus |
| • Estimation of serum – Albumin | • Estimation of Iron Profile |
| • Estimation of serum – Globulin | • Estimation of Hemoglobin |
| • Estimation of Inorganic phosphorous. | • Estimation of Hexagon Troponin + |
| • Estimation of Cholesterol/HDL/LDL Cholesterol. | • Estimation of Magnesium |
| • Estimation of Serum Triglyceride | • Estimation of Vitamin D |
| • Estimation of Serum Calcium | • Estimation of B12 |
| • Estimation of Alkaline & Acid Phosphatase | • 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.

M.Sc.-MLT – (Clinical Biochemistry)

Semester-IV

AUTOMATION

Subject Code: MMLT-402CB

Theory- Min. Hrs -: 80 Hrs., Practical- Min. Hrs -: 80 Hrs.,

Course Outcome

- To provide comprehensive knowledge of the automation in the laboratory.

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), Nano sensors- advantages and disadvantages, PCR & its applications.

PRACTICAL

Different test

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

All Clinical Biochemistry Practicals/Analysis done on fully Automated Analyzer, Minividas and ELISA Reader etc.

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.

M.Sc.-MLT, Semester-IV
Common to all specialization/discipline

DISSERTATION
Subject Code: MMLT-403CB
Min. hours- 120 hrs.

Every candidate pursuing M.Sc.-MLT degree course is required to carry out research work on a selected research project under the guidance of a recognized postgraduate teacher. The results of such a work shall be submitted in the form of dissertation. Topic for dissertation shall be assigned by the guide.

If the subject of Thesis entails collaboration with other departments or specialties, the collaborative portion of the work will be supervised by Co-Guide, designated by the University Institute of Health Sciences in consultation with the Guide. Where a Co-Guide is involved, the Thesis will be certified jointly by the Guide & Co-guide.

Every candidate shall submit synopsis to the University in the prescribed Performa containing particulars of proposed dissertation work, within 6 months from the date of commencement of the course on or before the dates notified by the university. The synopsis shall be sent through the proper channel. Such synopsis will be reviewed and the university will register the dissertation topic.

No change in the dissertation topic or guide shall be made without prior approval of the university. Guide will be only a facilitator, advisor of the concept and hold responsible in correctly directing the candidate in the methodology and not responsible for the outcome and results.

The dissertation should be written under the following headings.

1. Introduction
2. Aims or objectives of study
3. Review of literature
4. Material and methods
5. Results
6. Discussion
7. Conclusion
8. References
9. Master and Chart & Table (If Applicable)
10. Annexure (If Applicable)

The written text of dissertation/ research project shall not be less than 50 pages and shall not exceed 120 pages excluding references, tables, questionnaires and other annexure. It should be neatly typed in double line spacing on one side of bond paper (A4 size, 8.27" x 11.69") and bound properly. Spiral binding should be avoided. A declaration by the candidate for having done the work himself should also be included, and the guide, head of the department and Director/Coordinator of the institute shall certify the dissertation/ research project.

Every candidate is required to give power point presentation before final submission of dissertation. Four copies of Dissertation/research project shall be submitted to the university, through proper channel, along with a soft copy (CD), 2 months before the final examination. It shall be assessed by two examiners appointed by the university, one internal and one external. There will be a power point open presentation of the submitted dissertation as per the schedule given by the university. This presentation shall be jointly evaluated by external and internal examiner as per the criteria given below:

Objective(s) of the work done	50 Marks
Methodology adopted	100 Marks
Result and Discussion	100 Marks
Conclusion & outcome	50 Marks
Total	300 Marks

To pass in the dissertation a student must secure 150 marks.

If the student failed to secure the minimum passing marks he will resubmit the dissertation 1½ month before the supplementary exam.

M.Sc.-MLT, Semester-IV

Common to all specialization/discipline

TEACHING SKILLS/SEMINARS / SYMPOSIA/ JOURNAL CLUB ETC.

Min. Hrs -: 100 Hrs.

(a) Teaching Skills

Candidates should be encouraged to teach undergraduate students if any. This performance will be based on assessment by the faculty members of the department and from feedback from the undergraduate students.

(b) Seminar

- Seminars /recent advance presentation will be held every week, however, its timings are subject to clinical schedule. Topics must be well researched and must include common knowledge, recent advances, analysis and references.
- PG students should present minimum of two seminars (One in general and one in elective area) and Internal Assessment marks will depend on better topic selection and presentation.

(c) Journal Review Meeting (Journal Club):

The ability to do literature search, in depth study, presentation skills, and use of audio- visual aids are to be assessed. The assessment is made by faculty members and peers attending the meeting.

(d) Work diary / Log Book

Every student shall maintain a work diary and record his/her participation in the training programmes conducted by the department such as journal reviews, seminars, etc. Special mention may be made of the presentations by the candidate as well as details of clinical practice, if any conducted by the candidate by the student.

M.Sc.-MLT, Semester-IV

Common to all specialization/discipline

CLINICAL LAB PRACTICES OR CLINICAL TRAINING

Min. Hrs -: 180 Hrs.

Clinical Lab Practices

Post graduate students must do:

- Sample collection, storages & analysis of every sample given to them for various parameters.
- They should know proper laboratory management.
- They should work on every instrument according to their specialization.
- Maintenance and care of the instrument of the laboratory.
- They will do hospital/laboratory/blood bank postings for training & skill development.

OR

Clinical Training

The students will get their clinical training in a medical college / 100 bedded hospital with well-equipped Pathology/ Clinical Biochemistry/ Medical Microbiology Laboratory for at least one month.