GALGOTIAS UNIVERSITY

Syllabus of

Bachelor of Science in Medical Laboratory Technology

Name of School: School of Medical and Allied Sciences

Department: Department of Paramedical and Allied Health Sciences (Division of Medical Laboratory Technology)

Year: 2021-2025

Bachelor of Science in Medical Laboratory Technology

Vision

To be known globally in preparing highly competent Medical laboratory scientists through innovation, interdisciplinary research and excel in laboratory medicine field.

Mission:

M1: Establish state of art facilities for advancement and excellence in the field of Medical laboratory Technology education

M2: Collaborate with Medical laboratory professionals to align the curriculum and develop strong foundation .

M3: Make expertise health care professionals with global competency in handing advanced laboratory automation to work effectively in a wide range of laboratory settings.

Program Educational Objectives:

Graduates of Medical Laboratory Technology shall,

PEO-1

Establish/Maintain ethical standards of clinical laboratory as per regulations of accreditation bodies.

PEO-2

Undertake higher studies at any reputed institutions in the field of Medical and Allied sciences.

PEO-3

Evolve the new technologies and engage in entrepreneur activities.

Program Outcomes:

At the time of graduation Students of Medical Laboratory Technology programmeshall able to,

- **PO1. Thinking Abilities**

  Develop the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice and verify the accuracy of laboratory results obtained.

- **PO2. Planning Abilities**

Develop effective planning abilities including time management, resource management, delegation skillsand organizational skills. Develop and implement plans and organize work to meet deadlines.

- **PO3. Communication**

  Develop professional conduct and interpersonal communication skills with patients, laboratory personnel, other health care professionals, and with the public & communicate effectively with societyat large

- **PO4. Medical Laboratory Technology Knowledge**

  Possess and comprehend the core and basic knowledge associated with the profession of Medical laboratory Technology including basic diagnosis. Provide technical information about test results;Prepare and document medical tests and clinical results.

- **PO5. Medical Laboratory Technology Ethics**

- Honor personal values and apply ethical principles in professional and social contexts. Perform within theguidelines of the code of ethics established by state and local regulatory groups.

- **PO6. Environment and sustainability**

- Understand the impact of the professional medical laboratory technology solutions in environmentalcontexts and demonstrate the knowledge of and need for sustainable development.

- **PO7. Life-long learning**

- Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change in identify learning needs and to satisfy theseneeds on an ongoing basis upgrading skills in laboratory Sciences.

- **PO8. Modern tool usage**

- Learn, select, apply & develop appropriate methods and procedures, resources, and modern laboratory-related computing tools with an understanding of the limitations to operate and maintainlaboratory equipment

Bachelor of Science in Medical Laboratory Technology - Curriculum

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT	ETE
1.	**BLLUCT1001**	Professional Communication I	**1**	**0**	**4**	**3**	**20**	**30**	**50**
2	**BMLS1004**	Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)	**2**	**-**	**-**	**2**	**5**	**10**	**35**
3	**BMLS1005**	Medical Law and Ethics	**2**	**-**	**-**	**2**	**5**	**10**	**35**
4	**BMLS1011**	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control,, Disaster management and Antibiotic resistance)	**3**	**-**	**-**	**3**	**5**	**10**	**35**
5	**BMLS1007**	Professionalism and values	**1**	**-**	**-**	**1**	**50**		
6	**BMLS1008**	Introduction to National Healthcare Delivery System in India	**1**	**-**	**-**	**1**	**50**		
7	**BMLS1009**	Principals of Management with special reference to Medical Laboratory Science (MLS) management	**2**		**-**	**2**	**5**	**10**	**35**
8	**BMLS1051**	Basic computers and information Science Practical		**-**	**4**	**2**	**15**		**35**
9	**BMLS1053**	Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS) – Practical	**-**	**-**	**2**	**1**	**15**		**35**
10	**BMLS1054**	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance) – Practical	**-**	**-**	**4**	**2**	**15**		**35**
11	**BCEUCT1001**	Environmental Science	**0**	**1**	**0**	**0.5**	**20**		
12	**BLUCT1002**	Liberal Arts/Creative arts	**0**	**0**	**1**	**0.5**	**20**		
13	**BMLS1057**	Bio medical Waste Management	**1**	**0**	**0**	**1**	**50**		
14	**BMLS1055**	Clinical observation(15Days)	**0**	**0**	**0**	**2**	**50**		

		Total	**13**	**1**	**15**	**23**			
Semester II									
Sl No	**Course Codee**	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT	ETE
1	**BMLS2001**	General Medical Microbiology	4	-	-	4	**10**	**20**	**70**
2	**BMLS2002**	Basic Haematology	4	-	-	4	**10**	**20**	**70**
3	**BMLS2003**	Basic Clinical Biochemistry	4	-	-	4	**10**	**20**	**70**
4	**BMLS2004**	Human Anatomy and Physiology	4	-	-	4	**10**	**20**	**70**
5	**BLLUCT1002/BLEUCT1001**	Professional Communication-II/Foreign language	1	-	4	3	**20**	**30**	**50**
6	**BMLS2051**	General Medical Microbiology – (Practical)	-	-	4	2	**30**		**70**
7	**BMLS2052**	Basic Haematology – (Practical)	-	-	4	2	**30**		**70**
8	**BMLS2053**	Basic Clinical Biochemistry – (Practical)	-	-	2	1	**30**		**70**
9	**BMLS2054**	Human Anatomy and Physiology – (Practical)	-	-	4	2	**30**		**70**
10	**BMLS2055**	Clinical observation (15Days)	**0**	**0**	**0**	**2**	**50**		
		Total	18		14	27/28			
Semester III									
Sl No	**Course Code**	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT	ETE
1	**BMLS3006**	Systematic Bacteriology	**3**	**-**	**-**	**3**	**10**	**20**	**70**
2	**BMLS3007**	Basics of Haematological diseases	**3**	**-**	**-**	**3**	**10**	**20**	**70**
3	**BMLS3008**	Biochemical metabolism	**3**	**-**	**-**	**3**	**10**	**20**	**70**
4	**BMLS3004**	Fundamentals of Histology	**3**	**-**	**-**	**3**	**10**	**20**	**70**
5	**BMLS3005**	Blood Banking & Genetics	**3**	**-**	**-**	**3**	**10**	**20**	**70**

6	**BMLS3051**	Systematic Bacteriology – (Practical)	**-**	**-**	**4**	**2**	**30**		**70**
7	**BMLS3052**	Basics of Hematological diseases – (Practical)	**-**	**-**	**4**	**2**	**30**		**70**
8	**BMLS3053**	Biochemical metabolism – (Practical)	**-**	**-**	**4**	**2**	**30**		**70**
9	**BMLS3054**	Fundamentals of Histology – (Practical)	**-**	**-**	**2**	**1**	**30**		**70**
10	**BMLS3055**	Blood Banking & Genetics – (Practical)	**-**	**-**	**2**	**1**	**30**		**70**
11	**BCSUCT1001**	AI & Its Applications (Practical)	**0**	**0**	**4**	**2**			**50**
12	**BMLS3056**	Clinical observation(15Days)	**0**	**0**	**0**	**2**	**50**		
		Total	15		20	27			

Semester IV

Sl No	**Course Code**	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT	ETE
1	**BMLS4006**	Applied Bacteriology	**3**	**-**	**-**	**3**	10	20	70
2	**BMLS4002**	Applied Haematology – I	**3**	**-**	**-**	**3**	10	20	70
3	**BMLS4003**	Analytical Clinical Biochemistry	**3**	**-**	**-**	**3**	10	20	70
4	**BMLS4007**	Applied Histopathology – I	**3**	**-**	**-**	**3**	10	20	70
5	**BMLS4005**	Medical Mycology and Virology	**4**	**-**	**-**	**4**	10	20	70
6	**BMLS4051**	Applied Bacteriology – (Practical)	**-**	**-**	**4**	**2**	30		70
7	**BMLS4052**	Applied Haematology - I - (Practical)	**-**	**-**	**4**	**2**	30		70
8	**BMLS4053**	Analytical Clinical Biochemistry– (Practical)	**-**	**-**	**4**	**2**	30		70
9	**BMLS4054**	Applied Histopathology - I – (Practical)	**-**	**-**	**4**	**2**	30		70
10	**BMLS4055**	Medical Mycology and Virology– (Practical)	**-**	**-**	**2**	**1**	30		70
11	**BMLS4056**	Clinical observation(Mini project)	**0**	**0**	**0**	**2**	50		
		Total	**16**		**18**	**27**			

Semester V									
Sl No	Course Code	Name of the Course				Assessment Pattern			
			L	T	P	C	IA	CAT	ETE
1	**BMLS5006**	Immunology & Bacterial serology	**4**	**-**	**-**	**4**	**10**	**20**	**70**
2	**BMLS5002**	Applied Haematology – II	**3**	**-**	**-**	**3**	**10**	**20**	**70**
3	**BMLS5003**	Applied Clinical Biochemistry – I	**3**	**-**	**-**	**3**	**10**	**20**	**70**
4	**BMLS5007**	Applied Histopathology - II	**3**	**-**	**-**	**3**	**10**	**20**	**70**
5	**BMLS5008**	Immunopathology & Molecular Biology	**3**	**-**	**-**	**3**	**10**	**20**	**70**
6	**BMLS5051**	Immunology & Bacterial serology – (Practical)	**-**	**-**	**2**	**1**	**30**		**70**
7	**BMLS5052**	Applied Haematology - II l– (Practical)	**-**	**-**	**4**	**2**	**30**		**70**
8	**BMLS5053**	Applied Clinical Biochemistry – I – (Practical)	**-**	**-**	**4**	**2**	**30**		**70**
9	**BMLS5054**	Applied Histopathology-II l– (Practical)	**-**	**-**	**2**	**1**	**30**		**70**
10	**BMLS5055**	Immunopathology & Molecular Biology – (Practical)	**-**	**-**	**2**	**1**	**30**		**70**
11	**BMLS5056**	Clinical observation/Major Project (4 Weeks)	**0**	**0**	**0**	**4**	**100**		
		Total	16		14	27			

Semester VI									
Sl No	Course Code	Name of the Course				Assessment Pattern			
			L	T	P	C	IA	CAT	ETE
1	**BMLS6001**	Medical Parasitology & Entomology	4	-	-	4	10	20	70
2	**BMLS6002**	Advanced Haematology	3	-	-	3	10	20	70
3	**BMLS6006**	Applied Clinical Biochemistry – II	3	-	-	3	10	20	70
4	**BMLS6004**	Cytopathology	4	-	-	4	10	20	70
5	**BMLS6005**	Research methodology and Biostatistics	3	-	-	3	10	20	70

6	**BMLS6051**	Medical Parasitology & Entomology – (Practical)	-	-	4	2	30		70
7	**BMLS6052**	Advanced Haematology – (Practical)	-	-	2	1	30		70
8	**BMLS6053**	Applied Clinical Biochemistry – II – (Practical)	-	-	4	2	30		70
9	**BMLS6055**	Cytopathology – (Practical)	-	-	2	1	30		70
10	**BLEUCT1003**	Creativity, Innovation and Entrepreneurship & IPR	1	0	2	2	35	25	40
11	**BMLS6056**	Clinical Observation(15Days)	0	0	0	2	50		
		Total	18		14	27			

Semester VII

Sl No	**Course Code**	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT	External(viva)
1	**BMLS7003**	MLT Internship-I	0	0	720	16			100
2	**BMLS7004**	Internship Seminar	0	0	0	2			100
		Total				18			

Semester VIII

Sl No	**Course Code**	Name of the Course					Assessment Pattern	
			L	T	P	C	IA	External (Viva)
1	**BMLS8003**	MLT Internship-II	0	0	720	16		100
2	**BMLS8004**	Project	0	0	0	8		100
		Total				24		

Detailed Syllabus

Name of The Course	Introduction to National Healthcare Delivery System in India				
Course Code	**BMLS1008**				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	1	**0**	**0**	**1**	

Course Objectives

1. Apply knowledge on understanding what is health care delivery

2. Identify Health scenario of India, Demography& Vital Statistics

3. Explain National Health Programme-Background objectives, action plan, targets, operations.

Course Outcomes

CO1	Recall various healthcare delivery systems & National Health Programme- Background objectives, action plan, targets, operations,
CO2	Make use of National Health Programme-Background objectives, action plan, targets, operations & AYUSH system of medicine
CO3	Identify Health scenario of India, Demography, Vital Statistics & basics in Epidemiology.

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
50			50

Course Content:

Unit I: Introduction to healthcare delivery system & National Health Programme 5 Hours
Healthcare delivery system in India at primary secondary and tertiary care, Community participation in healthcare delivery system, Health system in developed countries, Latest :National Health Mission, National Health Policy, Issues in Health Care Delivery System in India. Current National Health Programme

Unit II:Introduction to AYUSH system of medicine & Health scenario of India 5 Hours
Introduction to Ayurveda, Yoga and Naturopathy, Unani Siddha, Homeopathy, Need for integration of various system of medicine. Health scenario of India – Current and future, Public health – India (epidemiology and demography)
Unit III: Demography & Vital Statistics & Epidemiology 5 Hours
Demography & Vital Statistics- Demography – its concept Vital events of life & its impact on demography, Significance and recording of vital statistics,Current Census & its impact on health policy. Natural History of diseases, Methods of Epidemiological studies, Epidemiology of communicable & non-communicable diseases, disease transmission, host defence immunizing agents, cold chain, immunization, disease monitoring and surveillance of current diseases in india.

Suggested Reading

1. Vikas Singh, D J Bhaskar, ChandanAgali R, Mallika Kishore, Safalya S Kadtane, Harender Singh. "AdenomatoidOdontogenictumour: Report of a Case and Review of Literature". International Journal of Scientifi c Study. 2014;1(4):63-66.
2. Hand book of Health care quality & patient safety
3. Wilson &Walkar'sPrinicples and techniques of Biochemistry and Molecular Biology by Andreas Hofmann

Name of The Course	**Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)**				
Course Code	**BMLS1004**				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	2	**0**	**0**	**2**	

Course Objectives

1. Recall basic concepts in Medical Lab Science
2. Explain Medical Terminology, Record keeping
3. Explain and give orientation to Medicallaboratory sciences

Course Outcomes

CO1	Explain Medical Terminology &basic concepts in Medical Lab Science
CO2	Explain the record keeping process and tools in health care
CO3	Build knowledge on specific role in different departments and design a own laboratory set up.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
5	10	35	50

Course Content:

Unit-1: Medical Terminology & Orientation to Medical Laboratory Science 12 Hours
Derivation of medical terms, Define word roots, prefixes, and suffixes, Conventions for combined morphemes and the formation of plurals, Basic medical terms, Form medical terms utilizing roots, suffixes, prefixes, and combining roots Interpret basic medical abbreviations/symbols, Utilize diagnostic, surgical, and procedural terms and abbreviations related to the integumentary system, musculoskeletal system respiratory system, cardiovascular system, nervous system and endocrine system,. Medical Lab Science – Introduction Career opportunities in MLS, Role of a Medical lab Professional in Health care system.
Unit-2: Record keeping 6 Hours
Standard procedures in record keeping.Interpret medical orders/reports, Data entry and management on electronic health record system.Advanced tools to maintain records in Health care.
Unit-3: Introduction and Subject specific role of a various departments in Medical lab and laboratory design 12 Hours
Overview of the role of Medical lab. Professional Microbiology,Hematology,Biochemistry,Medical Microbiology,Histopathology etc Organization Levels of laboratory,Plan of Modern laboratory and facilities required,laboratory design and layout
List of advanced equipment's used in different departments - Basic use and applications of each type

Suggested Reading

1. An Introduction to Medical Lab Technology by F J Baker and Silverton
2. Medical Laboratories Management- Costeffective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur
3. Medical Laboratory Technology by Mukherjee

Name of The Course	**Medical Law and Ethics**			
Course Code	**BMLS1005**			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	2	**0**	**0**	**2**

Course Objectives

1. Apply their knowledge on medical ethics
2. Explain Organ transplantation & Medico legal aspects of medical records

Course Outcomes

CO1	Define Medical ethics, Code of conduct Definition & Basic principles of medical ethics
CO2	Outline what is Malpractice and negligence, Autonomy and informed consent & Care of the terminally ill & insurance policy and develop protocol to avoid near miss or sentinel events.
CO3	Explain Organ transplantation & Medico legal aspects of medical records & Obtaining an informed consent and ethics of MLT profession

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
5	10	35	50

Course Content:

Unit-1: Introduction to medical ethics 8 Hours
Medical ethics – Definition – Goal – Scope, Introduction to Code of conduct, Basic principles of medical ethics – Confidentiality
Unit-2: Malpractice and negligence, Autonomy and informed consent & Care of the terminally ill- & Professional Indemnity insurance policy 10 Hours
Malpractice and negligence – Rational and irrational drug therapy, Autonomy and informed consent – Right of patients Care of the terminally ill- Euthanasia. Development of standardized protocol to avoid near miss or sentinel events
Unit-3: Organ transplantation & Medico legal aspects of medical records & Obtaining an informed consent 12 Hours
Organ transplantation, Medico legal aspects of medical records – Medico legal case and type- Records and document related to MLC – ownership of medical records – Confidentiality Privilege communication – Release of medical information – Unauthorized disclosure – retention of medical records – other various aspects. Ethics in the profession of Medical Laboratory Science

Suggested Reading

1. **Medical Law and Ethics by Jonathan Herring**
2. **Medical Law and Ethics by Bonnie F Fremgen**

Name of The Course	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control Disaster management and Antibiotic resistance).
Course Code	BMLS1011
Prerequisite	

Co-requisite					
Anti-requisite					
		L	**T**	**P**	**C**
		3	0	0	3

Course Objectives

1. **To understand the need of quality and patient safety.**
2. **To get knowledge on Infection control and its prevention`ply knowledge**
3. **To get knowledge on disaster preparedness**

Course Outcomes

CO1	Outline Quality assurance and management
CO2	Apply knowledge on Basics of emergency care and life support skills
CO3	Discuss the Infection prevention and its control
CO4	Apply knowledge on antibiotic resistance
CO5	Apply knowledge in Disaster preparedness and management
CO6	Apply knowledge in laboratory automation

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
5	10	35	50

Course Content:

Unit-1: Quality assurance and Management 8 Hours

Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools & Introduction to current NABH guidelines

Unit-2 Basics of emergency care and Life support 8Hours

Vital signs and primary assessment, Basic emergency care – first aid and triage, Ventilations including use of bag-valve-masks (BVMs), Choking, rescue breathing methods, One- and Two-rescuer CPR, Using an AED (Automated external defibrillator) & Managing an emergency including moving a patient.

Unit-3: Infection prevention 8 Hours

Use of Personalprotective equipment (PPE) & Monitoring & controlling of cross infection (Protective devices)Prevention & control of common healthcare associated infections, Components of an effective infection control program, and Latest Guidelines (NABH and JCI) for Hospital Infection Control.

Unit-4: Antibiotic Resistance 8 Hours

Antibiotic Resistance- History of antibiotics How resistance happens and spreads, Types of resistance- intrinsic, acquired, passive, Trends in drug resistance & Actions to fight resistance, Bacterial persistence, Antibiotic sensitivity, Consequences of antibiotic resistance & Antimicrobial Stewardship – Barriers and opportunities, tools and models inhospitals

Unit -5 Disaster Management 8 Hours

Fundamentals of emergency management, Psychological impact management, Resource management, Preparedness and risk reduction & Key response functions (including public health,logistics and governance, recovery

Unit -6 Automation 5 Hours

Introduction to automation ,Steps of Automation,List of Autoanalyzers in different laboratories and their uses

Suggested Reading

1. NIH: DIADS guidelines for Good Clinical laboratorypractice Standards,2011
2. WHO: Good Clinical laboratory practice Standards.
3. https://www.cdc.gov/
4. Textbook of Preventive & social Medicine by parks 18th edition**.**

Name of The Course	**Professionalism and values**			
Course Code	**BMLS1007**			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	1			1

Course Objectives

1. Outline Personal values & Attitude and behavior
2. Make use of Code of conduct
3. Identify Importance of team efforts

Course Outcomes

CO1	Illustrate Professional values&Attitude and behaviour
CO2	Outline Code of conduct
CO3	Explain the importance of team efforts and Cultural issues

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
50			50

Course Content:

Unit-1: Professional values &Attitude and behaviour 6s Hours
Professional values – Integrity, Objectivity, Professional competence and due care, confidentiality, ethical or moral values. Attitude and behaviour – professional behaviour treating people equally
Unit-2: Code of conduct 4 Hours
Professional accountability and responsibility, misconduct,
Unit-3:Team efforts and Cultural issues 5 Hours
Differences between professions and importance of team efforts and Cultural issues in the healthcare environment

Suggested Reading

1. R. R. Gaur, R. Sangal, G.P. Bagaria, 2009, a Foundation Course in Value Education.

2. E.F. Schumacher, 1973, Small is Beautiful: A study of Economics as if people mattered, Blond & Briggs, Britain.
3. A. Nagraj, 1998, JeevanVidyaekParichay, Divya Path Sansthan, Amarkantak.
4. A.N. Tripathy, 2003, Human Values, New Age International Publishers
5. E G Seebauer& Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
6. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

Name of The Course	Principals of Management with special reference to Medical Laboratory Science (MLS) Management				
Course Code	BMLS1009				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	2	0	0	2	

Course Objectives

1. To develop knowledge on basic ethics, good lab practices,quality management system
2. To know the Laboratory Information system (LIS), Hospital Information system (HIS) and financial management.
3. To learn calibration and validation of clinical laboratory instruments

Course Outcomes

CO1	Explain in Basic ethics, good laboratory practices, accreditation of clinical laboratories.and safety in the management of clinical samples
CO2	Outline sample accountability & sample analysis and reporting results and the process of quality management system in the laboratory.
CO3	Interpret laboratory Informatorily system, calibration of laboratory instruments & management of financial, biomedical waste in hospital.

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
5	10	35	50

Course Content:

Unit-1:Ethical Principles and standards for a clinical laboratory professional &Good Laboratory Practice (GLP) Regulations and Accreditation Safety in a clinical laboratory 10 Hours
Duty to the patient, Duty to colleagues and other professionals Duty to the society. Introduction to Basics of GLP and Accreditation, Aims of GLP and Accreditation, Advantages of Accreditation, Brief knowledge about National and International Agencies for clinical laboratory accreditation.Basic process of lab accreditation for ISO, NABL etc,World class practices used in laboratory service. General safety precautions, HIV: pre- and post-exposure guidelines, Hepatitis B & C: pre- and post-exposure guidelines, Drug Resistant Tuberculosis. Patient management for clinical samples collection, transportation and

Unit-2: Sample accountability & Sample analysis and Reporting results & Quality Management system 10 Hours
Purpose of accountability, Methods of accountability Introduction to sample analysis, Factors affecting sample analysis. Basic format of a test report, Reported reference range Clinical Alerts, Abnormal results, Turnaround time, Results from referral laboratories, Release of examination results Alteration in reports. Introduction to Quality Management system, Quality assurance, Quality control system, Internal and External quality control. Biomedical waste management in a clinical laboratory. Introduction and importance of calibration and Validation of Clinical Laboratory instruments.
Unit-3: Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management & Ethics in Medical laboratory Practice, Procurement of equipment and Inventory Control. 10 Hours
Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management: Introduction Functions of a laboratory management system, Standards for laboratory management system, Introduction and awareness of financial management in aclinical laboratory. Ethics in Medical laboratory Practice: Understanding the term _Ethics Ethics in relation to the following: Pre-Examination procedures, Examination procedures, Reporting of results Preserving medical records, Access to Medical laboratory Records. Procurement of equipment and Inventory Control Audit in a Medical Laboratory, Introduction and Importance Responsibility, Planning, Horizontal, Vertical and Test audit Frequency of audit, Documentation.

Suggested Reading

5. Medical Laboratories Management- Costeffective methods by Sangeeta Sharma, RachnaAgarwal, SujataChaturvedi and Rajiv Thakur.
6. ICMR guideline for good clinical laboratory practices.
7. Textbook of Preventive & social Medicine by parks 18th edition**.**
8. NIH: DIADS guidelines for Good Clinical laboratory practice Standards,2011
9. WHO: Good Clinical laboratory practice Standards.
10. https://www.cdc.gov/

Name of The Course	Clinical Observation				
Course Code	BMLS1055				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	0	0	0	2	

Course Objectives

1. Apply essential knowledge in the entire chain of health care delivery system

2.Develop Basic knowledge on governance village , panchayat and frontline health workers

Course Outcomes

CO1	Apply essential knowledge in the entire chain of health care delivery system
CO2	Develop Basic knowledge on governance village , panchayat and frontline health workers

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
50			

Course Content:

Unit-1: Community orientation and clinical visit 8 Hours
The community orientation and clinical visit will include visit to the entire chain of the healthcare delivery system – Sub centre, PHC, CHC, SDH, DH and Medical College, private hospitals, dispensaries and clinics.
Unit-2: Clinical visit to their respective professional department. 7 Hours
The student will also be briefed regarding governance a village level including interaction and group discussion with village panchayat and front-line health workers. **Clinical visit to their respective professional department within the hospital**

Suggested Reading

1. ICMR guideline for good clinical laboratory practices.
2. Textbook of Preventive & social Medicine by parks 18th edition.
3. NIH:DIADS guidelines for Good Clinical laboratory practice Standards,2011
4. WHO: Good Clinical laboratory practice Standards.

Name of The Course	Basic computers and information Science-Practical

Course Code	BMLS1051
Prerequisite	
Co-requisite	
Anti-requisite	

	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To understand basics of computers
2. Build knowledge on using MS office: MS word, MS PowerPoint, MS Excel
3. To understand operating systems, softaware installation and technology relevant to computer usage
4. Apply their knowledge on understanding various computing skills

Course Outcomes

CO1	Demonstration of basic hardware of the computers and laptops
CO2	Distinguish between MS office: MS word, MS PowerPoint, MS Excel
CO3	Apply knowledge on software installation build knowledge relevant to usage of computers in clinical settings

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
15		35	50

Course Content:

Practical 1: Demonstrationcoıof basic hardware of the installation different software
Practical 2: Learning to use MS office: MS word, MS PowerPoint, MS Excel
Practical 3: Computer networks: Introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star ring, bus, mesh, tree, hybrid), components of network.
Practical 4: Internet and its Applications: Definition, brief history, basic services (E-Mail, File Transfer Protocol, telnet, the World Wide Web (WWW)), www browsers, use of the internet.
Practical 5: Data entry efficiency
Practical 6: Application of Computers in clinical settings

Suggested Reading

1. Computer Fundamentals (Concepts. Systems and applications) by P. K. Sinha (University of Tokyo, Japan) BPB Publications

2. Information technology byAnshuman Sharma (Lakhanpal Publisher)

Name of The Course	Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS) – Practical				
Course Code	BMLS1053				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	0	0	2	1	

Course Objectives

1. Apply knowledge in Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science

Course Outcomes

CO1	Apply knowledge on medical terminology.
CO2	Outline carrier opportunity and role of MLT in hospital care

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
15		35	50

Course Content:

1. General discussion on Medical Terminology and understanding basics of various diseases.
2. Coding
3. Assembling of patient files
4. Sensitization on career opportunities and role of MLS in Hospital Care
5. Visit to working;

6. Microbiology
7. Haematology
8. Biochemistry
9. Histopathology laboratories

Suggested Reading

1. Medical Laboratories Management- Costeffective methods by Sangeeta Sharma, RachnaAgarwal, SujataChaturvedi and Rajiv Thakur.

2. An Introduction to Medical Lab Technology by F J Baker and Silverton

Name of The Course	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)-Practical
Course Code	BMLS1054
Prerequisite	
Co-requisite	
Anti-requisite	

	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To gain knowledge about patient quality and patient safety & life support skills
2. To learn the Biomedical waste and environment safety, infection prevention and control.

Course Outcomes

CO1	Apply knowledge on quality & patient safety quality and patient safety & lifesupport skills
CO2	Apply knowledge in basic emergency care and life support skills
CO3	Apply knowledge in Infection prevention and control & Antibiotic Resistance

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
15		35	50

Course Content:

I. Quality and Patient safety: 1. Discussion on Concepts of Quality of Care 2. Approaches to Quality Improvement 3. Quality Improvement Tools
II. Basics of emergency care and life support skills: 1. Vital signs and primary assessment

2. Basic emergency care – first aid and triage 3. Ventilations including use of bag-valve-masks (BVMs) 4. Choking, rescue breathing methods 5. One- and Two-rescuer CPR 6. Using an AED (Automated external defibrillator). 7. Managing an emergency including moving a patient.
III. Infection prevention and control: 1. Demonstration of evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)], 2. Discussion on prevention & control of common healthcare associated infections, 3. Preparing Charts & Posters of Components of an effective infection control program, and 4. Guidelines (NABH and JCI) for Hospital Infection Control
IV. Resistance & Disaster preparedness and management

1. Discussion on various types of Antibiotics **2.** Demonstration of how Resistance Happens and Spreads **3.** Discussion on types of resistance- Intrinsic, Acquired, Passive **4.** Antibiotic sensitivity testing **5.** Display of Consequences of antibiotic resistance **6.** Demonstration of Antimicrobial Barriers and opportunities, Tools and models in hospitals. **7.** Discussion on fundamentals of emergency management, **8.** Management psychological impact **9.** Discussion on; • Resource management, • Preparedness and risk reduction**.**

Suggested Reading

1. The Essentials of Patient Safety by Charles Vincent.
2. Laboratory quality control and patient safety by De Gruyter.
3. https://www.cdc.gov/

Name of The Course	Biomedical Waste management				
Course Code	BMLS1057				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	

	1	**0**	**0**	**1**

Course Objectives

1. To learn the procedure of clinical sample collection
2. To gain knowledge in reporting and results, quality management system.

Course Outcomes

CO1	Discuss Hazardous waste generation and its management
CO2	Discuss the guidelines of Biomedical Waste Management and treatment options of disposal

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
50			

Course Content:

Unit-1 **Introduction**
Sources, types,composition and characteristic of hazardous waste, Hazardous Waste (Management and Handling) Latest Rules, and amendments, Federal Hazardous Waste Regulations under RCRA, Superfund/CERCLA and SARA. Toxicology, public health impact, Protocols, issues and challenges in transportation of hazardous waste.

Unit-II 8 hours
Latest National and International Amendments and guidelines of segregation, packaging, storage, transport of Biomedical waste. Treatment method- Autoclave, Hydroclave, Microwave, Chemical Disinfection, Solidification and stabilization, Bioremediation, Thermal Conversion Technologies, accumulation and storage of hazardous waste, land disposal of hazardous waste, other treatment and disposal method. Common Hazardous Waste Treatment facilities (TSDF).Modern techniques of Biomedical waste management. Health and safety rules. Role of health care management in reducing Biomedical waste.

Suggested Reading

1. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, RachnaAgarwal, SujataChaturvedi and Rajiv Thakur
2. https://www.who.int/
3. Tchobanoglous G., Theisen H., Viquel S.A., "Integrated Solid Waste Management: Engineering, Principles and Management issues", Tata McGraw Hill Publishing Company Ltd., New Delhi.
4. CPHEEO Manual on Municipal Solid Waste Management

Name of The Course	General Medical Microbiology			
Course Code	BMLS2001			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	4	-	-	4

Course Objectives

1. To learn the history, & basics of general medical microbiology, sterilization methods and life cycle of bacteria

2. To gain knowledge on different types of culture media

3. To learn bacterial immunity and different types of animals used in lab for higher studies.

Course Outcomes:

On completion of course student will be able to:

CO1	Demonstrate introduction of medical microbiology and different equipment used in microbiology
CO2	Illustrate & Practice the different types of sterilization and Biomedical waste management
CO3	Explain General characteristics, classification and growth of microbes
CO4	Demonstrate types and use of culture media
CO5	Explain Bacterial immunology and laboratory animal handling and care
CO6	Discuss and improve skills on new diagnostic methods in medical microbiology

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Introduction to Medical Microbiology 13 Hours
1. Definition, History, Host - Microbe relationship, 2. Safety measures in Clinical Microbiology, 3.Glassware used in Clinical Microbiology Laboratory: Introduction, Care and handling of glassware, Cleaning of glassware, 4. Equipment used in clinical Microbiology Laboratory, Introduction, Care and maintenance including calibration. 5. Microscopy: Introduction and history, Types, principle and operation mechanism of following microscopes, Light microscope, DGI, Fluorescent, Phase contrast, Electron microscope: Transmission/ Scanning.
Unit II: Sterilization 12 Hours
Sterilization: Definition, Types and principles of sterilization methods, Heat (dry heat, moist heat with special Reference to autoclave), Radiation, Filtration, Efficiency testing to various sterilizers. 2. Antiseptics and disinfectants: Definition, Types and properties, Mode of action - Uses of various disinfectants, Precautions while using the disinfectants - Qualities of a good disinfectant, Testing efficiency of various disinfectants. 3. Biomedical waste management in a Medical Microbiology laboratory: Types of the waste generated – Segregation – Treatment – Disposal
Unit III: General characteristics & classification of Microbes & Growth 11 hours
1. General characteristics & classification of Microbes: (Bacteria &fungi), Classification of microbes with special reference to prokaryotes & eukaryotes, Morphological classification of bacteria, Bacterial anatomy (Bacterial cell structures). 2. Growth and Nutrition of Microbes: General nutritional & other requirements of the bacteria, Classification of bacteria on the basis of theirnutritional requirements, Physical conditions required for growth. Normal growth cycle of bacteria (growth curve) Types of microbial cultures: Synchronous, Static, continuous culture.
Unit IV: Culture media 11Hours
Culture media: Introduction, Classification of culture media (Example & Uses) solid media, liquid media, semisolid, Media, routine/synthetic/defined media, basal media, enriched, enrichment, Selective differential media, sugar fermentation media,

transport media, preservation media and anaerobic culture media, Quality control in culture media, Automation in culture media preparation, Aerobic & anaerobic culture methods: Concepts, Methods Used for aerobic cultures, Methods used for anaerobic cultures.
Unit V: Immunology & Care of Animal 13Hours
1. Introductions to Immunology, Immunity, Antigens and Antibodies 2. Care & handling of laboratory animals: Introduction, General care & handling, Ethics & legality in use of laboratory animals
Unit VI Recent advance techniques in medical Microbiology 5 Hours
New diagnostic methods: Immunoassays, automated and semi-automated systems and Blood culture system.

Suggested Reading

1. Text book of Microbiology by Ananthanarayan
2. Medical Microbiology by Panikar&SatishGupte
3. Medical laboratory Technology vol. I, II, III by Mukherjee
4. Text book of Microbiology by CP Bhaveja
5. Text book of Microbiology by Prescott
6. Medical Laboratory Technology by Mukherjee

Name of The Course	Basic Haematology			
Course Code	BMLS2002			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	4	-	-	4

Course Objectives

1. Apply knowledge in basic hematology
2. Apply knowledge in blood component and formation
3. Apply knowledge in basic Quality assurance

Course Outcomes

On completion of course student will be able to:

CO1	Demonstrate the basic equipment used in haematology and explain composition of blood
CO2	Apply knowledge on blood and anticoagulant
CO3	Simplify the Hemopoiesis
CO4	Explain Haemostasis and urine analysis
CO5	Apply Knowledge on quality assurance Haematology
CO6	Discuss recently used techniques of blood collection procedures

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Introduction to Hematology 12 Hours
Introduction to Hematology Definition Importance Important equipment used Laboratory organization and safety measures in Hematology Laboratory Introduction to blood, its composition, function and normal cellular components.
Unit II: Blood and Anticoagulant 12 Hours
Introduction to blood, its composition, function and normal cellular components Anticoagulants: types, mode of action and preference of anticoagulants for different haematologicalstudies Collection and preservation of blood sample for various haematological investigations.

Unit III: Hemopoiesis 12 Hours
Formation of cellular components of blood (Hemopoiesis) Erythropoiesis Leucopoiesis ThrombopoiesisHaemoglobin: definition, types, structure, synthesis and degradation Morphology of normal blood cells.
Unit IV: Haemostasis 12 Hours
Normal Haemostasis& physiological properties of coagulation factors. Radioactivity: definition, half-life, physical decay and units Urine analysis.
Unit V: Quality assurance 12 Hours
Quality assurance in Haematology Internal and external quality control including reference preparation Routine quality assurance protocol Statistical analysis i.e. Standard deviation, Co-efficient of variation, accuracy and precision.
Unit VI: Updated Blood Collection procedures 6 Hours
Introduction to Blood Collection, Venepuncture by Vacutainer,CapillaryCollection, Blood Culture for Viral Culture, Blood Culture Collection: For Bacterial, Fungal or Mycobacterial Culture

Suggested Reading

1.Text book of Medical Laboratory Technology by Praful B. Godkar

2.Medical laboratory Technology by K.L. Mukherjee Volume I

3. Practical Haematology by J.B. Dacie

4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry

5. Atlas of Haematology (5th edition) by G.A. McDonald.

Name of The Course	Basic Clinical Biochemistry			
Course Code	BMLS2003			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	4	-	-	4

Course Objectives

1. To gain knowledge in cleaning of glassware, calibrations, pH meters and its derivation, preparation of various conc. Solutions and distillation plant in biochemistry.Course Outcomes

On completion of course student will be able to:

CO1	Demonstrate and analyse the roles and ethics in MLT with steps of cleaning.
CO2	Demonstrate the various calibrating techniques.
CO3	Apply knowledge on preparation of different types solutions and Working and maintenance of analytical balance
CO4	Explain the concept of maintenance of Blood pH and concept of pH meter.
CO5	Explain the different methods of distilled water preparation and process of osmosis.
CO6	Originate ideas about how to use techniques in field.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Introduction to Medical lab. Technology & Cleaning of glassware 12 Hours
Role of Medical lab Technology, Ethics and responsibility, Safety measures, First aid their biochemical findings, Steps involved in cleaning soda lime glass, Steps involved in cleaning borosil glass, Preparation of chromic acid solution and Storage
Unit II: Units of Measurement & Calibration of volumetric apparatus 12 Hours
S.I unit and CGS units, Conversion, Strength, molecular weight, equivalent weight, Normality, Molarity, Molality, Numerical, Calibration of Flask, Pipettes, Burettes & Cylinders
Unit III: Analytical balance & Volumetric analysis 12 Hours
Analytical Balance Principle, Working and Maintenance, Normal and molar solutions, Standard solutions, Preparation of reagents & Storage of chemicals

Unit IV: Concept of pH 12 Hours
Definition, Henderson Hassel batch equation, Pka value, pH indicator, Methods of measurement of pH, pH paper & pH meter Principle, working, maintenance and calibration of pH meter.
Unit V: Distilled water & Osmosis 12 Hours
Method of preparation of distilled water, Type of water distillation plants, Storage of distilled water, Osmosis Definition, Types of osmosis, Factors affecting osmotic pressure, VantHoff‘s equation, Applications of osmosis, Dialysis.
Unit VI 6 Hours
Purification ,Centrifugation, Filtration, Dialysis, Homogenization.

Suggested Reading

1. Text book of Medical Laboratory Technology by P. B. Godker

2. Medical Laboratory Technology by K.L. Mukherjee volume III

3. Text book of Medical Biochemistry by Chatterjee, Shinde

4. Biochemistry by Voet&Voet

5. Principal of Biochemistry by M. A. Siddiqi.

Name of The Course	Human Anatomy and Physiology			
Course Code	BMLS2004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	4	-	-	4

Course Objectives

1. To gain knowledge about cell and cell organelles & Tissues

2. To learn about muscular skeletal, Respiratory & Cardiovascular system, lymphatic system & sense of organ.

3. To develop knowledge Body fluids and their significance & Nervous system & Endocrine system.

Course Outcomes

CO1	Demonstrate Cell and cell organelles & Tissues.
CO2	Demonstrate the anatomy and physiology of muscular skeletal, Respiratory & Cardiovascular system.
CO3	Apply knowledge in lymphatic system &sense organs.
CO4	Classify the Body fluids and their significance & anatomy and physiology of Digestive system, Liver.
CO5	Explain anatomy and physiology of Urinary system &Genital system, Nervous system & Endocrine system.
CO6	Discuss the anomalies of human body

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Introduction to human Anatomy and Physiology, Cell and cell organelles, Tissues, Blood. 12 hours
Introduction to human Anatomy and Physiology: Cell and cell organelles, Structure and classification, Function, Cell division (Mitosis and Meiosis).Tissues: Definition, Classification with structure and Functions, Epithelial tissues ,Connective tissues, Muscular tissues, Nervous tissue: Blood: Composition, Function of blood.
Unit II: Muscular skeletal & system, Respiratory system Cardiovascular system. 12 Hours
Muscular skeletal system: Introduction, Classification, Structure and function of skeletal system, muscles and joints, Various movements of body. Respiratory system: Introduction, Structure, Function, Mechanism of breathing and respiration, Various terms involved in respiratory System, Vital capacity, Total Volume, Reserve volume, Total lung capacity. Cardiovascular system: Anatomy and physiology of heart, Blood circulation, Arteries and veins, Conductive system of

heart, Cardiac cycle, Introduction to ECG.
Unit III: Lymphatic system & Structure and function of sense organ 12 Hours
Lymphatic system: Introduction, Structure and function, Lymph nodes, Spleen, Thymus gland, Tonsils. Structure and function of sense organ: Eye, Ear, Nose, Tongue.
Unit IV: Body fluids and their significance, Digestive system and Liver 12 Hours
Body fluids and their significance: Important terms, types of body fluid, total body water, avenues by which water leaves and enters body, general principles for fluid balance, cardinal principle, How body fluids maintain Homeostasis, Electrolytes & ions Function of electrolytes, How electrolyte imbalance leads to fluid imbalance. Digestive system: Organization; accessory organs; structure & function (Mouth, Tongue, Teeth, Oesophagus, Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates, lipids & proteins. Liver: structure and function.
Unit V: Urinary system &Genital system, Nervous system & Endocrine system. 12Hours
Urinary system: Main parts, Structure &function of kidney, structure of nephron, physiology of excretion & urine formation, urine, additional excretory organs. Genital system: Structure of male and female reproductive system, Gametogenesis in male & female, menstrual cycle. Placenta and extra embryonic membranes. Nervous system: Parts, function & structure; brain, spinal cord, spinal & cranial nerves; all & none principle, role of neurotransmitters in transmission of nerve impulse, Endocrine system: Endocrine & exocrine glands, their location, structure & functions.
Unit VI Anomalies of human body 6 Hours
Human body anomalies-General ,Developmental ,Congenital

Suggested Reading

1. Anatomy & Physiology- Ross and Wilson

2. Anatomy and Physiology: Understanding the Human Body by Clark

3. Anatomy and Physiology for nurses by Evelyn Pearce

4. Anatomy and Physiology for nurses by Pearson

5. Anatomy and Physiology by N Murgesh.

Name of The Course	General Medical Microbiology - (Practical)			
Course Code	BMLS2051			
Prerequisite				
Co-requisite				
Anti-requisite				
L	T	P	C	
-	-	4	2	

Course Objectives

1. Apply practical knowledge in General medical microbiology laboratory

2. To practice the practical knowledge in medical microbiology such as microscopic examination

3. To learn the different methods of sterilization and hygiene techniques

4. To prepare different types of culture media and disinfects solutions.

5. To get knowledge on bacterial immunology and animal house

Course Outcomes:

On completion of course student will be able to:

CO1	Explain preparation of disinfects and follow the hygiene techniques in the lab
CO2	Illustrate & practice the different types of sterilization and microscope
CO3	Demonstrate types and use of culture media in different culture methods

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Practical
1. To demonstrate safe code of practice for a Microbiology laboratory
2. To prepare cleaning agents & to study the technique for cleaning & sterilization of glassware.
3. To demonstrate the working & handling of Compound microscope.
4. To demonstrate the method of sterilization by autoclave including its efficacy testing.
5. To demonstrate the method of sterilization by hot air oven including its efficacy testing.
6. To demonstrate the method of sterilization of media/solution by filtration.
7. Demonstration of Antiseptics, Spirit, Cetrimide&Povidone-Iodine.
8. To demonstrate the use of disinfectants.
9. Demonstrate the precaution while using disinfectants.
10. To prepare working dilution of commonly used disinfectants.
11. In-use test
12. Rideal-walker phenol co-efficient test.
13. Kelsey-Sykes test
14. To demonstrate the different morphological types of bacteria
15. Preparation of one culture media from each type
16. To demonstrate aerobic culture
17. To demonstrate anaerobic culture
18. Visit to animal house & demonstrate about care of laboratory animals

Suggested Reading

1. Text book of Microbiology by Ananthanarayan
2. Medical Microbiology by Panikar&SatishGupte
3. Medical laboratory Technology vol. I, II, III by Mukherjee
4. Text book of Microbiology by CP Bhaveja
5. Practical Medical Microbiology by Mackie and McCartney

Name of The Course	Basic Haematology – (Practical)			
Course Code	BMLS2052			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	-	-	4	2

Course Objectives

1. Apply knowledge in instruments/techniques used in Haematology

Course Outcomes:

On completion of course student will be able to:

CO1	Demonstrate usage and handling of haematology laboratory equipment and instruments
CO2	Demonstrate blood collection
CO3	Test urine for routine urine investigations

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Practical
1. Preparation of various anticoagulants: EDTA, Sodium Citrate, Oxalate with Fluoride
2. Collection of blood sample for various Lab Investigations
3. Familiarization and working of routine Haematology Lab. Instruments Microscopes
4. Demonstration of Haemocytometers
5. Demonstration of Colorimeter
6. Demonstration of Spectrophotometer
7. Demonstration of Glass pipettes & Auto pipettes Glassware
8. Demonstration of Sahli's Apparatus
9. Identification of Normal blood cells
10. Urine Analysis: Routine biochemistry of Urine for: pH Specific Gravity
11. Routine biochemistry of Urine for Glucose
12. Routine biochemistry of Urine for Ketones bodies
13. Routine biochemistry of Urine for Bilirubin
14. Routine biochemistry of Urine for Albumin
15. Microscopic Examination of Urine

Suggested Reading

1.Text book of Medical Laboratory Technology by Praful B. Godkar

2. Medical laboratory Technology by K.L. Mukherjee Volume-I

3. Practical Haematology by J.B. Dacie

4. De Gruchy's Clinical Haematology in Medical Practice

5. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry.

Course	Practical				
Course Code	BMLS2053				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	2	1

Course Objectives

1. Apply knowledge in reagent preparation, instruments/techniques used in basic clinical biochemistry

Course Outcomes

CO1	Demonstrate reagent preparation, procedure and principle of distillation & pH meter.
CO2	Demonstrate reagent preparation, procedure and labelling of different concentration of solution.
CO3	Demonstrate different steps involved in osmosis.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Practical
1. Cleaning of the laboratory glass ware (Volumetric and non-volumetric)
2. Preparation of distilled water
3. Principle, working and maintenance of pH meter.
4. To prepare 0.1 N NaOH solution.
5. To prepare 0.2N HCl solution.
6. To prepare 0.1 molar H2SO4
7. To prepare 0.2 Molar Sodium carbonate solution.
8. Demonstration of osmosis and dialysis.

Suggested Reading

1.Text book of Medical Laboratory Technology by P. B. Godker

2. Medical Laboratory Technology by K.L. Mukherjee volume III

3.Text book of Medical Biochemistry by Chatterjee, Shinde

4. Practical Clinical Biochemistry by Harold Varley.

5. Principal of Biochemistry by M. A. Siddiqi

Assessment (IA)	CAT	Exam (ETE)	Marks
30		70	100

Name of The Course	Human Anatomy and Physiology – (Practical)			
Course Code	BMLS2054			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	-	-	4	2

Course Objectives

1. To learn various parts of body, tissues, digestive system, respiratory system & Skin

2. To develop skills to prepare models & charts of parts of excretory system, Circulatory system from models.

3. To gain knowledge in Genital system, Nervous system & body fluids.

Course Outcomes

CO1	Demonstrate the anatomy of various organ systems of body
CO2	Demonstration anatomy of different bones and joints.
CO3	Demonstrate anatomy and physiology of different system by using different models and charts.

Continuous Assessment Pattern

Internal		End Term	Total

Course Content:

List of Practical
1. Demonstration of various parts of body
2. Demonstration of tissues of body
3. Demonstration of parts of digestive system
4. Demonstration of parts of respiratory system
5. Demonstration of parts of skin
6. Demonstration of parts of excretory system
7. Demonstration of various parts of circulatory system (Demonstration from models)
8. Examination of blood film for various blood cells from stained slides
9. Blood pressure estimation
10. Demonstration of various parts of nervous system (brain and spinal cord)(Model)
11. Structure of eye and ear (demonstration from models)
12. Demonstration of reflex action
13. Demonstration of structural differences between skeletal, smooth and cardiac muscles (permanent mounts)
14. Demonstration of various bones and joints
15. Demonstration of various parts of reproductive

system (Male and female from models and charts)
16. To study circulatory system from charts and transverse section (TS) of artery and vein from permanent slides.
17. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.
18. Study of Urinary system (charts)
19. Study of Genital system (male & female) from charts and TS of testis and ovary from permanent slides.
20. To study nervous system (From models / charts)
21. To study various body fluids.

Suggested Reading

1. William Davis, Understanding Human Anatomy and Physiology, McGraw Hill.

2. Anatomy & Physiology- Ross and Wilson

3. Anatomy and Physiology: Understanding the Human Body by Clark

4.Chaurasia's, Practical of Human Anatomy

Name of The Course	Systemic Bacteriology				
Course Code	BMLS3006				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives

1. Apply knowledge in General medical microbiology
2. To learn morphological characteristics of bacteria by staining
3. To develop the brief knowledge in pathogenesis and laboratory diagnosis of gram positive and gram negative bacteria
4. to know the mycobacterium and spirochetes pathogenesis and laboratory diagnosis
5. Discuss recent advance techniques for bacteria identification

Course Outcomes

CO1	Demonstrate and perform bacterial Culture and staining techniques for identification of bacteria
CO2	Explain principle and procedure of Biochemical examinations
CO3	Illustrate pathogenesis and laboratory diagnosis of Cocci
CO4	Illustrate pathogenesis and laboratory diagnosis of Bacilli
CO5	Explain classification, pathogenesis and lab diagnosis of Spirochetes
CO6	Modify and use recent advanced techniques for bacterial identification.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1 Bacterial culture and Staining hours : 8
1. Instruments used to seed culture media, Culture procedures – seeding a plate 2. Staining techniques in bacteriology: Significance of staining in bacteriology, Principle, Reagent preparation, procedures and interpretation of the following, Simple staining, Negative staining, Gram stain, Albert‘s stain, Neisser‘s stain, Ziehl –Neelsen staining, Capsule staining, Flagella staining, Spore staining and Fontana stain for spirochetes
Unit-2 biochemical tests for identification of different bacteria. Hours 8
Principle, procedures and interpretation of the following biochemical tests for identification of different bacteria. Catalase, Coagulase, Indole, Methyl Red, VogesProskauer, Urease, Citrate, Oxidase, TSIA, Nitrate reduction, Carbohydrate fermentation, Huge and Leifson, Bile solubility, H 2 S production, Demonstration of motility, Decarboxylases, CAMP, Hippurate hydrolysis, Nagler‘s reaction and Cholera-red reaction
Unit-3 hours 8
Definition, Classification, Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria: 1 Staphylococcus, 2. Streptococcus, 3. Pneumococcus, 4. Neisseria gonorrhoea and Neisseria meningitis,
Unit-4 hours8
Definition, Classification, Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria: 1. Enterobacteriaceae: Escherichia coli, Klebsiella, , Salmonella, Shigella, 2. Vibrio 3. Clostridiaof wound infection and 4. Mycobacterium tuberculosis complex, Atypical Mycobacteria and M.leprae
Unit-5 hours 8
Definition, Classification, Various characteristics (morphological, cultural and biochemical),

pathogenesis and laboratory diagnosis of the following bacteria: 1. Spirochetes – Treponema, Borrellia and leptospira, 2. Bordetella and brucella, 3. Rickettsia, 4. Chlamydia, 5. Actinomyces, 6. Pseudomonas
Unit-6: Advance techniques in systemic bacteriology Hours 5
Specimen collection from different areas from the human body for bacterial diagnosis Advance instruments used in Bacteriology: CMIA, ViteK, BacT Alert 3D system.

Suggested Reading

1. Text book of Microbiology by Ananthanarayan
2. Medical Microbiology by Panikar&SatishGupte
3. Medical laboratory Technology vol. I, II, III by Mukherjee
4. Text book of Microbiology by CP Bhaveja
5. Text book of Microbiology by Prescott
6. Medical Laboratory Technology by Mukherjee
7. Practical Medical Microbiology by Mackie and McCartney

Name of The Course	Basics of Haematological diseases			
Course Code	BMLS3007			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	-	-	3

Course Objectives

1. Apply knowledge on haematological disease

Course Outcomes

CO1	Apply knowledge about anaemia
CO2	Apply knowledge on leucocytes disorder
CO3	Examine the granulocytes defects
CO4	Classify and interpret bleeding disorders
CO5	Analyse the causes of thrombosis and apply knowledge on different anticoagulants
CO6	Discuss newly diagnosed haematological diseases

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1 Anaemia Hours :8
Anaemia-Introduction Classification Microcytic hypochromic anaemia Macrocytic anaemia, Normocytic normochromic anaemia
Unit-2 Disorders of Leukocytes Hours:8
Quantitative disorders of Leukocytes Cause and significance -Granulocytic and Monocytic Disorders Lymphocytic Disorders
Unit-3 Alterations in Neutrophils Hours:8
Morphologic Alterations in Neutrophils Toxic granulation Cytoplasmic vacuoles Döhle bodies May–Hegglin anomaly Alder–Reilly anomaly
Unit-4Bleeding disorders Hours:8
Bleeding disorders Introduction ,Causes of bleedingdisorders -Vascular defect ,Platelet defect ;Factor deficiency, Inhibitors ,Types of bleeding disorders ,Inherited bleeding disorders
Unit-5 Thrombosis Hours:8
Thrombosis Introduction, Causes of thrombosis Monitoring of Anticoagulants, Oral anticoagulants by INR Heparin.
Unit-6 Newly diagnosed haematological diseases hours 5
Introduction of Oral disorders with Haematological diseases, stimulated salivary flow rate (SSFR); decayed, missing and filled teeth (DMFT) index.

Suggested Reading

1. Text book of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's Clinical Haematology in Medical Practice
7. Wintrobe's Clinical Haematology– 2013 by John P. Greer, Daniel A. Arber, Bertil E. Glader, Alan F. List
8. https://doi.org/10.1007/s00784-019-03178-3

Name of The Course	Biochemical metabolism			
Course Code	BMLS3008			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	-	-	3

Course Objectives

1. To understand various metabolism process related to carbohydrates.
2. To understand various metabolism process related to protein.
3. To gain knowledge and solve on various metabolism process related to lipid.
4. To gain knowledge and solve on various metabolism process related to nucleic acids.
5. To understand the importance and concept of enzymes.

Course Outcomes

CO1	Apply knowledge on metabolism related to carbohydrates.
CO2	Apply knowledge on metabolism of protein.
CO3	Apply knowledge on metabolism to lipid.
CO4	Apply knowledge on metabolism of Nucleic acid
CO5	Apply knowledge on metabolism concept of enzymes and enzyme kinetics
CO6	Discuss theLaboratory diagnostic approaches in metabolic disorders

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1 hours : 8 Carbohydrate metabolism
Introduction, Importance and Classification, Digestion and Absorption, Metabolism: - Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis, Glycogenesis, Disorders of carbohydrate metabolism.
Unit-2 Protein metabolism Hours:8
Introduction, Importance and classification, Important properties of proteins, Digestion & absorption of Proteins,Metabolism of proteins, Disorders of protein metabolism and Urea Cycle
Unit-3 Lipid Hours-8
Introduction & Classification, Digestion & absorption of fats, Lipoproteins, fatty acid oxidation
Unit-4 Nucleicacids Hour-8
Introduction, Functions of Nucleic acid, Structure of DNA and RNA
Unit-5 Enzymes Hours-8
Introductions, Importance & Classifications, Properties of enzymes, Mechanism of enzyme action, Factors affecting enzyme action, Enzyme kinetics & enzyme inhibitors

Unit-6 Evaluating Inborn Errors of Metabolism hours-5
Laboratory diagnostic approaches in metabolic disorders, Diagnostic Advancement in Evaluating Inborn Errors of Metabolism

Suggested Reading

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Text book of Biochemistry by U. Satyanarayana& U. Chakrapani
3. Text book of Medical Biochemistry by Chatterjee, Shinde
4. Biochemistry by Voet&Voet
5. Biochemistry by Stryer
6. Principal of Biochemistry by Lehninger

Name of The Course	Fundamentals of Histology			
Course Code	BMLS3004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	3	-	-	3

Course Objective

Apply knowledge in disorder of the body organ and system

Course Outcomes

CO1	Outline the Alimentary and digestive system disease
CO2	Apply knowledge on digestive gland disease
CO3	Interpretation of the respiratory and execratory system disorder
CO4	Interpretation of the reproductive and nervous system disorder
CO5	Interpretation of the endocrine system disorder
CO6	Elaborate the endoscopy

Continuous Assessment Pattern

Internal		End Term	Total

Assessment (IA)	CAT	Exam (ETE)	Marks
10	20	70	100

Course Content:

Unit-1 hours : 8
Alimentary System: Diseases of mouth, Diseases of Oesophagus- Oesophagealvarices. Digestive System: Gastritis, Peptic ulceration, Appendicitis microbial diseases, food poisoning, hernia, Intestinal obstructions & mal absorption.
Unit-2 Hours 8
Accessory Digestive glands: Salivary glands- mumps Liver – hepatitis, liver failure, cirrhosis. Pancreas- pancreatitis. Gall Bladder- Gall stones, jaundice and cardiovascular diseases. Circulatory System: Diseases of Blood vessels- Atheroma, Arteriosclerosis, heart block. Disorders of Blood Pressure-Hyper & Hypotension.
Unit-3 Hours 8
Respiratory System: Upper respiratory tract infection, Bronchi, Asthma, Pneumonia, Lung abscess, Tuberculosis, Lung Collapse. Urinary System: Glomerulonephritis, Nephrotic syndrome, renal failure, renal calculi, Urinary obstruction, Urinary tract infection.
Unit-4 hours 8
Reproductive system: Sexually transmitted diseases, Pelvic inflammatory disease, disorder of cervix (CIN), Disease of ovaries, ectopic pregnancy, prostatitis, Infertility Nervous System: Neuronal damage, ICP, Cerebral Infarction, head injury, Alzheimer‘s disease, dementia.
Unit-5 Hours 8
Endocrine System: Pituitary: Hyper & Hypo secretions Thyroid: Goitre

Adrenal: Cushing Syndrome, Addison Disease Pancreas: Diabetes Sense Organs: Ear: Otitis Eye: Cataract
Unit-6 hours 8
Introduce to endoscopy, type of endoscopy, application of endoscopy ,capsule endoscopy

Suggested Reading

1. Anatomy &Physiology – Ross and Wilson
2. Human Anatomy and Physiology by Pearce
3. Di Fiore's Atlas of Histology
4. Text book of Pathology by Robbins
5. Text book of Pathology by HarshMohan

Name of The Course	Blood Banking & Genetics				
Course Code	BMLS3005				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives

To understand blood banking and blood transfusion -collection,testing,adverse reactions etc

To understand basic molecular genetics

Course Outcomes

CO1	Outline the blood banking ,ABO grouping & Rh grouping.
CO2	Demonstrate Compatibility test and cross match
CO3	Explain the blood component separation for transfusion and therapeutic purposes
CO4	Apply knowledge on fundamental concept of Genetics
CO5	Explain basic concept of molecular genetics and apply knowledge on Human, Microbial genetics
CO6	Develop skills in handling advanced techniques in Blood banking

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1 hours : 8
Introduction to Blood Banking History and discovery of various blood group systems ABO blood group system Rh and other major blood group system Sources of error in blood grouping and their elimination ABO grouping: Forward and reverse grouping. Rh grouping
Unit-2 Hours 8
Compatibility test in blood transfusion Collection of blood for cross matching from a blood bag, Major cross matching, Minor cross matching,Use of enzymes in blood bank specially Papain, Complications and hazards of blood transfusion, Laboratory investigations of transfusion reactions and mismatched blood transfusion, Precautions while procurement and storage of grouping antisera
Unit-3 hours 8
Various anticoagulants used to collect blood for transfusion purposes Selection of donor and procedure for collection of blood from a healthy donor Preparation of various fractions of blood for transfusion and therapeutic purposes such as: Packed red cells, washed red cells and FROZEN Red cells, Platelet Rich Plasma (PRP), Platelet concentrate and frozen platelets, Fresh plasma (FP), Fresh Frozen Plasma (FFP) and cryoprecipitate, Brief introduction of blood substitute/artificial blood. Haemopheresis: pertaining to Leucocytes, platelets and plasma. Quality control in blood bank
Unit-4 hours 8
Continuity of life-heredity, variation; Mendel's laws of inheritance, Chromosomal basis of inheritance; other patterns of inheritance- incomplete dominance, multi parallelism, quantitative inheritance.

Chromosomes - bacterial cell and eukaryotic cell; parallelism between genes and chromosomes; genome, linkage and crossing over; gene mapping; recombination
Unit-5 hours 8
Molecular genetics: DNA as a genetic material- its structure and replication; structure of RNA and its role in protein synthesis, Vectors, plasmids Human Genetics Microbial genetics
Unit-6 Recent techniques used in blood bank hours 8
Automation-solid phase technology, Gel Technology, Affinity Column Technology. Haemopheresis: pertaining to Leucocytes, platelets and plasma.

Suggested Reading

1. Di Fiore's Atlas of Histology
2. Medical Laboratory Technology by KL Mukherjee-Volume III
3. Text book of Pathology by Robbins
4. Textbook of Transfusion Science by Overfield, Hamer.
5. Phyllis S. Walker, MS, MT(ASCP)SBB

Name of The Course	Systemic Bacteriology – Practical			
Course Code	BMLS3051			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	T	P	C
	-	-	4	2

Course Objectives

1. Apply practical knowledge in systemic bacteriology laboratory
2. To learn morphological characteristics of bacteria by staining and culture methods
3. To develop the brief knowledge on Biochemical examinations for identification of bacteria
4. To know the identification and isolation from commonly isolated clinical samples

Course Outcomes

CO1	Apply practical knowledge in systemic bacteriology laboratory
CO2	Examine morphological characteristics of bacteria by staining and culture methods
CO3	Develop the brief knowledge on Biochemical examinations for identification of bacteria
CO4	Demonstrate the bacterial identification and isolation from commonly isolated clinical samples

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	To demonstrate the instruments used to seed culture media
2	To learn techniques for Inoculation of bacteria on culture media
3	To isolate specific bacteria from a mixture of organisms
4	To demonstrate simple staining (Methylene blue)
5	To prepare India ink preparation to demonstrate negative staining
	Bacterial identification: To demonstrate reagent preparation, procedure and interpretation for
6	Gram stain
7	Albert stain
8	Neisser's staining
9	Z-N staining
10	Capsule staining
11	Demonstration of flagella by staining methods
12	Spore staining
13	To demonstrate spirochetes by Fontana staining procedure
	To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria
14	Catalase
15	Coagulase
16	Indole

17	Methyl Red (MR)
18	VogesProskauer (VP)
19	Urease
20	Citrate
21	Oxidase
22	TSIA
23	Nitrate reduction
24	Carbohydrate fermentation
25	Huge and Leifson
26	Bile solubility
27	H2S production
28	Demonstration and motility
29	Decarboxylases
30	CAMP
31	Hippurate hydrolysis
32	Nagler‘s reaction
	To demonstrate various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.
33	Staphylococcus
34	Streptococcus
35	Corynebacterium
36	Escherichia coli
37	Klebsiella
38	Citrobacter
39	Enterobacter
40	Proteus
41	Salmonella
42	Shigella
43	Vibrio cholera
44	Mycobacterium tuberculosis
45	Pseudomonas

Suggested Reading

1. Text book of Microbiology by Ananthanarayan
2. Medical Microbiology by Panikar&SatishGupte
3. Medical laboratory Technology vol. I, II, III by Mukherjee
4. Text book of Microbiology by CP Bhaveja
5. Text book of Microbiology by Prescott
6. Medical Laboratory Technology by Mukherjee
7. Practical Medical Microbiology by Mackie and McCartney

Name of The Course	Basics of Haematological diseases – (Practical)				
Course Code	BMLS3052				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	-	-	4	2	

Course Objectives

Apply knowledge in instruments/techniques used in Haematology

Course Outcomes

CO1	Demonstrate Haematology instruments usage and maintenance
CO2	Demonstrate different blood cell counts and normal and abnormal morphology
CO3	Demonstration of different stains used in haematology

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	Parts of microscope; its functioning and care
2	Parts of centrifuge; its functioning and care
3	Familiarization and working of routine Haematology Lab. Instruments Microscopes
4	Cleaning and drying of glassware
5	Preparation of various anticoagulants

6	Collection of venous and capillary blood
7	Preparation of the stains and other reagents
8	Preparation of peripheral blood film (PBF)
9	Staining of PBF
10	Haemoglobin estimation methods (Sahli's, Oxyhaemoglobin, and cyanmethaemoglobin)
11	Differential leukocyte count (DLC)
12	Recognition and staining of various types of blood cells (normal and abnormal)
13	Preparation of thick and thin blood smear for malarial parasite (Leishman/Giemsa/JSB)
14	RBC counting
15	WBC counting
16	Platelet counting
17	Routine Examination of urine

Suggested Reading

1. Text book of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's Clinical Haematology in Medical Practice

Name of The Course	Biochemical metabolism – Practical				
Course Code	BMLS3053				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	4	2

Course Objectives

Apply knowledge in identification of carbohydrates and various biochemical test perform under biochemistry lab.

Course Outcomes

CO1	Determine the qualitative analysis of carbohydrates.
CO2	Determine and demonstrate the kidney function test
CO3	Estimate the cholesterol and its significance

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Suggested Reading

1. Textbook of Biochemistry by U. Satyanarayana& U. Chakrapani
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by Lehninger
5. Principal of Biochemistry by M. A. Siddiqi

Course Content:

List of Experiments	
1	To determine the presence of carbohydrates by Molisch test.
2	To determine the presence of reducing sugar by Fehling solutions
3	To determine the presence of reducing sugar by Benedict's method.
4	To determine starch by Iodine test.
5	Determination of Glucose in serum & plasma
6	Estimates of blood Glucose by Folin& Wu method
7	Determination of Urea in serum, plasma & urine.
8	Determination of Creatinine in serum or plasma
9	Determination of serum Albumin
10	Determination of Cholesterol in serum or plasma

Name of The Course	Fundamentals of Histology – (Practical)				
Course Code	BMLS3054				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	2	1

Course Objectives

Apply knowledge in disorder of body organ and system

Course Outcomes

CO1	To study squamous cell from cheek cells
CO2	Apply knowledge on preparation of slides from various organs and how to study organ slides

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	To study squamous cell from cheek cells (Buccal mucosa)
2	To study stained slide preparation from organs of digestive system
3	Study of stained slides of liver, pancreas, gall bladder
4	Study of various types of microscope and draw diagram in practical notebook
5	To study stained slide preparation from organs of circulatory system
6	To study stained slide preparation from organs of Respiratory system
7	To study stained slide preparation from organs of Nervous system
8	To study stained slide preparation from organs of Urinary system
9	To study stained slide preparation from organs of Endocrine system

Suggested Reading

- Anatomy &Physiology – Ross and Wilson
- Human Anatomy and Physiology by Pearce
- Di Fiore‘s Atlas of Histology
- Medical Laboratory Technology by KL Mukherjee-Volume III

Name of The Course	Blood Banking & Genetics- (Practical)				
Course Code	BMLS3055				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	2	1

Course Objectives

Apply knowledge in disorder of body organ and system

Course Outcomes

CO1	Demonstration of blood bags anticoagulants preparation for transfusion
CO2	Demonstrate Screening test for donar blood
CO3	Demonstration of component separation

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	Prepare Acid Citrate Dextrose (ACD)and Citrate Phosphate Dextrose (CPD) Solutions
2	Screening of blood donor: physical examination including medicalhistory of the donor
3	Collection and preservation of blood for transfusion purpose
4	Screening of blood for Malaria, Microfilaria, HBsAg, syphilis and HIV
5	Determine the ABO & Rh grouping
6	Perform Direct and Indirect Coomb’s test
7	Perform cross matching (Major &

	Minor)
8	Demonstration of component separation

Suggested Reading

- Mollison's Blood Transfusion in Clinical Medicine, 12th Edition by Harvey G. Klein
- Practical haematology by JB Dacie
- Transfusion Science by Overfield, Hamer
- Medical laboratory Technology by KL Mukherjee Volume-I
- Medical Laboratory Technology by Mukherjee

Name of The Course	Applied Bacteriology				
Course Code	BMLS4006				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives :To learn the diagnosis and methods of bacterial infection in human to gain knowledge on different types of quality checking methods for water, food and air to learn types of nosocomial infection and microbe's preservation methods.

Course Outcomes

On completion of course student will be able to:

CO1	Demonstrate and perform bacterial Culture and staining techniques for identification of bacteria
CO2	Explain principle and procedure of Biochemical examinations
CO3	Illustrate pathogenesis and laboratory diagnosis of Cocci
CO4	Illustrate pathogenesis and laboratory diagnosis of *Bacilli*
CO5	Explain classification, pathogenesis and lab diagnosis of *Spirochetes*
CO6	Develop knowledge on research on recent outbreaks bacterial infections

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Hours:8
Laboratory strategy in the diagnosis of various infective syndromes: Samples of choice, collection, transportation and processing of samples for laboratory., Diagnosis of the following complications: septicaemia and bacteraemia, Upper Respiratory tract infections, Lower respiratory tract infections, wound, skin, and deep sepsis, Urinary tract infections, Genital Tract infections, Meningitis, Gastro intestinal infections, Enteric fever, Tuberculosis (Pulmonary and Extra-pulmonary)
Unit II Hours:8
Antibiotic susceptibility testing in bacteriology: Definition of antibiotics, Culture medium used for Antibiotic susceptibility testing, Preparation and standardization of inoculum, Control bacterial strains, Choice of antibiotics, MIC and MBC: Concepts and methods for determination, Various methods of Antibiotic susceptibility testing with special reference to Stokes and Kirby-Bauer method.,
Unit III: 8 Hours
Basics of Nucleic acid techniques in diagnostic microbiology with special reference to Polymerase chain reaction (PCR)., Advances Automation in bacterial culture detection and antimicrobial susceptibility testing: Principles and importance.
Unit IV: 8 Hours
Examination of water: collection and transportation of water sample, Presumptive coliform count, Eijkman test, Introduction and importance of other bacteria considered as indicators of fecal contamination, membrane filtration tests, Interpretation of result. Examination of Milk and milk products: Basic Concepts regarding gradation of milk,various tests for bacteriological examination of milk., Examination of Air: Significance of air bacteriology in healthcare facilities, Settle plate method, Types of air sampling instruments, collection processing and reporting of an air sample.
Unit V: 8 Hours
Nosocomial Infection: Introduction, sources and types of nosocomial infections. Surveillance of hospital environment for microbial load and Role of microbiology laboratory in control of nosocomial infections. Epidemiological markers: Introduction, Types, Serotyping, Phage typing and Bacteriocin typing. Lyophilization
Unit VI 5 Hours
Molecular Analysis of Resistance Determinants in Diarrhea an Abundance of Resistance Genes and the Potential Role of the Microbiota in Its Dissemination

Suggested Readings:

1.Text Book of Microbiology by Anantanarayan
2.Medical Microbiology by Panikar & Satish Gupte
3.Text book of Microbiology by Prescott
4.Text book of Microbiology by CP Baveja

Name of The Course	Applied Haematology – I				
Course Code	BMLS4002				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives

1.Apply knowledge in blood cell count ,staining and examination of body fluids.

Course Outcomes
On completion of course student will be able to:

CO1	Demonstrate the haemoglobin and blood cell count
CO2	Explain estimation of ESR,PCV and haematocrit values
CO3	Examine the blood cells by using different stains
CO4	Interpretation of Normal and absolute values in Haematology and examination of semen
CO5	Apply knowledge and examine body fluid and coagulation study
CO6	Discuss recent advancements in haematology analyzer's

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Haemoglobinometry, Haemocytometer & Haemocytometer Hours: 8
Haemoglobinometry: Different methods to measure Haemoglobin with merits and demerits Haemocytometer: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors. RBC Count, Total leucocytes count (TLC), Platelet Count. Absolute Eosinophil count
Unit II: ESR, PCV, & Haematocrit 8 Hours
Principle mechanism and different methods with merit and demerits for the measuring Erythrocyte Sedimentation Rate (ESR) and its significance Different methods with merit and demerits for packed cell volume/ Haematocrit value Preparation of blood films Types, Methods of preparation (Thick and thin smear/film) and utility
Unit III: Staining techniques Hours: 8
Staining techniques in Haematology (Romanowsky's stains): Principle, composition, preparation of staining reagents and procedure of the following Giemsa's stain, Leishman's stain Wright's stain Field's stain JSB stain. Differential leucocytes count (DLC).
Unit IV: Normal and absolute values in Haematology Hours 8
Normal and absolute values in Haematology Physiological variations in Hb, PCV, TLC and Platelets. Macroscopic and microscopic examination of seminal fluid
Unit V: Examination of body fluids Hours 3
Examination of CSF and other body fluids for cytology i.e. pleural, peritoneal and synovial fluid etc. Preparation of Reagents for coagulation studies: M/40 Calcium chloride brain thromboplastin cephalin adsorbed plasma screening tests for coagulation studies and their significance
Unit VI: Recent Haematology Analyzer Hours 8
Introduction of Haematologyanalyser , Sysmex XN-9000 haematology system, Validating auto verification, Rule for haematologyanalyser.

Suggested Reading

1. Text book of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. PracticalHaematology by J.B. Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry
5. DeGruchy's Clinical Haematology in Medical Practice

Name of The Course	Analytical Clinical Biochemistry				
Course Code	BMLS4003				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives

1.Apply knowledge in instruments /techniques used in analytical biochemistry

Course Outcomes
On completion of course student will be able to:

CO1	Demonstrate different type of spectrophotometer and colorimeter.
CO2	Demonstrate various parts and working of photometry.
CO3	Apply knowledge on different types of chromatography.
CO4	Apply knowledge and perform different types of chromatography with its application and working.
CO5	Explain and perform different types of Electrophoresis.
CO6	Maximize the use of new developed technique in gene editing therapy.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Hours: 8
Introduction, Theory of spectrophotometry and colorimetry, Lambert`s law and Beer`s law, Applications of colorimetry and spectrophotometry
Unit II: 8 Hours
Introduction, General principles of flame photometry, Limitations of flame photometry, Instrumentation, applications of flame photometry, atomic absorption Spectroscopy – Principle & applications
Unit III Hours 8
Introduction, Types of chromatography, Paper Chromatography: Introduction, principle, types, details for qualitative and quantitative analysis, application, Thin layer chromatography: Introduction, experimental techniques, application of TLC, limitations, High performance thin layer chromatography, Column chromatography: Introduction, principle column efficiency, application of column chromatography
Unit IV: Hours 8
Gas chromatography: Introduction principle, instrumentation, application, Ion exchange chromatography: Introduction, Definition and principle, cation and anion exchangers, application,Gel Chromatography: Introduction Principle and method, application and advantages
Unit V: Hours 8
Introduction, Principle, Instrumentation, Applications, Types of electrophoresis, Paper electrophoresis, Gel electrophoresis
Unit VI Hours 8
Introduction, History, classification of CRISPR, CRISPER Case9, Mechanism, biological structure, application.

Suggested Reading

1. Instrumental Analysis by ChatwalAnand
2. Text book of Medical Biochemistry by Chatterjee, Shinde
3. Text book of Medical Laboratory Technology by P. B. Godker
4. Principal of Biochemistry by M. A. Siddiqi
5. Practical Clinical Biochemistry by Harold Varley

Name of The Course	Applied Histopathology – I				
Course Code	BMLS4007				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		3	-	-	3

Course Objectives

1. Apply knowledge in instruments / techniques used in histopathology
2. Collection,Processing of tissue
3. Staining of different histopathological specimens

Course Outcomes

On completion of course student will be able to:

CO1	Illustrate working principle, applications of various types of microscopes
CO2	Demonstrate the routine methods of tissue examination and collection, transport of specimens
CO3	Classify the fixative and explain decalcification technique
CO4	Explain the tissue processing and section cutting technique
CO5	Explain the staining and mounting technique
CO6	Discuss the advancements of automation in histopathology

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Hours 8
Compound microscope: Optical system, magnification and maintenance. Microscopy: Working principle Applications of various types of microscopes i.e. dark field, polarizing, phase contrast, and fluorescent microscope
Unit II: Hours 8

Safety measures in a histopathology laboratory, Basic concepts about routine methods of examination of tissues, Collection and transportation of specimens for histological examination
Unit III: Hours 8
Basic concepts of fixation Various types of fixatives used in a routine histopathology laboratory Simple fixatives Compound fixatives Special fixatives for demonstration of various tissue elements, Decalcification Criteria of a good decalcification agent technique of decalcification followed with selection of tissue, fixation, and de calcification, neutralization of acid and thorough washing Various types of decalcifying fluids:
Unit IV: Hours 8
Processing of various tissues for histological examination Procedure followed by Dehydration, Clearing, Infiltration and routine timing schedule for manual or automatic tissue processing. Components & principles of various types of automatic tissue Processors Embedding: Definition Various types of embedding media, Section Cutting Introduction regarding equipment used for sectioning Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping,.
Unit V : Hours 8
Staining, Impregnation and mountants- theory of Staining, classifications of dyes, Principles of dye chemistry stains and dyes and their uses types of stains, preparation of stains, solvents, aniline water and buffers etc. commonly used mountants in histotechnology lab;general staining procedures for paraffin Infiltrated and embedded tissue nuclear stains and cytoplasmic stains. equipment and procedure for manual staining and automatic staining technique. Mounting of cover slips,labelling and cataloguing the slides. routine staining procedures Haematoxylin and Eosin Staining,
Unit VI : Advancements in Histopathology Hours 5
Introduction to Automation in histopathology, fully automation in histopathology- Automatic tissue Processor with micro processor etc

Suggested Reading

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft

Name of The Course	Medical Mycology and Virology				
Course Code	BMLS4005				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	T	P	C	
	4	-	-	4	

Course Objectives

1. To learn the basic characteristics of virus and diagnosis of virus
2. To gain knowledge on fungi infections and diagnosis methods
3. To develop knowledge on recent advance techniques

Course Outcomes

On completion of course student will be able to:

CO1	Apply knowledge on basic characteristics of virus, collection, transport of viral specimens
CO2	Illustrate and perform diagnosis of virus
CO3	Explain the basic concept of fungal infections in human body.
CO4	Explain culture media, Techniques used for isolation and identification methods of fungi
CO5	Explain susceptibility tests and serological diagnosis for fungi
CO6	Discuss on specimen collection and diagnosis of recent outbreaks in virus and fungal infections

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit I: Hours 12
Introduction to medical virology, Introduction to medically important viruses, Structure and Classification of viruses., Multiplication of viruses., Collection, transportation and storage of sample for viral diagnosis
Unit II: Hours 14
Staining techniques used in Virology., Processing of samples for viral culture (Egg inoculation and tissue culture)., Rapid diagnosis of viral infections with special reference to HIV, HBV and HCV., EIA., Immunofluorescence and PCR
Unit III: Hours 10
Introduction to Medical Mycology, Basic concepts about superficial and deep Mycoses, Taxonomy and classification and general characteristics of various medically important fungi, Normal fungal flora, Morphological, cultural characteristics of common fungal laboratory contaminants
Unit IV: Hours 12
culture media used in mycology, direct microscopy in medical mycology laboratory, processing of clinical samples for diagnosis of fungal infections i.e. Skin, nail, hair, pus, sputum, CSF and other body fluids, techniques used for isolation and identification of medically important fungi and Methods for identification of yeasts and moulds
Unit V: Hours 12
Dimorphism in fungi., Antifungal susceptibility tests., Preservation of fungal cultures., Routine myco-serological tests and skin tests
Unit VI Hours 8
Recent pandemic outbreaks of virus and fungal infections-clinical specimen collection and diagnosis

Suggested Reading

1.Text book of Microbiology by Ananthanarayan
2.Medical Microbiology by Panikar & Satish Gupte
3.Text book of Microbiology by CP Bhaveja
4.Medical Laboratory Technology by Mukherjee
5.Medical Mycology by Dr. Jagdish Chander

Name of The Course	Applied Bacteriology – practical				
Course Code	BMLS4051				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	4	2

Course Objectives

1. Apply practical knowledge in Applied bacteriology laboratory
2. To learn identification of pathogenic bacteria from clinical sample, water, air, food and milk
3. To develop the brief knowledge on Antibiotic sensitivity test for identification of bacteria.

Course Outcomes

On completion of course student will be able to:

CO1	Demonstration and identification of pathogenic bacteria from clinical sample.
CO2	Illustrate and perform antibiotic sensitivity test and PCR for identification of bacteria.
CO3	To develop the brief knowledge on Antibiotic sensitivity test for identification of bacteria

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	Inoculation of different culture media
2	Isolation of pure cultures
	Processing of following clinical samples for culture and identification of bacterial pathogens:
3	Blood
4	Throat swab
5	Sputum
6	Pus
7	Urine
8	Stool for Salmonella, Shigella and Vibrio cholerae
9	C.S.F.
10	Demonstration of PCR
11	Demonstration of automation in bacterial culture detection and antimicrobial susceptibility testing
	Antimicrobial susceptibility testing
13	Introduction and terms used
14	Preparation and standardization of inoculum
15	To demonstrate reference bacterial strains
16	To determine MIC and MBC of known bacteria against a known antibiotic
17	To perform antibiotic susceptibility testing of clinical isolates by using Stokes method
18	To perform antibiotic susceptibility testing of clinical isolates by using Kirby-Bauer method
	Collection, transportation and processing of following articles for bacteriological examination:
19	Water

20	Milk
21	Food and
22	Air
23	To demonstrate sterility testing of intravenous fluid with positive and negative controls
24	Demonstration of serotyping and bacteriocin typing
25	Demonstration of lyophilization and other

Suggested Reading

1. Text book of Microbiology by Ananthanarayan
2. Medical Microbiology by Panikar & Satish Gupte
3. Text book of Microbiology by Prescott
4. Medical Laboratory Technology by Mukherjee
5. Practical Medical Microbiology by Mackie and McCartney

Name of The Course	Applied Haematology - I –– (Practical)				
Course Code	BMLS4052				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	4	2

Course Objectives

1. Apply knowledge in estimating different components of blood.

Course Outcomes

On completion of course student will be able to:

CO1	Differentiate different methods of Hb estimation and perform cell counts
CO2	Estimate ESR and interpret its significance
CO3	Demonstrate bleeding disorder

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	Hb Estimation Sahli‘s method Cyanmethahaemoglobin method Oxyhaemoglobin method
2	Total leukocyte count
3	Platelets count
3	Absolute Eosinophil count
4	Preparation of smear and staining with Giemsa and Leishman stain.
5	ESR(Wintrobe and Westergren method)
6	Packed cell volume (Macro&Micro)
7	Cytological examination of CSF and other body fluids
8	Physical and Microscopic examination of seminal fluid including sperm count
9	Perform normal DLC
10	Preparation of M/40 Calcium chloride Brain thromboplastin and standardization Cephalin Adsorbed plasma
11	Perform BT, CT, Hess test, PT and APTT
12	Hb Estimation: Sahli‘s method, Cyanmethahaemoglobin method Oxyhaemoglobin method

Suggested Reading

1. Text book of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. PracticalHaematology by J.B. Dacie
4. Atlas of Haematology (5th edition) by G.A. McDonald
5. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henry

Name of The Course	Analytical Clinical Biochemistry – Practical				
Course Code	BMLS4053				
Prerequisite					
Co-requisite					
Anti-requisite					
		L	T	P	C
		-	-	4	2

Course Objectives

1. Apply knowledge in instruments / techniques used in analytical biochemistry

Course Outcomes

On completion of course student will be able to:

CO1	Demonstrate and perform principle, procedure and working of spectrophotometer and photometer.
CO2	Demonstrate and perform principle, procedure and working of chromatography
CO3	Demonstrate and perform principle, procedure and working of electrophoresis.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	To demonstrate the principle, working & maintenance of spectrophotometer.
2	To demonstrate the principle, working &maintenance of colorimeter.

3	To demonstrate the principle, working & maintenance of flame photometer.
4	To demonstrate the principle, procedure of paper chromatography.
5	To demonstrate the principle & procedure of Gas chromatography.
6	To demonstrate the principle & demonstration of TLC.
7	To demonstrate the principle & procedure of column chromatography.
8	To demonstrate the principle & procedure of Electrophoresis.

Suggested Reading

1. Instrumental Analysis by Chatwal Anand
2. Practical Clinical Biochemistry by Harold Varley
3. Text book of Medical Biochemistry by Chatterjee, Shinde

Name of The Course	Applied Histopathology - I – (Practical)			
Course Code	BMLS4054			
Prerequisite				
Co-requisite				
Anti-requisite				
L	T	P	C	
-	-	4	2	

Course Objectives

1. Apply knowledge in histopathology technique

Course Outcomes

On completion of course student will be able to:

CO1	Demonstrate tissue processing
CO2	Demonstrate section cutting
CO3	Demonstrate tissue staining

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	Demonstration of instruments used for dissection
2	Use of antiseptics, disinfectants and insecticides in a tissue culture processing laboratory
3	Reception and labelling of histological specimens
4	Preparation of various fixatives
5	Testing of melting point of paraffin wax and perform embedding of given tissue in paraffin block
6	To process a bone for decalcification
7	To prepare ascending and descending grades of alcohol from absolute alcohol
8	Processing of tissue by manual and automated processor method
9	To demonstrate various part and types of microtome
10	To learn sharpening of microtome knife (Honing and stropping technique), and types of disposable blades in use (High and Low Profile).
11	To perform section cutting (Rough and Fine)
12	To practice attachment of tissue sections to glass slides
13	To learn using tissue floatation bath and drying of sections in oven (60-65C)
14	To perform & practice the Haematoxylin and Eosin staining technique
15	To perform & practice the Mallory's Phospho tungstic Acid Haematoxylin (PTAH)
16	To learn mounting of stained smears

Suggested Reading

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch
3. An Introduction to Medical Lab Technology by F J Baker and Silverton
4. Bancroft's Theory and Practice of Histopathological Techniques by John D Bancroft

Name of The Course	Medical Mycology and Virology – practical			
Course Code	BMLS4055			
Prerequisite				
Co-requisite				
Anti-requisite				
L	T	P	C	
-	-	2	1	

Course Objectives

1. Apply practical knowledge in Medical Mycology and Virology laboratory
2. To learn culture media preparation and diagnosis methods for identification of pathogenic fungi.
3. To develop the brief knowledge on diagnosis methods for identification of virus.

Course Outcomes

On completion of course student will be able to:

CO1	Perform Identification of fungi by culture, staining methods

CO2	Explain and perform sample collection for fungal examination
CO3	Perform and identify virus by culture, staining methods

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

List of Experiments	
1	To prepare culture media used routinely in mycology
2	To perform KOH preparation
3	Gram stain
4	Potassium Hydroxide - Calcofluor White method
5	India Ink preparation
6	Modified Kinyoun Acid Fast Stain for Nocardia
7	LCB preparation
8	To identify given yeast culture by performing various identification techniques studied in theory.
9	To identify given mould culture by performing various identification techniques studied in theory.
10	To demonstrate dimorphism in fungi
	To collect and process clinical samples for laboratory diagnosis of fungal infections i.e.
11	Skin
12	Nail
13	Hair
14	Body fluids and secretions
15	To demonstrate structure of viruses and their multiplication from charts etc.
16	To perform Giemsa stain, Seller‘s stain, immunofluorescent staining procedures for diagnosis of viral infections
17	Demonstration of fertilized hen egg
18	Demonstration of various inoculation routes in fertilized hen egg

Suggested Reading

1.Text book of Microbiology by Ananthanarayan
2.Medical Microbiology by Panikar&SatishGupte

3.Medical laboratory Technology vol. I, II, III by Mukherjee
4.Text book of Microbiology by CP Bhaveja
5.Medical Mycology by Dr. Jagdish Chande

Name of The Course	**Immunology & Bacterial serology**				
Course Code	**BMLS5006**				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	
	4	**0**	**0**	**4**	

Course Objectives:

1. **To Apply knowledge and Explain Antigens, Antibodies & Antigen-Antibody reactions**
2. **To perform Antibody reactions, Serological tests and complement system**

Course Outcomes:

On completion of course student will be able to:

CO1	Illustrate History and introduction to immunology & concept of Immunity
CO2	Explain Antigens, Antibodies & Antigen-Antibody reactions
CO3	Demonstrate Antibody reactions, Serological tests and complement system
CO4	Apply knowledge on understanding Immune response & Basic concepts of autoimmunity and brief knowledge about autoimmune diseases
CO5	Classify Autoimmunity, Automation & Vaccines
CO6	Discuss recent advancements in rapid diagnosis of viral infections.

Text Book (s)

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Textbook of Microbiology by Ananthanarayanan
3. Medical Microbiology by Paniker&SatishGupte

Reference Book (s)

1. Medical laboratory Technology Vol. I ,II, III by Mukherjee
2. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough
3. Immunology by Riot
4. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7255149/

Unit-1: History and introduction to immunology & concept of Immunity hours: 12
History and introduction to immunology. Immunity, innate, Acquired immunity, Basic concepts about their mechanismsSystem in India
Unit-2: Antigens, Antibodies & Antigen-Antibody reactions hours: 12
Definition, types of antigens and determinants of antigenicity. Definition, types, structure and properties of immunoglobulin, Antigen-Antibody reactions Definition, Classification, General features and mechanisms, Applications of various antigen antibody reactions
Unit-3: Antibody reactions, Serological tests and complement system hours: 12
Complement fixation test, Immuno- fluorescence, ELISA, SDS-PAGE & Western blotting ,Widal, VDRL, ASO, CRP, Brucella tube agglutination, Rose-Waaler. Complement system: Definition, Basic concepts about its components & Complement activation pathways
Unit-4: Immune response: hours: 12
Immune response: Introduction, Basic concepts of Humoral and Cellular immune responses, Hypersensitivity: Definition, Types of hypersensitivity reactions
Unit-5: Autoimmunity, Automation & Vaccines hours: 12
Basic concepts of autoimmunity and brief knowledge about autoimmune diseases: Automation in diagnostic serology: Vaccines: Definition, Types, Vaccination schedule & Brief knowledge about _Extended programme of immunization‘ (EPI) in India
Unit-6: Recent diagnosis in immunology and serology hours: 8
All testsof rapid lateral flow immunoassays reliable in diagnosing SARS-CoV-2 infection.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Test (ETE)	Total Marks
10	20	70	100

Name of The Course	**Applied Haematology – II**				
Course Code	**BMLS5002**				
Prerequisite					
Corequisite					
Antirequisite					
	L	**T**	**P**	**C**	

	3	**0**	**0**	**3**

Course Objectives:

1. To Apply knowledge in haematology automation and special haematology investigations

2. To gain knowledge on coagulation factors

3. To Build knowledge on Chromosomal studies in haematological disorders

Course Outcomes:

On completion of course student will be able to:

CO1	Outline the automation in haematology
CO2	Apply knowledge in bone marrow examination
CO3	Examine L.E cell
CO4	Determine coagulation factors and it's screening
CO5	Explain Chromosomal disorders in haematological
CO6	Discuss the advancements in automation used in haematology.

Text Book (s)

1. Textbook of Medical Laboratory Technology by Praful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Practical Haematology by J.B. Dacie

Reference Book (s)

1. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
2. Atlas of Haematology (5th edition) by G.A. McDonald
3. De Gruchy's Clinical Haematology in Medical Practice
4. Wintrobe's Clinical Haematology– 2013 by John P. Greer, Daniel A. Arber, Bertil E. Glader, Alan F. List
5. Dmitriy V. Tsykunov ; George A Kolokolnikov ; Andrey V Samorodov 10.1109/EIConRus49466.2020.9039509.

Unit-1: **hours: 8**

Safety precautions in Haematology
Basic concepts of automation in Haematology with special reference to: Blood cell counter Coagulometer

Unit-2: **hours: 8**

Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios) Processing and staining of trephine biopsy specimens Red cell anomalies Morphological changes such as variation in size shape & staining character. Reticulocytes: Definition, different methods to count, Absolute reticulocyte count and IRF (Immature reticulocyte fraction) and significance of reticulocytes.

Unit-3: hours: 8
Lupus Erythematosus (L.E) cell phenomenon. Definition of L.E. cell. Demonstration of L.E. cell by various methods. Clinical significance. Correction studies for Factor deficiency
Unit-4: hours: 8
Quantitative assay of coagulation factors Principle ProcedureScreening of inhibitors against coagulation factors APLA .
Unit-5: hours: 8
Karyotyping: Chromosomal studies in haematological disorders (PBLC and Bone marrow) Cyto-chemical staining: Principles, method and significance, Biomedical waste management in Haematology laboratory (Other than Radioactive material)
Unit-6: Advancements in Laboratory automation in Haematology hours: 8
Introduction, Types of automation used in hematology laboratory, Requiem for the STAT Test, Methods for Automation of Leukocyte Microscopy.

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Test (ETE)**	**Total Marks**
10	**20**	**70**	**100**

Name of The Course	**Applied Clinical Biochemistry–I**			
Course Code	**BMLS5003**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

1. **To gain knowledge on hazards and safety in laboratory**
2. **To know how organize and maintain laboratory**
3. **Apply knowledge in various biochemistry tests and application of quality control**

Course Outcomes:

On completion of course student will be able to:

CO1	Illustrate Hazards & safety in lab and to know how to maintain quality in Biochemistry laboratory
CO2	Demonstrate how to set up, organize and maintain laboratory
CO3	Demonstrate and perform various biochemical tests.
CO4	Estimate and perform different types of electrolyte.
CO5	Explain and understand the role of radioactive material and perform ELISA.
CO6	Test HbA1c,Carbon dioxide in TB patients and estimate electrolytes in body cavities fluids

Text Book (s)

1. Textbook of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Technology by Mukherjee
3. Textbook of Medical Biochemistry by Chatterjee Shinde.

Reference Book (s)

1. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
2. Practical Clinical Biochemistry by Harold Varley.

Internal Assessment (IA)	CAT	End Term Test (ETE)	Total Marks
10	20	70	100

Unit-1: Hazards and safety measures & QC hours: 8
Hazards & safety measures in clinical Biochemistry laboratory, Quality control and quality assurance in a clinical biochemistry laboratory
Unit-2: Lab organizations and records hour: 6
Laboratory organization, management and maintenance of records
Unit-3:Clinical Biochemical Test hours:10
Principles of assay procedures, Normal range in blood, Serum, Plasma and Urine and reference values for: Glucose, Proteins, Urea, Uric acid, Creatinine, Bilirubin, Lipids.
Unit-4: Electrolytes and other clinical tests hours:10
Principles, procedures for estimation & assessment of the following including errors involved and their corrections: Sodium, Potassium and Chloride, Iodine, Calcium, Phosphorus and Phosphates
Unit-5: Radioactivity & ELISA hours: 10
Instruments for detection of Radioactivity, Applications of Radioisotopes in clinical biochemistry, Enzyme linked immune sorbent assay
Unit- 6 Hours: 8
Estimation of electrolytes in body cavities fluid, Estimation of Carbon dioxide in TB patients, Importance, methods. Estimation of Hba1c test, principle, clinical importance.

Continuous Assessment Pattern

Name of The Course	**Applied Histopathology – II**			
Course Code	**BMLS5007**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives:

1. **Apply knowledge in advance techniques used in histopathology**

Course Outcomes:

On completion of course student will be able to:

CO 1	Apply knowledge in Cryostat sectioning and perform special stains
CO 2	Demonstrate the protein, nucleic acid and minerals
CO 3	Demonstrate the carbohydrates, fat and microorganisms

CO 4	Explain the histochemistry diagnostic applications and neuropathy technique
CO 5	Explain the working principle and its components Processing of museum technique, use of electron microscopy and microtomy technique
CO 6	Elaborate the Immunohistochemistry and FISH

Text Book (s)

1. Handbook of Histopathological Techniques by C F A Culling
2. Medical Lab technology by Lynch

Reference Book (s)

1. An Introduction to Medical Lab Technology by F J Baker and Silverton
2. Bancroft‘s Theory and Practice of Histopathological Techniques by John D Bancroft

Unit-1: **hours: 8**
Cryostat sectioning, its applications in diagnostic histopathology. Special Staining Procedures for detection of Connective tissue elements, Trichrome staining, muscle fibres, elastic, reticulin fibres, collagen fibres etc.
Unit-2: **hours: 8**
Metachromatic staining such as Toludine blue on frozen sections.Principles of metal impregnation techniques. Demonstration and identification of minerals and pigments, removal of Pigments/ artifacts in tissue sections.
Unit-3: **hours: 8**
Demonstration of Carbohydrates, lipids, fat & fat like substances. Demonstration of bacteria and fungi in the tissue section. Tissue requiring special treatment - Basic concepts
Unit-4 **hours: 8**
Enzyme histochemistry: Diagnostic applications and the demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases. Vital staining.
Unit-5: **hours:8**
Museum techniques. Electron Microscope: working principle and its components Processing, embedding and ultra-microtome
Unit -6 **hours 5**
Introduction to Immunohistochemistry, Application of Immunohistochemistry, Fluorescence in situ hybridization (FISH), positive control and negative control in stain .

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Test (ETE)	Total Marks
10	20	70	100

Name of The Course	Immunopathology & Molecular Biology			
Course Code	BMLS5008			
Prerequisite				
Corequisite				
Antirequisite				
	L	T	P	C
	3	0	0	3

Course Objectives:

1. Apply their knowledge on understanding basic molecular techniques

2. Apply their knowledge on understanding Handle and perform ELISA, PCR etc.

Course Outcomes:

On completion of course student will be able to:

CO 1	List basics of Immunology
CO 2	Outline Transplant Immunology
CO 3	Apply knowledge on Autoimmunity, Hypersensitivity
CO 4	Make use and apply knowledge in Molecular Biology Techniques
CO 5	Examine Chemical composition of DNA
CO 6	Elaborate the new advance technique in Immunology

Text Book (s)

1. Immunology by Ivan Roitt, JonathaanBrostoff and David Male
2. Immunology by Kuby
3. Medical Immunology by Daniel P Stites

Reference Book (s)

1. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
2. Elements of Biotechnology by PK Gupta
3. Watson Molecular Biology of Gene

Unit-1: Introduction to Immunology hours: 8
Cells of the immune system, Types and Mechanisms of immune response, Lymphoid organs of the Immune system.
Unit-2: Transplant Immunology hours: 8
MHC I & II, HLA Typing & Cross matching
Unit-3: Autoimmunity, Hypersensitivity hours: 8
Hypersensitivity: Definition, Types, Mechanisms, Autoimmunity: Basic concepts
Unit-4: Introduction to Molecular Biology hours: 8
Molecular Biology Techniques : Principle, Reagents used, procedure and applications in Medical diagnostics. Polymerase Chain Reaction and its advanced versions Gel electrophoresis
Unit-5: Chemical composition of DNA hours: 8
DNA replication, DNA damage and repair, Regulation of prokaryotic and eukaryotic gene expression & Cell Cycle
Unit 6 hour 8
B cell ELISpot assay, Microfluidic single-cell technology, next-generation sequencing (NGS)

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Test (ETE)	Total Marks
10	20	70	100

Name of The Course	**Immunology and Bacterial Serology – Practical**			
Course Code	**BMLS5051**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives:

- **Apply knowledge & Perform various serological tests**
- **Outline the principles and perform various serological tests**

Course Outcomes:

At the end of the course student will be able to,

CO1	Show Collection of blood sample by vein puncture, separation and preservation of serum
CO2	Organization and Preparation of various types of buffer of different pH and Molarity
CO3	Apply their knowledge & Perform various serological tests

Text Book (s)

- **Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2**
- **Textbook of Microbiology by Ananthanarayanan**
- **Medical Microbiology by Paniker Satish Gupte**

Reference Book (s)

- **Medical laboratory Technology Vol. I ,II, III by Mukherjee**
- **Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough**
- **Immunology by Riot**

List of Practical

1	Collection of blood sample by vein puncture, separation and preservation of serum
2	Performing Haemolysin titration for Rose-Waaler test
3	Preparation of Phosphate buffers, Verinol buffer, ASO buffer, Richardson‘s buffer, Buffers of different pH and Molarity, Tris buffer, Standardization of cell concentration by Spectrophotometer
4	Widal,
5	Brucella Tube Agglutination
6	VDRL (including Antigen Preparation
7	ASO (Anti-Streptolysin _O‘)
8	C-Reactive Protein (Latex agglutination)
9	Rheumatoid factor (RF) Latex agglutination
10	Rose Waaler test
11	Demonstration of antigen/antibody determination by Immunofluorescence (IF), Immunodiffusion, precipitation in Agarose gel (Ouchterlony), CCIEP, ELISA, SDS - PAGE and Western blotting.

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Test (ETE)**	**Total Marks**
30		70	100

Name of The Course	**Applied Haematology -II - (Practical)**
Course Code	**BMLS5052**
Prerequisite	
Corequisite	
Antirequisite	

	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

Course Objectives:

- **Apply knowledge in advance technique of Haematology**

Course Outcomes:

At the end of the course student will be able to,

CO1	Demonstrate RBC and WBC morphology and anomalies
CO2	Demonstrate the coagulation factor
CO3	Demonstrate Advance coagulation study

Text Book (s)

- **Textbook of Medical Laboratory Technology by Praful B. Godkar**
- **Medical laboratory Technology by KL Mukherjee Volume-I**
- **Practical Haematology by JB Dacie**
- **Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry**

Reference Book (s)

- **Atlas of Haematology (5th edition) by G.A. McDonald**
- **De Gruchy's clinical Haematology in medical practice**

List of Practical

1	Review the morphology of Normal and abnormal RBCs
2	Review the morphology of normal and immature WBCs
3	WBCs anomalies
4	Calculating INR and determining the ISI of thromboplastin
5	Quantitative Factor assays Factor VIII Factor IX Factor VII Factor X Factor V
6	Quantification of inhibitors (Bethesda method)
7	APLA : Lupus Anticoagulant (LA)
8	Anti-cardiolipin antibodies (ACA)
9	Perform Euglobulin clot lysis test (ELT)
10	Urea clot solubility test for factor XIII.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Test (ETE)	Total Marks
30		70	100

Name of The Course	**Applied Clinical Biochemistry–I - Practical**
Course Code	**BMLS5053**
Prerequisite	
Corequisite	
Antirequisite	

	L	**T**	**P**	**C**
	0	**0**	**4**	**2**

Course Objectives:

- **Apply knowledge in principle, procedure, reagent preparation and result interpretation of various clinical biochemistry.**

Course Outcomes:

At the end of the course student will be able to,

CO1	Demonstrate and perform various tests for kidney function test.
CO2	Demonstrate and perform various tests for liver function test.
CO3	Demonstrate and perform various tests of lipid profile test.
CO4	Demonstrate and perform electrolytes.

Text Book (s)

- **Text book of Medical Laboratory Technology by P. B. Godker**
- **Medical laboratory Technology by KL Mukherjee Volume-III**
- **Textbook of Medical Biochemistry by Chatterjee, Shinde**

Reference Book (s)

- **Practical Clinical Biochemistry by Harold Varley.**
- **Principal of Biochemistry by M. A. Siddiqi**

List of Practical

1	Estimation of Glucose in Urine and in Blood.
2	Estimation of Protein in Urine and Blood.
3	Estimation of Urea in blood.
4	Estimation of uric acid in blood.
5	Estimation of serum Bilirubin
6	Estimation of Total Cholesterol in blood.

7	Estimation of HDL Cholesterol.
8	Estimation of LDL Cholesterol.
9	Estimation of TG
10	Estimation of Creatinine in Blood
11	Estimation of serum calcium, Inorganic phosphate

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Test (ETE)**	**Total Marks**
30		70	100

Name of The Course	**Applied Histopathology -II – (Practical)**			
Course Code	**BMLS5054**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives:

- **Apply knowledge in advance histopathology technique**

Course Outcomes:

At the end of the course student will be able to,

CO1	Demonstrate frozen section
CO2	Demonstrate special stain
CO3	Demonstrate microorganisms and nucleic acid

Text Book (s)

- **Handbook of Histopathological Techniques by C F ACulling**
- **Medical Lab technology by Lynch**

Reference Book (s)

- **An Introduction to Medical Lab Technology by F J Baker and Silverton**
- **Bancroft‘s Theory and Practice of Histopathological Techniques by John D Bancroft**

List of Practical

1	To cut frozen section and stain for Haematoxylin and Eosin, Metachromatic stain Toluidine blue-_o‘ and Oil Red _O‘ staining for the demonstration of fat
2	To prepare Schiff‘s reagent in the lab and do Periodic Acid Schiff‘s (PAS) stain on a paraffin section
3	To prepare ammonical silver bath in the laboratory and stain paraffin embedded section for the demonstration of reticulin fibers.
4	To stain a paraffin section for the demonstration of smooth muscle by Van Gieson‘s Stain

5	To perform Masson‘s trichrome stain on a paraffin section for the demonstration of collagen fiber, muscle fiber and other cell elements.
6	To stain the paraffin section for the demonstration of the elastic fibers (EVG).
7	To stain Decalcified paraffin embedded sections for the presence of calcium salts (Von Kossa‘s method).
8	To stain a paraffin section for the following Mucicarmine, Alcian blue.
9	To stain a paraffin section for the demonstration of iron (Perl‘s stain)
10	To demonstrate the presence of bacteria and fungi in paraffin embedded sections using the following staining procedures AFB staining (ZiehlNeilson‘s staining) for M. tuberculosis and leprae Grocott‘s stain for fungi Schmorl‘s reaction for reducing substances (melanin)
11	To stain for nucleic acid (DNA and RNA) Feulgen Staining Methyl Green-Pyronin Staining Enzymatic methods

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Test (ETE)**	**Total Marks**
30		70	100

Name of The Course	**Immunopathology & Molecular Biology - (Practical)**			
Course Code	**BMLS5055**			
Prerequisite				
Corequisite				
Antirequisite				
	L	**T**	**P**	**C**
	0	**0**	**2**	**1**

Course Objectives:

- **How to prepare Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation**
- **Apply knowledge in Electrophoresis**

Course Outcomes:At the end of the course student will be able to,

CO1	Apply knowledge on prepare Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
CO2	Demonstrate Immunofluorescence: Anti-Nuclear Antibody (ANA), Anti- Neutrophil Cytoplasmic Antibody (ANCA)
CO3	Apply knowledge in Electrophoresis

Text Book (s)

- **Immunology by Ivan Roitt, JonathaanBrostoff and David Male**

- **Immunology by Kuby**
- **Medical Immunology by Daniel P Stites**
- **Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites**

Reference Book (s)

- **Elements of Biotechnology by PK Gupta**
- **Watson Molecular Biology of Gene**
- **Advanced Molecular Biology by R Twyman**

List of Practical

1	Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2	T and B cell separation
3	Immunofluorescence: Anti- Nuclear Antibody (ANA), Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4	AIDS Immunology and Pathogenesis (AIP)
5	Thyroid Microsomal antigen (TMA)- Agglutination reactions
6	Electrophoresis
7	Gel diffusion
8	Nephlometery
9	HLA: Typing Serology & Cross match, Molecular Typing
10	Nitro blue Tetrazolium Chloride Test (NBT)
11	FACS for CD4 and CD8
12	ELISA for lab. diagnosis of AIDS
13	Polymerase Chain Reaction and its advanced versions
14	Gel electrophoresis
15	Western blotting
16	Isolation of DNA and RNA
17	Estimation of DNA and RNA
18	Determination of molecular weight and quantification of DNA using agarose gel electrophoresis

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Test (ETE)**	**Total Marks**
30		70	100

Name of The Course	Medical Parasitology & Entomology
Course Code	BMLS6001
Prerequisite	
Co-requisite	
Anti-requisite	

L	**T**	**P**	**C**
4	0	0	4

Course Objectives

1. 1. To learn the basic characteristics and life cycle of parasites.
2. To learn the specimen collection and transportation for parasites.
3. To gain knowledge on diagnosis methods for parasite

Course Outcomes

CO1	Apply knowledge on basic characteristics and classification of parasites
CO2	Demonstrate life cycle of Helminthology/ Helminthic parasites
CO3	Analyse Stool specimen for parasites
CO4	Analyse blood sample for parasite
CO5	Determine specimen collection and transportation for parasite examination
CO6	Discuss on diagnosis of parasite by Electrophoretic Techniques

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
10	20	70	100

Course Content:

Unit-1:Basic Concept of parasites 12 Hours
Introduction to Medical Parasitology with respect to terms used in Parasitology., Protozoology/ Protozoan parasites: General characteristics of protozoa., Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Entamoeba sp.., Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of Intestinal and vaginal flagellates i.e. Giardia, Trichomonas sp., Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of blood and tissue flagellates i.e. Plasmodium and Toxoplasma sp.
Unit-2: Helminthology/ Helminthic parasites 14 Hours

General characteristics of Cestodes, Trematodes and Nematodes., Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of : Taeniasolium and saginata, Echinococcusgranulosus, Hymenolepis nana, Schistosoma Haematobium and mansoni, Fasciola hepatica and buski, Trichuristrichura, Trichinellaspirales, Strongyloidesstercoralis, Ancylostomaduodenale, Enterobiusvermicularis, Ascarislumbricoides, Wuchereriabancrofti and Dracunculusmedinensis.
Unit-3: Diagnostic procedures (Stool) 10 Hours
Examination of Stool for parasites, For intestinal protozoal infections, General rules for microscopic examination of stool samples, Collection of stool samples, Preparation of material for unstained and stained preparations, Staining methods i.e. Iodine staining and permanent staining, For Helminthic infections, Introduction, direct smear preparation and examination, Concentration techniques i.e. Flotation and sedimentation techniques and Egg counting techniques
Unit-4: Examination of blood for parasites 12 Hours
Examination of blood for parasites: Preparation of thin and thick blood film, Leishman staining, Examination of thick and thin smear, Field's stain, JSB stain and Examination of blood film for Malarial parasite and Microfilariae

Unit-5: **Collection, Transport, processing and preservation of samples for routine parasitological investigation 12 Hours**
Collection, Transport, processing and preservation of samples for routine parasitological investigations; Morphology, life cycle and lab-diagnosis of following parasites Giardia and Entamoeba, Roundworms and Hookworms, T. solium and T. saginata, Malarial parasite with special reference to P.vivax and P falciparum., Laboratory diagnosis of hydated cyst and cysticercosis., Concentration techniques for demonstration of Ova and Cysts (Principles and applications)
Unit-6: Advanced techniques for diagnosis of parasite infections **8 Hours**
Advanced techniques for diagnosis of parasite infections, Electrophoretic Techniques

1. Medical Parasitology by D.R. Arora
2. Textbook of parasitology by CP Bhaveja
3. Medical Entomology by A.K. Hati, Pub. Allied Book Agency
4. Textbook of Microbiology by Prescott

Name of The Course	Advanced Haematology
Course Code	BMLS6002

Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	3	**0**	**0**	**3**

Course Objectives

1. To learn the WBC and RBC cell abnormalities and its clinical symptoms.
2. To gain knowledge on Bleeding and platelet abnormalities and diagnosis methods.

Course Outcomes

CO1	**Determine examination of Anaemia.**
CO2	**Explain types of Leukaemia and Chromosomal abnormalities**
CO3	**Determine bleeding disorders and diagnosis methods**
CO4	**Examination of Platelet disorders**
CO5	**Explain Radioisotope techniques used in haematology**
CO6	**Discuss Single-cell Sequencing in Hematology**

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
10	**20**	**70**	**100**

Course Content:

Unit-1Anaemia	**8 Hours**
Laboratory diagnosis of Iron deficiency anaemia, Laboratory diagnosis of Megaloblastic Anaemia	

Pernicious anaemia and Classification and Laboratory diagnosis of Haemolyticanaemia
Unit-2: Leukaemia and Chromosomal studies 8 Hours
Definition, classification and laboratory diagnosis of Leukaemia., Chromosomal studies in various haematological disorders and their significance
Unit-3:bleeding disorders 8 Hours
Laboratory diagnosis of bleeding disorders with special emphasize to Hemophilia A, B & Von-Willebrand disease and DIC
Unit-4: Platelet disorder 8 Hours
Platelet disorder (Qualitative and quantitative)., Laboratory approach for investigating thrombosis.
Unit-5:Radioisotopes techniques 8 Hours
Using radioisotopes measurement of: Blood volume, Determination of Red cell volume and Plasma volume, Red cell life span, Platelet life span, Radiation hazards and its prevention and Disposal of radioactive material.
Unit-6:Single-cell Sequencing in Hematology8
Hematological malignancies, application of novel single-cell approaches, stem/progenitors cells in myeloid malignancy at single-cell resolution.

Suggested Reading

1. Textbook of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KLMukherjee Volume-I
3. Practical Haematology by JB Dacie
4. Clinical Diagnosis &Management by Laboratory methods (20th edition) by John Bernard Henary
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's clinical Haematology in medical practice

Name of The Course	Applied Clinical Biochemistry–II				
Course Code	BMLS6006				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To Apply knowledge in various field of biochemistry includes automation, qualitative and quantitative analysis of blood, enzymatic marker testing and rapid techniques in biochemistry

Course Outcomes

CO1	Apply knowledge on different types of automation in biochemistry
CO2	Demonstrate and perform various tolerance tests.
CO3	Perform and understand about qualitative and quantitative tests.
CO4	Estimate and perform different enzymatic test.
CO5	Explain and perform different type's rapid techniques and fluid analysis.
CO6	Explain the advancements in clinical biochemistry lab automation

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1: Automation Analysis 8 Hours
Automation in clinical biochemistry, and Clearance test for renal function.
Unit-2: Tolerance tests 8 hours
Method of estimation and assessment for: Glucose tolerance test -Interpretations
Unit III: Qualitative and quantitative analysis 8 Hours
Qualitative test for: Urobilinogen, Barbiturates, T3,T4 and TSH and Qualitative analysis ofRenal calculi.
Unit IV: Enzymes Markers 8 Hours
Principle, Clinical significance and Procedures for estimation of Acid phosphatase, Lactate dehydrogenase, Aspartate transaminase, Alanine transaminase, Creatine phosphokinase
Unit V: CSF & rapid techniques 8 Hours
Chemical examination of Cerebrospinal fluid and Brief knowledge about rapid techniques in clinical biochemistry
Unit VI Advanced automation and metabolic testing 5

Latest model in Fully automated ELISA Processor(Meril),Fully automated Hormone analyzer Metabolic tests: Apo A (apolipoprotein A), Apo B(apolipoprotein B), G-6PD (glucose 6 – phosphate dehydrogenase), LP(a) (lipoprotein a).

1. Textbook of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Technology by Mukherjee
3. Textbook of Medical Biochemistry by Chatterjee&Shinde.
4. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
5. Practical Clinical Biochemistry by Harold Varley.

Name of The Course	Cytopathology			
Course Code	BMLS6004			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	4	0	0	4

Course Objectives

1. To learn the Cryostat sectioning Enzyme Cytochemistry and aspiration cytology
2. To gain knowledge on automation used in cytology and diagnosis of effusion.
3. To learn liquid based cytology

Course Outcomes

CO1	Apply knowledge on importance of cytopathology in diagnosis
CO2	Simplify aspiration cytology techniques
CO3	Determine sex chromatin by staining and explain automation in cytology
CO4	Examination of Exfoliative cytology smear
CO5	Explain diagnosis of Liquid based cytology
CO6	Adapt advanced techniques in Telepathology, Digital cytopathology & in Molecular techniques

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
10	20	70	100

Course Content:

Unit-1: Cryostat section 13 Hours
Cryostat sectioning, its applications in diagnostic cytopathology., EnzymeCytochemistry: Diagnostic applications and Demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases.

Unit-2: Aspiration cytology Hours12
Aspiration cytology: Principle, indications & utility of the technique with special emphasis on role of cytotechnologist in FNAC clinics
Unit-3: Automation in cytology 12 Hours
Vital staining for Sex Chromatin and Automation in cytology
Unit-4: Exfoliative cytology12 Hours
Exfoliative cytology (Papanicolaou technique for the staining of cervical smears): Cervical cytology, Fluid Cytology, Urine, CSF and Body Fluids (Pleural, Pericardial, Ascitic)
Unit-5: Liquid based cytology 13 hours
Liquid based cytology: Principles and preparation, Cytocentrifuge, molecular cytology, Cell Block and Immune-cytochemistry
Unit -6 Advance technique 08 Hour

Telepathology/Telecytology (Digital Cytopathology), Molecular Techniques ,Immunocytochemistry, Fish Technique In Cytology

Suggested Reading

1. Textbook of pathology by Harsh mohan
2. Handbook of Histopathological Techniques by C F A Culling
3. Medical Lab technology by Lynch
4. An Introduction to Medical Lab Technology by F J Baker and Silverton
5. Bancroft‘s Theory and Practice of Histopathological Techniques by John D Bancroft
6. Diagnostic Cytology by Koss Volume –II

Name of The Course	Research methodology and Biostatistics				
Course Code	BMLS6005				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	
	3	0	0	3	

Course Objectives

1. To apply knowledge in basic research and research methodology, biostatistics, methods to be adapted to do research work data analysis and biostatistics

Course Outcomes

CO1	Illustrate the basic principles of research
CO2	Interpret the research findings and application of ethics.
CO3	Apply knowledge on basics of statistical methods and collection of data types.
CO4	Illustrate the basic of biostatistics and research tools
CO5	Analyse research knowledge in presenting the observation of the biological research
CO6	Modify the research work with use of specific tools used in the field of life sciences.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
10	20	70	100

Course Content:

Unit-1: Basic of research 6 Hours
Introduction to research methods, Identifying research problem, How this research differ from other experimental research, and exploratory research.
Unit II:Ethics 6 Hour
Ethical issues in research, Research design, Ethics of clinical trials, permission of ethical committee, social ethics.
Unit III: Biostatistics 10 Hours
Basic Concepts of Biostatistics, Types of Data, Research tools and Data collection methods, Need of biostatistics, Understanding of data in biostatistics, How & where to get relevant data, Relation between data & variables, Type of variables: defining data set
Unit IV: Sampling methods 10 Hours
Sampling methods, Probability rules & Probability distributions (Normal & Binomial) Collection of relevant data: sampling methods Construction of study: population, sample, normality and its beyond (not design of study, perhaps), Summarizing data on the pretext of underlined study, Understanding of statistical analysis (not methods)
Unit V:Research proposals 8 Hours
Developing a research proposal-Models by engaging patients information and data-base of the diagnostic approaches
Unit VI Use of advanced research tools 8 Hours

Management Software like Zotero/Mendeley, Software for paper formatting like LaTeX/MS Office, Software for detection of Plagiarism.

Suggested Reading

1. The Analysis of Biological Data (2nd edition) by Whitlock &Schluter
2. TextBook of Biostatisics and Research methodology by Karthikeyan,R.M .Chathurvedi,R.M.Bhosale3.
3. Textbook of Methods in Biostatistics byB.K.Mahajan 7th Edition
4. Textbook of Biostatistics byB.Annadural

Name of The Course	Medical Parasitology and Entomology			
Course Code	BMLS6051			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. To learn morphological characteristics and life cycle of parasites
2. To develop the brief knowledge on diagnosis of parasites from clinical specimen

Course Outcomes

CO1	Apply practical knowledge on diagnosis of parasites
CO2	Examine stool specimens for parasites by slide methods.
CO3	Demonstration of parasites from blood sample

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**
30		70	100

Course Content:

1.	Routine stool examination for detection of intestinal parasites with concentration methods:
2.	a)Saline preparation
3.	b)Iodine preparation
4.	c)(Floatation method
5.	d)Centrifugation method
6.	e)Formal ether method

7.	f)Zinc sulphate method
8.	Identification of adult worms from models/slides
9.	a)Tapeworm
10.	b)Tapeworm segments
11.	c)Ascaris (Roundworm)
12.	d)Hookworms
13.	e)Pinworms
14.	Malarial parasite:
15.	a)Preparation of thin and thick smears
16.	b)Staining of smears
17.	c)Examination of smears for malarial parasites (P. vivax and P. falciparum

Suggested Reading

1. Medical Parasitology by D.R. Arora
2. Textbook of parasitology by CP Bhaveja
3. Medical Entomology by A.K. Hati, Pub. Allied Book Agency
4. Textbook of Microbiology by Prescott

Name of The Course	Advanced Haematology - (Practical)
Course Code	BMLS6052
Prerequisite	
Co-requisite	
Anti-requisite	

	L	**T**	**P**	**C**
	0	0	4	2

Course Objectives

1. Apply knowledge in Advanced Haematology

Course Outcomes

CO1	Interpret histogram of automated cell counter and screening tests for enzyme deficiency.
CO2	Demonstrate Hb electrophoresis and identification of types of anaemia
CO3	Estimate and perform coagulation studies by advanced technique

Continuous Assessment Pattern

Internal Assessment (IA)	**CAT**	**End Term Exam (ETE)**	**Total Marks**

30		70	100

Course Content:

1.	Study and interpretation of Histogram of Automated Blood cell counter
2.	To estimate serum iron and total iron binding capacity.
3.	Screening tests for enzymes deficiency: Pyruvate Kinase, G6PD
4.	To estimate Hb-F, Hb-A2 in a given blood sample.
5.	To estimate plasma and urine Hemoglobin in the given specimens
6.	To demonstrate the presence of Hb-S by Sickling and Solubility tests.
7.	Perform Hb electrophoresis (alkaline)
8.	Perform osmotic red cell fragility.
9.	Detection of Fibrin degradation products (FDPs)
10.	To perform various platelet function tests such as whole blood clot retraction test, prothrombin consumption index (PCI) Platelet adhesion, aggregation and PF3 availability test.
11.	Estimation of Protein C, S
12.	Peripheral Blood Lymphocyte Culture for chromosome studies in Leukemia

Suggested Reading

1. Textbook of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KLMukherjee Volume-I
3. Practical Haematology by JB Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology (5th edition) by G.A. McDonald
6. De Gruchy's clinical Haematology in medical practice

Name of The Course	Applied Clinical Biochemistry–II - Practical				
Course Code	BMLS6053				
Prerequisite					
Co-requisite					
Anti-requisite					
	L	**T**	**P**	**C**	

	0	0	2	1

Course Objectives

1. Apply knowledge in understanding about tolerance; clearance and various enzymatic test perform in clinical biochemistry.

Course Outcomes

CO1	Apply knowledge and perform test glucose and insulin tolerance .
CO2	Demonstrate and perform the various test comes under renal clearance.
CO3	Estimate and perform enzymatic markers and their significance.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

1.	Estimation of Glucose tolerance test (GTT).
2.	Estimation of Insulin tolerance test (ITT).
3.	Determination of Uric acid in Urine.
4.	Determination of Creatinine clearance.
5.	Determination of Urea clearance.
6.	Determination of Serum acid phosphatase.
7.	Determination of Serum Alkaline phosphatase.
8.	Determination of Serum Lactate dehydrogenase.
9.	Determination of T3, T4 and TSH

Suggested Reading

1. Textbook of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Technology by Mukherjee
3. Textbook of Medical Biochemistry by Chatterjee&Shinde.
4. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
5. Practical Clinical Biochemistry by Harold Varley.

Name of The Course	Cytopathology - (Practical)
Course Code	BMLS6055
Prerequisite	
Co-requisite	

Anti-requisite				
	L	**T**	**P**	**C**
	0	0	2	1

Course Objectives

1. To learn the sample processing and smear preparation in cytology lab
2. To gain knowledge on advance techniques used in cytology
3. To perform staining techniques in cytology

Course Outcomes

CO1	Determine and perform all type of stains in cytopathology lab for diagnosis
CO2	Explain frozen sections of Gynae tissue
CO3	Utilize cytospin for diagnosis of body fluids

Continuous Assessment Pattern

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
30		70	100

Course Content:

1.	To perform Papanicolaou‘s stain on cervicalsmear
2.	To perform Guard‘s staining for demonstration sex chromatin (Barr bodies on a buccal smear
3.	To cut frozen sections of Gynaec tissue
4.	Giemsa stain
5.	H&E Stain
6.	PAS.Stain

Suggested Reading

1. Textbook of pathology by Harsh mohan
2. Handbook of Histopathological Techniques by C F A Culling
3. Medical Lab technology by Lynch
4. An Introduction to Medical Lab Technology by F J Baker and Silverton
5. Bancroft‘s Theory and Practice of Histopathological Techniques by John D Bancroft
6. Diagnostic Cytology by Koss Volume –II

Course Name	MLT Internship-I & MLT Internship-II/Seminar/Project
Course Code	BMLS7003 & BMLS8003/BMLS7004 & BMLS8004
Prerequisite	
Co-requisite	
Anti-requisite	

Medical Lab Technology Internship Programme :

All the students shall undergo Internship for a period of one year under the supervision of Lab super indent/Lab incharge/Pathologist at Super specialty/Multi specialty- hospitals/Diagnostic & research Centers of repute, work in the areas of Clinical Biochemistry,Microbiology,Immunology & serology,Blood bank and Molecular Techniques,Pathology,Histopathology,Hematology and Sample collection,processing and rejection.

Duration: Internship is for 12 months (July – December; January – June) or 1 year. (6 days / week; 6 hours / day) A minimum of 720 hours /semester (If 120 days working days).

Course Objectives:

During this period the interns would gain knowledge and exposure in the following domains-

- Perform clinical skills essential in providing basic diagnostic services such as Correctly collecttransport, receive, accept or reject and store blood /urine/stool and tissue samples, etc.; Conduct analysis of body fluids/ samples; Maintain, operate and clean laboratory equipment; Provide technical information about test results; Prepare and document medical tests and clinical results; etc.
- Explain quality assurance in Laboratory works
- Practice infection control measures
- Advanced knowledge of the scientific principles on which the tests and equipment function.
- Ensure readily availability of medical and diagnostic supplies
- Demonstrate techniques to maintain the personal hygiene needs
- Demonstrate actions in the event of medical and facility emergencies
- Exhibit professional behavior, personal qualities and characteristics of a Medical laboratory Technician
- Demonstrate good communication, communicate accurately and appropriately in the role of Medical laboratory Technician

Course Outcome

BMLS-7003/BMLS8003 CO1	Analyze and measure different body fluids sample and maintain the ethical standard , quality in laboratory medicine field

BMLS7004 CO1	Discuss the advancements and interpretations laboratory medicine filed
BMLS8004 CO1	Identify the research problem and design the project work in Medical Laboratory Science

Submission:

1.A log book must be maintained for day to day activities and signed by Lab superintendent or Lab incharge ,HoD of department on each semester end.

2.Project work completed with prior approval every semester end presented in End term external exam.

Examination:

At the end of each semester assessment made by external experts as per the university guidelines and evaluation made accordingly.

Evaluation Scheme:

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
		100	100

Name of TheCourse	Clinical Observation			
Course Code	**BMLS5056**			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	0	**0**	**0**	**4**

Name of TheCourse	Clinical Observation			
Course Code	**BMLS-1055/BMS2055/BMLS3056/4056/6056**			
Prerequisite				
Co-requisite				
Anti-requisite				
	L	**T**	**P**	**C**
	0	**0**	**0**	**2**

Course Objective

1. To apply clinical observations, which are referred to as “vital signs”; “patient observations” or just “Obs.”
2. Identify clinical observations that are physiological markers that help medical, nursing and other clinical staff to closely monitor patients.
3. Explain deteriorating circumstances and escalate to senior staff so that appropriate interventions are commenced to stop the patient deteriorating further

Course Outcome

CO1	Demonstrate Patient care introduction and different test observation and principle of Sample Handling and Processing
CO2	To Apply Knowledge on the interpretation of all the serological, pathological, microbiological test etc.

Evaluation scheme

Internal Assessment (IA)	CAT	End Term Exam (ETE)	Total Marks
50			50
100			100