

BABA FARID UNIVERSITY OF HEALTH SCIENCES



Ordinances & Syllabus

B.Sc. Medical Laboratory Technology

B.Sc. (MLT)

(w.e.f. 2009 admissions)

(Approved by the Board of Management on 17.03.2009)

Faridkot-151 203

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B.Sc. Medical Laboratory Technology
B.Sc. (MLT)

1. Duration of course

Duration of course shall be three and half years including six months Internship.

2. Admission criteria and qualifications:

The students shall be admitted as per the admission criteria and qualifications prescribed in the Notification issued by the Government of Punjab from time to time.

3. Medium of Instruction

The medium of instruction during the course and examinations shall be English.

4. Examination Schedule

- 4.1 The examination shall be held twice a year in the months of May/June and November/December or on such other dates as may be decided by the Board of Management on the recommendation of Faculty of Medical Sciences and Academic Council.
- 4.2 Normally, the University shall conduct not more than two examinations in a year, for any subject, with an interval of not less than four and not more than six months between the two examinations.
- 4.3 The last date by which admission forms and fees must reach the Registrar shall be as follows

| Examinations B.Sc.(MLT) | without late fee | with late fee of Rs.200/- | with late fee of Rs.500/- | with late fee of Rs.1500/- |
|----------------------------|---------------------|---------------------------------|---------------------------------|----------------------------------|
| May/June | March 1 | March 15 | March 31 | April 15 |
| Nov./Dec. | Sept. 15 | Sept. 30 | Oct. 15 | Oct. 31 |

Vice-Chancellor may permit acceptance of admission form and fee ten days before the commencement of examination with a late fee of Rs.2000/-

Sd/-

5. First Year B.Sc.(MLT) Examination:

The First Year B.Sc.(MLT) Examination shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Medical Laboratory Technology affiliated to this University.
- b) has his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75 per cent of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 10% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately
 - ii) of good moral character.

Note: 1) Internal Assessment shall be submitted to the University at least two weeks before the commencement of theory examinations. All the colleges shall adopt uniform criteria for Internal Assessment for which a record of each student shall be maintained in each department, which should be made available for inspection by the University.

The re-appear/fail students will be re-assessed every time for the purpose of improvement of Internal Assessment.

- 2) If a candidate fulfils the condition laid down in clause 5 (b) (i) and (ii) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.
- (c) The First Year B.Sc.(MLT) Annual Examination shall be held in May/June and the supplementary examinations in Nov./Dec.

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d) The First Year B.Sc.(MLT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

| S.N. | Subject | Theory | | | | Practical | | | Grand Total |
|------|--|--------|-------------|------|-------|-----------|------------|-------|-------------|
| | | Marks | Int.Assess. | Viva | Total | Marks | Int.Assess | Total | |
| 1. | Basic Principles of Biochemistry | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 2. | Fundamentals of Histopathology/ Histotechnology and Cytology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 3. | Basic Techniques in Laboratory Haematology, Blood Banking & Clinical Pathology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 4. | General Microbiology Immunology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |

- i) Each theory paper shall be of three hours duration.
- ii) The minimum number of marks to pass the examination shall be 50% in theory including Internal Assessment and Viva and 50% in practical including Internal Assessment in each subject separately.
- iii) A candidate who passes in one or more subjects shall be exempted from appearing in these subject (s) at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts, failing which he/ she shall have to appear in all the subjects of the examination.
- iv) A candidate who fails in one or more subjects in his/her 1st attempt, shall be permitted to attend classes in Second Year B.Sc.(MLT) course. However, he/she will be allowed to appear in Second Year B.Sc.(MLT) examination only after passing all the subjects of First Year B.Sc.(MLT) examination.
- v) A candidate securing 75% or above marks in any of the subjects shall be declared to have passed with distinction in that subject provided he has passed the examination in first attempt.
- vi) The grace marks up to a maximum of five marks may be awarded at the discretion of the University to the best advantage of failed student in theory papers only.

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6. **Second Year B.Sc.(MLT) Examination:**

The Second Year B.Sc.(MLT) Exam. shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Medical Laboratory Technology College affiliated to this University.
- b) has previously passed the First Year B.Sc.(MLT) examination of this University or an examination of any other recognised University/Institution in India considered equivalent for the purpose by the University
- c) has his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75 per cent of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 10% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately
 - iii) of good moral character.

Note: 1) Internal Assessment shall be submitted to the University at least two weeks before the commencement of theory examinations. All the colleges shall adopt uniform criteria for Internal Assessment for which a record of each student shall be maintained in each department, which should be made available for inspection by the University.

The re-appear/fail students will be re-assessed every time for the purpose of improvement of Internal Assessment.

- 2) If a candidate fulfils the condition laid down in clause 6 (c) (i) and (ii) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.

(d) The Second Year B.Sc.(MLT) Annual Examination shall be held in May/June and the supplementary examinations in Nov./Dec.

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e) The Second Year B.Sc.(MLT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

| S.N. | Subject | Theory | | | | Practical | | | Grand Total |
|------|---|--------|-------------|------|-------|-----------|------------|-------|-------------|
| | | Marks | Int.Assess. | Viva | Total | Marks | Int.Assess | Total | |
| 1. | Analytical Biochemistry & Metabolism | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 2. | Basic Cellular Pathology, Allied Techniques & Cytology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 3. | Fundamentals of Haematology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 4. | Systemic Microbiology including Mycology & Parasitology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |

- i) Each theory paper shall be of three hours duration.
- ii) The minimum number of marks to pass the examination shall be 50% in theory including Internal Assessment and Viva and 50% in practical including Internal Assessment in each subject separately.
- iii) A candidate who passes in one or more subjects shall be exempted from appearing in these subject(s) at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts, failing which he/ she shall have to appear in all the subjects of the examination.
- iv) A candidate who fails in one or more subjects in his/her 1st attempt, shall be permitted to attend classes in Third Year B.Sc.(MLT) course. However, he/she will be allowed to appear in Third Year B.Sc.(MLT) examination only after passing all the subjects of Second Year B.Sc.(MLT) examination.
- v) A candidate securing 75% or above marks in any of the subjects shall be declared to have passed with distinction in that subject provided he has passed the examination in first attempt.
- vi) The grace marks up to a maximum of five marks may be awarded at the discretion of the University to the best advantage of a failed student in theory papers only.

7. **Third Year B.Sc.(MLT) Examination:**

The Third Year B.Sc.(MLT) Examination shall be open to a person who

- a) has been enrolled for one academic year preceding the examination in a College of Medical Laboratory Technology affiliated to this University.
- b) has previously passed the Second Year B.Sc.(MLT) examination of this University or an examination of any other recognized University/Institution in India considered equivalent for the purpose by the University.
- c) his/her name submitted to the Registrar by the Principal of the college with the following certificates:-
 - i) of having attended separately in theory and practical/clinical not less than 75 per cent of the lectures delivered and practicals conducted in each of the subjects prescribed for the examination provided that deficiency in the number of lectures delivered and practicals conducted may be condoned by the Principal to the extent of 10% of the lectures delivered.
 - ii) of having secured at least 35% marks of the total marks fixed for internal assessment in each subject, separately
 - ci) of good moral character.

Note: 1) Internal Assessment shall be submitted to the University at least two weeks before the commencement of theory examinations. All the colleges shall adopt uniform criteria for Internal Assessment for which a record of each student shall be maintained in each department, which should be made available for inspection by the University.

The re-appear/fail students will be re-assessed every time for the purpose of improvement of Internal Assessment.

- 2) If a candidate fulfils the condition laid down in clause 6 (c) (i) and (ii) above for one or more subject (s) he/ she may be allowed to take the examination in such subject (s) in which he/ she fulfils the requirements.
- (d) The Third Year B.Sc.(MLT) Annual Examination shall be held in May/June and the supplementary examinations in Nov./Dec.
- e) The Third Year B.Sc.(MLT) examination shall be in the following subjects and candidate shall be required to pass all the subjects:-

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| S.N. | Subject | Theory | | | | Practical | | | Grand Total |
|------|---|--------|-------------|------|-------|-----------|------------|-------|-------------|
| | | Marks | Int.Assess. | Viva | Total | Marks | Int.Assess | Total | |
| 1. | Clinical Biochemistry Methods | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 2. | Special Histology, Histochemical Methods, Immunopathology & Cytopathology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 3. | Applied Haematology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |
| 4. | Applied Microbiology | 100 | 20 | 20 | 140 | 40 | 20 | 60 | 200 |

- i) Each theory paper shall be of three hours duration.
- ii) The minimum number of marks to pass the examination shall be 50% in theory including Internal Assessment and Viva and 50% in practical including Internal Assessment in each subject separately.
- iii) A candidate who passes in one or more subjects shall be exempted from appearing in these subject (s) at a subsequent examination, but the candidate must pass the examination in a maximum of four attempts, failing which he/ she shall have to appear in all the subjects of the examination.
- iv) The grace marks up to a maximum of five marks may be awarded at the discretion of the University to the best advantage of a failed student in theory papers only.
- v) A candidate securing 75% or above marks in any of the subjects shall be declared to have passed with distinction in that subject provided he has passed the examination in first attempt.

8. Appointment of Examiners

The examiners shall be appointed by the University on the recommendations of the Board of Studies in Medical Sciences (Undergraduates)/Faculty of Medical Sciences.

Examiners shall be from Medical Faculty with Postgraduate degree in concerned subject, with minimum rank of Associate Professor and having minimum three years teaching experience in medical institution.

Qualification, Post & teaching experience of person to be appointed as Examiner is not mentioned anywhere as discussed during meeting.

The teachers possessing M.Sc. & Ph.D. Degree from any non-medical institution / University shall not be appointed Examiners as they are not eligible to be appointed as Teachers in Medical Institutions.

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9. Paper setting and moderation of Question Papers

The University may get each paper set from External Examiner only. The moderation of question papers may be got done under the direction of the Vice-Chancellor, if necessary.

10. Evaluation of Answer Books

The answer books shall be got evaluated by putting fictitious roll numbers thereon or spot evaluation (table marking) or any other method under the direction of the Vice-Chancellor.

11. Declaration of Result

The Registrar/Controller of Examinations shall publish the result after the examination. The candidates shall be issued Detailed Marks Certificate through their Principals.

12. Internship

After successfully passing Third Year B.Sc.(MLT) examination the students shall undergo six months compulsory rotatory Internship as follows:-

| Sr. | Department | Period of Internship |
|-----|--|----------------------|
| 1 | Biochemistry | One & Half Month |
| 2. | Microbiology | One & Half Month |
| 3. | Pathology including Cytology and Immunopathology | One & Half Month |
| 4. | Haematology including blood transfusion and Clinical Pathology | One & Half Month |

13. Award of Degree

On successful completion of six months compulsory rotatory internship, duly certified by the Principal of the College, the students shall be awarded the Degree of Bachelor of Science (Medical Laboratory Technology) - B.Sc.(MLT).

Curriculum & Syllabus for B.Sc. MLT Course

Curriculum: - Pathology

The candidates registered for B.Sc. Medical Technology (Laboratory) will be given basic training in theoretical and practical aspects in the field of histopathology, cytopathology, clinical pathology, haematology, blood banking, immunopathology and maintaining of museum specimens. The students will also obtain the basic knowledge of morbid anatomy, physiology, histology and laboratory investigation/ tests in relation to various diseases. The principles of different techniques used for such investigations will also be imparted. The students will also be given training in Laboratory management, safety measures, quality control aspects and automatic technology. The training in the subject is aimed at making the student work independently in various advanced pathology laboratories of any hospital or medical institution.

The students will be posted for practical training in the department of Pathology for a period of 20 weeks in each year. The distribution of time for theory and practical each year will be as under: -

B.Sc. (MLT) - First Year

1. Histopathology / Histotechnology and Cytology
 - i. Theory and Tutorial Demonstrations - 60 hours
 - ii. Practical 10 weeks - 250 hours

2. Haematology, Clinical Pathology and Blood Banking
 - i. Theory and Tutorial Demonstrations - 60 hours
 - ii. Practical 10 weeks - 250 hours

B.Sc. (MLT) – Second Year

1. Basic Cellular Pathology, allied techniques and Cytology
 - i. Theory and Tutorial Demonstrations - 60 hours
 - ii. Practical 10 weeks - 250 hours

2. Fundamental of Haematology
 - i. Theory and Tutorial Demonstrations - 60 hours
 - ii. Practical 10 weeks - 250 hours

B.Sc. (MLT) – Third Year

1. Special Histological and Histochemical methods, Cytology and Immunopathology
 - i. Theory and Tutorial Demonstrations - 60 hours
 - ii. Practical 10 weeks - 250 hours

2. Applied Haematology
 - iii. Theory and Tutorial Demonstrations - 60 hours
 - iv. Practical 10 weeks - 250 hours

Syllabus for B.Sc. (MLT) First Year

1) HISTOPATHOLOGY

Fundamentals of Histopathology, Histotechnology and Cytology

a) Introduction

- i) Introduction to histopathology and laboratory organization
- ii) Laboratory equipment, uses and maintenance
- iii) Laboratory hazards and safety precautions
- iv) Compound microscope-optical system, magnification and maintenance.

b) Fundamental of Histotechnology

- i) Reception, recording and labelling of tissue specimens
- ii) Fixation and various simple fixatives
- iii) Processing of histological tissues for paraffin embedding.
- iv) Embedding and embedding media
- v) Decalcification
- vi) Microtomes-various types, their working principle and maintenance.
- vii) Microtome knives and knife sharpening (honing and stropping)
- viii) Practical section cutting, cutting faults and remedies.
- ix) Dye chemistry, theory and practice of staining – Haematoxyline and Eosin

c) Anatomy and Physiology

- i) The anatomic and physiological organization of human body and integrated physiology
- ii) Cell organization and function
- iii) Skeletal system, bones, joints and muscles.
- iv) Body fluids and their significance
- v) Blood morphology, chemistry and function
- vi) Respiratory system
- vii) Cardiovascular system
- viii) Alimentary system, mechanism and physiology of digestion and absorption.
- ix) Liver structure, function and Gall bladder
- x) Urinary system including prostate
- xi) Male and female genital system including Breast
- xii) Nervous System
- xiii) Spleen, Lymph node and R.E. system
- xiv) Endocrine gland and their functions.
- xv) Skin

2) CYTOLOGY

Collection and Processing of cytological specimen. Exfoliative Cytology and FNAC

Syllabus for B.Sc. (MLT) First Year

HAEMATOLOGY, BLOOD BANKING & CLINICAL PATHOLOGY

BASIC TECHNIQUES IN LABORATORY HAEMATOLOGY AND CLINICAL PATHOLOGY

- 1) Introduction to haematology and laboratory organization, Lab safety and instrumentation
- 2) Composition and functions of blood.
- 3) Formation of blood.
- 4) Various anticoagulants, their uses, mode of action and their merits and demerits.
- 5) Collection & preservation of blood for various haematological investigations.
- 6) Physiological variations in Hb, PCV, TLC and platelets.
- 7) Normal and absolute values in haematology.
- 8) Quality assurance in haematology.
- 9) Hemoglobinometry: various methods of estimation of Hb, errors involved and standardization of instruments.
- 10) Haemocytometry: procedures for cell counts, visual as well as electronic, red cell, leucocytes and platelet counts. Errors involved and means to minimize such errors.
- 11) Romanovsky dyes, preparation and staining procedures of blood smears.
- 12) Morphology of normal blood cells and their identifications.
- 13) Erythrocyte sedimentation rate, factors influencing ESR and various procedures for its estimation with their significance.
- 14) Hematocrit value by macro and micro methods their merits and demerits.
- 15) Basic techniques in blood banking.
- 16) Semen analysis.
- 17) Examination of abnormal urine. Physical, chemical and Microscopic Examination.

Syllabus for B.Sc. (MLT) Second Year

A) BASIC CELLULAR PATHOLOGY AND ALLIED TECHNIQUES & CYTOLOGY:

HUMAN HISTOLOGY

I. Study of various body tissues:-

- a) Epithelial tissue
- b) Connective tissue including bone and cartilage and adipose tissue.
- c) Muscular tissue
- d) Nervous tissue
- e) Glands, epithelial and endocrine.

II. Histological study of various systems of the body:-

- a) The circulatory system
- b) The alimentary system.
- c) The digestive system including liver, pancreas and gall bladder.
- d) The respiratory system.
- e) The Urinary system including prostate.
- f) The system of endocrine glands
- g) The reproductive system (male & female) including Breast.
- h) The Nervous system and organs of special senses.
- i) The skin & skin appendages.

FUNDAMENTAL OF APPLIED HISTOLOGY:-

I. Microscopy, working principle, maintenance and applications of various types microscopes:-

- Dark ground microscope
 - Polarizing microscope
 - Phase contrast microscope
 - Interference microscope
 - U.V. Light microscope
 - Micrometry
2. Metachromasia and metachromatic dyes.
 3. Haematoxylin stain. Its importance in histology.
 4. Amyloid-special stains
 5. Connective tissues and muscle stains, Trichrome staining, Van Gison staining, Reticulin stain, Verhoeff stain, PTAH stain.
 6. Demonstration and identification of minerals and pigments.

CYTOLOGY

B) THREE LECTURES ON THE FOLLOWING SUBJECTS:-

- I) Routine cytology stain - PAP stain & MGG stain.
- II) Special stains like PAS, Mucicarmine, Alcian blue.
- III) Cytologic screening and quality control in cytology laboratory.

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SYLLABUS FOR SECOND YEAR
HAEMATOLOGY

FUNDAMENTALS OF HAEMATOLOGY

1. Definition and classification of Anemias, General features and morphological changes in Iron deficiency, megaloblastic, haemolytic and hypoplastic anemias.
2. Haemoglobin disorders – various hemoglobinopathies- like sickle cell anemia, Thalassemia, spherocytosis, G6PD deficiency etc.
3. Definition & classification of leukemias, General features and morphological changes in various leukemias.
4. Normal haemostasis : coagulation factors, platelets, vascular components, inhibitors & fibrinolytic system.
5. Haemostatic disorders: deficiency of various coagulation Factors, quantitative and qualitative abnormality of platelets, abnormal vascular component & other factors.

Syllabus for B.Sc. (MLT) Third Year

SPECIAL HISTOLOGY AND HISTOCHEMICAL METHODS

APPLIED HISTOLOGY

Lectures:

1. Fixatives including compound fixatives
2. Frozen section
3. Lipids, identification and demonstrations.
4. Special stains for carbohydrates, PAS, Mucicarmine, stain for fats, Mucin – Alacian Blue, Silver stains.
5. Micro-organisms in the tissues: various staining techniques for their demonstration and identification.
6. Nucleic acids, DNA and RNA –special stains and procedures.
7. Cytoplasmic constituents and their demonstration.
8. Tissues requiring special treatment i.e. eye ball, B.M. biopsy, under calcified & calcified bones.
9. Enzyme histochemistry- demonstration of phosphatases, dehydrogenases.
10. Oxidases and peroxidases etc.
11. Museum techniques. Mounting of museum specimens.

CYTOPATHOLOGY

Lectures:

1. Cervical cytology: basis of detection of malignant and premalignant lesions.
2. Hormonal assessment with cytological techniques as well as sex chromatic and pregnancy tests.
3. Aspiration cytology: principles, indications and utility of the techniques with special emphasis on the role of cyto-technician in FNAC clinics.

IMMUNOPATHOLOGY

Lectures:

1. Cells and the organs of the immune system.
2. Humoral and cellular immune response.
3. Allergy
4. Immunological disorders and their investigations including SLE, Rhematoid arthritis, glomerulonephritis etc.
5. Infections and the immune system.
6. Immunology in Cancer and AIDS.

HAEMATOLOGY

APPLIED HAEMATOLOGY

1. Laboratory investigations for iron deficiency anaemia.
2. Laboratory investigations for megaloblastic anaemia.
3. Laboratory investigation for haemolytic anaemia including sickling test, red cell osmotic fragility test, Hein'z body detection, G-6-FD deficiency, Coombs test & Hb-electrophoresis.
4. Leukemia and lab investigation
5. Cytochemical staining procedures in various hemopoietic disorders.
6. Laboratory tests for assessing bleeding disorders. Prothrombin Time and Index.
7. Laboratory investigations for disseminated intravascular coagulation (DIC)
8. Mechanism of fibrinolysis: tests for fibrinolysis.
9. Platelet function tests and their interpretation.
10. Use of Radioisotopes in haematology.
11. Safety measures for handling radioisotopes.
12. B.M. aspiration study & B.M. biopsy- handling & processing the material.
13. Foetal haemoglobin
14. L.E. Cell phenomenon.
15. Plasma Haemoglobin.

MORBID ANATOY & HISTOPATHOLOGY

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|-------|--|----------------------|---------------------|
| 1. | Theory and practice Of Histopathological Techniques. | Bancroft and Stevens | Butterworths London |
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| 2. | Cellular Pathology Techniques. | C.F.A. Culling | Butterworths London |
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ANATOMY AND PHYSIOLOGY

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|-------|--|-------------------------------|----------------------|
| 1. | Rosh and Wilson Anatomy and Physiology In Health and illness | Kathleen J.W. et. al. | Churehill Livingston |
| <hr/> | | | |
| 2. | Principles of Anatomy and Physiology | G.J. Tartora B. Derrickson | John Wiley and sons |
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HAEMATOLOGY AND CLINICAL PATHOLOGY

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|-------|---|--------------------|-----------------------------------|
| 1. | An Introduction to Medical Laboratory Technology | F.J. Baker of al | Butterworths and co. London. |
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| 2. | Practical Haematology | J.V. Dacie and | Churchill livingston Edinburgh |
| <hr/> | | | |
| 3. | Haematology for Medical Technologists. | Charles F. Seiverd | |
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| 4. | Technical Haematology | Arthur Simmons | J.B. Lippinport |
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| 5. | Clinical Diagnosis and Management by Laboratory methods | Todd & Sanford | W.B. Saunders |
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| 6. | Medical Laboratory Technology | Lynch | W.B. Saunders |
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| 7. | Blood Coagulation | Thomson J. | Churchill Livingston |
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SYLLABUS FOR FIRST YEAR

B.Sc. MLT

BIOCHEMISTRY

Theory: 60 hours
Practicals: 250 hours

Basic Principles of Biochemistry

THEORY

Introduction: - Introduction to medical technology, role of medical laboratory technologists, ethics, responsibilities.

Digestion and absorption: - Carbohydrates, Proteins and fats.

Introduction (in short) and Properties: Carbohydrates, Proteins and fats.

Carbohydrates: - Introduction: Definition, Functions, Classification, Types (Monosaccharide, Disaccharide, Oligosaccharide & Polysaccharide)

Isomerism (Sterieisomerism, Optical, Epimers, Anomers, Mutarotation and enantiomers), Reducing properties (Oxidation and reduction), Glycosides.

Lipids (Essential fatty acids/Triacylglycerol/Phospholipids):- Introduction: Definition, Functions, Classification, Types (Simple, Complex, Derived, Miscellaneous, Neutral Lipids).

Antioxidants, Lipid Peroxidation.

Proteins, Amino Acids & Biologically important peptides:- Introduction, Functions, classification of proteins and amino acids, Types of biologically important peptide.

Properties: Isoelectric pH (Zwitter / Dipolar ions), Solubility, Molecular weight (proteins), Shape(Proteins), Acidic and basic proteins, Colour reaction of proteins, Denaturation of proteins. General properties of amino acids and proteins. General reactions of amino acids and proteins.

Safety measures for: - Corrosive chemicals, Toxic chemicals, Carcinogens, Explosive & Inflammable chemicals, infectious material (Biological material) with special consideration for AIDS and Hepatitis B & C, Electrical apparatus (centrifuge machines, water baths, Hotplates, Spectrophotometers, Flamephotometers) etc, Glass apparatus, Dispensers, Radiation Hazards, Low pressure systems (vacuum desiccators), Disposal of specimens and contaminated materials, laboratory waste etc.

First Aid and emergency treatment in: - Chemical injuries, Mechanical and thermal injuries, Electrical injuries. Obtaining help from emergency drug supply, First Aid Boxes, Special procedures common to several emergency conditions and taking care of treatment of shock, unconscious patients, Artificial respiration, Cardiac massage.

Preparation of: Reagents, standard solutions, acid and base solutions, Buffers,

Storage of chemical with example of:- Non corrosive, corrosive, & Light sensitive chemicals.

Units:- Unit of measurements of enzymes, mass, length and volume: S.K. units etc.

Radioisotopes, their use in Biochemistry and Hazards of radio isotope biophysical chemistry:-

*Solutions:- Mole, Molar and normal.

* pH measurement, pH indicators, Buffer solutions, pH meter

* Osmosis, Dialysis, Surface tension and colloids, Donnan's membrane equilibrium

Porphyrias:- Definition, Types

Biological specimens:- Blood (Preparation of plain vial, vials with anticoagulants like EDTA vial, Blood sugar vial, Citrate etc vial), Urine & faeces collection. Separation of serum/plasma, Preservation of biological samples (Blood, Tissues, Urine, Faeces), disposal of biological samples and labelling of specimens.

Statistics:- Mean, SD, CV, Normal distribution, Probability.

Normal/ Reference Range'- of routine biochemical investigations

Practical
Cleaning & Care

- General laboratory glassware
- Equipments (Balance, colorimeter, Spectrophotometer, water bath, hot air oven, flamephotometer, centrifuge machine).

Distilled Water:- Preparation, storage & check the purity of single, double and triple distilled water.

Analytical Balance:- Definition, Types, Cleaning and care

Volumetric Analysis: - Preparation of reagents, standard solutions. Acid and base solutions preparation and titration for normality.

Use of indicators:- Universal, paper

Chloride estimation:- in serum, urine, CSF.

Calibration and Measurement:- of Volumetric apparatus (Pipettes, Flask, Cylinder)

Qualitative Analysis in Urine: Interpretation/influencing factors, Determination/Procedure, Normal Values and physical examination of normal and abnormal urine.

Qualitative estimation in urine of:-

- Sugar
- Proteins
- Bile Pigments/Bile salts
- Ketone Bodies.
- Porphobilinogen/ Urobilinogen
- Hemoglobinuria
- Micro albuminuria
- Bence Jones Proteins.

Concept of colorimeter & Spectrophotometer: - Principle, working and types of filter.

Routine investigations:- Principle, procedure, calculation, normal value and interpretation of

- FBS
- Blood urea
- S Creatinine
- TSP/DSP
- S. Uric Acid
- S. Bilirubin
- S. Cholesterol
- Chloride
- Flamephotometric estimation of Na⁺ & K⁺

Stone Analysis: - Gallbladder, Kidney/Ureteric/ Urinary Bladder stones and their interpretation.

SYLLABUS FOR SECOND YEAR

B.Sc. MLT

BIOCHEMISTRY

ANALYTICAL, BIOCHEMISTRY AND METABOLISM

Theory

Simple metabolism:- Important aspects so that they can understand clinical tests and their interpretations.

All outlines are without formula

Carbohydrates: - Outline of Glycolysis, outline of TCA, outline of Gluconeogenesis, outline of Glycogen metabolism (Glycogenesis, Glycogenolysis- Glycogen storage disease, Hormonal regulation), Outline of HMP (Biomedical importance and metabolic disorder and regulation), GTT. (4 hrs.)

Lipids: - Outline of β fatty acid oxidation along with inborn errors, Outline of fatty acids synthesis, Outline of Cholesterol: Synthesis, Catabolism, Regulation, Inborn errors and atherosclerosis, Outline of Lipoproteins, Ketosis, Lipid Peroxidation and role of antioxidants. (4 hrs.)

Proteins and Aminoacids:- Oxidative and nonoxidative deamination, Transamination and decarboxylation, Transamidation, Transport and function of ammonia, Urea cycle with inborn errors of metabolism; Outline of metabolism, Specialised products and inborn errors of glycine, Phenylalanin, Tyrosine, Tryptophan, Methionine, Cysteine, Cystine and Histidine, Branch chain amino acids, Creatine metabolism (6 hrs.)

Nucleic acids: Definition, Types, Function. (3 hrs)

Nucleosides and Nucleotides: Definition.

Enzymes:- Definition, Properties of enzymes, Factors affecting enzyme activity in vitro units of Enzyme activity, application of enzymes (Therapeutic, Analytical, Diagnostic enzymes), Isoenzymes (Definition and Types), Enzyme pattern in diseases (MI, liver diseases, Muscle diseases, Cancer). (4-5 hrs)

Vitamins & Co-enzymes: - Concept of water soluble & fat-soluble vitamins (2-3 hrs)

Porphyrias: - Definition, Classification. (2 hrs.)

Chromatography:- Define, Types (Absorption, Ion exchange, Partition, Thinlayer, Paper, Gaschromatography). (1 hrs)

Electrophoresis:- Define, Types (paper, Cellulose acetate, Starch gel, Agar gel) (1 hrs.)

Practical:-

Colorimetry:- Definition, Principle/working, Types, Lambert and beer law, photoelectric colorimetry, standard calibration curve.

Spectrophotometer:- Definition, Principle/Working, Types (UV etc.)

Flamephotometer:- Definition, Principle/Working, types

Concept of standard (external and internal) and concept of blank, Drawing of standard curve

Special investigations lipid profile:- Cholesterol, Triglycerides, VLDL, LDL, Total Lipid, HDL

Flamephotometric estimation of Na⁺, K⁺, Ca⁺⁺ and Li⁺: - Estimation of Na⁺, K⁺, Ca⁺⁺ & Li⁺ levels in body fluids and their interpretation (Hypo and Hyper conditions)

Chromatography:- Definition, Types (Thinlayer, paperchromatography)

Electrophoresis:- Define, Type (Paper)

Demonstration of:- Semiautoanalyser, Elisa Reader

SYLLABUS FOR THIRD YEAR

B.Sc. MLT

BIOCHEMISTRY

CLINICAL BIOCHEMISTRY METHODS

Theory: -

Quality control of Clinical investigation (external & internal quality control)

Automation in clinical biochemistry

Laboratory organization management maintenance of records

Gastric function tests:- collection of sample & tests for blood, lactic acid and pH etc.

Pancreatic function tests

Liver function tests

Thyroid function tests

Kidney function tests

Practical:-

Estimations:- Principle, Procedure, Normal value, Interpretation

1. Urinary investigations

- Urinary proteins 24 hours
- 24 hrs Urinary urea
- 24 hrs Urinary creatinine
- 24 hrs uric acid
- Creatinine clearance test
- Urea clearance test

2. Electrolyte and Mineral estimation

- Serum and Urinary Calcium
- Serum and Urinary Inorganic Phosphates

3. Special Investigation

A. Hormonal assay

- Thyroid estimation (T3, T4, TSH)
- Infertility profile (LH, FSH, Estradiol, Prolactin)- Female sex hormones (Testosterone) –Male sex hormones)

B. Special tests for diabetes:- Insulin, Glycosylated Haemoglobin.

C. Cardiac marker:- CPK (MB), Troponin I/T

D. Serum iron, TIBC and serum magnesium

4. Gastric Analysis

5. Clearance test for renal function

6. Enzymes:-

- Amylase
- LDH
- CPK
- VGT

7. Clinical Significance and demonstration of following special investigations: -

- a. 17-Keto steroids in urine
- b. VMA in urine
- c. Serum Copper
- d. Urinary Copper
- e. Ceruloplasmin

Analysis of CSF:- Estimation of Proteins, Glucose, Chloride (in cases of viral meningitis, Bacterial meningitis, Tubercular meningitis)

Analysis of Ascitic fluid, Pleural fluid.

Stool examination for fat & occult blood

SYLLABUS FOR FIRST YEAR

B.Sc. MLT

MEDICAL MICROBIOLOGY

Theory: 60 hours
Practicals: 10 weeks

1. General Microbiology Theory

(Including General Bacteriology, Virology, Mycology, Parasitology & Immunology)

1. Introduction & brief history of Microbiology- Louis Pasteur, Robert Koch, Joseph Lister, Paul Ehrlich, Edward Jenner
2. Safety measures in Microbiology
3. Care and maintenance of laboratory equipments
4. Principles and methods of sterilization
5. Uses and modes of action of antiseptics & disinfectants
6. Handling and cleaning of glassware apparatus. Decontamination and disposal of contaminated material.
7. Preparation uses and standardization of culture media
8. Aerobic and anaerobic culture methods
9. Collection, transportation and processing of clinical samples for Microbiological investigations.
10. Principles and mode of action of antibiotics and chemotherapeutic agents for bacteria and fungi.
11. Care and handling of laboratory animals
12. Laboratory organization, management, recording of results and quality control in Microbiology.
13. Principles, functioning, care of microscopes i.e. Monocular/Binocular microscope, Dark ground microscope, Phase contrast microscope, Fluorescent microscope.
14. Principles of staining methods and preparation of reagents.
15. General characteristics and classification of bacteria & fungi
16. Growth and nutrition of microbes.

Immunology

1. Lymphoreticular System, T and B cells and their differences
2. Immune Response
3. Antigens, Antibodies, Complement System
4. Antigen- antibody reactions.
5. Hypersensitivity
6. Autoimmunity

Virology

1. General properties of viruses including Size, shape, symmetry. Cultivation of viruses by various methods, inclusion body formation and antiviral agents.
2. Classification of viruses by various methods
3. Lab diagnosis of viral infections, including collection, transportation processing and storage of various samples.

Practicals:

1. Collection, handling, storage of samples for viral diagnosis.
2. Washing, cleaning and sterilization of Media and glassware in virology
3. Use and sterilization of pipettes, syringes and other viruses contaminated instruments in the laboratory.
4. Demonstration of preservation of viruses, viral antigens and infected biological materials.
5. Usage of Laboratory animals

Parasitology

Theory:-

1. Introduction to Medical parasitology and safety measures.
2. Collection, preservation and processing of samples for parasites:- stool, blood, fluids.
3. General characters, classification of protozoa of medical importance.
4. Morphology, lifecycle, pathogenicity and lab, diagnosis of intestinal protozoa:- Entamoeba histolytica, Ent. coli, Giardia intestinalis, Balantidium coli, free living amoebae, Cryptosporidium, Isospora and Microsporidium.
5. Morphology, life cycle, pathogenicity and lab. Diagnosis of haemoprotozoa:-
 - Genus, Plasmodium, Toxoplasma gondii.
 - Genus Leishmania
 - Genus Trypanosoma

Practical:-

1. Stool examination:- Methods of collection, transportation and processing of stool samples for intestinal protozoa.
2. Examination of vaginal secretions for T. vaginalis.
3. Preparation of blood films for demonstration of haemoprotozoa.
4. Staining techniques and examination of cysts of Cryptosporidium parvum.

SYLLABUS FOR SECOND YEAR
B.Sc MLT

MEDICAL MICROBIOLOGY

Systemic Microbiology

Including Systemic Bacteriology/Virology/Mycology/Parasitology

Systemic Bacteriology

Theory:

To study Morphology, culture characters, biochemical reactions, pathogenicity, lab diagnosis and anti microbial sensitivity testing of the following organisms:-

1. Staphylococci including Micrococci
2. Genus – Streptococcus.
3. Genus – Neisseria.
4. Genus- Corynebacterium, Mycobacterium
5. Family Enterobacteriaceae
6. Pseudomonas, Vibrio, Hemophilus, Brucella, Bordetella.
7. Aerobic and anaerobic spore forming organisms i.e. Genus Bacillus & Clostridium
8. Non sporing anaerobes.
9. Spirochaetes, Mycoplasma, Helicobater, Campylobacter, Legionella.
10. Rickettsia and Chlamydiae.

Practicals:

Identification of various bacteria by studying colony characters, Gram's staining, Biochemical reactions, special tests for particular isolate.

Mycology

Theory:

Brief study of :-

1. Pathogenic and non-pathogenic fungi, Identification, pathogenicity, Lab. Diag & drug sensitivity of fungi.
2. Superficial mycosis including –dermatophytes.
3. S/C mycosis:- Sporothrix shenkii, Mycetoma, Chromoblastomycosis, Rhinosporidiosis.
4. Deep mycosis:- Histoplasmosis, Coccidioidomycosis, Blastomycosis, Paracoccidioidomycoses.
5. Candida
6. Nocardia
7. Cryptococcus
8. Actinomycosis

9. Lab. Contaminants.
10. Myotic Poisoning

Practicals:

1. Methods of collection and processing of hair, nail, skin, pus, sputum samples.
2. Identification of fungi by KOH preparation, Gram's staining.
3. Growth identification on SDA medium by LCB mount
4. Germ tube and chlamyospore formation of *Candida albicans*.
5. Hair bait and paraffin bait technique for isolation of geophilic fungi and *Nocardia* respectively.

Virology

Theory:

1. Different staining techniques used in virology
2. Brief knowledge about :-
Rabies virus, Polio virus, Hepatitis Viruses, HIV, Arbo viruses

Practicals:

1. Demonstration of staining technique to demonstrate inclusion bodies by Giemsa method.
2. Test to identify HBV, HCV, HIV, Dengue fever virus e.g. ELISA Test, TRIDOT test, COMBAIDS, Latex-agglutination, other rapid chromatogenic tests.

Parasitology:

Theory:

1. Study of intestinal and tissue nematodes
 - *Ascaris lumbricoides*
 - *Ancylostoma duodenale*/*Necator americanus*
 - *Trichinella spiralis*
 - *Trichiuris trichura*
 - *Dracunculus medinensis*
 - *W. Bancrofti*, *B. malayi*, *Loa Loa*, *Oncocerca volvulus*.
 - *Strongyloides stercoralis*.
 - *Enterobius vermicularis*.

Practicals:

1. Collection, Preparation by direct and conc. Methods for eggs of nematodes.
2. Blood films examination for microfilaria.
3. Egg counting techniques.

SYLLABUS FOR THIRD YEAR

B. Sc. MLT

MEDICAL MICROBIOLOGY

Applied Microbiology: - Theory/ Practical

1. Preservation of microbes and lyophilization methods.
2. Total and viable counts of bacteria
3. Testing of disinfectants –Rideal- Walker, Chick- Martin and in-use tests
4. Artificial active immunity by various types of vaccines.
5. Bacteriological examination of water, milk, food and air.
6. Nosocomial infection and sterility testing of I/V fluids and processing of various samples for hospital infections.
7. Epidemiological markers of micro-organisms- Serotyping, Bacteriophage and Bacteriocin typing methods.
8. Lab. Diagnosis of common bacterial infections viz. Pyogenic infection, respiratory tract infections, Meningitis, Diphtheria, Whooping cough, Gas gangrene, Food Poisoning, Enteric fever, acute diarrhoeal diseases, cholera, Urinary tract infection, Tuberculosis, Leprosy, Plague, Anthrax, Typhus fever, Syphilis, Gonorrhoea and other STD's
9. Serological tests:-

Widal, ASO, CRP, Rosewaller, Brucella agglutination, RA, H Bs Ag, HCV, VDRL, TPHA, FTA- ABS, RPR.
10. Lab. Diagnosis of fungal infections in various fungal infections.
11. Serological tests for infections and skin tests.
12. Advanced techniques in microbiology –ELISA, CIEP, PCR, Western blot, Co-agglutination, Branched DNA Technique
13. Rapid diagnostic methods and automation in Microbiology.

VIROLOGY

Theory:

1. Lab. Diagnosis of viral infections by various serological tests.
2. Mode of transmission of viral agents.
3. Prevention of viral diseases.

Practicals

1. Demonstration of anatomical structures in fertile hen's egg.
 - Inoculation of fertile eggs.
 - Egg inoculation techniques into
 - a) Chorioallantoic membrane
 - b) Amniotic cavity
 - c) Allantoic cavity

d) Yolksac

a. Harvesting of the materials from eggs inoculated by the method.

2. Demonstration of antiviral antibodies by ELISA test and other rapid tests.
3. Preparation of tissue culture media –
 1. Hank's Balanced Salt Solution
 2. Minimum Essential Medium
 3. Earle's Balanced Salt Solution

PARASITOLOGY

Theory:

To study Morphology, Life cycle, Pathogenicity and Lab. Diagnosis of Cestodes-*Diphyllobothrium latum*, *Taenia solium/saginata*, *E. granulosus*, *H.nana*, *T.multiceps*, *E. multilocularis*, Trematodes:- Schistosomes: Intestinal, blood and liver flukes.

Practicals:-

1. Stool examination for segments and ova of cestodes.
2. Casoni's test.

Introduction to Entomology:

Identification and role in various diseases of:-

- a) Mosquitos
- b) Flies
- c) Ticks
- d) Fleas