JAMIA HAMDARD
DEPARTMENT OF PARAMEDICAL SCIENCES
CBCS ENABLED SYLLABUS **M.Sc in Medical Lab Sciences**

SYLLABUS FOR mSC.
M.Sc in Medical Lab Sciences
Choice Based Credit System (CBCS)
Approval Date: 06th Nov 2018

DEPARTMENT OF PARAMEDICAL SCIENCES
JAMIA HAMDARD
Deemed to be University
Accredited in 'A' Grade by NAAC
Declared to be designated as Institute of Eminence (IoE) by MHRD, GOI
NEW DELHI 110062
www.jamiahamdard.edu

PROGRAM NAME: M.Sc in Medical Lab Sciences
PROGRAM CODE: 558
ACADEMIC SESSION OF INTRODUCTION OF THE PROGRAMME: (2022-2023)
SCHOOL NAME: SNSAH
DEAPRTMENT NAME: DEPARTMENT OF PARAMEDICAL SCIENCES

APPROVAL DATE OF THE BOARD OF STUDIES (B.O.S) MEETING FOR THE PRESENT SYLLABUS **6TH November 2018 (6TH BOARD OF STUDIES)**
APPROVAL DATE AND NUMBER OF ACADEMIC COUNCIL OF MEETING FOR THE PRESENT SYLLABUS **36th AC (9th November 2018)**

JAMIA HAMDARD, NEW DELHI - 110062
Internal Quality Assurance Cell (IQAC)

UGC – LEARNING OUTCOMES-BASED CURRICULUM

JAMIA HAMDARD, NEW DELHI - 110062
Internal Quality Assurance Cell (IQAC)

SCHOOL OF NURSING SCIENCES AND ALLIED HEALTH

Vision Statement (School Level): To create an institute of national and international repute in Paramedic offering state of the art education entailing the finest skills combined with compassionate patient care.

Mission Statements (School Level):

MS1: To provide the most advanced and comprehensive course offerings to health sciences student possible by employing the most qualified faculty, utilizing the most advanced technology.

MS 2: To provide a quality paramedical education and prepare human & competent global paramedic professional

MS 3: To provide highest level of quality patient care & can make contribution towards education & research.

DEPARTMENT OF PARAMEDICAL SCIENCES

Vision Statement (Department Level): To construct and develop a world-class, self- sufficient institute for paramedical and other health-related education at the undergraduate, graduate, and doctorate levels of global competence.

Mission Statements (Department Level):

MS1: To provide a quality paramedical education and prepare humane and competent global Paramedic Professionals capable of rendering highest level of quality patient care and can make contribution towards education and research.

MS 2: To assist students in developing critical thinking and application skills in order to instil a scientific temperament in students so that they can apply their knowledge in interdisciplinary fields such as biochemistry, microbiology, and pathology.

MS 3: To develop strong moral, ethical, and professional standards in students, as well as to enhance their overall personality and inculcates compassion.

Name of the Academic Program M.Sc In Medical Lab Sciences

QUALIFICATION DESCRIPTORS (QDs)
Upon the completion of Academic Programme M.Sc In Medical Lab Sciences, students will be able to:

QD-1: An integrated grasp of the core and discipline specific subjects covered in Medical Lab Sciences through experiential learning.
QD-2: To access, create, analyze knowledge and data, stitch diverse concepts and develop an aptitude for research, academia and industry
QD-3To develop communication skills though making presentations (oral or written), writing reports and expressing their science ideas through a technical note/design or via an art form;
QD-4 To develop confidence and a curiosity driven quest to work in large teams at national and international platforms and/or execute a research project/task independently and
QD-5 To to extrapolate/draw inferences and direct the acquired knowledge and transferable skills to real-life research questions as well in areas such as industry, management, scientific communication etc

Mapping Qualification Descriptors (QDs) with Mission Statements (MS)

	MS-1	**MS-2**	**MS-3**
QD-1	3	2	1
QD-2	2	3	1
QD-3	2	1	3
QD-4	1	3	2
QD-5	3	2	1

School of Nursing Sciences and Allied Health
Department of Paramedical Sciences

Name of the Academic Program M.Sc in Medical Lab Sciences
PROGRAM LEARNING OUTCOMES (PLOs)
After completing this Course, the students should be able to …….

PLO-1To gain knowledge of principles and processes underlying and design and develop various inter-disciplinary subjects related to Medical Laboratory Sciences.
PLO-2 Identify, formulate and obtain solutions to the challenging problems in the interdisciplinary fields of lab sciences using principles of medical lab science
PLO-3 Perform routine clinical laboratory procedures within acceptable quality control parameters in Hematology, Chemistry, Immunohematology, and Microbiology under the general supervision of a Clinical Laboratory Scientist or Pathologist.
PLO-4 Apply systematized problem-solving techniques to identify and correct procedural errors, identify instrument malfunctions and seek proper supervisory assistance, and verify the accuracy of laboratory results obtained.
PLO-5 Apply appropriate methodologies for planning and executing experiments related to different aspects of medical lab sciences. Also analyze and interpret the results of the experiments performed.
PLO-6 Apply reasoning informed by the contextual knowledge to assess societal and health issues and the consequent responsibilities relevant to the career in chemistry.
PLO-8 Apply appropriate methodologies for planning and executing experiments related to different aspects of medical lab sciences. Also analyze and interpret the results of the experiments performed.
PLO-9Apply reasoning informed by the contextual knowledge to assess societal and health issues and the consequent responsibilities relevant to the career in chemistry.
PLO-10 Recognize and participate in activities which will provide current knowledge and upgrading of skills in laboratory sciences.
PLO-11 To develop effective communication skill to ensure accurate and appropriate information transfer

PLO-12 Function effectively as an individual, as a member or as a leader in diverse teams and multi-disciplinary groups.

PLO-13 Demonstrate the knowledge and understanding of different aspects of medical lab sciences, economic decision-making and apply these to manage individual as well as team- based projects.

PROGRAM SPECIFIC OUTCOMES (PSOs)

After completing this Course, the students should be able to …….

PSO-1 Professionally competent and exhibit a sense of commitment to the ethical and humane aspects of patient care.

PSO-2 Recognize the role of the medical laboratory technologist in the assurance of quality health care.

PSO-3 Interpret and evaluate patient results and use quality assurance principles and practices to ensure the accuracy and reliability of laboratory information.

PSO-4 Exhibit a sense of commitment to perform a full range of testing in the contemporary medical laboratory encompassing pre-analytical, analytical, and post-analytical components of laboratory services.

Mapping of Program Learning Outcomes (PLOs) With Qualification Descriptors (QDs)

	QD-1	QD-2	QD-3	QD-4	QD-5
PLO-1	3	2	2	2	3
PLO-2	3	2	1	3	3
PLO-3	3	3	1	2	3
PLO-4	2	1	1	3	3
PLO-5	3	2	2	2	3
PLO-6	1	3	3	1	1
PLO-7	3	1	1	2	3
PLO-8	1	1	3	1	1
PLO-9	2	1	3	1	2
PLO-10	2	1	3	1	1
PSO-1	3	2	3	2	3
PSO-2	3	2	2	3	1
PSO-3	3	3	3	2	1
PSO-4	3	3	2	3	2

M.Sc. Medical Lab Sciences

Vision:

The M.Sc. Medical laboratory Technology Course is of 2 years duration aimed at advanced training and academic excellence in the field of laboratory techniques for those students who have passed BMLT and the students graduated in Microbiology and Biochemistry, B.Sc. in Life Sciences, BSc. Nursing with a good scientific foundation. These students will be eligible for higher studies in their respective fields and will have better opportunities in the field of teaching and scientific research (Molecular diagnostics, Molecular Biotechnologies etc.) in India as well as abroad. These post graduates will play an important role in determining the quality of health care provided to patients. These Post Graduates have multiple carrier choices in the form of independent laboratories, Jobs in Public Health industry etc.

a.	Name of the Course	MSc. IN MEDICAL LABORATORY SCIENCE
b.	Nature	Regular
c.	Duration	Minimum: 2 Year
d.	Medium of Instruction and Examinations	English
e.	**Eligibility Criteria**	
	Educational Requirements	Eligibility for the admission: B.Sc. Medical Laboratory techniques with 50%
f.	Commencement of the course	July of every year
h.	Mode of Admission	As per the norms prescribed by Jamia Hamdard from time to time
i.	Period of Completion (Span Period)	Not more than 05 years
J.	Fees	As per university norms.
k.	Total Number of Students per year	15 (Inclusive seats for NRI/ Sponsored candidates) Additional seats are available for foreign nationals.
l.	Total number of Annual examinations	02
m.	Total Theory Papers	As given in following pages

Course Structure

The course work shall be divided into two years annual system of examinations as given below:

I Year July to mid-June

II Year July to mid-June

During an academic year, a candidate shall be enrolled only for one course of study and shall not appear at any other examination of this or any other University. The annual course outline, total marks allocated to each course, internal assessment and Annual examinations marks for all specialization are listed in Annexure. Detailed course content of the syllabus shall be prescribed by the Board of Studies (BOS) and shall be reviewed periodically.

The BOS, depending on circumstances prevailing in the market, may change any paper and increase or decrease the number of optional papers.

Title of the courses MSc. Medical Lab Sciences

Course of study Beside Theory Classes in Pathology, Microbiology and Biochemistry students shall be posted to HAHC Hospital or any other specialized hospital for practical training in the laboratories.

Work record

Every candidate shall attend symposia, Seminars, conference, journal review meetings and lectures during each academic year as prescribed by the department.

Every candidate shall make a work diary and record his or her participation in the training program, presentations given by the candidate and details of laboratory work conducted by the candidate. The candidate will also be involved in teaching and Training of under Graduate Courses.

Dissertation:

Each candidate pursuing M.Sc. MLS course has to select a topic under the guidance of a recognized post graduate teacher; prepare and submit a synopsis and carry out dissertation work for one year. The result of such work should be submitted in the form of thesis. Every candidate shall submit to the registrar of the university in the prescribed Performa two hard copies of the synopsis within six months from commencement of the course.

The synopsis should be send through proper channel. The university shall make a committee for review of synopsis and if found suitable shall register the topic for dissertation. No change in dissertation topic or guide shall be made without prior approval by the university.

The dissertation is aimed to train in research methods and techniques. It includes identification of problem, formulation of hypothesis, search and review of literature, resent advances, critical analysis and interpretation of results.

The dissertation should be written under the following headings:

- Introduction
- Aims and Objectives
- Review of literature
- Material and Methods
- Results
- Discussion

• Conclusion
• Summary
• References
• Tables
• Annexure

The text of dissertation should be Minimum of fifty pages and shall not exceed 100 pages excluding references, tables, questionnaires and other annexure. It should be typed neatly typed on one side of A4 sized paper and bound properly. Spiral binding shall not be done. A declaration by the candidate that the work is done by him or her shall be included. The guide, head of the department and head of the institution shall certify the bonafide of the dissertation.

Four hard copies of the dissertation should be submitted to the university through proper channel along with the soft copy two months before the 2nd year examination. It shall be assessed by two examiners appointed by the university, one internal and one external. No marks will be awarded for dissertation. A candidate will be eligible to appear in 2nd year examination after acceptance of the dissertation. In a genuine case, if dissertation is left to be cleared, permission may be granted to sit in 2nd year examination with prior approval of the Vice Chancellor. The certificate of successful completion of course to such be awarded only after submission and acceptance of the thesis.

Student guide ratio:-5:1. A recognized guide shall supervise dissertation work of not more than five students per academic years

Attendance

a) All students must attend every lecture delivered, however, to account for the late joining or other such contingencies, the attendance requirement for appearing in the semester examinations shall be a minimum of 75% of the total taken separately in theory and posting.
b) The course shall be pursued on full time basis. No candidate shall be permitted to work in a hospital or laboratory outside the institution while pursuing the course in Jamia Hamdard, however the Dissertation work can be carried out out side Jamia Hamdard if required after permission through HOD Paramedical Sciences.
c) In order to maintain the attendance record of a course, a roll call will be taken by the teacher in every scheduled lecture.
d) Attendance on account of participation in the prescribed functions of NCC, NSS, Inter-University sports, educational tours/field work assigned by the university to students shall be credited to the aggregate, provided the attendance record, duly counter signed by the officer in-charge, is sent to the Head of Department within two weeks time after the function/activity.
e) The teacher in-charge will consolidate the attendance record for the lectures for each student. The statements of attendance of students shall be displayed on the Department's Notice Board by the teacher concerned at the beginning of the following month and consolidated attendance before the conclusion of each year as given in the University Calendar. A copy of the same shall be sent to the Head of Department for record. Notices displayed on the Notice Board shall be deemed to be a proper notification, and no

individual notice shall be sent to students.

f) If a student is found to be continuously absent from the classes without information for a period of 30 days, the teacher in charge shall report it to the Head of Department, who will inform the Registrar through the Dean. Registrar will issue a notice to such student, as to why his/ her admission should not be cancelled. The Registrar will take a decision on cancellation of admission within 30 days of issue of the notice. A copy of the order shall be communicated to the student.

g) A student with less than 75% attendance in the lectures and 80% in lab postings shall be detained from appearing in the annual examination each year. The Dean of Faculty concerned may consider application for the condonation of shortage of attendance up to 5% on account of sickness or any other extra ordinary circumstances, provided the medical certificate duly certified by registered Medical Practitioner, had been submitted within 7 days of the recovery from the illness.

h) A student detained on account of attendance will be re-admitted to the same class in the next academic year on payment of current fees except Enrolment and identity card fees

Internal Assessment

Internal assessment for 25 markseach in respect of theory and Practical. Papers will be based on written tests, assignments, presentations, viva-voice etc.

- The evaluation shall be done by subject teacher and marks will be notified within 15 days of such test.
- There shall be two written tests in each year. The test will be conducted as per the academic calendar individual faculty member to announce the date for tests or conduct them as per academic calendar.
- Average of the two tests or best of the two tests will be compute for internal assessment.
- The teacher concerned shall maintain records of marks of various components of evaluation for each student.
- The internal assessment marks shall be submitted by head of the Department tothe Registrar at the end of each year.
- A candidate who has to reappear (as an ex-student) in the annual examination of a course will retain the marks of internal assessment.
- A student who will be required to seek re-admission, for whatever reason, will have to appear for internal assessment and tests afresh.

Setting of Question paper:

- The question paper will be of 75 marks comprising of long Questions, Short notes, along with objective types questions with distribution of marks accordingly. The duration of theory paper will be of three hours.

- The paper setter should set and send question paper to the examination Department in a sealed envelope within a week of receiving letter, No hard or soft copy should be kept by the paper setter to maintain the confidentiality. The whole procedure should be completed by the examination department one week before the commencement of examination with due confidentiality .

Annual Examinations:

Eligibility to appear in Annual Examination

A candidate will be eligible to appear in Annual examination if he or she has satisfactory completed the prescribed course and fulfilled the prescribed attendance.

a) The Annual examinations shall be held at the end of each Academic year as notified in the academic calendar. There shall be a supplementary examination after three months of declaration of result of annual examination
b) The duration of each theory paper will be 3 hours.
c) The question papers shall be set by either an external or an internal examiner duly appointed by the Board of Studies and approved by the Vice Chancellor.
d) The papers set by the examiners shall be moderated by a panel of moderators constituted by the Board of Studies at the time of approving the panel of examiners.
e) The minimum pass marks shall be 50 % in each theory and Practical/viva-voce .

Span Period

A student must complete all the requirements of the course within a period of five years from his/ her admission; otherwise the admission of the candidate will be cancelled and the candidate has to apply afresh for the course.

Schedule of examination:

The university will conduct one (Annual) examinations in a year .

a) The number of examiners for practical and viva voce shall be two, comprising of
b) one internal and one external examiner appointed by the university.
c) A candidate shall not be admitted to the practical examination for the first time unless he/she produces the class record book certified by the head of the department.
d) A failed candidate needs to reappear in that paper he or she has not cleared.
e) Classification of successful candidate:
f) For each Annual Examination a successful candidate is one who has achieved 50% marks in each Theory and practical separately and has achieved 50% of the total Marks
g) Grading System
h) The grade awarded to a student in any particular course will be based on his/her performance in Sessional and final examinations combined together. The letter grades and their equivalent numerical points are listed below:

% Of Marks Scored	Grade	Description of Performance
80% or more	A+	Outstanding
75% or more but less than 80%	A	Excellent
70% or more but less than 75%	B+	Very Good
60% or more but less than 70%	B	Good
50% or more but less than 60%	C	Average
less than 50%	F	Fail
Absent/ Detained	I	Incomplete

FIRST YEAR

COURSE DESIGN
School of Nursing Sciences and Allied Health
Department of Paramedical Sciences

Name of the Academic Program M.Sc in Medical Lab Sciences

First Year

Course Code: MLS 101
Title of the Course: General Biochemistry
L-50 T -25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 To understand structure and function of proteins, nucleic acids, carbohydrates, fats, Vitamins,co-enzymes, etc and will understand the chemical properties of these bio-molecules and their functions.

CLO-2 To explain disciplinary knowledge and understanding of biochemistry, structure and function of biological molecules.

CLO-3 The students will learn basic concepts of Bioenergetics, mechanisms of oxidative phosphorylation and photophosphorylation.

CLO-4. To acquire fundamental knowledge on enzymes and their importance in biological reactions

CLO-5 They will understand composition and structure of biomembranes, transport mechanisms across biological membranes and will learn the concept and mechanism ofATP synthesis.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit 1: **25 Hours**

Physical chemistry:

An overview of the cell and cell structure and functions Prokaryotic and

eukaryotic cells; Cell organelles: Membrane biology: Major cell functions:
The Dissociation of Water , Dissociation of Acids and Bases.,mixtures of a weak Acid with its salt, pH ,Hendersen Hasselbalch equqtion definition of pH ,buffers,buffer range,buffer capacity, Indicators ,Choice and Range of Indicators , Colloids Ampholytes and the Isoelectric Point Osmptic Pressure,oncotic pressure Diffusion and Dialysis , Surface Tension

and Adsorption, Gibbs–Donnan equilibrium, their biological physiological and medical importance

Unit 2 **20 Hours**

1) Chemistry, biomedical importance of biomolecules `

i) Amino acids and protein chemistry

Structure, nomenclature, classification based on R-groups,R group chractors,nutritional requiment,metabolic fate . Acid-base behavior, chemical reactions of amino acids.

Stereoisomerism and optical properties with respect to peptide bonds. Structure and properties of amino acids, Zwitterion and isoelectric pH, titration curve. Physical and chemical properties,Peptides of biomedical importance

Proteins

Higher order of protein structure- characteristics of primary, secondary, tertiary and quaternary structures of proteins Classification of proteins according to their structures, properties and functions, Isoelectric point of proteins.

X-ray crystallography, NMR spectroscopy, Separation techniques- Electrophoresis and chromatography. Structure of collagen, myoglobin, haemoglobin, Plasma proteins Albumin, globulin, haptoglobin, transferrin, ceruloplasmin etc, functions of plasma proteins.

Structural organization with respect to myoglobin, hemoglobin.O2 dissociation curves for and haemoglobin, factors affecting release of O2, mutant haemoglobins. Hemoglobin variants and derivatives. Abnormal hemoglobins, hemoglobinopathy and thalassemia

Carbohydrates: Brief account on the occurrence of carbohydrates, structure, properties and biological importance. Functional groups, hemiacetal formation, conformation of pyranose and furanose rings. Asymmetric carbon atoms in monosaccharides, mutarotation, anomeric sugars. Classification: reducing and non-reducing disaccharides and homo, hetero polysaccharides mucopolysaccharides.Proteoglycans and glycoproteins .Glycosidic bonds and Glycosides Derivatives of sugars: Deoxy sugars, amino sugars and their N-acetyl derivatives. O- and N glycosides. Physical and chemical properties of carbohydrates

Lipids: Classification of lipids, Physical and chemical properties

Derived lipids- FA, steroids, eicosanoids-chemistry, distribution, classification and functions. Simple lipids.:Fats Triacylglycerols: structure, function. Stereochemical numbering, prochirality.and waxes. General Fatty acids: nomenclature, Definition, functions, classification: Saturated and unsaturated fatty acids,number of carbon atoms. Essential fatty acids. Complex lipids Phosphoglycerolipids: Phosphosphingolipids, Glycosphingolipids their structure and functions,lipoproteins.. Blood group antigens (ABO). Derived lipids Cholesterol nomenclature, stereochemical structure. Bile acids (primary, secondary, conjugated bile acids): structure and function. Application of their detergent effect. Steroid hormones. Structure, function. Vitamin D3 and its biologically active derivatives. Isoprene and its biologically active derivatives. Coenzyme Q: Dolichol phosphate. Eicosanoids:

classification,synthesis, biological and pharmacological functions.Biochemical basis of aspirin and fish oil in CAD patients.
Membranes:Structure and functions,fluid mosaic model ,liposomes.

Unit 3: Enzymes **10 Hours**

Introduction: Definition, classification and properties of enzyme. Coenzymes and Cofactors, multifunctional enzymes and multienzyme complex.
Classification of enzymes, properties of enzymes – catalytic power, specificity, Units of enzyme activity, Active site – Fisher and Koshland models, formation of enzyme – substrate

complex. Nature of active site.Factors affecting enzyme activity, ribozymes, abzyme and synzymes. Kinetics: Michaelis Menten equation,Concept and significance of Km and Vmax, , Kcat, specificity constant (Kcat/Km). Significance of enzyme turnover. Double reciprocal plot -Lineweaver –Burk plot. Enzyme inhibition: reversible irreversible inhibition, competitive, non-competitive and uncompetitive and suicidal inhibition.Mechanism and clinical importance.
Enzyme regulation – general mechanisms of enzyme regulation .Isoenzymes, properties. Application of Enzymes: Diagnostic, Analytical and Therapeutic importance Immobilised enzymes. Drugs as enzyme inhibitors in antibacterial antiviral & antitumor therapy

Unit 4: Bioenergetics, Biological Oxidation, Electron Transfer Chain And Oxidative Phosphorylation **20 Hours**

i) Bioenergetics:
Thermodynamics principles Coupling , Concept of Energy , Relationship Between Standard Free Energy Change and Equilibrium Constant , Standard Free Energy Changes at pH 7.0 or
$\Delta G^{\circ\prime}$, ATP as Universal Currency of Free Energy in Biological Systems , Free Energy of Hydrolysis of ATP and other Organophosphates , Structural Basis of the High Group Transfer Potential of ATP , ATP Hydrolysis and Equilibria of Coupled Reactions , Role of High Energy Phosphates as the 'Energy Currency' of the Cell , Interconversion of Adenine Nucleotides
Biologic oxidation:
Biological oxidations and oxidative phosphorylation.
Role of oxido-reductases Cytochrome P450 system Free radicals formation, scavenging oxygen free radicals. Antioxidants. Role in diseases. Respiratory chain and oxidative phosphorylation, components of respiratory chain control, site specific inhibitors, uncouplers. High energy phosphate compounds
Clinical correlations:

1. Cyanide poisoning
2. Hypoxic injury

Vitamins
Introduction to Vitamins Water-Soluble vs. Fat-Soluble .Differences. Structure, functions ,sources,
daily requirement ,diseases associated with vitamin deficiency
6. Minerals
Biochemical role of minerals (sodium, potassium, magnesium, fluorine, calcium, phosphorus, iron, iodine, chloride, Zinc Molybdenum Manganese, copper & selenium etc.), sources, Recommended dietary allowances, Clinical

disorders associated with metabolism of these minerals.

Endocrine Biochemistry

i. General characteristics of hormones and other signaling molecules; classification, functions, mechanism of action.

ii. The synthesis, secretion, metabolism and modes of action of hormones.

iii. Hormones of pituitary

iv. Hormones of the adrenal cortex Glucocorticoids, mineralo corticoids, their biosynthesis, secretion, transport, metabolism and their metabolic effects.

v. Hormones of pancreas and GI tract.,Diabetes Mellitus- laboratory diagnosis.

vi. Hormones of adrenal medulla-catecholamines and their derivatives - biosynthesis, excretion, storage, regulation and metabolic effects.

vii. Hormones of thyroid and parathyroids

Reference Books:

1. Molecular Cell Biology (2016) 8th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York).
2. Biochemistry (2016) 6th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston),
3. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2
4. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York).

Teaching-Learning Strategies in brief

1. Lectures- Class room lectures and use of black/green/white boards.ICT tools involving smart boards, power point presentations, live demonstrations, videos, animations, models, improve the understanding and make the teaching sessions enjoyable.
2. Discussions :Discussions are critical components of learning, and can be used as a platform for students to be creative and critical with old and new ideas.
3. Practical: After completion of experiments in practical class, students should be given related problems. This will enhance the ability of problem based learning (PBL).
4. Case Studies: To express acquired knowledge, skills and attitudes, case based learning (CBL) can be used where students can be given case specific problems both for theory and practical courses to find creative solutions to complex problems.
5. Project work: The students are encouraged to carry out small project work of their choice to quench their curiosity. In order to understand

research,student can undertake a small dissertation work where he/she exhaustively performs the literature search and compiles them as a meaningful presentation.

Assessment methods and weightages in brief

Internal assessment for 25 marks in respect of theory papers will be based on written tests assignments, presentations, viva-voice etc. The Semester examinations shall be held at the end of each semester as notified in the academic calendar.

Course Code: MLS 102

Title of the Course: General Bacteriology and Immunology

L-50 T-25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 To explain disease symptoms with causative agent, isolate and identify pathogens.

CLO-2 Aquire fundamental knowledge of Molecular biology Techniques

CLO-3 Evaluate different type of bacteria and their role in diseases and ability to isolate and cultivate bacteria.

CLO-4 To understand the mechanism of action of antimicrobial drugs and prophylaxis

CLO-5 To understand and learn human defence mechanism

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

UNIT-1 **50Hours**

General Bacteriology

Bacterial Morphology and Physiology

Normal flora

Definition of infection and infectious disease: natural bacteriological ecosystem.

Sterilization & Disinfection

Culture media and preparation

bacterial genetics

Bio-safety including universal precautions

Diagnostic procedures.

Specimen selection and collection (blood, urine, sputum, faeces, others).

Specimen processing: smears, staining, cultures including cell cultures,

susceptibility testing, and antigen detection.
Preservation of cultures
Identification of bacteria
Basis of Molecular biology techniques.
Bacteriological and viral serology.

2. Antibiotics and antiviral agents

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

UNIT II Immunology **25 Hours**

1. Immunity: innate and acquired immunity, mechanisms of innate immunity inflammation
2. inflammatory cells, mediators, inflammatory response types, cells and organs of immune system, evolution of immunity.
3. Antigens
4. Immunoglobulin: Structure and function, classes and subclass-antibody diversity, monoclonal antibodies-hybridoma technique and MAB production, application in biomedical research, clinical diagnosis and treatment.
5. Compliment system: function and pathways
6. Antigen- Antibody reactions and immunological methods
7. Immune Response: Clonal selection theory and related theories, primary and secondary response, humoral and cell mediated response, antigen processing and presentation, MHC-structure and role in antigen presentation, MHC genes, maturation activation and differentiation of B cells and T cells.
8. Hypersensitivity
9. Auto Immunity
10. Transplantation Immunity
11. Tumor Immunity
12. Immunity against bacteria: Virus, Fungi and Parasites.
13. Immunological methods in clinical laboratories: Method interpretation and application

Reference Books

1. Tortora, Gerard J, et al. *Microbiology : An Introduction*. San Francisco, Ca, Pearson Benjamin Cummings, 2010.
2. Madigan, Michael T, et al. *Brock Biology of Microorganisms*. San Francisco Pearson/Benjamin Cummings, 2009.
3. Willey, Joanne M, et al. *Prescott, Harley, and Klein's Microbiology*. Boston ; Madrid, Mcgraw-Hill Higher Education, 2008.
4. Atlas, Ronald M. *Principles of Microbiology*. Dubuque, Ia, Wm. C. Brown Publishers, 1997..
5. Pelczar, M.J., Chan, E.C.S. and Kreig, N.R. (2002) Microbiology. 5th Edition, Tata McGraw-Hill, New Delhi.
6. Stanier, Roger Y, et al. *General Microbiology*. London, Macmillan, 1995.
7. Cappuccino, James G, and Chad Welsh. *Microbiology : A*

Laboratory Manual. 12th ed., New York, Pearson, 2019.
8. Salle A. *Fundamental Principles of Bacteriology*. New Delhi, Tata Mcgra-Hill Publishing Company Limited, 2007.

Teaching-Learning Strategies in brief

1. Lectures- Class room lectures and use of black/green/white boards.ICT tools involving smart boards, power point presentations, live demonstrations, videos, animations, models, improve the understanding and make the teaching sessions enjoyable.
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5. Project work: The students are encouraged to carry out small project work of their choice to quench their curiosity. In order to understand research,student can undertake a small dissertation work where he/she exhaustively performs the literature search and compiles them as a meaningful presentation.

Assessment methods and weightages in brief

Internal assessment for 25 marks in respect of theory papers will be based on written tests assignments, presentations, viva-voice etc. The Semester examinations shall be held at the end of each semester as notified in the academic calendar.

Course Code: MLS 103

Title of the Course: Clinical Pathology

L-50T-25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……

CLO-1 To explain the basic nature of disease processes from the standpoint of causation, epidemiology, natural history, and the structural and functional abnormalities that result.

CLO-2 To demonstrate a working understanding of the pathogenesis of a variety of common and uncommon diseases..

CLO-3 To classify diseases of various body systems and how they manifest clinically and histopathologically.

CLO-4 To devise likely diagnoses from clinical scenarios by recognizing key manifestations of congenital, hemodynamic, inflammatory, infectious, metabolic, environmental, and neoplastic diseases.

CLO-5 Utilize high quality peer-reviewed literature to maintain currency in the management of pathologic conditions.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit-I **25 Hours**

Blood Parasites

1. Bone marrow – preparation of bone marrow smears, Trephine biopsy smears Staining of B.M Aspiration Smear, Demonstration of Iron stain
2. Automation in hematology - demonstration
3. Organization and quality control in the laboratory.

Collection, transport, preservation and processing of various clinical specimens

Unit-II **50 Hours**

Urine examination, Physical, chemical and microscopic, Urine analysis by Strip method Sputum examination – collection of specimen

i. Physical examination

Microscopic – Gram's stain, Ziehl Neelsen stain for AFB

Chemical examination

Gastric analysis

Indications , contra indication, Method of collection

Fasting gastric juice – Macroscopic and microscopic examination i Fractional test meal

Augumented Histamin test

Hollander's test

Cerebrospinal fluid analysis

Method of obtaining CSF, indications, contra indications.

Examination of CSF : i. Physical examination

ii. Biochemical examination

Microscopic examination

Cytological examination

bacteriological examination

Body fluids

Microscopic examination of Pleural, Pericardial, synovial, ascitic and peritonial fluid. Pregnancy Test- Method ,interpretation

Reference Books:

1. Goljan, Edward. *Rapid Review Pathology*. Philadelphia, Pa Elsevier, 2019.
2. Kumar, Edward C. *Robbins and Cotran Review of Pathology.* S.L., Elsevier - Health Science, 2020.
3. Kumar, Vinay, et al. *Robbins Basic Pathology*. 9th ed., Philadelphia, Pennsylvania Elsevier, 2018.
4. Cross, Simon S. *Underwood's Pathology : A Clinical Approach*. Edinburgh, Churchill Livingstone Elsevier, 2019.
5. Roberts, Fiona, et al. *Pathology Illustrated*. Edinburgh ; New York, Elsevier, 2018.

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Assessment methods and weightages in brief

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Course Code: MLS 104
Title of the Course: Systemic Bacteriology, mycology and Virology
L-50T-25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)
After completing this Course, the students should be able to …….
CLO-1 To explain disease symptoms with causative agent, isolate and identify pathogens.
CLO-2 Aquire fundamental knowledge of Molecular biology Techniques
CLO-3 Evaluate different type of bacteria and their role in diseases and ability to isolate and cultivate bacteria.
CLO-4 Evaluate different type of virus and their role in diseases and ability to isolate and cultivate bacteria.
CLO-5 Evaluate different type of fungi and their role in diseases and ability to isolate and cultivate bacteria.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PSO 1	PSO 2	PSO 3	PSO 4
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:
UNIT-I **25 Hours**
Systematic Bacteriology:
Morphology, major diseases caused, epidemiology, laboratory identification, antibiotic susceptibility and drug resistant pattern of
Gram positive aerobic cocci of medical importance including Staphylococcus, Micrococcus, Streptococcus etc.
Gram negative aerobic cocci of medical importance including Neisseria, Moraxella etc. Gram positive bacilli of medical importance.
Gram negative bacilli of medical importance including Enterobacteriaceae, Vibrios, , Haemophilus, Bordetella, Brucella, Gardnerella, Pseudomonas & other non-fermenters. Helicobacter, Campylobacter Mycobacteria
Anaerobic bacteria and anaerobic techniques.
SpirochaetesChlamydiae

Mycoplasmas. Rickettsia

UNIT-II **25 Hours**

Mycology

1. General characteristics & classification of fungi
2. Morphology & reproduction of fungi
3. Isolation & identification of fungi

Morphology, major diseases caused, epidemiology and laboratory identification:

4. Yeasts and yeast like fungi of medical importance including Candida, Cryptococcus, Malassezia, Geotrichum, Saccharomyces etc.
5. Mycelial fungi of medical importance including Aspergillus, Zygomycetes.
6. Pseudoallescheria, Fusarium, Piedra, other demataceous hyphomycetes and other hyalohyphomycetes etc.
7. Dimorphic fungi including Histoplasma, Blastomyces, Coccidioides,
8. Paracoccidioides, Sporothrix, ,Penicillium marneffei etc.
9. Dermatophytes
10. Fungi causing mycetoma, keratomycosis & otomycosis.
11. Pneumocystis carinii infection
12. Rhinosporidium seeberi.
13. Antifungal agents & invitro antifungal susceptibility tests.

UNIT-III

Virology **25 Hours**

1. The nature of viruses.
2. Classification of viruses
3. Morphology: virus structure
4. Virus replication
5. The genetics of viruses
6. Bacteriophages
7. DNA & RNA virus: Pathogenicity, epidemiology; isolation and identification from clinical specimens, lab diagnosis of: Herpesviruses, Adenovirus, Hepatitis viruses, picornaviruses, Rotaviruses, orthomyxoviruses, paramyxoviruses, rabiesvirus, papovavirus, HIV, Oncogenic viruses.

Reference Books

1. Tortora, Gerard J, et al. *Microbiology : An Introduction*. San Francisco, Ca, Pearson Benjamin Cummings, 2010.
2. Madigan, Michael T, et al. *Brock Biology of Microorganisms*. San Francisco Pearson/Benjamin Cummings, 2009.
3. Willey, Joanne M, et al. *Prescott, Harley, and Klein's Microbiology*. Boston ; Madrid, Mcgraw-Hill Higher Education, 2008.
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Assessment methods and weightages in brief

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Course Code: MLS 105
Title of the Course: Metabolism of Biomolecules
L-50 T-30 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 Gain understanding on fundamental biochemical principles of metabolism of biomolecules (Carbohydrates, Proteins, Lipids and Nucleic acids) and the associated bioenergetics.

CLO-2 Learn the biochemical reactions in metabolic pathways and understand their interrelations, logics and patterns

CLO-3 Understand the role of enzymes in the biochemical reactions and the connect between biochemical defects and metabolic disorders.

CLO-4 Explain the structures and function of biomolecules (carbohydrates, amino acids, lipids and nucleotide)
CLO-5 Gather a firm understanding and relevance of stringent regulation of metabolic pathways.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit-I **25 Hours**

i) Introduction to metabolism

ii) Metabolism of carbohydrates

Major carbohydrate components of food. Their digestion and absorption. Lactose intolerance. GLUT family glucose transporters (localization, special characteristics and role).

Gycolysis ,TCA cycle – regulation,amphibolic nature,anaplerotic reactions. Glycogen metabolism and its regulation, Cori cycle. Gluconeogenesis and control of blood glucose, metabolism of fructose, galactose, metabolism of ethanol. Pentose phosphate & uronic acid pathway and their significance. Molecular mechanism and metabolic rationale of Pasteur- effect.Blood glucose regulation.Metabolism of RBC's.

Clinical correlation:

a) Glycogen storage diseases
b) Essential fructosuria, fructose intolerance galactosemia
c) Lactic acidosis
d) G6PD deficiency
e) Alcoholism – Methanol poisoning

Unit-II **25 Hours**

iii) Metabolism of Lipids

Digestion, absorption – role of bile salts. Storage and mobilisation of fats, Denovo synthesis and oxidation of fatty acids, ketone bodies- formation, utilisation. Regulation of ketogenesis-ketosis. Metabolism of unsaturated fatty acids and Eicosanoids- prostaglandins, leukotrienes. Lipids transport –structure metabolism and functions of different classes of lipoproteins. Separation of lipoprotein classes.

Cholesterol, synthesis, transport and excretion. Bile acids primary and secondary, synthesis and functions formation. Role of cholesterol in the development of atherosclerosis - relationship of hypercholesterolemia- and dietary fat intake. Metabolism in adipose tissue, fatty liver and lipotrophic factors

Clinical correlation:

1. Obesity 2. Ketoacidosis 3. Fatty liver 4. Hyperlipidemias 5. Atherosclerosis 6. Metabolic diorders associated with lipid oxidation

iv) Amino acid metabolism

Dynamic state of body proteins, protein turnover, Digestion and absorption, pathways of amino acid degradation, transamination,oxidative deamination. Metabolism of ammonia-urea cycle. .

Unit-III **25 Hours**

Metabolism of amino acids – glycine, serine, aromatic amino acids, sulphur containing amino acids, histidine, arginine, glutamic acid,branched chain amino acids (first three steps) and metabolic disorders associated with them along with laboratory diagnosis. Catabolism of Carbon skeletons of Amino acids.

Specialized products obtained from amino acid metabolism and their importance (Polyamines, creatine, nitric oxide) Degradation of neurotransmitters One-carbon metabolism.

Clinical correlations:

1. Inborn errors of metabolism associated with various amino-acids.

v) Integration of metabolism

a. Integration of carbohydrate, protein and lipid metabolism18

Hormonal regulation of mammalian metabolism. Inter conversion of major foodstuffs, tissue specific metabolism- liver, muscle,erythrocytes, heart, adipose tissue, brain etc.Metabolism in early,prolonged starvation stress.

Clinical correlations:

1. Starvation
2. Uncontrolled diabetes mellitus
3. Metabolic response to stress, injury
4. Haemolysis, erythrocyte membrane stability.

vi) Porphyrins and heme metabolism Heme metabolism:

Porphyrins chemistry and properties and Porphyrias .Biosynthesis of heme, its regulation Catabolism of heme. Jaundice: Biochemical basis of Jaundice and distinguishing features of different types of Jaundice acquired and inherited.

viii) Xenobiotic Metabolism:

Reference Books:

1. Nelson, D.L. and Cox, M.M. (2017). *Lehninger principles of biochemistry*. New York, USA: W. H. Freeman.
2. Plummer, D.T. (2012). *An introduction to practical biochemistry*. New Delhi, India: McGraw-Hill College.
3. Sawhney, S.K. and Singh, R. (2005). *Introductory practical biochemistry*. Oxford, UK: Alpha Science International.

Suggested Readings for Theory and Practical

4. Berg, J., Gatto, G., Stryer, L. and Tymoczko, J. L. (2019). *Biochemistry*. New York, USA: W. H. Freeman and Company.
5. Devlin, (2011). *Textbook of biochemistry with clinical correlations*. UK: Wiley T & Sons.

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Assessment methods and weightages in brief

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Course Code: MLS 106
Title of the Course: Biochemistry Practicals
P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……
CLO-1 Analyse specimen with the help of diagnostic kits that are used in clinical laboratories.
CLO-2 Gain knowledge in diagnosis through the presentations made on the known case studies.
CLO-3 Able to demonstrate quantitative analysis of biomolecules in clinical biochemistry
CLO-4Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.
CLO-5 Able to perform quantitative analysis of specimen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PSO1	PSO2	PSO3	PSO4
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CLO2	2	2	2	2	2	2	2	2	3	3	2	2	2	2
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CLO4	3	3	2	3	2	2	3	2	3	3	3	3	2	2
CLO5	3	2	2	2	3	3	2	3	3	3	3	1	2	2

Detailed Syllabus: **200 Hours**

1. Good Clinical Laboratory Practices
2. Quality control
3. Routine clinical chemistry
4. Basic Techniques
5. Endocrinology

Reference Books:

a. Molecular Cell Biology (2016) 8th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York).

b. Biochemistry (2016) 6th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston),

c. Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

d. Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York).

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Assessment methods and weightages in brief

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Course Code: MLS 107
Title of the Course: - Clinical Pathology Practical/ Viva Voce
P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 With the help of diagnostic kits that are used in clinical laboratories, students will learn to do analysis of specimen.
CLO-2 Through the presentations made on the known case studies, students will learn how to apply the gained knowledge in diagnosis.
CLO-3 Able to demonstrate quantitative analysis of specimen in clinical pathology.
CLO-4 Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.
CLO-5 Able to perform quantitative analysis of specimen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

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CLO5	3	2	2	2	3	3	2	3	3	3	3	1	2	2

Detailed Syllabus: **200 Hours**

1. Urine examination, Physical, chemical and microscopic. Urine examination by Strip method
2. Examination of Cerebrospinal fluid [CSF] and body fluids.
3. Pregnancy Test
4. Examination of Semen.

Reference Books

1. Goljan, Edward. *Rapid Review Pathology*. Philadelphia, Pa Elsevier, 2019.
2. Kumar, Edward C. *Robbins and Cotran Review of Pathology.* S.L., Elsevier - Health Science, 2020.
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Course Code: MLS 108

Title of the Course: - Microbiology Practical/ viva voce

P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 Analyse specimen with the help of diagnostic kits that are used in clinical laboratories.

CLO-2 Gain knowledge in diagnosis through the presentations made on the known case studies.

CLO-3 Able to demonstrate quantitative analysis of specimen in clinical microbiology.

CLO-4 Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.

CLO-5 Able to perform quantitative analysis of specimen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
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CLO5	3	2	2	2	3	3	2	3	3	3	3	1	2	2

Detailed Syllabus: **200 Hours**

Practical

a) Care and operation of Microscopes viz. Light, Dark ground, Phase contrast, Fluorescence microscopes, etc.

b) Preparation of stains viz. Gram's Albert's, Ziehl –Neelsen and other special stains and performing of staining.

c) Washing and sterilization including plugging and packing.30
d) Handling & operation of autoclave, hot air oven, distillation plant, microbial filters and sterility tests.
e) Care and maintenance of common laboratory equipments.
f) Preparation of various liquid and solid media.
g) Preparation of reagents required for routine diagnosis.
h) Tests for in-vitro drug resistance.
i) Techniques to demonstrate the motility.
j) Immuno-diffusion methods
k) Preparation, examination and interpretation of direct smears from clinical specimens, viz. gram stain, sputum for AFB – ZN & auramine O, slit smears for M.Leprae.-ZN stain, conjunctival smear for Chlmydiae – Giemsa/Iodine.
l) Techniques of anaerobiosis.
m) Identification of bacteria of medical importance upto species level.
n) Quantitative and semi-quantitative analysis of urine.
o) Skin tests like Mantoux, Lepromin etc.
p) Mycology: Collection of specimens.
q) Direct examination of specimens by KOH, Lactophenol cotton blue stains.
r) Isolation and identification of common laboratory contaminants and pathogenic yeasts and moulds
s) Special techniques.
t) Maintenance of stock cultures.
u) Virology Preparation of glassware (washing, sterilization) & media for tissue culture
v) Sample collection for virology tests
w) Viral Serological tests. (rapid, ELISA, NT, westernblot etc)
x) Molecular detection methods
y) Viral Microscopy: Tzank smear, IFA etc

Reference Books:

1. Tortora, Gerard J, et al. *Microbiology : An Introduction*. San Francisco, Ca, Pearson Benjamin Cummings, 2010.
2. Madigan, Michael T, et al. *Brock Biology of Microorganisms*. San Francisco Pearson/Benjamin Cummings, 2009.
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8. Salle A. *Fundamental Principles of Bacteriology*. New Delhi, Tata Mcgra-Hill Publishing Company Limited, 2007.

Teaching-Learning Strategies in brief

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Assessment methods and weightages in brief

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SECOND YEAR

Course Code: MLS 201
Title of the Course: - Molecular Biology and Medical Genetics
L-50 T-30 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……

CLO-1 Acquire basic concepts of central dogma and will understand the concept of DNA replicated and repair and hence the consequences of improper processes.

CLO-2 Gain knowledge about basic transcription apparatus, mechanisms of transcription in bacteria and in eukaryotes and inhibitors of transcription.

CLO-3 learn about structure of gene, RNA splicing pathways, variants of splicing, mechanism of determining the sex of Drosophila and mRNA transport.

CLO-4 Gain knowledge about features of genetic code, types of RNA, ribosomal structure, process of translation in prokaryotes and eukaryotes and inhibitors of protein synthesis.

CLO-5 Learn about mutations, which are considered instrumental for species deviation and eventually diversity

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit I **25 Hours**

Molecular biology

1) Chemistry and metabolism of nucleotides,

Introduction:Chemical structures of nucleotides, Synthesis, regulation and salvage pathway of purine and pyrimidine nucleotides,Synthesis of Deoxyribonucleotides, Catabolism of purines and pyrimidines. Nucleotide Coenzymes, Analogues of purines and pyrimidines, application in medicine. Inherited metabolic disorders purine and pyrimidine nucleotides

2)Nucleic acids structure , function and organization

DNA structure ,types and their differences ,tautomerism.; Nucleosome and higher levels of organization and packaging of eukaryotic DNA in the chromosome Physical properties of DNA: Denaturation, melting point,supercoiling,cot1/2 value

RNA: Structure of ribonucleotides (RNA), types of RNA, similarities and differences between RNA and DNA, functions of the RNA. RNA as hereditary Information

Unit II **25 Hours**

3) Nucleic Acid Metabolism

i) Replication DNA replication and differences in prokaryotes and eukaryotes.DNA damage and repair.Inhibitors of replication.

ii) Transcription

Transcription in prokaryotes and eukaryotes, differences transcription factors,promoters, enhancers ,silencers ,post transcriptional modification,differential RNA processing,RNA editing.RNA as catalyst.

iii) Translation and post translational modifications

Translation in prokaryotes and eukaryotes,their differences post translational modification mutations- classification, molecular basis of Ames test.Genetic code

Secretion and transport of proteins to membranes (integral membrane proteins) and various organelles; Signal hypothesis; Protein targeting to peroxisome;; Nuclear pore complex and its function; Trafficking across nucleus; Nucleolus and the synthesis of ribosome;

iv) Regulation of gene expression

In prokaryotes- negative and positive Control, concept of Operon chromatin remodeling, histone modification, DNA methylation, imprinting, epigenetic regulation of transcription,differential RNA processing,RNA editing role of epigenetics in normal development and oncogenesis

Unit III **25 Hours**

4) Molecular biology techniques

DNA cloning , Restriction enzyme , transformation of bacterial cells, Probes gel electrophoresis, cloning vectors.Genomic, cDNA libraries, Southern blot , Northern blot , Western blot , DNA micro array ,Polymerase Chain Reaction Real-time PCR , enzymelinked immunosorbent assay (ELISA) RFLP, Gene therapy,DNA finger printing

5) Molecular mechanisms in specialized tissues

Molecular mechanisms of vision, neuropeptides- endorphins and enkephalins. Clinical correlations:

1. Myasthenia gravis
2. Parkinsonism
3. Night blindness
4. Cataract

2. Molecular mechanisms of cell deaths and aging.

7) Biochemistry of cancer – Tumour markers

Reference Books

1. Cox, M. M. Doudna J. A. and Donnell, M. O. (2012). 1st Edition. *Molecular biology: Principles and practice.* London, UK: W H Freeman & Co Publishers, ISBN-13: 978-0- 716-7998-8.
2. Hardin, J. Bertoni, G. P. Kleinsmith, L.J. and Becker, W.M. (2008). 7th Edition. *The world of the cell.* San Francisco, USA: Benjamin Cummings Publishers, ISBN-13:978- 0805393934.
3. Karp, G. (2013). 7 th Edition. *Cell and molecular biology: Concepts and experiments.* New Jersey, USA: Wiley Publishers, ISBN-13:978-1118206737.
4. Watson, J. D. Baker T. A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2013). 7th Edition. *Molecular biology of the gene.* New York, USA: Cold Spring Harbor Laboratory Press, ISBN-13: 978-0-321-76243-6.

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Assessment methods and weightages in brief

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Course Code: MLS 202
Title of the Course: - Clinical biochemistry and recent advances
L-50 T-25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)
After completing this Course, the students should be able to …….
CLO-1 Understand the Basic concepts and principles of Clinical Biochemistry, detail on the various biological specimens including the process of collection, preservation and storage.
CLO-2 Gain understanding of the need for Gastric function tests, Collection of gastric contents, their examination
CLO-3Understand the Blood groups, Blood banking and adverse reactions of blood transfusions.
CLO-4 Understand the pathophysiological processes responsible for common biochemical disorders such as jaundice, Pancreatitis, Fatty liver etc.
CLO-5 Understand Formation of urine and gain perception on the various renal function tests and renal disorders

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

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CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:
Unit I: **50 Hours**
Clinical Biochemistry: Role of Biochemistry in diagnosis of disease

- GIT: Acidity curves, qualitative quantitative analysis of gastric and duodenal contents, pancreatic disorders and exocrine function- malabsorption syndromes.
- LFT (Liver function test), normal range, lab findings and differential diagnosis of jaundice, bilirubin metabolism, cirrhosis, hepatic coma, hepatitis, gall stones, cholecystitis and tumors.
- KFT (Kidney function test), normal range, clearance of parameters, Acute Renal Failure (ARF)and Chronic Renal Failure(CRF),urine analysis for normal and abnormal constituent, normal

Blood glucose, renal threshold,

- GTT (glucose tolerance test), Diabetes and glycated Hb, glycogen storage disorders, lipid profile - normal range, coagulation Disorders: PT, APTT interpretation etc., anemia workup

-Hb indices, iron studies, storage form, peripheral blood smear, Abnormal Hb-identification,

- Lipid Profile Tests, NCEP guidelines , Hypercholesterolemia, Atherosclerosis
- CSF analysis, bacterial/viral and fungal meningitis, ascitic/ pleural fluid analysis,
- Inborn errors of Metabolism- phenylketonuria, alkaptonuria, homocystinuria and albinism, Hartnup's disease, galactosemia, Tay Sach's disease and Niemann Pick's disease, Hunter and Hurler Syndrome, Lesch-Nyhan syndrome,
- Acid- Base Balance disorders- acidosis/alkalosis/ mixed, fluid and electrolyte balance and disorders
- Diagnostic enzymology- cardiac Biomarkers (lactate dehydrogenase, Creatine kinase, Trop T), AST, ALT, ACP, Gamma glutamyl transferase and Alkaline phosphatase,

Amylase

Unit:II **25 Hours**

Nutrition

Definition of BMR and SDA and factors affecting these. Body mass, body fat, and body water

- Essential nutrients

Carbohydrates , Glucose, Other sugars and starch Dietary fibre,Lipids and proteins. Dietary and nutrient recommendations Dietary guidelines Nutrient recommendations Dietary Reference Intakes

Dietary sources, intake levels, physiological role, and requirement of major nutrients.27 The role of diet in the development of chronic diseases, such as cardiovascular disease, cancer, diabetes, etc.

Thermogenic effects of foods.

Energy requirements of man and woman and factors affecting energy requirements. Biochemical role, sources, deficiency, requirement of vitamins - fiber in the diet., Proteins,

Major classes of dietary lipids Fats- unsaturated fatty acids. Nutritional significance of dietary calcium, iron, iodine, Protein- energy malnutrition, malabsorption syndromes The role of nutrition in growth and health through the life cycle.
o Pregnancy and lactation
o childhood, and adolescence

References Books

1. Burtis, C A. *Tietz Textbook of Clinical Chemistry and Molecular Diagnosis.* St. Louis: Elsevier Saunders, 2006.
1. Devlin, Thomas M, and Cram101 (Firm. *Textbook of Biochemistry with Clinical Correlations*. Cram101 Inc, 2013.
2. Gaw, Allan, et al. *Clinical Biochemistry.* Edinburgh, Churchill Livingstone, 1999.
3. Basten, Graham. (2011). Introduction to clinical biochemistry: interpreting blood results
4. Kaplan, Lawrence A, and Amadeo J Pesce. *Clinical Chemistry : Theory, Analysis, Correlation : With 509 Illustrations and 25 Color Plates*. St. Louis, Mo., Mosby/Elsevier, 2010

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Assessment methods and weightages in brief

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Course Code: MLS 203
Title of the Course: - Applied Hematology, Blood Transfusion and Blood Banking
L-50 T-25 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 Correlate hematological findings with those generated in other areas of the clinical laboratory, patient symptoms and clinical history, to make appropriate and effective on-the- job professional decisions.

CLO-2 Perform basic hematological laboratory testing, assess laboratory data and report findings according to laboratory protocol.

CLO-3 Adapt hematology laboratory techniques and procedures when errors and discrepancies in results are obtained to effect resolution in a professional and timely manner.

CLO-4Distinguish normal and abnormal hematological laboratory findings to predict the diagnosis of hematological disorders and diseases.

CLO-5 Recognize laboratory results consistent with leukemia and other white blood cell disorders.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

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CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	1	2	2	2	2	2	2	1
CLO3	3	3	3	2	2	2	2	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	1	2	3	1	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit I **25 Hours**

Applied Hematology Theory

1. General aspects: Blood cell formation,(haemopoiesis). Morphology and Regulation of heaemopoiesis.
2. Red cells – Basic aspects of anaemia definition, patho physiology ,classification and clinical features. Investigation of a case of anaemia in general.
3. Microcytic hypochromic anaemias Sideroblastic anemia,

Anaemia of chronic infection, Thalassaemia. Iron deiciency anaemia – Iron metabolism , causes of iron deficiency, clinical features, laboratory investigations.

4. Macrocytic Anaemias Megaloblastic, Non megaloblastic Megaloblastic anaemia – Etiology, clinical features, laboratory investigation. Pernicious anaemia.

5. Normocytic normochronic anaemia .Anaemia in systemic disorders, Acute blood loss, Renal failure, Liver disorders etc.

6. Disorders of Haemoglobin Structure of Hb and Synthesis, Normal and Abnormal haemoglobins, Hamoglobinopathies

7. Haemolytic anaemia Definition, pathogenesis, classification, clinical features, Extrinsic factors & Intrinsic factors – investigation.

Laboratory investigations to establish a case of haemolytic anaemia.

1. Peripheral smear – specific morphologic abnormalities
2.Special tests
a) Osmotic fragility test
b) Sickling test
c) Kleihaure acid elution test
d) Alkali denaturation test
e) Ham's test ,
f) Sucrose lysis test
g) Electrophoresis – HbF, HbA2 estimation
h) Tests for G6PD deficeiency
8. Aplastic anaemia ,Pancytopenia.
9. Polycythaemia – classification Clinical features, laboratory investigation

Unit II **25 Hours**

Leucocyte disorders Leukaemoid reaction Leukaemias: Definition, acute and chronic Diagnostic criteria , Cytochemical staining and Immunophenotyping Plasma cell disorders – Plasma cell myeloma – definition. Clinical features, laboratory investigations.

10Haemorrhagic disorders: Definition: Pathogenesis, clinical features, Classification: a. Primary hemostasis, b. secondary hemostasis – causes and investigations of both. Fibrinolysis.

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

Thromobcytosis – Definition ,Etiology,. Lab Investigations Coagulation disorders – Inherited -Haemophilia A and B, von Willebrand's disease, Acquired: Vit. K deficiency, Liver disease, DIC Investigation of Haemorrhagic disorders.

Tests of vascular and platelet function - Bleeding time, Clot retraction ,Patelet count. Disseminated intravascular coagulation- Definition, Pathogenesis, laboratory investigations

Unit III **25 Hours**

Introduction to Immuno Haematology

1. Blood groups
ABO System – ABO sub groups, Bombay

group, secretors, non secretors, Rh system –
Importance of Rh system
Du red cells
(A variant
of Rh
system)
MNS
System –
clinical
significance
2. Blood transfusion – indications for blood transfusion
3. Blood donation , Donor registration, Donor selection, Blood
collection. Adverse donor reaction
4. Anticoagulants used to store blood. Changes occuring in the stored blood
5. Blood group systems – antigen – antibody reaction ,ABO
system- Forward grouping reverse group
6. Rh system Inheritence & nomenclature Rh grouping –
Rh antigen and antibodies DuVariant Anti D type of
reagents and their application
7. Coomb's test – Application – DCT, ICT Rh antibody titre
8. Compatibility testing – Major and Minor
10. Blood components – Indications
preparation of blood components 11
Autologous transfusion
13. Haemolytic disease of the new born
and exchange transfusion
16.Transfusion reactions and
investigation of transfusion reaction
17.Transfusion transmitted infections .
19. Haemapheresis- Definition ,Types of pheresis
,Machines and Techniques. 23.Disposal of wastes
and biologically hazardous substance in the blood
bank 24.Medico legal aspects of blood transfusion
25.Technical advances and
future trends in blood banking
27.Orientation of a routine
blood bank
28.Quality Assurance - General condition ,Equipment
,Reagents ,Donor processing 29.Drugs control regulation
and Blood Bank

References Books

a) Mehta, Atul B, and Keith Gomez. *Clinical Haematology*. Boca Raton, Crc Press, Taylor & Francis Group, 2018.

b) Bain, Barbara J, et al. *Dacie and Lewis Practical Haematology*. Philadelphia, Elsevier Limited, 2017

c) Eastham, R D. *Clinical Heamatology.* Baltimore, Williams & Wilkins, 1970.

d) Wintrobe, Maxwell M, and John P Greer. *Wintrobe's Clinical Hematology. Vol. 1*. Philadelphia, Wolters Kluwer Health/Lippincott Williams & Wilkins, 2009.

e) Lynch, Matthew J, and Stanley S Raphael. *Lynch's Medical Laboratory Technology. Vol. 1*. Philadelphia ; London, Saunders, 1976.

f) James Campbell Todd, et al. *Todd-Sanford-Davidsohn Clinical Diagnosis and Management by Laboratory Methods*. Philadelphia, Saunders, 1979.

g) Ramnik Sood. *Textbook of Medical Laboratory Technology*. New Delhi, Jaypee Brothers, 2006.

h) Gordon Carle Degruchy, and J V Dacie. *Clinical Haematology in Medical Practice*. Oxford, Blackwell Scientific Publications, 1960.

i) World Health Oraganisation. *The Clinical Use of Blood : Handbook.* Geneva, World Health Organisation, 2001.

j) Ortho Diagnostics. *Blood Group Antigens & Antibodies as Applied to the ABO & Rh Systems.* Don Mills, Ont., Ortho Diagnostics, 1969.

k) Klein, Harvey G, et al. *Mollison's Blood Transfusion in Clinical Medicine*. 12th ed., Oxford, Wiley Blackwell, 2014.

l) Boorman, Kathleen E, et al. *Blood Group Serology : Theory, Techniques, Practical Applications*. Edinburgh ; New York, Churchill Livingstone ; New York, 1977.,

m) Aabb. *Technical Manual, 12th-16th Editions ; Standards, 1st-26th Editions.* Bethesda, Maryland, Aabb, 2009..

n) Simon, Tol, et al. *Rossi's Principles of Transfusion Medicine*. Hoboken, Nj, John Wiley & Sons, Ltd, 2022

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Assessment methods and weightages in brief

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Course Code: MLS 204
Title of the Course: -- Cytopathology and Histopathology
L-50 T-30 **Credits 3**
COURSE LEARNING OUTCOMES (CLOs)
After completing this Course, the students should be able to …….

CLO-1 be able to identify and describe in detail the microscopic structure of the major organs, tissues and cells of the body
CLO-2 be able to explain the theoretical background to surgical cutup, tissue fixation, tissue processing, microtomy and staining using routine and specialized techniques
CLO-3 be able to demonstrate proficiency in the preparation of routine formalin-fixed, paraffin-embedded tissue sections
CLO-4 be able to identify and explain the causes of technical defects in histological preparations, how to rectify such defects and how they could influence the diagnostic process
CLO-5 be able to demonstrate proficiency in haematoxylin and eosin staining, selected special stains and immunohistochemical methods.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

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CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	1	2
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CLO4	3	3	2	3	2	1	2	2	3	3	3	3	1	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:
Unit 1 **50 Hours**
Histopathology
General introduction of Histopathology– Reception,Recording,Handling,Labeling, Fixation Fixation of tissue– Various Fixative and their preparation Theory of Tissue ProcessingIntsruments (Tissue Processor, Embedding Station, Microtome, Cryostat)– Introduction in Histological techniques,Various types and their working Principle,Section cutting–Paraffin and frozen ,Filing of slides, paraffin blocks reports and requisition forms. Preparation of Stain and Fixatives
Handling of Cryostat - Dry mount
Micro-organisms in tissues & various techniques for the demonstration and identification, staining and interpretation, Immunohistochemistry

Unit II **25 Hours**

Cytology

Preparationof
smear for F.N.A.C
Ultrasound guided
F.N.A.C CTguided
F.N.A.C
Automation in Cytology
Intsruments(Centrifuge, Cytospin) –Introduction and their working
Principle Liquid Cytology Various Fixatives and their preparation, Staining and mounting
Pap smear theory, Identification of cells in a normal Vaginal smear PH, buffer preparation of reagents and solutions, Cervical cytology–Method, Collection, Transportation,Special instrctionsfor Requisition
,Causesfor rejection, Limited reports, Result of Paptest –Aspects of Paptest

References Books

1. Frederick, Charles. *Handbook of Histopathological and Histochemical Techniques : (Including Museum Techniques)*. London, Butterworths, 1974.
2. S Kim Suvarna, et al. *Bancroft's Theory and Practice of Histological Techniques*. 8th ed., Oxford, Elsevier, 2019.

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Course Code: MLS 205
Title of the Course: -Biomedical Techniques and Lab Management
L-30 T-20 P-15 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1: Gain knowledge about the assays and analyzing data

CLO-2To handle the equipment available and identify the suitable and appropriate experiments for their research

CLO-3 be able to demonstrate the principal concepts in using analytical and preparatory technique

CLO-4 Be able to handle various equipment's used in biochemical analysis and troubleshoot them

CLO-5 Be able to implement a database and report on the process.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	1	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	1	2
CLO3	3	3	3	2	2	3	1	2	2	2	2	2	1	3
CLO4	3	2	2	3	2	2	2	2	3	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit 1-Biomedical Techniques **30 Hours**

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

Unit II- **35 Hours**

Laboratory ManagemenT

1. Preparation of operating budgets; general aspects of financial management of laboratories:

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

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

1. Laboratory safety: Fire, chemical, radiation and infection control (Body substance precautions), hazardous waste and transport of hazardous materials
2. Training of technical staff: Familiarity is needed with the syllabi of various training programs; knowledge of the teaching requirements and level of knowledge technical staff; understanding of qualifications of technologists trained in other countries.
3. Maintenance of records: Procedure manuals ward manuals, quality control programs, patient data retrieval.
4. Personnel management: Personnel policy manual; job descriptions; labor, supervision relations; conducting job interviews; motivation, recognizing job distress syndrome; delegation to a laboratory manager.
5. Hospital organization; interactions between the laboratory service and the rest of the hospital.

6. Professional ethics.

7. Quality assurance; total quality management; development and monitoring of performance indicators.
8. Public relations; hospital and community.
9. Basic clinical epidemiology
10. Laboratory Data Processing:
11. General principles of methods for reduction of data into forms suitable for electronic data handling systems (computerized accessioning functions, sample identification and tracking (e.g. bar code systems), result reporting, storage and retrieval, electronic data transfer).
12. Use of computers in quality control and management; use of computers for calculating analytical results (eg. non-linear functions).
13. General aspects of system design; central vs. stand-alone systems, host computers and equipment interfaces.
14. Laboratory information systems LIS), Hospital information systems (HIS)
15. Personal computer use; word processing, spreadsheets, data-base, graphics, statistics, presentations, email, internet. Security of data storage and transmission
16. Data base structures and data mining.
17. Appropriate access control to patient information.

Practicals / Tutorials **10 Hours**

1. Chromatography: paper, thin layer, gel, ion-exchange, demonstration of HPLC and GLC
2. Electrophoresis: slide gel, PAGE, Agarose gel, Native, SDS PAGE of Blood Sample. (Demo only)
3. Photometry, spectrophotometry, atomic absorption spectrophotometry24
4. Cell fractionation – methods

References Books

- Laboratory Management. Ayoub Kafyulilo.
- Laboratory management and safety good. Chala Dandessa.

- Lab management. Pratik Poladia.
- Laboratory management. Tapeshwar Yadav.

Teaching-Learning Strategies in brief

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Assessment methods and weightages in brief

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Course Code: MLS 206
Title of the Course: -Clinical and Applied Microbiology and parasitology
L-75 **Credits 3**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……

CLO-1: Provide students with a hands-on familiarity with basic research procedure and associated critical and investigative thinking skills utilizing identification of unknown microorganismal specimens

CLO-2 Provide students with an understanding of important facts, concepts, and the investigative procedures of a microbiology producing accurate, skilled clinical laboratory workers with strong ethical and professional values.

CLO-3Evaluate methods used to identify infectious agents

CLO-4 Appropriate use of antimicrobial agents and common mechanisms of antimicrobial action and resistance

CLO-5 The course also helps to students to know the epidemiology and prophylaxis methods related to the pathogen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CLO1	3	2	3	3	3	3	3	3	3	3	3	3	2	2
CLO2	2	3	2	2	2	2	2	2	2	2	2	2	2	2
CLO3	3	3	1	2	2	2	3	2	2	2	2	2	2	3
CLO4	3	3	2	3	2	2	2	2	1	3	3	3	2	2
CLO5	3	3	2	2	3	2	2	2	3	3	3	2	2	2

Detailed Syllabus:

Unit-I **50 Hours**

1. Hospital acquired infections: Causes, surveillance and prevention
2. Biological waste management.
3. Bacteriology of Milk, Water and Air
4. Molecular biology techniques for characterization of microbes and viral agents.
5. Automation in Microbiology
6. Animal & human ethics involved in microbiological work Specimen collection and laboratory diagnosis of:
7. Respiratory tract infections
8. Urinary tract infections
9. Central nervous system infections,
10. Sexually transmitted and reproductive tract infections,
11. Gastrointestinal infections,
12. Pyrexia of unknown origin
13. Infections of eye, ear & nose,
14. Skin & wound infections
15. Septicaemia, endocarditis, haemorrhagic fever etc.
16. Opportunistic infections.

Unit II **25 Hours**

Parasitology

1. Protozoan parasites of medical importance: Entamoeba, Giardia, Trichomonas, Leishmania, Plasmodium, Toxoplasma, Cryptosporidium, Isospora, Cyclospora, Microsporidium etc.
2. Cestodes: Taenia, Echinococcus, Hymenolepis.
3. Trematodes: Schistosomes, Fasciola, , Paragonimus, Clonorchis,.
4. Nematodes: Trichuris, Trichinella, Stronglyloides, Hookworm, Ascaris, Toxocara,

Enterobius,
Filarial
worms,
Dracunculu
Ectoparasites: Common arthropods and other vectors.

Reference Book

1. R Ananthanarayan C K Jayaram Paniker. *Ananthanarayan and Paniker's Textbook of Microbiology.* S.L., Orient Blackswan Pvt Ltd, 2020.
2. W Robert Bailey, et al. *Bailey and Scott's Diagnostic Microbiology : A Textbook for the Isolation and Identification of Pathogenic Microorganisms.* Saint Louis, C.V. Mosby, 1978. 3 Greenwood, David, and Et Al. *Medical Microbiology : A Guide to Microbial Infections : Pathogenesis, Immunity, Laboratory Diagnosis and Control*. Edinburgh Etc., Churchill Livingstone, 2012.
4. Gupte Satish, and Jaypee Brothers (Jaypeedigital. *The Short Textbook of Medical Microbiology for Dental Students*.

Jaypee Brothers Medical Publisher (P) Ltd, 2012.
5. C K Jayaram Paniker, and Sougata Ghosh. *Paniker's Textbook of Medical Parasitology*. New Delhi, Jaypee/The Health Sciences Publisher, 2018.
6. Koneman, Elmer W. *Color Atlas and Textbook of Diagnostic Microbiology*. Philadelphia, Lippincott, 1983.
7. Cheesbrough, Monica. *District Laboratory Practice in Tropical Countries. Vol.*
1. Cambridge, Cambridge University Press, 1999.
8. Mackie, T J, et al. *Mackie and McCartney Practical Medical Microbiology*. New Delhi (India), Elsevier, 2007.
9. Delves, Peter J, et al. *Essential Immunology.* Estados Unidos, Blackwell, 2006.

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Assessment methods and weightages in brief

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Course Code: MLS 207
Title of the Course: -Practical/ Viva voce-Biochemistry
P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to ……

CLO-1 Analyse specimen with the help of diagnostic kits that are used in clinical laboratories

CLO-2 Gain knowledge in diagnosis through the presentations made on the known case studies.

CLO-3 Able to demonstrate quantitative analysis of biomolecules in clinical biochemistry

CLO-4 Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.

CLO-5 Able to perform quantitative analysis of specimen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO1	**PLO2**	**PLO3**	**PLO4**	**PLO5**	**PLO6**	**PLO7**	**PLO8**	**PLO9**	**PLO10**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CLO1	3	2	3	3	3	3	1	3	3	3	3	2	1	2
CLO2	2	2	2	1	2	2	2	2	3	3	2	2	2	2
CLO3	3	2	3	3	3	1	3	2	3	3	2	1	1	3
CLO4	3	3	2	3	2	1	3	2	3	3	3	3	2	2
CLO5	3	2	2	2	3	2	2	3	3	3	3	1	2	2

Detailed Syllabus:

Practicals : **200 Hours**

Mol
Biology
Techniques
Clinical
Biochemist
ry Recent
Advances

Text books for references:

a) Molecular Cell Biology (2016) 8th ed., Lodish, H., Berk, A., Kaiser, C.A., Krieger, M., Bretscher, A., Ploegh, H., Amon, A. and Scott, M.P., W.H. Freeman & Company (New York).

b) Biochemistry (2016) 6th ed., Garret, R. H. and Grisham, C.M., Cengage Learning (Boston),

c) Principles of Biochemistry (2008) 3rd ed., Voet, D.J., Voet, J.G. and Pratt, C.W., John Wiley & Sons, Inc. (New York), ISBN:13: 978-0470-23396-2

d) Lehninger: Principles of Biochemistry (2017) 7th ed., Nelson, D.L. and Cox, M.M., W.H. Freeman and Company (New York).

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Assessment methods and weightages in brief

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Course Code: MLS 208
Title of the Course: - Clinical Pathology Practical/ Viva Voce
P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 Analyse specimen with the help of diagnostic kits that are used in clinical laboratories

CLO-2 Gain knowledge in diagnosis through the presentations made on the known case studies.

CLO-3 Able to demonstrate quantitative analysis of specimen in clinical pathology.

CLO-4 Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.

CLO-5 Able to perform quantitative analysis of specimen.

Mapping of Course Learning Outcomes (CLOs)with Program Learning Outcomes (PLOs) and Program Specific Outcomes (PSOs)

	PLO 1	**PLO 2**	**PLO 3**	**PLO 4**	**PLO 5**	**PLO 6**	**PLO 7**	**PLO 8**	**PLO 9**	**PLO 10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
CLO1	3	2	3	3	3	3	1	3	3	3	3	2	1	2
CLO2	2	2	2	2	2	2	2	2	3	3	2	2	2	2
CLO3	3	2	2	2	3	1	3	2	2	3	2	1	1	3
CLO4	3	3	2	2	2	2	3	2	3	2	3	3	2	2
CLO5	3	2	2	2	3	3	2	3	1	3	3	1	2	2

Detailed Syllabus:

Practical **200 Hours**

1. Staining and Interpretation of Peripheral smears.
2. Microcytic hypochromic anaemia- Peripheral smear, bone marrow Examination Bone marrow. Ironstain .
3. Macrocytic Anaemia- Peripheral smear, bone marrow. Examination,
4. Plasma Hb Estimation
5. Haemolytic Work up

Peripheral smear – spceific morphologic abnormalities

1. Plasma cell Disorders :

Serum Protein Electrophoresis Urine Electrophoresis

2. Investigation of Haemorrhagic disorders

Test of vascular and platelet function – Bleeding time, Clot retraction, Platelet count. Bone marrow examination.

Tests for coagulation disordrs:

Screening tests – First line tests- Prothrombin time (PT), Activated partial thromboplastin time(APTT),

Thrombin time(TT), INR.

3. Bone marrow examination – Preparation of B.M Aspiration and Trephine biopsy smears staining
4. Organisation and quality control in the laboratory
5. Cleaning of glass ware
6. Preparation of Reagents, Diluting fluids, Stains – Leishman's stain Geimsa stain

M.G.G stain

Reference Books:

1. Goljan, Edward. *Rapid Review Pathology*. Philadelphia, Pa Elsevier, 2019.
2. Kumar, Edward C. *Robbins and Cotran Review of Pathology.* S.L., Elsevier - Health Science, 2020.
3. Kumar, Vinay, et al. *Robbins Basic Pathology*. 9th ed., Philadelphia, Pennsylvania Elsevier, 2018.
4. Cross, Simon S. *Underwood's Pathology : A Clinical Approach*. Edinburgh, Churchill Livingstone Elsevier, 2019.
5. Roberts, Fiona, et al. *Pathology Illustrated*. Edinburgh ; New York, Elsevier, 2018

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Course Code: MLS 209
Title of the Course: - Microbiology Practical/ viva voce
P-200 **Credits 8**

COURSE LEARNING OUTCOMES (CLOs)

After completing this Course, the students should be able to …….

CLO-1 Analyse specimen with the help of diagnostic kits that are used in clinical laboratories

CLO-2 Gain knowledge in diagnosis through the presentations made on the known case studies

CLO-3 Able to demonstrate quantitative analysis of specimen in clinical microbiology.

CLO-4 Analyse and evaluate prognosis of a disease and know the relevance of preventive measures taken in healthcare.

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CLO4	3	3	2	3	2	2	3	2	3	3	3	3	2	2
CLO5	3	2	2	2	3	3	2	3	3	3	3	3	2	2

Detailed Syllabus:

Practical **200 Hours**

Care and operation of Microscopes viz. Light, Dark ground, Phase contrast, Fluorescence microscopes, etc.

Preparation of stains viz. Gram's Albert's, Ziehl –Neelsen and other special stains and performing of staining.

Washing and sterilization including plugging and packing.30

Handling & operation of autoclave, hot air oven, distillation plant, microbial filters and sterility tests.

Care and maintenance of common laboratory equipments. Preparation of various liquid and solid media.

Preparation of reagents required for routine diagnosis. Tests for in-vitro drug resistance.

Techniques to demonstrate the motility.

Immuno-diffusion methods

Preparation, examination and interpretation of direct smears from clinical specimens, viz. gram stain, sputum for AFB – ZN & auramine O, slit smears for M.Leprae.-ZN stain, conjunctival smear for Chlmydiae – Giemsa/Iodine.

Techniques of anaerobiosis.

Identification of bacteria of medical importance upto species level. Quantitative and semi-quantitative analysis of urine.

Skin tests like Mantoux, Lepromin etc. Mycology:

Collection of specimens.

Direct examination of specimens by KOH, Lactophenol cotton blue stains.

Isolation and identification of common laboratory contaminants and pathogenic yeasts and moulds

Special techniques.

Maintenance of stock cultures.

Virology Preparation of glassware (washing, sterilization) & media for tissue culture Sample collection for virology tests

Viral Serological tests. (Rapid, ELISA, NT, westernblot etc) Molecular detection methods

Viral Microscopy: Tzank smear, IFA etc

Collection of specimens for Microbiological investigations such as blood, urine, throat swab, rectal swab, stool, pus, OT specimens.

Plating of clinical specimens on media for isolation, purification & identification Preparation of antibiotic discs & performance of antimicrobial susceptibility testing. Standard practices in laboratory and safety precautions.

Quality control of media reagents etc.

Aseptic practices in laboratory and safety precautions Disposal of infectious/ contaminated material.
Bacteriology of food, water, milk, air.
Parasitology: Examination of feces for parasitic ova and cysts by direct and concentration methods.
Examination of blood for protozoa and helminthes.
Examinations of other specimens for e.g. urine, C.S.F. bone marrow etc. for parasites. Staining techniques-Leishman, Giemsa, Modified Acid Fast, Trichrome.
Identification of common arthropods and other vectors. Collection of specimens & preservation of parasites.

References Book

1. R Ananthanarayan C K Jayaram Paniker. *Ananthanarayan and Paniker's Textbook of Microbiology.* S.L., Orient Blackswan Pvt Ltd, 2020.
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