



AMRITA

VISHWA VIDYAPEETHAM

A Multi Campus University with 'A' Grade Accreditation by NAAC

AMRITA SCHOOL OF MEDICINE

Amrita Centre for Allied Health Sciences

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PROGRAM

BSc Medical Laboratory Technology

(Revised with effect from 2014-2015 onwards)



A Super Specialty Tertiary Care Hospital Accredited by ISO 9001-2008, NABL & NABH

Our Chancellor



SPIRITUAL PRINCIPLES IN EDUCATION

“In the gurukulas of ancient rishis, when the master spoke it was love that spoke; and at the receiving end disciple absorbed of nothing but love. Because of their love for their Master, the disciples’ hearts were like a fertile field, ready to receive the knowledge imparted by the Master. Love given and love received. Love made them open to each other. True giving and receiving take place where love is present. Real listening and ‘sraddha’ is possible only where there is love, otherwise the listener will be closed. If you are closed you will be easily dominated by anger and resentment, and nothing can enter into you”.

“Satguru Mata Amritanandamayi Devi”

Introducing AIMS

India is the second most populous nation on earth. This means that India's health problems are the world's health problems. And by the numbers, these problems are staggering 41 million cases of diabetes, nearly half the world's blind population, and 60% of the world's incidences of heart disease. But behind the numbers are human beings, and we believe that every human being has a right to high-quality healthcare.

Since opening its doors in 1998, AIMS, our 1,200 bed tertiary care hospital in Kochi, Kerala, has provided more than 4 billion rupees worth of charitable medical care; more than 3 million patients received completely free treatment. AIMS offers sophisticated and compassionate care in a serene and beautiful atmosphere, and is recognized as one of the premier hospitals in South Asia. Our commitment to serving the poor has attracted a dedicated team of highly qualified medical professionals from around the world.

The Amrita Institute of Medical Sciences is the adjunct to the term "New Universalism" coined by the World Health Organization. This massive healthcare infrastructure with over 3,330,000 sq. ft. of built-up area spread over 125 acres of land, supports a daily patient volume of about 3000 outpatients with 95 percent inpatient occupancy. Annual patient turnover touches an incredible figure of almost 800,000 outpatients and nearly 50,000 inpatients. There are 12 super specialty departments, 45 other departments, 4500 support staff and 670 faculty members.

With extensive facilities comprising 28 modern operating theatres, 230 equipped intensive-care beds, a fully computerized and networked Hospital Information System (HIS), a fully digital radiology department, 17 NABL accredited clinical laboratories and a 24/7 telemedicine service, AIMS offers a total and comprehensive healthcare solution comparable to the best hospitals in the world. The AIMS team comprises physicians, surgeons and other healthcare professionals of the highest caliber and experience.

AIMS features one of the most advanced hospital computer networks in India. The network supports more than 2000 computers and has computerized nearly every aspect of patient care including all patient information, lab testing and radiological imaging. A PET (Positron Emitting Tomography) CT scanner, the first of its kind in the state of Kerala and which is extremely useful for early detection of cancer, has been installed in AIMS and was inaugurated in July 2009 by Dr. A. P. J. Abdul Kalam, former President of India. The most recent addition is a 3 Tesla Silent MRI.

The educational institutions of Amrita Vishwa Vidya Peetham, a University established under section 3 of UGC Act 1956, has at its Health Sciences Campus in Kochi, the Amrita School of Medicine, the Amrita Centre for Nanosciences, the Amrita School of Dentistry, the Amrita College of Nursing, and the Amrita School of Pharmacy, committed to being centres of excellence providing value-based medical education, where the highest human qualities of compassion, dedication, purity and service are instilled in the youth. Amrita School of Ayurveda is located at Amritapuri, in the district of Kollam. Amrita University strives to help all students attain the competence and character to humbly serve humanity in accordance with the highest principles and standards of the healthcare profession.

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Part I
Rules and Regulations

Under Graduate Programmes (Bachelor of Sciences)

I.1. Details of Under Graduate Courses :			
Sl.No.	Course	Duration	Conditions of Eligibility for admission to the course
1	Medical Laboratory Technology (MLT)	4 years	Pass in plus Two with 50% marks with Physics, chemistry and Biology
2	Medical Radiologic Technology (MRT)	4 Years	First class in plus two with Mathematics, Physics, Chemistry, and Biology
3	Emergency Medical Technology	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
4	Anaesthesia Technology	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology
5	Respiratory Therapy (RT)	3 Years + one year Internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology
6	Dialysis Therapy	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology
7	Physician Assistant	3 years + one year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
8	Cardio Vascular Technology (CVT)	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
9	Echocardiography Technology	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
10	Cardiac Perfusion Technology (CPT)	3 Years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
11	Diabetes Sciences	3 years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
12	Optometry	3 Years + One year Internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
13	Optometry (Lateral Entry)	2 Years + One year Internship	Pass in two year Diploma in Optometry
14	Bachelor of Audiology & Speech Language Pathology (BASLP)	3 years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.
15	Neuroelectro-physiology	3 years + One year internship	Pass in plus two with 50% marks in Physics, Chemistry and Biology.

I.2. Medium of Instruction:

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

I.3. Eligibility:

Generally Science Graduates with Physics, Chemistry, and Biology are eligible for admission to the Under Graduate Courses except in respect of certain specialties for which other qualification or subjects are specifically called for. Essential qualifications for eligibility are mentioned under clause I.1

II. General Rules:

Admissions to the courses will be governed by the conditions laid down by the University from time to time and as published in the Regulations for admissions each year.

II.1. Duration of the Course

Duration details are mentioned under clause No.I of this booklet.

Duration of the course	: 4 Years (3 years + 1 year Internship except for courses at serial number 1 and 2 in clause I.1)
Weeks available per year	: 52 weeks
Vacation / holidays	: 5 weeks (2 weeks vacation + 3 weeks calendar holidays)
Examination (including preparatory)	6 weeks
Extra curricular activities	: 2 weeks
Weeks available	: 39 weeks
Hours per week	: 40 hours
Hours available per academic year	: 1560 (39 weeks x 40 hours)

Internship wherever specified are integral part of the course and needs to be done in Amrita Institute of Medical Sciences, Kochi itself.

II.2. Discontinuation of studies

Rules for discontinuation of studies during the course period will be those decided by the Chairman /Admissions, Amrita School of Medicine, and Published in the "Rules and Regulations" every year.

II.3. Educational Methodology

Learning occurs by attending didactic lectures, as part of regular work, from co-workers and senior faculty, through training offered in the workplace, through reading or other forms of self-study, using materials available through work, using materials obtained through a professional association or union, using materials obtained on students own initiative, during working hours at no cost to the student.

II.4. Academic Calendar

Course will follow and annual scheme as per details mentioned under:

FIRST YEAR

Commencement of classes – August 2018

First sessional exam – November 2018

Second sessional exam – February 2019

Model Exam (with practical) – May - June 2019 (one week study leave)

University exam (with practical) – June - July 2019 (10 days study leave)

Annual Vacation – 3 weeks after the University examination.

SECOND YEAR

Commencement of classes – August 2019

First sessional exam – November 2019

Second sessional exam – February 2020

Model Exam (with practical) – May - June 2020 (one week study leave)

University exam (with practical) – June - July 2020 (10 days study leave)

Annual Vacation – 2 weeks after the University examination

THIRD YEAR

Commencement of classes – August 2020

First sessional exam – November 2020

Second sessional exam – February 2021

Model Exam (with practical) – May 2021 (one week study leave)

University exam (with practical) – June 2021 (10 days study leave)

Annual Vacation – 2 week after the University examination.

FOURTH YEAR

Commencement of classes – August 2021

First sessional exam – October 2021

Second sessional exam – February 2022

Model Exam (with practical) – May 2022 (one week study leave)

University exam (with practical) – June 2022 (10 days study leave)

Annual Vacation – 1 week after the University examination.

Date of completion of fourth academic year – 31st July 2022

III. Examination Regulations:

III.1. Attendance:

75% of attendance (physical presence) is mandatory. Medical leave or other types of sanctioned leaves will not be counted as physical presence. Attendance will be counted from the date of commencement of the session to the last day of the final examination in each subject.

III.2. Internal Assessment:

- Regular periodic assessment shall be conducted throughout the course. At least three sessional examinations in theory and preferably one practical examination should be conducted in each subject. The model examination should be of the same pattern of the University Examination. Average of the best of two examinations and the marks obtained in assignments / viva / practical also shall be taken to calculate the internal assessment.
- A candidate should secure a minimum of 35% marks in the internal assessment in each subject (separately in theory and practical) to be eligible to appear for the University examination.
- The internal assessment will be done by the department thrice during the course period in a gap of not more than three months and model exam will be the same pattern of university examination. The period for sessional examinations of academic year are as follows :
 - **First Sessional Exam : November**
 - **Second Sessional Exam : February**
 - **Model Exam : May /June**
- Each student should maintain a logbook and record the procedures they do and the work patterns they are undergoing. It shall be based on periodical assessment, evaluation of student assignment, preparation for seminar, clinical case presentation, assessment of candidate's performance in the sessional examinations, routine clinical works, logbook and record keeping etc.
- Day to day assessment will be given importance during internal assessment, Weightage for internal assessment shall be 20% of the total marks in each subject.
- Third sessional examinations (model exam) shall be held three to four weeks prior to the University Examination and the report shall be made available to the Principal ten days prior to the commencement of the university examination.

III.3. University Examinations:

- University Examination shall be conducted at the end of every academic year. A candidate who satisfies the requirement of attendance and internal assessment marks, as stipulated by the University shall be eligible to appear for the University Examination.
- One academic year will be twelve months including the days of the University Examination. Year will be counted from the date of commencement of classes which will include the inauguration day.
- The minimum pass marks for internal assessment is 35% and for the University Examination is 45%. However the student should score a total of 50% (adding the internal and external examination) to pass in each subject (separately for theory and practical)
- If a candidate fails in either theory or practical paper, he/she has to re-appear for both the papers (theory and practical)
- Maximum number of attempts permitted for each paper is five (5) including the first attempt.
- The maximum period to complete the course shall not exceed 6 years.
- All practical examinations will be conducted in the respective clinical areas.
- Number of candidates for practical examination should be maximum 12 to 15 per day
- One internal and external examiner will jointly conduct the theory evaluation and practical examination for each student during the final year.

III.4. Eligibility to appear university Examination:

A student who has secured 35% marks for Internal Assessment is qualified to appear for University Examination provided he/she satisfies percentage of attendance requirement as already mentioned at the III (1).

III.5. Valuation of Theory – Revaluation Papers:

1. Valuation work will be undertaken by the examiners in the premises of the Examination Control Division in the Health Sciences Campus.
2. There will be **Re-Valuation** for all the University examinations. Fees for revaluation will be decided by the Principal from time to time.
3. Application for revaluation should be submitted within 5 days from date of result of examination declared and it should be submitted to the office with payment of fees as decided by the Principal

III.6. Supplementary Examinations:

Every main University examination will be followed by a supplementary examination which will normally be held within four to six months from the date of completion of the main examination.

As stipulated under clause No. III.2 under Internal Assessment, HOD will hold an internal examination three to four weeks prior to the date of the University Examination. Marks secured in the said examination or the ones secured in the internal examination held prior to the earlier University Examination whichever is more only will be taken for the purpose of internal assessment. HODs will send such details to the Principal ten days prior to the date of commencement of University examination.

Same attendance and internal marks of the main examination will be considered for the supplementary examination, unless the HOD furnishes fresh internal marks and attendance after conducting fresh examination.

Students who have not passed / cleared any subjects in the first University examination will be permitted to attend the second year classes and also eligible to appear for second year university examination along with first year supplementary examination. However, he / she can appear for the third (final) year university examination, only if he / she clear all the subjects in the first as well as in the second year examinations.

Students of supplementary batches are expected to prepare themselves for the University Examinations. No extra coaching is expected to be provided by the Institution. In case at any time the Institution has to provide extra coaching, students will be required to pay fees as fixed by the Principal for the said coaching.

III.7. Rules regarding carryover subjects:

A candidate will not be permitted to continue the second, third and fourth year respectively of the course if he/she has failed in more than 3 subjects in the first, second or third year university examinations.

IV. Criteria for Pass in University Examination - Regulations:

IV.1. Eligibility criteria for pass in University Examination:

In each of the subjects, a candidate must obtain 50% in aggregate for a pass and the details are as follows:

- A separate minimum of 35% for Internal Assessment.
- 45% in Theory & 35% in Viva.
- A separate minimum of 50% in aggregate for Practicals / Clinics (University Examinations).
- Overall 50% is the minimum pass in subject aggregate (University Theory + Viva + Practicals + Internal Assessment).

IV.2. Evaluation and Grade:

1. Minimum mark for pass shall be 50% in each of the theory and practical papers separately (including internal assessment) in all subjects except English. Only a minimum of 40% is required to pass in English
2. A candidate who passes the examination in all subjects with an aggregate of 50% marks and above but less than 65% shall be declared to have passed the examination in the second class.
3. A candidate who passes the examination in all subjects in the first attempt obtaining not less than 65% of the aggregate marks for all the three years shall be declared to have passed the examination with First Class.
4. A candidate who secures an aggregate of 75% or above marks is awarded distinction. A candidate who secures not less than 75% marks in any subject will be deemed to have passed the subject with distinction in that subject provided he / she passes the whole examination in the first attempt.
5. A candidate who takes more than one attempt in any subject and pass subsequently shall be ranked only in pass class.
6. A Candidate passing the entire course is placed in Second class / First class / Distinction based on the cumulative percentage of the aggregate marks of all the subjects in the I, II and III (Final) university examinations
7. Rank in the examination: - Aggregate marks of all three year regular examinations will be considered for awarding rank for the B.Sc Graduate Examination. For the courses where the number of students are more than 15 only, rank will be calculated as under :
 - Topmost score will be declared as First Rank.
 - Second to the topmost will be declared as Second Rank.
 - Third to the topmost will be declared as Third Rank.
 - There will be no ranking if the number of candidates is less than 15.

V. Internship:

V.1. Eligibility for Internship - Regulations:

Wherever internship is a part of the curriculum, students will have to do the internship in Amrita Institute of Medical Sciences itself. A candidate must have passed in all subjects to become eligible to undergo compulsory internship of one year or a period fixed in the curriculum.

“Internship has to be done continuously for a period provided in the syllabus except in extra ordinary circumstances where subject to the approval of the Principal the same may be done in not more than two parts with an interruption not exceeding six months. In any case Internship shall be completed within 18 months from the date of acquiring eligibility to do the internship.

V.2. Attendance and leave details during Internship:

For 30 days of duty an intern will be eligible for casual leave and one weekly off. A Student will become eligible to receive his/her degree only after completion of internship to the complete satisfaction of the Principal.

VI. General considerations and teaching / learning approach:

There must be enough opportunities to be provided for self learning. The methods and techniques that would ensure this must become a part of teaching-learning process.

Proper records of the work should be maintained which will form the basis for the students assessment and should be available to any agency that is required to do statutory inspection of the school of the course.

VII. Project:

Each student should submit a project in consultation with HOD and guidance under Project Guide, 3 months prior to their final year university exam. The student will be eligible to appear for the final year examination only after submission of the project.

VIII. Maintenance of Log Book and Practical Record

Every graduate student shall maintain a record of skills he/she has acquired during the training period certified by the various Heads of Departments/Program Coordinator under whom he/she has undergone training.

- In addition, the Head of the Department shall involve their graduate students in Seminars, Journal Club, Group Discussions and participation in Clinical, Clinical-Pathological meetings.
- The Head of the Departments/Program coordinator shall scrutinize the logbook in every month.
- At the end of the course, the student should summarize the contents and get the log book certified by the Head of the Department.

The log book should be submitted at the time of practical examination for the scrutiny of the Board of Examiners.

A certified practical Record is compulsory for each subject and that will be evaluated at the time of concerned Practical Examination. A maximum of 10 marks shall be given for the record.

Part II Syllabus

INTRODUCTION AND ADVANCEMENT

Medical Laboratory Technology is an Allied Health speciality concerned with the diagnosis, treatment and prevention of disease through the use of clinical laboratory tests. Though the Medical Lab technologists spend less time with patients than doctors and nurses, medical laboratory professionals are just as dedicated to patient's health. As vital members of the health care team, medical laboratory professionals play a critical role in collecting the information needed to give the best care to an ill or injured patient. The fact is, the practice of modern medicine would be impossible without the tests performed in the laboratory.

Medical laboratory professionals have unlimited choices of practice settings. Hospitals, clinics, nursing homes, public health facilities, and commercial laboratories all have positions open right now for qualified laboratory professionals. In these settings, communication and research skills are highly prized. Employment of clinical laboratory workers is expected to grow about as fast as the average for all occupations. As the volume of laboratory tests increases with population growth and the development of new types of tests.

Bachelor's in Medical Lab Technology

With a career in the medical laboratory, you make the choices. Your opportunities are limited only by your imagination. Clinical laboratory testing plays a crucial role in the detection, diagnosis, and treatment of disease. Clinical laboratory technologists, also referred to as clinical laboratory scientists or medical technologists. Medical and clinical laboratory technologists generally have a bachelor's degree in medical technology. They perform complex chemical, biological, hematological, immunologic, microscopic, and bacteriological tests. Technologists microscopically examine blood, tissue, and other body substances. They make cultures of body fluid and tissue samples, to determine the presence of bacteria, fungi, parasites, or other microorganisms. They analyze samples for chemical content or reaction and determine blood glucose and cholesterol levels. They also type and cross match blood samples for transfusions.

Objectives of the course

At the end of the course the candidates shall be:

- Aware of the principle underlying the organization of a clinical laboratory.
- Able to do routine and special investigative procedures in medical laboratory practice.
- Provide a good theoretical and practical education who plan to work within the field of medical laboratory technology and science.
- Develop knowledge and skill in accordance with the society's demand in medical Laboratory technology.
- Qualify the students for official approval as medical laboratory technologist.
- Able to operate and maintain all equipments used in laboratory diagnostics.
- Able to establish and manage a clinical or Research laboratory.

Programme description

The course of study enhances student's knowledge and skills in several major categorical areas of medical laboratory technology. The degree in medical laboratory technology pro-

vides advanced skills to practicing laboratory professionals in health administration, leadership, quality assurance and health informatics.

Course structure

The course shall comprise of both theory and practical studies in different branches of Medical laboratory technology and its related subjects such as

1. Anatomy
2. Physiology
3. Medical Laboratory Science and Ethics
4. Biochemistry
5. General Microbiology
6. Immunology
7. Mycology
8. Virology
9. Applied Microbiology
10. Parasitology
11. Entomology
12. Systemic Diagnostic Bacteriology
13. Transfusion technology
14. General and Clinical Pathology
15. Hematology
16. Cytology
17. Histopathology techniques
18. Cytogenetics
19. Molecular biology
20. Electronics and Computer science & Biomedical instrumentation technology related to cardiothoracic surgery, Cardiology, Neurology, Neurosurgery, Nephrology, Gastroenterology, Respiratory medicine, and Nuclear medicine.

Hours distribution for each subject

Subject		Total Hours/subject/year			
		Theory Hours	Practical Hours	Clinical Posting Hours	Total Hours /year
First Year					
Paper-I	I A Anatomy	100	80	-	180
	I B Physiology	115	65	-	180
Paper-II	Biochemistry-I	130	230	-	360
Paper-III	Basic Microbiology & Immunology	130	230	-	360
Paper-IV	Basic Medical Laboratory Science & Haematology – I	130	230	-	360
Second year					
Paper V	Biochemistry II	90	174	96	360
Paper VI	General Microbiology	90	174	96	360
Paper VII	Parasitology & Entomology	90	174	96	360
Paper VIII	Haematology-II& Clinical Pathology	90	174	96	360
Third year					
Paper IX	Biochemistry III	100	200	150	450
Paper X	Bacteriology	100	200	150	450
Paper XI	Cytology and Transfusion technology	100	200	150	450
Paper XII	Computer Application, Research methodology, Biostatistics & Laboratory management	90	-	-	90
Final year					
Paper XIII	Biochemistry IV	90	180	160	430
Paper XIV	Mycology, Virology and Applied Microbiology	90	180	160	430
Paper XV	Histotechnology and Cytogenetics	90	180	160	430
Paper XVI	Project	150			150
	**Training at reputed external Hospitals/ National Institutions				100
	Grand Total				5860

Program Outcomes (PO)

- PO1:** Fundamental knowledge on the subject
- PO2:** Effective communication skills.
- PO3:** Knowledge in professional ethics
- PO4:** Leadership qualities and team work
- PO5:** Problem Analysis and solving skills
- PO6:** Basic knowledge on research methodology
- PO7:** Higher Technical skills and competences
- PO8:** Higher study options in many fields
- PO9:** Employability in various sectors
- PO10:** Better employment opportunities

Program Specific Outcomes (PSO)

- PSO1:** Perform procedures as per laboratory standards for the correct diagnosis of the diseases by testing the samples
- PSO2:** Basic knowledge about the principles and operations of all laboratory equipments
- PSO3:** Basic knowledge on normal values and interpretation of results
- PSO4:** Core knowledge on Cytotechnology, Immunology, Microbiology, Immunohematology, Phlebotomy, Histotechnology, Toxicology
- PSO5:** Employability as technologist in Govt hospitals, Private hospitals, Clinics, Medical Laboratories and Research organizations
- PSO6:** Entrepreneurship in Medical Laboratory Sciences

BMLT40

Value Based Education (Elective Course)

- CO1: The attitude to be a good human being, with the curiosity to continue lifelong learning.
- CO2: The conviction to do service to humanity - to put the interests of the individual patient as the foremost priority. Acquisition of values of gender sensitivity, environment & sustainability.
- CO3: Acquisition of the "skills for life" in addition to the skills to live.
- CO4: Acquisition of positive lifelong values including ethics and etiquette.
- CO5: The "practical applications" of the right values

Syllabus – Anatomy

2.10. Content of each subject in each year

FIRST YEAR

Paper I - Anatomy & Physiology BMLT1

Paper I A - ANATOMY - Theory -100Hours & Practical-80 hr

Paper I B- Physiology – 115 Hours & Practical 65 hrs

Paper I A – ANATOMY INCLUDING HISTOLOGY- Theory -100 Hours& Practical- 80 hr

Course Description: The Course is designed to enable students to acquire General knowledge of the normal structure of various human body systems and more emphasis given to those relevant for Medical Laboratory Technology students .The Course content is divided in to 3 categories; must know, desirable to know and nice to know, which is indicated as must know (***) , desirable to know (**) and nice to know (*).A maximum of 60% of questions for the University examination should be from must know portions of the content, 30% may be from desirable to know portions of content and a maximum of 10% of questions from Nice to know content for university examination. There will be no University practical and viva examination for Paper –I Anatomy & Physiology and also no practical internal assessment. But practical classes should be conducted as per the Hour distributed for the same.

Anatomy including Histology

CO1: Knowledge of general anatomy and locomotion.

CO2: Knowledge of basic human anatomy and histology of CVS and Respiratory systems.

CO3: Knowledge of basic human anatomy and histology of CNS, GI, excretory and reproductive systems.

CO4: Knowledge of basic human anatomy and histology of endocrine system and special senses.

Topics

1) Introduction to Anatomical terms organization of the human body.

- a) Microscopic structure of Human cell **
- b) Classification, functions and Microscopic Structures of Primary tissues, Epithelial tissue, connective, tissue, muscular tissue, Nervous tissue **(With Histology) ****
- c) **Histology** of Cartilage – Hyaline, Elastic, fibro cartilage **

2) The Skeletal System

- a) Classification of bones, constituents of bone and bone tissue. Functions of Skeleton, Microscopic Structure of compact bones.**
- b) **Histology:** Bone cross section and longitudinal section *

- c) Organizations of skeleton, Structure of typical vertebrae. *
- d) Brief study on individual bones: Axial skeleton, appendicular skeleton, cartilages and its classifications.*
- e) Scapula, Humerus, Radius & ulna, Sacrum, Clavicle, Hip bones, pelvic bones, femur, tibia, fibula*
- f) Carpel and tarsal bones.
- g) Classification of joints**, movements*, with examples type of ligament *
- h) Skull bones - Importance of sutures: coronal, sagittal and lamboid, cranial fossae, foramen magnum (elementary knowledge only). Bones of Cranium, Auditory meatus, Mandible and Ramus.*
- i) Difference between foetal and adult skull. **

3) Muscular System

- a) General function and actions of Nerve supply and blood supply of muscles*. Classification of muscles*. Diaphragm. *
- b) Nerve supply and blood supply of hands and legs. ***
- c) **Histology** of Muscle, voluntary or striated, cardiac muscle, Smooth muscle or plane muscle. **

4) Thorax

- a) Thoracic cavity***, Mediastinum***, Pleura ***

5) Respiratory System

- a) Trachea and lungs – Position, relation, structure***, and blood supply*. Broncho-pulmonary segments. Bronchiole, alveoli and muscles of respiration. **
- b) **Histology** of Trachea and lungs***

6) Heart

- a) Position, shape, size, structure, borders, chambers of heart, valves, pericardium***, blood supply* and nerve supply of heart*,
- b) Conducting system of heart**. Arterio-ventricular node. **

7) Vascular system

- a) Blood vessels, classification and its structure***
- b) Differences in the structure of artery and vein. Portal venous system. ***
- c) **Histology:** Large artery – Aorta, Medium sized artery, Large veins – Inferior vena cava, Medium sized vein**

8) Lymphatic System

- a) Lymph node, spleen, thymus, tonsil, lymphatic duct.(With Histology) ***

9) Digestive System

- a) Oral cavity, salivary glands, teeth, tongue, pharynx, esophagus, stomach ***
- b) Glands in digestive system, small intestine - duodenum, jejunum, ileum***.
- c) Pancreas, liver, gall bladder, gall stone, biliary tract. Large intestine, colon, appendix, rectum-recto-vesical and recto-uterine pouch (**With detailed Histological approach**) ***.

10) Urinary System

a) Kidney, nephron***, ureter, urinary bladder and its relation in male and females, urethra. **(With detailed Histological approach)** ***, blood supply**, venous drainage**,

11) Reproductive system

a) Male reproductive system*** – testis, seminiferous tubules, epididymis, seminal vesicles, external genitalia of male. **(With Histology)*****

b) Female reproductive system – vagina, cervix, uterus, fallopian tubes, ovary, ovarian follicles **(With Histology)**. ***

12) Nervous System

a) Classification and structure of neurons, brain - parts, ventricles, cranial nerves, spinal cord, spinal nerves.**(with Histology)****

b) Histology of Neuron, Spinal ganglion, Sympathetic ganglion. Nerve Fibre – Optic nerve, Sciatic nerve **

13) Integumentary system.

a) Skin - parts, function. **(Histology)****

14) Endocrine system.

a) Pituitary glands, thyroid, parathyroid, suprarenal gland. ***

b) **Histology** of Pituitary, Thyroid & parathyroid, Adrenal gland and Pancreas. ***

15) Special senses

a) Olfactory epithelium, taste buds of tongue. **

b) Structure of ear, eye; functions. **

Practical***

80 hours.

Demonstration of gross anatomy – organs

Demonstration of Veins, arteries and nerves in the hands and legs

Demonstration of bones

Identification of normal tissues

Human skeleton-parts demonstration

Preparation of histology slides

Microscopic demonstration and identification of histology slides as per theory.

Museum jars, Preparation & Demonstration.

Visit an Anatomy museum

Text Books

1. Gross Anatomy - Chaurasia vol 1,2,3

2. Histology - I. B .Singh's text book.

3. General Anatomy - Chaurasia.

Paper I B- Physiology – 115 Hours & Practical 65 hrs

Course Description: The Course is designed to enable the students to acquire knowledge of the normal physiology of various human body systems and understand the alterations in physiology in diseases and apply this. More emphasis shall be given to those relevant for medical Laboratory Technology students. The Course content is divided into 3 categories; **must know, desirable to know and nice to know**, which is indicated as must know (***) , desirable to know (**) and nice to know (*). A maximum of 60% of questions for the University examination should be from must know portions of the content, 30% may be from desirable to know portions of content and a maximum of 10% of questions from Nice to know content for university examination. There will be no University practical and viva examination for Paper – I B - Physiology and also no practical internal assessment. But practical classes should be conducted as per the Hour distributed for the same.

CO1: Knowledge of general physiology, nerve-muscle physiology and haematology.

CO2: Knowledge of basic human physiology with respect to CVS, Respiratory system and GI system.

CO3: Knowledge of basic human physiology of excretion and CNS.

CO4: Knowledge of basic human physiology of special senses and endocrine system.

Topics

1) Introduction to physiology

Homeostasis ***

2) Blood physiology

- a) Composition and functions of blood****
- b) Plasma proteins – types, functions ***
- c) RBCs – morphology, functions, erythropoiesis****
- d) WBCs – classification, morphology, functions, WBC count, leucopoiesis****
- e) Platelets – normal count, thrombopoiesis****
- f) PCV, ESR, osmotic fragility, RBC count, blood indices – MCH, MCV, MCHC**
- g) Hemostasis – mechanism***
Coagulation of blood – extrinsic and intrinsic pathway***
- h) Bleeding time, clotting time***
- i) Blood groups – ABO system, determination, importance, mismatch blood transfusion, Rh system***

3) Respiratory system

- a) Functional anatomy – phases of respiration – inspiration and expiration – mechanism**
- b) Lung volumes and capacities – values**
- c) Spirometry*
- d) Pulmonary gas exchange – diffusion of gases, transport of respiratory gases in blood – O₂ and CO₂***
- e) O₂ – Hb dissociation curve***
- f) Regulation of respiration – chemical and neural***

4) Cardiovascular system

- a) Functional Anatomy, Conducting system and spread of cardiac impulse Cardiac cycle – definition, duration of phases. ***

- b) Heart sounds, Pulse – Definition, Heart rate, Systemic circulation**
- c) ECG – Basic principle of recording, types of leads – Normal ECG**
- d) Cardiac output – definition**
- e) Determination of blood pressure and normal values, regulation, determination of BP in man. ***

5) Endocrine system

- a) General introduction, Hormones – definition***
- b) Endocrine glands – names, their secretions, major functions, (hypothalamus, pituitary, thyroid, parathyroid, pancreas, adrenal glands, ovary and testis). ***

6) Muscle and nerve

- a) Transport across cell membrane, Resting membrane potential and its bands
Action potential – its basis, refractory period, latent period. ***
- b) Neuron – Morphology, properties ***
- c) Muscle – Types, difference between them, properties. **
- d) Neuromuscular junction, structure, neuromuscular transmission. **

7) Nervous system

- a) Introduction, organization of brain and spinal cord, functions. ***
- b) Synapse – definition, types, synaptic transmission and synaptic inhibition. **
- c) Reflex action – definition, components, important properties, importance **
- d) Cerebral cortex – Gross structure importance, EEG, Cerebellum – Gross structure, functions, Hypothalamus – functions**
- e) Thalamus – functions, Basal ganglia – functions**
- f) Autonomic nerves system**
- g) CSF –Production, circulation, composition, functions***
- h) Lumbar puncture. **

8) Special senses

- a) Vision – Basic optics. Briefly on refractory errors of eyes, Visual receptors, visual pathway**
- b) Audition –Functional anatomy, Functions of ear**
- c) Olfaction, Gestation**

9) Digestive system

- a) Functional Anatomy – Innervations, Salivary secretion***
- b) Gastric secretion – phases, control, Gastric – functions; Pancreatic secretion – functions, regulation; Liver – functional anatomy, Bile – functions and composition***
- c) Small intestine – secretion, GI motility-Deglutition, Peristalsis; Functions of stomach,
small intestine and colon. ***

10) Excretory system

1. Renal system***

- a) Kidney - Functional anatomy of kidney, Functions of kidney***
- b) Urine formation – glomerular ultra filtration, tubular reabsorption, tubular secretion***
- c) Glomerular filtration rate – definition, measurement, factors affecting. ***
- d) Tubular functions – re-absorption of sodium, water, glucose, tubular secretion of H⁺ (Acidification of urine) **
- e) Diuresis and diuretics, micturition**
- f) Dialysis**

2. Skin

Mechanism of temperature regulation**.

11) Reproductive system

- a) Sex determination, Role of hormones in sexual differentiation in fetal life**
- b) Male reproductive system – organs, functions of testis; Female reproductive system – functions of ovaries***
- c) Menstrual cycle – ovarian cycle and uterine cycle***
- d) Fertilization, pregnancy, functions of placenta, Parturition, Pregnancy test principle***

Practical***

65 Hours

1. Haemoglobin estimation
2. ESR determination
3. RBC count
4. WBC count
5. Differential count
6. PCV, Red cell indices.
7. Osmotic fragility test
8. Bleeding time, Clotting time
9. Blood grouping
10. Measurement of Blood pressure in man

Text Books

1. Essentials of Medical Physiology - K. Sembulingam & Prema Sembulingam.
2. Text book of physiology for BDS students - Prof. Jain A.R.
3. Text book of physiology - choudhary
4. Text book of physiology - Ganong
5. Text book of physiology - G.K.Pal.

Course outcome :

CO1 : Handle glasswares, chemicals and instruments.

CO2 : Identify biologically important substance in a given sample.

CO3 : Knowledge of anticoagulants, preservatives in the lab and preparation of distilled and double distilled water.

Introduction to the Chemistry of the LIVING THINGS AND CELL.

- Cell structure, cell organelles and bio membrane –structure and function, cell fraction
- Units of measurements

Laboratory glass wares. Glass - composition, properties, varieties, grades of glassware's. General laboratory wares; Glass and plastic- PVC, polycarbonate, Teflon etc.

Advantages and disadvantages of various disposable lab ware.

- Cleaning of laboratory glass wares. Preparation of cleaning solutions. Care of laboratory wares and utensils.
- Grades of chemicals, storage and handling of chemicals and reagents.
- Laboratory safety - General principles, laboratory hazards and safety measures, universal safety precautions.
- First aid in the laboratory
- Expressing concentrations of solutions in Physical Unit and in Chemical Units
- Water the universal solvent, Ionization of Water, weak acids and weak bases, dissociation constants, buffer systems, Henderson Hasselbach equation, PH and PH meter.
- Method of measuring liquids and weighing solids, care of single pan balance, analytical balance, electrical and electronic balance.
- Calibration of pipette and other volumetric apparatus.
- Primary standard chemicals and secondary standard chemicals. Volumetric analysis- preparation of normal solutions, percentage solutions, molal solutions, molar solutions. Preparation of standard solutions of Oxalic acid, Sodium hydroxide, Hydrochloric acid, Sulphuric acids, Silver nitrate and Potassium permanganate.
- Dilution of solution. Inter conversion of concentration - Normal, Molar, Molal and Percentage solution. Preparation of reagents for various biochemical analysis.
- chemical indicators and theory of indicators.
- Collection, preservation and processing of biological specimens for biochemical analysis, preparation and use of anticoagulants and urine preservatives.
- Preparation and storage of distilled water, double distilled and deionised water.
- Evaluation of water purity.
- Colorimetric analysis, spectrum of light, monochromatic light, polychromatic light, absorption and transmission of light. Principle of colorimetric analysis, selection of filters, Colorimetry, spectrophotometry, Flourimetry, Atomic Absorption Spectrophotometry, nephelometry, Flame photometry etc
- Radio-Isotopes, basic principles of radioactivity, detection and measurements of radioactivity and applications.

- General laboratory equipment-Principle, use and maintenance of the following, instruments / apparatus - centrifuge, cold centrifuge, homogenizer, desiccators, vortex mixer, magnetic stirrer.
- Viscosity, surface tension, properties of colloids, emulsions, adsorption, partition coefficient and its application to biological systems.
- Osmosis, dialysis and Donnan membrane equilibrium.

CHEMISTRY OF BIOLOGICAL MOLECULES

CARBOHYDRATES

- Classification, chemistry and properties of monosaccharide, disaccharides and polysaccharides. Stereoisomers, epimers, and reactions of monosaccharide and other carbohydrates. Digestion and absorption of carbohydrates. Mucopolysaccharides and glycoproteins.

PROTEINS

- Classification, properties and biological function,
- AMINO ACIDS Structure & properties- peptide bond, primary, secondary, tertiary and quaternary structures, sequence analysis.
- Digestion and absorption of proteins.
- Lipo proteins and nucleo proteins, structural proteins.
- Colour reactions of amino acids and proteins

LIPIDS

- Classification of lipids, chemistry and properties of fatty acids - saturated, & unsaturated fatty acids, triglycerides, phospholipids and steroids.
 - Saponification number, Iodine number and rancidity. Digestion and absorption of lipids,
 - Cell membrane: Structure and function – fluid Mosaic model and, transport mechanisms.

NUCLEIC ACIDS

- Chemistry of purines, pyrimidines, nucleosides, nucleotides, nucleic acids, nucleosomes. Structure of DNA and RNA.

BIOCHEMISTRY PRACTICALS 230 Hours

- Measurements of liquids, Weighing solids
- Calibration of pipette and other volumetric glass wares
- Preparation of saturated solution and half saturated solutions
- Preparation of standard solutions, % solutions (V/V. W/V normal and molar solutions.
- Preparation of buffers: acetate ,phosphate and tris buffers and measurement of pH
- Cleaning of lab wares and laboratory utensils, preparation of cleaning fluids.
- Preparation of distilled and deionised water
- Preparation of anticoagulants and preservatives for specimen collection.
- Use and proper maintenance of -Analytical balance, Electronic balance, Centrifuge, Colorimeter, spectrophotometer, pH meter, Homogenizer, Desiccators
- Measurement of pH, preparation of buffers
- Titration of acids and bases, preparation of standard solution of Sodium hydroxide, Hydrochloric acid, sulphuric acid. Silver nitrate and Potassium permanganate solutions

- Reactions of carbohydrates, reactions of glucose, fructose, maltose, lactose, sucrose, dextrin, starch and glycogen.
- Reactions of Amino acids, colour reactions of albumin, globulin, casein, gelatin and pepsin.
- Reactions of fatty acids and cholesterol
- Reactions of NPN substances (urea, uric acid, creatinine)

RECOMMENDED TEXT BOOKS

1. An Introduction to medical laboratory technology - Baker - P Silvertown.
2. Harper's Biochemistry - Robert K. Murray
3. Text Book of Biochemistry - Vasudevan and Sreekumari.
4. Medical Laboratory Technology - Kanai. L. Mukharjee

Paper III Basic Microbiology & Immunology BMLT3

130 hours

Basic Microbiology-55 hours

Course Outcome :

CO1 : Knowledge regarding the morphological characters of bacteria.

CO2 : Preparation of smear, fixation and staining of bacterial smears and its quality control methods.

CO3 : Familiarizing the use of microscope, autoclave, hot air oven, water bath, steamer, filters etc.

CO4 : Knowledge about the common disinfectants and its uses and should be able to prepare the working dilutions of same.

CO5 : Emphasize Classification of microbes on the basis of hazards, Principles of classifications of laboratory safety cabinet and its applications.

1. Introduction to Microbiology

Historical review (Contributions of E.Jenner, L.Pastuer Robert Koch and postulates, Anton van Leeuwenhoek, Alexander Fleming) and scope of microbiology Role of medical microbiology in diagnosis and control of infections.

2. Sterilizations and disinfection:

Definitions of sterilization, disinfection, antisepsis. Classification of sterilization and disinfection. Different methods of sterilization: Heat, radiation, filtration, chemical methods

(Emphasis should be given to each method) Selection of material for sterilization or disinfection

3. Sterilization –Physical methods and chemical methods

Autoclaves : Different types, principles, operating procedures, precautions, applications

and quality control.

Disinfection-Physical methods and Chemical methods

4. **Filtration** : Methods, principles, types of filter, applications
5. **Radiation** : Principles, methods, applications
6. **Chemical methods:**
 - Factors influencing the performance of the chemical disinfectants.
 - Sporocidal disinfection.
 - Different types of chemical agents used for disinfection. Emphasis should be given to its mode of action,
 - MIC, its period of exposure, application and limitations.
 - Quality control tests for each method,
 - Decimal reduction time (D Value).
7. **Testing of disinfectants-**

In use test, Rideal - Walker test or Chick - Martin test
(Students should know the sterilization or disinfection of the following - floors, work benches, safety cabinets, rooms, operation theatres, skin, hospital wares, and laboratory equipments. Theatre instruments, different types of media, plastic materials, cotton materials, instruments used in surgery etc.)

 - Preparation of disinfectant for laboratory use.
 - Decontamination of equipments and wastes especially in microbiology.
 - Washing, cleaning, packing and sterilization of glasses and storage of sterile articles.
 - Classification of microbes on the basis of hazards.
 - Principles of classifications of laboratory safety cabinet and its applications.
8. **Incubators:** design, different models, working principles, precautions, calibration of temperature.
Anaerobic incubators, Walk in incubator -principles and its applications.
9. **Cell morphology** : Prokaryotic and Eukaryotic cell – structure and function
10. **Morphology of bacteria.**

Anatomy of the bacterial cell. (Special emphasis should give to cell wall, capsules, flagella, plasmid, bacterial spores, spheroplasts, protoplasts, L -forms).
11. **Staining**

Definition of stains. Acidophilic, Basophilic and Neutral stains. Preparation of smears, its fixation and uses. Principles, preparation of reagents, procedures, modification. Uses, advantages and disadvantages of the following staining methods.

 - Simple staining
 - Differential staining(Gram's staining, A.F.B. staining)
 - Negative staining
 - Fluorochrome staining
 - Staining of volutin granules
 - Staining of spirochetes
 - Special stains for spores, Capsules, Flagella.

Course Outcome :

1. CO1 : Differentiate between innate and adaptive immunity, and the main defences lines as well as biological barrier to the infections.
2. CO2 : Illustration of the cell types and organs involved in the immune function.
3. CO3 : mphasize and describe the antigen-immunogen and antibody as well as the interaction between them.
4. CO4 : Employ antigen –antibody interaction to conduct different immunological and serological tests in the laboratory.
5. CO5 : Interpret the complement systems, components, activation pathway and their biological roles.
6. CO6 : Relate the roles of importance of cytokines with immune responses in both health and disease conditions.
7. CO7 : Illustrate the adverse effect of immune system including hypersensitivity and Autoimmunity.
8. CO8 : Interpret immunization and its role in role in protection against diseases.
 - Definitions of infection, Pathogenicity, Virulence, Primary infection, nosocomial infection
 - Description of different sources of infection and how they are transmitted to others.
 - A brief introduction of different predisposing factors responsible for bacterial infection.
 - Structure and function of Immune system
 - An introduction to immunity and immune system, classification of immunity
 - Descriptive study of Innate immunity and its determinants
 - A descriptive study of Acquired Immunity
 - Classification of Acquired Immunity with its detailed description
 - Immune responses
 - Principles of cell mediated and humoral immunity
 - Discussion on cellular immune responses (more emphasis should be given for lymphokines or cytokines, TNF, Interferon)
 - Lymphocytes subsets and its functions, Natural killer cells.
 - Antigens and their properties, Super Antigens, Hetrophile Antigens.
 - Immunoglobulin and their structure and functions.
 - Monoclonal antibody
 - Major Histocompatibility complex – a brief description of gene organization, structure and its functions, transplantation.
 - A brief description of complement and its properties
 - Activation and regulation of complement path ways.

- Biological effects of complement
- A brief introduction of Immunodeficiency disease and Hypersensitivity reactions.
- Discussion on Auto immunity.
- A detailed study of Vaccines & adjuvants.
- Descriptive study of **Antigen-antibody reactions** –
Precipitation, Agglutination, Complement fixation, Neutralization, ELISA, RIA, IF, (more emphasis should be given to ELISA, IF, Counter current immunoelectrophoresis)

PRACTICALS

230 Hours

- Introduction and demonstration of Laboratory Equipments used in Microbiology.
- Cleaning of new and used glass wares for microbiological purposes. Students should be familiar to use autoclave, hot air oven, water bath, steamer etc.
- Demonstration of different types of physical methods of sterilization
- Sterilization of heat labile fluids, glass wares, liquids, plastic and other laboratory and hospital wares.
- Demonstration of different methods of disinfection
- Students should be familiar to use different types of filters and its decontamination.
- Rideal - Walker test or chick - Martin test for the phenol co-efficient determination.
- Test for minimum inhibitory concentration of at least 2 commercially available disinfectants, In use test
- Students should prepare the working dilutions of common disinfectant.
- Decontamination of wastes and carcasses - method
- Students should be thorough to work with light microscope
- Study of the morphological characters of bacteria
- Detection of motility *- Hanging drop examinations with motile bacteria, non motile bacteria. Method by using semi solid medium.
- Preparation and examination of wet films*. Direct microscopic examination of wet film
Preparation of smear, fixation and staining of bacterial smears and its quality control methods
- Simple staining methods* – Pure culture, mixed culture
- Gram's staining and any one modification* – Pure culture - Mixed culture
- A.F.B. staining and its modification *- Normal smear, AFB positive smear
Fluorochrome staining and its demonstration
- Special staining technique for the demonstration of bacterial capsule(any two methods)
- Special staining technique for the demonstration of spores (any one method)
- Special staining technique for the demonstration of Flagella (Any one method)
- Special staining technique for the demonstration of volutin granules
- Preparation of stains and reagents used for the above staining technique. Quality Control testing for the stains.

(More emphasis should be given and the students should be thorough with these* marked techniques)

RECOMMENDED BOOKS

1. Mackie & Macartney practical medical Microbiology - Collee. Fraser, Marmion, Simmons
2. Medical Laboratory Manual for Tropical Countries Vol-1 & Vol - 2 Monica Cheesbrough
3. Text Book of Microbiology : Baveja
4. Essential Immunology - Roitt
5. Text Book of Microbiology -Ananthanarayanan & Jayaram Panikker

REFERENCE BOOKS

1. Medical Microbiology - David green Wood, Slack Pentherer
2. Topley and Wilson's Microbiology and Microbial infections 9th edi: Leslie Collier, Albert Balow Vol – 2 Systematic Bacteriology
3. Medical Laboratory Technology – Kanai. L. Mukherjee.
4. Sterilization and Disinfection – G. Sykes
5. Sterilization and Disinfection – Black.
6. Bailey and Scott's Diagnostic Microbiology : Forbes Sahn, Weissfeld
7. Foundations in Microbiology -Talaro, Taloro
8. Microbiology an Introduction – Tortora, Funke, Case.
9. Microbiology – Prescott Harly Klein.
10. Laboratory Experiments in Microbiology – Johson Case.
11. Microbiology in practice - Lois Beisheir.
12. Microbiology – A Laboratory Manual.- Cappuccino, Sherman
13. Microbiology – Pelczar, Chan, Krieg.
14. Introductory Immunology - Davie
15. Fundamental Immunology - Paul
16. Basic & Clinical Immunology - Daniel P. Stites.

Paper IV Basic Medical Laboratory Science and Haematology-I BMLT4 130hours

BASIC MEDICAL LABORATORY SCIENCES - 50 Hours

SECTION A: BASIC LABORATORY SCIENCE

Course Outcome :

1. Organization of clinical laboratory.
2. Lab ethics and lab safety.
3. Laboratory hazards and first aid.
4. Use and care of different types of glassware and laboratory equipments.
5. To understand the working principle and application of different types of microscopes.
6. Knowledge about life support.

1.Introduction to National Healthcare System-5 hours**

The course provides the students a basic insight into the main features of Indian health care delivery system and how it compares with the other systems of the world. Topics to be covered under the subject are as follows:

1. Introduction to healthcare delivery system
 - a. Healthcare delivery system in India at primary, secondary and tertiary care
 - b. Community participation in healthcare delivery system
 - c. Health system in developed countries.
 - d. Private Sector
 - e. National Health Mission f. National Health Policy
 - g. Issues in Health Care Delivery System in India
2. National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programme.
3. Introduction to AYUSH system of medicine (not asked for University examination)
 - a. Introduction to Ayurveda.
 - b. Yoga and Naturopathy c. Unani
 - d. Siddha
 - e. Homeopathy
4. Health scenario of India- past, present and future
5. Demography & Vital Statistics-
 - a. Demography – its concept
 - b. Significance and recording of vital statistics
 - c. Census & its impact on health policy
6. Epidemiology
 - a. Principles of Epidemiology
 - b. Natural History of disease
 - c. Methods of Epidemiological studies
 - d. Epidemiology of communicable & non-communicable diseases, disease transmission,
host defence, immunizing agents, cold chain, immunization, disease monitoring and
surveillance. Study Spelling is critical and will be counted when grading tests.

Topics to be covered under the subject are as:

1. Derivation of medical terms.
2. Define word roots, prefixes, and suffixes.
3. Conventions for combined morphemes and the formation of plurals.
4. Basic medical terms.
5. Form medical terms utilizing roots, suffixes, prefixes, and combining roots.
6. Interpret basic medical abbreviations/symbols.
7. Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, and endocrine system.
8. Interpret medical orders/reports.
9. Data entry and management on electronic health record system.

3.Basics of emergency care and life support skills**

Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include immediate recognition of sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). Initial recognition and response to heart attack and stroke are also considered part of BLS. The student is also expected to learn about basic emergency care including first aid and triage. Topics to be covered under the subject are as follows:

- a. Vital signs and primary assessment
 - b. Basic emergency care – first aid and triage
 - c. Ventilations including use of bag-valve-masks (BVMs)
 - d. Choking, rescue breathing methods
 - e. One- and Two-rescuer CPR
 - f. Using an AED (Automated external defibrillator).
 - g. Managing an emergency including moving a patient
- At the end of this topic, focus should be to teach the students to perform the maneuvers in simulation lab and to test their skills

with focus on airways management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/operate on the above mentioned modalities.

4. Medical law and ethics

1. Medical ethics - Definition - Goal - Scope
2. Introduction to Code of conduct
3. Basic principles of medical ethics – Confidentiality
4. Malpractice and negligence - Rational and irrational drug therapy
5. Autonomy and informed consent - Right of patients
6. Care of the terminally ill- Euthanasia
7. Organ transplantation
8. Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC - ownership of medical records - Confidentiality Privilege communication - Release of medical information - Unauthorized disclosure - retention of medical records - other various aspects.
9. Professional Indemnity insurance policy
10. Development of standardized protocol to avoid near miss or sentinel events
11. Obtaining an informed consent

5. Basics of Medical Laboratory

- Role of Laboratory in Health care delivery
- Care of laboratory wares, equipments and chemicals: general principles.
- Glass – composition, properties, varieties, grades of glass wares.
- Making simple glass wares in the laboratory – glass blowing techniques
- Common laboratory wares – PVC, polycarbonate, plastic.
- Advantages and disadvantages of various disposable lab ware.
- Cleaning of laboratory wares. Preparation of cleaning solutions. Care of laboratory wares and utensils.

- Laboratory safety – General principles, laboratory hazards and safety measures, universal safety precautions.

6. Microscopes

- History and development of microscopes.
- A brief review of light microscopes, its image formation, numerical aperture & resolution, magnification.
- Different types of objectives, eye piece, condensers and illuminations, their applications.
- Methods of use of microscopes for the demonstration of wet films and dry preparations.
- Care and safe use of microscopes.
- Classification of microscopes.
 - Bright field monocular & binocular microscopes.
 - Phase contrast microscope.
 - Dark ground microscope.
 - Fluorescent microscope.
 - Electron microscope.
 - Principles, methods of safe working, different parts, use, preparation of smears for its examinations and application of the above microscopes.
- Micrometry – Light microscopic micrometry, Photographic micrometry and electron microscopic micrometer.

7. Haematology-I

80 Hours

Course Outcome :

1. CO1 : Blood collection sites and collection methods.
 2. CO2 : Knowledge about smear preparation, methods and staining.
 3. CO3 : Basic routine tests in haematology lab.
 4. CO4 : Automation in Haematology
 5. CO5 : Collection and processing of Bone marrow.
- Origin, development, maturation, function and fate of blood cells.
 - Capillary and Venous blood. Methods of blood collection.
 - Various anticoagulants, their functions, uses, advantages and disadvantages.
 - Principles of staining, Romanowsky stains, preparations and staining properties of various Romanowsky stains with emphasis to Leishman's stain. Preparation and use of Buffer solutions in staining.
 - Preparation of Blood smears. Thin smear, thick smear, wet preparations and buffy coat preparation.
 - Leishman staining,
 - Different Leucocyte count in Blood smear with recognition of abnormal blood cells.
 - Collection of bone marrow and Preparation of Bone marrow smears, Morphologic

study of Marrow films and its differential count. Indications of Bonemarrow aspiration.

- Different types of Haemocytometers, their ruling
- Total count of RBCs, WBC (with correction of NRBC), Eosinophils and platelets. Micropipette methods and Bulk dilution technique, their advantages and disadvantages. Composition, function, preparation and storage of various diluting fluid. Errors in sampling, mixing, diluting and counting, Quality control methods in cell counts.
- Automatic Blood cell counters.
- Haemoglobin and Estimation of Haemoglobin – Principles, techniques, advantages and disadvantages of different methods. Normal and abnormal values. Errors and quality control in various methods.
- Abnormal Haemoglobin Method of identification of abnormal Haemoglobin. Sickling phenomenon. Hb-F and its demonstration. Principles and different methods of determining ESR and PCV. Advantages and disadvantages of each method. Clinical significance of ESR and PCV, Normal values.
- Methods of determination of Red Cell Indices (MCV, MCH, MCHC and Colour Indices) and its significance.
- Supravital staining technique – Principles and uses, Demonstration and counting of Reticulocytes. Composition and preparation of Brilliant Cresyl Blue and New methylene blue stains.

(NB- ** marked topics are desirable to know only. It will not be the part of assessment by the university exam)

Practical

- Care and use of light microscope
- capillary and venous blood collection
- Preparation of anticoagulated bottle
- Preparation of Romanowsky staining solutions
- Preparation of diluting fluids for cell counts.
- Preparation of thick and thin smears and their staining
- Haemoglobin estimation- cyanmethaemoglobin method and Sahli's method
- ESR determination
- RBC count
- WBC count
- Differential count
- Platelet count
- Absolute eosinophil count
- Reticulocyte count
- PCV, Red cell indices.
- Osmotic fragility test

Reference Books

1. Laboratory acquired infections – C.H. Collins.
2. Clinical Diagnosis and Management by Laboratory methods – Todd, Sandford, Davidson
3. Manual of clinical laboratory methods-Copal.E.Hopier

4. Medical laboratory methods-Dr.Ramnik sood
5. Clinical laboratory methods-Beuer.
6. Introduction to Medical laboratory technology-Baker
7. Practical haematology- Dacie and Lewis

SECOND YEAR

PAPER V

90 hours

BIOCHEMISTRY – II BMLT5

Course Outcome :

Biochemistry II

CO1 : They would have a thorough knowledge of different metabolic pathways within the body and the inborn errors associated with it.

CO2 : Estimation and interpretation of various metabolic products and its normal level in blood.

CO3 : They get an introduction to clinical biochemistry lab.

1. CARBOHYDRATE METABOLISM:

- Glycolysis, Cori's Cycle, Oxidation of pyruvates. Citric Acid Cycle, Hexose Mono Phosphate Shunt Pathway, Glucuronic acid Pathway, Gluconeogenesis,
- Glycogenolysis, Regulation of Glycogen Metabolism, Fructose Metabolism, Galactose Metabolism, Glyoxlate Cycle, Hormonal regulation of Blood Glucose, Hyperglycemia & Diabetes Mellitus, Diabetic Ketoacidosis, Glycosuria,
- Hypoglycemia, Pentosuria, fructosuria, galactosemia & Glycosycated Hemoglobin.
- Investigation of disorders of carbohydrate metabolism: glucose, Glucose tolerance tests & other tolerance tests

2. METABOLISM OF PROTEINS & AMINO ACIDS :

- Metabolism of individual amino acids
- Catabolism of Amino Acids, Formation of Ammonia, Transamination and Oxidative deamination. Urea Cycle.
- Formation of Creatine and Creatinine. One Carbon Metabolism, Conversion of amino acids to specialized products.
- Principles and methods for the estimation of Urea, creatine, creatinine ,Total protein and Albumin

• METABOLISM OF LIPIDS :

- Oxidation of fatty acids, Biosynthesis of fatty acids, Ketogenesis.
- Biosynthesis of Triglycerides, Phospholipids & Sphingolipids
- Biosynthesis of cholesterol & Bile Acids,
- Plasma Lipoproteins, Apolipoproteins & Lipoprotein metabolism
- Obesity, Fatty Liver, Lipotropic factors and ketosis
- PUFA , Lipid per oxidation & Eicosanoids-Prostaglandins & Leukotrienes .
- Lipid and Lipoprotein measurements- blood sampling and storage, Estimation of lipids-Cholesterol, Triglycerides, Phospholipids & lipoproteins- Colorimetric and enzymatic methods

Inter – relation between the metabolism of Carbohydrate, lipids and proteins

- Generation of ATP, substrate level phosphorylation & Oxidative phosphorylation

- Brief outline of Electron transport chain
- **NUCLEIC ACID METABOLISM :**
 - Biosynthesis of Purine and Pyrimidine nucleotides, de novo and salvage pathway,
 - Degradation of purine and pyrimidine nucleotides.
 - Principles & methods for the estimation of Uric acid
- **COMMON INBORN ERRORS OF METABOLISM :**
 - Disorders of Carbohydrates metabolism - Glycogen storage diseases, galactosemia, fructose & Lactose intolerance.
 - Disorders of lipid metabolism-DYSLIPOPROTEINEMIA- Hypolipoproteinemia, Hyperlipoproteinemia, Atherosclerosis and sphingolipidosis.
 - Disorders of Amino Acid metabolism, Cystinuria, Homocystinuria, Cystathionuria, Phenylketonuria, Alkaptonuria, Albinism. Maple Syrup Urine diseases, Hartnups's diseases.
 - Disorders of Nucleic acid metabolism - Gout, Lesch-Nyhan Syndrome, Laboratory diagnosis of Inborn errors of metabolism
- **VITAMINS AND CO-ENZYMES :**
 - Vitamins- water soluble-Chemistry, sources, RDA, Biochemical role, Deficiency and assay
 - Vitamins Fat soluble-chemistry, sources, RDA, biochemical role, Deficiency, toxicity and assay
 - Estimation of Vitamin A, C, E and B.
- **NUTRITION :**
 - Nutritional importance and Calorific value of food- BMR
 - Protein energy malnutrition- Kwashiorkor and Marasmus.
- **URINE :**
 - Composition of normal and abnormal constituents.
 - Routine examination of Urine, Specific gravity, reactions, detection of protein, reducing sugar, ketone bodies, bile pigment, bile salts, Urobilinogen and blood in Urine.
 - Urinary screening for Metabolic inherited diseases
- **C.S.F AND OTHER BODY FLUIDS:**
 - Physical and chemical examinations. Estimation of sugar, protein and chloride.
 - Composition and Chemical analysis of Synovial, Pleural, Peritoneal, Pericardial, Amniotic fluid etc.
 - Estimation of sugar, protein and chloride in CSF
- Common Laboratory methods, estimation and its interpretation of Glucose, protein, Cholesterol (total & HDL), Uric Acid, Creatine, Creatinine, Urea, Triglyceride, phospholipids, Total lipids, Glycosylated Haemoglobin and tests for inborn errors of Amino acid metabolism.

PRACTICAL - BIOCHEMISTRY – II

174 HOURS

- Estimation and standardization of Blood/Serum/Plasma constituents glucose, Urea, Total protein, Albumin, Cholesterol, Triglyceride, Phospholipids, total lipid - Uric Acid, Creatine, Creatinine, Ammonia, Non-protein nitrogen, Amino Acid Nitrogen.
- Qualitative detection of normal and abnormal constituents of Urine.

- Quantitative analysis for Urine protein, Bence-Jone's protein, Reducing sugars and chloride in Urine, Urea, Creatinine, Uric Acid, Aminoacids, Ammonia, Keto acids in Urine.
- Estimation of sugar, protein and chloride from C.S.F., plural fluid, peritoneal fluid, amniotic fluid - foam test.
- Glucose tolerance test and GCT.
- Estimation of Kotone bodies in blood and urine.
- Estimation of Glycosylated HB.
- Estimation of Vitamin A,C,E and Metabolites of Vitamins in Urine (B complex)
- Tests for inborn errors of Amino Acid metabolism in Urine.

RECOMMENDED TEXT BOOKS:

1. Harper's Biochemistry : R. K. Murray and Grannor
2. Test book of Biochemistry : Vasudevan and Sreekumari
3. Practical – Clinical Biochemistry - Volume 1 : Harold Yarkey
4. Clinical Biochemistry - Principles and Practice : Praful B. Godkar.
5. Clinical Laboratory methods and diagnosis : Gradwohl.

REFERENCE BOOKS :

1. Principles of Biochemistry : Lehniger
2. Biochemistry : Lubert Strayer
3. Text Book of Clinical Chemistry : Novert W. Teitz
4. Biochemistry with Clinical Correlation : Devlin.
5. Internal Medicine : Harrison.
6. Clinical Diagnosis and Management by laboratory methods : John Bernard Henry

Paper VI

GENERAL MICROBIOLOGY BMLT6 – 90 hours

Course Outcome :

1. CO1 : Knowledge about culture media preparation and different cultivation and identification methods employed in microbiology laboratory.
2. CO2 : Familiarizing the use of automated cultivation and identification systems.
3. CO3 : Illustrate the role of experimental animals in laboratory diagnosis.

Topic

- Classification and taxonomy of Micro organisms.
- Bacterial growth and Nutrition – Batch culture, Continuous culture, and growth curve, total count and viable count.
- A brief description on microbial metabolism, catabolism, respiration and Anabolism.

NUTRIENTS FOR MICROBIAL GROWTH

- Physical conditions required for bacterial growth- Oxygen, CO₂, Temperature, water, pH, Light, osmotic pressure.
- Major requirements and common ingredients of culture media.
- Media for microbial growth – classification of media- Routine laboratory media like
- Basal - Peptone water, Nutrient broth, Nutrient agar
- Enriched - Blood agar, Chocolate agar, R.C.M
- Enrichment - Alkaline- Peptone Water, Selenite F broth
- Selective - MaC conkey agar, XLD, DCA, TCBSA, L.J.medium, Tellurite blood agar
- Differential - MaC conkey agar, CLED.
- Transport media, Anaerobic media.
- Principles and method of preparation, pH adjustments- different methods, sterilization, storage of different types of media.
- Quality control in media preparation.
- Cultivation of Bacteria – Equipments and devices used in the cultivation bacteria.
- Inoculation methods, incubation methods, Inoculation on different types of culture media in Petri dish, Slopes, Butt, Broths.
- Incubation methods
- Morphological study of bacterial colonies on plated media.
- Growth characteristics of bacteria on liquid media.
- Anaerobic culture methods with recent advance.

Quantiation of Microorganisms:

- Quantitation of microorganism - using photoelectric colorimeter and spectrophotometer.
- Total count and viable count
- A brief description method of measuring bacterial growth by determining its dry weight, wet weight, Total nitrogen concentration.
- Preparation of Mc Farland standard and its interpretation / Simple opacity tubes.

Typing methods

- Bacteriophage and Bacteriophage typing method.
- Bacteriocin and Bacteriocin typing

Biochemical Tests

- Tests for identification of bacteria, detailed study of the principle, preparation of media, reagents used different methods, interpretation and quality control for the following identification tests.
- Tests for the metabolism of Carbohydrates- OF test, simple sugar media, TSI/KIA, citrate utilization, MR, VP tests
- Tests for the metabolism of proteins and Amino acids- Indole, PPA, Gelatin liquefaction, Amino acid metabolism test
- Tests for enzymes. - Catalase, Urease, Nitrate reductase, Coagulase, and Oxidase.
- Tests for the metabolism of fat.
- Rapid identification tests.

BACTERIAL GENETICS

- General Principles of Bacterial Genetics
- Genetic Organization and Regulation of the Bacterial cell
Genotypic Phenotypic variation, Operon model of gene expression
- Mutation -Types of mutation, Mutagens, Isolation of mutants
- Gene transfer – Transformation, Conjugation, Transduction
- Plasmids & Transposons.

CARE AND MANAGEMENT OF LABORATORY ANIMALS

- A Basic knowledge of the feeding, housing, breeding and care of the following animals
- -rabbit, rat, mouse, guinea pig.
- Handling and care of normal and infected animals in the laboratory and in the animal house.
- Collection of blood samples
- Killing of animals and post- mortem examination
- Different routes of animal inoculations: scarification, subcutaneous injections, intravenous inoculation, intra-peritoneal inoculations, intramuscular inoculations, intracerebral, intra-testicular inoculation.
- Animal House records
- Disposal of dead animals

PRACTICALS 174 Hours

- Preparation and use of pH indicator solutions
- Preparation of Reagents used for pH adjustments
- Adjustments of pH for Acidic medium and alkaline medium by using Lovibond Comparator
- Cleaning and preparation of glassware for media preparation and sterilization

- Preparation of sterile Saline. Students should be familiar to prepare the commonly used laboratory media and also they should know its sterilization, Quality control and storage.
- Peptone water, Nutrient broth, Nutrient agar, Blood agar, Chocolate agar, R.C.M , Alk.Peptone Water, Selenite F broth, MaC conkey agar, XLD, TCBSA, L.J.medium, Transport medium (anyone) and other Media routinely used for the isolation for medically important bacteria.
- Preparation and standardization of bacterial loop.
- Inoculation methods on plate media, liquid media and slope media
- Inoculation and isolation of pure and mixed bacterial culture
- Study of colony characters on different media.
- Viable count of bacteria from a culture. Preparation of standard opacity tubes.
- Aerobic and Anaerobic incubation technique
- Preparation, Sterilization, Quality control, Inoculation and use of Biochemical media and its reagents used in bacteriology.
- Preparation of Reagents like methyl red indicator, V.P.Reagent, Nitrate reagents, Ferric Chloride. ONPG, H₂O₂, Oxidase reagent, Kovac's reagent, Ehrlich's reagent.
- Inoculation methods and Quality control in different Biochemical media.
- Anaerobic cultivation methods - Anaerobic jar - Other methods-Quality control
- Students should visit an Animal house and observe the organization and management of animal houses and its stock. Also they should observe the management of animals on experiments, safe handling of laboratory animals like Rabbit, Rat, Mouse, Guinea Pig.

RECOMMENDED BOOKS

- Mackie & McCartney practical medical Microbiology - Colle. Fraser, Marmion, Simons
- Medical Laboratory Manual for Tropical Countries Vol - 2 Monica Cheesbrough

REFERENCE BOOKS

1. Medical Microbiology - David green Wood, Slack Pentherer
2. Topley and Wilson's Microbiology and Microbial infections 9th edi: Leslie Collier, Albert Balow Vol – 2 Systematic Bacteriology.
3. Cowan & Steel's Manual for the Identification of Medical Bacteria – G.I Barron, K.K.A.Feltham.

Paper – VII

PARASITOLOGY & ENTOMOLOGY BMLT7

90 hours

Parasitology

45 hours

Course Outcome :

1. CO1 : Knowledge in the life cycle of medically important parasites and the organs commonly involved in the infection.
2. CO2 : Studying the distribution and epidemiology of the parasites.
3. CO3 : Acquiring practical skills in fundamental parasitological techniques.
4. CO4 : Knowledge about methods of parasite control.

An elementary study of the types of animal associations, parasitism commensalism and

Symbiosis.

Types of Parasites. Classification of protozoa & Helminthes.

An elementary knowledge of the structure, life history of parasites belonging to the following genera with reference to the forms seen in human pathological material and the methods used to identify them.

- a. **Protozoa** : Entamoeba, Dientamoeba, Iodamoeba, Trichomonas, Trypanosome, Leishmania, Giardia, Plasmodium, Isospora, Balantidium, Toxoplasma, Pneumocystis carinii, Cryptosporidium. Cabiesia.
 - b. **Platyhelminthes** : Diphylobothrium, sparganum, Taenia, Echinococcus, Hymenolepis, Schistosoma, Fasciola, Fasciolopsis, Clonorchis, Paragonimus
 - c. **Nemathelminthes** : Ascaris, Ancylostoma, Necator, Strongyloides, Trichinella, Enterobius, Trichuris, Filaria.
- **Collection, preservation and transport of specimens** for parasitological examination, preservation of specimens of parasite eggs or embryos, preserving fluids.
 - **Detection of Intestinal parasites** : Detection and identification of amoeba and other intestinal protozoa and other parasites in faecal samples.
 - **Detection of Blood parasites** : Detection and identification of Malaria, Microfilaria and other blood parasites.
 - **Examination of biopsy material and other body fluids:** Brief account of spleen puncture for diagnosis of kala-azar, bone marrow biopsy, lymph node, and skin biopsy for parasites.
Examination of urine for parasites.

Practical

87 Hours

- Identification of parasites of Medical importance dealt in the theory
- Macroscopic and microscopic examination of stool for adult worms, ova, cysts, larvae.
- Concentration techniques for intestinal parasites in stool.
- Collection of blood and preparation of thick & thin smears.
- Staining of blood smears for blood parasites
- Examination of blood smears for malaria & microfilaria and their identification.

Entomology

45 hours

Course Outcome :

1. CO1 : Understanding of biology of vectors and intermediate hosts.
2. CO2 : Knowledge regarding the biology, life cycles, pathogenesis and diagnosis of parasitic infections in humans and their relation to human health and disease control strategies.
3. CO3 : Understanding of different methods to control insects and spread of infection.

Introduction. Classification of Arthropods of public health importance.

- Role of Arthropods in the transmission of diseases.
- Mosquito: Morphology, Lifecycle, Bionomics and public health importance of anophel-les, Culex, Aedes and Mansonia.
- Mosquito Control: Various methods. Mosquito – borne diseases and their control.
- Phlebotomes (Sand fly): Morphology, Life cycle, public health importance and control.
- House Fly: Morphology, life cycle and public Health importance.
- Black Fly (Simulium) morphology, life cycle, public health importance and control.
- Fleas : Morphology, life cycle disease transmitted and control
- Louse: Morphology, lifecycle, disease transmitted and control.
- Bedbug: Morphology, Lifecycle, disease transmitted and control.
- Ticks: Morphology, Lifecycle, disease transmitted and control.
- Trombiculid: Morphology, Lifecycle, disease relationship and control.
- Sarcoptes scabiei: morphology, life cycle, Public Health Importance and control.
- Cyclopes: Morphology, Public Health importance and control.
- Insecticides used for the control of Arthropods of Public Health Importance, Classifi-cation, Insecticide, resistance, Bioassay test

Practical

87 Hours

- Identification of arthropods of Medical importance dealt in the theory.
- Identification up to genera of common vectors of Malaria, Filariasis, Japanese Encephalitis and Dengue.
- Collection and preservation of arthropods of public health importance.
- Preparation of permanent mounts of arthropods of public health importance. (Minimum 10 slides)
- Dissection of Mosquitoes to display mouth parts, wings, and legs.

Books recommended:

1. Medical parasitology: N.C.Dey
2. A guide to medical entomology: W W Service
3. Entomology in human and animal health: Harwood and Maurice T James
4. Text book of Medical parasitology- KD.Chatterjee
5. Medical Laboratory Manual for Tropical Countries Vol-1 Monica Cheesbrough
6. Text Book of Parasitology- Jayaram Panickar

Paper VIII
90 hours

Haematology-II and Clinical Pathology BMLT8

Haematology-II

Course Outcome :

1. CO1 : Understanding different types of anemia and leukemia giving emphasis to its laboratory investigations.
2. CO2 : Knowledge of first and second line investigations in coagulation.
3. CO3 : Automation in haematology.

4. CO4 : Recent techniques and advances in haematology.
 - Morphology of Red cells in Health and diseases.
 - Systematic methods of examination of Blood Film (Blood picture) and Reporting.
 - Definition, classification and etiology of anaemia.
 - Disorders of structure and synthesis of Haemoglobin.
 - Principle, method and significance of Ham's test.
 - Laboratory diagnosis of various types of anaemia, Polycythaemia, Polycythaemia vera Leucocytosis, Leucopenia, Eosinophilia, Neutrophilia, Basophilia, Lymphocytosis, Monocytosis, Agranulocytosis
 - Infectious mononucleosis.
 - Definition and classification of Leukaemia,
 - Blood and Bone marrow findings in Acute Myeloid Leukaemia (AML) Acute Lymphatic (ALL) Chronic Myeloid Leukaemia (CML), Chronic lymphatic Leukaemia (CLL), Leukaemoid Blood Reactions.
 - Multiple myeloma.
 - Cytochemistry – Peroxidase, PAS, LAP, esterase.
 - Perl's Staining and its significance.
 - Identification of parasites (Malaria, Microfilaria, L.D. bodies and Trypanosomes) in Blood and Bone marrow films.
 - General introduction to Bone marrow transplantation techniques.
 - LE phenomenon and demonstration of LE cell, Principle
 - Coagulation factors, mechanism of blood coagulation, Fibrinolytic system, Disorders of coagulations.
 - Laboratory methods used in the investigation of haemostasis:- Clotting time, Bleeding time, Partial Thromboplastin time, Plasma prothrombin time, INR. Thromboplastin generation time, Prothrombin consumption time, Thrombin time, Test for fibrinogen degradation product. Test for fibrinolysis. Assay of plasma fibrinogen.
 - Haemophilia and its laboratory parameters.
 - Disorders of Platelets and Blood vessels.
 - Platelet function test.
 - Automation and Recent advance in Haematological Techniques.

Clinical Pathology

30 Hours

Course Outcome :

1. CO1 : Complete urine analysis.
2. CO2 : Tests that done in clinical pathology other than routine urine test.
3. CO3 : QC Measures in clinical pathology.
4. CO4 : Automation.

Urine

- Microscopical examination of urine, collection of urine and its preservation, Colour, cloudiness, specific gravity, reaction, pH

- Different methods for detection, importance and its interpretation of – Protein, Sugar, Bile pigment, Bile salt, Urobilinogen, ketone bodies, Bence-Johnes proteins & Blood
- Examination and identification of sediment for: various cells, crystals, casts, parasites.
- Concentration methods for examination identification of urine sediment for: Gonococci, Trichomonas vaginalis, monilia.
- Pregnancy test-Production of HCG, HCG level at various stages of pregnancy, pregnancy test, Different types of pregnancy test such as Gravindex test & card test.

Faeces

- Examination of motion sample for: colour, mucous, consistency, ova, Amoeba, cyst, Parasites, Pus cells, RBCs & crystals.
- Detection of occult blood in stool, measurement of faecal urobilinogen & faecal fat, their importance interpretations.

Sputum

- Method for the collection, examination of sputum for AFB, sputum in disease.

Semen

- Methods of collection, Macroscopic and microscopic examination of semen, Motility, count, other findings.
- Staining and morphological studies of spermatozoa, importance & interpretation in each step of investigation in case of infertility.

CSF

- Collection, transport, preservation, examination and interpretation total and differential count, staining methods, CSF in disease.

Other body fluids

- Examination of Ascitic fluid, Pleural fluid, Pericardial fluid, Synovial fluid.

Practical

174 Hours

- Peripheral blood smear examination and reporting
- Haemoglobin electrophoresis
- Blood cell cytochemistry- Peroxidase, PAS, LAP, Esterase
- Perl's stain
- Osmotic fragility test
- Sickling tests
- LE cell demonstration
- Bleeding Time, Clotting Time, PT and APTT, clot retraction test, fibrinolysis test
- Serum electrophoresis of myeloma proteins.
- Familiarisation of automation in Haematology
- Urine analysis, pregnancy test
- Examination of feces, detection of occult blood in stool, fecal urobilinogen and fecal fat detection
- Semen analysis
- Examination of CSF
- Examination of body fluids

- Examination of sputum

Books recommended for reference

1. Lynch's Medical Laboratory Technology - Raphael
2. Gradworl clinical laboratory methods & diagnosis
3. Medical laboratory technology and clinical pathology- Lynch, Raphael, Meller
4. Manual of clinical laboratory methods- Copal. E. Hopier
5. Medical laboratory methods- Dr. Ramnik sood
6. Clinical laboratory methods- Beuer.
7. Introduction to Medical laboratory technology- Baker
8. Clinical pathology and bacteriology- Sachdev
9. Clinical pathology- Batra.
10. Hand book of routine urine analysis- Graft
11. Practical haematology- Dacie and Lewis.

THIRD YEAR

Paper IX Biochemistry-III (BMLT31)

Theory: 96

Hrs

Course Outcome :

1. CO1 :They get an on hand experience on separation techniques like chromatography and electrophoresis and its interpretation.
2. CO2 : Introduction to clinical enzymology, haemoglobin and interpretation of haemoglobin electrophoresis.
3. CO3 : Knowledge on sophisticated techniques like ELISA, RIA, Ag-Ab reactions.

9. ENZYMES:

Classification , Co-enzymes, Co factors, Mechanism of enzyme action, factors affecting in Enzyme action , Enzyme Kinetics, Michaelis Menton constant, Enzyme

Inhibition , Regulatory enzymes, Immobilization of enzymes.

Clinical Enzymology

- Enzyme activity determinations-End point assay and Kinetic assay.
- Principles & Methods for the estimation of Phosphatases, Transaminases, Amylase, lipase, Lactate dehydrogenase, Creatine kinase, Ceruloplasmin, Glucose 6 phosphate dehydrogenase, Aldolase, 5'-Nucleotidase, Leucine Amino peptidase ,Gamma gluta-

myl

transpeptidase, Cholin esterase, Enolase , Isocitrate dehydrogenase

- Isoenzymes in Diagnostic Biochemistry.
Plasma enzyme pattern in diseases- MI, Liver disease, Muscle disease etc

10. HAEMOGLOBIN

- Chemistry and properties of Haemoglobin and myoglobin, Chemistry of respiration, Transport of gases . Oxygen dissociation curve, Isohydric transport of Carbodioxide, Biosynthesis of Haemoglobin, Catabolism of Haem,
- Bile pigments- Bilirubin and related chromoproteins.
- Haemoglobin derivatives , Haemoglobin variants, Jaundice
- Principles & Methods for the estimation of Direct and total Bilirubin, Urobilinogen and urobilin.
- Congenital disorder of haem metabolism

11. PORPHYRINS

- Porphyrins and disorders of porphyrin metabolism.
- Chemistry of porphyrins
- Porphyrins: primary and secondary porphyrias and its analytical procedures.
- Methods for the estimation porphyrias and its precursors in urine.

12. Analytical Calculi- Urinary & Biliary calculi.

13. ELECTROPHORESIS

- Theory of electrophoresis, General methods of Electrophoresis- paper, gel, disc and Immunoelectrophoresis, isoelectric focussing.
- Electrophoresis of Serum protein and its interpretations
- Electrophoresis of Haemoglobin and its interpretations.
- Electrophoresis of Lipoproteins and its interpretations

6. CHROMATOGRAPHY

- Principles and application of Chromatography, Forms of chromatography- absorption, ionexchange, gel, paper, thin layer, HPLC and gas liquid chromatography.
- Chromatography of Aminoacid , Aminogram and chromatography of sugars & lipids.
- Aminoacidurias.

7. IMMUNOLOGICAL METHODS & RELATED TECHNIQUES

- Antigen- Antibody reactions. Immunodiffusions (ID), Immunoelectrophoresis, Radioimmunoassay (RIA), ELISA and Fluorescent immunoassay(FIA)
- Receptor assays
- Clearance tests-urea, creatinine, inulin

PRATICAL 200 Hours

1. Activity determination of Clinically important enzymes- Alkaline Phosphates , Acid phosphates, Alanine amino transferase , Aspartate aminotransferase, Amylase, Ceruloplasmin, LDH, CPK and G6 PD
2. Testing and semiquantitative assesment of urobilinogen in urine estimation of urobilin in urine, Estimation of porphyrin and porphobilinogen
3. Estimation of bilirubin - direct and total.
4. Qualitative analysis of Urinary calculi.
5. Qualitative analysis of Biliary calculi
6. Estimation of Haemoglobin, myoglobin and abnormal haemoglobins- Hb electrophoresis
7. Estimation of Lipoproteins - electrophoresis
8. Identification of substances by column chromatography, Thin layer chromatography, paper chromatography, amino acids (Amino gram) and sugars.
9. High performance Liquid Chromatography
10. Technique of paper electrophoresis, agar gel electrophoresis of serum proteins, Polyacrylamide gel electrophoresis of serum proteins & LDH.
11. Clearance tests - Creatinine and Urea clearance
12. Technique of RIA (T3, T4 and TSH) and ELISA.

Recommended text books

1. Text book of Biochemistry- DM.Vasudevan and Sree kumari. S
2. Practical Clinical Biochemistry- Harold varley
3. Practical biochemistry - Wilson and walker

Reference books

1. Principles of Biochemistry –Lehninger,
2. Biochemistry- Lubert stryer,
3. Text book of Clinical chemistry- Teitz,
4. Clinical chemistry – Kaplan.
5. Clinical chemistry –Marshal.

SYSTEMIC BACTERIOLOGY

Detailed Systematic and diagnostic study of bacteria (emphasis should be given for medically important, pathogenic and related organism). A detailed study of general characters, classification, different pathogenic species, non-pathogenic (brief account only), morphology, staining characters, cultural characteristic in different culture media, susceptible to physical and chemical agents, biochemical reactions, antigenic properties, special tests for identification of species, epidemiology, specimens and its collection, lab diagnosis, antibiotic sensitivity of the following bacteria.

- Staphylococcus, Streptococcus, Pneumococcus, Anaerobic cocci, Neisseria species,
- Listeria, Bacillus, Clostridium, Pseudomonas, Legionella, Nonfermenting gram negative rods, Bordetella, Brucella, Haemophilus, Pasteurella,
- Enterobacteriaceae (brief introduction of all the genus and detailed study for the medically important genus such as Escherichia, Klebsiella, Serretia, Enterobacter, Citrobacter, Proteus, Morganella, Providencia, Salmonella, Shigella, Yersinia),
- Mycobacteria.
- Actinomyces, Nocardia.
- Vibrio, Aeromonas
- Campylobacter, Helicobacter,
- Bacteriodes, Chlamydia, Rickettsiae, Mycoplasma,
- Preservation of bacteria.
- Normal flora in a healthy human body.

DIAGNOSTIC BACTERIOLOGY

1. Specimen processing

- Collection, preservation, transport and processing of clinical specimens for the diagnosis of bacterial infections.- Urine, Pus, CSF, Blood, Stool, Rectal swab, Body fluids, Exudates, Sputum, Throat swab, Eye specimens, Ear specimens, Tissues, Skin specimens.
- Knowledge of safety procedures in dealing with biological materials

2. Antibiotic susceptibility tests

- Basic knowledge of various antimicrobial agents and their action on microbes.
- Detailed study of different methods of antibiotic susceptibility tests, media used, preparation of antibiotic disc, selection of drugs, quality control drug resistance, beta lactamase detection, antibiotic assay in blood and body fluids.
 - Reading and reporting culture for sensitivity of organisms to different antibiotics.

3. Bacterial infections and clinical syndromes.

Detailed study of multiple etiology involving microorganisms and their laboratory diagnosis for the following clinical syndromes.

- Pyrexia of unknown origin, Enteric fever.

- Upper and lower respiratory tract infections, plueropulmonary and bronchial infections,
Tuberculosis.
- Urinary tract infections.
- Sexually transmitted diseases.
- Gastrointestinal infections, food poisoning, peritonitis.
- Infections in central nervous system – meningitis.
- Skin and soft tissue infections.
- Eye infections.
- Ear, Nose, Throat infections

Students should know lab diagnosis of the following clinical conditions

- Brucellosis, Q fever, Gas gangrene, Diphtheria, Rat bite fever, Relapsing fever, Rheumatic fever, Plague, Leptospirosis, Anthrax, Leprosy.
- Bacterial infections in the immunocompromised patient.

4. Bacterial Serology

Students should know in detailed the serodiagnosis of bacterial infections such as:

- Enteric fever – Widal test
- Syphilis – STS- VDRL Test, RPR, Treponemal tests-TPHA, TPI, FTA-ABS
- Streptococcal infections- ASO Test, Anti DNAase B, Antihyaluronidase test
- Brucellosis
- Rickettsial fever
- Primary atypical pneumonia.

(An illustrative knowledge of collection of specimens, preservation, principles, preparation of antigens, methods, and interpretation).

Practical

174 Hours

Identification of medically important bacteria from pure culture.

- Staphylococcus.
- Streptococcus.
- Meningococcus, Gonococcus.
- Escherichia , Klebsiella, Serretia, Proteus, Salmonella, Shigella.
- Psuedomonas, Acinetobactor.
- Vibrio.
- Haemophilus.
- Students should be familiar with the collection, transportation and processing of all type of clinical specimens for the diagnosis of bacterial infections discussed in theory. Knowledge of safety procedures in handling biological specimens is mandatory and will be assessed on a continuous manner.
- Different methods & interpretation of antibiotic sensitivity tests.
- Isolation and identification of Mycobacterium tuberculosis from clinical specimens. Preparation of smear, staining, culture and reporting, concentration technique for the diagnosis of tuberculosis.
- Examination of specimens from patient for the diagnosis of leprosy.

Bacterial Serology

- Antigen preparation and standardization for Widal test. Widal test technique and interpretations
- VDRL Test, RPR, TPHA
- ASO Test
- Brucella agglutination test.

Recommended Books

1. Medical Microbiology - David green Wood, Slack Pentherer
2. Mackie & Macartney practical medical Microbiology - Colle. Fraser, Marmion, Simmons
3. Text Book of Microbiology : Ananthanarayanan & Jayaram Paniker
4. Medical Laboratory Manual for Tropical Countries Vol-2 Monica Cheesbrough.
5. Bailey and Scott's Diagnostic Microbiology :Forbes Sahn, Weissfeld

REFERENCE BOOKS

1. Topley and Wilson's Microbiology and Microbial infections 9th edi: Leslie Collier, Albert Balow Vol – 3 Bacterial Infections.
2. Medical Bacteriology - C. H. Collins
3. Principles and Practice of Infectious diseases – Mandell, Bennett, Dolin Vol- 1 &
4. Colour Atlas and Text book of Diagnostic Microbiology Koneman & Allan Janda
5. Basic Laboratory Procedure in clinical Bacteriology WHO, Geneva.
6. Gradwohl's Clinical Laboratory Methods and diagnosis Vol – 2- Alex. C.Sonne.
7. Medical Microbiology – Murray, Kobayashi.
8. Medical Microbiology – Mims, Play fair, Roitt.
9. Microbiology and Infection – Inglis.
10. Microbiology Pelczar, Chan, Krieg.

Paper XI - CYTOLOGY & TRANSFUSION TECHNOLOGY – BMLT33

100 hours

CYTOLOGY 40 Hours

Course Outcome :

1. CO1 : Processing of all samples in Cytology.
2. CO2 : Normal cytology of FGT, RT, UT, GIT, CSF & serous effusions.
3. CO3 : Demonstration of PAP & MGG staining.
4. CO4 : QC measures done in Cytology lab.
5. CO4 : Automation in Cytology.

Introductions to Cytology

- History, development and scope of cytology.
- Cell structure, function, cell cycle, division with recent advances.
- Cytology of epithelial and connective tissues.

Cytopathology Techniques.

Fixation of Cytology specimens – various fixatives, pre fixation, coating and spray fixation, advantages and disadvantages.

- i) Staining – Routine cytology stain Pap, MGG, H&E advantages and disadvantages.
- ii) Collection, preparation of gynecological and non-gynecological specimens- exfoliative cytology.
Gynecological – vaginal, cervical, endocervical, endometrial
Non-gynecological – sputum, bronchial, Body fluids (serous effusions), CSF, urine.
- iii) Concentration technique in cytology - Centrifugation, cyto-centrifugation, membrane filters, cell blocks.
- iv) Liquid based cytology – monolayer preparation.

Female Genital Tract Cytology

- Cervical cytology : Normal cells in cervical smear, Inflammatory lesions of the female genital tract – specific and nonspecific inflammation.
- Respiratory tract cytology – sputum, bronchial materials.
- Urinary cytology – urine.
- Serous effusions.
- CSF.
- GIT. (Gastro Intestinal Tract cytology.)
- FNAC – Scope, advantages and disadvantages,
- Organization of cytology lab.
- Cytology laboratory safety.
- Quality control measures in cytology.
- Automation in cytology – Preparation, staining, Auto screening.

TRANSFUSION TECHNOLOGY

60 hours

Course Outcome :

1. CO1 : Clinical & laboratory aspects of transfusion medicine.
 2. CO2 : How to provide effective blood & blood products.
 3. CO3 : Importance of blood donation & the tests related to it's screening.
 4. CO4 : Automation in Blood bank.
 5. CO5 : Recent advances in Blood Bank.
- General introduction to Blood Banking.
 - Blood group and its inheritance. Laws of Heredity.
 - ABO blood group system and its distribution.
 - Inheritance and distribution of Rhesus system. General introduction to Rh system.
 - Antigen Antibody reactions in immune Haematology.
 - Naturally occurring and immune antibodies. Complement and Blood group antibodies.
 - Preparation of grouping sera.
 - General methods of Antigen and antibody detection.
 - ABO grouping methods and factors influencing.

- Rh-typing methods (using complete and incomplete anti-D).
- The MNs blood group system. P-Blood group system. Lutheran Blood group system.
Kell Blood group system, Lewis Blood group system. Duffy Blood group system, Kidd blood group system, Private Blood group, Bombay Blood group. Diego and I / I system. Du Antigen and their importance.
- Collection and storage of Blood sample for blood grouping, preservation of Red cells in Glycerol and in liquid Nitrogen, Storage of sera. Preparation and use of Enzyme

treated

Red cells in Blood grouping methods of differentiation of group A1 from Group A2. Secretors Non-secretors and the method to detect them.

- Blood grouping for Antenatal work. ABO and Rh Haemolytic disease of new born and principle of coomb's test - Direct and indirect their method and applications. Exchange

change

Blood transfusion. Prevention methods of Rh-Haemolytic disease of Newborn.

- Compatibility test in blood transfusion and abnormal reactions which are not due to ABO or D- incompatibility. Compatibility testing method in urgent and Non-urgent cases. Special problems of compatibility.
- Antibody Titrations: Basic titration technique, Numerical scoring of results.
- General Management and Essential components in Blood Bank.
- Grouping, Cross matching and Serological tests on donor blood.
- Screening of Donors: Physical and clinical Examination. Copper sulphate method for Haemoglobin, Screening for Parasitic infections – Malaria, Filariasis. VDRL test, Icteric Index, grouping and Rh-typing, Antibody screening, Screening for HBs Ag, HCV and HIV.
- Anticoagulant solution used in blood Transfusion. Pyrogen and its complications. Test for detecting pyrogens.
- Temperature for storage of Blood. Preservation / storage of Blood. Transport of Blood.
Storage of Plasma. Disadvantage of storage. International colouring of Blood labels.
- Transfusion Reaction, Principles and methods of investigating Transfusion Reactions.
- Transmission of diseases by blood transfusion.
- Component Therapy: Preparation of Transfusion of Leucocytes pure blood, Red cells, concentration. Platelet rich plasma. Platelet concentrate, Factor VIII. Plasma apheresis.
- Transfusion in Vonwillibrant Disease, Transfusion of plasma, Transfusion of leucocyte /granulocyte, leucopheresis. Transfusion of plasma components and preparation of Cryoprecipitate, its use and advances.
- Automation in recent developments in Blood Banking.

Practical

200

Hours

- Preparation of fixatives used in cytology
- Papanicolaou staining, May Grunwald Giemsa stain
- Shorr stain

- Processing and staining of various fluids for cytological examination
- Examination of normal and inflammatory cervical smears.
- Demonstration of normal cytology of respiratory tract, urinary tract, CSF, effusions.
- Preparation of 5% red cell suspension.
- ABO Blood grouping – cell grouping and serum grouping
- Rh typing methods
- Du typing
- Preparation of IgG coated cells, Direct and Indirect Antiglobulin tests
- Antibody titration
- Secretory status
- Screening tests done in donors
- Collection and storage of blood in blood bank
- Separation of packed red cells, FFP and cryoprecipitate

BOOKS RECOMMENDED FOR CYTOLOGY

1. Diagnostic Cytology and its Histopathologic Basis - Vol 1 & II- E.G. Koss
2. Test Book of Cytology - Walter.V. Bran & i. Eldrige
3. Cytological techniques - J.F. Baker
4. Exfoliative cytology in Gynecological practice - Erisa.G. Wachtel
5. Diagnostic cytopathology in the uterine cervix - Glaudes Gempal
6. Atlas of Diagnostic cytology - Glaudes Gempal
7. Functional medical laboratory technology A comprehensive series of manual histology and cytology -Stanley.L.Lamber, Robert Rothatem Avi
8. Compendium on diagnostic cytology, Tutorial of cytology – Weid, George etal
9. Manual and atlas of fine needle aspiration cytology - Svante R, Orell.

Recommended books for Blood Banking :

1. Basic Essentials of Blood Group Theory and Practice - Boorman and Dodd
2. Introduction to Blood Group serology - Boorman and Dodd
3. Essentials of Blood groupin and clinical applications - K. S. Ranganathan
4. Blood group Serology - Boorman
5. Laboratory Hand book of Blood Transfusion Technique - Farr
6. Blood Grouping Techniques - Schief and Boyd
7. Technical methods and procedures of the American Association of Blood Banks -Revised 1956
8. Clinical Blood Transfusion - Kay
9. Blood Transfusion – Kelton
10. Blood Transfusion in Clinical Medicine - P. L. Mollison
11. Manual of Clinical Blood Transfusion – Brozovic

Paper XII BMLT34
COMPUTER APPLICATIONS, RESEARCH METHODOLOGY, BIostatISTICS &
LABORATORY MANAGEMENT - 90 HOURS

CO1: Basic knowledge in computer applications

CO2: Basic knowledge in Research Methodology and Biostatistics

CO3: Basics of Laboratory Managements

1 Basic Computer Sciences -20 hours

Topic

- a. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.).
- b. Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge.
- c. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs.
- d. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.
- e. Introduction of Operating System: introduction, operating system concepts, types of operating system.
- f. Computer networks: introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network.
- g. Internet and its Applications: definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
- h. Application of Computers in clinical settings.
- i. Introduction to alternative operating systems like Linux.
- j. Introduction to alternatives to MS office like Open Office –
- k. Introduction to OpenDocument Drawing, OpenDocument Presentation and Open-Document Spreadsheet

Practical on fundamentals of computers –

1. Learning to use MS office: MS word, MS PowerPoint, MS Excel
2. To install different software.
3. Data entry efficiency

2. Research Methodology & Biostatistics - 25 hours

- a. Introduction to research methods
- b. Identifying research problem
- c. Ethical issues in research
- d. Research design
- e. Biostatistics: Probability & Sampling distribution; Estimation, Hypothesis testing & application; Correlation & regression analysis.
- f. Research methodologies: Study population; Variables; Sampling; Sample size determination; Plan for data collection; Methods of data collection; Plan for data processing and analysis; Ethical considerations.
- g) Developing a research proposal
- h) Computer Application in Research: Elementary knowledge of Statistical Analysis

3. Quality assurance and management – 10 hours

1. Concepts of Quality of Care
2. Quality Improvement Approaches
3. Standards and Norms
4. Quality Improvement Tools
5. Introduction to NABL guidelines

4. Bio medical waste management and environment safety- 5 hours

The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:

- a) Definition of Biomedical Waste
- b) Waste minimization
- c) BMW – Segregation, collection, transportation, treatment and disposal (including color coding)Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste
- d) BMW Management & methods of disinfection
- e) Modern technology for handling BMW
- f) Use of Personal protective equipment (PPE)
- g) Monitoring & controlling of cross infection (Protective devices)

5. Principals of Management – 15 hours

- a. Introduction to management
- b. Strategic Management
- c. Foundations of Planning
- d. Planning Tools and Techniques
- e. Decision Making, conflict and stress
- f. management
- g. Managing Change and Innovation
- h. Understanding Groups and Teams
- i. Leadership
- j. Time Management
- k. Cost and efficiency (including finance management)
- l. Fundamentals of emergency management,
- m. Psychological impact management,
- n. Resource management,
- o. Preparedness and risk reduction,
- p. Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

Infection prevention and control – 5 hours

- a. Evidence-based infection control principles and practices [such as sterilization, disinfection, effective hand hygiene and use of Personal protective equipment (PPE)],
- b. Prevention & control of common healthcare associated infections, c) Components of an effective infection control program, and
- c. Guidelines (NABH and JCI) for Hospital Infection Control

Professionalism and Values – 10 hours

- a. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality X
- b. Personal values- ethical or moral values
- c. Attitude and behaviour- professional behaviour, treating people equally
- d. Code of conduct , professional accountability and responsibility, misconduct
- e. Differences between professions and importance of team efforts

- f. Cultural issues in the healthcare environment.

Reference Books

1. ABC of Research Methodology and Applied Biostatistics—A Primer for Clinicians and Researchers by N Parikh Mahendra, Gogtay Nithya.
2. Fundamentals of Computer Science and Information Technology: Umesh Kumar Singh and Sumit Jain
3. Laboratory Management, Principles and Processes, Third Edition, Dr. Denise M. Harmening
4. Linne & Ringsrud's Clinical Laboratory Science: Concepts, Procedures and Clinical Applications by Turgeon
5. Henry's Clinical Diagnosis and Management by Laboratory Methods, 22nd Edition, By Richard A. McPherson, MD and Matthew R. Pincus,

No	Topic	Theory Question paper mark pattern
1.	Part I Basic Computer Sciences for Allied Health Sciences	30
2.	Part 2 Research Methodology & Biostatistics	30
3.	Part 3 Quality assurance and management	10
4.	Part 4 Biomedical waste management	5
5.	Part 5 Principals of Management	15
6.	Part 6 Infection prevention and control	5
7.	Part 7 Professionalism and Values	5
	Total	100

FOURTH YEAR

BIOCHEMISTRY – IV BMLT41

90

Paper XIII
hours

Course Outcome :

1. CO1 : Elaborate knowledge on molecular biology and techniques related.
2. CO2 : Knowledge on Quality control, calibration and pre and analytical variables.
3. CO3 : Organisation of a laboratory.

1. MINERAL METABOLISM AND ESTIMATION

- Calcium, phosphate, magnesium, sodium, potassium, Chloride, Iron, Copper, Zinc, Iodine: metabolism and disorders.
- Methodology of the estimation of the above minerals in blood, plasma and other body Fluids

2. FUNCTION TESTS

- Liver function tests: Disease of the liver-Jaundice, acute and chronic hepatitis, Cirrhosis, Cholestasis etc
- Kidney function tests
 - Glomerular function and measurements, clearance tests,
 - Tubular function tests, clinical syndromes
- Gastro intestinal function tests
 - Collection of Gastric Juice. Tests for Gastric Function, Stimulation methods-Test Meals, Measurements of other Gastric Components, Malabsorption, Tests for occult blood in faeces, Tests for malabsorption studies, Schilling test, D-xylose absorption test, faecal

fat estimation.

-Estimation of free and total acidity

- Pancreatic function tests
 - Tests in Pancreatic diseases
 - Serum Enzymes and Urinary Enzymes
 - Direct stimulation tests and indirect stimulation of the pancreas-Sweat tests
- THYROID FUNCTION TESTS-hyperthyroidism and hypothyroidism
- GONADAL FUNCTION TESTS –disorders in males and females
- FETAL PLACENTAL FUNCTION TESTS -Hemolytic disease of Newborns, biochemical assay for fetal lung maturity, Biosynthesis of Estriol , measurements and clinical applications.

3. ACID-BASE BALANCE

- Body buffer system
- Respiratory regulation of PH, renal regulation of PH.
- Disturbance in acid base balance, Anion gap, metabolic acidosis, metabolic alkalosis, Respiratory acidosis, Respiratory alkalosis,
- Fluid and Electrolyte balance, osmolality, methodology of Blood PH and Gases estimation.

4. AUTOMATION

Definition, functions, principle. Different parts and functions, merits and demerits of different autoanalyser.

- Continuous flow analysers
- Discrete Analysers
 - 1).Batch Analyzers – i) Semi auto analyzer, ii) Fully automated analyser
 - 2).Stat Analyzer. – i) Centrifugal Analyzer, ii) Dry chemistry analyzer
- Recent trends in automation of clinical chemistry.
- Laboratory Informatics.

5. **QUALITY CONTROL**

- Definition of precision, Accuracy, Standard deviation
- Pre –analytical variables and Analytical variables
- Quality control charts, control sera
- Quality control programme
 - Internal quality control and External quality control
- Establishment and use of reference values, Analytical and Statistical procedures used in establishing reference values.
Knowledge of NABL and other accreditation processes with respect to quality control.

6. **HORMONES**

- General properties of hormones. Hormone action, pituitary hormones, hypothalamic hormones, Hormones of Pancreas, Thyroid, Parathyroid hormones, Hormones of adrenal medulla, adrenal cortex and Gonad.
 - Different methods for estimation of hormones and hormone metabolites in blood and Urine. Steroid hormones.
 - Chemistry & Metabolism. General techniques in steroid determination. 17-Oxo steroids and Oxogenic steroids prostersterone
 - Determination of Oestrogens, in plasma and Urine Urinary oestriol
 - Determination of Catecholamines Urinary VMA.
 - Determination of urinary 5 HIAA
7. Toxicology and drug assay in clinical biochemistry. General methods of analysis and screening test for common drugs used in therapy. General methods of analysis and screening tests for common poisons including insecticides and other pesticides, heavy metals etc
8. Organization and management of the Clinical biochemistry laboratory
9. Molecular Biology :- replication of DNA – DNA repair
- Transcription – Genetic code
 - Translation- steps ,factors ,inhibitors, post translational modification, protein folding & protein targeting
 - Molecular genetics, gene expression , recombinant DNA Technology Gene therapy
 - Techniques in Molecular Biology-recombinant DNA technology,
 - Blotting techniques.
 - PCR
 - Genomic library,
 - human genome project, cloning, FISH.

PRACTICALS

180 Hours

1. Estimation of calcium, phosphorus, magnesium, Iron and Copper, Sodium and Potassium by flame Photometry.
2. Diagnosis of disease with clinical correlation and Biochemical analysis of blood and Urine.
3. Determination of clearance-urea and creatinine

4. Gastric juice analysis
 - a. Titrable acidity
 - b. Test for malabsorption studies, D-Xylose
 - c. Stool fat, Occult blood in faeces
5. Blood gas analysis, PH, PO₂, PCO₂.
6. Estimation of biocarbonates
7. Estimation of hormone metabolites in Urine - 17-Ketosteroids,17-Ketogenic ,Steroids, Urinary oestriol, Urinary VMA, 5 HIAA
8. Familiarization and usage of all types of auto analyser
9. Plotting of quality control charts and calculation of standard deviation
10. Toxicological assays.

RECOMMENDED TEXT BOOK-BIOCHEMISTRY-PAPER IV

1. Text book of clinical chemistry - Nobert. W. Teitz
2. Practical clinical biochemistry - Harold . Varkey-vol.1 & Vol. II
3. Clinical Biochemistry-Principles & Practice- Praful. B. Godkar

REFERENCE BOOKS

1. Lecture notes on clinical chemistry - L.G. Whitby
2. Biochemistry a care oriented approach- Montgomiry
3. Biochemistry in clinical practice - William's and Marks
4. Clinical chemistry - Kaplan
5. Clinical Chemistry in diagnosis and treatment : Philip .D. Mayne
6. Biochemistry - Trehan
7. Methods in Biostatistics - B.K. Mahajan
8. Clinical chemistry – Michael L.Bishop
9. clinical biochemistry metabolic and clinical aspects – William. J.marshall 7 stephen k.Bangert

Section- MYCOLOGY & VIROLOGY

MYCOLOGY

Course Outcome :

1. CO1 : Differentiate between common laboratory contaminants and pathogens.
2. CO2 : Isolation and identification of fungal pathogens.
3. CO3 : Illustrate Laboratory different detection methods, control prevention of fungal infections.

- Introduction to Mycology
 - A brief study of classification of fungi
- Morphology of fungus, yeasts, yeast like fungi
 - Dimorphic fungi, Filamentous fungi
- Reproduction of fungus

Medically important fungi

- Basic knowledge of medically important fungi and actinomycetes-
- Candida species, Cryptococcus, Sporothrix, Blastomyces, Paracoccidioides brasiliensis, Coccidioides immitis, Histoplasma,
- Agents of Chromomycosis, Penicillium, Fusarium, Cladosporium, Curvularia, Rhizopus, mucor, Aspergillus, Trichoderma species, streptomyces, Syncephalastrum, Cephalosporium and other medically important fungi.
- Dermatophytes, piedra, Alternaria, Rhinosporidium Torulopsis, Nocardia, Fonsecaea, Phialophora, Basidiobolus.
- Mycotoxins.

(Emphasis should be given to its morphology. Growth characteristics on Routine culture media and special media if any, tests used for its identification, pathogenicity, laboratory diagnosis and epidemiology prophylaxis.)

Fungal infections

- Basic knowledge of different types of fungal infections its causative agents and its epidemiology.
 - o Superficial mycoses
 - o Subcutaneous mycoses
 - o Systemic mycoses
 - o Opportunistic pathogens and its infections
 - o Ophthalmic infection
- Common media and stains used in Mycology
- Culture technique for fungal identification
- Laboratory animals in Mycology
- Special stains in fungus identification
- Types of specimens, its collection, transportation, Preservation and processing for the diagnosis of fungal infections
- Antifungal Susceptibility and its recent developments
- Serological methods for the diagnosis of fungal infection.
- Preservation of fungus
- Fungal infections in immunocompromised individuals.

VIROLOGY 30 Hours

INTRODUCTION TO VIROLOGY

Course Outcome :

1. CO1 : Understanding key Virology concepts and principle of viral classification.
2. CO2 : Knowledge about infectious viruses of medical importance in humans and the diseases they cause.
3. CO3 : Illustrate Laboratory detection methods, control prevention of viral infection and antiviral therapy.

General properties of viruses-Morphology, Replication, effects of viruses on the host cells.

- Principles of virus ,Taxonomy and classification.
- An elementary knowledge of medically important DNA and RNA viruses (Classification, Morphology, Pathogenicity, Host range, Methods of Laboratory diagnosis, prophylaxis and epidemiology).
- More emphasis should be given to HBV, HIV, Flavi virus and other common viral infection in India.
- Emerging viral diseases in Kerala

Cultivation of viruses

- Different methods of cultivation and isolation of viruses.
- Animal inoculation
- Embryonated egg inoculation-Anatomy of embryonated egg, Techniques of various routes of inoculation
- Tissue culture techniques
 - Classification with examples
 - Cell culture containers and cleaning
 - Preparation of media, reagents and solutions
 - Propagation, maintenance, preservation of various cell cultures
 - Description of common cell culture
 - Contamination in cell culture
 - Detection of virus growth in cell culture - C.P.E, Metabolic inhibition, Haemadsorption, Interference, Immunofluorescence
- Cytological and Cytochemical diagnostic methods
- Inclusion bodies- methods of staining and demonstration

DIAGNOSTIC VIROLOGY

- Collections, preservations, Transportation, Processing, Isolation and identification of the following specimens for viral diagnosis.
 - Skin lesion, Vesicle fluid,
 - Biopsy specimens,
 - C.S.F and other sterile fluids, pus, buffy coat,
 - Nasopharyngeal secretions, sputum,
 - Urogenital specimens
 - Faeces or rectal swab.
- Knowledge of safety procedures in dealing with biological materials
- Knowledge of viral infections in the context of immunocompromised individuals.

Serological diagnosis of viral infection,

- Paul Bunnel test
- Haemagglutination and Haemagglutination inhibition test
- viral neutralization tests
- Immunofluorescence
- Immunoelectron microscopy.

APPLIED MICROBIOLOGY - 30 Hours **Nosocomial infections**

Course Outcome :

1. CO1 : Develop an understanding of appropriate and relevant fundamental and applied scientific knowledge with the ability to use and apply that knowledge in a wide range of situations, including new situations within the professional discipline.
2. CO2 : The selection and use of appropriate laboratory and other materials and equipment and the ability to employ them in a safe and responsible manner to achieve the desired outcome.
3. CO3 : Apply scientific principles and methods to identify and solve problems associated with a particular area of professional expertise.

- Diagnosis and its control
- Infection associated with blood transfusion
- Infection associated with intravascular canula
- Post operative infections
- UTI
- Surgical and trauma related infections
- Respiratory infections and other hospital acquired infections
- Antibiotic resistance in hospitalized patients
- Collection of specimens for sterility tests, its transportation and processing
- Epidemiological aspects of control infections and diseases
- Epidemiological markers in bacterial infections
- Typing methods in Bacteriology
- Microbial bio- film -prevention, control and removal
- Role of microbiology lab for infection control in hospital Emerging infectious dis-

eases

- Collection, transportation and processing of specimens for the diagnosis of Hospital acquired infection

Bacteriology of air

Examination of Air-a brief review of microorganisms causing air borne diseases.

Examination of air in theatre or cabinets. Different methods in detail

Water Bacteriology

- Bacteriology of drinking water
- A brief review of microorganisms causing water borne diseases
- Examination of water - Methods of collection of water,
- Presumptive coli form count, Eijkman test or confirmatory E. coli test
- Membrane filtration methods

Microbiology of Milk and Milk products

- Milk born infections
- Examination of milk and milk products
- Preparation media and reagents for the study of water, food, milk and air
- Methylene blue test or phosphatase test, colony count test, Milk ring test, Turbidity test, whey agglutination test

Bacteriology of Food and food products

- Examination of food and food products.
- A brief review of micro organisms causing food borne diseases.
- Collection of samples and its processing-frozen food, canned food and preserved food.

Automation in diagnostic microbiology-

- Principles and its applications in diagnostic approach
Microbiology Laboratory Physical design
Management and organization Quality in the clinical Microbiology Laboratory
Genetically modified microorganisms Principles of luminescence assay

Molecular Diagnostic methods

- Molecular diagnostic techniques relevant to medical microbiology. Illustrative knowledge of restriction fragment length polymorphism.
- PCR and its modifications including nested PCR, Multiplex PCR. Special emphasis to Real-time PCR.
- Principles of different hybridization techniques Principles of recombinant DNA technology Blotting techniques
- Vaccines for infectious diseases
- Role of genetic engineering in vaccine developments

Serology

- Rheumatoid factor test- Roswaaler test, Latex agglutination test
- Antinuclear Antibody test- Fluorescent Antibody test, Agglutination test
- Detection of C- Reactive protein
- Haemolysin production and titration

PRACTICALS

180 Hours

Virology

- Demonstration of different type of cell lines.
- Demonstration of egg inoculation,
- Demonstration of CPE, Inclusion bodies, Paul Bunnel test,
- Demonstration of Viral Haemagglutination test, Viral Haemagglutinations inhibition test, Viral neutralization test,
- Demonstration of immunofluorescence technique; Electron microscopy

MYCOLOGY

- Study of growth characteristics, microscopic examination and identification of medically important fungi, collection, transportation and processing of specimens for mycological examination.
- Slide culture technique
- Germ tube test for yeast identification

Serology

- Rosewaaler test, Latex agglutination test.
- Antinuclear antibody tests.
- Detection of C-Reactive protein.

Haemolysin production and titration

ELISA

Examination of water- methods of collection of water and processing

Presumptive coliform count and confirmatory tests

Membrane filtration methods

Examination of milk and milk products

Preparation media and reagents for the study of water, food, milk and air

Methylene blue test or phosphatase test, colony count test

Milk ring test, Turbidity test, whey agglutination test

Examination of food and food products

Collection of samples and its processing –Frozen food, canned food and preserved food

PCR technique and its modifications

TEXT BOOKS

1. Medical mycology : Rippon
2. Text Book of Microbiology :Ananthanarayanan & Jayaram Panikker
3. Mackie & Macartney Practical
4. medical microbiology :Collee, Fraser, Marmion, Simmons
5. Bailey and Scott's Diagnostic Microbiology :Forbes Sahn, Weissfeld.
6. Medical Virology : Fenner and White

REFERENCE BOOKS

1	Principles and Practice of Infectious diseases	Mandell, Bennett, Dolin Vol- 1
2	Medical Microbiology	David Greenwood, Slack,
3	Mycology for the Clinical Laboratory	Gary S Moore, Douglass M Jaciow
4	Mannual of Clinical Mycology	Conant.N.F., Smith, Baker. R.D
5	Human Infections and Fungi	I Roger Der

Course Outcome :

1. CO1 : Knowledge about tissue processing for different microscopic techniques.
2. CO2 : Cut a section from given block and do H & E stain on it.
3. CO3 : Demonstrate atleast 6 special stains in Histopathology.
4. CO4 : Knowledge about museum mounting technique & IHC.
5. CO5 : Knowledge about automation in Histopathology.

Histopathological Techniques

- General understanding of the terms – Histology, Histopathology and Histopathological techniques.
- General organization of a Histopathology laboratory and basic requirements for a histopathology laboratory. Role of Histopathology laboratory in the diagnosis of diseases.
- Reception of specimens, identification and recording in the Registers, General introduction to the processing of tissues.
- Methods of examination of Fresh tissue specimens-Teased preparations, squash preparations, impression smears and frozen sections.

Fixation

- Aim of fixation. Qualities of fixatives. Classification of fixatives. Formalin fixative. Advantages and disadvantages of formalin fixatives. Methods of removing formalin pigment and deposits from cut sections. Use, advantages and disadvantages of other simple fixatives like mercuric chloride, potassium dichromate, chromic acid, osmium tetroxide, picric acid, Acetic acid Ethyl alcohol and Trichloroacetic Acid, Composition, uses, advantages and disadvantages of 10% Formol Saline, Buffered Neutral Formalin, Mercuric chloride.
- Choice of Fixatives, Composition uses advantages and disadvantages of Zenker's fluid, Bouins fluid Carnoys fixatives, Hellys fluid, Heidenhain's Susa, Clark's fluid, Flemming's fluid, Champy's fluid, Zenker's formol and Mullers fluid different histochemical fixatives, their merits and demerits
- Post Chromatization, Secondary fixation.

Tissue processing

- Dehydration, aim of dehydration, various dehydrating agents employed, their merits and demerits. Technique of dehydration clearing – aim of clearing, various clearing agents, their advantages and disadvantages.
- Impregnation – need and time requirement for impregnation and technique of paraffin wax impregnation.
- Principles, operation, parts and care of automatic tissue processors
- Special processing techniques: Fixation, processing and section cutting of bones, cartilages, connective tissue, CNS, pancreas, skin, teeth and eyeball.

Automated machines for tissue processing and hand processing.

Decalcification

Aim of decalcification, selection of tissue, Fixation of tissue, various decalcifying agents

used, decalcification techniques – end point determination and qualities of ideal decalcifying agents.

Embedding

- Different types of embedding media, advantages disadvantages. Method of embedding, principles uses advantages of vacuum embedding. Uses, advantages and disadvantages of Ester wax embedding, gelatin embedding, Celloidin embedding, double embedding and embedding using water. Resin embedding.

Casting/Blocking

- Types of moulds used. Technique of casting

Sectioning

- Different types of Microtome: - Rocking, Rotary, sledge, sliding and freezing microtome. Their operations and specifications. Different types of microtome knives, knife angle. Choice and care of knives. Sharpening of microtome knives, honing and different types of hone employed and honing technique. Stropping and different types of strops employed and techniques of stropping. Parts care and operation of automatic knives sharpening machine.
- Cutting of paraffin wax embedded sections: - Trimming of blocks, fixing the block on the microtome. Technique of sections cutting. Cutting serial sections recognition and correction of faults in paraffin sections.
- Fixation of sections to slides- water bath method, hot stage method and warmed slide method.
- Cutting of celloidin embedded section – Fixing of celloidin embedded sections on slides.
- Preparation and use of albumenised and starched slides.
- Special situations such as sectioning of teeth using microtome – forensic application

Staining

- Principles and Theory of staining, Biological staining, Basic staining technique. Classification of dyes. Principle of dye chemistry. Mordents, accentuators and accelerators. Uses of controls in staining procedure.
- Haematoxylin : - composition, preparation, uses, staining results advantages and disadvantages of all the different haematoxylin.
- Principle, preparation, storage, staining technique observation and interpretation of Haematoxylin and eosin stain.

Staining methods of following in tissue sections.

- Carbohydrates
 - Glycogen
 - Mucins – acid & neutral.
- Lipid – myelin.
- Pigments
 - Endogenous – haemosiderin, bile pigment, melanine, lipofuscins.
 - Artifact - formalin, malarial, schistosome, mercuri, chromic oxide.
- Minerals – Calcium, Copper.
- Connective tissues – collagen, reticular, elastic.
- Fibrin.
- Muscle striations.
- Microorganisms – bacteria, AFB, fungi, viral inclusion-HBs Ag.
- Special situations such as staining for biological samples such as semen

Advanced techniques in Histopathology

- Cryostat and their uses. Principle, care and operation of cryostat.
- Automation in histopathology
- Immuno cytochemistry and its application.
- Enzyme histochemistry, Immunofluorescent techniques in tissue sections.
- In situ hybridization.
- Electron microscopy- processing and Techniques.

Postmortem room Technique

- Collection and preservation of tissue, collection of materials for laboratory studies.

Museum Technique

- General introduction, organization of a museum. Source of materials, need for preservational mounting, Reception, preparation, labeling, fixation of various specimens and organs, storage of specimen, mounting of museum specimens, museum jars, perplex and glasses, their advantages and disadvantages, Demonstration of Bone, calculi, Transparent specimen (Fetal skeleton) amyloid. Modern methods in museum technique.

Cytogenetics

Course Outcome :

CO1 : Basic concepts of genetics.

CO2 : Role of genetics in prevention & management of various disease.

CO3 : Structure of chromosome & it's abnormalities.

CO4 : Karyotyping.

CO5 : Awareness of advanced techniques like FISH & SKY.

- Human sex chromosomes.
- Sampling staining and demonstration of Barr body. Reporting and interpreting Barr test.
- Demonstration of Y-chromosome, Origin and demonstration of drumstick, small clubs, sessile nodules and balloons. Drumstick count and its interpretation.

Karyotyping

- Methods of Chromosome analysis
- Banding techniques.
- Chromosome analysis with blood and bone marrow. Morphology of chromosome and their identification. Criteria for chromosome identification. Identification criteria of group to group of chromosome. Conventional designation.

Chromosome Defects

- Physiologic factors are influencing the aetiology of chromosome defects, Types of chromosome defects- Structural abnormalities and human autosomal syndromes. Philadelphia chromosome and chromosome changes in Neoplasia, abnormalities of sex chromosome at birth, at puberty and in adults.
- Turner's syndrome, Down's syndrome, Klinefelter syndrome,
- Advanced methods in cytogenetic – FISH, SKY.
- Clinical utility of Bone Marrow culture.

Practical 180 HOURS

- Preparation of commonly used fixatives- Formalin, Bouins, Zenkers, Carnoys
- Automatic tissue processors
- Decalcification
- Embedding
- Section cutting
- Cryostat section cutting
- Preparation of haematoxylin stains- Harris, Ehrlich's, Mayers, Weigert's, PTAH, Verhoeff's
- Special stains- PAS, Perl's ,Reticulin, Vangieson, Masson Trichrome, Verhoeff's elastic stain, Masson Fontana, Alcian blue, AFB, Wade- Fite, Methenamine stain, Von Kossa, PTAH, Oil red O stain, Mucicarmine stain.
- Chromosome preparation
- Karyotyping
- Preparation of karyotype from bone marrow specimen
- Barr body demonstration

TEXT BOOK

Hand book of histopathological techniques- CFA culling

BOOKS RECOMMENDED FOR REFERENCE

1. Basic Histology - L.C. Junquera
2. Manual of Histological staining AFTP Fasicle 3rd Edition Reprinted 1982
3. Lynch's Medical Laboratory Technology - Raphael
4. Self Assessment in Histological Techniques- Bancroft
5. Manual of Histological Techniques - Bancroft
6. Histopathology – A step-by-step approach - Lewis
7. Basic Histopathology - Wheather
8. Colour Atlas of Histopathology - Curran
9. Cellular pathology technique - 5th Edition

BOOKS RECOMMENDED FOR CYTOGENETICS

1. Human Chromosomes- Manual of basic techniques – Ram . S. Verma, Arvid Babu.
2. Cytogenetics, FISH and molecular testing in hematologic malignancies – Wojciech Gorczyca

Paper XVI

Project (150 Hours)

Submission of a Project work is a compulsory requirement for the B Sc MLT – course. Each student can choose a topic for the project in any one of the subjects – Microbiology/Biochemistry/Pathology which would be approved by his/her supervising teacher. The topics for project shall be divided equally among total number of students from the three main subjects Microbiology/Biochemistry/Pathology.

The option for topics selection for the project will be based on the following criteria

- Total marks obtained in all the previous university examinations up to 3rd year.

- If total marks obtained equal for more than one student then marks obtained for the optional subject may be considered.

The supervising Teacher should have minimum 3 years full time teaching experience in the concerned subject. The student should be under the guidance of the supervising staff, carry out the work on the topic selected and prepare a project report including results and references. The project report duly certified by the supervising staff and head of the department of MLT one month prior to fourth year university practical examination should be submitted to the fourth year B Sc MLT University practical examination of concerned subject.

The project report evaluation will be conducted by the concerned subject internal and external examiners together in the Fourth year B Sc MLT University practical examination.

SCHEME OF EXAMINATION

a) The following rule may be followed when distributing mark

Paper I		
Theory	Paper I A (Anatomy)	50 Marks
	Paper I B (Physiology)	50 Marks
Sessional marks		
Internal Marks Theory	Paper I A (Anatomy)	12 Marks
	Paper I B (Physiology)	13 Marks
Other Papers		
Theory		100 marks
Practical		First year and second year— 100 Third year and fourth year – 150 marks (10 marks for
Oral		50 marks
Sessional marks		
Theory		25 marks
Practical		25 marks

b) The detailed scheme of mark distribution in each subject is shown in the table

First Year BSc MLT

Paper	Theory						Practical						Grand Total		
	University		Sessional		Total		University		Sessional		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-I	100	50	25	12.5	125	62.5	-	-	-	-	-	-	-	125	62.5
Paper-II	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-III	100	50	25	12.5	125	62.5	100	50	25	12.5	50	125	62.5	300	150
Paper-IV	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	350	175
Total Mark														1025	512.5

Second Year

Paper	Theory						Practical						Grand Total		
	University		Sessional		Total		University		Sessional		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-V	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	62.5
Paper-VI	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Paper-VII	100	50	25	12.5	125	62.5	100	50	25	12.5	50	125	62.5	300	150
Paper-VIII	100	50	25	12.5	125	62.5	100	50	25	12.5	50	175	87.5	300	150
Total Mark														1200	600

Third Year

Paper	Theory						Practical						Grand Total		
	University		sessional		Total		University		sessional		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-IX	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-X	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XI	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XII	100	50	25	12.5	125	62.5	-	-	-	-	-	-	-	125	62.5
Total Mark														1175	587.5

Final Year

Paper	Theory						Practical						Grand Total		
	University		sessional		Total		University		sessional		viva	Total			
	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min		Max	Min	Max	Min
Paper-XIII	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XIV	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XV	100	50	25	12.5	125	62.5	150	75	25	12.5	50	225	112.5	350	175
Paper-XVI Project							50							50	50
Total Mark														1100	550

3.5. Duration of theory and practical exams

Year of study	Paper	Subject	Duration of exam		Description
			Theory (Hours)	Practical (Days)	
First Year	Paper-I A	Anatomy including Histology	2	-	For practical examination one batch comprises maximum of 25
	Paper-I B	Physiology	2	-	
	Paper-II	Biochemistry-I	3	1	No Practical Exam for anatomy & physiology.
	Paper-III	Basic Microbiology & Immunology	3	1	
	Paper-IV	Basic Medical Laboratory Science & Haematology – I	3	1	
Second Year	Paper-V	Biochemistry-II	3	1	
	Paper-VI	General Microbiology	3	2	In case of two batches, Practical exam in paper- VI can be completed in 3 days. (1st & 2nd day for first batch and 2nd & 3rd day for second batch.)
	Paper-VII	Parasitology & Entomology	3	1	
	Paper-VIII	Haematology-II & Clinical Pathology	3	1	

Third year	Paper-IX	Biochemistry -III	3	3	
	Paper-X	Bacteriology	3	2	In case of two batches, Practical exam in paper - X can be completed in 4 days. (1st, 2nd & 3rd day for first batch and 2nd, 3rd & 4th day for second batch.)
	Paper-XI	Cytology and Transfusion technology	3	2	In case of two batches, Practical exam in paper - XI can be completed in 3days. (1st&2nd day for first batch and 2nd&3rd day for second batch.)
	Paper-XII	Computer Application, Research methodology & Laboratory management.	3	-	No practical exam for Paper- XII
Fourth year	Paper-XIII	Biochemistry-IV	3	3	In case of two batches, Practical exam in paper – XIII &XIV can be completed in 4 days. (1st, 2nd & 3rd day for first batch and 2nd, 3rd & 4th day for second batch.)
	Paper - XIV	Mycology, Virology & Applied Microbiology	3	3	
	Paper XV	Histotechnology & Cyto genetics.	3	2	
	Paper XVI	Project			Power point presentation & viva of the project for a

Question Paper setting and evaluation

c) Question Paper pattern

All the question paper should be of standard type. Each theory paper will be of 3 hours duration and shall consist of twenty two questions with a maximum of 100 marks. Theory paper in all the subjects shall consist of Two essay type questions with 10 marks each, Ten brief answer type questions carrying 5 marks each, Ten short answer type questions carrying 3 marks each except in Paper - I Paper I (Anatomy and Physiology) consist of two divisions named as Paper I A - Anatomy including Histology and Paper I B - Physiology. Each division carries 50 marks and shall consist of one essay type question with 10 marks, five brief answer type questions carrying 5 marks, five short answer type questions carrying 3 marks. Also examination in paper I A and Paper I B will be conducted separately in 2 days. The Maximum duration allowed for Paper I A and Paper I B is 2 hours each.

Valuation of Project

The project report evaluation will be conducted by the internal and external examiners together in the concerned subject of Fourth year B Sc MLT University practical examination.

Candidate who has secured a minimum of 50% marks in the University examination (theory and practical separately) and 50% marks in Total for theory block (University theory examination and internal assessment) and 50% in practical block (University Practical, Viva & Internal assessment) separately in any subject or subjects shall be declared to have passed in that subject / subjects. There will be no minimum marks for viva examination. A candidate who fails in any subject or subjects in the examination may need to appear only for that subject or subjects in the subsequent supplementary or regular university examination.

Five marks (or as per university regulations) may be given as grace mark either in a subject alone or distribute it among subjects so as to make the candidate eligible for a Pass.

Model question paper for each subject with question paper pattern

**First Year B.Sc. MLT Degree Examinations
Paper I A - ANATOMY INCLUDING HISTOLOGY**

Time: 2 Hours Total Marks: 50

Answer all Questions. Draw Diagrams wherever necessary.

Essay

1. Describe the respiratory system under the following headings:

- Parts
- Relations
- Microscopic anatomy of lungs
- Broncho pulmonary segments

(2+3+2+3=10)

Short notes

(5x 5=25)

2. Liver
3. Synovial joint
4. Microscopic structure of kidney
5. Prostate
6. Right atrium

Answer briefly

(5x3=15)

7. Fallopian tube
8. Thymus
9. Neuron
10. Vermiform appendix
11. Deltoid muscle.

B.Sc MLT Degree Examinations

Paper I B - PHYSIOLOGY

Time: 2 Hours

Total Marks: 50

Answer all Questions. Draw Diagrams wherever necessary.
Write the Answers in books containing 32 Pages.

Essay (10 marks)

1. Define blood pressure. Explain the short term regulation of blood pressure. Describe any one method of determination of blood pressure (2+5+3=10)

Short notes

(5X5=25 marks)

2. Oxygen dissociation curve
3. Pain pathway
4. Water re-absorption in renal tubule
5. T-lymphocytes
6. Deglutition

Answer briefly

(5x3=15 marks)

7. Pregnancy test
8. Parathormone
9. Plasma proteins
10. Functions of placenta
11. Tidal volume

First B.Sc MLT Degree Examinations

PAPER II . BIOCHEMISTRY-I

Time: 3 Hours

Total Marks: 100

Answer all Questions.

Draw Diagrams wherever necessary.

Essay (2x10=20)

1. Enumerate the various hazards that can occur in a clinical lab and discuss about the hazards from dangerous chemicals . (3 + 7 = 10)
2. What are the different levels of organization of proteins. Discuss the primary structure of proteins with suitable example . (2 + 8 =10)

Short notes (10x5=50)

3. Fluorimetry
4. Functions of lipids.
5. Flame photometry.
6. Glucose transporters.
7. Denaturation of proteins.
8. Structure of biomembrane.
9. Structure and functions of t RNA.
10. Active transport across cell membrane.
11. Preparation of 500ml of 0.1M silver nitrate.
12. Preparation of cleaning solution for biochemical glass wares in a clinical lab.

Answer briefly (10x3=30)

13. Histones.
 14. Lysosomes
 15. Distilled water.
 16. Rancidity of fat.
 17. Oxidation of glucose.
 18. Anomerism in sugars
 19. Units of radio activity.
 20. Composition of borosilicate glass wares.
 21. Muta rotation and its practical importance.
 22. Define normality. Mention the procedure for preparation of 100 ml of 1N HCl.
-

First Year B.Sc. MLT Degree Examinations.
Paper III- Basic Microbiology & Immunology

Time: 3 Hours

Total Marks: 100

Answer all questions & Draw diagrams wherever necessary

Essay (2x10=20)

1) Define sterilization. What are the different methods of sterilization?

Write in detail about moist heat sterilization. (1+3+6=10Marks)

2) Classify Immunoglobulins. Discuss the structure and functions of immunoglobulins.

(1+9=10Marks)

Short notes

(10x5=50)

- 3) Robert Koch
- 4) Safety cabinets
- 5) Bacterial flagella.
- 6) ELISA
- 7) Differentiate Gram positive and negative cell wall
- 8) Vaccines.
- 9) Monoclonal antibody
- 10) Classical complement pathway.
- 11) Hypersensitivity reactions
- 12) Lymphocyte subsets

Answer Briefly

(10x3=30)

- 13) Sintered glass filters
- 14) Negative staining
- 15) In-use test
- 16) Different types of Membrane filters
- 17) Chemo sterilizer
- 18) Super antigens
- 19) Agglutination reactions 66
- 20) AFB staining
- 21) Neutralisation test
- 22) interferon

First Year B.Sc. MLT Degree Examinations

Paper IV. Basic Medical Laboratory Science & Haematology – I

Time: 2 Hours

Total Marks: 100

Answer all questions

Draw diagrams wherever necessary

Essay (2x10=20)

1 Define differential leucocyte count. Write the preparation & uses of different types of blood smears (2+8=10 marks)

2. Mention different types of microscopes. Describe aberrations of light microscope.

Describe the principle working & applications of Dark ground microscope (2+3+5=10 marks)

Short notes

(10x5=50)

3 .Platelet count

4. ESR

5. Red cell indices

6. Romanowsky stains

7. Diluting fluids

8. Goals & Scopes of Medical ethics

9. Laboratory hazards

10. Micrometry

11. Total WBC count

12. Cyanmethaemoglobin method (10x5=50marks)

Answer Briefly

(10x3=30)

13.PCV

14. Reticulocyte

15. Citrate as anticoagulant

16. Red cell indices

17. Buffy coat smears

18. Demonstration of HbF

19. Principles of automated cell counters

20. Preparation of bone marrow smears

21. Vacutainers

22. Megakaryocyte

SECOND YEAR BSc MLT EXAMINATION (Model Question Paper)

Paper- V. Biochemistry - II

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Discuss briefly the De novo synthesis of purine nucleotides (10)
2. Discuss various methods of cholesterol estimation. Write any one method in detail
(4+6=10)

Short Notes

(10x5=50)

3. CSF analysis
4. Gluconeogenesis
5. Urea cycle
6. Phenyl ketonuria
7. Energetics of TCA cycle
8. Importance compound
9. Fatty liver
10. Bile acid synthesis
11. Biuret method of total protein estimation
12. Functions of vitamin A

Answer Briefly

(10x3=30)

13. Cori's cycle
14. Significance of HMP pathway
15. Galactosemia
16. Polyamine synthesis
17. Role of vitamin K in coagulation
18. Functions of vitamin C
19. Niemann - pick disease
20. Biosynthesis of phosphatidyl serine
21. Role of biotin in fatty acid synthesis
22. Glucuronic acid pathway

SECOND YEAR BSc MLT EXAMINATION (Model Question Paper)

Paper- VI. General Microbiology

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Enumerate bacterial enzymes detected in your lab. Discuss in detail. (2+8=10)
2. Enumerate the different methods of transmission of genetic material in bacteria. Describe each. (2+8=10)

Short notes (10x5=50)

3. TSI
4. Modern anaerobic culture methods
5. typing of bacteria
6. selective media
7. classification of microorganisms
8. Germ free animals
9. Guinea pig
10. Euthanasia in lab animals
11. Lac operon
12. Turbidometric method of measuring bacterial growth

Answer briefly (10 x3=30)

13. RCM
14. Enrichment media
15. Chocolate agar
16. Of test
17. PPA test
18. Postmortem examination of animals
19. Disposal of carcasses
20. Solidifying agents in culture media
21. Isolation of bacterial mutants
22. Genotypic and phenotypic variations in bacteria

SECOND YEAR BSc MLT EXAMINATION (Model Question Paper)

Paper- VII. Parasitology and Entomology

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Describe the morphology life cycle pathogenesis clinical features and laboratory diagnosis of malaria (10)
2. Classification of insects of medical importance. Discuss briefly binomics of anopheles (7+3=10)

Short Notes

(10x5=50)

3. Hydatid cyst
4. Schistosoma haematobium
5. Toxoplasma gondii
6. Pathogenic free living amoeba
7. Laboratory diagnosis of kala-azar
8. Transmission of infection by insects
9. Insecticides and resistance
10. Cyclops and its control
11. Sarcoptes scabiei
12. Mosquito control measures

Answer Briefly

(10x3=30)

13. Bile stained ova
14. Diphylobothrium latum
15. Balantidium coli
16. Trichomonas vaginalis
17. Xeno diagnosis
18. Integrated vector control
19. Head louse
20. Biological control
21. Life cycle of hard tick
22. Rat flea

SECOND YEAR BSc MLT EXAMINATION (Model Question Paper)

Paper- VIII. Haematology and Clinical Pathology

Time: 3 hrs Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Define leukemia. Classify it. Explain the blood and bone marrow findings in CML (2+3+5=10)
2. What is HCG. Mention HCG levels at various stages of pregnancy. Explain different card tests used for the detection of pregnancy. (1+4+5=10)

Short Notes

(10x5=50)

3. Urine preservatives
4. Prothrombin time
5. Bence Jones protein
6. Examination of blood for parasites
7. Hbs
8. Fibrin degradation products
9. Laboratory diagnosis of iron deficiency anaemia
10. Semen analysis
11. Leukaemiod reactions
12. Myeloperoxidase stain

Answer briefly

(10x3=30)

13. Detection of ketone bodies in urine
14. Bleeding time
15. Fouchet's test
16. CSF cell count
17. Measurement of faecal fat
18. Haemoplilia
19. Occult blood in stool
20. Organised sediments of urine
21. Automated blood cell counter
22. Ham's test

**Third year BSc MLT Degree Examinations
Paper IX . BIOCHEMISTRY III**

Time: 3Hours

TotalMarks:100

- Answer all questions
- Draw diagrams wherever necessary

Essays: (2x10=20)

1. Discuss the basic principle of Chromatography. Write the detailed procedure for separation of urinary Amino acid by Chromatography. (2 +8=10)
2. Describe the biosynthesis of Heme synthesis. Add a note on its regulation (8+2=10)

Short notes: (10x5=50)

3. Bohr effect
4. Isoenzymes of Alkaline phosphatase
5. SDS-PAGE
6. Estimation of serum Bilirubin
7. Co-enzymes
8. Acute intermittent porphyria
9. Factors affecting the electrophoretic mobility
10. Common laboratory investigations for porphyrias
11. Affinity Chromatography
12. Urinary calculi analysis

Answer briefly: (10x3=30)

13. Glucose -6-phosphate dehydrogenase
14. K_m Value of enzymes
15. Active site of enzymes
16. Suicide inhibition
17. Creatine kinase
18. Isoelectric focussing
19. Foetal Haemoglobin
20. Significance of Transaminases
21. Crigler-Naajar syndrome
22. Fluorescent immunoassay

Third year BSc MLT Degree Examinations

Paper X. BACTERIOLOGY

Time:3 Hours

Total Marks:100

- Answer all questions
- Draw diagrams wherever necessary

Essays: (2x10=20)

1. Enumerate the bacteria causing pyogenic meningitis. Write in detail the Laboratory diagnosis of Pneumococcal meningitis (2+8=10)
2. Classify the serological tests used to diagnose syphilis. How do you diagnose a case of syphilis in a laboratory (2+8=10)

Short notes:

(10x5=50)

3. CAMP test
4. Gas gangrene
5. Diarrhoeogenic Escherichia coli
6. Disc diffusion method of sensitivity tests
7. Laboratory diagnosis of Cholera
8. Processing of sputum for isolating Mycobacterium tuberculosis
9. Helicobacter pylori
10. Selective and Enrichment media for salmonella and Shigella
11. Preservation of bacteria.
12. Mycoplasma pneumoniae.

Answer briefly:

(10x3=30)

13. McFaydean reaction.
14. Diene Phenomenon
15. Significant bacteriuria
16. Chigger borne typhus
17. Rat bite fever
18. Sulphur granules
19. Lyme disease
20. Cell wall active antimicrobial agents
21. Lepromin test
22. ASO test

Paper XI . CYTOLOGY & TRANSFUSION TECHNOLOGY

Time: 3Hours

Total Marks:100

- Answer all questions
- Draw diagrams wherever necessary

Essays: (2x10=20)

1. Explain the techniques of collection of various samples from respiratory tracts. Enumerate the advantages & disadvantages of each sample. (5+5=10)
2. Mention different components used in blood bank. Explain preparation & use of FFP. (3+7=10)

Short notes:

(10x5=50)

3. Cell block
4. Storage of blood in blood bank
5. FNAC
6. Fixatives used in cytology
7. Plasma pheresis
8. Papanicolaou staining
9. Bombay blood group
10. Cross matching
11. Blood grouping sera
12. Quality control in cytology

Answer briefly:

(10x3=30)

13. Lectins used in blood bank
14. Cell cycle
15. Mailing of smears in cytology
16. LISS
17. DU Antigen
18. Processing of fluids in cytology
19. Transfusion transmitted diseases
20. Pre-fixation of cytological specimens
21. Dangerous O group
22. Cyto centrifuge

Third year BSc MLT Degree Examinations
Paper XII. COMPUTER APPLICATIONS, RESEARCH METHODOLOGY, BIOSTATISTICS

& LABORATORY MANAGEMENT

Time:3 Hours Total Marks:100

- Answer all questions
- Draw diagrams wherever necessary

ESSAY (2x10=20)

1. Define Correlation and regression . Describe the method of measuring correlation

(3+3+4=10 marks

2. How are charts useful in Excel? Compare any three chart types available in Excel

(4 +6=10)

Short notes

(10x5=50)

3. Quality improvement tools
4. Statistical Hypothesis
5. Collection, transportation and disposal of radioactive waste
6. Merits and demerits of Random sampling
7. Types of operating system
8. Basic guide lines for value educations
9. Different steps involved in research process
10. Ethical issues in qualitative research
11. Application of computer in clinical settings
12. NABL guidelines

Answer briefly

(10x3=30)

13. Types of probability
14. personal protective equipment
- 15 .Psychological impact of management
16. Fourth generation computers
- 17 Editing a document file
18. Common health care associated infections
19. What is text formatting
20. WAN
- 21 .Define information management
22. Coefficient of variation

FOURTH YEAR BSc MLT DEGREE EXAMINATION- (Model Question Paper)
PAPER. XIII. Biochemistry - IV

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Describe the different mechanisms by which acid base balance is maintained in our body.
2. Explain the iron metabolism in the body and its disorders

Short Notes

(10x5=50)

3. Mutations
4. Genetic code
5. Post translational modification
6. Calcium homeostasis
7. Inhibitors of transcription and translation
8. Glomerular function tests
9. 17-ketosteroids
10. Levy-Jenning chart
11. Discrete auto analyzers
12. Estimation of VMA

Answer Briefly

(10x3=30)

13. Wilson's disease
14. D-xylose test
15. Phosphorus estimation
16. Serum electrolytes
17. Hepatic jaundices
18. Cardiac profile
19. Pre-analytical variables
20. Urinary oestriol
21. Blood gas analysis
22. Anterior pituitary hormones

FOURTH YEAR BSc MLT DEGREE EXAMINATION

(Model Question Paper)

PAPER. XIV. Mycology, Virology and Applied Microbiology

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Enumerate hepatitis viruses. Explain the laboratory diagnosis of viral hepatitis
(1+9 =10)
2. Define nosocomial infections. Enumerate the etiological agents, laboratory diagnosis and control of nosocomial infections
(1+2+5+2=10)

Short notes

(10x5=50)

3. Dermatophytes
4. Dimorphic fungi and its infections
5. Automation in microbiology
6. Confirmatory tests for HIV infection.
7. Bacteriological examination of water sample
8. Detection of viral growth in cell culture.
9. Rhinosporidiosis
10. Dengue fever
11. Antinuclear antibody tests
12. PCR and its application in diagnostic microbiology

Answer briefly

(10 x3=30)

13. Otomycosis
14. Rabies vaccine
15. Epstein barr- virus
16. Prions
17. Settle plate method
18. Corn meal agar
19. RFLP
20. Methylene blue reduction test
21. Kyasanur forest disease
22. Calcofluor white staining

FOURTH YEAR BSc MLT DEGREE EXAMINATION- (Model Question Paper)
PAPER. XV . Histotechnology and Cytogenetics

Time: 3 hrs

Maximum marks: 100

Answer all questions

Draw diagrams wherever necessary

Essays (2x10=20)

1. Explain the principle, procedure and applications of immunohistochemistry
(2+5+3 =10)
2. Explain the steps involved in the metaphase preparation from blood and bone marrow specimens

Short Notes

(10x5=50)

3. Decalcification
4. Museum technique
5. Microtome
6. Cleaning agents
7. Connective tissue stains for collagens
8. Klinifilter's syndrome
9. FISH
10. Immuno fluorescent technique in histopathology
11. Chromosomal changes in cancers
12. Grouping of human chromosomes

Answer Briefly

(10x3=30)

13. Dehydrating agents
14. Turner's syndrome
15. Mitogens
16. 'Y' bodies
17. GTG banding
18. Section adhesive
19. Resin embedding media
20. Demonstration of melanin in tissues
21. Cryostat
22. Histokinitte

Model of scheme for Biochemistry Practical examination.

Year& Paper	Exercise	Marks
1st year – Biochemistry-I	1.Record	10
	2.Identification of Carbohydrate /protein.	50
	3.Volumetric analysis of NaOH/HCl/H ₂ SO ₄ /Na ₂ CO ₃ /KMnO ₄ /AgNO ₃ . (Any one of the tests may be given to each student on random basis)	40
	Total	100
2nd Year- Biochemistry-2	1.Record	10
	2. Standard curve preparation with test analysis- Glucose/Urea/Creatinine/Uric acid/ Cholesterol/Proteins. (Any one of the tests may be given to each student on random basis)	50
	3.Vitamin C /Vitamin A/GTT/ GCT/ Urine analysis- abnormal constituents/ CSF biochemistry. (Any one of the tests may be given to each student on random basis)	40
	Total	100
3rd year- Biochemistry-3	1.Record	10
	2.Paper chromatography/ Thin layer Chromatography/cellulose acetate electrophoresis/ Agar gel electrophoresis. (Any one of the tests may be given to each student on random basis)	50
	3. Estimation of serum bilirubin /estimation of urinary porphyrin/estimation of urinary porphobilinogen/urinary calculi analysis/urea clearance/ creatinine clearance. (Any one of the tests may be given to each student on random basis)	40
	4. Activity determination of serum AST/ ALT/ALP/ ACP/ Amylase/LDH/ CPK/ G6PD/ Ceruloplasmin. (Any one of the tests may be given to each student on random basis)	50
	Total	150
4th year project evaluation	Project content, Methods & findings	25
	Presentation	10
	Open viva	15
	Total	50

Model of scheme for Pathology Practical examination.

Year& Paper	Exercise	Marks
1st year –Basic Laboratory Sciences and Hematology -1	1.Record	10
	2.Differential count/ RBC Count/ WBC count/PLT count/ AEC/ Reticulocyte count (Any one of the tests may be given to each student on random basis)	40
	3.Hb estimation by Sahli’s Hb and Cyanmeth Hb methods/PCV/ESR/ Osmotic fragility /Red cell indices calculation (Any one of the tests may be given to each student on random basis)	30
	4. Spotters(10 spotters)	20
	Total	100
2nd Year- Clinical Pathology and Hematology-II	1.Record	10
	2. Peripheral smear preparation and examination/MPO staining/ SBB staining/ PAS staining/ Perl’s stain/ Urine analysis/Semen analysis/CSF analysis (Any one of the tests may be given to each student on random basis)	40
	3. Hb electrophoresis/ Sickling test/ BT/ CT/ PT/ APTT/ Ham’s test/ Faces analysis/ pleural fluid, peritoneal, synovial fluid analysis (Any one of the tests may be given to each student on random basis)	30
	4. Spotters(10 spotters)	20
	Total	100
3rd year-	1.Record	10

Cytology and Transfusion technology	2. Compatibility testing/ABO cell and serum grouping/ Papanicolaou staining/ MGG staining (Any one of the tests may be given to each student on <i>random basis</i>)	40
	3. Secretory status in saliva/ Titration of antisera/ Short's stain/ Rh typing by albumin and enzyme addition technique. (Any one of the tests may be given to each student on random basis)	40
	4. DCT/ ICT/ DU typing/ Examination of normal and inflammatory smear (Any one of the tests may be given to each student on random basis)	30
	5. Spotters(15 spotters)	30
	Total	150
4th Year- Histo technology and cytogenetic	1. Record	10
	2. Section cutting/ Metaphase spread preparation from bone marrow/ H&E staining (Any one of the case may be given to each student on <i>random basis</i>)	40
	3. PAS staining/ Van Gieson's staining/ Gomori's reticulum/ Perl's Prussian Blue staining/ Barr body demonstration in buckle smear (Any one of the tests may be given to each student on random basis)	40
	4. Honing and stropping/Preparation of Bouin;s , Carnoy's and Zenker's fixative/ Demonstration of drum stick appendages. (Any one of the tests may be given to each student on random basis)	30
	5. Spotters(15 spotters)	30
	Total	150
4th year project	Project content, Methods &	25

evaluation	findings	
	Presentation	10
	Open viva	15
	Total	50

Model of scheme for Microbiology Practical examination.

Year& Paper	Exercise	Marks
1st year –Basic Microbiology	1.Record	10
	2.Gram staining	25
	3.AFB Staining	20
	4.Motility testing	15
	5.AFB Staining techniques(capsule, spore, volutin granules, spirochetes),Preparation of articles for sterilization (Any one of the tests may be given to each student on random basis)	10
	Spotters	20
	Total	100
2nd Year- General Microbiology	1.Record	10
	2.Adjustment of pH of culture medium	10
	3.Media Preparation (Pouring & sterility test)	15
	4.Isolation of mixed culture	15
	5.Spotters	20
	6.Biochemical tests (Any six tests may be given to each student on random basis- 6*5)	30
	Total	100
2nd year – Parasitology & Entomology	1.Record	10
	2.Macroscopic & microscopic examination of stool.	5
	3. Concentration techniques for intestinal parasites in stool.	15
	4. Preparation of Thin and Thick blood smears.	5
	5. Staining , examination & identification of blood parasites.	20
	6. Dissection of mosquitoes to display mouthparts, wings & legs	20

	7. Collection, Preservation & preparation of permanent mounts of arthropods of public health importance	25
	Total	100
3rd year- Bacteriology	1. Record	10
	2. Case study (Samples) (Grams stain, Motility, Biochemical reactions and AST.)	100
	Total	150
4th Year- Virology, Mycology and Applied microbiology	1. Record	10
	2. Identification fungus	50
	3. ELISA	20
	4. Case study (specimen) for Hospital acquired infn	50
	5. Water analysis	20
	Total	150
4th year project evaluation	Project content, Methods & findings	25
	Open viva	10
	Total	50

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