THE ASSAM
ROYAL GLOBAL UNIVERSITY
GUWAHATI

Royal School of Medical and Allied Sciences (RSMAS)

Department of Medical Laboratory Technology (MLT)
Post Graduate Program
Specialization in Hematology and Blood banking, Medical Microbiology

W.E.F

AY - 2025- 26

(Based on National Education Policy 2020)

1. Introduction:

India is one of the fastest-growing economies globally, with knowledge creation and research playing a pivotal role in sustaining this momentum. As the nation aspires to establish itself as a leading knowledge society and one of the largest economies, there is an urgent need to expand research capabilities and outputs across disciplines.

At Royal Global University, we align ourselves with this national vision by fostering a robust ecosystem of research and innovation, nurturing a vast talent pool that is critical for achieving these ambitious goals.

The National Education Policy (NEP) 2020 emphasizes the transformation of higher education to support India's transition to a knowledge-driven economy. Key initiatives such as multidisciplinary education with multiple entry and exit options, undergraduate research opportunities, and a learning outcomes-based curriculum are at the forefront of this transformation.

The postgraduate (PG) programmes at Royal Global University are designed to advance students' expertise in their chosen fields and equip them for higher research pursuits. These programmes provide the advanced knowledge and specialized skills necessary for students to evolve from learners to innovators, contributing meaningfully to the nation's knowledge economy.

In line with NEP 2020, Royal Global University offers restructured degree programmes to provide flexible and holistic education. The policy envisions undergraduate programmes with various certification options, including:

- A UG certificate after completing 1 year of study,
- A UG diploma after 2 years,
- A Bachelor's degree after a 3-year programme, or
- A preferred 4-year multidisciplinary Bachelor's degree, offering students the opportunity to explore holistic and multidisciplinary education alongside their chosen major and minors.

Similarly, postgraduate programmes at Royal Global University are designed with flexibility to cater to diverse academic and professional aspirations, fostering a new generation of knowledge creators who will shape India's future as a global leader.

Royal Global University remains committed to empowering students and creating an educational environment that embodies the principles of NEP 2020, driving innovation and excellence in higher education.

2. Recommendations of NEP 2020 Pertinent to Postgraduate Education

- A **2-year PG programme** may be offered, with the second year exclusively dedicated to research for students who have completed a 3-year Bachelor's programme.
- For students who have completed a **4-year Bachelor's programme with Honours or Honours with Research**, a **1-year PG programme** could be introduced.
- An **integrated 5-year Bachelor's/Master's programme** may also be offered.
- Universities are encouraged to provide PG programmes in core areas such as **Machine Learning**, multidisciplinary fields like **AI + X**, and professional domains such as **healthcare**, **agriculture**, and **law**.
- A **National Higher Education Qualifications Framework (NHEQF)** will define higher education qualifications in terms of learning outcomes. The PG programme levels will correspond to **Levels 6, 6.5, and 7** under the NHEQF.
- The PG framework must align with the **National Credit Framework (NCrF)** to facilitate the creditization of learning, including the assignment, accumulation, storage, transfer, and redemption of credits, subject to appropriate assessment.

3. Key Features of the Postgraduate Curriculum Framework

- **Interdisciplinary Flexibility**: Students can transition between different disciplines of study.
- **Choice of Specialization**: Students with a UG qualification, including a major and minor(s), have the flexibility to pursue their PG programme in their major, minor(s), or any other subject, provided they demonstrate the required competence.
- **Learner-Centric Options**: Opportunities are provided for students to select courses aligned with their interests.
- **Diverse Learning Modes**: Flexibility to adopt alternative learning methods, including offline, Open and Distance Learning (ODL), online, and hybrid modes.
- **Mobility and Credit Flexibility**: In line with the UGC (Establishment and Operation of Academic Bank of Credits in Higher Education) Regulations, 2021, and the UGC Guidelines for Multiple Entry and Exit in Academic Programmes, students benefit from greater academic mobility. These frameworks support the implementation of the proposed **"Curriculum and Credit Framework for Postgraduate Programmes"**.

4. Credit Requirements and Eligibility Criteria for PG Programmes

- A 1-year (2-semester) PG programme at level 6.5 on the NHEQF requires a Bachelor's degree with Honours or Honours with Research and a minimum of 160 credits.
- A 2-year (4-semester) PG programme at level 6.5 on the NHEQF requires a 3-year (6-semester) Bachelor's degree with a minimum of 120 credits.
- For professional PG programmes such as M.E., M.Tech., etc., a 2-year (4-semester) PG programme at level 7 of the NHEQF requires a 4-year Bachelor's degree (e.g., B.E., B.Tech.) with a minimum of 160 credits.
- A student is eligible for a PG programme in a discipline corresponding to either their major or minor(s) from their UG programme. Admission may be granted based on performance in the UG programme.
- Regardless of the major or minor disciplines pursued during UG, a student can seek admission to any discipline of a PG programme if they qualify through a National level entrance examination in the relevant discipline.

5. Generic Learning Outcomes at the Postgraduate Level

Under the **National Higher Education Qualifications Framework (NHEQF)**, higher education qualifications are classified across levels ranging from **Level 4.5 to Level 8**. These levels represent sequential stages of learning, defined through a set of learning outcomes that outline what learners are expected to **know, understand, and demonstrate** upon successfully completing a programme of study at a specific level.

Learning outcomes are articulated as measurable graduate attributes, which students must achieve and demonstrate upon completing their programme. For postgraduate studies, these outcomes ensure students are equipped with advanced knowledge, skills, and competencies essential for their academic and professional growth.

- **NHEQF Level 4.5** corresponds to the learning outcomes expected in the first year (first two semesters) of an undergraduate programme.
- **NHEQF Level 8** corresponds to the outcomes appropriate for a doctoral-level programme.

Postgraduate programmes fall between **Level 6.5 and Level 7**, as outlined in the NHEQF. The framework ensures that PG students acquire both depth in their subject knowledge and the ability to apply their learning to complex, real-world challenges.

For a comprehensive understanding of the detailed learning outcomes for PG programmes, refer to the **National Higher Education Qualifications Framework (NHEQF).**

5.1 Graduate Attributes & Learning outcomes descriptors for a higher education qualification at level 6.5 on the NHEQF

Qualifications that signify completion of the postgraduate degree are awarded to students who:

GA1: have demonstrated knowledge and understanding that is founded upon and extends and/or enhances that typically associated with the first cycle, and that provides a basis or opportunity for originality in developing and/or applying ideas, often within research context.

GA2: can apply their knowledge and understanding, and problem-solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.

GA3: have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments.

GA4: can communicate their conclusions, and the knowledge and rationale underpinning these, to specialist and non-specialist audiences clearly and unambiguously.

GA5: have the learning skills to allow them to continue to study in a manner that may be largely self-directed or autonomous.

The PG degree (e.g. M.A., M.Com., M.Sc., etc.) will be awarded to students who have demonstrated the achievement of the outcomes located at level 6.5 on the NHEQF. Refer Table 5.1.1

Table 5.1.1

Element of the descriptor	**NHEQF level descriptors** *The graduates should be able to demonstrate the acquisition of:*
Knowledge and understanding	• advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning, • advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field(s) of learning or professional practice, • procedural knowledge required for performing and accomplishing complex and specialized and professional tasks relating to teaching, and research and development.
General, technical and professional skills required to perform and accomplish tasks	• advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning.

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
	• advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. • specialized cognitive and technical skills relating to a body of knowledge and practice to analyse and synthesize complex information and problems.
Application of knowledge and skills	• apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyse problems and issues, including real-life problems, associated with the chosen fields of learning. • apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems.
Generic learning outcomes	**Effective Communication and Presentation** • Listen attentively, analyze texts and research papers, and present complex information clearly to diverse audiences. • Communicate technical information, research findings, and explanations in a structured manner. • Concisely discuss the relevance and applications of research findings in the context of emerging developments and issues. **Critical Thinking and Analytical Skills** • Evaluate evidence reliability, identify logical flaws, and synthesize data from multiple sources to draw valid conclusions. • Support arguments with evidence, address opposing viewpoints, and critique the reasoning of others. **Self-Directed Learning and Professional Development** • Address personal learning needs in chosen fields of study, work, or professional practice. • Pursue self-paced learning to enhance knowledge and skills, particularly for advanced education and research. **Research Design and Methodology**

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
	• Define and articulate research problems, formulate hypotheses, and design relevant research questions. • Develop appropriate tools and techniques for data collection and analysis. • Use statistical and analytical methods to interpret data and establish cause-and-effect relationships. **Research Execution and Ethics** • Plan, conduct, and report investigations while adhering to ethical standards in research and practice. • Apply research ethics rigorously in fieldwork and personal research activities. **Problem-Solving and Decision-Making** • Make informed judgments and decisions based on empirical evidence and analysis to solve real-world problems. • Take responsibility for individual and group actions in generating solutions within specific fields of study or professional practice.
Constitutional, humanistic, ethical, and moral values	• embrace and practice constitutional, humanistic, ethical, and moral values in one's life, • adopt objective and unbiased actions in all aspects of work related to the chosen fields/subfields of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • support relevant ethical and moral issues by formulating and presenting coherent arguments, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants, avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
Employability & job-ready skills, entrepreneurship skills and capabilities/qualities and mindset	• adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive the shift in employers' demands for skills, particularly with respect to the transition towards more technology-assisted work

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
	involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group/team outputs and for managing work that is complex and unpredictable requiring new strategic approaches.

Note: Schools/ Departments are instructed to form their Programme Outcomes based on the Graduate attributes. Table 5.1.1 is given as reference outline to frame the Programme Level Outcomes.

5.2 Learning outcomes descriptors for a higher education qualification at level 7 on the NHEQF

The PG degree (e.g. M.E./M.Tech. etc.) is awarded to students who have demonstrated the achievement of the outcomes located at level 7 on the NHEQF. Table 5.1.2 are the descriptors for qualifications at levels 7 on the NHEQF.

Table 5.1.2

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
Knowledge and understanding	• advanced knowledge about a specialized field of enquiry with a critical understanding of the emerging developments and issues relating to one or more fields of learning, • advanced knowledge and understanding of the research principles, methods, and techniques applicable to the chosen field(s) of learning or professional practice, • procedural knowledge required for performing and accomplishing complex and specialized and professional tasks relating to teaching, and research and development.
General, technical and professional skills required to perform and accomplish tasks	• advanced cognitive and technical skills required for performing and accomplishing complex tasks related to the chosen fields of learning. • advanced cognitive and technical skills required for evaluating research findings and designing and conducting relevant research that contributes to the generation of new knowledge. • specialized cognitive and technical skills relating to a body of knowledge and practice to analyse and synthesize complex information and problems.

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
Application of knowledge and skills	• apply the acquired advanced theoretical and/or technical knowledge about a specialized field of enquiry or professional practice and a range of cognitive and practical skills to identify and analyse problems and issues, including real-life problems, associated with the chosen fields of learning. • apply advanced knowledge relating to research methods to carry out research and investigations to formulate evidence-based solutions to complex and unpredictable problems.
Generic learning outcomes	**Effective Communication and Presentation** • Analyse texts and research papers critically and present complex information clearly and concisely to diverse audiences. • Communicate technical information, research findings, and their applications in a structured and concise manner, considering emerging developments and issues. **Critical Thinking and Analytical Skills** • Evaluate the reliability and relevance of evidence, identify flaws in arguments, and synthesize data from multiple sources. • Draw valid conclusions supported by evidence while addressing opposing viewpoints. **Research Design and Execution** • Define problems, formulate research questions and hypotheses, and use quantitative and qualitative data to test and establish hypotheses. • Develop appropriate tools for data collection and apply statistical and analytical techniques for data interpretation. • Plan, execute, and report research findings while adhering to ethical standards. **Self-Directed Learning and Professional Growth** • Meet personal learning needs in chosen fields of study or practice through self-paced and self-directed learning. • Upgrade knowledge and research-related skills to pursue advanced education and contribute to professional practice. **Problem-Solving and Decision-Making**

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*
	• Generate solutions to real-world problems through informed judgments and decision-making based on analysis and empirical evidence. • Take responsibility and accountability for individual and group actions in addressing challenges within the chosen field or profession. **Application and Synthesis** • Synthesize and articulate issues, design research proposals, and explore the relevance and implications of findings in professional and academic contexts. • Predict cause-and-effect relationships and make strategic decisions to address challenges in a multidisciplinary environment.
Constitutional, humanistic, ethical, and moral values	• embrace and practice constitutional, humanistic, ethical, and moral values in one's life, • adopt objective and unbiased actions in all aspects of work related to the chosen fields/subfields of study and professional practice, • participate in actions to address environmental protection and sustainable development issues, • support relevant ethical and moral issues by formulating and presenting coherent arguments, • follow ethical principles and practices in all aspects of research and development, including inducements for enrolling participants, avoiding unethical practices such as fabrication, falsification or misrepresentation of data or committing plagiarism.
Employability & job-ready skills, entrepreneurship skills and capabilities/qualities and mindset	• adapting to the future of work and responding to the demands of the fast pace of technological developments and innovations that drive shift in employers' demands for skills, particularly with respect to the transition towards more technology-assisted work involving the creation of new forms of work and rapidly changing work and production processes. • exercising full personal responsibility for the output of own work as well as for group/team outputs and for managing work that are complex and unpredictable requiring new strategic approaches.

Element of the descriptor	NHEQF level descriptors *The graduates should be able to demonstrate the acquisition of:*

Note: Schools/ Departments are instructed to form their Programme Outcomes based on the Graduate attributes. Table 5.1.2 is given as reference outline to frame the Programme Level Outcomes.

The levels of PG programmes as per the NHEQF are summarized in Table 5.1.3

Level	Credits	Qualification	Credit Requirement Per year	Credit Points	Total Notional Learning hours
6	160	1 – yr P.G. Diploma	40	240	1200
6.5	160	1-Year PG after a 4-year UG	40	260	1200
6.5	120	2-Year PG after a 3-year UG	40	260	1200
7	160	2-Year PG after a 4-year UG such as B.E., B. Tech. etc	40	280	1200

6. Curricular Components

2-year PG: Students entering 2-year PG after a 3-year UG programme can choose to do:

- only course work in the third and fourth semester or
- course work in the third semester and research in the fourth semester or
- only research in the third and fourth semester.

1-year PG: Students entering 1-year PG after a 4-year UG programme can choose to do

- only coursework or
- research or
- coursework and research.

5-year Integrated Programme (UG+PG): At the PG level, the curricular component of 5-year integrated programme will be similar to that of 2-year PG mentioned above.

Programmes designed to enhance students' analytical abilities for optimal problem-solving typically focus on advanced skills and real-world experience, with a reduced emphasis on research components. These programmes should feature a curriculum distinct from other academic offerings, tailored to meet their specific objectives.

7. Credit Distribution

7.1 For 1-year PG

Table: 7.1.1

Curricular Components	PG Programme (one year) for 4-yr UG (Hons./Hons. with Research) Minimum Credits			
	Course Level	Coursework	Research thesis/project/Patent	Total Credits
Coursework + Research	500	20	20	40
Coursework	500	40	--	40
Research			40	40

7.2 For 2-year PG

Table: 7.1.2

Curricular Components		PG Programme (one year) for 4-yr UG (Hons./Hons. with Research) Minimum Credits			
		Course Level	Coursework	Research thesis/project /Patent	Total Credits
PG Diploma		400	40	--	40
1st Year (1st & 2nd Semester)		400 500	24 16	--	40
Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma					
2nd Year (3rd & 4th Semester)	Coursework & Research	500	20	20	40
	Coursework (or)	500	40	--	40
	Research			40	40

Exit Point:

For those who join 2-year PG programmes, there shall only be one exit point. Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma.

8. Course Levels

400-499: Advanced courses which would include lecture courses with practicum, seminar-based course, term papers, research methodology, advanced laboratory experiments/software training, research projects, hands-on-training, internship/apprenticeship projects at the undergraduate level or First year Postgraduate theoretical and practical courses

500-599: For students who have graduated with a 4-year bachelor's degree. It provides an opportunity for original study or investigation in the major or field of specialization, on an individual and more autonomous basis at the postgraduate level.

9. Switching Subjects in Postgraduate Programme

The first degree often inspires students to explore alternative career paths that may require a shift in their field of study. While transitioning to a different discipline through a postgraduate degree can be challenging, the **National Education Policy (NEP)** provides the necessary flexibility to make it achievable. Postgraduate programmes offer students the opportunity to change their field and pursue their aspirations through the following pathways:

- Students are eligible for admission to a PG programme in either the **major or minor discipline** studied during their undergraduate programme.
- Irrespective of the major or minor disciplines pursued in the undergraduate programme, students may seek admission to **any discipline** of PG programmes by qualifying the relevant National or University-level entrance examination.

Furthermore, candidates who have completed:

- A **4-year UG programme**,
- A **3-year UG + 2-year PG programme**, or
- A **5-year integrated UG + PG programme** in STEM subjects is eligible for admission to **M.E. or M.Tech. programmes** in related fields.

This framework enables students to redefine their academic trajectory and achieve their professional goals in a new discipline.

References:

1. **Curriculum and Credit Framework for Postgraduate Programmes,** https://www.ugc.gov.in/pdfnews/4682468_Curriculum-and-Credit-Framework-for-Postgraduate- Programmes.pdf
2. **The National Education Policy 2020** (https://www.education.gov.in/sites/upload_files/mhrd/files/NEP_Final_English_0.pdf)
3. **National Credit Framework (NCrF)** (https://www.ugc.gov.in/pdfnews/9028476_Report-of-National-Credit-Framework.pdf)
4. **The National Higher Education Qualifications Framework (NHEQF)** (https://www.ugc.gov.in/pdfnews/2990035_Final-NHEQF.pdf)
5. **Curriculum and Credit Framework for Undergraduate Programmes.** (https://www.ugc.gov.in/pdfnews/7193743_FYUGP.pdf)

Semester- wise and component wise distribution of credit.

PG Programme (one year) for 4-yr UG (Hons./Hons. with Research) Minimum Credits

	Semester	Course Code	Component	Level	Credits				
Year	PG Diploma	-----		400	40				
	Common subject								
1st Year	**1st Semester**	**Theory and Practical**		**400**	**24**				
		Subject Code	**Name of subjects**	**Level**	**L**	**T**	**P**	**C**	**TCP**
		MLT244C101/ MLT244C111	Clinical Pathology (Theory +Lab)	400	2	0	4	4	4
		MLT244C102/ MLT244C112	Biochemistry I (Theory + lab)	400	2	0	4	4	4
		MLT244C103/ MLT244C113	Microbiology I (Theory +Lab)	400	2	0	4	4	4
		MLT244C104/ MLT144C114	Histopathology and Cytopathology (Theory +Lab)	400	2	0	4	4	4
		MLT244C105	Advanced Diagnostic Techniques	400	3	1	0	4	4
		MLT244C106	Biostatistics and Research Methodologies	400	3	1	0	4	4
	Total Credit				**14**	**2**	**16**	**24**	**24**
	2nd Semester	**Theory and Practical**		**500**	**L**	**T**	**P**	**C**	**TPC**
		MLT244C201/ MLT244C211	Serology and Immunology (Theory +Lab) / Haematology I and Blood Banking I (Theory + Lab)	500	2	0	4	4	4
		MLT244C202/ MLT244C212	Biochemistry II (Theory + Lab)	500	2	0	4	4	4
		MLT244C203/ MLT244C213	Diagnostic Molecular Biology (Theory + Lab)	500	2	0	4	4	4
		MLT244C204	Medical Lab Managment	500	3	1	4	4	4
	Total Credit				**9**	**1**	**16**	**16**	**16**

Students who exit at the end of 1st year shall be awarded a Postgraduate Diploma

Specialization in Medical Microbiology									
2nd Year	3rd Semester	**Theory and Practical**		**Level**	**Credit**				
				300	**40**				
		Subject Code	**Name of subjects**	**Level**	**L**	**T**	**P**	**C**	**TCP**
		MLT244C301/ MLT244C311	Clinical Microbiology (Theory+Lab)	500	3	0	6	6	6
		MLT244C302/ MLT244C312	Immunology and Serology (Theory+Lab)	500	3	0	6	6	6
		MLT244C303	Bioethics, IPR, Biosafety	500	3	1	0	4	4
		MLT244C304	Cytogenetics and molecular genetics	500	3	1	0	4	4
	Specialization in Hematology and Blood banking								
	3rd Semester	MLT244C301/ MLT244C311	Hematology-II (Theory+Lab)	500	3	0	6	6	6
		MLT244C302/ MLT244C312	Blood banking-II and Coagulation (Theory+Lab)	500	3	0	6	6	6
		MLT244C303	Bioethics, IPR, Biosafety	500	3	1	0	4	4
		MLT244C304	Cytogenetics and molecular genetics	500	3	1	0	4	4
	Total Credit				**12**	**2**	**12**	**20**	**20**
	4th Semester	**Research/Dissertation**		**Level**	**L**	**T**	**P**	**C**	**20**
		MLT244C421	Project/Dissertation	500	0	0	20	20	20
	Total Credit				**0**	**0**	**20**	**20**	**20**

Level: Semester I

Level: 400

Title of the Paper: Clinical Pathology (Theory+ Lab)

Subject Code: MLT244C101/ MLT244C111

L-T-P-C: 2-0-4-4 (T+ P) **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**

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.

Title of the Paper: Clinical Pathology Lab

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

Level: 400

Title of the Paper: Biochemistry I (Theory+ Lab)

Subject Code: MLT244C102/ MLT244C112

L-T-P-C: 2-0-4-4 (T+ P) **Total credits: 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 outcome

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:

Module	**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	**9**

	metabolism, abnormalitiesof protein in plasma, disorders of plasma lipids and lipoprotein.	
TOTAL		**36**

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.

Title of the Paper: Biochemistry Lab I

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:

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

Level: Semester I

Level: 400

Subject: Microbiology I (Theory+ Lab)

Subject Code: **MLT244C103/ MLT244C113**

L-T-P-C: **2-0-4-4 (T+P)** **Total credits: 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**

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.

Title of the Paper: Microbiology Lab I

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

Level: 400

Subject: Histopathology and Cytopathology (Theory+Lab)

Subject Code: **MLT244C104/ MLT244C114**

L-T-P-C: **2-0-4-4 (T+P)** **Total credits: 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, E m b e d d i n g , 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 Fixation of Tissues and fixative , grossing, dehydration, Decalcification and tissue processing	**9**
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

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

Level: 400

Title of the Paper: Advanced Diagnostic Techniques (T)
Subject Code: MLT244C105

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 immunoassays.

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,	**16 hours**
II	Thin layer chromatography, HPLC, Gas liquid chromatography, Ion exchange chromatography and their application in diagnosis.	**16 hours**
III	Basic Principle of electrophoresis, Paper electrophoresis, Gel electrophoresis, PAGE, SDS-PAGE,	**16 hours**
IV	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**
	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 I

Level: 400

Title of the Paper: Biostatistics and Research Methodologies
Subject Code: MLT244C106

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	**16 hours**

	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	
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.

Level: Semester II

Level: 500

Title of the Paper: Serology and Immunology (Theory+Lab) (Specialization in Medical Microbiology)

Subject Code: MLT244C201/MLT244C211

L-T-P-C: **2-0-4-4 (T+P)** **Total credits: 4**

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

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

Level: 500

Subject: Hematology I and Blood Banking I (Theory+Lab) (Specialization in Hematology and Blood banking)

Subject Code: **MLT244C201/ MLT244C211**
L-T-P-C: **2-0-4-4 (T+P)** **Total credits: 4**

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 I and blood banking I Lab

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

Level: 500

Subject name: Biochemistry-II (Theory + Lab)

Subject Code: **MLT244C202/MLT244C212**

L-T-P-C: **2-0-4-4(T+P)** **Total credits: 4**

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 results.	**BT 2**
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 Lab

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

Level: 500

Title of the Paper: Diagnostic Molecular Biology (Theory + Lab)

Subject Code: MLT244C203/MLT244C213(T+P)

L-T-P-C: 2-**0-4-4 (T)** **Total credits: 4**

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	9
TOTAL		**36**

Subject: Diagnostic Molecular Biology Lab

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 Free

Level: Semester II

Level: 500

Subject: Medical laboratory management (Theory)
Subject Code: MLT244C403

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

Course Objectives: The main objective of the course is to Explain and apply principle of effective test utilization, Interpret, implement and complying law, regulation, accrediting standards and guidelines of Govt. and NG organizations.Design, implement and evaluate resources in lab

Communicate effectively with laboratory personnel and health care professional.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Become professional competent in medical laboratory	**BT 1**
CO 2	Exhibit a sense of commitment to the ethical and human aspect of patient care	**BT 2**
CO 3	Recognize the role of clinical laboratory scientist in the assurance of quality health care	**BT 3**
CO 4	Application of safety and governmental regulation and standards as applied to medical laboratory practice.	**BT 4**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I.	The importance of laboratory quality Overview of the quality management system The quality management system model History of Laboratory quality management International laboratory standards	9

II.	Laboratory design Geographic or spatial organization Physical aspects of premises and rooms Safety management programme Identification of risks Personal protective equipment Emergency management and first aid Summary	9
III.	Equipments Overview Selecting and acquiring equipment Getting equipment maintenance programme Implementing an equipment maintenance programme Troubleshooting, service, repair and retiring equipment Equipment maintenance documentation	9
IV	Purchasing and inventory Overview Purchasing Implementing an inventory management programme Quantification Forms and logs Receipt and storage of supplies Monitoring inventory Summary	9
TOTAL		**36**

Reference Books:

1. Medical Laboratory Technology Methods & interpretation- Ramnik Sood.

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

Specialization in Medical Microbiology

Level: Semester III

Level: 500

Subject: Clinical Microbiology (T+P)

Subject Code: MLT244C301/MLT244C311
L-T-P-C: 3-0-6-6 **Total credits: 6**

Course Objectives:

This course provides introduces theory including the host-microbe interactions, mechanisms of infection, and immune responses to microbial pathogens. It also take into to Identify clinically significant bacterial pathogens and their role in human diseases. Demonstrate proficiency in fungal culture, microscopic identification, and molecular diagnostic techniques. The course also presents Understand antiviral therapy, vaccine development, and emerging viral infections and epidemiology, and control measures for parasitic infections.

Course Outcomes:

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Describe the host-microbe interactions, mechanisms of infection, and immune responses to microbial pathogens including perform and interpret bacterial culture techniques, staining procedures, biochemical tests, and molecular diagnostics.	**BT 1**
CO 2	Recognize common fungal pathogens and their associated infections including microscopic identification, molecular diagnostic techniques and understand the antifungal therapy, resistance mechanisms, and emerging fungal diseases.	**BT 2**
CO 3	Recognize test structure, classification, and replication of viruses relevant to human health followed by understand antiviral therapy, vaccine development, and emerging viral infections.	**BT 3**
CO 4	Recall the medically important parasites, including protozoa and helminths, and their life cycles along with principles of methods, selection and use of appropriate analytical equipment and molecular diagnostic methods for parasite	**BT 4**

DETAILED SYLLABUS

Modules	Course Content	Periods
I.	**Applied Bacteriology:** Epidemiological aspects of control infections and diseases, hospital acquired infections, surgical acquired infections, Microbiology of air, bacteriology of water, milk, food and its born diseases, Automation in diagnostic microbiology. **Advances in Medical Microbiology:** Emerging diseases: Bacterial infections: Listeriosis, VRE(Vancomycin resistant enterococci), H.pylori, E. coli serotype O157:H7	9
II.	**Medical Mycology:** Introduction to Mycology, Classification of fungi, Immunity to fungal infections, Superficial mycosis- Pityriasis vessicolor, dermatophytes. Subcutaneous mycosis: Mycetoma, Rhinosporidiosis, Chromoblastomycosis. Systemic mycosis- Histoplasmosis, Blastomycosis, Para Coccidioidomycosis. Opportunistic mycosis: candidiasis, Aspergillosis, Zygomycosis, Penicillin. Common media and special stains used in mycology, Serological tests for mycotic infections.	9
III.	**Medical Virology:** General characteristics and classification of viruses, different methods of cultivation and isolation of viruses, cell culture containers and cleaning, Propagation, maintenance and preparation of various cell cultures. **Diagnostic Virology:** Collections, preservations, transportation, processing, Isolation and identification of the clinical specimens for viral diagnosis (Skin lesion, vesicle fluid, biopsy specimens, nasopharyngeal secretions). Serological diagnosis of viral infection: Paul Bunnel test, Hemagglutination test, viral neutralization tests.	9

IV	**Medical Parasitology:** Introduction to medical parasitology, safety measures, classification of human parasites. Morphology, transmission, life cycle and lab diagnosis of Protozoa, Schistosoma spp, Fasciola spp, Taenia spp, Echinococcus granulosus, Plasmodium spp, Cryptosporidium, Ascaris lumbricoides, Filaria, Enterovius vermicularis, Strongyloidesstercoralis, Leishmania donovani, Balantidium coli. Vector control measures, Principles of Integrated Vector management and Insect Pest management, Pesticides and Environmental pollution by pesticides and safe handling practice of pesticides.	9
TOTAL		36

Reference Books:

1. **Murray's Medical Microbiology"** – Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller.
2. **"Jawetz, Melnick & Adelberg's Medical Microbiology"** – Geo. Brooks, Karen Carroll, Janet Butel & Stephen Morse.
3. **"Koneman's Color Atlas and Textbook of Diagnostic Microbiology"** – Elmer W. Koneman.
4. **"Garcia & Bruckner's Diagnostic Medical Parasitology"** – Lynne S. Garcia.
5. **"Fields Virology" (Volumes 1 & 2)** – David M. Knipe & Peter M. Howley.

Course: C-2

Subject: Immunology and Serology(T+P)

Subject Code: M**LT244C302/MLT244C312**
L-T-P-C: **3-0-1-4** **Total credits: 4**

Course Objectives:

The objective of the course is to introduce students acquire knowledge of basic concepts of the immune system, including innate and adaptive immunity along with the structure, function, and interactions of immune cells and molecules (e.g., antibodies, cytokines, complement system). This course has been formulated to impart comprehensive knowledge on different types of serological techniques, including agglutination, precipitation, ELISA, Western blot, and immunofluorescence assays. To introduce the knowledge based on principles of monoclonal antibodies, vaccine development, and immune-based therapeutics.

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 antigen processing and presentation, immune responses, and immunological memory and recall the importance of role of immunomodulation in disease prevention and treatment.	**BT 1**
CO 2	To outline the structure, function, and interactions of immune cells and molecules like antibodies, cytokines, complement system and the importance of various experiments related to blood specimen and cells by preparation of different serological test.	**BT 2**
CO 3	To identify the different types of serological techniques, including agglutination, precipitation, ELISA, Western blot, and immunofluorescence assays and highlights the importance of various infectious diseases, autoimmune disorders, and blood typing.	**BT 3**
CO 4	To analyse and recognize the immunological basis of allergic reactions and hypersensitivity testing such as HIV, VDRL, TPHA etc.	**BT 4**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I.	Structure and function of Immune system, Introduction to immunity and its classification with details, discussion on cellular immune responses, Lymphocytes subsets and its functions, NK cells. Antigens and their properties, super antigens, heterophile antigens, Immunoglobulin and their structure and functions, Antigen-antibody reactions, Monoclonal antibody.	9
II.	Major histocompatibility complex with its structure, functions, Complement and its properties along with activation and regulation of complement path ways and biological effects of complement. Brief introduction to immunodeficiency diseases and hyper sensitivity reactions, discussion on Autoimmunity.	9
III.	Study of Bacterial vaccines and adjuvants, Study of serodiagnosis of bacterial infections: Enteric fever- WIDAL test, Syphilis- STS, VDRL test, RPR, Treponemal tests- TPHA, TPI, FTA-ABS. Streptococcal infections- ASO test, Anti DNAse B, Anti- hyaluronidase test.	9

IV	Definitions of Infection, pathogenicity, virulence, primary infection, nosocomial infection and other types. Description of different types of infection and transmission to others. Brucellosis, Brucella agglutination test, Rickettsia fever, Primary atypical pneumonia, Weil Felix test, Serotyping of E.coli and Salmonella species, New rapid serological diagnostic methods for bacterial infections.	9
TOTAL		36

Text Books:

1. **"Kuby Immunology"** – Judy Owen, Jenni Punt & Sharon Stranfor Lewis
2. Textbook of Medical Lab Technology- Praful B. Godkar.
3. **"Roitt's Essential Immunology"** – Peter J. Delves & Seamus J. Martin
4. **"Clinical Immunology and Serology: A Laboratory Perspective"** – Christine Dorresteyn

Reference Books:

1.Medical Laboratory Technology Methods & interpretation- Ramnik Sood.

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

Course: C-3

Subject: Clinical Microbiology (Practical)

Subject Code: MLT244C311

L-T-P-C: **0--0-4-2 (P)**

DETAILED SYLLABUS

Modules	Course Content	Periods
I	Microbial analysis of water, air, milk, food, PCR, RT-PCR	**3**
II	Media and stains preparation for Mycology, Diagnostic methods in Mycotic infections, 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, Serological tests in Mycology.	**3**
III	Anima cell cultures, media sterilization and demonstration of different type of cell lines, demonstration of egg inoculation, serological tests for viral infections, immunofluorense technique, western blot technique, ELISA and IFA viral disease diagnosis, Sero diagnosis of Viral diseases: HBV, HCV and HIV.	**3**

IV	Preparation of stains and reagents: Leishman, Giemsa, Fields, Carbol fuschin and phosphate buffer, Macroscopic and microscopic examination of stool for adult worms, ova, cysts, larvae, Concentration techniques for intestinal parasites in stool, Preparation of culture media for parasite cultivation, Preparation of thick and thin smear.	**3**
TOTAL		**12**

Text Books:

1. **Murray's Medical Microbiology"** – Patrick R. Murray, Ken S. Rosenthal & Michael A. Pfaller.
2. **"Jawetz, Melnick & Adelberg's Medical Microbiology"** – Geo. Brooks, Karen Carroll, Janet Butel & Stephen Morse.
3. **"Koneman's Color Atlas and Textbook of Diagnostic Microbiology"** – Elmer W. Koneman.
4. **"Garcia & Bruckner's Diagnostic Medical Parasitology"** – Lynne S. Garcia.
5. **"Fields Virology" (Volumes 1 & 2)** – David M. Knipe & Peter M. Howley.
6. Textbook of Medical Lab Technology- Praful B. Godkar.

Reference Books:

1.Medical Laboratory Technology Methods & interpretation- Ramnik Sood.

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

Course: C-4

Subject: Immunology and Serology (Practical)

Subject Code: MLT244C312

L-T-P-C: **0--0-4-2 (P)**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I	Demonstration of Indirect immunofluorescence method for detection of anti -nuclear antibodies (ANA), ELISA technique, Different types of Immunoglobulin (IgA, IgM, IgG, IgE, IgD) antibody test, Agglutination test, Precipitation test, neutralization test, opsonization test.	**4**
II	Immunoblotting technique, Diagnosis of allergic diseases by skin prick test(SPT), Handling of Electrophoresis, Flow cytometer, Demonstration of Anti-hyaluronidase antibody test.	**4**
III	Antigen preparation and standardization for WIDAL test along with interpretations. Common serological tests for the diagnosis of bacterial infections: VDRL test, RPR test, TPHA test, ASO test, Brucella agglutination test.	**4**
TOTAL		**12**

Text Books:

1. **"Kuby Immunology"** – Judy Owen, Jenni Punt & Sharon Stranfor Lewis
2. Textbook of Medical Lab Technology- Praful B. Godkar.
3. **"Roitt's Essential Immunology"** – Peter J. Delves & Seamus J. Martin

4. **"Clinical Immunology and Serology: A Laboratory Perspective"** – Christine Dorresteyn Stevens

5. "Practical Immunology" – Frank C. Hay & Olwyn M.R. Westwood

6. "Manual of Clinical Laboratory Immunology" – Noel R. Rose & Barbara Detrick.

Reference Books:

1.Medical Laboratory Technology Methods & interpretation- Ramnik Sood.

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

3. "Abbas: Cellular and Molecular Immunology" – Abul K. Abbas, Andrew H. Lichtman & Shiv Pillai

Specialization in Hematology and Blood banking

Level: Semester III

Level: 500

Subject: Haematology II (Theory + Lab)
Subject Code: M**LT244C301/ MLT244C311**
L-T-P-C: **3-0-6-6** **Total credits: 6**

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.	**ANEMIA** Introduction: General considerations Clinical effects. Evaluation and classification Disorders of iron metabolism - Iron deficiency and related disorders – IDA, pathology, clinical features, etiology, signs and symptoms, laboratory, evaluation, and management. Sideroblastic anemias -Classification, clinical and laboratory features. Hemolytic anemias- General considerations, classification, clinical features, mechanism of cell destruction, laboratory evaluation.	9
II.	**SICKLE CELL ANAEMIA** Pathophysiology, molecular basis of sickling, Sickle cell anaemia (HbSS). Clinical features, laboratory features, diagnosis. Sickle cell trait- clinical features & diagnosis. , Other sickling syndromes. Thalassemia, pathophysiology, clinical features, laboratory diagnosis. Other Hbpathies.	9
III.	**MEGALOBLASTIC ANAEMIA** Normal physiology and pathophysiology, clinical and laboratory features. Inherited & Acquired Aplastic Anaemia syndromes - Diagnostic approach to clinical management. Fanconi anaemia Clinical and laboratory features. Diagnostic testing. Pathophysiology. Erythrocytosis- definition & terminology, physiology, classification and approach to the patients. Polycythaemia.	9

IV	**LEUKEMIAS** Introduction, Molecular genetics, Advances in technology. Acute and chronic leukemia - Classification, pathophysiology, clinical features, and laboratory findings. Myeloproliferative disorders Introduction, clinical features, laboratory Myelodysplastic syndrome – introduction, features, etiology, classification.	9
TOTAL		36

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

Subject: Haematology II (Lab)

Subject Code: M**LT244C311**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I	Laboratory investigation of hemoglobinopathies: CBC, Hb, TRBC count, MCV & RDW	**3**
II	Laboratory identifications of megaloblastics anemia, Iron deficiency anemia, hemolytic anemia, microscopic examination of blood: normal and abnormal, Sickling test.	**3**

III	Special tests: osmotic fragility test, Heinz body preparation, LE Cellpreparation, Test for Iron and TIBC in serum, detection of G-6-PD deficiency.	**h**
IV	Bone marrow: Smear preparation and fixation, routine stain, MGG, PAS, sudan black, iron, fats	**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 III

Level: 500

Subject: Blood Banking II & Coagulation (Theory + Lab)
Subject Code: M**LT244C302/ MLT244C312**

L-T-P-C: **3-0-6-6** **Total credits: 6**

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. Describe hemostasis including platelet structure, physiology and function, intrinsic and extrinsic coagulation pathways, terminology and factors involved in the coagulation process	**BT 1**
CO 2	To outline and the importance of various experiments related to blood specimen and cells by preparation of blood film. Recognize general clinical findings of coagulation disorders including platelet function disorders, clotting factor disorders and DIC and their laboratory findings	**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. Recognize test principle and patient results associated with the following: thrombin time, fibrinogen levels, factor XIII assays, FDPs, D-dimer, mixing studies, heparin assay and platelet function assay.	**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. Recall principles of methods, selection and use of appropriate analytical equipment; and perform advanced laboratory tests for PT, APTT, INR, Protein C and S and bleeding time tests.	**BT 4**

DETAILED SYLLABUS

Modules	**Course Content**	**Periods**
I	Blood Group System – ABO blood Group system, subgroup of ABO, Variants of ABO blood group system. Rh blood group system. Other Blood Group systems Normal hemostasis- Introduction, Physiological control Primary and Secondary hemostasis. Role of the vascular system, Structure and functions of blood vessels. Clinical evaluation of bleeding patients. Manifestations of disordered hemostasis.	9

II	Compatibility Testing, Transfusion Reaction and HDN Compatibility testing and special methods of routine and emergency cross match Types of Transfusion reaction Investigation of Transfusion reaction. Haemolytic disease of Newborn due to ABO, Rh or Other blood group incompatibility Blood Collection &Component Preparation. Miscellaneous bleeding manifestations. Bleeding disorders caused by vascular abnormalities. Platelets in hemostasis, Platelet production Structure and function of platelets.	**9**
III	Screening of Donor. Phlebotomy of Blood Donor. Storage and transportation of blood. Mandatory screening tests-HIV1&HIV2, HBsAg, HCV, RPR & Malaria. Component preparation: Red cell concentrate; Fresh Frozen Plasma; Cryoprecipitate; Platelet concentrate. Automation, Biosafety and Quality Control in Blood Banking. Mechanical purpura structural malformations of vessels. Preanalytical variables including sample collection. Performance of coagulation tests.	**9**
III	Automation in Blood collection. Automation in blood grouping, Cross matching. Bio safety and Biomedical waste management. Quality Control in blood banking. Prothrombin time, Activated Partial Thromboplastin time, Thrombin time Principle, method, Reagents, Normal values, Interpretation, expression of results. Measurement of fibrinogen - Fibrinogen assay.	**9**
	TOTAL	**36**

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.
Manual of Transfusion Medicine-Ramadas Nayak.

Subject: Blood Banking II & Coagulation (Lab)
DETAILED SYLLABUS

Modules	Course Content	Periods
I	Laboratory screening of donors blood. Blood grouping- ABO grouping, Forward grouping (Slide & Tube), Reverse grouping- Preparation of pooled A, B & O cells. Routine hemorrhagic disorder tests: BT, CT, Clot retraction and lysis time, platelet count, platelet aggregation studies,	**3**
II	Coombs test: Direct and indirect coombs test. 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). General approach to investigation of hemostasis: PT, APTT, TT, Mixing studies. Coagulation factor assays, Factor VIII inhibitor studies,	**3**
III	Selection of blood donor, Crossmatching Techniques, Major, Minor, Saline, Albumin, Coomb's. Emergency Cross matching, pre and post Blood collection of donor. Platelet Aggregation studies, thrombic work-up, D-dimer tests, FDP	**3**
IV	**Donor selection, Post donation care, Preservation and storage of blood, Preparation and storage of blood components.** Protein C, protein S, anti-thrombin – III, Factor V Leiden, Antiphospholipid antibody workup.	**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.

Semester III

Level: 500
Title of the Paper: Bioethics, IPR, Biosafety
Subject Code: MLT244C303

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

Course Objectives. This subject aims to introduce students to Intellectual Property Rights and apprise them of ethical issues in the biological sciences and the laws pertaining to these in both the global and national context. This course would help students to also adhere to the ethical practices appropriate to the various scientific disciplines at all times and to adopt safe working practices relevant to the different biotech industries & fields of research.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	Estimate the risk of recurrence of various inherited disorders in affected families	**BT 1**
CO 2	Explain the essential elements of genetic counseling and indications for prenatal Diagnosis	**BT 2**
CO 3	Estimate the risk of recurrence of various inherited disorders in affected families	**BT 3**
CO 4	Explain the essential elements of genetic counseling and indications for prenatal Diagnosis	**BT 4**

Detailed Syllabus

Modules	**Topics (if applicable) & Course Contents**	**Periods**
I	Concept of Property: Tangible and Intangible Property, Intellectual Property-0rigin Development and Objectives, Classification of Intellectual Property-Patents, Copyright, Trademark, Industrial Design, Geographical Indications, Protection of Plant Varieties and Traditional Knowledge, Relevance of Intellectual Property Rights for Science and Technology; Patentability Criterion-Discovery and Invention, Patentable Subject Matters;	**16 hours**

II	Novelty, Utility (Industrial Applicability), Non-Obviousness (Inventive Step) and Written Description, Product Patents vis-à-vis Process Patents; Patentability of Biotechnology Inventions; Patent Laws in Indian and International Perspective; Indian Patent Act 1970 (Patent Amendment Acts- 1999, 2002 and 2005); International Conventions relating to Intellectual Property; General Agreement on Trade and Tariff (GATT); Trade Related Aspects of Intellectual Property Rights (TRIPS)	**16 hours**
III	Biosafety: Definition and requirement; Important symbols and their meaning, Biosafety in relation to human health, environment, transgenic research and applications; International Legal Instruments on Biosafety Cartagena Protocol on Biosafety, Nagoya Protocol Laws relating to Biosafety in India: The Biological Diversity Act, 2002, Biosafety procedures, rules and guidelines under Environment (Protection) Act 1986 and Rules 1989; Biosafety Regulation: Principles and Practices in Microbial and Biomedical Labs; Guidelines for research involving genes; Regulatory bodies at National and International level.	**16 hours**
IV	Nature, Concept and Relevance of Bioethics; Basic Principles of Bioethics; Legal, Social and Economic Impacts of the Products and Techniques in Biotechnology; Bioethics in Plants, Animals and Microbial Genetic Engineering; Ethical issues in Healthcare; Biopiracy and Bioethics: Application of IPR regime to Biological Resources and Biopiracy, Access to Biological Resources, Benefit Sharing and Informed Consent	**16 Hours**
	Total	**64**

Text books:

1. Cornish, W. R., Intellectual Property (Latest Edition)

2. Intellectual Property Rights by Paul Goldstein

3. Intellectual Property Rights by K. R. G. Nair, Ashok Kumar, K. R. G. Nair

4. Kilner, John, et.al, eds., Cutting-Edge Bioethics. Eerdmans 2002.

Reference Books:

1. B.L. Wadera, Patents, Trademarks, Copyright, Designs and Geographical Indications

2. S. Ignacimuthu, Bioethics, Alpha Science International, Limited (2009)

3. Matthew Rimmer, Intellectual Property and Biotechnology: Biological Inventions (2008)

4. Arthur L. Caplan, Robert Arp, Contemporary Issues in Bioethics (2014)

Semester III

Level: 500
Title of the Paper: Cytogenetics and molecular genetics (Theory)
Subject Code: MLT244C304

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

Course Objectives:

The course entails to educate the student about Knowledge of basic cytogenetic laboratory techniques SP2 necessary to prepare tissue samples or cytogenetic diagnosis.

Course Outcomes

On successful completion of the course the students will be able to:		
SI No	**Course Outcome**	**Blooms Taxonomy Level**
CO 1	To review recent case reports and text from the cytogenetics CP1 literature, to become familiar with the fields of genetics and cytogenetics, and applications to clinical medicine.	**BT 1**
CO 2	Understand the importance of genetics in personalized CP2 medicine	**BT 2**
CO 3	Estimate the risk of recurrence of various inherited disorders in affected families	**BT 3**
CO 4	Explain the essential elements of genetic counseling and indications for prenatal Diagnosis	**BT 4**

Detailed Syllabus

Modules	Topics (if applicable) & Course Contents	Periods
I	History of cytogenetics, Chromosome analysis, Cytogenetic Nomenclature, Structure of genes - Classifications of genetic disorders. Mendelian disorders/Single gene disorders (Classification with examples), Definition & examples of numerical chromosomal abnormalities	**16 hours**
II	Down syndrome Klinefelter's syndrome - Turners syndrome- Gaucher's disease Niemen Pick disease Laboratory investigations of genetic disorders	**16 hours**
III	Karyotyping, Barr body identify. DNA structure, replication, organization of prokaryotic and eukaryotic genome Cell division - Mitosis and Meiosis Techniques employed - FISh, CGH, PCR - Flow cytometry Transcription and translation	**16 hours**
IV	Application of recombinant DNA technology in medicine TCR, RFLP, DNA fingerprinting - Gene therapy Applications of molecular genetic testing in non-malignant disorders.	**16 Hours**
	Total	**64**

Text Books:

1. Gupta P.K., Genetics, ISBN-10 8171339328, ISBN-13 978-8171339328, Rastogi Publications, Meerut.

2. Watson, J. D., Baker T.A., Bell, S. P., Gann, A., Levine, M., and Losick, R., Molecular Biology of the Gene, 7th edition, 2012. Cold Spring Harbour Lab. Press, Pearson Pub.

3. Fairbanks, D.J.,Genetics: The Continuity of Life, Wadsworth Publishing, ISBN-10: 0534252796

4. Russel, P.J.,iGenetics, Pearsons Education India, ISBN-10: 9332571627, ISBN-13: 978-

9332571624

Reference Books:

1. Karp, G..Cell and Molecular Biology: Concepts and Experiments, 6th edition, 2010. John Wiley & Sons. Inc.

2. Klug, W., Cummings, M., Spencer, C.A., Palladino, M.A., Concept of Genetics, ISBN-10: 9789332577466, ISBN-13: 978-9332577466, Pearsons Education India.

Course Outcomes

Level: Semester IV

Level: 500

Project/ Dissertation

Code: MLT244C421
Total credits: 20 (P)

Course Objectives:

This dissertation in **Medical Laboratory Technology (MLT)** aims to develop research skills, critical thinking, and practical application of laboratory sciences in healthcare. By the end of the dissertation, students should be able to formulate a clear and focused research question or hypothesis relevant to medical laboratory sciences and also organize research findings into a structured dissertation, including an abstract, introduction, methodology, results, discussion, and conclusion.

Level: Semester IV

PROJECT/DISSERTATION

Each candidate pursuing Msc. MLT course is required to carry out work on selected research to carry out work on selected research project/dissertation under the guidance of a recognised post graduate teacher in same field.

The dissertation/research project is aimed to train a graduate student in research methods and techniques. It includes identification of problem, formulation, formulation of hypothesis, search and review of the literature, design of the research study, collection of data, analysis of data, interpretation of results and finally frame conclusions.

The dissertation / research project should be written under following heading:

INTRODUCTION

AIMS OR OBJECTIVES OF STUDY

FORMULATION HYPOTHESIS

REVIEW OF LITERATURE

MATERIALS AND METHODS

RESULTS

DISCUSION AND INTERPRETATION

CONCLUSION

SUMMARY

REFERENCES

TABLES

ANNEXURE

SYNOPSIS Every candidate should submit a synopsis to the registrar of the university in the prescribed format containing particulars of proposed dissertation work after obtaining ethical clearance from the Institutional Ethical Committee comprising principal and other senior faculty of the college within 6 months from the date of admission on or before the date notified by the university.

The synopsis shall be sent through the proper channel. Such synopsis will be reviewed and the dissertation topic will be registered by the university.

Synopsis should be written under following heading:-

Proposed research project topic

Introduction

Aim of Study

Objective of the study

Formulation hypothesis

Review of literature

Materials and methods

Statistics

References

The written text of synopsis shall not exceed 8(eight) pages including all the above mentioned topics.

DISSERTATION SUBMISSION

The candidate should submit their dissertation work at the end of 10 months of second year of the M.sc. MLT course.

The candidate should submit six (6) copies of dissertation (with hard binding) to the Principle/Head of the Institution. Institute shall be submitted four (4) copies of dissertation to

the registrar on the 22nd month of the commencement of course on or before the date notified by the university.

EVALUATION OF DISSERTATION

Dissertation valuation of the candidates will be conducted by the Internal and External examiners together on the basis of work, presentation and defense viva at the time of second year M.sc. MLT practical examination.

STANDARD FORMAT OF DISSERTATION

The written text of dissertation shall not be less than 100 pages and shall not exceed 150 pages excluding references, tables, questionnaires and annexure. It should be neatly typed (font size 12 – Time New Roman or font size 123 Arial) in double line spacing on one side of the bond paper (A-4 Size) and bound properly. The Guide and the head of the Institution shall certify the dissertation.

CHANGE OF DISSERTATION TOPIC/ GUIDE

No change in the dissertation topic/guide shall be made without prior approval from the university.

ABSTRACT

Abstract provides a brief summary of the dissertation/thesis, summing up clearly the problem examined, the methods used, and the main findings. The abstract is a one-paragraph, self-contained summary of the most important elements of the paper. The abstract word limit is between 250 and 300 words. All numbers in the abstract (except those beginning a sentence) should be typed as digits rather than words. Key words (max.10) should be given, chosen from subject concerned headings. Each word should be separated by semicolon.

GENERAL PRINCIPLES

PAPER

Use only one side of high quality, plain white (unlined in any way) bond paper, minimum 20-lb weight, and "8 ½ x 11" in size. Erasable paper should not be used.

TYPE SIZE AND PRINT

The fond size should be visible to the reader, preferably Times New Roman 12 pt .No italicization.68 Size of the title should be 14 and bold; the size of sub-title should be 12 and bold. Print should be letter quality or laser (not dot matrix) printing with dark black characters that are consistently clear and dense. Use the same type of print and print size throughout the document.

PAGINATION

Number all of the pages of your document, including not only the principal text, but also all

Plates, tables, diagrams, maps and so on. Roman numerals are used on the preliminary pages (Pages up to the first page of text) and Arabic numerals are used on the text pages. The numbers themselves can be placed anywhere on the page, however they should be consistent.

SPACING

Use double spacing except for long quotations and foot notes which are single spaced.

MARGINS

Margin size; "generous"- Use plenty of room on the top, bottom, left & right (1"minimum). To allow for binding, the left hand margin must be 1.5". Other margin should be 1.0". Diagrams or photographs in any form should be a standard page size, or if larger, folded so that a free left-hand margin of 1.5" remains and the folded sheet is not larger than the standard page.

PHOTOGRAPHS

Professional quality black-and-white photographs are necessary for clear reproduction. Colors are allowed, but you should be certain the colored figure will copy clearly and will not be confusing when printed in black and white.

FILE FORMAT

Dissertation format should be in Doc (Ms Word document) or PDF (portable document Format), Image file in JPG or TIFF format and audio visual in AVI (Audio Video Interleave), GIF, MPEG (moving picture expert) files format.