Ordinance & Syllabus
For
M.Sc. – MLT
academic programme

Duration :
2 years

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

ORDINANCE

Chapter
"A"

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.
   - The pattern of this course shall be annual. This course shall be divided into two professional examinations namely M.Sc.-MLT-1st Year at the end of first academic year, M.Sc.-MLT-2nd year at the end of second academic year.

3. **Specialization/Discipline**
   There shall be following specialization/discipline:
   - **M.Sc.-MLT in Clinical Biochemistry**
   - **M.Sc.-MLT in Pathology**
   - **M.Sc.-MLT in Medical Microbiology & Immunology**

   M.Sc.-MLT Degree will be awarded as per the specialization/discipline of the student passed.

4. **No. of Seats**
   There shall be 10 seats in each specialization/discipline. Total no. of seats will be 10x3=30

5. **Admission.**

   Eligibility Criteria:
   - The students who have passed B.Sc.-MLT Course from any recognized Institutions/ University with minimum of 55% marks (50% for SC/ST)
   - Candidates passing B.Sc MLT through Correspondence course shall not be eligible.

   Mode of Admission:

   - The candidates for admission to this course shall be selected through an entrance test conducted by the University or on the basis of merit of marks in B.Sc.-MLT or as per the rule decided by the CSJM University time to time.

6. **Medium of instruction:**
   English shall be the medium of instruction in the class and in the University examination.

7. This Course shall be run under self finance scheme.

8. 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. Training should include involvement in hospital/laboratory, experimental work and research studies. Student admitted in this course should take part in seminars, group discussion, core demonstrations, journal review meeting and other continuing education programme, workshop, under graduate teaching activities and community work etc.

9. Course of Study

There are three specialization/discipline in M.Sc.-MLT Course

1. Clinical Biochemistry
2. Pathology
3. Medical Microbiology & Immunology

Subjects in the first year shall be common to all the four specialization/discipline. In the second year the student will study the subject of his/her specialization/discipline. They will appear in the examination accordingly.

M.Sc.-MLT –Part-1 (1st Year)

S. No.	Subjects	Subject code	Teaching Hours		
			Theory	Practical	Total
1.	Biochemistry, Biomedical Techniques & Laboratory Management	MMLT-101	160	160	320
2.	Clinical Pathology, Hematology & Immunopathology	MMLT-102	160	160	320
3.	General Microbiology, Immunology and Immunological Techniques	MMLT-103	160	160	320
4.	Research Methodology & Biostatistics	MMLT-104	100	-	100
5.	Dissertation		-	-	-
6.	Teaching Skills/ Seminars/Symposia/Journal Club etc.*		-	-	260
		Total Hours			1320

*** Not included in University Exam**

M.Sc.-MLT –Part-2 (2nd Year)

Specialization/Discipline– Clinical Biochemistry

S. No.	Subjects	Subject code	Teaching Hours		
			Theory	Practical	Total
1.	Clinical Biochemistry	MMLT-201B	160	160	320
2.	Endocrinology, Tumor Markers & Automation	MMLT-202B	160	160	320
3.	Dissertation	MMLT-203	-	-	-
4.	Teaching Skills/ Seminars/Symposia/Journal Club etc.*	-	-	-	260
5.	Clinical Lab Practices*	-			440
		Total Hours			1340

*** Not included in University Exam**

M.Sc.-MLT –Part-2 (2nd Year)

Specialization/Discipline– Pathology

S. No.	Subjects	Subject code	Teaching Hours		
			Theory	Practical	Total
1.	Hematology & Clinical Pathology	MMLT-201P	160	160	320
2.	Blood Transfusion	MMLT-202P	160	160	320
3.	Dissertation	MMLT-203	-	-	-
4.	Teaching Skills/ Seminars/Symposia/Journal Club etc.*	-	-	-	260
5.	Clinical Lab Practices*	-			440
		Total Hours			1340

*** Not included in University Exam**

M.Sc.-MLT –Part-2 (2nd Year)

Specialization/Discipline – Medical Microbiology & Immunology

S. No.	Subjects	Subject code	Teaching Hours		
			Theory	Practical	Total
1.	Systemic Bacteriology, Applied Microbiology and Immunology	MMLT-201M	160	160	320
2.	Virology, Mycology & Parasitology	MMLT-202M	160	160	320
3.	Dissertation	MMLT-203	-	-	-
4.	Teaching Skills/ Seminars/Symposia/Journal Club etc.*	-	-	-	260
5.	Clinical Lab Practices*	-			440
		Total Hours			1340

*** Not included in University Exam**

10. Attendance to appear in the annual University examination :

The permission to appear in annual 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.

11. 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 (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 candidate by the student.

(f) Mid Term Examination/Class Test/Assignments

There will be half yearly examination on the students of every academic year. Various class test may be taken by the department and assignments may be given to students on various topics. Marks of half yearly examination will be included in internal assessment.

(g) Records

Records, log books and marks obtained in half year exam/tests will be maintained by the Head of the Department and will be made available to the University.

12. Dissertation:

Every candidate pursing 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.

Fulltime recognized PG Teacher/Guide from other institute can act only as a co-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), 6 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.

13. 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.

- **For M.Sc.-MLT in Pathology**
  MBBS, MD (Pathology) with 02 years teaching/professional experience.
  Or
  MBBS, Ph.D. (Faculty of Medicine) with 02 years teaching/professional experience in related subject.
  Or
  MBBS with 5 years teaching experience in related subject.
  Or
  M.Sc.-MLT in Pathology or related subject with 5 years teaching experience after the post graduate qualification in teaching institute.
- **For M.Sc.-MLT in Medical Microbiology & Immunology**
  MBBS, MD (Medical Microbiology)/M.B.B.S, M.Sc.-in Medical Microbiology with 02 years teaching/professional experience.
  Or
  MBBS, Ph.D. (Faculty of Medicine) with 02 years teaching/professional experience in related subject.
  Or
  MBBS with 5 years teaching experience in related subject.
  Or
  MBBS/Ph.D.(Life Science) with 5 years teaching experience in related subject.
  Or
  M.Sc. (Medical Microbiology) or M.Sc.-MLT in Microbiology and Immunology/ related subject with 5 years teaching experience after the post graduate qualification in 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.

14. Examination :

There shall be an annual University examination at the end of each academic year in the form of theory papers examination and practical examinations. The candidate shall be required to appear in every subject as specified in the course structure for each year.

Duration of Examination :

Each theory paper examination shall be of three hours duration.

Examiners :

The board of examiners for theory papers examination shall consist of 50% internal and 50% external examiners and for practical examination there should be one external examiner and one internal examiner (of the institute). All examiners shall be decided by honorable Vice Chancellor of the University.

Evaluation :

The answer books of the annual University examination shall be evaluated as per the university rules.

"B"

Regulations : Scheme of Examination

M.Sc.-MLT –Part-1 (1st Year) University Examination
(Common to all specialization/discipline)

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1.	Biochemistry, Biomedical Techniques & Laboratory Management	MMLT-101	80	20	100	50	80	20	100	50	200
2.	Clinical Pathology, Hematology & Immunopathology	MMLT-102	80	20	100	50	80	20	100	50	200
3.	General Microbiology, Immunology and Immunological Techniques	MMLT-103	80	20	100	50	80	20	100	50	200
4.	Research Methodology & Biostatistics	MMLT-104	80	20	100	-	-	-	-	-	100
										Grand Total	700

M.Sc.-MLT –Part-2 (2nd Year) University Examination

Specialization/Discipline– Clinical Biochemistry

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1.	Clinical Biochemistry	MMLT-201B	80	20	100	50	80	20	100	50	200
2.	Endocrinology, Tumor Markers & Automation	MMLT-202B	80	20	100	50	80	20	100	50	200
3.	Dissertation	MMLT-203	-	-	-	-	-	-	300	150	300
										Grand Total	700

M.Sc.-MLT –Part-2 (2nd Year) University Examination

Specialization/Discipline– Pathology

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1.	Hematology & Clinical Pathology	MMLT-201P	80	20	100	50	80	20	100	50	200
2.	Blood Transfusion	MMLT-202P	80	20	100	50	80	20	100	50	200
3.	Dissertation	MMLT-203	-	-	-	-	-	-	300	150	300
										Grand Total	700

M.Sc.-MLT –Part-2 (2nd Year) University Examination

Specialization/Discipline– Pathology

S. No.	Subjects	Subject code	THEORY MARKS				PRACTICAL MARKS				Total marks
			Theory Paper	Internal Assessment	Total	Minimum marks	Practical	Internal Assessment	Total	Minimum Marks	
1.	Systemic Bacteriology, Applied Microbiology and Immunology	MMLT-201M	80	20	100	50	80	20	100	50	200
2.	Virology, Mycology & Parasitology	MMLT-202M	80	20	100	50	80	20	100	50	200
3.	Dissertation	MMLT-203	-	-	-	-	-	-	300	150	300
										Grand Total	700

Internal Assessment

- It will be for theory and practical both.
- It will be done through the whole year.
- Candidate must obtain at least 35% marks in theory and practicals separately in internal assessment to be eligible for the annual university examination.

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

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

Total = 20 marks

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

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

Total = 20 marks

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

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

Total = 20 marks

Criteria for Passing

- A candidate is declared to have passed University examination in a subject, if he/she secures 50% of the marks in theory and 50% in practicals separately. For computation of 50% marks in theory, the marks scored in the internal assessment (theory) shall be added to the University conducted written examination and for passing in practical the marks scored in University conducted practical examination and internal assessment (practical) shall be added together.

Grace Marks:

- If a candidate fails in one subject (theory only) in the annual University examination, five grace marks will be given to the candidate by the University before the declaration of result.
- Candidate failing in practical examination will be considered as failed.

Supplementary Examination:

- A candidate failing in a subject but securing at least 30% aggregate marks will be required to appear in the university examination after 3 months in that subject/ subjects while attending classes of next year. Those who secure less than 30% aggregate marks will be required to appear in all the subjects.
- If the candidate fails in supplementary examination his/her session will be shifted by one year. The candidate will have to take admission in the previous year and pay the tuition, examination and other fee for the academic year. He/she will have to appear in all the subjects in the examination.
- Supplementary examination will be held not earlier than 3 months and later than 6 months from the date of annual University examination.

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:

- Candidate will be awarded division at the end of 2nd academic year as follows:
  - Distinction - 75% and above marks in any subject.
  - First division - 60% and above in the aggregate of marks of all subjects
  - Second division- 50% or more but less than 60% in the aggregate of marks of all subjects.

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.

"C"

Fee Structure

Tuition Fee, Examination fee and other fees - As decided by the University from time to time.

Security Deposit/ Caution Money (Refundable after completion of the course): As decided by the University from time to time.

"D"
Syllabus

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

M.Sc.-MLT -First Year

Biochemistry, Biomedical Techniques & Laboratory Management
Subject Code : MMLT-101
Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

THEORY

A - BIOCHEMISTRY

1. CHEMISTRY OF CARBOHYDRATES
   - Definition and Function
   - Classification
   - Isomerism of Monosaccharides
   - Properties of Monosaccharides
   - Modified Monosaccharides
   - Disaccharides
   - Polysaccharides
1. CHEMISTRY OF PROTEINS
   - Definition, function of Proteins
   - Classification of Amino acids
   - Properties of Amino acids
   - Classification and properties of proteins
   - Structural organization of proteins
2. CHEMISTRY OF LIPIDS
   - Definition and function of Lipids
   - Classification of Lipids
   - Properties of Lipids
3. NUCLEIC ACIDS
   - Nucleotides and its bases
   - DNA in detail
   - RNA and its classification
   - High energy compounds
4. ENZYMES
   - Classification of Enzymes
   - Factors affecting enzyme activity
   - Inhibitors
   - Specificity
   - Enzyme Kinetics
   - Enzymes in clinical diagnosis
5. Clinical significance, principle of estimation
   - Bilirubin General types and Jaundice
   - Liver Function Test
     - i) Bilirubin estimation
     - ii) Alkaline phosphates and acid phosphates estimation
     - iii) SGOT, SGPT Estimation
   - Glucose tolerance test (GTT) importance and principle and techniques of GTT
   - Insulin tolerance test

- Gastric juice analysis
- Xylose absorption test
- Analysis of calculi

6. Cerebrospinal fluid analysis
   - Composition and function of CSF
   - Clinical significance of CSF analysis
   - Estimation of sugar and proteins in CSF
7. Urine chemistry
   - Automation in Urine chemistry
   - Physical and Chemical examination of Urine samples. Qualitative tests for inorganic urinary ingredients
   - Common qualitative and quantitative tests of urine
   - Clearance test for urine function
8. Blood gases and pH, carboxyhemoglobin, CO, Met Hb, O_2 saturation
9. Blood collection procedures- theory of anticoagulation.
10. Bio-Medical waste: Types, potential risks and their safe management.

B: -BIOMEDICAL TECHNIQUES

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-cemsitry, 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.

C. LABORATORY MANAGEMENT

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

CLINICAL BIOCHEMISTRY

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- Analysis of body fluids.
8- Biochemical examination of semen.
9- Buffers & Buffering Capacity.
10- Estimation of blood sugar by Folin wu method & Glucose Oxidase Method
11- Estimation of blood urea.
12- Estimation of blood uric acid.
13- Estimation of serum creatinine
14- Estimation of total serum protein
15- Estimation of Inorganic phosphorous
16- Estimation of Cholesterol/HDL/LDL Cholesterol by enzymatic method.
17- Estimation of Serum Triglyceride
18- Estimation of Serum Calcium
19- Estimation of Serum Bilirubin- total & direct

20- Estimation of Alkaline & Acid Phosphatase
21- Estimation of SGOT, SGPT, GGTP
22- Estimation of LDH
23- Estimation of serum – total protein
24- Estimation of serum Globulin
25- Estimation of serum – Albumin
26- Estimation of CK Nac
27- Estimation of CK MB
28- Estimation of Sodium
29- Estimation of Potassium
30- Estimation of Phosphorus
31- Estimation of TIBC
32- Estimation of Hemoglobin
33- Estimation of Serum Amylase
34- Estimation of common parameters in urine through use of strips.

BIOMEDICAL TECHNIQUES

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

LABORATORY MANAGEMENT

Demonstration of various methods of quality control

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

M.Sc.-MLT -First Year

Clinical Pathology, Hematology & Immunopathology
Subject Code : MMLT-102
Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

THEORY

A. CLINICAL PATHOLOGY

1. Collection, transport, preservation and processing of various clinical specimens
2. Urine examination, Physical, chemical and microscopic.
3. Test for haemosiderin pigment.
4. Renal function tests.
5. Stool examination
   - collection of specimen of feaces
   - 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
   - Augumented Histamin 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. Body fluids
   Microscopic examination of Pleural, Pericardial, synovial, ascitic and peritonial fluid.
10. Pregnancy Test- Method, interpretation.

B. HEMATOLOGY

1. Haemotopoesis – Origin, development, function and fate of blood cells.
2. Erythropoiesis – Origin, development of RBCs, biosynthesis of Hb, control of Erythropoiesis.
3. Disorders of Red blood cells, Erythrocyte Indices, Red cell inclusion bodies
4. Anaemia-
   Definition, Pathophysiology, classification -morphologic and Etiologic classification and clinical features. Investigations in a case of anaemia.
   Morphologic – Microcytic hypochromic anaemia, macrocytic anaemia.
   Haemolytic anaemias – Definition, classification, clinical features.

Investigations to establish a case of hemolytic anaemia.
Tests done -
i. Peripheral smear – specific morphologic abnormalities
ii. Reticulocyte count
Corrected reticulocyte count
Reticulocyte production index
iii. Osmotic fragility test
iv. Coomb's test
v Sickling phenomenon
vi. Kleihauer acid Elution test
vii. Alkali denaturation test
viii Ham's test, Sucrose lysis Test
ix Electrophoresis – HbF & Hb A_2 estimation
x. Test for G6PD deficiency
Aplastic anemia. Pancytopenia, Anemia due to abnormal globin synthesis
Polycythaemia.

4. Disorders of white Blood cells – Leucocytosis, Leukopenia, Leukaemoid reaction, Myelodysplastic syndrome(MDS) .
Leukaemias –Definition, Etiology, Clinical features.
Classification- [French American British- FAB classification], Lab Investigations
Cytochemistry of Acute leukaemias
Chronic myeloid leukaemia -clinical presentation. Investigations. Philadelphia chromosome.
Leucocyte Alkaline Phosphatase [LAP score.]
Chronic lymphocytic leukaemia
5. Plasma cell disorders – classification
Plasma cell myeloma – definition,clinical features, investigations.
6. Myelo Proliferative disorders – general features, classification – investigations
Lympho Proliferative disorders - general features, classification, Investigations
7.
8. Lipid Storage Disorders
9. Haemoparasites
10. Bone marrow examination
11. Haemorrhagic disorders
Definition – Pathogenisis, Clinical feature, Classification. - vascular disorders, Platelet disorders, coagulation disorders, Fibrinolysis.
Normal haemostasis
Investigation of heamorrhagic disorders
Tests of vascular and Platelet function – Bleeding time, Clot retraction, Platelet count
B.M Aspiration, Platelet Aggregation Studies.
Tests for Coagulation Disorders
Screening test – First line tests
Prothrombin time (PT), Activated Partial Thromboplastin Time(APTT), Thrombin Time (TT)
Second line tests – Mixing experiments. Urea Solubility Test [Test for Factor XIII]
Coagulation Factor assay. Factor VIII: C Inhibitor Study.
Disseminated Intravascular Coagulation [DIC]-Definition, Pathophysiology, Clinical Feartures and Laboratory Investigations.
Fibrinogen assay
12. Thrombotic disorders –Classification, Pathogenesis, Clinical Features and Laboratory Investigations. Antiphospholipd, Antibody Syndrome.
13. Automation in Haematology

C. 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 foetails, warm-antibody disesases, 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, Dermatomyosis, Rheumatic fever, Rhematoid arthritis, Progressive systemic sclerosis.
6. Atopic anaphyllactic reactions: reaginic antibody, anaphylaxis, atopic allery – factors involved, asthma, hay fever, food allergy, insect allergy, atopic eczma, delayed hypersensitivity reactions, contact dematitis, viral infections, graft-host relationship in pregnancy.
7. Autoallergic diseases: encephalomyelitis, multiple sclerosis, orchitis, thyroiditis, sjogren's syndrome.
8. Granulomatous reactions: Infectious diseases like Tuberculosis, Leprosy.
9. Autoimmune diseases-organ specific and systemic.
10. Immunomodulators
11. Clinical transplantation-Kidney, Bone marrow, Heart.
12. Immunology of AIDS, Tumour and Tumour markers.
13. Immunohaematology- Campatibility testing.

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. HEMATOLOGY

1. Blood collection. Anticoagulants used in Hematology
2. Red cell indices
3. E.S.R., PCV, Platelet count, Absolute Eosinophil count
4. Reticulocyte count
5. Stains used in Hematology
   i. Preparation of blood film
   ii. Preparation of Leishman's stain, Giemsa stain and MGG stain
6. Peripheral smear staining by Leishman's stain. Interpretation of peripheral smear. Differential count.
7. Microcytic hypochromic anemia –
   Investigations including serum Iron & TIBC
8. Macrocytic anemia- Investigations including B_{12} & folate assay, schilling test
9. Hemolytic anemia- General Lab investigations

10. Hemolytic anemia- Special Tests.
    i. Osmotic fragility test
    ii. Alkali denaturation test
    iii. Sickling test
    iv. Hb electrophoresis
    v. Investigations of G6PD deficiency
    vi. Autoimmune hemolytic anemia investigations
    vii. Coomb's test
11. Blood Parasites
12. Bone marrow – preparation of bone marrow smears, Trephine biopsy smears Staining of B.M Aspiration Smears. Demonstration of Iron stain
13. Leukemia - Interpretation of Peripheral smear in Leukemia. Cytochemical stains – Demonstration
14. Haemorrhagic disorders
    i. Collection and anticoagulants used – Demonstration
    ii. BT, CT – Demonstration
    iii. PT, INR, APTT, TT- Demonstration
    iv. Mixing experiments – Demonstration
    v. Test for D-Dimers- Demonstration
    vi. Assay of coagulation factors - Demonstration
    vii. Factor VIII: C Inhibitor Study – Demonstration
    viii. Urea Solubility Test for Factor XIII- Demonstration
    ix. Fibrinogen assay - - Demonstration
15. Thrombotic work up - Demonstration Investigation for Antiphospholipid Antibody- Demonstration
16. Automation in hematology - demonstration
17. Cleaning of glassware
18. Preparation of Stains, Reagents, Diluting fluids.

C. IMMUNOPATHOLOGY

1. Serological tests (Screening &diagnostic) used in different pathological conditions.
2. Delayed type hypersensitivity testing.
3. Detection of tumor & cancer markers.
4. Histocompatibility testing.
5. Blood grouping & cross matching.
6. Coomb's Test - Direct & Indirect.
7. Setting up of Immuno histochemistry lab.

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

M.Sc.-MLT -First Year

General Microbiology, Immunology and Immunological Techniques
Subject Code : MMLT-103
Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

THEORY

A. GENERAL MICROBIOLOGY

1. General aspects.

The investigation of biological samples in infectious diseases is different from the other branches in that it requires general knowledge of pathogenic agents (bacteria or viruses) and of host reaction.

- Definition of infection and infectious disease: natural bacteriological ecosystem.
- Pathogenicity of bacteria and viruses.
- General epidemiology of infection and infectious diseases.
- Sterilization & Disinfection
- Culture media and its preparation
- Bacteriology of Milk, Water and Air

2. Diagnostic procedures.

- Specimen selection and collection (blood, urine, sputum, faeces, others).
- Specimen processing: smears, staining, cultures including cell cultures, susceptibility testing, antigen detection.
- Preservation of cultures
- Usual techniques for microbe and virus identification (including principal differential characteristics).
- Molecular biology techniques for characterization of microbes and viral agents.
- Bacteriological and viral serology.

3. Bacterial and viruses.

Brief description of responsible bacteria and viruses in bacteriological and viral syndromes or diseases (including principal differential characteristics).

- Bacterial: *Neisseria gonorrhoeae* and *N. meningitidis*, *Staphylococcus aureus*, Coagulase Negative Staphylococcus, *Streptococcus pyogenes* (especially *S. agalactiae* and *S. pneumonia*), *Escherichia coli*, *Salmonella*, *Shigella* and other Enterobacteriaceae,
- *Vibrio cholerae*, *Pseudomonas aeruginosa*, *Haemophilus influenzae*, *Clostridium perfringens*, *C. tetani*, *Bacteroides* spp, *Lister monocytogenes*, *Legionella*, *Mycobacterium tuberculosis* and others, *Treponema pallidum*, *Chlamydia*, *Mycoplasma*, etc.Corynebacterium diphtheriae, Bacillus anthracis, B.cereus, Non sporing Anaerobes, Bordetella, Brucella, Yersinia, Actinomyces, Pasteurella, Franciesella,
- Viruses: herpes (herpes simplex, herpes varicellae, cytomegalovirus, Epstein Barr virus); hepatitis A, B, C, D, E; human immunodeficiency virus; enteroviruses (poliovirus); rubella, mumps, measles, parvovirus B19, RSV, myxovirus, rhinovirus, coronavirus, adenovirus, rotavirus, papillomavirus, rabies, Arboviruses, Poxviruses, Oncogenic Viruses, etc.

4. Antibiotics and antiviral agents

- Basic knowledge of antibiotics and antimicrobial therapy.
- Antibiotic and antiviral sensitivity test.
- Antibiotic and antiviral resistant mechanisms.

5. Medical Parasitology & Mycology

Epidemiology, main clinical signs, basis for biological diagnosis (including a brief description of parasites and fungi without biochemical characteristics), treatment.

- Amoebiasis: *Entamoeba histolytica.*
- Giardsis, cryptosporidiosis and uro-genital trichomoniases.

- Malaria.
- Toxoplasmosis.
- Intestinal, hepatic and urinary helminthiasis: strongyloidiasis, ancylostomiasis, enterobiasis, ascariasis, schistosomiasis (*Schistosoma mansoni* and *S haematobium*), fascioliasis (*Fasciola hepatica*) and taeniasis (*Taenia saginata*).
- Fungal infections (*Candida albicans*, *Cryptococcus neoformans*, etc.).
- Aspergillus infections (*Aspergillus fumigatus*).
- Dermatophyte infections (*Microsporum canis*, *Epidermophyton floccosum*, *Trichophyton rubrum*, *Trichophyton mentagrophytes*).
- Leishmaniosis.
- Echinococcosis.
- Pneumocystosis.
- Filariasis.
- Leptospirosis

6. Usual techniques for parasite and fungus identification.
7. Immunological and molecular diagnosis of parasitic and mycological diseases.

B. IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

Characteristics of the Immune System

1. Define CD antigens.
2. Define primary and secondary lymphoid tissues.
3. Define mucosal-associated lymphoid tissues.
    - oral
    - nasopharyngeal
    - gut-associated
    - reproductive
4. Describe blood-lymph circulation and lymphatics.
5. Organization of lymph nodes
    - Explain hematopoietic cell distribution in lymph nodes.
    - Provide examples and locations of lymph nodes in head and neck.

Innate and Adaptive 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

Adaptive Immunity

- Humoral immunity.
- Cell-mediated immunity.
- T cells, T cell subsets, B cells, and plasma cells.

Antigens and Immunogens

- Antigen and immunogen.
- Relative antigenicity of macromolecules.
- Antigenic determinants and epitopes.
- Types of antigens with examples.
- 'Hapten' and its function in the immune system

Immunoglobulins (Igs)/Antibodies (Abs):
1. Source from B cells and plasma cells
2. B cell/antibody/specificity relationship
3. Structure of immunoglobulins:
    - Molecular components of Igs
    - Heavy and light chains
    - Variable and constant regions
    - Define allotype, isotype, idiotype.

Classification of immunoglobulins
1. Differences based on heavy and light chains.
2. Functional properties of Ig classes.
3. Evidence for number of antigenic determinants recognized by Igs.

T cells
1. Classification of T cells (Th1, Th2, αβ and γδ T cells).
2. Molecular and cellular features of T cell receptor (TCR) to B cells receptor (Ig molecule).
3. Development of T cells in the thymus.
4. The genes' rearrangement in TCR development.
5. T cell-associated molecule - the TCR complex
    - CD3 molecules
    - T cell signaling by CD3
6. Define αβ and γδ T cells, including
    - Tissue distribution
    - Differential functions of αβ and γδ T cell.

The Complement System
1. Complement system and how it is used.
2. Step-by-step examples of how complement works:
    - The classical complement pathway
    - The alternate complement pathway
3. Representative infectious agents and products that activate complement.
4. Biological effects mediated by complement.
5. The effects of complement on the immune system.
6. The significance of complement at oral mucosal surfaces.

Antigen Processing and Presentation
1. Use as a function of T cell activation.
2. Cells involved in antigen processing and presentation.

The Major Histocompatibility Complex (MHC)
1. Gene nomenclature for MHC antigens.
2. Numbers of human MHC genes.
3. The tissue distribution of MHC antigens.
4. The structure of MHC Class-I and Class-II molecules.
5. Processing of Peptide Antigens

Cell-Mediated Immunity (CMI)
1. Cells involved in CMI and the role played in the immune response.
2. The mechanisms of tissue cell destruction by T cells.
3. Concept of 'Memory T Cell'.
4. Natural Killer (NK) cell.
5. 'Super Antigen' and give examples in disease.

PRACTICAL

A. GENERAL MICROBIOLOGY

1. Collection of clinical materials like blood, urine, stool, sputum, swabs, CSF etc.
2. Parasitology - collection, preservation and transportation of faecal material for examination of parasites. Concentration techniques of stool for ova and cyst. Wet preparation of faecal sample for ova and cyst. Identification of ova and cyst in stool sample.
3. Procedure of techniques of sputum for AFB.
4. Procedure of skin clipping of Leprae Bacilli.
5. Identification of organisms with Biochemical reactions of common organism like - Staphylococus, E.coli - Klebsiella, shigella, Salmonella, Proteus, Pseudomonas.
6. Antibiotic Sensitivity tests
7. Preservation of stock culture
8. Bacteriology of water
9. Collection of specimen for fungal examination like skin scrapings, swabs, CSF.
10. Fungal examination by wet preparation
11. Fungal culture
12. ELISA HIV & HBsAg test (Demonstration only)
13. Western blot test (Demonstration Only)
14. Incubation of fertile eggs and inoculation by various routes. (Demonstration only)

B. IMMUNOLOGY AND IMMUNOLOGICAL TECHNIQUES

1. VDRL Tests
2. Brucella Agglutination test
3. Weil felix test (Demonstration only)
4. Paul Bunnel test (Demonstration only)
5. RA test
6. CRP test
7. TPHA
8. ELISA
9. ASLO
10. WIDAL
11. Pregnancy Test

M.Sc.-MLT -First Year

Research Methodology & Biostatistics
Subject Code : MMLT-104
Theory- Min. Hrs -: 100 Hrs.

THEORY

RESEARCH METHODOLOGY

1. Research in Laboratory Technology
   - Introduction
   - Research for Laboratory Techniques: Why? How? and When?
   - Research – Definition, concept, purpose, approaches
   - Internet sites for Laboratory Technician

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 in Laboratory Technology.

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

BIOSTATISTICS

1. Biostatistics
   - Introduction
   - Definition
   - Types
   - Application in Laboratory Technology
2. Data
   - Definition
   - Types
   - Presentation
   - Collection methods
3. Measures of central value
   - Arithmetic mean, median, mode. Relationship between them
   - Partitioned values- Quatertiles, 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

12. Sampling
    - Definition
    - Types-Simple, Random, Stratified, Cluster & Double Sampling.
    - Need for sampling
    - Criteria for good samples
    - Application of sampling in community
    - Procedures of sampling & sampling design errors.

M.Sc.-MLT –First Year

Teaching Skills/Seminars/Symposia/Journal Club etc.
(Common to all specialization/discipline)
Min. Hrs -: 260 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 –Second Year

Clinical Biochemistry

Subject Code : MMLT-201B

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.,

THEORY

1. CARBOHYDRATE METABOLISM AND ITS DISORDERS.
   - Chemistry and Metabolism of carbohydrates.
   - Clinical features and laboratory findings in insulin resistance, Type 1, Type 2 and
   - gestational diabetes mellitus; diagnostic and monitoring criteria for diabetes; investigation of hypoglycemic syndromes.
   - Glucose tolerance test procedures and interpretation; in pregnancy.
   - Ketosis and lactic acidosis.
   - Differential diagnosis of coma; hyperosmolar coma.
   - Hemoglobin A1c; fructosamines; C-peptide.
   - Insulin tolerance test; glucagon and somatostatin.
   - Use and dangers of provocative tests, e.g. tolbutamide and glucagon.
   - Assay of insulin, proinsulin and insulin antibodies.
   - Albuminuria.
   - Antibodies (anti-GAD, Anti-insulin, ect.).

2. PROTEINS, DISORDERS OF PROTEIN METABOLISM.
   - Chemistry and Metabolism of Proteins and Ammaino acids.
   - Clinical features and laboratory findings in disorders of the plasma proteins; acute phase proteins.
   - Serum protein and albumin, serum and urine protein electrophoresis.
   - Causes of hypoalbuminemia; hypo- and hyperglobulinemias.
   - Alpha-1-antitrypsin deficiency.
   - Ammaino aciduras, screening test for ammaino acid disorders.
   - Methods for protein detection in body fluids.

3. LIPID METABOLISM AND LIPOPROTEIN DISORDERS.
   - Complete Chemistry and metabolism of lipids.
   - Clinical features and laboratory findings in disorders of triglycerides, lipoproteins and cholesterol metabolism.
   - Lipoproteins and apolipo proteins metabolism; HDL, LDL, VLDL, apoA, apoB, apoC, apoE and their receptors.
   - Fat absorption, transport, storage and metabolism.
   - Investigation and principles of treatment of hyperlipidemias.
   - Assessment of risk factors for atherosclerosis.
   - Lipoprotein, lecithin: cholesterol acyltransferase (LCAT).
   - Lipid profile, Separation of lipoproteins

4. CHEMISTRY AND METABOLISM OF 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, 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.

- Sodium and potassium, chlorine, calcium and phosphorus, magnesium, sulfur metabolism, Iron, copper, Zinc, Manganese, Molybdenum, Cobalt, Selenium, Iodine, Fluroine, chromium, Water Balance.

8. BIOLOGICAL OXIDATION AND ELECTRON TRANSPORT CHAIN (ETC.)

- Oxidoreductases, Redox potential, Mitochondrial respiratory chain, electron shuttles, oxidative Phosphorylation, Uncouplers of oxidative Phosphorylation.

9. LIVER AND BILIARY TRACT STATUS

- The dynamics and mechanisms of liver enzyme release and the clinical utility of measuring hepatic enzymes (e.g., aspartate aminotransferase, alanine aminotransferase, γ-glutamyltransferase, alkaline phosphatase, and lactate dehydrogenase).
- The biochemical assessment of liver function by nonenzyme analytes such as albumin, ammonia, bile acids, bilirubin, urea nitrogen, cholesterol, total protein, and triglycerides.
- Bilirubin metabolism, fractionation of bilirubin (conjugated, unconjugated, δ-bilirubin, direct vs indirect) and unique aspects of neonatal bilirubin. Understand the conditions and genetic defects that affect bilirubin metabolism, transport and clearance (e.g., Gilbert disease and Dubin-Johnson syndrome).
- Jaundice

10. RENAL FUNCTION

- The basic physiology of renal function. The basic categories of renal diseases (e.g., pre renal azotemia, obstructive azotemia, glomerulonephritis, acute vs chronic renal failure, uremic syndrome) and be familiar with the National kidney Foundation practice guidelines for these conditions. The laboratory analytical methods (e.g., Jaffe vs creatinase) for the assessment of renal function (creatinine, urea nitrogen, glomerular filtration rate) and proteinuira. The concept of creatinine clearance, how it can be used to estimate glomerular filtration rate, and the various methods employed to measure it. Renal handling of electrolytes and key metabolites and the interpretation of urinary electrolyte measurements.
- The definition of osmolality, molecules in serum that contribute to osmolality, and calculation of osmolal gap as well as the principle of the osmometer. The common pitfalls and sources of error during estimation of the osmolal gap (e.g., hyperproteinemia, hyperlipidemia, hypermagnesemia). The differential diagnosis of an unexplained, increased osmolal gap, including alcohol or glycol ingestion, alcoholic or diabetic ketosis or ketoacidosis, and osmotherapy (e.g., mannitol or glycerol administration), among others. The principles of fluid balance.

11. GASTRIC & PANCREATIC FUNCTION

- The clinical manifestations of gastric, pancreatic, and intestinal disease and diagnostic methodologies such as the breath tests for Helicobacter pylori, fecal occult blood, lipase and amylase (e.g., fractionation of amylase; pancreatic vs salivary and amylase/creatinine clearance ratio).
- The role of gastrointestinal hormones and enzymes in digestion and the evaluation of malabsorption and diarrheal sydromes.

12. ACID-BASE CHEMISTRY WATER AND ELECTROYLTES BALANCE.

- Define the Henderson-Hasselbach equation. Physiologic buffers systems and the role of respiratory and renal compensation. Categories of clinical disorders of acid-base balance (metabolic and respiratory acidosis, metabolic and respiratory alkalosis, mixed disorders).
- The differential diagnosis of common electrolyte disorders

13. ISOENZYMES AND CLINICAL ENZYMOLOGY

14. PEDIATRIC CLINICAL BIOCHEMISTRY

- Problems of specimen collection; capillary specimens.
- Reference range differences in infants and children: Those that vary significantly with age and sex (inorganic phosphorus, creatinine, alkaline phosphatase, aspartate aminotransferase, creatine kinase).
- Special problems in pediatrics: Respiratory distress syndrome , gastrointestinal disease (fat absorption, disaccharide intolerance, protein-losing neonatal
- hyperbilirubinemia; cystic fibrosis; neuroblastoma (VMA ,HVA); enteropathy), , Heavy metal poisoning in children.

PRACTICAL

Clinical Biochemistry Practical

Anti Coagulants.
Blood Specimen Collection.
Protein precipitants.
Estimation of blood sugar by Folin wu method & Glucose Oxidase Method
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
Estimation of Serum Bilirubin- total & direct
Estimation of Alkaline & Acid Phosphatase
Estimation of SGOT, SGPT, GGTP
Estimation of LDH
Estimation of serum – total protein
Estimation of serum – Albumin
Estimation of CK Nac
Estimation of CK MB
Estimation of Sodium
Estimation of Potassium
Estimation of Phosphorus
Estimation of Iron Profile
Estimation of Hemoglobin
Estimation of Hexagon Troponin +
Estimation of Magnesium
Estimation of Blood Urea Nitrogen
Estimation of Vitamin D
Estimation of Serum Amylase
Estimation of Fe binding Capacity
Estimation of 17-Ketosteroids in urine
Estimation of Serum chloride, HCO^-_3, pH, PO_2, PCO_2 blood gas analysis

M.Sc.-MLT –Second Year

Endocrinology, Tumor Markers & Automation

Subject Code : MMLT-202B

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

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, Leuteinizing Hormone, Thyroid stimulating hormone (TSH), Adrenocorticotropic 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, myxodema, autoimmune thyroiditis, tumors of the thyroid gland, hyperthyroidism, Graves disease, Calcitonin, Parathyroid Hormone (PTH)
12. Adrenocortical hormones-synthesis and secretion, Aldosterone & its function, Addisons 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. Gastrointestintal 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 (rT3). 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; T4; free T_3 methods; T-uptake methods; TSH suppression and stimulation tests).

TUMOR & CANCER MARKERS:

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.

AUTOMATION AND POINT OF CARE TESTING (POCT)

FREE RADICALS AND ANTIOXIDANTS

AUTOMATION

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, PCR & its applications.

PRACTICALS

ENDOCRINOLOGY

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

TUMOR & CANCER MARKERS:

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-15-3

OTHER ELISA TESTS

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

M.Sc.-MLT (Clinical Biochemistry)

REFERENCE BOOKS:

1. Strayer H.Gerjmetal-W.H.Freeman and company New York.
2. Lehnineger's Principles of Biochemistry – Lehnineger. A.L., Nelson. D.L., Eral-C.B.S. Publishers and distributors, New Delhi.
3. Harper Illustrated Biochemistry – Murray R.K. Grannar, D.K. Mayes-P.A. Eral, McGrawHill.
4. Medical Biochemistry – N.V. Bhagavan -Academic Press.
5. Text Book of Biochemistry – A.S. Saini, C.B.S Publishers and distributors.
6. Teitz fundamentals of Clinical Chemistry – Burtis. C.A. Ashoowd E. R. – Har Court (India) Ltd.
7. Varley's Practical Clinical Biochemistry – Gowenlock and Bell William Heinemann.
8. Text Book of Biochemistry with Clinical Correlations – Devlin T.M. Wiley Liss, New York.
9. Clinical Physiology of Acid-Base balance and Electrolyte disorders – Rose. B.D – Mcgraw-Hill International edition New York.
10. Methods in Bio-Statistics for Medical students – Mahajan. B.K. Jaypee brothers Medical Publishers, New Delhi.
11. Manual of Practical Biochemistry for M.B.B.S –S.K.Gupta, Veena Singh Ghalaut- Arya publishing Company, New Delhi.
12. Clinical Chemistry – Theory analysis and Correlation – Kalpan. L.A. and pesse. A.G- C.V. Moslay and Company St. Louis, M.O.
13. Principles of Biochemistry – CBS Publishers – Lehninger, Nelson, Cox.

M.Sc.-MLT –Second Year

Hematology & Clinical Pathology

Subject Code : MMLT-201P

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

THEORY

HEMATOLOGY

1. General aspects:
   Blood cell formation,Sites of haemopoiesis. Development of blood cells. Morphology and Regulation of heaemopoiesis.
2. Red cells
   Basic aspects of anaemia, definition, patho physiology ,classification and clinical features. Investigation of a case of anaemia in general.
3. Microcytic hypochromic anaemias
   Sideroblastic anemia
   Anaemia of chronic infection
   Thalassaemia.
   Iron deiciency anaemia – Iron metabolism ,causes of iron deficiency, clinical features, laboratory investigations.
4. Macrocytic Anaemias
   Megaloblastic
   Non megaloblastic
   Megaloblastic anaemia – Etiology, clinical features, laboratory investigation. Pernicious anaemia.
5. Normocytic normochronic anaemia
   Anaemia in systemic disorders
   Acute blood loss, Renal failure
   Liver disorders etc.
6. Disorders of Haemoglobin
   Structure of Hb and Synthesis
   Normal and Abnormal haemoglobins
   Hamoglobinspathies
7. Haemolytic anaemia
   Definition, pathogenesis, classification, clinical features, Extrinsic factors & Intrinsic factors - investigation
   Laboratory investigations to establish a case of haemolytic anaemia.
   I. Peripheral smear – spceific morphologic abnormalities
   II. Special tests
      a) Osmotic fragility test
      b) Sickling test
      c) Kleihaure acid elution test
      d) Alkali denaturation test
      e) Ham's test ,
      f) Sucrose lysis test
      g) Coomb's test
      h) Electrophoresis – HbF, HbA_2 estimation
      i) Tests for G6PD deficeiency
   III. Hemolytic disease of new born – causes and investigations
8. Aplastic anaemia
   Pancytopenia.
9. Polycythaemia
   Classification Clinical features, laboratory investigation
10. Leucocyte disorders
    Leukaemoid reaction – type of leukaemoid and diagnosis.
    Myelodysplastic syndrome [MDS] Definition, clinical features, peripheral smear and Bone marrow findings.
    Leukaemias: Definition, –French- American-British [FAB] and

World Health Organization- classification of acute leukaemias
Diagnostic criteria , Cytochemical staining and Immunophenotyping
Chronic Leukaemias: classification, Diagnostic criteria .

11. Myeloproliferative disorders –
Classification ,Clinical features, laboratory investigations.
Chronic myeloid leukaemia in detail.

12. Lymphoproliferative disorders-
Chronic lymphocytic leukaemia in detail.

13. Plasma cell disorders – classification.
Plasma cell myeloma – definition. Clinical features, laboratory investigations.

14. Haemorrhagic disorders:
Definition: Pathogenesis, clinical features,
Classification: a. Primary hemostasis, b. secondary hemostasis – causes and investigations of both.
Fibrinolysis.

15. Platelet disorders:
Quantitative – Thrombocytopenia - Idiopathic thromobcytopenic purpura (ITP)
Classification, clinical featrues, diagnosis and bone marrow findings in ITP.
Qualitative platelet disorders.
Thromobcytosis – Definition ,Etiology,. Lab Investigations

16. Coagulation disorders –
Inherited -Haemophilia A and B, von Willebrand's disease,
Acquired: Vit. K deficiency, Liver disease, DIC
Tests of vascular and platelet function - Bleeding time, Clot retraction ,Patelet count.
Platelet aggregation studies. Bone marrow examination.
Tests for coagulation disorders: Screening tests- First line tests -Prothrombin time (PT),
Activated partial thromboplastin time(APTT) Thrombin time (TT)
Second line tests – Mixing experiments.
Coagulation factory assay.
Urea solubility tests for Factor XIII.
Factor VIII inhibitor study.
Fibrinogen assay.
Disseminated intravascular coagulation- Definition, Pathogenesis, laboratory investigations

17. Thrombotic disorders:
Classification - Inherited and Acquired.
Clinical features, Investigation of thrombotic disorders:
Tests: i. Protein C
ii Protein S,
iii. AT-III
iv Factor V leiden
Antiphospholipid antibody syndrome: Defintion clinical feature laboratory investigation.

18. B.M.Examination- Aspiration and Trephin biopsy staining
19. Molecular genetics in hematology

CLINICAL PATHOLOGY

Histopathology

1. Introduction to Histopathology, expfoliative Cytology.
2. Basic steps for Tissue Processing- Fixing, Embedding, Microtomy, Staining, Mounting, methods of decalcifications, assessment of decalcification, solution for decalcification.
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

Histopathology

1. Microtome, instrument, principle, use in section cutting, parts and working of commonly used microtome, different kinds of microtome, rotary, base sledge, sliding, low temperature microtome, cryostat, microtome knives, homing and stropping knives.
2. Fixation of tissue, different kind of fixatives, sample fixative, compound fixative, formaldehyde, mercuric chloride, osmium, Picric acid, alcohols, other acids, formalin, buffered formalin, osmic acid, zenleer soln, he; ly's soln, cytological fixatives, nuclear fixatives, fixation of smear etc., decalcification, method of decalcification, assessment of decalcification, soln for decalcification.
3. Processing of tissue, dehydration, impregnation in the wax, manual and automatic tissue processor, gelatin embedding, celloidin embedding, double embedding, cytological fixatives, preparation of different smears, vaginal, sputum, membrane.
4. Section cutting of paraffin sections, section preparation from frozen sections, fixing of tissue to slide, preparation of celloidin section and fixation. Staining techniques, natural dyes, synthetic dyes, basic and acidic dyes, haematoxylin staining, Pap, flicker & Conn, methanamine silver nitrate, ziehl neelsen's stain, propylene glycol sudan technique, papanicolaou, harn's alum, Haematoxylin, acridine orange technique.
5. H&E Staining
6. PAP Staining

M.Sc.-MLT –Second Year

Blood Transfusion

Subject Code : MMLT-202P

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

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, 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 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 TRANSFUSION
   - History of transfusion
   - Principal & indications for 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.

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. BLOOD COLLECTION
   - Blood collection packs.
   - Anticoagulants.
   - Taking & giving sets in Blood transfusion.
   - Techniques of collecting blood from a donor.

- Instructions given to the donor after blood donation.
- Adverse donor reaction.

5. TESTING DONOR BLOOD
   - Screening donor's blood for infectious agents - HIV, HCV, HBV, Trepanoma palladium, Plasmodium, HTLV.
   - Bacterially contaminated Blood.

6. BLOOD DONOR RECORDS
   - Blood donation record book.
   - Recording results.
   - Blood donor card.

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

8. MAINTENANCE OF BLOOD BANK RECORDS
   - Blood bank temperature sheet.
   - Blood bank stock sheet.
   - Blood transfusion request form.

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

10. 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.

11. BLOOD TRANSFUSION REACTIONS
    - Investigation of a Transfusion reaction.
    - Hemolytic transfusion reaction.
    - Actions to take when transfusion reaction occurs.

12. Transfusion Transmitted Infections
13. Haemapheresis
    - Definition
    - Types of pheresis
    - Machines and Techniques.
14. Tissue banking
15. Cord blood banking
16. Stem cell processing, storage and transplantation
17. Disposal of wastes and biologically hazardous substance in the blood bank
18. Medico legal aspects of blood transfusion
19. Technical advances and future trends in blood banking
20. Paternity testing
21. Quality Assurance

- General condition
- Equipment
- Reagents
- Donor processing

22.Drugs control regulation and Blood Bank

PRACTICAL

1. Blood grouping –
   - ABO grouping
   - Forward grouping (slide & tube method)
   - Reverse grouping – preparation of pooled A, B & O cells
   - Grading of Reaction. Other methods of grouping.
   - ABO antibody titration, Cold antibody titration.

2. Rh grouping & Rh typing (slide & tube method)
   - Du Testing
   - Rh – antibody titration
3. Antiglobulin Testing
   - Direct and Indirect
   - Preparation of Coomb's Control Cells.
4. Compatibility Testing
   - Selection of blood
   - Crossmatching Technique – Major, Minor, Saline, Albumin, Coomb's
   - Emergency –Cross matches
5. Blood Collection
   - Donor selection
   - Blood collection [Phlebotomy]
   - Post donation Care
6. Preservation and Storage of blood
7. Preparation and Storage of blood Components
   - Packed Cells ,Fresh Frozen plasma [FFP], Platelet Concentrate, Cryoprecipitate
   - Component transfusion – selection of blood group
8. Crossmatching in Special Situations
9. Exchange transfusion – selection of blood group
10. Autoimmune haemolytic anaemia
11. Investigation of Blood Transfusion reaction
12. Testing for transfusion Transmitted Diseases
    - Elisa-HIV,HBsAg ,HCV
    - VDRL Test
    - Malaria
13. Quality control – Methods
    - Reagents
    - Test methods
    - Products
    - Documents
    - Equipment
14. Apheresis procedures - Types of pheresis, Machines and Techniques.
15. Biomedical Waste management
16. Orientation of a blood bank
17. Blood Bank Administration
    - Record keeping
    - Computerization in blood transfusion services

REFERENCE BOOKS:

HEMATOLOGY & CLINICAL PATHOLOGY

1. Clinical Haematology, Illustrted – Colour Atls Victor Hoffbrand, John E Peth't.
2. Practical Haematolgoy –Dacie, Lewis.
3. Haematology – Williams
4. Wintrobe clinical haematology Vol- I.
5. Wintrobe clinical haematology Vol- II.
6. Lynch's Medical Lab – Technology Latest edition
7. Clinical Diagnosis & Management – Todd & Sanford.
8. Medical Laboratory Technology by Sood, Jaypee Brothers.
9. Clinical Haematology in Medical Practice – G.C. Degruchy.

HISTOPATHOLOGY

1. Atlas of Histopathology, J.P.
2. Histopathology, Guy Orchard
3. Histopathology, William Stewart.
4. Histotechnology, Freida L. Carson.
5. Forensic Histopathology, Darin P. Trelka.
6. Diagnostic Criteria Handbook in Histopathology, P.J. Tadrous.

BLOOD TRANSFUSION

1. Technical manual – AABB
2. The Clinical use of Blood Handbook, WHO
3. ABO Rh system – Ortho diagnostics
4. Compatibility testing – Ortho diagnostics
5. Compendium of transfusion medicine, Fr. R. N. Makroo.
7. Blood transfusion in Clinical Medicine – Mollision.
8. Blood group Serology, Theory, Techniques, Practical application – K.E.Boorman , B.E Dodd, P.J. Lincoln.8.Technical Manual, AABB.
9. Rossi's Principles of Transfusion Medicine, Toby L.Simon ,Walter H Dzik,Edward L. Snuder , Christopher P. Stowell Ronald G. Strauss, Lippincott.

M.Sc.-MLT –Second Year

Systemic Bacteriology, Applied Microbiology and Immunology

Subject Code : MMLT-201M

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

THEORY

SYSTEMATIC BACTERIOLOGY & APPLIED MICROBIOLOGY

1. Normal flora of the human body.
2. Collection transport, processing of specimens of diagnosis of bacterial, viral and fungal infection in the following cases. Respiratory tract infections, gastrointestinal tract infections, genital tract infections, CNS infections wounds and abscesses, Eye, ear and sinus infections, infections of the blood, tissue samples for culture.Biological safety in clinical laboratory, quality control, modern techniques employed in clinical laboratory.
3. Nosocomial infections: Epidemiology, bacterial and viral infections, infections in paedriatic patients, surveillance and control programmes, organizations and associations involved, role of microbiology lab in prevention and control, devices associated intravascular infections and its control, device associated intravascular infections and its control, sterilization, disinfections and antisepsis in hospitals.
4. Respiratory tract infections: Upper respiratory tract: aetiology, transmission, pathogenesis, epidemiology and clinical features of following:

   Common cold, Pharyngitis and Tonsillitis, otitis and sinusitis, acute epiglottitis, oral cavity infections, laryngitis, and tracheitis, diphtheria.

   Lower respiratory tract- whooping cough, bronchitis, RSV infections, Bacterial diagnosis of respiratory tract infections.
5. Urinary tract infections and sexually transmitted diseases- Bacterial, viral and fungal infections of the urinary tract, etiology, pathogenesis, transmission, clinical features and diagnosis of syphilis, gonorrhoea, Chlamydial infections, HIV, bacterial, Vaginosis, genital herpes, papiloma virus infections, opportunistic STDs.
6. Gastrointestinal tract infections: etiology, pathogenesis, clinical features, and diagnosis of diarrhoel diseases (bacterial and viral), H.pylori, food poisoning, parasites in the GI tract, systemic infections from GI tract.
7. Central nervous system infections: meningitis caused by bacteria, viruses, fungi and protozoa, viral encephalitis, brain abscesses, tetanus, botulism.
8. Infections of the skin, ear and eye: Etiology, transmission, diagnosis and prevention.
9. Microbiology of air, water and mild: common pathogens encountered, methods for microbiological analysis, methods for purification.
10. Identification of Non-fermenters- Pseudomonas, Acinetobacter, Stenotrophomonas
11. Commercial kit systems-API, Automated and semi-automated identification systems-BACTEC, Vitek
12. Quick screening methods, Chromogenic agar media
13. Bacteriology of Milk, Water and Air
14. Molecular biology techniques for characterization of microbes and viral agents. Bacteriological and viral serology.
15. Bacteriological and viral syndromes or diseases:

epidemiology, main clinical signs, basis for biological diagnosis, treatment.

- Meninged syndrome.
- Septicaemic syndrome.
- Urinary and genital infections.
- Bacteriological and viral diarrhoeas.
- Respiratory infections.
- Human acquired immunodeficiency syndrome.
- Sexually transmitted diseases.
- Hepatic virus infections.
- Cytomegalovirus infections

IMMUNOLOGY

1. History of immunology, innate and acquired immunity, mechanisms of innate immunity inflammation-inflammatory cells, mediators, inflammatory response types, antigens, cells and organs of immune system, evolution of immunity.
2. Immunoglobulin: Structure and function, classes and subclass-Cryoglobins, immunoglobulins genes –Organisation and expression, antibody diversity, class switching, monoclonal antibodies-hybridoma technique and MAB production, application in biomedical research, clinical diagnosis and treatment.
3. Immune Response: Clonal selection theory and related theories, primary and secondary response, humoral and cell mediated response, antigen processing and presentation, role of accessory molecules, MHC-structure and role in antigen presentation, MHC genes, maturation activation and differentiation of B cells and T cells, lymphocyte trafficking, TCR-structure and generation of diversity, cytokine properties and function, cytokine receptor, therapeutic uses, ADCC, NK cell regulation of immune response, advances in the development of vaccines (eg. Haemophilus B conjugate, Pertusis, Cholera, Malaria, Hepatitis B, Polio, HIV, Antitumour) adjuvants.
4. Compliment system: function, compliment receptors, activation pathways, control mechanisms, role in inflammation, kinin cascade, kinnins in disease.
5. Immunity against bacteria: Virus, Fungi and Parasites.
6. Immunological methods in clinical laboratories: Method interpretation and application of the following.
    a. Double diffusion in agar
    b. Single radial immuno diffusion
    c. Electrophoresis and immunoelectrophoresis
    d. Chromatography
    e. Ion exchange
    f. Affinity (gel)
    g. RIA
    h. Elisa
    i. Western blotting
    j. Detection of immune complexes, nephelometry
    k. Immunoflouresence
    l. Agglutination test direct and indirect
    m. Haemagglutination and haemagglutination inhibition
    n. Complement assays-CFT
    o. Hemolytic assays
    p. Detection of cellular immunity-delayed hypersensitivity skin test
    q. Assays for lymphocytes-T and B cells
    r. Flow cytometry
    s. FACS
    t. Mixed lymphocyte culture
    u. NK cells neutrophil function test
    v. Histocompatibility testing
7. Auto Immunity
8. Transplantation Immunity
9. Tumor Immunity

PRACTICALS

SYSTEMATIC BACTERIOLOGY & APPLIED MICROBIOLOGY

1. Study of normal flora of human body.
2. Isolation, characterization and identification of pathogens form various clinical specimens.
3. Study of morphological, culture and biochemical characters of common bacterial pathogens
4. Study of antibiotic sensitivity of common pathogens.
5. Study of microbial flora of air in various localities.
6. Microbial analysis of water.
7. Microbial analysis of milk.
8. Procedure of skin clipping for Leprae bacilli.
9. Preservation of stock culture
10. Bacteriology of food

IMMUNOLOGY

1. Double diffusion technique
2. Radial immuno diffusion
3. Haemagglutination inhibition test
4. Haemagglutination test
5. Latex agglutination test
6. Complement fixation test
7. Immunoelectrophoresis
8. Countercurrent immunoelectrophoresis
9. FITC conjugation of antibodies
10. Lymphocyte culture
11. Isolation of lymphoid organs in mice
12. RIA demonstration

M.Sc.-MLT –Second Year

Virology, Mycology & Parasitology

Subject Code : MMLT-202M

Theory- Min. Hrs -: 160 Hrs., Practical- Min. Hrs -: 160 Hrs.

THEORY

VIROLOGY

Study of the biological properties, pathogenecity, epidemiology, isolation and identification from clinical specimens, lab diagnosis, treatment and immunoprophylaxis of following viruses :

Parvoviruses, Adenoviruses, Herpes viruses, Pox viruses, Hepatitis viruses, Picorna viruses, Rota viruses, Orthomyxoviruses, Paramyxoviruses, Rubella virus, Pabies virus, Papova virus, HIV & Oncogenic viruses.

MYCOLOGY

Study of the following Fungi: Epidemiology, pathogenesis, laboratory diagnosis, treatment and prophylaxis of the following fungi :

Superficial mycosis Ptyriasis versicolor, Tinea nigra, Tinea piedra, Dermatophytes, Subcutaneous mycosis Mycetoma, Sporotrichosis, Chromoblastomycosis, Rinosporidiosis, Lobomyscosis, Systemic mycosis Histoplasmosis, blastomycosis, Coccididiomycosis, paracoccididiomycosis, Oppurtunistic mycosis, Crytococcosis, paracoccididiomycosis, Oppurtunistic mycosis- Crytococcosis, Candidiasis, Aspergillosis, Zygomycosis, Keratomycosis and Otomycosis, Allergic fungal diseases, Mycotoxicosis.

PARASITOLOGY

Study of morphology, important developmental stages, symptoms, pathogenesis, epidemiology, diagnosis, treatment, prevention of following parasites :

Entamoeba histolytica, Naeglaria, Giardia, Trichomonas, Balantidium, Isospora, Crytosporidium, Malarial parasites, Trypanosoma, Leishmania, Toxaplasma gondii, Pneumocystis carinii, Taenia Echinococcus, Schistostoma, Paragonimius, Diphyllobothrium, Ascaris, Enterobius, Ancylostoma, Trichuris trichura, Wuchereria, Dracunculus, Trichinella spiralis.

PRACTICALS

- Common diagnostic tests used for detection of viral infections.
- Identification of fungal pathogens in clinical specimens.
- Diagnostic tests for detection of parasitic infections- methods for demonstration of parasites in clinical specimens
- preparation of blood smear for detection of filarial parasites.
- ELISA test HIV & HBsAg.

REFERENCE BOOKS:

1. Text book of Microbiology by Ananthnarayan, Orient Longman.
2. Diagnostic Microbiology by Bailey & Scott, Mosby.
   Medical Microbiology by Greenwood & Slack; Churchill Livinstone.
3. The Short Textbook of Medical Microbiology by Satish Gupte; Jaypee.
4. Text book of Medical Parasitology by Panikar; Jaypee.
5. Colour Atlas and Textbook of Diagnostic Microbiology by Koneman, Williams Wilkins.
6. District Laboratory in Tropical Countries , Monica Cheesbrough, Cambridge.
7. Mackie & Maccarteney Practical Medical Microbiology; Churchill Livingstone.
8. Essential Immunology, Roitts & Delves 10th Edition; Blackwel Science.

M.Sc.-MLT –Second Year

Dissertation

(Common to all specialization/discipline)

Subject Code : MMLT-203

Dissertation:

Every candidate pursing 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.

Fulltime recognized PG Teacher/Guide from other institute can act only as a co-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), 6 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 –Second Year

Teaching Skills/Seminars/Symposia/Journal Club etc.
(Common to all specialization/discipline)
Min. Hrs -: 260 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 –Second Year

Clinical Lab Practices
(Common to all specialization/discipline)
Min. Hrs -: 440 Hrs.

Clinical Lab Practices

- 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.