REVISED ORDINANCE GOVERNING REGULATIONS AND CURRICULUM OF

M.Sc., MEDICAL LABORATORY TECHNOLOGY COURSE - 2019

Rajiv Gandhi University of Health Sciences,
Karnataka, Bangalore

The Emblem

The Emblem of the Rajiv Gandhi University of Health Sciences is a symbolic expression of the confluence of both Eastern and Western Health Sciences. A central wand with entwined snakes symbolises Greek and Roman Gods of Health called Hermis and Mercury is adapted as symbol of modern medical science. The pot above depicts Amrutha Kalasham of Dhanvanthri the father of all Health Sciences. The wings above it depicts Human Soul called Hamsa (Swan) in Indian philosophy. The rising Sun at the top symbolises knowledge and enlightenment. The two twigs of leaves in western philosophy symbolises Olive branches, which is an expression of Peace, Love and Harmony. In Hindu Philosophy it depicts the Vanaspathi (also called as Oushadi) held in the hands of Dhanvanthri, which are the source of all Medicines. The lamp at the bottom depicts human energy (kundalini). The script “Devahitham Yadayahu” inside the lamp is taken from Upanishath Shanth i Manthram (Bhadram Karnebh i Shrunuyanadev…), which says “May we live the full span of our lives allotted by God in perfect health” which is the motto of the Rajiv Gandhi University of Health Sciences.

ರಾಜೀವ್ ಗಾಂಧಿ ಆರೋಗ್ಯ ವಿಜ್ಞಾನಗಳ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಕರ್ನಾಟಕ, ಬೆಂಗಳೂರು
RAJIV GANDHI UNIVERSITY OF HEALTH SCIENCES, KARNATAKA, BENGALURU
4th T Block, Jayanagar, Bengaluru – 560 041

Ref: ACA/DCD/AHS/M.Sc., MLT/374/2019-20 **Date: 28/08/2019**

NOTIFICATION

Sub: Revised Ordinance pertaining to Regulation and Curriculum of M.Sc., Medical Laboratory Technology.

Ref: 1) Minutes of BOS Allied Health Sciences held on 13/05/2019
2) Proceedings of Faculty meeting held on 15/05/2019
3) Proceedings of AC meeting held on 17/06/2019
4) Proceedings of Syndicate meeting held on 29/06/2019

In exercise of the powers vested under Section 35(2) of RGUHS Act, 1994, the Revised Ordinance pertaining to Regulation and the curriculum of M.Sc., Medical Laboratory Technology is notified herewith as per Annexure.

The above Regulation shall be applicable to the students admitted to the said course from the academic year 2019-20 onwards.

By Order,
Sd/-
REGISTRAR

To

The Principals of all affiliated Allied Health Sciences Course colleges of RGUHS, Bangalore.

Copy to :

1. The Principal Secretary to Governor, Raj Bhavan, Bangalore - 560001
2. The Principal Secretary Medical Education, Health & Family Welfare Dept., M S Building, Dr.B.R. Ambedkar Veedhi, Bangalore – 01
3. PA to Vice – Chancellor/PA to Registrar/Registrar (Eva.)/Finance Officer, Rajiv Gandhi University Health Sciences, Bangalore
4. All Officers of the University Examination Branch/ Academic Section.
5. Guard File / Office copy.

REVISED ORDINANCE GOVERNING REGULATIONS & CURRICULUM OF M.Sc.,MEDICAL LABORATORY TECHNOLOGY- 2019

1. **Title of the Courses**

   Master of Science in Medical Laboratory Technology Course is available in the following three specialties:

   a. M.Sc. Clinical Biochemistry
   b. M.Sc. Microbiology &Immunology
   c. M.Sc. Haematology & Blood Transfusion

2. **Duration of the Course:**

   The duration of the Master's Degree in Medical Laboratory technology including submission of project work on the topic registered shall be for a period of two years from the commencement of the academic term on full time basis.

3. **Eligibility for Admission**

a. The students who have passed B.Sc. MLT Course from Institutions affliated to RGUHS are eligible for this course.

b. Students who have passed B.Sc MLT course from other Universities considered equivalent by RGUHS are eligible for this course.

c. Candidates passing B.Sc MLT through Correspondence course shall not be eligible

4. **Selection Criteria**

   Selection shall be based on merit in the qualifying examination.

5. **Eligibility certificate:**

   No candidate shall be admitted for the postgraduate degree course unless the candidate has obtained and produced the eligibility certificate issued by the university. The candidate has to make the application to the university with the following documents along with the prescribed fee.

   Pass / degree certificate issued by the university.
   Marks cards of all the university examinations passed.

Migration certificate.
Certificate of conduct.
Proof of SC/ST or category I as the case may be

Candidates should obtain the eligibility certificate before the last date for admission as notified by the university.

A candidate who has been admitted to post-graduate course should register his/her name in the university within a month of admission after paying the registration fee.

6. Medium of instruction

English is the medium of instruction for the subjects of study as well as for the examination.

7. Course of study

There are three specialties in M.Sc MLT course. Both main & subsidiary subjects in first year shall be common to all the three specialties. In the second year the student will study subject of his/her specialization.

Subjects for study in 1st year M.Sc MLT course are shown in Table - I .

Table - I Distribution of teaching hours in 1st year M.Sc MLT subjects

Sl.No.	Main Subjects	Theory No. of hours	Practical No. of hours	Total
1.	Biochemistry	150	250	400
2.	Clinical Pathology&Haematology	80	100	180
	Immunopathology	40	100	140
3.	General Microbiology and Immunology	60	100	160
	and Immunological Techniques	60	100	160
	Total	390	650	1040

Sl.No.	Subsidary Subjects	Theory No. of hours	Practical No. of hours	Total
1.	Biochemistry	30	20	50

Subjects of specialization & hours of teaching for 2nd year M.Sc MLT course are shown in

Table - II.

Table- II Distribution of teaching hours in 2nd year M.Sc MLT subjects of specialization

Sl.No.	Subsidary Subjects	Theory No. of hours	Practical No. of hours	Total
1.	Biochemistry	360	720	1080
1.	Clinical Pathology&Haematology	360	720	1080
1.	General Microbiology and Immunology	360	720	1080

8. Attendance

Every candidate should have attended at least 80% of the total number of classes conducted in an academic year from the date of commencement of the term to the last working day as notified by university in each of the subjects prescribed for that year separately in theory and practical .Only such candidates are eligible to appear for the university examinations in their first attempt.Special classes conducted for any purpose shall not be considered for the calculation of percentage of attendance for eligibility.

A candidate lacking in prescribed percentage of attendance in any one or more subjects either in Theory or Practical in the first appearance will not be eligible to appear for the University Examination either in one or more subjects .

9. Monitoring Progress of Studies

Work Diary/Log Book- Every candidate shall maintain a work diary and record his/her participation in the training programmes- Field work, Clinical work, Seminars, Field work records and Case records etc. (Refer section III for model check lists and log book copy). Special mention may be made of the presentations by the candidate as well as details of Field/Clinical work conducted by the candidate. The work diary shall be scrutinized and certified by the concerned faculty members.

Periodic Tests: The College shall conduct three tests each in First and Second year for Internal Assessment. The Third test shall be conducted one month prior to the annual university examination so that it also serves the purpose of preparatory examination. These tests will be considered for internal assessment.

Records: Records and marks obtained in tests will be maintained by the college and made available to the university.

10. Dissertation/Research project

Each candidate pursuing M.Sc. MLT Course is required to carry out work on selected research project under the guidance of a recognized post graduate teacher. The results of such a work shall be submitted in the form of dissertation/ research project.

The dissertation/ research project is aimed to train a graduate student in research methods and techniques. It includes identification of problem, formulation of a hypothesis, search and review of literature, getting acquainted with recent advances, designing of a research study, collection of data, critical analysis, interpretation of results and drawing conclusions.

Every candidate shall submit to the Registrar (Academic) of the University in the prescribed Performa, a synopsis containing particulars of proposed dissertation/ research project work within six months from the date of commencement of the course on or before the date 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/ research project topic. No change in the dissertation topic/ research project or guide shall be made without prior approval of the University.

The dissertation/ research project should be written under the following headings:
Introduction
Aims or objectives of study
Review of literature
Material and methods
Results
Discussion
Conclusion
Summary
References
Tables
Annexure

The written text of dissertation/ research project shall not be less than 50 pages and shall not exceed 100 pages excluding references, tables, questionnaires and other annexure. It should be neatly typed in double line spacing on one side of 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 should also be included, and the guide, head of the department and head of the institution shall certify the dissertation/ research project.

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. No marks shall be awarded for Dissertation/ research project. Acceptance of the dissertation/ research project is a pre-requisite for a candidate to be permitted to appear for final examination. If there are corrections in the dissertation / research project suggested by the examiner(s), the candidate may make such corrections and may be allowed to re-submit in time and if approved can appear for the xamination.

11. Guide

The academic qualification and teaching experience required for recognition as Guides by the

University are:

a. M.D. in Biochemistry/M.Sc in Clinical Biochemistry[Medical] and three years teaching experience after the PG qualification in a recognized Institution, or Ph.D. in Medical Biochemistry /Clinical Biochemistry/Clinical Research with teaching experience of at least two years in a recognized institution, or M.Phil. in ClinicalBiochemistry with five years of teaching experience after M.Phil. qualification from a recognized institution, or M.Sc. MLT with five years of teaching experience after the postgraduate qualification in a recognized Institution.

The age of guide/teacher shall not exceed 63 years.

The guide student ratio shall be 1:5.

Relaxation criteria: In view of acute shortage of teachers in this new specialty, those having three years full time teaching experience, after post graduation, may be considered as PG teachers. They may be permitted to be guides and examiners for the next three-years from the time of this notification. Similarly, persons aged more than 63 years may be considered as eligible to guide at the discretion of the University for at least three more years from the time of this notification.

Eligibility for guide for each speciality

Full time faculty involved in teaching in the same college/institution
MD - in respective subjects -8yrs experience after MD.

M.Sc. - in respective subjects (only Medical Microbiology/Medical biochemistry degrees acceptable with minimum 8 yrs experience
Student : Guide ratio - 5:1.

12. Schedule of examination

a. University Examination will be held in two parts - Part I and Part II, at the end of I year and at the end of II year respectively. Candidates will not be allowed to take the Part II examination unless he/she has passed all papers of the Part I examination. The prescribed examination fee as laid down by the University from time to time for each entry to Part I and Part II examination shall be paid.

b. The University examination will be conducted at the end of each year on a date notified by the university from time to time. Not more than two examinations shall be conducted in an academic year.

c. Failed candidates may appear in the subsequent examination after paying the required fee.

d. Carry over: A candidate who has appeared in all the subjects of I year in the university examination is eligible to go to 2nd year provided he/she has passed in any two subjects. However the candidate has to pass in the failed subjects to become eligible to appear for 2nd year university examination.

A failed candidate in any subject has to appear for both theory and practical examination in the subsequent examination.

A candidate is permitted not more than four attempts (actual appearance) to clear the first year or pass the first year examination within three academic years, from the year of admission, whichever is earlier. A candidate will not be allowed to continue the course if he/she fails to comply with the above stipulation.

The number of examiners for clinical and viva-voce shall be two, comprising of one internal and one external examiner.

13. Scheme of examination

a. Internal Assessment

1. Internal Assessment marks shall be awarded to the candidates in each paper as detailed in the scheme of examination.. The marks secured by the candidates in each subject shall be forwarded to the University 15 days before the University Examinations.

2. The marks of the internal assessment must be published on the notice board of the respective colleges.

3. If a candidate is absent from the test due to genuine and satisfactory reasons, such a candidate may be given a re-test within a fortnight.

There shall be minimum of two internal assessment examination in 1st year & subject of specialty in 2nd year conducted by the colleges at regular intervals both in theory & practical which includes seminars. The average of best two examination Marks shall be taken into consideration by calculating marks for the internal assessment.

b. University examination

The University conducts two examinations in a year at an interval not less than four to six months.

i. First year M.Sc MLT

Both the main and subsidiary subjects for M.Sc. MLT course will be common in the first year.

i. **Written examination : -** Written examination shall consist of three theory papers each of three hours duration. Each paper shall carry 100 marks.

ii. **Practical examination : -**
There shall be one practical examination in each of first year subject. The duration of each practical examination is of three hours which carries 100 marks.

iii. **Viva- voce : -** This shall aim at assessing depth of knowledge, logical reasoning, confidence & oral communication skills. Total marks shall be 30. Both internal & external examiners shall

conduct the viva- voce.

The particulars of subjects for examination and distribution of marks are shown in the Table -III

Sl. No.		Biochemistry	Haematology & Blood Transfusion	Microbiology
A. 1.	Theory Written paper No of papers and maximum marks for each paper	One 1x100	One 1x100	One 1x100
2.	Internal Assessment [Theory]	20	20	20
	Total Theory	120	120	120
B. 1.	PRACTICAL Practical	100	100	100
2.	Viva -Voce	30	30	30
3.	Internal assessment	20	20	20
4.	* Record	30	30	30
	Total Practicals	180	180	180
	Grand Total	300	300	300

*Records -To be assessed by the external examiners during University Practical examination.

Subsidiary subject for Ist year M.Sc. MLT: -

**Biostatatics:	Theory	100 marks
	Pass Percentage	35

**Examination to be conducted by respective colleges

ii. Second year M.Sc MLT

In the second year the student will appear for the examination in the subject of his/ her specialization.

i. **Written examination :** Written examination shall consists of two theory papers in his/her specialization & each of three hours duration. Each paper shall carry 100 marks.

ii. **Practical examination :** There shall be one practical examination in each of the specialization subject of 2nd year M.Sc MLT course. The duration of each practical examination is of three hours which carries 100 marks.

iii. **Viva- voce :** This shall aim at assessing depth of knowledge, logical reasoning, confidence & oral communication skills. Total marks shall be 40. Both internal & external examiners shall conduct the viva- voce.

The particulars of subjects for examination and distribution of marks are shown in the Table -IV

Table-1V Examination and Distribution of marks for Subjects of Specialization in Second year M.Sc MLT course.

Sl. No.		Biochemistry	Haematology & Blood Transfusion	Microbiology
A. 1.	Theory Written paper No of papers and maximum marks for each paper	Two 2x100	Two 2x100	Two 2x100
2.	Internal Assessment [Theory]	20	20	20
	Total Theory	220	220	220
B. 1.	PRACTICAL Practical	100	100	100
2.	Viva -Voce	40	40	40
3.	Internal assessment	20	20	20
4.	* Record	20	20	20
	Total Practicals	180	180	180
	Grand Total	400	400	400

*Records -To be assessed by the external examiners during University Practical examination.

14. Eligibility for the examination

a. A candidate shall register for all the subjects of a year when he/she appears for the examination of that year for the first time.

b. A candidate shall not be admitted to the practical examinations for the first time unless he/she produces the class record book certified by the Head of the Department. At subsequent practical, the marks awarded for the class records at the first appearance in that subjects will be taken for declaration of results.

15. Pass criteria

Theory 50%, which includes marks, obtained in written examination and internal assessment.

Practical 50% which includes marks obtained in practical examination, viva-voce, internal assessment and records.

A candidate has to pass in theory and practical separately to pass in a subject in the university examination.

GOALS AND OBJECTIVES

1. Goals:

The goals of postgraduate training in various specialties in M.Sc MLT are to train graduates who will:

- Practice respective specialty efficiently and effectively, backed by scientific knowledge and skill.
- Exercise empathy and a caring attitude and maintain high ethical standards.
- Continue to evince keen interest in continuing professional development in the specialty and allied specialties irrespective of whether in teaching or practice.
- Willing to share the knowledge and skills with any learner, junior or a colleague.
- To develop faculty for critical analysis and evaluation of various concepts and views & to adopt most rational approach.

2. Objectives:

The objective is to train a candidate so as to ensure higher competence in both general and special area of interest and prepare him/her for a career in teaching, research and specialty practice. A candidate must achieve a high degree of professional proficiency in the subject matter and develop competence in research and its methodology as related to the field concerned.

The above objectives are to be achieved by the time the candidate completes the course. The objectives may be considered as under -

1. Knowledge (Cognitive domain)
2. Skills (Psycho motor domain)
3. Human values, ethical practice and communication abilities (affective domain)

Knowledge:

- Demonstrate understanding of basic sciences relevant to specialty.
- Acquire the detailed knowledge about the fundamentals and advances of the respective specialty.
- Update knowledge by self-study and by attending courses, conferences and seminars relevant to specialty.

- Undertake audit, use information and carryout research both basic and professional with the aim of publishing or presenting the work at various scientific gatherings.

Skills :

Acquire adequate skills and competence in performing various tasks as required in the specialty.

Human values, ethical practice and communication abilities:

- Adopt ethical principles in all aspects of the professional practice.
- Foster professional honesty and integrity
- Discharge the duties irrespective of social status, caste, creed or religion of the customer/client.
- Develop oral and written communication skills.
- Provide leadership and get the best out of his or her team in a congenial working atmosphere.
- Apply high moral and ethical standards while carrying out human or animal research.

Be humble and accept the limitations in his or her knowledge and skill and to ask for help from colleagues when needed.

COURSE DESCRIPTION

A. Minimum requirment of infrastructure, staff, laboratory facilities for M.Sc. MLT course

1. Basic Infrasructure applicable to all three specialities:

1. Institute should have its own Hospital with full fledged Clinical Laloratory or its own diagnostic centre or own independent Clinical laboratory provided the above mentioned facilities fullfill the minimum work load criteria for each of the subject speciality mentiond here under.

Basic Laboratories:

1. Three labs with area of 800sq.ft each
2. One lab for Immunopathology 10x10 sqft Electricity with back -up
3. One class room with capacity for 30 students measuring 500sq.ft.
4. One departmental Seminar room measuring 250sq.ft for each specilaty with A. V aids - OHP,Slide projector and computer with accessories are compulsory.
   LCD Projector (optional)
   Other infrastructure criteria- Principals room, students common room, staffroom, Library, office room, Store room, preparation room etc will be as per minimum criteria. Norms of B.Sc MLT course.

II. Infrastructure subject wise:
Biochemistry

a. Laboratory equipments

1. Chemical Balance/single Pan Balance
2. Coloriemeter
3. Spectro Photometer
4. Flame Photometer/ ISE Electrolyte analyser
5. pH meter
6. Chromatography instruments
7. Electrophoresis unitG
8. Semi auto analyser
9. Auto analyser
10. Electro Chemiluminescence / Drug and Harmone analyser (optional)
11. Blood gas analyser
12. Refrigerator

Apart from the above mentioned equipements ,necessary glass ware, kits, chemicals, as per the syllabus requiremnts should be made available in adequate quantity.

b. Minumum work load criteria for conducting M.Sc MLT. in Clinical Biochemistry.

100 different bio-chemical tests per day [Routine and special tests]

Infrasctructure - Microbiology

a. Laboratory equipments

1. Auto clave
2. Hot air oven
3. Incubator
4. Centrifuge
5. Water distillation/Purification unit
6. PHmeter
7. B.O.D. Incubator
8. Physical Balance
9. Digital Balance
10. Refrigerator
11. Microscope
    - Monocular 10
    - Binocular - 5
    - Dark field Microscope - 1
    - Fluroscent microscope - 1
12. ELISA reader
13. Electrophoresis unit
14. Anaerobic Jar
15. Micropipettes
16. Pressure cooker
17. Laminar air flow
18. Water bath
19. VDRL shaker
20. Deep freezer - 1

Apart from the above mentioned equipments necessary glassware, kits, chemicals as per the syllabus requirements should be made available in adequate quantity

b. Minimum work load criteria for conducting M.Sc MLT course in Microbiology and Immunology

100 different types of samples per day including serological tests

i. Serological tests- 50/day
ii. Cultures - 20/day

COURSE CONTENT
FIRST YEAR M.Sc MLT
BIOCHEMISTRY- I

THEORY:

Section-A: - CLINICAL BIOCHEMISTRY 80 Hours

I. Over view: Chemistry, properties and functions of Biomolecules-Carbohydrates, aminoacids and proteins, enzymes, lipids, non protein nitrogenous substances

II. Carbohydrates
Fate of glucose. Classification of Diabetes mellitus and other categories of glucose intolerance. Diagnosis . Determination of glucose in body fluids. Reductometric and enzymatic methods in glucose measurements. Self monitoring of blood glucose. Use, care and maintenance of glucometers.

III. Amino acids and proteins: Charge and Chemical properties of amino acids and proteins. Non standard amino acids. Use of amino acid analysis in diagnosis of disease.
Structural organization of proteins: Forces and Bonds. Primary structure of proteins. Higher levels of protein organization. Protein folding. Determination of primary structure.

IV.Non protein nitrogenous compounds: Clinical importance of Urea, Creatinine and Uric acid. Laboratory evaluation of NPN.

V. Plasma proteins : Total proteins. Classification of minor and major proteins by electrophoretic mobility. Biochemistry, function and clinical significance of albumin, α1-antitrypsin, α1-fetoprotein, C-reactive protein, β2-microglobulin. Methodological aspects and analytical considerations. Clinical significance of Igs. Paraproteinemia and laboratory evaluation. Separation of protein by electrophoresis.

VI. Diagnostic enzymology: Sources of plasma enzymes and influence of factors. Clearance of enzymes, enzyme release. Distribution of diagnostically important enzymes and laboratory evaluation. Clinical importance.

VII. Lipoproteins: Classification, functions, metabolism and disorders. Lipoproteins and coronary artery diseases. Lipid profile and laboratory methods

VIII. Specimen collection: Blood, Urine and their collection. Specimen variables within control of Laboratory personnel for biochemical analysis. Patient management during specimen collection Preservation, Transport, Storage and disposal.
Preservatives for combined biochemical analysis in urine . Physical and Chemical examination of Urine samples. Reagent sticks in urinalysis. Qualitative and quantitative tests of urine in diagnosis.
Sources of biological variation.
Acquisition of Blood, urine, ABG and other body fluid samples at laboratory. Criteria for rejection.
Clinical importance, reference intervals, and principle of estimation of some routine biochemical analytes

IX. Cerebrospinal Fluid: Blood- CSF barrier. Components. Test ordering and analytical considerations for CSF. Clinical significance of CSF analysis

X. Analytical considerations
Tolerance tests: OGTT, OGCT, Extended GTT.
Xylose absorption test
Creatinine Clearance tests
ACTH stimulation tests
Water deprivation tests and measurement of osmolality
Ammonium chloride loading tests- measurment of pH
Calculated parameters in clinical laboratory

XI. Water Electrolyte balance
Body fluid compartments, Electrolyte and water composition, Reasons for composition differences. Homeostasis and disorders. Laboratory methods for electrolyte measurement - an overview.

XII. Acid – Base balance
Buffer systems and their role in regulating the pH of body fluids. Conditions associated with abnormal acid-base status.
Hemoglobin and the oxygen dissociation curve. Abnormal hemoglobins. Blood gases. Reference intervals for arterial blood gases. Acquisition of arterial blood gas samples. Pre-analytical variables.
Arterial Blood gas estimation. Analytical considerations

XIII. Energy metabolism and nutrition
XIV. Radio active isotopes

SECTION- B
LABORATORY PRINCIPLES ***40 hrs***

I. Clinical laboratory
- Scope of laboratory services.
- Laboratory design: Functional components of Clinical laboratory. Various types of laboratory. A standardized clinical laboratory set up. Factors affecting productivity of a laboratory

II. Basic Principles and Practice in Clinical laboratory
1. Clinical laboratory supplies:
- Glassware and plasticware.
- Reagents: Chemicals, solutions, reference materials, water specifications

2. Clinical laboratory equipments
- Weighing balance, Spectrophotometer, Thermometer, pH meter, Centrifuges. Use, care and their maintenance

3. Units of measurements
- Conventional and SI. Unit conversions

4. Laboratory mathematics – calculations and conversions
- Diffferent solutions. Strength of solutions. Dilutions-simple and serial

III. Laboratory safety and regulations
- Safety responsibility-employer and employee.
- Safety equipment.
- Biologic safety, Chemical safety, Radiation safety, Fire safety.
- Control of other hazards-ergonomic, electrical, mechanical and compressed gases.

- Transport of hazardous materials
- Disposal of chemical, radioactive and biohazardous waste.
- Accident documentation and investigation

IV. Training of technical staff in Clinical laboratory: Areas of training. Role of lab supervisors in training. Job description of various levels. Hands on approach to various laboratory practices.

V. Public relations: Interpersonal skillsat work place. Laboratory approach to patient community
VI. **Instrument comparisons in laboratory .**
VII. Risk management in laboratory

LABOROATORY TECHNIQUES **40 hrs**

I.Chromatography: Basic concepts, Principles, practical considerations, applications, emerging trends

- Paper, thin-layer, ion exchange, affinity, gel filtration, gas-liquid and HPLC.

II. Electrophoresis: Basic concepts, Principles, practical considerations, applications, emerging trends

- Paper, agarose gel, polyacrylamide gel, capillary and cellulose acetate.

III. Photometric techniques:Basic concepts, Principles, practical considerations, applications, emerging trends

- Colorimetry and spectrophotometry. Performance parameters, Multiple wavelength readings

IV. Other Photometric techniques:Principle, instrumentation, applications

- Reflectance photometry, Flame emission spectrophotometry, Atomic absorption spectrophotometry

V.Electrochemical techniques in routine analysis

- **P**otentiometry- Basic concepts, Reference and indicator electrodes. Care and methodology. Experimental considerations and interferences.

VI.Centrifugation Techniques

- Basic principle of sedimentation, Instrumentation
- Preparative and analytical centrifugation in clinical and research laboratory

VII. Cell Fractionation

- Basic concepts, Process of separation. Biochemical activities of different fractions, marker enzymes.

VIII. Osmometry: Basic concepts, Principle, instrumentation , applications

VI. Work simplification processes in Clinical laboratory- A stepwise approach from manual to fully automated systems

1. Analytical methods
2. Reagent and solvent dispensing system
3. Sample transport and delivery
4. Analytical Systems

VIII. Total Quality management:

- Fundamental principles. TQM framework
- Elements of Quality assurance Programme
  1. Types of preanalytical variables
  2. Analytical variables- documentation, inventory, competence and various laboratory processes. Use of stable reference materials-calibrators & controls, LJ charts and Westgard rules. .
  3. Postanalytical variables
  4. Internal QC Procedures , Use of Internal Quality Control material. Properties. Types. Care and procedural steps in reconstitution of commercial controls. Preparation In-house preparation.
  5. Use of computers in quality control and management; use of computers for calculating analytical results
- External Quality Assessment Schemes and Proficiency Testing Programmes.
- **Laboratory Accreditation , ISO guidelines , NABL etc.**

IX. Documentation in Laboratory/Maintenance of records: Patient entry registers, Procedure manuals, Registers of Reagents, consumables and accessories, quality control data, patient data and all relevant lab records.

PRACTICALS *120 Hours*

I. Qualitative

1. Reactions of Carbohydrates, amino acids, NPN.
2. Spot tests for amino acids to diagnose inherited disorders
3. Analysis of urine for normal constituents
4. Analysis of urine for abnormal constituents
5. Commerical reagent sticks in urine analysis

II. Quantitative

a. Standardization of manual methods for estimation of biochemical analytes

1. Blood glucose by 1. reductometric method 2. Glucose Oxidase method
2. Blood Urea by 1. Diacetyl Monoxime method 2. Urease method
3. Serum and Urine Creatinine by Jaffe's method
4. Serum total protein by Biuret method
5. Serum albumin by BCG method
6. Urine protein by Sulphosalicylic acid method
7. Estimation of AST and ALT by Bergmeyer and Bernett

b. Automated methods: Instrumentation, calibrator use, details of diagnostic kits necessary

1. Lipid profile: Cholesterol by Cholesterol oxidase method
   Triglycerides by GOP/PA method
   HDL Cholesterol by precipitation method
   Freidwald's formula for LDL calculation
   Direct LDL measurement

2. Electrolyte analysis: Electrolyte analyzer
3. ABG analysis: ABG analyzer.
4. T3, T4 and TSH

III. Separative procedures:

1. Paper Chromatography: Detection of individual amino acids in test solution in comparison with a standard and calculation of Rf value
   Demonstration of thin layer plate preparation
2. Agarose gel Electrophoresis: Technique of preparation of agarose gel slides. Electrophoreti quantification of electrophoretic bands

Text Book references

- Biochemistry by Lubert Stryer -W.H.Freeman and company New York
- Lehninger's- 3rd edition. Principles of Biochemistry – Lehninger, Nelson. D.L.,
- Harper Illustrated Biochemistry – Murray R.K. Grannar, D.K. Mayes-P.A. Eral 28th edtion
- Medical Biochemistry – N.V. Bhagavan -Academic Press 4th edition 2002.
- Text Book of Biochemistry – A.S. Saini, C.B.S Publishers and distributors 2nd edition.
- Tietz fundamentals of Clinical Chemistry – Burtis. C.A. Ashwood E. R. 3rd, 4th editions
- Tietz Text book of Clinical Chemistry and molecular diagnostics – Burtis. C.A. Ashwood E. R. 3rd, 4th and 5th editions
- Varley's Practical Clinical Biochemistry 4th, 5th, 6th editions
- Text Book of Biochemistry with Clinical Correlations – Devlin T.M. Wiley Liss, New York 6th Edition
- Clinical Physiology of Acid-Base balance and Electrolyte disorders – Rose. B.D – Mcgraw-Hill International edition New York 4th edition
- Methods in Bio-Statistics for Medical students – Mahajan. B.K. Jaypee brothers Medical Publishers, New Delhi.
- Clinical Chemistry – Theory analysis and Correlation – Kalpan. L.A. 4th edition
- Principles of Biochemistry -4th edition; Lehninger, Nelson, Cox.
- Clinical Chemistry-Principles, procedures, correlations- 5th edition by Michael L. Bishop, Edward P. Fody and Larry Schoeff.
- Textbook of Medical Laboratory technology 2nd edition by Godkar and Godkar.
- Short textbook of Medical Laboratory for technicians -1st edition by Sadish Gupte
- Textbook of Biochemistry (For Medical Students)-5th Edition by DM Vasudevan & Sreekumari S
- Textbook of Medical Biochemistry-7th Edition by MN Chatterjea & Rana Shinde
- The National Medical Series for Independent study . Biochemistry-4th edition by Victor L. Davidson and Donald B. Sittman.
- Biochemistry – 3rd revised edition by U Sathyanarayana & U Chakrapani
- Practical Clinical Biochemistry, methods and interpretation –2nd edition by Ranjna Chawla
- Mark's Basic Medical Biochemistry- A clinical approach 2nd Edition by Smith, Marks and lieberman
- Clinical Chemistry-Laboratory Management and Clinical Correlations by Kent Lewandrowski
- Clinical Diagnosis and management by laboratory methods 20th edition by John Bernard Henry
- Medical Laboratory technology 6th edition by Ramnik Sood. Vol. 1 and 2
- Biophysical chemistry-Principles and Techniques by Upadhay, Upadhay and Nath

Journals for Reference:
Indian Journal of Clinical Biochemistry
Clinica Chemica Acta
Journal of Laboratory Clinical Medicine
Journal of Clinical Investigation
Biochemistry Journal
Clinical Chemistry
European Journal of Biochemistry
Annals of Biochemistry
Lab medica

SCHEME OF EXAMINATION OF BIOCHEMISTRY-I.
M.Sc., MLT I year

I. THEORY EXAMINATION: One paper of 3 hrs duration carrying 100 marks

PAPER :-BIOCHEMISTRY-I **Max marks : 100 mks**
Sec A: Clinical Biochemistry Max marks : 50 marks
Sec B: Laboratory Principles & Techniques Max marks : 50 marks

Type of questions	No of questions	Marks for each questions	Total
Long Essay	02	10	20
Short Essay	05	06	30

II. PRACTICAL EXAMINATION - **Max Marks: 100**
Any one practical under each category with bench viva

I. Qualitative - 30 Marks

- Identification of constituents of biochemical importance in the unknown solution (Carbohydrate/ Protein/ NPN)
- Analysis of normal urine / unknown abnormal urine

II. Techniques - 40 Marks

- Chromatography (Identification of individual amino acids in a mixture in comparison with amino acid standard solution and calculation of Rf value)
- Electrophoresis (Preparation of agarose gel slide and quantification of proteins)

III. Quantitative estimation by manual methods - 30 Marks
(Standardization and determination of unknown concentration)

- Blood Glucose
- Serum total protein
- Serum albumin
- Serum Creatinine
- Urine Creatinine
- Blood Urea

IV. VIVA-VOCE-50 Marks
Theory topics in syllabus to be covered by Internal and external examiners

Grand Total -150 marks

MICROBIOLOGY- I

THEORY:

SECTION A: CLINICAL/GENERAL MICROBIOLOGY **(80 hrs)**

I. General aspects **(12 hrs)**

- History/ Microscopy/staining
- Bacteriology, morphology and Anatomy
- Bacterial growth
- Culture media and culture methods
- Normal flora of the body
- Bacteriology of water, air and milk

II. Infection and infectious agents **(45 hrs)**

- Infection - Definition, types and mode of transmission
- Hospital infections – causative agents, mode of transmission and prophylaxis
- Virulence factors in microbes **(5 hrs)**
- Brief description, pathogenicity and lab diagnosis of pyogenic infections, enteric fever, bacillary dysentery, cholera, tuberculosis and syphilis **(15 hrs)**
- Introduction to viruses – Briefly describe HIV, hepatitis, polio, rabies, arbovoiral infections, herpes and myxoviral infections **(10 hrs)**
- Introduction to parasites – briefly describe morphology, life cycle, pathogenicity and lab diagnosis of E. Histolytica. Plasmodium, E. granulosus, Ascaris, Ancylostoma, W. bancrofti **(10 hrs)**
- Introduction to fungi - briefly describe Dermatophytes, Opportunistic fungi, Subcutaneous fungi, dimorphic fungi, Candida and Cryptococcus **(5 hrs)**

III. Diagnostic procedures **(12 hrs)**

- Specimen collection and transport of various clinical specimens
- Lab diagnosis of bacterial, fungal, parasitic and viral infections
- Quality control
- Safety precautions in the laboratories
- Universal precautions

IV. Biomedical waste and disposal **(6 hrs)**

- Sterilization and disinfection
- Biomedical waste disposal

V. Antimicrobial agents **(5 hrs)**

- Antimicrobial agents and actions
- Anti microbial susceptibility testing
- Mechanism of Resistance
- Antiviral, antibacterial, antifungal, antihelminthic drugs

PRACTICALS

Gram Stain
ZN and Alberts stain
Spotters
Culture media
Antibacterial susceptibility testing
Stool examination

SECTION B: IMMUNOLOGY + MOLECULAR BIOLOGY (80 hrs)

I. IMMUNOLOGY **(40 hrs)**

Structure and function of immune system – immune response
Antigen, Antibody, Antigen-Antibody reactions
Immunity – Innate, Acquired AMI, CMI
Hyper sensitivity/auto immunity
Complement system
MHC and tumor Ags
Immuno deficiency diseases
Immunization schedule

II. MOLECULAR BIOLOGY **(20 hrs)**

III. LIBRARY ASSIGNMENT **(20 hrs)**

PRACTICALS IMMUNOLOGY

WIDAL
VDRL Test/ RPR test
Brucella Agglutination test
Weil Felix test (Demonstration only)
Paul Bunnel test (Demonstration only)
RA test, CRP test, ASO test
TPHA
ELISA

MOLECULAR BIOLOGY

TOPICS:

DNA – Structure, replication
Organization of Prokaryotic and Eukaryotic genome, mitosis and meiosis
FISH, CGH, Flow cytometry
Transcription and translation, types of RNA, Lac operon
Bacterial genetics, Recombinant DNA Technology, Expression vectors – Transformation, transduction, conjugation
Mutation, Physical and chemical mutations, types of mutation
Application of recombinant DNA Technology in medicine
TCR, RFLP, DNA finger printing, gene therapy

MOLECULAR BIOLOGY PRACTICALS (Demonstration only)

PCR Demonstration
DNA Isolation
Plasmid analysis by Restriction Digestion
Protein Gel Electrophoresis
DNA Gel Electrophoresis

THEORY EXAMINATION

(1 PAPER -100 marks - 3 hours duration - having 2 sections of 50 Marks each)

PAPER II- MICROBIOLOGY –I

Section A- Clinical Microbiology --- 50 marks
Section B – Immunology & Molecular Biology - 50 Marks

QUESTION PAPER MODEL

Section A Clinical microbiology

Type of Question	No	Marks	Questions to be answered	Total
Long Essay	1	20	1	20
Short Essays	8	5	6	30

Section B Immunology and molecular biology

Type of Question	No	Marks	Questions to be answered	Total
Long Essay	1	20	1	20
Short Essays	8	5	6	30

PRACTICAL EXAMINATION **(100 marks)**

Gram Stain - 10
Spotters/ Case history charts - 20
Stool examination - 10
ZN/Albert's stain - 10
Serology (widal / VDRL) - 20
ASO/CRP/RF - 10
Mycology - 10
Record - 10

Viva Voce –50 marks (Both internal & external examiners shall conduct the practical & viva voce examination

HAEMATOLOGY AND BLOOD TRANSFUSION- I

THEORY

SECTION- A : HAEMATOLOGY and CLINICAL PATHOLOGY **60hrs**

HAEMATOLOGY

1) Intorduction to haematopoiesis (1hrs)
2) Haematopoietic stem cells (1hrs)
3) Morphology of Normal bone marrow (1hrs)

B) RBC DISORDERS

5) CLASSIFICATION OF ANAEMIA (1HRS)
6) IRON DEFICIENCY ANEMIA (1HRS)
7) MEGALOBLASTIC ANEMIA (1HRS)
8) APRROACH TO DIAGNOSIS OF HEMOLYTIC ANEMIAS (1HRS)
9) THALASEMIA (1HR)
10) SICKLE CELL ANEMIA (1HR)
11) SPHEROCYTIC ANEMIA, ELIPCTOCYTOSIS, G6PD (1HRS)
12) IMMUNOHEMOLYTIC ANEMIAS (2HRS)

- **a. AIHA –(1HRS)**
- **b. AUOIMMUNE HA(1HRS)**

13) APLASTIC ANEMIA, PURE RED CELL APLASTIA (1HRS)
14) MIHA (MICROANGIOPATIC HAEMOLYTIC ANAEMIA)- PNHA- (1HRS)
15) ANEMIA OF CHRONIC DISEASE, SIDEROBLASTIC ANEMIA, LEUCO ERYTROBLASTIC ANEMIA- (1HR)
16) P-SMEAR EXAMINATION
17) RED CELL INDICES , RDW (1HRS)
18) RETICULOCYTE COUNT, HB ESTIMATION (1HRS)
19) ANTI HUMAN GLOBULIN TEST (1HRS)
20) BONE MARROW EXAMINATION &B.M BIOPSY IN ANEMIAS(2HRS)

C) WBC

1) Morphology of Granulocyte & Agranulocytes & their normal values (1hrs)
2) Neutrophilia, Eosinophilia, lymphocytosis, Monocytosis, Neutropenia, peripheral smear in infectious mononucleosis (1hrs)
3) Qualitative disorders of Leucocytes (1hrs)
4) Classifications of Acute leukemias (1hrs)

- **a. FAB classication Acute Leukemias**
- **b. WHO CLASSIFICATION ACUTE LEUKEMIAS**

5) BLOOD PICTURES,PATHOLOGY & LAB DIAGNOSIS OF ACUTE LEUKEMIA (2HRS)

(INCLUDING MORPHOLOGY OF MYELOBLAST)

- **a. AML (1HRS)**
- **b. ALL (1HRS)**

6) **CYTOCHEMISTRY IN ACUTE LEUKEMIAS(1HR)**
7) **CLASSIFICATIONS OF MDS & PERIPHERAL SMEAR & BONE MARROW PICTURES (1HRS)**
8) **WHO CLASSIFICATION OF MYELOPROLIFERATIVE NEOPLASM & DEFINITION & LAB DIAGNOSIS OF ESSENTIAL THROMBOCYTOPENIA & PRIMARY MYELOFIBROSIS (1HRS)**
9) **CML- DEFINITION, PH CHROMOSOME, CLINICAL FEATURES, LAB FINDINGS (2HRS)**
10) **DEFINITION, CLASSIFICATION & LAB FINDING IN POLYCYTHEMIA VERA**
11) **CLL- DEFINITION, PATHOLOGY ,CLINICAL FEATURES, LAB FINDINGS (1HRS)**
12) **PLASMA CELL MYELOMA/MULTIPLE MYELOMA – PATHOLOGY LAB FINDINGS (2HRS)**
13) **WHO CLASSIFICATION OF LYMPHOID NEOPLASM (1HRS)**
14) **BRIEF OVERVIEW OF CD- MARKERS IN LYMPHOMA(1HRS)**
15) **HODKIN'S LYMPHOMA(1HRS)**
16) **REACTIVE FOLLICULAR HYPERPLASIA, FOLLICULAR LYMPHOMA & BURKITTS LYMPHOMA (1HRS)**

D)
1) AUTOMATION IN HAEMATOLOGY (2HRS)
2) QC IN HAEMATOLOGY (2HRS)
3) ORGANIZATION (1HRS)

E)
1) Normal Haemostasis

Coagulation Cascade- fibrinoytic System
2) Classification of Bleeding disorders (1hrs)
3) Approach to Bleeding disorders (1hrs)
4) Causes of thrombocytopenia (1hrs)
5) ITP (1hrs)
6) Heriditary disorder of platelet functions (1hrs)
7) Coagulation disorders-classifications-1hr
8) VWD, & Haemophilia(1hrs)
9) DIC (1hrs)
10) Definition & classification hyper coagulable states (1hrs)
11) Antiphospholipid Ab Syndrome (1hrs)
12) BT, CT, Clot retraction time,Hess test (1hrs)
13) PT/INR ,APTT (1hrs)
14) Fibrinogen Assy , FDP (1hrs)

HAEMATOLOGY PRACTICALS **60 hours**

Phlebotomy and methods of collection of blood- (2hrs)
Anticoagulants used in Haematology- (1 hr)
Red cell indices- calculations, manual & automated methods -(1 hr)
Erythrocyte sedimentation rate- methods, reporting- (1 hr)
Packed cell volume- (1 hr)

Platelet counting- (1 hr)
Absolute Eosinophil count- (1 hr)
Reticulocyte count- (2 hrs)
Stains used in Haematology lab- (10 hrs)
Leishman'sGiemsa,
MGG, Pearl's Prussian Blue, Sudan Black,
PAS, JSB, and Myeloperoxidase
Preparation of Leishman stain, Giemsa stain and MGG Stain -(6 hrs)
Preparation of blood smear and staining by Leishman's stain -(2 hrs)
RBC count & WBC count- (1 hr)
Differential count- (1 hr)
Reporting of peripheral smear- (2 hrs)
Slides for interpretation- Microcytichypochromicanaemia,
Macrocyticanaemia and Haemolyticanaemia (6 hrs)
Special tests for Haemalyticanaemias- (10 hrs)
Osmotic fragility test
Alkali denaturation test
Sickling test
Hb Electrophoresis
Investigation of G6PD deficiency
Investigation of Autoimmune hemolytic anemia
Coomb's test

Tests for the detection of Hemoparasites (4 hrs)
Bone marrow- preparation of bone marrow smears, staining and demonstration of Iron
(4 hrs)
Leukemia- Interpretation of peripheral smear in Leukemia and demonstration of cytochemical stains
(4 hrs)

CLINICAL PATHOLOGY **30hours**

Collection, Transport, Preservation and processing of various clinical specimens and their safe disposal- (2 hrs)
Urine examination – physical, chemical and microscopic (4 hrs)
Test for hemosiderin pigment
Stool examination- collection, transport, preservation
and methods of examination : (3 hrs)
Concentration and Floatation method of examination of stool
Microscopic examination of stool for ova and cysts
Chemical examination of stool and test for occult blood
Sputum examination- (4 hrs)
collection of sputum, physical examination, microscopic examination of
smear after Grams stain and Zeil Nelson's stain for acid fast bacilli and
chemical examination of sputum
Gastric analysis- (3 hrs)
Indications, contraindications, methods of collection, fasting gastric
juice, fractional test meal, Augmented Histamine test, and Hollander's
test

Cerebrospinal fluid analysis- (3 hrs)
methods of collection, indications and contraindications for CSF analysis, physical examination, Biochemical examination, and microscopic for cytology and bacteriology

Examination of body fluids- (4 hrs)
collection, transport, preservation and physical , chemical and microscopy in various disorders

Microscopic analysis of Pleural fluid, Pericardial fluid, Synovial fluid, Ascitic/ peritoneal fluid (3 hrs)

Semen analysis (2 hrs)

Pregnancy tests, methods and interpretations (1 hr)

CLINICAL PATHOLOGY PRACTICALS 40 hours

Urine examination- physical, chemical and microscopic (6 hrs)

Stool examination- macroscopic examination, concentration & floatation method , microscopic examination ,

Benzedine test for occult blood (10 hrs)

Sputum examination – (6 hrs)
macroscopic, microscopic and AFB staining

Examination of CSF and body fluids (12 hrs)

Examination of semen (4 hrs)

Pregnancy test (2 hrs)

SECTION- B: IMMUNOPATHOLOGY AND MEDICAL GENETICS

IMMUNOPATHOLOGY 20hrs

1)TYPE 1 HYPERSENSITIVITY –PATHOGENESIS AND BRONCHIAL ASTHMA(1HR)
TYPE 2 HYPERSENSITIVITY-PATHOGENESIS EXAMPLES (1HR)
TYPE 3 HYPERSENSITIVITY- PATHOGENESIS EXAMPLES (1HR)
TYPE 4 HYPERSENSITIVITY- PATHOGENISIS OF GRANULOMA & TUBERCULOSIS(1HR)
2) OVER VIEW OF INNATE & ADOPTIVE IMMUNITY(2HR)
CELLS OF THE IMMUNE SYSTEM & THEIR ROLES & FUNCTIONS
3) CLASSIFICATIONS OF AUTO IMMUNE DISEASES(1HR)
Pathogenisis of immune tolerance & auto immune disease(1hr)
Pathogenisis, clinical features & laboratory diagnosis of SLE(2hr)
Pathogenisis, clinical features & laboratory diagnosis of RA(1hr)
Clinical features of systemic sclerosis, scleroderma, hashimotosis thyroiditis, sjigrons syndrome(2hr)
4) Transplantation pathology(4hr)
Types of graft
Major histocompatability molecules

Rejections of transplant
Overview of hemotopoietic stemcells transplantation
Complications of transplantation

5)HIV (3hr)
Definition, structure, laboratory diagnosis,life cycle of HIV in humans, stages of infections, opportunistic infections & CD4 Complications

IMMUNOPATHOLOGYPRACTICALS **40 hours**

Serological tests (screening and diagnostic)
in various pathological conditions (20 hrs)
Delayed type hypersensitivity testing (5 hrs)
Detection of tumour markers- demonstraton(5 hrs)
Histocompatibility testing- demonstration(5 hrs)
Setting up of Immuno histochemistry lab (5 hrs)

MEDICAL GENETICS **10 hours**

1. **STRUCTURE OF GENES (1HR)**
2. **CLASSIFICATIONS OF GENETIC DISORDERS(1HR)**
3. **MENDELIAN DISORDERS / SINGLE GENE DISORDERS , CLASSIFICATIONS WITH EXAMPLE(1HR)**
4. **DEFINITION & EXAMPLES OF NUMERICAL CHROMOSOMAL ABNORMALTIES(2HR)**
5. **DOWN SYNDROME, KLINEFILTERS SYNDROME,TURNERS SYNDROME(1HR)**
6. **GOUCHERS DISESE,NIEMEN PICK DISEASE(1HR)**
7. **LABORATORY DIAGNOSIS OF GENETIC DISORDERS (1HR)**
8. **KARYOTYTPING, BARRBODY INDENTIFICATION (2HR)**

GENETICS PRACTICALS **20 hours**

Study of Karyotypes I (4 hrs)
Normal Karyotyping in humans- male (46 XY) and female(46XX), G banded metaphase plates

Study of Karyotyping II (8 hrs)
Abnormal Karyotyping – Down's syndrome (Autosomal), Turner syndrome and Klinefelter syndrome (sex chromosome)

Sex chromatin (8 hrs)
Buccal smear study and staining methods for Barr body

Blood smear study of drum sticks in neutrophils

SCHEME OF EXAMINATION

Theory: There shall be one paper of 3 hours duration carrying 100 marks each

PAPER III: HAEMATOLOGY AND BLOOD TRANSFUSION- I

Section- A: Haematology and Clinical pathology 50 Marks
Section- B: Immunopathology and Medical genetics 50 Marks

Type of questions and distribution of marks for each section carrying 50 marks

Type of questions	No of questions for each subject	No of questions and marks for each question	Total marks
Long essay	2	2X10	20
Short essay	5	5X6	30

PRACTICAL EXAMINATION Total-100 Marks

1. Spotters 20 Marks
2. Staining and reporting the peripheral smear 20 Marks
3. Special tests (Any two) 10 Marks
   a. RBC/WBC count
   b. Reticulocyte count
   c. Absolute Eosinophil count
   d. ESR or PCV
   e. Osmotic fragility test
   f. Sickling test

4. Interpretation of automated tests in Haematology 20 marks
5. Clinical pathology
   a. Urine examination- 20marks
      Physical,
      Chemical (any two tests)-
         1. Sugar & Ketone bodies
         2. Protein and blood
         3. Bile salts and Bile pigments
      Microscopic

   b. Stool examination- 10 marks
      Macroscopic
      Microscopic

Special tests and occult blood

VIVA VOCE EXAMINATION **50 Marks**

1. Haematology	15 marks
2. Clinical pathology	20 marks
3. Immunology	15 marks

Both internal and external examiner shall conduct the practical and viva voce examination

COURSE CONTENT
SECOND YEAR M.Sc MLT
CLINICAL BIOCHEMISTRY

PAPER - I **80 hrs**

SECTION A – CLINICAL BIOCHEMISTRY

I. Liver Function

- Overview of biochemical functions of liver. Mechanism and patterns of injury in liver disease.
- Bilirubin metabolism and disorders. Inherited disorders
- Diagnostic strategy: Biochemical assessment of liver function by nonenzyme and enzyme analytes. Laboratory considerations
- Biliary tract diseases-gall stones and cholecystitis. Laboratory analysis of gall stones

II. Renal function

- Overview of renal function
- Categories of renal diseases and NKF practice guidelines.
- Analytical method for assessment of renal function (creatinine, urea nitrogen, glomerular filtration rate) and proteinuira.
- Determination of actual creatinine clearance rate, use of algorithms in predicting clearance rate
- Renal handling of electrolytes. Clinical importance of electrolytes.
- Renal calculi and laboratory analysis.
- Osmolality and its measurement. Osmometry. Calculated parameter. Osmolal gap estimation and pitfalls.
- Overview of renal replacement therapy.Laboratory support for renal replacement therapy

III. Gastric, pancreatic and intestinal function

- Outline of clinical manifestations of gastric, pancreatic, and intestinal diseases. GIT hormones and enzymes in digestion and evaluation of malabsorption and diarrheal syndromes. Laboratory evaluation of biochemical analytes in diagnosis of abnormalities.

IV. Cardiac function

- Biochemistry and tissue distribution of cardiac markers.
- Clinical utility of cardiac markers in diagnosis and management .
- Analytical measurement of cardiac enzymes and other analytes including total homocysteine, hSCRP, cardiac troponins, and myoglobin

V. General endocrine function

- Hormones- Classification. General characteristics and function.

- Hormone assays and clinical significance of some hormones analysed routinely in biochemistry laboratory (T3, T4, TSH, FT3, FT4, FSH, LH, PRL, Testosterone, Chorionic gonadotropin, Insulin, ACTH, Cortisol)
- Usefulness of placental hormone -Chorionic gonadotropin in normal and abnormal pregnancy. Laboratory evaluation
- Usefulness of anti-TPO in thyroid abnormalities

VI. Porphyrin and Hemoglobin

- Chemistry and synthesis of porphyrins . Formation of Hemoglobin and myoglobin.
- Clinical significance and disease correlation. Laboratory diagnosis of porphyrias, hemoglobinopathy. Myoglobinuria

VII. Tumor markers

- Classification. Clinical applications.
- Laboratory evaluation of specific tumour markers- ALP, PSA, ACTH, calcitonin, β-hCG, AFP, CEA, CA15-3, CA-125, CA 19-9.

VIII. Pediatric clinical biochemistry

- Problems of specimen collection; capillary specimens. Biological reference intervals
- Heavy metal poisoning in children.
- Newborn screening

IX. Urine, CSF, Synovial and serous body fluids:

- Urinary analysis- An approach to automation.
- Indications, specimen and analytical considerations for biochemical analysis - CSF,Synovial and serous body fluid analysis

SECTION B **40 hrs**

LABORATORY MANAGEMENT

I. Working of a Clinical Biochemistry Laboratory

II. Laboratory personnel: Role of lab personnel in Patient Management; Soft skills in patient handling

III. Automation: History of automated analyzers. Processes used in automation, Types of automation. Steps in automated analysis, Total laboratory automation.

IV. An approach to Laboratory Equipments: Equipment procurement and evaluation. Details of specific instruments / devices for analyte estimations (routine chemistry, hormone, tumour markers, electrolytes, drugs, metals, blood gases, amino acids, serum proteins)

V. Point-Of-Care-Testing (POCT): Requirements, Classification Applications. Characteristics of POCT analyzer. Examples of POCT devices

VI. Biological Reference Intervals: Definition. Establishment. Validation of reference intervals. Diagnostic efficacy.

VII. Analytical Biochemistry

- Method selection & evaluation. Analytical performance criteria. Basic concepts in relation to analytical methods. Measurement of imprecision and inaccuracy. Method comparisons.
- Detection methods: Photometer, Fluorometer, Luminometer, Potentiometer, amperometer.
- Method principles: Kinetic and rate methods. Labelled immunoassays. General considerations and assay design.
- Separation techniques: Chromatography and Electrophoresis.

VIII. Diagnosis of inborn errors of metabolism: Qualitative and quantitative tests in diagnosis of inborn errors of metabolism

IX. Standardization / Calibration processes: Calibration of basic equipments by laboratory personnel. Calibration of methods-colorimetric and enzymatic.

X. Total Quality management:

- Fundamental principles. TQM framework
- Elements of Quality assurance Programme
  6. Types of preanalytical variables
  7. Analytical variables- documentation, inventory, competence and various laboratory processes. Use of stable reference materials-calibrators & controls, LJ charts and Westgard rules. Internal QC Procedures.
  8. Postanalytical variables
- External Quality Assessment Schemes and Proficiency Testing Programmes. Laboratory Accreditation

XI. Toxicology testing in Clinical laboratory:

1. **Therapeutic drugs and their management (TDM)**: Mechanism of action of drugs. Absorption, Distribution, Biotransformation and Excretion of drugs. Clinical utility of TDM. Analytical considersations.
   - Overview of specific drugs and their analysis in serum/blood: Carbamazepine, Phenobarbital, Phenytoin, Valproic acid, Digoxin, Theophylline, Cyclosporine, Lithium
2. **Toxic agents:** Source, Routes of entry, Metabolism and overview of analysis
   - Carbon monoxide, Alcohol, Iron, Arsenic, Lead.
3. **Drugs of abuse:** Urinary Barbiturates, Cannabinoids, Amphetamine, Benzodiazepines

XII. Clinical laboratory informatics : Computer basics. Word processing, spreadsheets, data-base, graphics, statistics, presentations, email, internet.
Laboratory Information Systems (LIS).

XIII. Wet chemistry and Dry chemistry

PAPER II- BIOCHEMISTRY 80 hrs

I. Carbohydrates

1. Chemistry, Metabolism and disorders.
2. Hormones that Regulate blood glucose and their overview.
3. Diabetes mellitus (DM) - Classification of DM and other categories of glucose intolerance. Pathogenesis of Type I and Type II DM. Laboratory diagnosis and criteria for the diagnosis of DM. Chronic complications of DM. Gestational Diabetes mellitus (GDM). Screening and diagnosis of GDM.
4. Role of laboratory:
    a. Diagnosis of inborn errors of carbohydrate metabolism by qualitative and chromatographic techniques.
    b. Differential diagnosis and management of DM. Methods for determining Blood Glucose and Glycated Hemoglobins. Self monitoring of blood glucose. Qualitative, and quantitative methods for urinary glucose urinary albumin excretion.

II. Amino Acids & Proteins

1. Chemistry, Metabolism and disorders.
2. Specific :
    a. Aminoacidurias: Clinical Implications
    b. Plasma proteins: Clinical significance, genetic deficiency and laboratory considerations of major plasma proteins classified based on electrophoretic mobility

Proteins and albumin in other body fluids: Clinical significance and analytical considerations in urine, CSF, ascitic fluid, peritoneal, pleural fluid

3. Role of laboratory:

a. Diagnosis of inborn errors of amino acid metabolism by qualitative and chromatographic techniques.

b. Measurement of serum, urine and other fluids based on electrophoretic mobility. Separation of serum protein electrophoresis by slide agarose gel electrophoresis. Quantitation of different fractions.

III. Lipids

1. Metabolism and their disorders
2. Association of Lipids and lipoproteins with coronary heart disease. NCEP recommendations for lipid and lipoprotein measurements. Sources of variation in lipid and lipoprotein measurments. Technical considerations in measurements of lipids. Methodological considerations for HDL and LDL quantification.
3. Role of laboratory:

a. Diagnosis of various disorders by lipoprotein electrophoresis and reliable methods in measuring lipids and lipoproteins.

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IV. Nucleic acids

Chemistry, Metabolism and disorders.

V. Biochemistry of cancer.

VI. Enzymes

Structural organisation and composition. Enzyme Kinetics, Factors affecting enzyme activity, Inhibition. enzymology: Measurement of reaction rates and enzyme mass. Enzymes as analytical reagents,

applications of immobilized enzymes. Isoenzymes and Diagnostic Enzymology

VII. Vitamins

Water soluble and Fat soluble vitamins

VIII. Mineral metabolism and disorders

Copper, Zinc, Manganese, Magnesium, Molybdenum, Fluorine, Sodium, Potassium, Chlorine, Calcium, Phosphorus, Iron

IX. Free radicals and antioxidants

X. Analytical techniques: Photometry, fluorometry, luminometry, voltammetry, amperometry, conductometry, turbidimetry, nephelometry,

Practical Syllabus
M.Sc. MLT Biochemistry- II

I. Practical approach to basic laboratory practices

1. Preparation of different Buffers and buffered substrates. (Phosphate , acetate, etc.). Buffering capacity.
2. Colorimetry and spectrophotometry.
   Checking wavelength and extinction Colorimetric experiment to select a complementary filter.
   Standardization of a colorimeter/ spectrophotometer using colored solution
   Graphing of Beer's law- drawing calibration curves. Concept of one point calculation or calibration (T/S X concentration of standard)

II. Qualitative procedures

1. Spot tests/ color reactions: Carbohydrates, amino acids, NPN, proteins as qualitative tests for diagnosis disorders
2. Calculi: Renal and gall

III. Separative procedures (Should aim at diagnosing abnormalities in patients. Control biological specimens to be used while testing besides quantitation)

Chromatography: Paper and TLC for Carbohydrates and amino acids
Electrophoresis: serum proteins, haemoglobin, lipoproteins

IV. Enzyme kinetics

1. Effect of temperature on Enzyme activity.
2. Effect of substrate concentration on Enzyme activity.
3. Effect of pH on the rate of reaction.
4. Effect of enzyme concentration on the rate of reaction.

V. Clinical Biochemistry Practicals

1. **Miscellaneous**
   a. **Specimen:** collection, acquisition, processing
   b. Calibration Processes in Clinical Laboratory

Calibration of pipettes, thermometers, centrifuges, balances

c. Quality Control serum : Preparation of in-house QC serum

2. Quantitative analysis by Manual and Semi automated/ automated methods where appropriate

- **Standardization / calibration data of all analytes necessary**
- **Instrumentation, calibrator use, details of diagnostic kits necessary**
- **Indications for analytes for CSF fluid and other fluids where appropriate**
- **Calculated parameters where appropriate**

(Includes analytes mentioned in I yr, M.Sc., MLT syllabus)

8. Blood / Serum- Glucose, urea, creatinine, uric acid, calcium, inorganic phosphorus, total protein, total and conjugated bilirubin, AST, ALT, ALP, GGT, Cholesterol, triglycerides, HDL, LDL (calculation) Amylase, Lipase, Ceruloplasmin, ADA, Creatine Kinase, LDH, Iron, TIBC.
9. Urine urea, creatinine, proteins, uric acid, calcium, phosphate, VMA, 17-keto steroids, 5-HIAA
10. Blood and urine Xylose
11. Electrolyte analysis: Colorimetric/Flame photometry/ ISE
12. ABG analysis: ABG analyzer.
13. T3, T4 and TSH: any immunochemical method.
14. Drugs: Lithium and Phenytoin (or any other)
15. Demonstration- Ion exchange chromatography, HPLC of any analyte

VII. Case reports

Text Book references

- Biochemistry – Stryer H.Gerjmetal-W.H.Freeman and company New York 5th edition 2002.
- Lehninger's Principles of Biochemistry – Lehninger. A.L., Nelson. D.L., Eral-C.B.S. Publishers and distributors, New Delhi 3rd edition.
- Harper Illustrated Biochemistry – Murray R.K. Grannar, D.K. Mayes-P.A. Eral 27th edtion, McGrawHIll.
- Medical Biochemistry – N.V. Bhagavan -Academic Press 4th edition 2002.
- Text Book of Biochemistry – A.S. Saini, C.B.S Publishers and distributors 2nd edition.
- Teitz fundamentals of Clinical Chemistry – Burtis. C.A. Ashwood E. R. 3rd, 4th and 5th editions
- Varley's Practical Clinical Biochemistry – Gowenlock and Bell William Heinemann, 4th, 5th, 6th editions
- Text Book of Biochemistry with Clinical Correlations – Devlin T.M. Wiley Liss, New York 5th Edition
- Clinical Physiology of Acid-Base balance and Electrolyte disorders – Rose. B.D – Mcgraw-Hill International edition New York 4th edition
- Methods in Bio-Statistics for Medical students – Mahajan. B.K. Jaypee brothers Medical Publishers, New Delhi.
- Clinical Chemistry – Theory analysis and Correlation – Kalpan. L.A. 4th edition
- Principles of Biochemistry – CBS Publishers – Lehninger, Nelson, Cox.
- Clinical Chemistry-Principles, procedures, correlations- 5th edition by Michael L. Bishop, Edward P. Fody and Larry Schoeff.
- Textbook of Medical Laboratory technology 2nd edition by Godkar and Godkar.
- Short textbook of Medical Laboratory for technicians -1st edition by Sadish Gupte
- Textbook of Biochemistry (For Medical Students)-5th Edition by DM Vasudevan & Sreekumari S

- Textbook of Medical Biochemistry-6th Edition by MN Chatterjea & Rana Shinde
- The National Medical Series for Independent study . Biochemistry-4th edition by Victor L. Davidson and Donald B. Sittman.
- Mark's Basic Medical Biochemistry- A clinical approach 2nd Edition by Smith, Marks and lieberman
- Clinical Chemistry-Laboraotry Management and Clinical Correlations by Kent Lewandrowski
- Clinical Diagnosis and management by laboratory methods 20th edition by John Bernard Henry
- Medical Laboratory technology 6th edition by Ramnik Sood.
- Biophysical chemistry-Principles and Techniques by Upadhay, Upadhay and Nath

Journals for Reference:

Indian Journal of Clinical Biochemistry
Clinica Chemica Acta
Journal of Laboratory Clinical Medicine
Journal of Clinical Investigation
Biochemistry Journal
Clinical Chemistry
European Journal of Biochemistry
Annals of Biochemistry
Lab medica
Science
JAMA
Lancet
Any other relevant journals

SCHEME OF EXAMINATION OF BIOCHEMISTRY-II.
M.Sc., MLT II year
BIOCHEMISTRY II

I. THEORY EXAMINATION: 2 papers of 3 hrs duration, carrying 100 marks each.

Day 1: PAPER-IDuration : 3 Hrs Max Marks:100

SECTION – A CLINICAL BIOCHEMISTRY Max Marks: 50
SECTION – B LABORATORY MANAGEMENT Max Marks: 50

Type of questions	No of questions for each subject		No. of questions & marks		Total Marks (100)	
	Sec A	**Sec B**	**Sec A**	**Sec B**	**Sec A**	**Sec B**
Long Essay	1	1	1x20	1x20	20	20
Short Essay	3	3	3x10	3x10	30	30

Day 2: PAPER-IIDuration : 3 Hrs

BIOCHEMISTRY

Type of questions	No of questions for each subject	No. of questions and marks	Total Marks
Long Essay	1 +1	2x20	40
Short Essay	6	06x10	60

II. PRACTICAL EXAMINATION: Day 1 & 2 Max. mks 100

1. Separative procedures -30 mks
   Chromatography or Electrophoresis (Should aim at diagnosing abnormalities in patients. Quantitation)
2. Calibration- 15 mks
   Pipette / thermometer/ spectrophotometer
3. Case reports - 5 mks
4. Quantitative estimations – 20 mks (10 + 10)
   Standardization of the analyte and determination of unknown concentration of one enzyme and one non-enzyme analyte
5. Enzyme Kinetics – 20 mks
   Temperature / pH / Substrate Concentration / enzyme concentration
6. Explaining one instrument to the examiner onsite (available in the laboratory) - 10 mks

III. VIVA-VOCE-50 Marks

1. Theory topics in syllabus to be covered by Internal and external examiners (40 mks)
2. Presentation of project work (10 mks)

Grand Total -150 mks

MICROBIOLOGY II

Paper I – Systematic Bacteriology, Applied Microbiology & Immunology

Systematic Bacteriology (60 hours)

Gram Positive Bacteria: Systematic study of the following bacteria with special reference to morphology, cultural characteristics, pathogenicity, lab diagnosis and prophylaxis -

- Staphylococcus
- Streptococcus
- Pneumococcus
- Corynebacterium
- Bacillus
- Mycobacterium
- Clostridium
- Actinomycetes

Gram Negative Bacteria:

- Neisseria
- Haemophilus
- Bordetella
- Brucella
- Enterobacteriaceae
- Salmonella & Shigella
- Vibrio,
- Campylobacter & Helicobacter
- Pseudomonas, Burkholderia & non fermenters
- Yersinia

Spirochaetes & Others:

- Treponemes, Leptospira & Borrelia
- Mycoplasma, Chlamydia & Rickettsia
- Non sporing anaerobes
- Gardenerella, Legionella & Listeria
- Miscellaneous Bacteria

Applied Microbiology:

1. Normal microbial flora of the human body
2. Collection, transport and processing of specimens in the following infections
   - Respiratory tract infection
   - Gastro intestinal tract infection
   - UTI and female genital tract infection
   - Central nervous system
   - Pyogenic infection
   - Pyrexia of unknown origin
3. Nosocomial infection
   - Epidemiology – source – control – surveillance and control programmes
   - Role of Microbiology in prevention and control
   - Device associated intravascular infection and control
   - Environmental sampling of OTs and hospital environments
   - Bioaerosols
   - Significance of MRSA, Pseudomonas aeruginosa. Acineto bacter
   - Sterilization, disinfection and antisepsis in hospital (Biomedical waste management)
   - CSSD
4. Respiratory tract infection with special reference to C diphtheriae, Streptococcus, tuberculosis, pneumonia, causative agents, clinical symptoms and lab diagnosis of sore throat, pneumonia, atypical pneumonia
5. Urinary tract infection
   - Lower and upper UTI
   - Bacterial, viral and fungal infection of urinary tract
   - Predisposing factors clinical features aetiology and lab diagnosis of UTI
6. Sexually transmitted infections – causative agents, lab diagnosis of sexually transmitted diseases with special reference to syphilis, gonorrhoea, Bacterial vaginosis and Gardenerella vaginalis, non gonococcal urethritis
7. Gastro intestinal tract infection – etiology. C/F and diagnosis - Food poisoning – Infectious – toxic – intermediate types - botulism

8. Pyrexia of Unknown Origin (PUO) – Causative agents and lab diagnosis of PUO with special reference to Enteric fever, Brucellosis
9. Central nervous system infection – causative agents and lab diagnosis of
   - Pyogenic meningitis
   - tuberculosis meningitis
   - Asceptic meningitis
10. Pyogenic infections and miscellaneous infections
    Aetiology, lab diagnosis of pyogenic infection with special reference to
11. Zoonotic infection- Definition, types and causative agents, with special reference to plague, leptospirosis, anthrax and bovine tuberculosis
12. Recent diagnostic techniques – commercial kit – system – API, automated and semiautomated identification system
    BACTEC, Vitek, Quick screening methods, chromogenic agar media, molecular techniques like PCR in the diagnosis
13. Antimicrobial susceptibility testing, antimicrobial therapy
    Kirby Bauer, stokes, E. test, MIC determination

PRACTICALS – BACTERIOLOGY

- Isolation, characterization and identification of pathogen from various clinical specimen
- Study of morphology, cultural and biochemical characters of common bacterial pathogen
- Antimicrobial susceptibility testing
- Microbiological analysis if water, milk
- Study of Microbial flora of air in various localities
- Preservation of stock culture
- Skin clipping for lepra bacilli

IMMUNOLOGY **(40 HRS)**

1. Introduction to immunology
   Immunity- innate acquired active and passive – local and heard immunity
   Mechanisms

2. Structure and functions of immune system
   Central and peripheral lymphoid organs
   B cells and T cells
   Major Histocompatibility Complex (MHC)

3. Immune response
   Primary and secondary immune response
   Humoral and cellular immune response
   Detection of CMI
   Cytokines
   Super Antigens

4. Antigen and antibodies
   Definition and determinants and classes of antigens
   Antibodies (Immunoglobulins)
   Definition – structure – types – functions
   - Abnormal Immunoglobulins

- Monoclonal Antibodies and hybridoma techniques, applications in biomedical research
- Factors influencing antibody production
- Theories of antibody production
  Clonal selection and direct template theory

5. Antigen and antibody reaction
   - Types – measurement – titre – sensitivity. Specificity
   - Precipitation reactions – mechanism – application
   - Agglutination – Mechanism, application, ELISA – Principle – types (details)
     CFT, RIA, Immunoblot technique like Western blot
     Immunofluorescence – Principle- Direct, indirect

6. Complement system
   General – properties – components
   Classical and alternate pathway – biosynthesis and deficiency syndromes

7. Immunodeficiency disease
   Primary and secondary immunodeficiency diseases
   Types of immunodeficiency diseases with examples

8. Hyper sensitivity
   Definition – classification and types I – IV

9. Auto immunity
   Definition – mechanism – classification with example

10. Immunology of transplantation and malignancy
    Types of transplants – allograft, reaction – mechanism of allograft rejection
    Tumor antigens – immunological surveillance

11. Prophylactic immunization
Active – passive – combined
Immunization schedule

PRACTICALS – IMMUNOLOGY

- Double diffusion technique
- Radial immuno diffusion
- Haemagglutination
- Latex Agg
- Electrophoresis
- CIEP
- PCR, IF, RIA (If facility available ELISA

PAPER II – VIROLOGY, MYCOLOGY AND PARASITOLOGY

VIROLOGY (50 HRS)

1. Systematic study of the following viruses: their biological properties, pathogenecity, epidemiology; isolation and identification from clinical specimens, lab diagnosis, treatment and immunoprophylaxis against parvoviruses ,Adenoviruses, Herpes viruses, pox viruses, Hepatitis viruses, picorna viruses, Rota viruses, orthomyxoviruses, paramyxoviruses, Rubella virus, Rabies virus, papova virus, HIV, Oncogenic viruses, Arboviruses
   -Recent advances in diagnosis of viral infections
   - Viral Vaccines
   - Antiviral agents

MYCOLOGY (20 HRS)

2. Systematic study of the following Fungi: Epidemiology, pathogenesis, laboratory diagnosis, treatment and prophylaxis against **superficial mycoses** Ptyriasis versicolor, Tinea nigra, Tinea piedra, Dermatophytes, **Subcutaneous mycoses**, Mycetome, Sporotrichosis, chromoblastomycosis, Rinosporidiosis, Lobomycosis, **Systemic mycoses**, Histoplasmosis, blastomycosis, coccididiomycosis, paracoccidiomycosis, **Opportunistic mycoses**-Cryptococcosis, candidiasis, Aspergillosis, Zygomycosis, Keratomycosis and Otomycosis, Allergic fungal diseases, Mycotoxicosis,

PARASITOLOGY (60 HRS)

3. Study of morphology, life cycle, clinical symptoms, pathogenesis, epidemiology, diagnosis, treatment, prevention of following parasites.
   Entamoeba histolytica, Naeglaria, Giardia, Trichomonas, Balantidium, Isospora, Crytosporidium, Microsporidium, Malarial parasites, Trypanosoma, Leishmania, Toxaplasma gondii, Pneumocystis carinii, TaeniaEchinococcus, Schistostoma, Paragonimius, Diphyllobothrium, Ascaris, Enterobius, Ancylostoma, Trichuris trichura, Wuchereria, Dracunculus, Trichinella spiralis, Strongyloides
   -Diagnosis of parasitic infections
   - Stool Examination for ova & cyst
   - Peripheral smear examination for parasites
   - Cultivation of Parasites

PRACTICALS

- Common diagnostic tests used for detection of viral infections
- Identification of fungal pathogens in clinical specimens including slide culture
- Diagnostic tests for detection of parasitic infections – methods for demonstration of parasites in clinical specimens – stool examination (direct and concentrated)
- Preparation of blood smear for detection of malarial and filarial parasites
- ELISA test HIV and HBsAg

SCHEME OF EXAMINATION -THEORY

Paper –I SYSTEMATIC BACTERIOLOGY APPLIED MICROBIOLOGY AND IMMUNOLOGY – 100 marks
Paper –II - VIROLOGY, MYCOLOGY AND PARASITOLOGY -100 marks

M Sc MLT II YEAR – PAPER I (THEORY)
SYSTEMATIC BACTERIOLOGY APPLIED MICROBIOLOGY AND IMMUNOLOGY

THEORY EXAMINATION

Duration: 3 Hrs
Distribution of Marks Max Marks: 100

Type of questions	No of questions for each subject	No of questions and marks for each question	Total Marks
Long Essay	1 (SB), 1 (IM)	2x20	40
Short Essay	3 (SB), 1 (IM) 2 (AM)	06x10	60

SB: Systematic Bacteriology. IM: Immunology. AM: Applied Microbiology

Subject wise distribution as follows:
Systematic Bacteriology (SB)- 50
Applied Microbiology (AM)- 20
Immunology (IM) - 30
Total - 100

M Sc MLT II YEAR – PAPER II (THEORY)
VIROLOGY, MYCOLOGY AND PARASITOLOGY
THEORY EXAMINATION

Duration: 3 Hrs
Distribution of Marks Max Marks: 100

Type of questions	No of questions for each subject	No of questions and marks for each question	Total Marks
Long Essay	1 (P), 1 (V)	2x20	40
Short Essay	2 (P), 2 (V) 2 (M)	06x10	60

P – Parasitology V – Virology M – Mycology

Subject wise distribution as follows:
Parasitology (P) - 40
Virology (V) - 40
Mycology (M) – 20
Total - 100

M Sc MLT II year – Microbiology II (PRACTICAL EXAMINATION)

DURATION: 3 days Max Marks: 100

1. Identify the given pure culture and perform antimicrobial susceptibility testing (N Broth / N agar slope may be provided) - 15
2. Identification of mixed culture (A specimen with a case history will be given for identification. Identify the Isolates and perform antimicrobial susceptibility testing for the pathogen)- 25
3. Media Preparation- 10
4. Virology – HIV / HBsAg by ELISA method (3rd or 4th generation ELISA assays only applicable and not rapid tests) - 10
5. Stool examination. Focus 2 different ova. Draw neat labeled diagram. Any one concentration technique may be done - 10
6. Identify both the fungal colonies, demonstrate microscopical characteristics and perform slide culture for the rapid growing filamentous fungus- 20
7. Serology exercise : Perform a serological test – Widal/VDRL/Brucella agglutination- 10

PRACTICALS 100
VIVA VOCE - 50 (10 marks for the project report assessment)

Total 150

Text book for references:

1. Text book of Microbiology by Ananthnarayan, 7th Edition, Orient Longman
2. Diagnostic Microbiology by Bailey & Scott 11th Edition; Mosby
   Medical Microbiology by Greenwood & Slack 16th Edition; Churchill Livinstone
3. Text book of Medical Parasitology by Panikar 5th Edition; Jaypee
4. Colour Atlas and Textbook of Diagnostic Microbiology by Koneman 5th Edition ; Williams Wilkins
5. Mackie & Maccarteney Practical Medical Microbiology 14th Edition;
   Churchill Livingstone
6. Essential Immunology, Roitts & Delves 10th Edition; Blackwell Science
7. Medical Microbiology ,Jawetz, Melnick and Adelberg's McGrawhill
8. Text book of Medical Parasitology – P Chakraborthy

HAEMATOLOGY AND BLOOD TRANSFUSION- II

SECTION: A HAEMATOLOGY- THEORY 60 hrs

1. HEMATOPOIESIS – ERYTHROPOIESIS, MYELOPOIESIS, THROMBOPOIESIS (2HRS)
2. PERIPHERAL BLOOD SMEAR INTERPRETATION(2HR)

RBC:- INCLUSION & ABNORMAL RBCS
WBCS PLATELETS:- MORPHOLOGY & INTERPRATATION

3. B.M ASPIRATION & BIOPSY:- INDICATION, CONTRAINDICATION, SITES, PROCEDURE(1HRS)
4. B.M ASPIRATION:- NORMAL MORPHOLOGY INCLUDING CELLULARITY, M:-E RATIO(1HRS)
5. B.M BIOPSY:- NORMAL MORPHOLOGY(1HRS)
6. ANTICOAGULANTS & BLOOD COLLECTION(1HRS)
7. PCV- METHODS, PROCEDURE & CLINICAL SIGNIFICANCES(1HRS)
8. ESR- METHODS , PROCEDURE & CLINICAL SIGNIFICANCES (1HRS)
9. HB ESTIMATION- - METHODS , PROCEDURE & CLINICAL SIGNIFICANCES (1HRS)
10. RBC, WBC COUNT, PLATELET COUNT(1HRS)
11. APPROACH TO DIAGNOSIS OF HEMOLYTIC ANEMIAS(1HRS)
12. OSMOTIC FRAGILITY TEST & SICKLING TEST-(1HRS)
13. RETICULOCYTE COUNT INCLUDING RPI ETC….(1HRS)
14. ELECTROPHORESIS(1HR)
15. ALKALI DENATURATION TEST, ACID ELUTION TEST(1HR)
16. TEST FOR G6PD DEFICIENCY(1HRS)
17. COOMB'S TEST(1HRS)
18. HEMOLYTIC DISEASE OF NEWBORN& INVESTIGATION(2HRS)
19. RBC DISORDERS
    1. CLASSIFICATION OF ANEMIAS(1HRS)
    2. IRON DEFICIENCY ANEMIA-METABOLISM, ABSORPTION, LAB DIAGNOSIS(1HRS)
    3. MEGALOBLASTIC ANEMIA(2HRS)
       a) VITAMIN B12 DEFICIENCY-
       b) FOLATE DEFICIENCY-
       c) B.M FINDINGS, LAB DIAGNOSIS
    4. APLASTIC ANEMIA- ETIOLOGY, EXAMPLES & PANCYTOPENIA(1HRS)
    5. CLASSIFICATION OF INHERITED B.M FAILURE SYNDROME & THEIR CLINICAL FEATURES (1HRS)
    6. HERIDITARY SPHEROCYTOSIS, ELIPCTOCYTOSIS(1HRS)
    7. G6PD DEFICIENCY ANEMIA, PYRUVATE DEFICIENCY ANEMIA(C/F, LAB DIAGNOSIS, PATHOGENESIS(1HRS)
    8. IMMUNE HEMOLYTIC ANEMIA- CLASSIFICATION, COLD AB, WARM AB IN DETAIL (1HRS)
    9. MECHANICAL HEMOLYTIC ANEMIA(1HRS)
    10. THALASEMIC SYNDROMES- CLASSIFICATION & LAB DIAGNOSIS OF ALPHA &β THALASEMIA(2HRS)

11. **Sickle cell Anemia-pathologenesis & lab diagnosis(1hrs)**

20) WBC Disorders

1. **Non neoplastic disorders of WBCs (1hrs)**
2. **Neutrophilia, eosinophilia,Monocytosis, lymphocytosis, Agranulocytosis(1hrs)**
3. **Acute leukemias- etiology classification(1hrs)**
4. **Blood pictures in AMI & ALL including cytochemistry(1hrs)**
5. **Chronic myeloid leukemias- etiology, Blood pictures(1hrs)**
6. **Classification of lymphoid neoplasms(WHO)(1HRS)**
7. **Non hodkins lymphoma ,Burkitts lumphoma, follicular lymphoma, large B-cell lymphoma(1hrs)**
8. **WHO classification of myeloproliferative neoplasma, definition & lab diagnosis(1hr)**
9. **Plasma cell neoplam(2hrs)**

21) Platelet

1. **Normal Hemostasis & coagulation cascade & fibrinolytic system (1hr)**
2. **BT, CT, (1hr)**
3. **PT/TNR, APTT(1hr)**
4. **Second line investigations- examine mixing studies (1hr)**
5. **Fibrinogen assay & FDP (1hr)**
6. **Classification of Bleeding disorders(1hr)**
7. **Approach to Bleeding disorders(1hr)**
8. **ITP(1hr)**
9. **Hemophilia & VWD(1hr)**
10. **DIC(1hr)**
11. **Antiphospholipid Syndrome(1hr)**
12. **Platelet Qualitative disorders(2hr)**
13. **Qc in Hemotology laboratory(2hr)**
14. **Flow cytometry &CD Markers(1hr)**

PRACTICALS 25 hrs

1. staining & interpretation of perepheral smears.
2. test for coagulation disorders. -
   A. screening test : pt. aptt, tt, inr.
   B. mixing studies
   C. coagulation factors assay.
   D. urea solibility tests for factor xiii.

E. factor viii inhibitor studies.
F. fibrinogen assay.
G. d-dimer tests.
H. ibrinogen degradation products.

3. investigation for hemmoraghic disorders.: test for vasculature & platelet function, bleeding time, clot retraction time & platelet cou nt.
4. platelet aggregation studies.
5. thrombotic work-up. a. protein c. protein s. at-iii, factor v leiden.
6. antiphospholipid antibody work- up.
7. bone marrow examination: preparation of bone marrow aspiration, trephine biopsy and smear staining.
8. organization & quality control in the coagulation lab.
9. prepation of reagents & diluting fluids.

SECTION: B. BLOOD TRANSFUSION : THEORY 40 hrs

Introduction to Immune Hematology

1. History of transfusion medicine
2. Blood groups & genetics: ABO system, secretors, nonsecretors, Rh system, importance of Rh system. Du red cells [A variant of Rh system], MNS System, - clinical significance.
3. Blood transfusion - indications for blood transfusion.
4. Blood donation, donor registration, donor selection, blood collection. Adverse donor reaction.
5. Anticoagulants used to store blood, changes occurring I n the stored blood.
6. Blood group systems antigen antibody reaction, ABO system – forward grouping, reverse grouping.
7. Rh system – inheritance & nomenclature Rh grouping, Rh antigen & antibodies. Du variant, Anti D type of reagents and their application.
8. Coombs test application: DCT, ICT Rh antibody titre.
9. Compatibility testing: Major & minor. Coombs crossmatch.
10. Blood components – indications, preparation of blood components.
11. Autologous transfusion.
12. Transfusion transmitted disease.
13. Hemolytic disease of the new born and exchange transfusion.
14. Transfusion therapy.
15. Transfusion in special situations – Auto immune hemolyticanemia.
16. Transfusion reactions and investigation of transfusion reaction.
17. Immunomodulation and graft versus host reactions.
18. Haemapheresis – definition, types of pheresis, machines and techniques.
19. Tissue banking.
20. Cord blood banking.
21. Stem cell processing, storage & transplantation.
22. Disposal of wastes & biologically hazardous substance in the blood bank.
23. Medico legal aspects of blood transfusion.
24. Technical advances & future trends in blood banking.
25. Paternity testing.

26. Orientation of a routine blood bank.
27. Quality Assurance – general condition, equipment, reagents, donor processing.
28. Drugs control regulation & blood bank.

PRACTICALS 25hrs

1. blood grouping – forward/reverse grouping.
2. preparation – of pooled ABO cells.
3. crossmatching
4. grading of reactions
5. other methods of blood grouping – gel method. and microtitre plate method, antibody titration.
6. cold antibody titration.
7. rh typing – slide & tube method.
8. Du testing
9. coombs test – direct & indirect.
10. preparation of coombs cells & serum.
11. compatibility testing
12. emergency cross matches
13. blood collection
14. donors selection
15. post donation care.
16. preservation & storage of blood.
17. preparation & storage of blood
    a. components
18. packed cells, fresh frozen plasma
19. platelet concertrate.
20. cryoprecipitate
21. component transfusion.
22. exchange transfusion.
23. autoimmune haemolytic anemias
24. investigation of blood transfusion reactions.
25. testing for transfusion transmission diseases.
26. quality control – methods , reagents, test methods , products, documents, equipments.
27. apheresis procedures- types of pheresis, machines & techniques – demonstration.
28. record keeping & documentation
29. compulsary blood donation camps. – Minimum 15 camps

Log book to be maintained
Project work – 6 months. Minimum cases: - 35. Discretion of the guide & minimum cases to obtain statistical significance.

RECOMMENDED BOOKS;

TECHNICAL MANUAL – AABB RECENT EDITION.
CLINICAL USE OF BLOOD HANDBOOK – WHO.
COMPENDIUM OF TRANSFUSION MEDICINE – Fr. R.N. MAKROO.

BLOOD TRANSFUSION IN CLINICAL MEDICINE.- MOLLISION.
BLOOD GROUP S ERELOGY, THEORY,TECHNIQUES , PRACTICAL APPLICATIONS – K. E.BOORMAN, B.E. DODD, P.J. LINCOLN.
TECHNICAL MANUAL AABB- RECENT EDITION.

PATTERN OF EXAMINATION- THEORY

PAPER I: HAEMATOLOGY II
DURATION- 3 HOURS MAX MARKS: 100

Type of questions	No. of questions	Marks for each question	Total marks
Long Essay	2	20	40
Short Essay	6	10	60

PAPER II: BLOOD TRANSFUSION
DURATION- 3 HOURS MAX MARKS: 100

Type of questions	No. of questions	Marks for each question	Total marks
Long Essay	2	20	40
Short Essay	6	10	60

PRACTICAL EXAMINATION TOTAL MARKS =100

DAY 1.
HAEMATOLOGY

1. SPOTTERS (INCLUDING SLIDES, INSTRUMENTS) -20 MARKS
2. CASE STUDY OF PATIENT , DRAWING BLOOD, PREPARING FILM AND INTERPRETATION OF PERIPHERAL SMEAR -10 MARKS
3. SCREENING OF HAEMORRHAGIC DISORDERS TEST - 20 MARKS
   PTT,APTT, TT, PLATELET COUNT

TOTAL = 50 MARKS

DAY 2.
BLOOD TRANSFUSION

1. BLOOD GROUPING/ TYPING - 10 MARKS
   OR Rh TYPING & Du TESTING
2. COOMB'S TEST – DIRECT AND INDIRECT - 10 MARKS
3. CROSS MATCHING - 10 MARKS
   MAJOR / MINOR, SALINE, ALBUMIN AND COOMB'S
4. SELECTION OF DONOR, BLOOD COLLECTION - 20 MARKS
   AND COMPONENT PREPARATION

TOTAL = 50 MARKS

VIVA –VOCE- 50 MARKS
DISTRIBUTION OF MARKS;

1. HAEMATOLOGY : 20 MARKS
2. BLOOD TRANSFUSION : 20 MARKS
3. PROJECT WORK : 10 MARKS

TOTAL: 50 MARKS