THE ASSAM
ROYAL GLOBAL UNIVERSITY

ROYAL SCHOOL OF MEDICAL AND ALLIED SCIENCES (RSMAS)

DEPARTMENT OF MEDICAL LABORATORY TECHNOLOGY(MLT)

Learning Outcomes-based Curriculum Framework (LOCF) for

Postgraduate Programme in MLT

W.E.F 2023-24

Preamble

The following aspects have been taken into cognizance by faculty members and members of Board of Studies while framing the MSc MLT syllabus:

1. The learning outcomes of the M.Sc. MLT programme are designed to help students analyze, appreciate, and critically engage with theoretical knowledge and practical experiences in the field of medical sciences.
2. It is significant to note that the M.Sc. MLT syllabus is the point of reference for the LOCF recommendations approach is envisioned to provide a focused, outcome-based syllabus at the postgraduate level with an agenda to structure the teaching-learning experiences in a more student-centric manner.
3. The arrangement of courses/papers in the semesters is in accordance with the credit load in each semester and the overall credit. Of course, the selection of subjects and topics is made to ensure preliminary understanding of the subject and to retain courses in the third and fourth semester that require greater attention and specialization. Courses are incorporated keeping in view that each program prepares students for sustainability and life-long learning. The assam royal global university hopes the LOCF approach of the program M.Sc. MLT (2 years) will help students in making an informed decision regarding the goals that they wish to pursue in further education and life, at large.
4. The overarching concern of the LOCF framework is to have definite and justifiable outcomes, including and their realization by the end of the programme. This also includes enhancing students' personalities, preparing students for the job market—including research area, diagnostic laboratory and hospitals sector.

1.1 Introduction

The learning outcomes-based curriculum framework for a M.Sc. degree in medical laboratory technology is structured to offer a broad outline within which a medical laboratory technology program could be developed. The course is upgraded keeping in mind the aspirations of students, changing nature of the subject as well as the learning environment. Courses within medical laboratory technology have been revisited to incorporate recent advancements, techniques to upgrade the skills of learners.

The new structure is expected to enhance the level of understanding among students and maintain the standard of medical laboratory technology degrees/program across the country. Effort has been made to integrate use of recent technology and use of MOOCs to assist teaching-learning process among students. This framework permits the review of postgraduate attributes, qualification descriptors, program learning outcomes and course-level learning outcomes periodically.

The framework offers flexibility and innovation in syllabi designing and in methods adopted for

teaching- learning process and learning assessment. The major objective is to elevate the subject knowledge of the students, making them critical thinkers and able to solve problems and issues related to medical laboratory technology logically and efficiently.

Overall, this course has been modified to upgrade skills related to biological science and provide our students a competitive edge in securing a career in hospital, diagnosis laboratory, academia, clinical research and development in private as well as public sectors.

1.2 Learning Outcomes-based Approach to Curricular Planning

The basic premise of learning outcomes-based approach to curriculum planning and development is that higher education qualifications such as a Master degree programmes are earned and awarded on the basis of the following factors--(a) achievement of outcomes, demonstrated in terms of knowledge, understanding, skills, attitudes and values and (b) academic standards expected out of the graduates of a programme of study.

The expected learning outcomes are used as reference points to formulate postgraduate attributes, qualification descriptors, programme learning outcomes and course learning outcomes which in turn will help in curriculum planning and development, and in the design, delivery, and review of academic programmes.

The masters degree in medical laboratory technology as a subject, is framed for the students to attain sufficient knowledge during the course. The course learning outcome of medical laboratory technology are aimed at fascinating he learners to acquire knowledge, skills understanding, value, attributes, and academic standards. A student is awarded by M.Sc. medical laboratory technology based on the attainment of these outcomes at the end of the programme.

The key outcomes that underpin curriculum planning and development at the undergraduate level include postgraduate Attributes, Qualification Descriptors, Programme Learning Outcomes, and Course Learning Outcomes. The LOCF for M.Sc. MLT programme is based on these specific learning outcomes and academic standards expected to be attained by postgraduates of this programme.

An outcome-based approach provides greater flexibility to the teachers to develop and the students to adopt different pedagogical strategies in an interactive and participatory ecosystem. The Assam Royal Global University has addressed this aspect since its inception through the CBCS curricula adopted by the university in 2017. This approach is further consolidated through identifying further relevant and common outcomes beneficial to the student community and by developing such outcomes that not only match the specific needs of the students but also expands their outlook and values. Moreover, this curriculum keeps into perspective the fact that the focus is not just on domain knowledge or

outcomes only but on processes and approaches to be employed in pedagogical transactions. This is important in order to ensure the efficacy of the curriculum adopted.

1.2.1 Nature and Extent of Masters degree Programme in MLT

A Master degree in MLT with internship (Msc. MLT) is a 2 year degree for the courses mention above. A Master degree is divided into 4th semester.

CREDIT DISTRIBUTION

Semester	Credits
I	22
II	24
III	27
IV	29

Total Credits = 102

1.Qualification descriptors at this level reflect in-depth and specialized knowledge and understanding of their subjects enriched by domain knowledge, student knowledge, critical thinking, and effective communication skills. Knowledge at this level includes generic information about what all holders of the qualification are able to gather, and the qualities and skills that they develop in the course of the postgraduation programme. Courses, therefore, reflect diverse aspirations of diverse types of students, and skills, learning needs and personal circumstances. Programmes assess not only academic skills but other skills and attributes including clinical posting at various hospital and laboratories. The Department of MLT, The Assam Royal Global University, Guwahati aims at a curriculum design that fulfils these qualification descriptors.

2.The attributes and outcomes associated with M.Sc. MLT programme are comprised of structured learning opportunities and therefore the programme is devoted to classroom learning, group and individual learning, and library and clinical lab posting. The key component in the programme is developing the ability to communicate from basic level to critical level communication.

3.The critical perspective developed during the M.Sc. MLT programme helps students to link the degree to life skills including professional skills with an understanding of human and literary values.

1.2.1 Aims of Master Degree Programme in MLT

The M.Sc. MLT programme is inclusive and broad-based even as it carries imprints of specialized areas of study. In this programme, students practical exposure is given importance. The objectives of the LOCF syllabus in MLT revisit traditional expectations of teaching and learning MLT by centre-staging outcomes that are demonstrable through the following key attributes: understanding, use,

communication, expansion, and application of subject knowledge with a clear awareness. The LOCF syllabus of M.Sc. MLT programme highlights the following: (i) the concept of teaching medical related core subjects in MLT programme, (ii) the core objectives of MLT programme is targeted at imparting through subject knowledge, practical exposures and clinical posting. (iii) application and use of knowledge of MLT programme in contributing to the society and the world at large through health care sectors, (iv) demonstration of professional awareness and problem-solving skills, (v) demonstration of basic knowledge of digital knowledge platforms; (vi) develop the ability to recognize the professional and social/ hospital/laboratory utility of the subject, and (vii) in the process understand, appreciate and imbibe values of life. The overall objectives of the Learning Outcomes based Curriculum Framework (LOCF)for M.Sc. degree in MLT literature are—

- **Prospects of the Curriculum:** Formulating graduate attributes, qualification descriptors, programme learning outcomes, and course learning outcomes that are expected to be demonstrated by the holder of the degree of M.Sc. MLT.
- **Core Values**: Enabling prospective students, parents, employers, etc. to understand the nature and level of learning outcomes (knowledge, practical skills, attitudes) or attributes suitable to the M.Sc. MLT programme.
- **Bridge to the World**: Providing a framework to see the subject as a bridge to the world in such a way that while recognizing the different conditions in pluralistic society, the students also are aware of a core of shared values such as (i) commitment to the knowledge of the subject to understand the world at large, (ii) development of each person's unique potential, (iii) respect for others and their rights, (iv) social and civic responsibility, participation in democratic processes; social justice and cultural diversity, and (v) concern for the natural and cultural environment
- **Assimilation of Ability, Balance, Harmony and Inclusiveness:** Identify and define such aspects or attributes of M.Sc. MLT graduate should be able to demonstrate on successful completion of the programme.
- **Frame for National Standards:** Providing a frame of reference for maintaining national standards with international compatibility of learning outcomes of MLT and academic standards to ensure global competitiveness, and to facilitate graduate mobility
- **Pliability:** Formulating outcomes that are responsive to social and technological changes in order that the pedagogy will meet student's needs arising from the changes. The LOCF approach encourages effective use of new technologies as tools for learning and provide a balance between what is common to the education of all students and the kind of flexibility and openness required for education
- **Pedagogy:** Provide higher education institutions an important point of reference for designing teaching-learning strategies, assessing student learning levels, and periodic review of

programmes and academic standards for M.Sc. MLT with a shift from domain knowledge to processes of realising the outcomes

- **Development:** The specific objectives of the M.Sc. MLT programme are to develop the student's ability to demonstrate the following outcomes:

    1. Disciplinary Knowledge
    2. Communication Skills
    3. Critical Thinking
    4. Analytical Reasoning
    5. Problem Solving
    6. Research-Related Skills
    7. Self-Directing Learning
    8. Technical Competence
    9. Values: Moral and Ethical, Literary and Human
    10. Digital Learning

The details are explained below:

1.3 Graduate Attributes (GA)

GA 1: Disciplinary Knowledge:

a) Ability to identify, learn and write about different diagnostic methods, and engage with various diagnostic fields and laboratories/ hospital and critical concepts.

b) Ability to understand appreciate, analyze and use different theoretical frameworks and develop one's critical position and present one's views coherently and persuasively.

c) Ability to situate one's own learning, to be aware of one's position in terms of society and upgrading technology.

GA 2: Critical Thinking:

a) Ability to read and analyse extant scholarship

b) Ability to substantiate critical evaluation of laboratory reports.

(The Assam Royal Global University has made ***Communicative English (CEN)*** compulsory all the Postgraduate levels for all students across all semesters. A student at the PG level will study papers of Communicative English as **Ability Enhancement Compulsory Course (AECC)** with a view to improving the communicative as well as soft skills of students and prepare them for the job-market in the future.)

GA 3: Problem Solving:

a) Ability to transfer critical skills to read other cultural texts

b) Ability to read any unfamiliar texts

GA 4: Analytical Reasoning:

a) Ability to evaluate the strengths and weaknesses in scholarly texts spotting flaws in their arguments

b) Ability to use critics and theorists to create a framework

GA 5: Research-Related Skills:

a) Ability to problematize; to formulate hypothesis and research questions, and to identify and consult relevant sources to find answers

b) Ability to plan and write a research paper

GA 6: Self-Directing Learning:

a) Ability to work independently in terms of reading critical texts

b) Ability to carry out personal research, postulate questions and search for answers

c) Ability to use digital sources, and read them critically

d) Ability to use digital resources for presentations

GA 7: Communication Skills and **Leadership Readiness:**

a) Ability to speak and write clearly in standard, academic English

b) Ability to listen to and read carefully various viewpoints and engage with them.

c) Ability to use critical concepts and categories with clarity

d) Ability to lead group discussions, to formulate questions for the class in literary and social texts

GA 8: Technical Competence:

a) Ability to apply specific technical and instrumental principles and information.

b) Ability to drive success in technical oriented and knowledge base positions.

GA 9: Digital Learning:

a) Ability to facilitated learning by giving control over time and pace.

b) Ability to build the skills needed to navigate technology and to get the best out of it.

GA 10: Moral and Ethical Values and Life-long Learning:

a) Ability to interrogate one's own ethical values, and to be aware of ethical issues

b) Ability to retain and build on critical reading skills

c) Ability to transfer such skills to other domains of one's life and work

1.4 Qualification descriptors for a Master degree in MLT

The qualification descriptors for the Masters in MLT will focus on the following five learning attributes: understanding, use, communication, expansion, and application of subject knowledge with a clear understanding of one's location. This also involves an awareness on the differences that exist among students based on class, caste, gender, community, region, etc. in order that they can transcend these differences with transparency of purpose and thought. The key qualification descriptor for M.Sc. MLT includes the following:

i. An integrated grasp of the core and discipline specific subjects covered in Biomedical Science through stories of discovery and rigor of experiential learning.

ii. How to access, create and analyze knowledge and data, stitch diverse concepts and apply in the management of human diseases, public health, and related areas.

iii. Appreciation for interdisciplinary skills as the key theme in thinking, comprehending, and solving the local and global issues in medical research and development.

iv. An aptitude for diagnosis laboratory, research, academia, and hospital experimental skills and their application required for identifying problems and issues relating to the disciplinary area and field of study.

v. Communication skills though making presentations (oral or written), writing reports, and expressing their science ideas through a technical note/design or via an art form.

vi. Apply subject-specific skills in MLT to foster a larger sense of ethical and moral responsibility among patients in order to see, respect, and transcend differences among various life-forms. The programme will strengthen the student's competence to enable them to identify, analyze and evaluate and find sustainable solutions and/or answers to keys issues around in the world.

1.5 Programme Learning Outcomes relating to Masters degree in MLT programme

Students graduating with the degree in MLT will be able to achieve the following:

PO 1: Ability to attain knowledge and understanding of the origin and development of English language and literature.

PO 2: Ability to substantiate critical readings of literary texts and place them in historical contexts

PO 3: Ability to classify areas of concern in literary discourses and identify sources to explore answers for the same.

PO 4: Ability to evaluate literary theories and assess their arguments to create new frameworks

PO 5: Ability to identify research gaps, formulate research questions and ascertain relevant sources to find substantive explanations.

PO 6: Ability to successfully complete internship within stipulated time.

PO 7: Ability to formulate logical arguments by analysing and evaluating intrinsic ideas.

PO 8: Ability to work independently and carry out personal research, postulate questions and search for answers.

PO 9: Ability to communicate and read carefully various viewpoints and engaging them in group discussion.

PO 10: Ability to interrogate one's own ethical values, and to be aware of ethical issues and to transfer such skills to other domains of one's life and work and pave way for lifelong learning.

1.6 Masters in MLT Programme Specific Outcomes:

PSO 1: Understand and describe the various aspects of importance in health-related field.

PSO 2: Ability to critically analyze various report interpretations.

PSO 3: Ability to engage in various clinal postings and equipped with practical experiences.

PSO 4: Ability to demonstrate communicative competence, interpersonal skills and creative acumen through effective classroom practices like group discussions, presentation sessions and mock interviews.

1.7 Teaching Learning Process

Teaching and learning in this programme involves classroom lectures as well as tutorial and remedial classes.

Tutorial classes: Tutorials allow closer interaction between students and teacher as each student gets individual attention.The tutorials are conducted for students who are unable to achieve average grades in their weekly assessments. Tutorials are divided into three categories, viz. discussion-based tutorials (focusing on deeper exploration of course content through discussions and debates), problem-solving tutorials (focusing on problem solving processes and quantitative reasoning), and Q&A tutorials (students ask questions about course content and assignments and consolidate their learning in the guiding presence of the tutor).

Remedial classes: The remedial classes are conducted for students who achieve average and above average grades in their weekly assessments. The focus is laid to equip the students to perform better in the exams/assessments. The students are divided into small groups to provide dedicated learning support. Tutors are assigned to provide extra time and resources to help them understand concepts with advanced nuances. Small groups allow tutors to address their specific needs and monitor them. Following methods are adopted for tutorial and remedial classes:

- Written assignments and projects submitted by students
- Project-based learning
- Group discussions
- Home assignments
- Class tests, quizzes, debates organised in the department
- Seminars and conferences
- Extra-curricular activities like cultural activities, community outreach programmes etc.
- Field trip, excursions, study tour, interacting with eminent authors, etc.

1.8 Assessment Methods

	Component of Evaluation	**Marks**	**Frequency**	**Code**	**Weightage (%)**
A	**Continuous Evaluation**				
I	Analysis/Class test	Combination of any three from (i) to (v) with 5 marks each	1-3	C	25%
Ii	Home Assignment		1-3	H	
Iii	Project		1	P	
Iv	Seminar		1-2	S	
V	Viva-Voice/Presentation		1-2	V	
Vi	MSE	MSE shall be of 10 marks	1-3	Q/CT	
vii	Attendance	Attendance shall be of 5 marks	100%	A	5%
B	Semester End Examination		1	SEE	70%
	Project				**100%**

M.Sc. Medical Laboratory Technology

Programme Structure

1st semester							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects *(Please Add rows, as required)*							
1	MLT244C101/MLT244C111	Clinical Pathology (Theory +Lab)	**2**	**1**	**1**	**4**	**4**
2	MLT244C102/MLT244C112	Biochemistry (Theory + lab)	**2**	**1**	**1**	**4**	**4**
3	MLT244C103/MLT244C113	Microbiology I (Theory +Lab)	**2**	**1**	**1**	**4**	**4**
4	MLT244C104/MLT144C114	Histopathology and Cytopathology (Theory +Lab)	**2**	**1**	**1**	**4**	**4**
Ability Enhancement Compulsory Courses (AECC)							
5	**CEN984A101**	**Communicative English – I**	**1**	**0**	**0**	**1**	**1**
6	**BHS984A103**	**Behavioural Science – I**	**1**	**0**	**0**	**1**	**1**
Elective: Discipline Specific DSE							
7	**MLT244D101**	DSE – 1 (Advanced Diagnostic Techniques)	**3**	**1**	**0**	**4**	**4**
		TOTAL CREDIT	**14**	**4**	**8**	**22**	**22**

2nd semester							
Sl.No.	**Subject Code**	**Names of subjects**	**L**	**T**	**P**	**C**	**TCP**
Core Subjects *(Please Add rows, as required)*							
1	MLT244C201/MLT244C211	Microbiology -II (Theory +Lab)	**2**	**1**	**1**	**4**	**4**
2	MLT244C202/MLT244C212	Haematology I and Blood Banking I (Theory + Lab)	**2**	**1**	**1**	**4**	**4**
3	MLT244C203/MLT244C213	Biochemistry- II (Theory + Lab)	**2**	**1**	**1**	**4**	**4**
4	MLT244C204/MLT244C214	Diagnostic Molecular Biology (Theory + Lab)	**2**	**1**	**1**	**4**	**4**
Ability Enhancement Compulsory Courses (AECC)							
5	**CEN984A201**	**Communicative English – II**	**1**	**0**	**0**	**1**	**1**
6	**BHS984A123**	**Behavioural Science – II**	**1**	**0**	**0**	**1**	**1**
Elective: Discipline Specific DSE							
7		**AEEC/SEC/-1***	**2**	**0**	**0**	**2**	**2**
8	**MLT244D201**	DSE – 2(Biostatistics and Research Methodologies)	**3**	**1**	**0**	**4**	**4**
		TOTAL CREDIT	**16**	**4**	**8**	**24**	**24**

Level: Semester I

Course: C-1

Title of the Paper: Clinical Pathology

Subject Code: MML232C101

L-T-P-C: 2-1-1-4 (T) **Total credits: 4**

Course Objectives: The course is designed with an objective to give the students basic knowledge on the different types of biological specimen, different methods to collect them and the abnormal conditions related to it.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall about the different types of biological specimens commonly tested in clinical laboratory and the procedure to collect and analyze it.	**BT 1**
CO 2	To explain the clinical importance of 24 hours urine examination.	**BT 2**
CO 3	To apply the knowledge on sputum examination and other body fluids.	**BT 3**
CO 4	To analyze the physical and microscopic examination of the various biological specimen.	**BT 4**

Detailed syllabus:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	Collection, transport, preservation and processing of various clinical specimens such as blood, urine, stool, CSF, Semen and other body fluids and their safe disposal. Physical, chemical and microscopic examination of the pathological specimens.	**9**
II	Sputum examination: collection of specimen-Physical examination, Microscopic- Gram's stain, Zeihl-Neelsen stain for AFB, Chemical examination. Stool Examination- Collection, transport and preservation. Concentration and flotation method of examination of stool. Physical, microscopic and chemical examination.	**9**
III	Analysis of Body fluids: Pleural, Pericardial, synovial, ascitic/peritoneal, Semen and CSF fluid (physical, biochemical and microscopic examination). Other body fluids analysis- saliva, tears, sweat etc.	**9**
IV	Gastric analysis, Indications, contraindications. Method of collection, Fasting gastric juice, Macroscopic and microscopic examination, Fractional test meal, Augmented Histamine Test, Hollander's test. Pregnancy test, Method interpretation.	**9**

TOTAL	**36**

Title of the Paper: Clinical Pathology Lab

L-T-P-C: **0-0-1-1 (P)**

Detailed syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	Urine examination- physical, chemical, and microscopic examination. Ph, specific gravity, Glucose, protein, bile pigments, bile salts, urobilinogen,	**3**
II	Sputum examination, stool examination- physical chemical, microscopic and concentration floatation method. Gastric analysis-	**3**
III	Examination of CSF- physical, chemical and microscopic. Pregnancy test. Semen analysis-physical, chemical and microscopic. Pleural fluid analysis-physical, chemical, and microscopic.	**3**
IV	Pleural fluid analysis-physical, chemical, and microscopic. Pericardial fluid analysis- physical, chemical and microscopic. Synovial fluid analysis- physical, chemical, and microscopic.	**3**
TOTAL		**12**

Text Books:

1. Textbook of Medical Lab Technology- Praful B Godkar, Darshan P. Godkar

2. Medical laboratory Technology Methods and Interpretation-Ramniksood.

3.Parasitology-K.D. Chatterjee.

4.Medical Laboratory Technology by Sood 5th Edition, Jaypee Brothers.

Reference Book:

1. Clinical Diagnosis & Management -Todd & Sanford 19th edition 1996.

2.Lynch's Medical lab-Technology Latest edition.

Level: Semester I

Course: C-2

Title of the Paper: Biochemistry -I

Subject Code: MLT232C102

L-T-P-C: 2-1-1-4 (T) **Total credits:(T+P) 4**

Course Objectives: The course is designed to provide a wholesome Understand the chemistry of carbohydrate, lipids, the liver function tests in physiological and pathological disorders.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Bloom's Taxonomy Level**
CO 1	To **recall** the core knowledge on chemistry of Carbohydrates, and their applied aspects.	**BT 1**
CO 2	To **explain** the chemistry of lipids and enzymes.	**BT 2**
CO 3	To **develop** a wide knowledge of the Liver function test, and their applied importance.	**BT 3**
CO 4	To analyze the various biochemical experiments related to urine examination etc	**BT 4**

COURSE OUTLINE:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	**Chemistry of Carbohydrates:** Definition and function, Classification, Isomerism of Monosaccharides, Properties of Monosaccharides, Modified Monosaccharides, Disaccharides, Polysaccharides. Chemistry of proteins: Definition, function of Proteins, Classification of amino acids, properties of Aminoacids, Classification and properties of proteins, Structural organization of proteins.	**9**
II	Chemistry of Lipids: Definition and function of Lipids, classification of lipids, Properties of Lipids. Nucleic acids: Nucleotides and its bases, DNA in details, RNA and its classification, High energy compounds. Enzymes: Classification of enzymes, factors affecting enzyme activity, Inhibitors, Specificity, Enzyme Kinetics, Enzymes in clinical diagnosis.	**9**
III	Clinical significance, principle of estimation-Bilirubin General types amd jaundice, Liver function test: Bilirubin estimation, Alkaline phosphate and Acid phosphate estimation, SGOT, SGPT, Glucose tolerance test, Insulin tolerance test, Gastric juice analysis, Xylose absorption test, Analysis of calculi, Cerebrospinal fluid analysis: Composition and function of CSF, estimation of sugar and protein in CSF.	**9**
IV	**Urine chemistry:** Automation in Urine chemistry, Physical and chemical examination of Urine sample, common qualitativw and quantitative tests of Urine, Clearance test for Urine function, Electrolytes; sodium, potassium, chloride, total and ionized calcium, phosphorus, magnesium. Blood gases, pH, carbooxyhaemoglobin, O2 saturation, Disorder of carbohydrate metabolism, abnormalitiesof protein in plasma, disorders of plasma lipids and lipoprotein.	**9**
TOTAL		**36**

Title of the Paper: Biochemistry Lab I

L-T-P-C: **0-0-1-1 (P)**

Detailed syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	Estimation of blood glucose, Estimation of protein, Estimation of serum creatinine, estimation of urea	**3**
II	Estimation of total cholesterol, Estimation of triglycerides, Estimation of HDL,	**3**
III	Estimation of SGOT, Estimation of SGPT, Estimation of Alkaline, Phosphatase, Estimation of acid phosphatase.	**3**
IV	Estimation of bilirubin, Estimation of Na+, K+ and Ca+, Estmation of urine through use of strips, estimation of T3,T4 and TSH by elisa method.	**3**
TOTAL		**12**

Text Books:

1. Harper Illustrated Biochemistry- N.V. Bhagvan- Academic Press 4th edition 2002.

2. Textbook of Biochemistry- A.S. Saini, C.B.S Publishers and distribution 2nd edition.

Reference Books:

1. Varley's Practical Clinical Biochemistry- Gowenlock and Bell William Heinmann, 6th edition 1992.
2. Clinical Chemistry- Theory analysis and Correlation- Kalpan.L.A. and pesse A.G- C.V. Moslay and Company, New Delhi.

Level: Semester I

Course: C3

Subject: Microbiology

Subject Code: M**ML232C103**

L-T-P-C: **3-1-1-4(T)** **Total credits:(T+P)4**

Course Objective:

The objective of the course is to impart knowledge on bacterial morphology, bacterial metabolism, bacterial genetics, introduction to parasitology. This will also provide knowledge on general virology and development of immunity, immunological agents and immunological tests carried out to fight against infections.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To **recall** the classification of microorganism, their morphology, bacterial growth requirements etc.	**BT 1**
CO 2	To **understand** the genetics of bacterial diseases.	**BT 2**
CO 3	To **identify** the viruses, parasitic diseases.	**BT 3**
CO 4	To **analyze** the immune system, and organs related to immune system.	**BT 4**

Detailed syllabus:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	Historical background, classification of microorganisms, eukaryotes and prokaryotes, methods of studying microbes, staining, microscopy, electron microscopes and specimen preparation of EM, culture methods and media. Bacterial morphology, shape and arrangement of bacterial cells, ultrastructure of cell wall, cytoplasmic membrane, outer envelope, flagella, fimbria and pilae. Bacterial metabolism and growth: requirements nutritional classification, effect on pH, temperature, oxygen on growth, Bacterial growth curve.	**9**
II	Bacterial genetics; Bacterial genome, extrachromosomal genome, role of plasmid, artificial transformation, conjugation in gram positive and gram-negative organisms. Introduction to parasitology: Parasitism, direct and indirect life cycles, hosts, commensalism, symbiosis, medically important parasites: Protozoa and Helminths.	**9**

III	History of immunology, innate and acquired immunity, mechanisms of innate immunity, inflammation-inflammatory cells, mediators, inflammatory response types, antigens, cells and organs of immune system. Immunoglobulin: Structure and function, classes and subclasses. Antigen and types of antigens.	**9**
IV	Compliment system: function, compliment receptors, activation pathways, control mechanisms, role in inflammation, kinincascade and kinnins in disease. Hypersensitivity, autoimmunity and immunodeficiency diseases.	**9**
TOTAL		**36**

Title of the Paper: Microbiology Lab I

L-T-P-C: **0-0-1-1 (P)**

Detailed syllabus:

Modules	Topics (if applicable) & Course Contents	Periods
I.	Instrument in microbiology, Code and conduct of laboratory personnel, Staining technique. Simple staining, Grams staining, Acid fast staining. Quality control in the clinical Microbiology Laboratory.	**3**
II	Negative staining, Albert staining, Spore staining, Fungal staining method. Stool examination, wet mount preparation, stool concentration technique, stool culture technique.	**3**
III	Media Preparation, simple media, differential media, enriched media, enrichment media, special media, selective media, transport media, biochemical media.	**3**
IV	Serological Tests Agglutination, Precipitation, ELISA, Neutralisation test, Immunoblotting, Opsonisation, Radioimmuno assay.	**3**
TOTAL		**12**

Text Books:

1. Ananth Narayan and Panikar's Text Book of Microbiology, 10thedn, 2017, Orient-Longman, Chennai

2. Sastry SA, Bhat S, Essentials of medical microbiology, 2ndedn, 2018, CBS publisher and distributors.

3. Edward Alcamo, Fundamentals of Microbiology, 4thedn, 2004,Benjamin-cummings Pub. Co. Ltd.

4. Bergeys manual of systematic bacteriology, 2ndedn, 2012, Vol-I to V, Williams and Wilkins- A Waverly company.

Reference Books:

1. Harvey AR, Lippincott's Illustrated Reviews Microbiology, 3rdedn, 2012, wolter and klower publications.

2. Mims R, Medical microbiology, 1stedn, 2020, Mosby publisher.

3. Prescott and Dunn., Industrial Microbiology, 8th edn, 2011, CBS Publishers & Distributors, Delhi.

4. Pelczar, Chan Kreig, Microbiology, 5thedn, 2001, Tata McGraw Hill publisher ltd.

5. Martin Frobisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. 1987, Saunders, Philadelphia.

Level: Semester I

Course: C4

Subject: Histo and Cytopathology

Subject Code: **MML232C104**

L-T-P-C: **3-1-1-4 (T)** **Total credits:**

(T+P)4

Course Objectives:

The objective of the course is to introduce the students to Cells, Tissues, Classification of fixatives, Tissue Processing-Definition, Grossing, Dehydration, Clearing, Impregnation, Embedding, tissue cutting in the microtome and the principle behind the staining techniques.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall about the classification of fixatives and details of each fixatives.	**BT 1**
CO 2	To explain the basic concept of tissue processing and the various steps involve in the staining process	**BT 2**
CO 3	To apply the knowledge of various principles of different stains and identify the different tissue and cells in practical class.	**BT 3**
CO 4	To analyze the difference between routine stains and special stain.	**BT 4**

Detailed syllabus:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	Introduction to histopathology Tissue- epithelial tissue, connective tissue, muscular tissue, nervous tissue. Managing the laboratory- Safety and organomic in the laboratory	**9**

	Fixation of Tissues and fixative , grossing, dehydration, Decalcification and tissue processing	
II	Microtomy, Paraffin and Frozen section, Embedding/blocking, Staining of common histological stain and different types of Hematoxylin (Preparation and method of stain) Quality control in routine H&E stain, Special Histological stains.	**9**
III	Introduction to Cytology and its branches, Progressive changes of the cells, Course of cell injury and cell death, Specific non-neoplastic diseases affecting cells- inflammatory disorder, acute inflammation, subacute inflammation, chronic inflammation and granulomatous inflammation.	**9**
IV	Exfoliative cytology-Preservation, Sputum, bronchial aspirate, brush mucous rich sample, pleural, peritoneal, Gastric washing collected in normal saline and other Bloody fluids. Interventional cytology-Sites from where material is obtained, FNAC, staining techniques in cytology.	**9**
TOTAL		**36**

Title of the Paper: Histo and Cytopathology Lab I

L-T-P-C: **0-0-1-1 (P)**

Detailed syllabus:

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I.	Instrumentation- Hot air oven, Microtomy, tissue floatation bath.	**3**
II	Demonstration method of fixatives.	**3**
III	Method of sample receiving, registering, and labeling.	**3**
IV	MGG stain, PAP stain, H and E stain, PAS stain, Mucicarmine stain, Masson trichrome stain, Van Gieson's stain, and Zn stain.	**3**
TOTAL		**12**

Text Books:

1. Bancroft's theory and practice of Histlogical techniques by S.Kim Suvama, Christopher Layton, John D. Bancroft.

2. Histopathology, A self instructional text by Freida L. Carson.

Reference Books:

1. Textbook of Medical Laboratory Technology- Praful B. Godkar, Darshan P Godkar.

2. Medical Laboratory Technology Methods & interpretation- RamnikSood.

3. Manual of Medical Laboratory Technology Techniques by S.Ramakrishnan & KN Sulochana

Level: Semester I

Course: DSE

Title of the Paper: Advanced Diagnostic Techniques

Subject Code: MML232D101

L-T-P-C: 3-1-0-4 **Total credits: 4**

Course Objectives

The course entails to educate the student about the basic concept on chromatography, basic concept on electrophoresis, centrifugation and all the immunoassay.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall about the principles, types and applications of chromatography.	**BT 1**
CO 2	To classify the different types of electrophoresis, its applications and its uses in clinical diagnosis.	**BT 2**
CO 3	To apply the knowledge on centrifugation.	**BT 3**
CO 4	To analyze the application of radioisotopes in clinical biochemistry, to also analyze the different immunoassay and their applications.	**BT 4**

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I	Chromatography, its principle, types and applications. Paper Chromatography, Thin layer chromatography, HPLC, Gas liquid chromatography, Ion exchange chromatography and their application in diagnosis.	**16 hours**
II	Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE, Agarose gel electrophoresis, buffer systems in electrophoresis. Electrophoresis of proteins and nucleic acids, haemoglobin, immunoglobulin's, isoenzymes Applications of electrophoresis in clinical diagnosis,	**16 hours**
III	Centrifugation, fixed angle and swinging bucket rotors , RCF and	**16 hours**

	sedimentation coefficient, differential centrifugation, density gradient centrifugation and Ultracentrifugation	
IV	Radioisotopes, Radioactivity, instruments for radioactivity measurement, applications of radioisotopes in clinical biochemistry **Immunoassay**: ELISA, RIA, FIA, FACS and their applications in clinical diagnosis	**16 Hours**
	Total	**64**

Text Books

1. Singh &Sahni,(2008),Introductory Practical Biochemistry,2nd edition, Alpha science
2. Lehninger,(2013),Principles of Biochemistry,6th edition, W H Freeman
3. Wilson & Walker, Practical Biochemistry,2nd edition

Recommended Books:

1.Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition, Elsevier Publications
2. Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22nd edition, Elsevier

Level: Semester II

Course: C-1

Title of the Paper: Microbiology II

Subject Code: MML232C201

L-T-P-C: **2-1-1-4 (T)** **Total credits: 4 (T + P)**

Course Objective:

The objective of the course is to impart knowledge on medically important bacteria, understanding the complement system. This will also provide knowledge on microbiology techniques like Elisa, antigen- antibody reaction. Knowledge on instruments that are used in microbiology lab, staining procedures, serological tests etc.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To **recall** the Medically important bacteria etc.	**BT 1**
CO 2	To **understand** the complement system, autoimmune diseases, immunodeficiency diseases.	**BT 2**
CO 3	To **identify** the microorganisms through staining procedures, to identify the instruments used in microbiology laboratory.	**BT 3**
CO 4	To **analyze** the antibody antigen reactions, and serological tests.	**BT 4**

DETAILED SYLLABUS

Modules	Course Content	Periods
I.	Medically important bacteria: staphylococcus, streptococcus, pneumococci, mycobacterium, enterobacteracae, vibrio, pseudomonas, Corynebacterium, clostridium, treponema palladium.	9
II	**General Virology:** Morphology and nomenclature, virus replication, viral genetics, Pathogenicity of viruses and susceptibility to chemical agents, Epidemiology of viral infections, cultivation of viruses, Vaccines and antiviral drugs, Bacteriophages.	9
III.	Antigen-antibody reactions: Agglutination, precipitation, complement fixation, ELISA, Neutralisation test, Immunoblotting, Opsonisation, Immunofluroscense, Radioimmunoassay, etc.	9
IV.	Introduction to mycology: classification of fungus, medically important fungi, laboratory diagnosis of fungal infections. Biomedical Waste Management, Nosocomial infections, Bacterial normal flora.	9
	TOTAL	36

Subject: Microbiology Lab-II

L-T-P-C: **0-0-1-1 (P)**

Modules	Course Content	Periods
I	Instruments in microbiology, Code and conduct of laboratory personnel. Biomedical waste management.	**3**
II	Gram's staining, ZN staining, Catalase test, Coagulase test, oxidase test, Motility test, IMViC tests. Germ tube techniques, KOH wet mount, Calcofluor staining.	**3**
III	Antimicrobial sensitivity testing: Diffusion methods, Dilution methods. Handling laboratory accidents	**3**
IV	Serological tests: Widal test, weil felix test, paul bunnel test, VDRL, HIV and HBsAg detection, TPHA, RPR, ELISA.	**3**

TOTAL	12

Text Books:

1.Peppler J H, Microbial Technology, 2nd edn, 1979, Academic press.

2.Ananthnarayan and Panikar's Text Book of Microbiology, 10th edn, 2017, Orient-Longman, Chennai

3.Sastry SA, Bhat S, Essentials of medical microbiology, 2nd edn, 2018, CBS publisher and distributors.

4. Edward Alcamo, Fundamentals of Microbiology, 4th edn, 2004,Benjamin-cummings Pub. Co. Ltd.

5. Bergeys manual of systematic bacteriology, 2nd edn, 2012, Vol-I to V, Williams and Wilkins- A Waverly company.

Reference Books:

1. Harvey AR, Lippincott's Illustrated Reviews Microbiology, 3rd edn, 2012, wolter and klower publications.

2. Mims R, Medical microbiology, 1st edn, 2020, Mosby publisher.

3. Prescott and Dunn., Industrial Microbiology, 8th edn, 2011, CBS Publishers & Distributors, Delhi.

4. Pelczar, Chan Kreig, Microbiology, 5th edn, 2001, Tata McGraw Hill publisher ltd.

5. Martin frobisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. 1987, Saunders, Philadelphia.

Level: Semester II

Course: C-2

Subject: Haematology-I and Blood Banking I

Subject Code: M**ML232C202**

L-T-P-C: **3-1-1-4 (T)** **Total credits: 4 (T+P)**

Course Objectives:

The objective of the course is to introduce students acquire knowledge of Formation of red blood cells, white blood cells, platelets, and understand the disorders related to the blood cells. This course has been formulated to impart comprehensive knowledge on different types of blood group system. To introduce the knowledge based on blood donation, preparation of patient, and post- donation care. The students will learn about the compatibility tests and how to prepare blood components.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**

CO 1	To define what is haematopoiesis, leucocytosis, plasma cell disorders and recall the importance of different types of blood cells, and the related disorders etc.	**BT 1**
CO 2	To outline and the importance of various experiments related to blood specimen and cells by preparation of blood film.	**BT 2**
CO 3	To identify the different types of blood groups and classify the different types of blood donors, and highlights the importance of various indications of blood transfusion.	**BT 3**
CO 4	To analyse the different tests such as compatibility tests, coombs test, donor screening etc and get a proper concept of basic techniques in bloodbank.	**BT 4**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I.	Haematopoiesis: Origin, development, function and fate of blood cells. Erythropoiesis- Origin, development of RBCs, Disorders of RBC: Anaemia. Disorders of white blood cells- Leucocytosis, Leukopenia, Leukaemias Classification- (French American British- FAB classification) Lab investigation, Chronic myeloid leukaemia, Chronic Lymphocytic Leukaemia.	9

II.	Plasma cell disorder- classification, Plasma cell myeloma- definition, clinical features, Haemorrhagic disorders, vascular disorders, platelet disorder, coagulation disorders, Normal haemostasis. Organization and quality control in the laboratory,	9
III.	History of Transfusion Medicine, Blood groups and ABO System- ABO sub groups. Bombay group, Secretors, Non secretors. Du red cells (A variant of Rh system), MNS system, Blood transfusion- indications for blood transfusion, Rh system.	9
IV	Blood Donation, Donor registration, Donor selection, Blood collection, Adverse reaction. Anticoagulant used to store blood, Changes occurring in the stored blood. Blood group systems- antigen- antibody reaction , ABO system Forward grouping, reverse grouping, Coomb's test, Complatibility testing- Major , Minor, Blood components- preparation of blood components.	9
TOTAL		36

Subject: Haematology and blood banking Lab-I

L-T-P-C: **0--0-1-1 (P)**

DETAILED SYLLABUS

Modules	Course Content	Periods
I	Blood collection, Anticoagulants used in Haematology, Red cell indices, ESR, PCV, Platelet count, Absolute Eosinophil count, Reticulocyte count, Stains used in Haematology.	**3**
II	Preparation of Blood film, Preparation of leishman stain, Interpretation of peripheral smear, Differential count, Investigation including serum Iron & TIBC. Different morphological investigation of pheripheral blood smear., BT, CT, PT, INR, APTT, TT, and quality control in the laboratory,	**3**
III	Blood grouping- ABO grouping, Forward grouping (Slide & Tube), Reverse grouping- Preparation of pooled A, B & O cells. Rh- antibody titration, direct and indirect, Preparation of coombs control cells, Compatibility testing. Other methods of grouping, Rh grouping & Rh typing (slide and tube method)	**3**
IV	Selection of blood donor, Crossmatching Techniques, Major, Minor, Saline, Albumin, Coomb's. Emergency Cross matching, pre and post Blood collection of donor. Donor selection, Post donation care, Preservation and storage of blood, Preparation and storage of blood components.	**3**
TOTAL		**12**

Text Books:

1. Practical Haematology- Daicie & Lewis, Barbara J. Bain, Imedlda Bates, Make A Laffan, SMitchell

Lewis
2. Textbook of Medical Lab Technology- Praful B. Godkar.
3.Clinical Haematology in Medical Practice- de Gruchy.
4.Clinical Haematology Principles, procedures, correlations by E. Anne Stiene Martin, Chery A. Lotspiech- steininger, John A. Koepke.
5. Principles & Practice of Transfusion Medicine by RN Makroo
6.The Textbook of Blood Bank and Transfusion Medicine -Satish Gupte.

Reference Books:

1.Medical Laboratory Technology Methods & interpretation- Ramnik Sood.
2.Textbook of Medical Laboratory Technology- Praful B. Godkar, Darshan P Godkar.
3. Manual of Transfusion Medicine-Ramadas Nayak.

Level- Semester II

Course: C-3

Subject name: Biochemistry-II

Subject Code: **MLT232C203**

L-T-P-C: **3-1-1-4(T)** **Total credits: 4(T+P)**

Course Objectives:

The objective of the course is to introduce students acquire knowledge of the clinically important body fluids and the associated biochemistry. Also, focusing on different processes of sample collection and various methods of sample rejection criteria which gives the greatest impact on accuracy of result.

This course has been formulated to impart comprehensive knowledge on different types of isoenzymes and their involvement in helping diagnose and monitor different medical conditions, emphasizing on their functions, and the associated clinical test.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall the clinically important body fluids and the associated biochemistry	**BT 1**
CO 2	To outline the crucial step of sample collection in diagnostic and research processes, ensuring the accuracy and reliability of the	**BT 2**

	results.	
CO 3	To identify the different enzymes involved in various clinical tests, helping diagnose and monitor different medical conditions.	**BT 3**
CO 4	To analyze diagnostic procedures used to assess the functioning of the stomach and its ability to secrete digestive enzymes, acids, and other components involved in the digestion process..	**BT 4**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I.	Introduction to clinical biochemistry and body fluids. Definition and scope of clinical biochemistry in diagnosis, biochemistry of urine, blood and clinical entities in body fluids.	**9**
II.	Specimen collection and analysis. Collection of sample, sample acceptance and rejection criteria, transport of sample, storage of specimen for appropriate test, reference ranges.	**9**
III.	Introduction to Iso-enzymes: Lactate dehydrogenase, creatine kinase, aspartate amino amylase, isocitrate dehydrogenase., Enzymes as therapeutic agents, Enzymes used for diagnosis. Test based on blood levels of thyroid hormones – T3, T4,TSH. Test based on metabolic effects of thyroid hormone, Scanning of thyroid gland	**9**
IV	Organ Function Test: Liver function tests- Tests for Liver Function, Serum bilirubin, Classification of jaundice, Bile acids and bile salts, Tests based on metabolic capacity of liver, Tests based on synthetic function. Renal function tests- Urea clearance tests, Endogenous creatine clearance tests, Tests for renal blood flow, Test based on tubular function, Water dilution tests.	**9**
TOTAL		**36**

Subject: Biochemistry-II

L-T-P-C: **0--0-1-1 (P)**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I	Glucose tolerance test (GTT), Renal Function test (urea, creatinine, uric acid)	**3**

II	Liver Function Test (Total, Direct and Indirect Blirubin, SGPT , SGOT, albumin)	**3**
III	Demonstration of estimation of glycosylated hemoglobin (HbA1C), Quality control.	**3**
IV	Vitamins and hormone estimation. Thyroid Function Test (T3,T4,TSH)	**3**
TOTAL		**12**

Text Books:

1. Lehinger Principle of Biochemistry, David L Nelson, 7th edition, WH freeman Publishers
2. Fundamentals of biochemistry,JL jain and Sanjay Jain,S Chand Publishers.

Reference Books:

1. Text book of Medical Biochemistry – MN Chaterjee, Rana Shinde, Jaypee publishers.
2. Biochemistry, U. Sathyanarayana, Elsevier
3. Harper's Biochemistry,28th edition, Robert K Murray, Tata McGraw publishers

Level- Semester - II

Title of the Paper: Diagnostic Molecular Biology

Subject Code: MML232C204

L-T-P-C: 2-**1-1-4 (T)** **Total credits: 4(T+P)**

Course Objectives:

The course is designed with an objective to provide a basic introduction of molecular biology, role and importance of translation and transcription processes occurring within the living cell and techniques in molecular biology like PCR, RT-PCR etc

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall about the general concepts of nucleic acid and its types- DNA and RNA.	**BT 1**

CO 2	To explain how replication, transcription and translation processes occur within the living cell.	**BT 2**
CO 3	To apply the knowledge gained during the course in Performing the various practical activities.	**BT 3**
CO 4	To analyze the effects of various factors on molecular events such as replication, transcription and translation.	**BT 4**

DETAILED SYLLABUS

Modules	**Course Contents**	**Periods**
I.	Nucleic Acids, DNA, RNA, composition, structure, types, denaturation andrenaturation of DNA, chemistry of DNA	9
II	Basic transcription apparatus, Initiation, elongation and termination of transcription, Eukaryotic Transcription of mRNA, tRNA and rRNA, types of RNA polymerases, transcription factors Introduction of translation	9
III	Nucleic acid amplification testing, PCR, Principle, Types, applications, Thermal cycler, RT PCR, reverse transcriptase PCR, Nested PCRBlotting techniques, southern blotting and Western blotting	9
IV	Radioisotopes and its application in measurement of blood volume, determination of red cell volume and plasma volume, red cell life span, platelet life span, radiation hazards and its prevention disposal of radioactive material Introduction and applications of Flow cytometry, Stem cell banking, Prenatal Diagnosis	9
	TOTAL	**36**

Subject: Diagnostic Molecular Biology Lab-I

L-T-P-C: **0-0-1-1 (P)**

Modules	**Course Content**	**Periods**
I	PCR- Side Directed Mutagenesis, DNA Isolation.	**3**
II	DNA Cloning, Bacterial Transformation and Fusion Protein Purification.	**3**
III	(Demonstration only), Plasmid Analysis by Restriction Digestion.	**3**
IV	Protein gel Electrophoresis, DNA Gel Electrophoresis.	**3**
TOTAL		**12**

Recommended Books:

1. Basic Biotechnology (Paperback) By Colin Ratledge and Bjorn Kristiansen. Cambridge University Press.

2. Introduction to Biotechnology (Paperback) By William J. Thieman and Michael A. Palladino. Benjamin Cummings; US Ed edition.

3. Recombinant DNA Principles and Methodologies By James Joseph Greene, CRC Press.

4. Molecular Biotechnology: Principles and Applications of Recombinant DNA (Paper-back) By Bernard J Glick and Jack J Pasternak. Publisher: American Society for Microbiology.

5. Laboratory Techniques in Biochemistry and Molecular Biology; DNA sequencing (Vol 10). By J Hindley. Elsevier Biomedical

Reference Book:

1. Teitz,(2007),Fundamentals of Clinical Chemistry,6th edition,Elsevier Publications

2. Henry's Clinical Diagnosis and Management by Laboratory Methods,(2011),22ndedition, Elsevier

3. Singh &Sahni,(2008),Introductory Practical Biochemistry,2nd edition, Alpha science Lehninger, (2013),Principles of Biochemistry,6th edition, W H Freeman

Level: Semester II

Course: DSE

Title of the Paper: Biostatistics and Research Methodologies

Subject Code: MML232D201

L-T-P-C: 3-1-0-4 **Total credits: 4**

Course Objectives

The course entails to educate the student about the basic concept on research, its approaches, the criteria of a good research. In this subject we learn how to collect data on research, the processing of data and testing on hypothesis.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To recall about different methodology on research, an idea on a good research, the different research problem faced while making a research.	**BT 1**
CO 2	To classify the different methods of design and data collection, the criteria for selecting a sample.	**BT 2**
CO 3	To apply the knowledge of processing and analyzing of data.	**BT 3**
CO 4	To analyze the application, steps, characteristics and limitations in a hypothesis.	**BT 4**

DETAILED SYLLABUS

Modules	Topics (if applicable) & Course Contents	Periods
I	**Introduction:** Introduction to research methodology: meaning, objectives of research, types of research, research approaches, significance of research, research process, criteria of good research, defining research problem: selecting the problem necessity and techniques in defining the problem.	**16 hours**
II	**Research, sample design and data collection: Research Design**: need and features of good design, types, basic principles of experimental design, developing a research plan. **Sample design:** criteria for selecting a sample procedure, characteristics of good sampling procedure types of sample design, selecting random samples. **Methods of data collection:** Collection of primary data, observation method, interview method, collection of data through questionnaire and schedules and other methods. Collection of secondary data, selection of appropriate method for data, collection, case study method, guidelines for developing questionnaire, successful interviewing, survey vs. experiment	**16 hours**
III	**Processing and analysis of data:** data analysis (elements), statistics in research, measures of central tendency, dispersion, asymmetry, regression analysis, multiple correlation and regression, partial correlation, association in case attributes **Sampling Fundamentals**: Definition, need, central limit theorem, sampling theory, concept of standard error, estimation, estimating population mean, proportion, sample size and its determination	**16 hours**
IV	**Testing of hypothesis:** Meaning basic concepts, important parametric tests, limitations of tests of hypothesis. Chi-square test: Applications, steps characteristics, limitations. Analysis of variance and co-variance: basic principles, techniques, applications, assumptions and limitations. Analysis of non-parametric tests	**16 hours**
	Total	**64**

Text books:

1.Research Design: Qualitative, Quantitative and Mixed Methods Approaxches, 4th Edition, by John W. Creswell.

2. Qualitative Research: A Guide to Design and Implementation 4th edition, , by Sharan B. Merriam (Author), Elizabeth J. Tisdell

3. Quantitative Inquiry and Research Design: Choosing Among Five Approaches 3rd Edition, by John W. Creswell

Recommended Books:

1. Fundamental of Research Methodology and Statistics by Y.K. Singh

2. Research Methodology Methods and techniques by by C.R Kothari, Gaurav Garg.