

Curriculum / Syllabus
For
Four Year (Eight Semester)
Bachelor of Medical Laboratory Sciences
{BMLS}

(Based on model curriculum 'Medical Laboratory Sciences' Ministry of Health and Family Welfare, Government of India)



Faculty of Medicine
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Bachelor of Medical Laboratory Sciences

Background

Qualifications in medical laboratory science can be accomplished with a course duration ranging from 4 years of Bachelor's degree (BMLS) (inclusive of 6 months of internship).

The aim of the recommended curricula is to produce professionals who are technically and clinically competent and are well versed with importance of quality assurance in Medical Laboratory Sciences (MLS). They should understand the theoretical basis for evidence-based practice and be effective members of the multidisciplinary team. They should always be prepared to participate in or initiate research into practice. They should be able to work according to registration requirements of the respective country/ state.

All aspects of medical laboratory Science have been considered in the development of this curriculum together with the identification of the roles expected for different levels of medical laboratory professionals based on their qualification and experience. The need for connecting the dots between the education and employment practices has been the road map for devising this curriculum.

The National Curriculum Taskforce on Medical Laboratory Science has successfully designed the career and qualification map indicating the growth opportunities for a professional in the career pathway based on the level as indicated in the National Skills Qualification Framework (NSQF). The career pathway indicates level 4 as the entry level after the completion of a minimum 2.5 years of Diploma level programme including 6 months internship in medical laboratory science (Diploma in Medical Laboratory Science) and level 5 as the entry level after completion of a minimum 4 years of Baccalaureate level programme including 6 months internship in medical laboratory science (Bachelor in Medical Laboratory Science – BMLS).

Bachelor of Medical Laboratory Science (BMLS)

Introduction

Objectives/aim of the program:

- Proficiently perform a full range of clinical laboratory tests
- Develop and evaluate test systems and interpretive algorithms.
- Manage information to enable effective, timely, accurate, and cost-effective reporting of laboratory-generated information.

Program Education Objectives (PEOs):

- **PEO 1:** To inculcate scientific knowledge and professional ethics for serving in the field of Medical Laboratory Sciences.
- **PEO 2:** Graduates will have pursued career in Government and private diagnostic labs, hospital labs, clinical labs, public health labs, R & D and successful entrepreneurship.
- **PEO 3:** To equip the students with advanced analytical skills for conducting various diagnostic tests, instrument calibration and develop new testing kits.
- **PEO 4:** Graduates will become a fast learner with opportunities to accept the role as a professional, relate to clinical or research, grow personally and adapt to change.
- **PEO 5:** Graduates will contribute significantly in a team through professional competency and along with maintain ethical value.

Program Outcomes (POs):

- **PO 1:** Student will have **thorough knowledge** and become qualified and skilled laboratory diagnostic professionals.
- **PO 2:** Student will be a qualified professional in Medical Laboratory Sciences and be ready to work, identify and **analyze** problem in hospitals and research laboratories.
- **PO 3:** Student will be able to **design solutions** for established laboratory, safety regulations and regulations governing regulatory compliance related to medical sciences laboratory practices.
- **PO 4:** Student will be able to **perform/investigate** various diagnostic tests, analysis and bring forth important and vital information about the status and particulars of an individual's health.

- **PO 5:** Student will be able to demonstrate effective analysis of scientific issues through the use of **modern tools and techniques** in case studies, clinical diagnostic laboratory and research laboratory.
- **PO 6:** Apply reasoning informed by the contextual knowledge to **assess societal**, health, safety, and medico-legal issues and the consequent responsibilities relevant to the professional medical laboratory practice.
- **PO 7:** Understand the impact of the professional medical laboratory sciences solutions in **environmental protection** contexts for sustainable development.
- **PO 8:** Student will exhibit a sense of **commitment to the ethical** and human aspects of patient care.
- **PO 9:** Student will be a competent as **individual and team leader**, committed to life-long learning to meet current and future workplace challenges in medical laboratory science.
- **PO 10:** **Communicate effectively** on health care associated community and with society at large, such as, being able to comprehend and produce original reports and design documentation, make effective presentations.
- **PO 11:** Demonstrate knowledge and understanding of the medical laboratory sciences principles and apply these **to manage projects scientifically and financially**.
- **PO 12:** Students have ability to preparation and engage in independent and **life-long learning** in the field of medical laboratory sciences.

Program Specific Objectives (PSOs):

PSO 1: Student will be able to demonstrate the theoretical knowledge and technical skills to ensure the accuracy of diagnostic as well research laboratory test result.

PSO 2: Student will be able to communicate courteously and effectively with laboratory personnel, other health care professionals, patients and the public.

PSO 3: Student will be able to demonstrate laboratory practice standards in safety, professional behavior and ethical conduct.

Semester wise Course Curriculum and Credit distribution**First Semester: Foundation Course**

Course Code	Course Title	Credit		Marks Distribution				Total Marks
				Theory		Practical		
		IA	UE	IA	UE			
BMLS111	Introduction to National Healthcare Delivery System in India	2	-	30	70	-	-	100
BMLS112	Basic Computers and Information Science	4	-	30	70	-	-	100
BMLS113	Communication and Soft Skills	4	-	30	70	-	-	100
BMLS114	Medical Terminology, Record Keeping	2	-	30	70	-	-	100
BMLS115	Medical Law and Ethics	2	-	30	70	-	-	100
BMLS116	Introduction to Quality and Patient safety (IQPS)	2	-	30	70	-	-	100
BMLS117	Professionalism & Values	2	-	30	70	-	-	100
BMLS118	Principals of Management	2	-	30	70	-	-	100
BMLS119	Environmental Science	4	-	30	70	-	-	100
	Total	24	-	270	630	-	-	900

Second Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE	IA	UE	
BMLS211	General Clinical Microbiology	4	-	30	70	-	-	100
BMLS212	Basic Hematology	4	-	30	70	-	-	100
BMLS213	General Human Anatomy	4	-	30	70	-	-	100
BMLS214	General Human Physiology	4	-	30	70	-	-	100
BMLS215	General Clinical Microbiology (Practical)	-	2	-	-	30	70	100
BMLS216	Basic Hematology (Practical)	-	2	-	-	30	70	100
BMLS217	General Human Anatomy (Practical)	-	2	-	-	30	70	100
BMLS218	General Human Physiology (Practical)	-	2	-	-	30	70	100
BMLS219	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	-	-	-	-	-	-
	Total	16	8	120	280	120	280	800

Third Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE	IA	UE	
BMLS311	Systematic Bacteriology	4	-	30	70	-	-	100
BMLS312	Basics of Hematological diseases	4	-	30	70	-	-	100
BMLS313	Basic Clinical Biochemistry & Metabolism	4	-	30	70	-	-	100
BMLS314	Fundamentals of Histology	4	-	30	70	-	-	100
BMLS315	Systematic Bacteriology (Practical)	-	2	-	-	30	70	100
BMLS316	Basics of Hematological diseases (Practical)	-	2	-	-	30	70	100
BMLS317	Basic Clinical Biochemistry & Metabolism (Practical)	-	2	-	-	30	70	100
BMLS318	Fundamentals of Histology (Practical)	-	2	-	-	30	70	100
BMLS319	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	-	-	-	-	-	-
	Total	16	8	120	280	120	280	800

Fourth Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE	IA	UE	
BMLS411	Applied Clinical Bacteriology	4	-	30	70	-	-	100
BMLS412	Applied Hematology - I	4	-	30	70	-	-	100
BMLS413	Analytical Clinical Biochemistry	4	-	30	70	-	-	100
BMLS414	Applied Histopathology - I	4	-	30	70	-	-	100
BMLS415	Applied Clinical Bacteriology (Practical)	-	2	-	-	30	70	100
BMLS416	Applied Hematology – I (Practical)	-	2	-	-	30	70	100
BMLS417	Analytical Clinical Biochemistry (Practical)	-	2	-	-	30	70	100
BMLS418	Applied Histopathology – I (Practical)	-	2	-	-	30	70	100
BMLS419	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	-	-	-	-	-	-
	Total	16	8	120	280	120	280	800

Fifth Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE	IA	UE	
BMLS511	Immunology & Bacterial Serology	4	-	30	70	-	-	100
BMLS512	Applied Hematology – II	4	-	30	70	-	-	100
BMLS513	Applied Clinical Biochemistry – I	4	-	30	70	-	-	100
BMLS514	Applied Histopathology - II	4	-	30	70	-	-	100
BMLS515	Immunology & Serology (Practical)	-	2	-	-	30	70	100
BMLS516	Applied Hematology – II (Practical)	-	2	-	-	30	70	100
BMLS517	Applied Clinical Biochemistry – I (Practical)	-	2	-	-	30	70	100
BMLS518	Applied Histopathology – II (Practical)	-	2	-	-	30	70	100
BMLS519	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	-	-	-	-	-	-
	Total	16	8	120	280	120	280	800

Sixth Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE			
BMLS611	Medical Parasitology & Entomology	4	-	30	70	-	-	100
BMLS612	Advanced Hematology	4	-	30	70	-	-	100
BMLS613	Applied Clinical Biochemistry – II	4	-	30	70	-	-	100
BMLS614	Cytopathology	4	-	30	70	-	-	100
BMLS615	Medical Parasitology & Entomology (Practical)	-	2	-	-	30	70	100
BMLS616	Advanced Hematology (Practical)	-	2	-	-	30	70	100
BMLS617	Applied Clinical Biochemistry – II (Practical)	-	2	-	-	30	70	100
BMLS618	Cytopathology (Practical)	-	2	-	-	30	70	100
BMLS619	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory	-	-	-	-	-	-	-
	Total	16	8	120	280	120	280	800

Seventh Semester

Course Code	Course Title	Credit		Marks Distribution				Total Marks
		Theory	Practical	Theory		Practical		
				IA	UE	IA	UE	
BMLS711	Medical Mycology and Virology	4	-	30	70	-	-	100
BMLS712	Blood Banking & Genetics	4	-	30	70	-	-	100
BMLS713	Immunopathology & Molecular Biology	4	-	30	70	-	-	100
BMLS714	Research Methodology and Biostatistics	4	-	30	70	-	-	100
BMLS715	Medical Mycology and Virology (Practical)	-	2	-	-	30	70	100
BMLS716	Blood Banking & Genetics (Practical)	-	2	-	-	30	70	100
BMLS717	Immunopathology & Molecular Biology (Practical)	-	2	-	-	30	70	100
BMLS718	Research Methodology and Biostatistics (Practical)	-	2	-	-	30	70	100
BMLS719	Guest Lecture/Tutorial/Seminar/visit to any medical research institution or reputed clinical laboratory							-
	Total	16	8	120	280	120	280	800

Eighth Semester

Course Code	Course Title	Credit	Marks Distribution	
			IA	UE
BMLS811	Medical Laboratory Sciences Internship	26	50	150

FIRST SEMESTER

Course Title/ Subject Name: Introduction to National Healthcare Delivery System in India

Course Code/ Subject Code: BMLS111

Course Objectives:

1. The course provides the students a basic insight into the main features of Indian health care delivery system
2. Familiarity with implementation of health care delivery processes in India.

Course Outcomes:

1. Student will have thorough **knowledge** of healthcare delivery system in India that will help to analyses the scenario.
2. Student will have **understood** about government policies and they implement in their working place.
3. Students will have ability to **differentiate** amongst the AYUSH System and how they work.
4. Students will have use **modern tools** for **explain** demographic situations of Health sciences in India.
5. Student will **analyze** the healthcare system with respect of Epidemiology.
6. Graduates will able to **generate** daily log book for patients for better treatment and diagnosis.

Introduction to National Healthcare Delivery System in India

UNIT-1: Introduction to healthcare delivery system

Healthcare delivery system in India at primary, secondary and tertiary care, Community participation in healthcare delivery system, Health system in developed countries. Private Sector, National Health Mission, National Health Policy, Issues in Health Care Delivery System in India, National Health Programme- Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programme.

UNIT-2: Introduction to AYUSH system of medicine

Introduction to Ayurveda, Yoga and Naturopathy, Unani, Siddha, Homeopathy, Need for integration of various system of medicine, Importance of Sun-rays, action-reactions of Sun-rays on human body, Different types of diet - Ideal diet, Natural diet, and balanced diet, Fasting - Its principles and physiological effects

UNIT-3: Health scenario of India

Past, present and future, Public health of India (epidemiology and demography), Demography & Vital Statistics, Demography – Its concept, Vital events of life & its impact on demography, Significance and recording of vital statistics, Census & its impact on health policy

UNIT-4: Epidemiology

Principles of Epidemiology, Natural History of disease, Methods of Epidemiological studies, Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

Suggested Reading:

1. Rural Health Care Delivery System in India, DVH Babu; The Associated Publishers, Ambala Cantt.
2. Jaysawal, D. N. (2015). Rural health system in India: A review. *International Journal of Social Work and Human Services Practice*, 29-37.
3. Rao, K. S. (2016). *Do we care?: India's health system*. Oxford University Press.
4. De, U. K., Pal, M., & Bharati, P. (2018). *Issues on Health and Healthcare in India*. Springer.
5. Sundar, D. K., Garg, S., & Garg, I. (Eds.). (2015). *Public health in India: Technology, governance and service delivery*. Routledge.

Course Title / Subject Names: Basic Computers and Information Science

Course Code / Subject Code : BMLS112

Course Objectives:

1. The students will be able to appreciate the role of computer technology in health care system.
2. The course has focus on computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation.

Course Outcomes:

1. Students will able to **identify** hardware and software of computer and laptop.
2. Students will able to **understand** mechanism of working principle of computers.
3. Students will use **modern software** to get better results during diagnosis of disease.
4. Students will able to **analyze** results in MS excel sheets.
5. Student will able to **evaluate** various operating systems for better work.
6. Students will able to **design & create** various types of MS office file for their work.

UNIT-1: Introduction to computer

Introduction, characteristics of computer, block diagram of computer, generations of computer, computer languages. Input output devices: Input devices (keyboard, point and draw devices, data scanning devices, digitizer, electronic card reader, voice recognition devices, vision-input devices), output devices (monitors, pointers, plotters, screen image projector, voice response systems). Processor and memory: The Central Processing Unit (CPU), main memory. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices.

UNIT-2: Windows & Operating Systems

History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.). Introduction of Operating System: introduction, operating system concepts, types of operating system.

UNIT-3: Microsoft Office

Introduction to MS-Word: introduction, components of a word window, creating, opening and inserting files, editing a document file, page setting and formatting the text, saving the document, spell checking, printing the document file, creating and editing of table, mail merge. Introduction to Excel: introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs. Introduction to power-point: introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs.

UNIT-4: Computer Network

Introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network. 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.

Suggested Readings:

1. Information technology by Anshuman Sharma (Lakhanpal Publisher)
2. Computer Fundamentals (Concepts. Systems and applications) by P. K. Sinha (University of Tokyo, Japan) BPB Publications

Course Title / Subject Names: Communication and Soft Skills

Course Code / Subject Code : BMLS113

Course Objectives:

1. The students will be able to communicate in English through speaking or writing.
2. This course trained students to draft letters and application regarding official work.

Course Outcomes:

1. Students will have good **knowledge** about English grammar and drafting letters.
2. Students will have able to **understand** how to proper arrange of words in sentences.
3. Student will able to **respond frequently** asked questions develop leadership skill that help in laboratory managements.
4. Students will able to **explain** answers and write formal or informal letter.
5. Students will able to select appropriate word or sentences during answer writing and letter drafting.
6. Students will able to **design and assemble** official application and letters.

UNIT-1: Basic Writing Skills

Sentence Structures, Tenses, Use of phrases and clauses in sentences, Importance of proper punctuation, Creating coherence, Organizing principles of paragraphs in documents, Techniques for writing precisely

UNIT-2: Communication

Basic concepts & principles of good communication, Special characteristics of health communication, Types & process of communication, Barriers of communication & how to overcome

Non-Verbal Communication & Personality Development

Importance and Elements; Body Language. Concept, Essentials, Tips, Meaning, Nature, Features, Stages, Models; Learning Skills; Adaptability Skills.

UNIT-3: Identifying Common Errors in Writing

Subject-verb agreement, Noun-pronoun agreement, Misplaced modifiers, Articles, Prepositions, Redundancies

UNIT-4: Nature and Style of Sensible Writing

Describing, Defining, Classifying, providing examples or evidence, writing introduction and conclusion, Note-taking, Comprehension, Précis Writing, Essay Writing, letters, E-mails, report, case study, collecting the patient data etc

Suggested Readings:

1. Kulbushan Kumar, R S Salaria, Effective Communication Skills, Khanna Publishing House, Delhi.
2. Practical English Usage. Michael Swan. OUP. 1995.

3. Remedial English Grammar. F.T. Wood. Macmillan. 2007
4. On Writing Well. William Zinsser. Harper Resource Book. 2001
5. Study Writing. Liz Hamp-Lyons and Ben Heasley. Cambridge University Press. 2006.
6. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
7. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
8. Universal English Prof. Prasad Kataria Publications, 2019.
9. "Communication Skills for Professionals"-Nira Konar, Prentice Hall of India 2nd edition, New Delhi, 2011
10. Gajendra Singh Chauhan, Smita Kashiramka and L. Thimmesha. Functional English. Cengage, 2019.

Course Title / Subject Names: Medical Terminology & Record Keeping

Course Code / Subject Code : BMLS114

Course Objectives:

1. The students will learn about terminology used in hospital as short hand reference in patient's details and book keeping.
2. This subject will elaborate knowledge about Medical Laboratory Sciences.

Course Outcomes:

1. Student will have **knowledge** about the suffix, prefix and roots and terminology used in healthcare systems.
2. Students will able to **summarize** suffix, prefix and basic term used for reference.
3. Students will able to **classify** medical term for their use in report writing and during discussion with doctors.
4. Students will be able to **interpret and generate** medical orders/reports.
5. Students will able to **select** the appropriate suffix and prefix during diagnosis report writing.
6. Students will have ability to **generate** data for entry and management on electronic health record system.

UNIT-1: Introduction to Medical Terminology

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. External Anatomy and Internal Anatomy, Interpret basic medical abbreviations/symbols.

UNIT-2: Terms Relating to the Body as a Whole

Study of the Body, Basic Structures, Cells, Tissues, Organs, Systems, Directions, Anatomic Planes and Position

UNIT-2: Terms by Organ Systems

Utilize diagnostic terms, surgical terms, symptomatic terms, oncology terms, operative terms, laboratory terms and procedural terms and abbreviations related to the integumentary system, musculoskeletal system, respiratory system, cardiovascular system, nervous system, genit0-urinary system and endocrine system.

UNIT-4: Record Keeping

Hospital Medical Record, Content of the Medical Record, Special Records, Required Characteristics of Entries in Medical Records. Record Numbering and Filing Systems, Physical Facilities in the File Area, Protective Covers for Records, Organizational Patterns of Files, Record Control, Locating Misfiles, Color Coding of Record Folders, Transportation of Records, Medical Record Retention Policies Interpret medical orders/reports. Data entry and management on electronic health record system.

Suggested Readings:

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

Course Title / Subject Names: Medical Law and Ethics

Course Code / Subject Code : BMLS115

Course Objectives:

1. In this Subject student learn Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care.
2. Advances in medical sciences, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large.

Course Outcomes:

1. On completion of the course the students have **knowledge** about the medical law and ethics.
2. Able to **classify** the legal and illegal issues faced in hospital and health care centers.
3. The students should **understand** the code and conduct of ethics for medical professions.
4. They will be able to **integrate** patient more lawfully in clinical and hospital setting and maintain their records.
5. Students will able to **evaluate** legal circumstances arises in health care facility.
6. Students will able to **design** efficient legal and ethical aspects of subject matter.

UNIT-1: Introduction

Describe Medical Ethics and explain its historical emergence, Describe and discuss Bioethics, Medical ethics – Definition, Goal & Scope, Introduction to Code of conduct, Basic principles of medical ethics. Confidentiality, Malpractice and negligence - Rational and irrational drug therapy.

UNIT-2: Consent

Define Consent. Describe different types of consent and ingredients of informed consent. Describe the rules of consent and importance of consent in relation to age, emergency situation, mental illness and alcohol intoxication, Autonomy and informed consent: Right of patients, Care of the terminally ill: Euthanasia, Organ transplantation

UNIT-3: Medico Legal Aspects

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.

UNIT-4: Ethics in Research

Discuss legal and ethical issues in relation to stem cell research, Professional Indemnity insurance policy, Clinical research & Ethics Discuss human experimentation including clinical trials, Discuss the constitution and functions of ethical committees, Describe and discuss

Ethical Guidelines for Biomedical Research on Human Subjects & Animals, Ethics in the profession of Medical Laboratory Science

Suggested Readings:

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

Course Title / Subject Names: Introduction to Quality and Patient Safety (IQPS)

Course Code / Subject Code : BMLS116

Course Objectives:

1. The subject will introduce the students to the basic concepts of quality in health care and develop skills to implement sustainable quality assurance program in the health system.
2. It will sensitize them in basic emergency care, infection prevention & control with knowledge of bio- medical waste management and antibiotic resistance.

Course Outcomes:

1. Students will have **knowledge** about standard norm of hospital set by NABH to deliver world class health service.
2. Student will **classify** Bio-medical waste for their managements in healthcare system
3. Students will able to **enforce/provide** CPR and other first aid procedure which can save people lives in emergency situation.
4. Students will able to **analyze** emergency situation for human health towards antibiotic resistance.
5. Student will also able to **select** antibiotic, which are resistance or sensitivity.
6. Students will able to **generate** antibiotic resistance pattern for a specific antibiotic.

UNIT-1: Quality assurance and Disaster management

Concepts of Quality of Care, Quality Improvement Approaches, Standards and Norms, Quality Improvement Tools, Introduction to NABH guidelines Fundamentals of emergency management, Psychological impact management, Resource management, Preparedness and risk reduction, Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

UNIT-2: Basics of emergency care and life support skills – Basic life support (BLS), Fundamental aspects of BLS, Sudden cardiac arrest (SCA) and activation of the emergency response system, early cardiopulmonary resuscitation (CPR), and rapid defibrillation with an automated external defibrillator (AED). 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: Bio-Medical Waste Management & Environment Safety

Definition of Biomedical Waste, Waste minimization, BMW: Segregation, collection, transportation, treatment and disposal (including color coding). Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste, BMW Management & methods of disinfection, Modern Technology for handling BMW, Use of Personal protective equipment (PPE), Monitoring & controlling of cross infection (Protective devices)

UNIT-4: Infection Prevention & Control

Evidence-based infection control principles and practices, Control of Microbial Growth: Sterilization, Pasteurization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE), Prevention & control of common healthcare associated infections, Components of an effective infection control program, and Guidelines (NABH and JCI) for Hospital Infection Control

UNIT-5: Antibiotic & Its Resistance

History and introduction of antibiotics, mechanism of action of antibiotics, how resistance happens and spreads, Types of resistance: intrinsic, acquired & passive, Trends in antibiotic resistance, Actions to fight resistance, Bacterial persistence, Antibiotic Sensitivity, Consequences of antibiotic resistance, Antimicrobial Stewardship: Barriers and opportunities, tools and models in hospitals

Suggested Readings:

1. The Essentials of Patient Safety by Charles Vincent
2. Laboratory quality control and patient safety by De Gruyter

Course Title / Subject Names: Professionalism & Values

Course Code / Subject Code : BMLS117

Course Objectives:

1. The Subject on professionalism & Value will deliver the concept of what it means to be a professional and how a specialized profession is different from a usual vocation.
2. It also explains how relevant is professionalism in terms of healthcare system and how it affects the overall patient environment.

Course Outcomes:

1. Students will **remember** to professional codes of conduct and ethical standards in all aspects.
2. Students will able to **analyze** ethical issues and dilemmas in health practice, employing ethical reasoning to resolve conflicts and make sound decisions.
3. Graduates will able to **understand** effective communication skills to interact with patients, colleagues, and other healthcare professionals.
4. Students will able to **apply** principles of patient autonomy, confidentiality, and informed consent in clinical settings, ensuring patient rights and dignity are upheld at all times.
5. Graduates will able to **evaluate** the importance of lifelong learning and professional development, engaging in healthcare system.
6. Students will able to **create** a healthy environment for patient and other healthcare professionals.

Professionalism & Values

UNIT-1: Professional Values

Integrity, Objectivity, Professional competence and due care, Confidentiality. Core values- Accountability, Altruism, Compassion/ caring, excellence, Integrity & professional duties, social responsibility.

UNIT-2: Personal Values

Ethical or moral values, Attitude and behavior, professional behavior, treating people equally, Duality of Personality; Theory of Action (Karma); Managing Mind for Ethics & Values: Aspirations and Greed, Lust, Anger, Haughtiness, Infatuation, Agitations and Disturbances, Stress of Immoral Act; Paths of Self Development; Stages of Self Development.

UNIT-3: Code of conduct

Code of conduct, professional accountability and responsibility, misconduct, Differences between professions and importance of team efforts

UNIT-4: Value System in Work Culture

Indian value system, Cultural issues in the healthcare environment. Entry level health care practitioner, direct access, autonomy in profession, practitioner of practice and evidence based practice.

Suggested Readings:

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, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
4. P.L.Dhar, R.R.Gaur, 1990, Science and Humanism, Common wealth Publishers.
5. A.N. Tripathy, 2003, Human Values, New Age International Publishers
6. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
7. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.

Course Title / Subject Names: Principals of Management

Course Code / Subject Code : BMLS118

Course Objectives:

1. Subject is intended to provide a knowledge about the basic principles of Management and their working methods to achieve to outcomes in jobs.
2. To develop students' critical thinking and decision-making skills in various managerial contexts.

Course Outcomes:

1. Students will **learn** about different types of management involved in healthcare sector.
2. Graduates will able to **understand** time management and working cost efficiently.
3. Students will able to **apply** management concepts to analyze and solve real-world organizational problems.
4. Graduates will able to **analyze** effectively in managerial roles through written reports and presentations.
5. Students will able to **evaluate** ethical implications of managerial decisions and actions.
6. Students will able to **create** collaborate efficiently in team settings to accomplish common goals.

UNIT-1: Introduction to Management

Definition, Nature- Features of Management, Management Functions, Management as a Process, Importance of Management, Management and Administration. Roles of a Manager, Levels of Management. Principles of Management- Fayol's principles of management, scientific Management. Strategic Management: Meaning, Definition, Elements, Scope and Dimensions, Process, Importance, Strategic Decisions and SWOT Analysis.

UNIT-2: Planning & Decision-making

Meaning and Definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objectives. Decision-making: Meaning, Characteristics, Decision-Making Process, Guidelines for Making Effective Decision, Types of Decisions.

UNIT-3: Conflict, Stress Management, Managing change and innovation

Definition and meaning of stress, relation between stress and performance. Causes of stress. Conflict meaning and causes, determinants of conflict, remedies of Stress and conflict management. Managing change and innovation: Definition, types of change, change management Process, change management, strategies of change management. Innovation meaning, drivers and types.

UNIT-4: Group, Team & Leadership

Definition and meaning, Formation of Group, Classification, Properties, Roles, norms, status, size and cohesiveness, Group decision making, understanding teams, creating effective teams. Leadership: Definition, Meaning, Factors, Theories, Principles and Leadership Styles.

UNIT-5: Time & Cost Management

Meaning, characteristics, objectives of Time Management Importance of Time Management.
Cost and efficiency: Definition, Meaning, Types of Cost. Relation between cost and efficiency.

Suggested Readings:

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, Jeevan Vidyack Parichay, Divya Path Sansthan, Amarkantak.
4. E G Seebauer & Robert L. Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press
5. B. P. Banerjee, 2005, Foundations of Ethics and Management, Excel Books.
6. Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur

Course Title / Subject Names: Environmental Science

Course Code / Subject Code : BMLS119

Course Objectives:

1. The student will be made aware of the environment in general, natural resources, ecosystems, environmental pollution.
2. Students also learn social issues related to environment, human population and the environment and understanding the hospital environment.

Course Outcomes:

1. Students will have **knowledge** about natural resources of the earth and ecosystem.
2. Students will be able to **understand** how to manage environmental pollutions.
3. Student can **apply** their knowledge for protection of our environment.
4. Students will able to **analyze** consequences and effects of pollution in our environment.
5. Graduates will able to **evaluate** human intervention in the cause of different type of populations.
6. Students will able to **design** project that helps in controlling environmental pollutions.

UNIT-1: Environment & Natural Resources

Introduction, Definition and scope and importance of multidisciplinary nature of environment. Physical environment; biotic environment. **Natural Resources: Forest Resources:** Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. **Water resources:** Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. **Mineral Resources:** Use and exploitation, environmental effects of extracting and using mineral resources, case studies. **Food Resources:** World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. **Energy resources:** Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. **Land Resources:** Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

UNIT-2: Ecosystem

Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem, Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT-3: Biodiversity and its Conservation

Introduction & Definition: Genetic, species and ecosystem diversity. Biogeographical classification of India, Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of

wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT-4: Environmental Pollutions

Definition, Cause, effects and control measures of: Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, nuclear hazards, Solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

UNIT-5: Social Issues & Environmental Policies

Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation. Public awareness.

Suggested Readings:

1. Agarwal, K. C. 2001 Environment Biology, Nidi Publ. Ltd. Bikaner.
2. Jadhav, H & Bhosale, V.M. 1995. Environment Protection and Laws. Himalaya Pub House, Delhi 284 p.
3. Rao M. N. & Datta A.K. 1987. Waste water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345 p.
4. Daniel D. Chiras 2010. Environmental Science. 1st Indian Edition, Jones and Bartlett India Pvt. Ltd. 4262/3, Ansar Road, Daryaganj, New Delhi.
5. Principle of Environment Science by Cunningham, W.P.
6. Essentials of Environment Science by Joseph.
7. Environment Pollution Control Engineering By Rao, C.S.
8. Perspectives in Environmental Studies by Kaushik, A.
9. Elements of Environment Science & Eng. By Meenakshi.
10. Elements of environment Eng. by Duggal.

SECOND SEMESTER

Course Title / Subject Name: General Clinical Microbiology

Course Code / Subject Code: BMLS211

Course Objectives:

1. To impart knowledge of historical discoveries in domain of Microbiology
2. To make students familiar with organization of cellular components and their functions

Course Outcomes:

1. Student will have thorough **knowledge** of microbial world and their importance.
2. Student will be able to **differentiate** application of antiseptic & disinfectants.
3. Graduate will be able to **analyze** bacterial growth on solid media as well in liquid media.
4. Students will be able to **categorize and collect** biomedical waste produced by healthcare center.
5. Student will be able to **determine** which culture media and culture conditions are better for growth of bacteria.
6. Students will be able to **assemble** log book for instrument and experiments in microbiology laboratory.

UNIT-1: Introduction to Medical Microbiology

Definition, History, Safety measures in Clinical Microbiology, Glassware used in Clinical Microbiology Laboratory: Introduction, Care and handling of glassware, Cleaning and sterilization of glassware, Equipment used in clinical Microbiology Laboratory, Care and maintenance including calibration

UNIT-2: Microscopy & Staining

Introduction and history, Types, principle and operation mechanism of Light microscope, Dark Field Microscopy, Fluorescent Microscopy, and Phase contrast Microscopy, Electron microscope: Transmission Electron Microscope (TEM) & Scanning Electron Microscope (SEM)

Significance of staining in bacteriology, Principle, Reagent preparation, procedures and interpretation of Simple staining, Negative staining, Gram stain, Albert's stain, Neisser's stain, Ziehl-Neelsen staining, Capsule staining, Flagella staining, Spore staining, Fontana stain for spirochetes

UNIT-3: Control of growth microorganisms

Physical Methods: Sunlight, Boiling, Pasteurization, Sterilization, Types and principles of sterilization methods, Heat (dry heat, moist heat with special reference to autoclave)

Chemical Methods: Chemical sterilization, Antiseptics and disinfectants: Definition, Types and properties, Mode of action of various antiseptics & disinfectants, Precautions while using the antiseptics & disinfectants

UNIT-4: General characteristics of Microbes: (Bacteria & fungi)

Classification of microbes with special reference to prokaryotes & eukaryotes, Morphological classification of bacteria, Bacterial anatomy (Detailed Bacterial cell structures), General nutritional & other requirements of the bacteria, Classification of bacteria on the basis of their nutritional requirements, Physical conditions required for growth. Normal growth cycle of bacteria (growth curve), Calculation of Number of cells.

UNIT-5: Culture & Culture Media

Introduction, Classification of culture media, solid media, liquid media, semisolid, synthetic, defined media, basal media, enriched media, 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. Instruments used to seed culture media, Culture procedures: seeding a plate (Streaking & Pour Plate techniques)

Suggested Readings:

1. Practical Medical Microbiology by Mackie and McCartney
2. Text book of Microbiology by Ananthanarayan
3. Medical Microbiology by Panikar & Satish Gupte
4. Medical laboratory Technology vol. I, II, III by Mukherjee
5. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Cheesbrough
6. Text book of Microbiology by Prescott

Course Title / Subject Names: Basic Hematology

Course Code / Subject Code: BMLS212

Course Objectives:

1. Students will be able to know the different components of blood and it's formation.
2. They will also come to know about the function of blood and diseases related to disorders of the blood.
3. They will also learn about the quality assurance in Hematology.

Course Outcomes:

1. Students will have **knowledge** about the importance of blood in our body and it's function.
2. The students will also learn about the different hematological tests performed in the clinical laboratory.
3. They will also **learn** about the importance of diet which will help in the formation of blood.
4. Students are able to **explain** the different hematological disorders.
5. Students are able to estimate the blood cell counting and interpret the results.
6. As they are also able to learn urine **analysis**, they are also able to learn clinical pathology tests related to renal disorders.
7. Students are able to **summarize** the importance of radioisotopes in diagnostic laboratory.

UNIT-1: General

Introduction to Hematology, Definition, Importance, Important equipment used Hematology, Laboratory organization and safety measures in Hematology Laboratory, Blood Pressure & its measurements

UNIT-2: Blood

Introduction to blood, its composition, function and normal cellular components, ESR, blood volume measurements. RBC, WBC & platelet counts, Functions of RBC, WBC and platelets. Basis of blood coagulation. **Anticoagulants:** types, mode of action and preference of anticoagulants for different hematological studies. Collection and preservation of blood sample for various hematological investigations

UNIT-3: Haemopoiesis/Hematopoiesis

Formation of cellular components of blood (Haemopoiesis), Erythropoiesis, Leucopoiesis, Thrombopoiesis, Hemoglobin: definition, types, structure, synthesis and degradation, Morphology of normal blood cells, Normal Hemostasis & physiological properties of coagulation factors, Radioactivity: definition, half-life, physical decay and units

UNIT-4: Quality Assurance

Quality assurance in Hematology, 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

Suggested Readings:

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

Course Title / Subject Names: General Human Anatomy

Course Code / Subject Code: BMLS213

Course Objectives:

1. To develop an understanding of the structure and function of organs and organ systems in normal human body.

Course Outcomes:

1. The student will have knowledge of anatomy of organ systems of the body based on the anatomical region.
2. They should be able to **identify** the macroscopic structures in different anatomical regions.
3. Students will able to **use** microscope to visualize structure of organ systems in relation to their functions.
4. Students will able to **differentiate** cell types of different organ systems.
5. They should be able to **understand** the disease like tuberculosis, asthma etc. by observing the medical imaging and co relate with other report (hematology and biochemistry etc.).
6. Students will able to **assemble** human skeleton.

UNIT-1: General

Tissues: Definitions, Types, characteristics, classification, location, functions and formation. Musculoskeletal system: Bones: types, structure, Axial & appendicular skeleton. Bone formation and growth, Joints – classification and structure. Types and structure of muscles. Movements at the joints and muscles producing movements.

UNIT-2: Nervous System

Structure of Neuroglia and neurons Parts and classification CNS: Structure of Brain and spinal cord and their functions. PNS: Cranial nerves and spinal nerves ANS: Sympathetic and Parasympathetic

UNIT-3: Cardiovascular, Respiratory & Digestive System

Circulatory system: Structure of the Heart, Structure of Blood Vessels - arterial and venous system. **Respiratory:** Parts, Nasal cavity and Paranasal air sinuses, trachea, Gross and microscopic structure of lungs, Diaphragm and Pleura.

Digestive System: Parts, & Structure of Tongue, Salivary glands, stomach, Intestines, Liver, Pancreas.

UNIT-4: Urinary System, Reproductive System

Urinary System: Parts, structure of Kidney, Ureters, Urinary Bladder and Urethra.

Reproductive System: Parts of the system. Gross structure of both male and female reproductive organs.

UNIT-5: Endocrine System & Special Senses

Endocrine System: Gross structure of Pituitary, Thyroid, Parathyroid, Pancreas, Adrenal glands.

Special Senses: Structure of Skin, Eye, Nose, Tongue (Auditory and Olfactory apparatus)

Suggested Readings:

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. Human Anatomy by Inderbir Singh
6. Ross & Wilson Anatomy & Physiology in Health & Illness by Waugh (A)
7. Text Book of Human histology by Inderbir Singh
8. Theory and Practice of Histological Techniques by Bancroft (JD)
9. Human Genetics by Gangane (SD)

Course Title / Subject Names: General Human Physiology

Course Code / Subject Code: BMLS214

Course Objectives:

1. To impart knowledge of Bodily Physiological Systems, how does it work as functional approaches accompanied by mechanism of actions of respective Physiological Systems.
2. To make students familiar with organization of Bodily Process, roles of each and every organ specific Organ system, along with constructive knowledge of Human Body

Course Outcomes:

1. Student will have acquired descriptive knowledge of Major Human Organs and to Explain their role in the maintenance of Healthy Individuals
2. Student will have interplay between **differentiates** organs Functions, how all tissues and Cells interact with each other as cell-cell Communications and Signaling.
3. Student will **understand** as learning outcome for maintenance of Biological Homeostasis as Equilibrium in variable Environment
4. Students will able to **integrate** the role of all organs as a single unit of all Organ systems by means of explanation.
5. Students will able to **evaluate** symptoms during organ infections or disorders.
6. Students will able to **assemble** organ system knowledge for understanding of organ system functions.

UNIT-1: Cells & Tissues

Structure and function of each cell organelles, Cell division: Mitosis & Meiosis, Definition, and Classification with structure and functions, Epithelial tissues, Connective tissues, Muscular tissues, Nervous tissues

UNIT-2: Digestive System

Organization; accessory organs; function (Mouth, Tongue, Teeth, Esophagus, Pharynx, Stomach, Intestine, Rectum, Anus); Digestive glands; physiology of digestion of carbohydrates, lipids & proteins

UNIT-3: Urinary & Reproduction System

Function of kidney, Structure of Nephron, measurement and regulation of GFR, mechanism of urine formation & excretion. Additional excretory system, Gametogenesis in male & female, Menstrual cycle, fertilization and formation of germ layers, pregnancy, parturition, lactation. Sex hormones. Basis of contraception.

UNIT-4: Cardio Vascular & Respiratory System

Physiology of heart, cardiac cycle, heart sounds, definitions of cardiac output, stroke volume, principles of measurements of cardiac output. ECG: methods of recording and ECG waves. Normal values of blood pressure, heart rate.

Principles of respiration, respiratory muscles, lung volumes and capacities, collection and composition of inspired alveolar and expired airs. Transport of oxygen and carbon dioxide.

UNIT-5: Nervous & Endocrine System

Structure of neuron, nerve impulse, myelinated and non-myelinated nerve. Neurotransmitters in transmission of nerve impulses. Various parts of nervous system, Parts and functions of brain, spinal cord, spinal & cranial nerves. EEG, functions of cerebellum, basal ganglia, thalamus & hypothalamus.

Names of endocrine glands, their locations & secretions, functions of various hormones, Brief account of endocrine disorders.

UNIT-6: Special Senses Organs

Vision: Structure of eyeball, retina, visual pathway, accommodation, visual acuity, error of refraction, color vision. **Hearing:** Brief account external, middle and inner ear, hearing tests.

Suggested Readings:

1. Textbook of Medical Physiology by G.K. Pal.
2. Review of Medical Physiology by Ganong
3. Samson Wrights Applied Physiology.
4. Text book of Medical Physiology by Guyton(AC)
5. Text book of Medical physiology by A.B. Das Mahapatra.

Course Title / Subject Names: General Clinical Microbiology (Practical)

Course Code / Subject Code: BMLS215

Course Objectives:

1. To impart knowledge of historical discoveries in domain of Microbiology
2. To make students familiar with organization of cellular components and their functions

Course Outcomes:

1. Student will have thorough **knowledge** of microbial world and their importance.
2. Student will able to **differentiate** application of antiseptic & disinfectants.
3. Graduate will able to **analyze** bacterial growth on solid media as well in liquid media.
4. Students will able to **categorize and collect** biomedical waste produced by healthcare center.
5. Student will able to **determine** which culture media and culture conditions are better for growth of bacteria.
6. Students will able to **assemble** log book for instrument and experiments in microbiology laboratory.

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. To demonstrate the different morphological types of bacteria
14. Preparation of one culture media from each type

Course Title / Subject Names: Basic Hematology (Practical)

Course Code / Subject Code: BMLS216

Course Objectives:

1. Students will be able to know the different components of blood and its formation.
2. They will also come to know about the function of blood and diseases related to disorders of the blood.
3. They will also learn about the quality assurance in Haematology.

Course Outcomes:

1. Students will have **knowledge** about the importance of blood in our body and its function.
2. The students will also learn about the different haematological tests performed in the clinical laboratory.
3. They will also **learn** about the importance of diet which will help in the formation of blood.
4. Students are able to **explain** the different hematological disorders.
5. Students are able to estimate the blood cell counting and interpret the results.
6. As they are also able to learn urine **analysis**, they are also able to learn clinical pathology tests related to renal disorders.
7. Students are able to **summarize** the importance of radioisotopes in diagnostic laboratory.

List of Practical:

1. Preparation of various anticoagulants
 - 1.1. EDTA (Ethylenediaminetetraacetic Acid)
 - 1.2. Sodium Citrate
 - 1.3. Oxalate with Fluoride
2. Collection of blood sample for various Lab Investigations
3. Demonstration of following Instruments used in Haematology Lab.
 - 3.1. Microscopes
 - 3.2. Haemocytometers
 - 3.3. Colorimeter
 - 3.4. Spectrophotometer
 - 3.5. Sahli's Apparatus
4. Identification of Normal blood cells from given blood samples
5. Analysis urine sample collected from clinical laboratory
 - 5.1. Routine biochemistry of Urine
 - 5.1.1. pH
 - 5.1.2. Specific Gravity
 - 5.1.3. Glucose
 - 5.1.4. Ketones
 - 5.1.5. Bilirubin
 - 5.1.6. Albumin
6. Perform Microscopic Examination of Urine from given samples

Course Title / Subject Names: General Human Anatomy (Practical)

Course Code / Subject Code: BMLS217

Course Objectives:

1. To develop an understanding of the structure and function of organs and organ systems in normal human body.

Course Outcomes:

1. The student will have **knowledge** of anatomy of organ systems of the body based on the anatomical region.
2. They should be able to **identify** the macroscopic structures in different anatomical regions.
3. Students will able to **use** microscope to visualize structure of organ systems in relation to their functions.
4. Students will able to **differentiate** cell types of different organ systems.
5. They should be able to **demonstrate** anatomical structure of human body/ parts.
6. Students will able to **assemble** human skeleton.

List of Practical:

1. Demonstration of human skeleton
2. Demonstration of parts of digestive system
3. Demonstration of parts of respiratory system
4. Demonstration of parts of excretory system
5. Demonstration of various parts of circulatory system (Demonstration from models)
6. Structure of eye and ear (demonstration from models)
7. Demonstration of structural differences between skeletal, smooth and cardiac muscles (permanent mounts)
8. Demonstration of various bones and joints
9. To study circulatory system from charts and transverse section (TS) of artery and vein from permanent slides.
10. To study digestive system from charts and TS of liver, spleen and pancreas from permanent slides.

Note: Demonstrations can be done with the help of models, charts and histological slides

Course Title / Subject Names: General Human Physiology (Practical)

Course Code / Subject Code: BMLS218

Course Objectives:

1. To impart knowledge of Bodily Physiological Systems, how does it work as functional approaches accompanied by mechanism of actions of respective Physiological Systems.
2. To make students familiar with organization of Bodily Process, roles of each and every organ specific Organ system, along with constructive knowledge of Human Body

Course Outcomes:

1. Student will have acquired descriptive knowledge of Major Human Organs and to Explain their role in the maintenance of Healthy Individuals
2. Student will have interplay between **differentiates** organs Functions, how all tissues and Cells interact with each other as cell-cell Communications and Signaling.
3. Student will **understand** as learning outcome for maintenance of Biological Homeostasis as Equilibrium in variable Environment
4. Students will able to **integrate** the role of all organs as a single unit of all Organ systems by means of explanation.
5. Students will able to **evaluate** symptoms during organ infections or disorders.
6. Students will able to **assemble** organ system knowledge for understanding of organ system functions.

List of Practical:

1. Demonstration of various types of tissues.
2. Demonstration of various parts of circulatory system (Demonstration from models)
3. Examination of blood film for various blood cells from stained slides
4. Estimation of blood cells with the help of hemocytometer.
5. Blood pressure estimation
6. Demonstration of reflex action (Video)
7. Identification of instruments used in study of cardio vascular system, respiratory system, nervous system and special senses. (Pictures & Videos)
8. Recording of heart sound and heart rate with stethoscope.

Note: Demonstrations can be done with the help of models, charts and histological slides

THIRD SEMESTER

Course Title / Subject Names: Systematic Bacteriology

Course Code / Subject Code: BMLS311

Course Objectives:

1. To acquire knowledge of different types of bacterial culture procedures, staining procedures and tests used for identification of bacteria.
2. To make students familiar with morphology, biochemical cultural characteristics, & laboratory diagnosis of various bacteria.

Course Outcomes:

1. Student will have **gain knowledge** of microbial culture media, culture procedures and properties of pathogenic bacteria.
2. Student will learn **classification** of different type of staining techniques for microbe's visualization.
3. Students will able to **differentiate** microbes specially bacteria on the basis of biochemical properties of bacteria.
4. Learn to **explain** Microbial growth and nutrition, pathogenesis, and laboratory diagnosis of pathogenic bacteria.
5. Student will able to **evaluate** pathogenicity of different bacteria as well as different microbes.
6. Student able to **design** efficient workflow for characterization of pathogenic bacteria or microbes.

UNIT-1: Biochemical Tests/Assays

Principle, procedures and interpretation of the biochemical tests: Catalase, Coagulase, Indole, Methyl Red & Voges-Proskauer (MR-VP), Urease, Citrate, Oxidase, TSIA, Nitrate reduction, Carbohydrate fermentation, Huger and Leifson, Bile solubility, H₂S production, Demonstration of motility, Decarboxylases, CAMP, Hippurate hydrolysis, Nagler's reaction, Cholera-red reaction

UNIT-2: Gram-Positive Bacteria

Introduction, Classification, Various characteristics (morphological, cultural and biochemical), pathogenesis and laboratory diagnosis of the following bacteria

Staphylococcus, *Streptococcus*, *Pneumococcus*, *Corynebacterium*, *Actinomyces*, Clostridia of wound infection, *Clostridium perfringens* & *Clostridium botulinum*

UNIT-3: Gram-Negative Bacteria

Neisseria gonorrhea, *Neisseria meningitis*, *Haemophilis*, *Vibrio*, *Aeromonas* and *Plesiomonas*, *Bordetella* and *Brucella*, *Rickettsia*, *Pseudomonas*, *Burkholderia*

UNIT-4: Enterobacteriaceae

Escherichia coli, *Klebsiella*, *Citrobacter*, *Enterobacter*, *Proteus*, *Salmonella*, *Shigella*, *Yersinia enterocolitica* and *Yersinia pestis*

UNIT-5: Mycobacteria & Other Bacteria with Unusual Growth Requirements

Mycobacterium tuberculosis complex, Atypical *Mycobacteria* and *M. leprae*, **Spirochetes:** *Treponema*, *Borrellia* and *leptospira* **Bacteria without Cell wall:** *Mycoplasma* and *Ureaplasma*

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Paniker & Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee

Course Title / Subject Names: Basics of Hematological Diseases

Course Code / Subject Code: BMLS312

Course Objectives:

1. The students will be made aware of various diseases like anemia, quantitative disorders of Leucocytes, morphological alterations in blood cells, bleeding disorders.
2. The subject gives knowledge about genetic basis of hematological disease including bleeding disorder.

Course Outcomes:

1. Students will have knowledge that enable to **explain** blood related disease.
2. Students will able to **classify** different type of blood related disease or genetic basis of hematological disorder.
3. They will **carry out** different tests those diagnose hematological disease.
4. Students will able to **differentiate** among hematological disease on the basis of its causative base.
5. Student will able to **evaluate** different type hematological diagnosis method that used in healthcare systems.
6. Students able to **design or create** modified diagnosis method that is better than available test.

UNIT-1: Hemoglobin

Structure and Function, Oxygen Binding Capacity, Genetic Inheritance of Hemoglobin, Mechanism of Hemoglobin Synthesis in RBC, Iron transport, uptake, and supply. Protoporphyrin IX (heme) formation, adult hemoglobin, Hemoglobin quantification.

UNIT-2: Blood Cells Disorders

Quantitative disorders of Leukocytes Cause and significance, Granulocytic and Monocytic Disorders, Lymphocytic Disorders. Morphologic Alterations in Neutrophils, Toxic granulation, Cytoplasmic vacuoles, Döhle bodies, May-Hegglin anomaly, Alder-Reilly anomaly, Pelger-Huët anomaly, Chédiak-Higashi syndrome

UNIT-3: Bleeding disorders

Introduction, Types & Causes of bleeding disorders, Vascular defect, Platelet defect, Factor deficiency, Inhibitors, Hyper fibrinolysis, Types of bleeding disorders, Inherited bleeding disorders, Acquired bleeding disorders. Laboratory diagnosis of bleeding disorders with special emphasize to Hemophilia A, B & Von-Willebrand disease. Disseminated intravascular coagulation (DIC), Platelet disorder (Qualitative and quantitative)

UNIT-4: Thrombosis

Introduction, Causes of thrombosis, Monitoring of Anticoagulants, Oral anticoagulants by INR, Heparin. BT, CT, PT, Platelet count, Fibrinogen Assay. Laboratory approach for investigating thrombosis.

Suggested Readings:

1. Textbook of Medical Laboratory Technology by Praful B. Godkar
2. Medical Laboratory Technology by K L Mukherjee Volume-I
3. Practical Hematology by J.B. Dacie
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Hematology by G.A. McDonald
6. De Gruy's clinical Hematology in medical practice
7. Wintrobe's Clinical Hematology– 2013 by John P. Greer, Daniel A. Arber, Bertil E. Glader, Alan F. List

Course Title / Subject Names: Basic Clinical Biochemistry & Metabolism

Course Code / Subject Code: BMLS313

Course Objectives:

1. To acquire the knowledge about various metabolic pathways occurring in human.
2. To learn about the nucleic acids and action of various enzyme present in the cells.

Course Outcomes:

1. Students will have thorough **knowledge** of deficiency diseases related to biomolecules.
2. Students will able to **understand** the various metabolism pathways and disorders of our body.
3. Students will able to **apply** their knowledge towards correlating disorder to biological molecules and it's functional.
4. Students will able to **differentiate** structure function mechanism of action and disorder of various enzymes in human body.
5. Students will be able to **select** appropriate tools for diagnosis of enzymes deficiencies and role of enzymes and vitamins.
6. Students will able to **assemble** all metabolic pathway towards understanding of biochemical disorders.

UNIT-1: General

Distilled water: Method of preparation of distilled water, Storage of distilled water, **Volumetric analysis:** Normality Molarity Molality, Preparations of Standard solutions. **Concept of pH:** Definition, Henderson Hassel batch equation, pKa value, Methods of measurement of pH: pH paper, pH meter: Principle, working, maintenance and calibration of pH meter, **Osmosis:** Definition, Types of osmosis, Factors affecting osmotic pressure: Vant Hoff's equation, Applications of osmosis: Dialysis

UNIT-2: Carbohydrate

Structure & classification of carbohydrates (monosaccharide's, disaccharides and polysaccharides, starch, glycogen and cellulose). Structure, properties and importance storage polysaccharides (glycogen). Digestion and Absorption of carbohydrates. Metabolism: Glycolysis, Citric acid cycle, Gluconeogenesis, Glycogenolysis, Glycogenesis, Disorders of carbohydrate metabolism. Glycogen storage disease, G6PD deficiency, Pyruvate kinase deficiency & Galactosemia

UNIT-3: Amino Acids & Protein

Classification, structure and properties of amino acids. Peptide bond, Introduction, Importance and classification proteins. Primary, secondary, tertiary and quaternary structure of proteins. Important properties of proteins, Digestion & absorption of Proteins, Metabolism of proteins, Disorders of protein metabolism and Urea Cycle: Phenylketonuria, Alkaptonuria, Maple Syrup Urine Disease, Biologically Active Peptide

UNIT-4: Lipids

Building blocks of lipids - fatty acids, glycerol. Storage lipids – triacylglycerol. Classification Lipids. Digestion & absorption of fats/ Lipids, Lipoproteins, Fatty acid biosynthesis & fatty acid oxidation of odd and even number of fatty acids, LDL, HDL, VLDL. Role of LDL in atherosclerosis & Hyperlipoproteinemia

UNIT-5: Enzymes

Introduction, Importance & Classifications, Properties of enzymes, Mechanism of enzyme action, Factors affecting enzyme action, Enzyme inhibitions, Coenzymes and Cofactors, Activation energy, Allosteric enzymes, Regulatory enzyme, Ribozyme, Zymogen. Therapeutic uses of enzymes.

Suggested Readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

Course Title / Subject Names: Fundamentals of Histology

Course Code / Subject Code: BMLS314

Course Objectives:

1. Students will study about structure and function of various organ system of human.
2. Student will study diseases associated with different body organs and systems.

Course Outcomes:

1. Students will **explain** organ systems and **identify** the cells and tissue of human organ systems.
2. Students will **classify** human organ system on the basis of their function.
3. Students will use **modern techniques** to diagnosis when organ system related issues arises.
4. Students will **integrate** their knowledge to differentiate the working principle of organ systems.
5. Students will have knowledge to **evaluate** working capacity of different organs.

UNIT-1: Alimentary System & Digestive System

Alimentary System: Diseases of mouth, Diseases of Esophagus- Esophageal varices. **Digestive System:** Gastritis, Peptic ulceration, Appendicitis microbial diseases, food poisoning, hernia, Intestinal obstructions & mal absorption. Accessory Digestive glands: Salivary glands- mumps. Liver – hepatitis, liver failure, cirrhosis. Pancreas- pancreatitis. Gall Bladder- Gall stones, jaundice and cardiovascular diseases.

UNIT-2: Circulatory System & Respiratory System

Circulatory System: Diseases of Blood vessels- Atheroma, Arteriosclerosis, heart block. Disorders of Blood Pressure-Hyper & Hypotension.

Respiratory System: Upper respiratory tract infection, Bronchi, Asthma, Pneumonia, Lung abscess, Tuberculosis, Lung Collapse.

UNIT: 3 Urinary System & Reproductive system

Urinary System: Glomerulonephritis, Nephrotic syndrome, renal failure, renal calculi, Urinary obstruction, Urinary tract infection.

Reproductive system: Sexually transmitted diseases, Pelvic inflammatory disease, disorder of cervix (CIN), Disease of ovaries, ectopic pregnancy, prostatitis, Infertility

UNIT: 4 Nervous, Endocrine System & Sense Organs

Nervous System: Neuronal damage, ICP, Cerebral Infarction, head injury, Alzheimer's disease, dementia.

Endocrine System: Pituitary: Hyper & Hypo secretions, Thyroid: Goiter, Adrenal: Cushing Syndrome, Addison Disease, Pancreas: Diabetes

Sense Organs: Ear: Otitis & Eye: Cataract

Suggested Readings:

1. Anatomy & Physiology – Ross and Wilson
2. Human Anatomy and Physiology by Pearce
3. Di Fiore's Atlas of Histology
4. Medical Laboratory Technology by KL Mukherjee-Volume III
5. Text book of Pathology by Robbins

Course Title / Subject Names: Systematic Bacteriology (Practical)

Course Code / Subject Code: BMLS315

Course Objectives:

1. To acquire knowledge of different types of bacterial culture procedures, staining procedures and tests used for identification of bacteria.
2. To make students familiar with morphology, biochemical cultural characteristics, & laboratory diagnosis of various bacteria.

Course Outcomes:

1. Student will have **gain knowledge** of microbial culture media, culture procedures and properties of pathogenic bacteria.
2. Student will learn **classification** of different type of staining techniques for microbe's visualization.
3. Students will able to **differentiate** microbes specially bacteria on the basis of biochemical properties of bacteria.
4. Learn to **explain** Microbial growth and nutrition, pathogenesis, and laboratory diagnosis of pathogenic bacteria.
5. Student will able to **evaluate** pathogenicity of different bacteria as well as different microbes.
6. Student able to **design** efficient workflow for characterization of pathogenic bacteria or microbes.

List of Practical:

1. To demonstrate the instruments used to seed culture media
2. To isolate specific bacteria from a mixture of organisms.
3. To demonstrate simple staining (Methylene blue)
4. To prepare India ink preparation to demonstrate negative staining.
5. Perform Gram's staining of given bacterial sample/ culture. (Procedure, Observation & Interpretation)
6. Perform Albert staining of given bacterial sample/ culture
7. Perform Neisser's staining of given bacterial sample/ culture
8. Perform Z-N staining of given bacterial sample/ culture
9. Perform Capsule staining of given bacterial sample/ culture
10. Perform Spore staining of given bacterial sample/ culture
11. To demonstrate spirochetes by Fontana staining procedure
12. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria.
 - 12.1. Catalase
 - 12.2. Coagulase
 - 12.3. Indole
 - 12.4. Methyl Red (MR)
 - 12.5. Voges Proskauer (VP)
 - 12.6. Urease
 - 12.7. Citrate
 - 12.8. Oxidase

- 12.9. TSIA
- 12.10. Nitrate reduction
- 12.11. Carbohydrate fermentation
- 12.12. Huger and Leifson
- 12.13. Bile solubility
- 12.14. H₂S production
- 12.15. Demonstration and motility
- 12.16. Decarboxylases
- 12.17. CAMP
- 12.18. Hippurate hydrolysis
- 12.19. Nagler's reaction
- 13. To demonstrate various characteristics (morphological, cultural and biochemical) of bacteria commonly isolated from clinical samples i.e.
 - 13.1. *Staphylococcus*
 - 13.2. *Streptococcus*
 - 13.3. *Corynebacterium*
 - 13.4. *Escherichia coli*
 - 13.5. *Klebsiella*
 - 13.6. *Enterobacter*
 - 13.7. *Salmonella*
 - 13.8. *Shigella*

Course Title / Subject Names: Basics of Hematological Diseases (Practical)

Course Code / Subject Code: BMLS316

Course Objectives:

1. The students will be made aware of various diseases like anemia, quantitative disorders of Leucocytes, morphological alterations in blood cells, bleeding disorders.
2. The subject gives knowledge about genetic basis of hematological disease including bleeding disorder.

Course Outcomes:

1. Students will have knowledge that enable to **explain** blood related disease.
2. Students will able to **classify** different type of blood related disease or genetic basis of hematological disorder.
3. They will **carry out** different tests those diagnose hematological disease.
4. Students will able to **differentiate** among hematological disease on the basis of its causative base.
5. Student will able to **evaluate** different type hematological diagnosis method that used in healthcare systems.
6. Students able to **design or create** modified diagnosis method that is better than available test.

List of Practical:

1. Preparation of various anticoagulants

2. Collection of venous and capillary blood
3. Preparation of the stains/ staining solutions and other reagents
4. Preparation of peripheral blood film (PBF)
5. Perform staining of PBF
6. Estimate hemoglobin from given blood sample (Methods: Sahli's, Oxyhaemoglobin, and cyanmethaemoglobin)
7. Estimate differential leukocyte count from given blood sample (DLC)
8. Recognition and staining of various types of blood cells (normal and abnormal)
9. Preparation of thick and thin blood smear for malarial parasite (Leishman/Giemsa/JSB)
10. Perform RBC & WBC counting of given blood sample
11. Perform Platelet counting of given blood sample
12. Perform routine Examination of urine sample

Course Title / Subject Names: Basic Clinical Biochemistry & Metabolism (Practical)

Course Code / Subject Code: BMLS317

Course Objectives:

1. To acquire the knowledge about various metabolic pathways occurring in human.
2. To learn about the nucleic acids and action of various enzyme present in the cells.

Course Outcomes:

1. Students will have thorough **knowledge** of deficiency diseases related to biomolecules.
2. Students will be able to **understand** the various metabolism pathways and disorders of our body.
3. Students will be able to **apply** their knowledge towards correlating disorder to biological molecules and its functional.
4. Students will be able to **differentiate** structure function mechanism of action and disorder of various enzymes in human body.
5. Students will be able to **select** appropriate tools for diagnosis of enzymes deficiencies and role of enzymes and vitamins.
6. Students will be able to **assemble** all metabolic pathway towards understanding of biochemical disorders.

List of Practical:

1. Cleaning of the laboratory glass ware (Volumetric and non-volumetric)
2. Preparation of distilled water
3. 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 H_2SO_4
7. To prepare 0.2 Molar Sodium carbonate solution.
8. Demonstration of osmosis and dialysis.
9. To determine the presence of carbohydrates by Molisch test.
10. To determine the presence of reducing sugar by Fehling solutions

11. To determine the presence of reducing sugar by Benedicts method.
12. To determine starch by Iodine test.
13. Determination of Glucose in serum & plasma by GOD-POD method
14. Estimates of blood Glucose by Bertholet method / Urease GLDI
15. Determination of Urea in serum, plasma & urine by Jaffe's method
16. Determination of Creatinine in serum or plasma
17. Determination of serum Albumin by BCG method
18. Determination of Cholesterol in serum or plasma by CHOD-POD method

Course Title / Subject Names: Fundamentals of Histology (Practical)

Course Code / Subject Code: BMLS318

Course Objectives:

1. Students will study about structure and function of various organ system of human.
2. Student will study diseases associated with different body organs and systems.

Course Outcomes:

1. Students will **explain** organ systems and **identify** the cells and tissue of human organ systems.
2. Students will **classify** human organ system on the basis of their function.
3. Students will use **modern techniques** to diagnosis when organ system related issues arise.
4. Students will **integrate** their knowledge to differentiate the working principle of organ systems.
5. Students will have knowledge to **evaluate** working capacity of different organs.
6. Students will have knowledge to **design efficient** project work flow related to our organ systems.

List of Practical:

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 microscopes 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

FOURTH SEMESTER

Course Title / Subject Names: Applied Clinical Bacteriology

Course Code / Subject Code: BMLS411

Course Objectives:

1. This course will cover the laboratory strategy in the diagnosis of various infective syndromes.
2. This will also cover bacteriological examination of water, milk, food, air, I/V fluids and nosocomial infections.
3. Further it will make the candidate familiar to epidemiology, epidemiological markers and preservation of microbes.

Course Outcomes:

1. Student will have **gain knowledge** about organ specific infections and their diagnosis.
2. Student will **understand** mechanism of action of different antibiotic, and antibiotic susceptibility testing.
3. Student **carry out** different diagnosis method such as AST, nucleic amplification (NAAT) tests such as PCR & RT-PCR.
4. Graduates will able to **analyze** specimen and samples for choice of diagnosis methods for different disease
5. Student will able to **evaluate** efficacy of different type of diagnosis methods available for a disease.
6. Graduates will able to **create and assemble** series of experiment that help in diagnosis of disease.

UNIT 1: Diagnosis by Organ System

Samples of choice, collection, transportation and processing of samples for laboratory diagnosis of the following:

Septicemia and bacteremia, Upper Respiratory tract infections, Lower respiratory tract infections, Urinary tract infections, Genital Tract infections, Meningitis, Gastro intestinal infections, Enteric fever, Tuberculosis (Pulmonary and Extra-pulmonary), Wound, skin, and deep sepsis, Pyrexia of unknown origin

UNIT-2: Antibiotic susceptibility Testing & Molecular Diagnosis techniques

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

Molecular Diagnosis techniques: Basics of Nucleic acid techniques in diagnostic microbiology with special reference to Polymerase chain reaction (PCR & RT-PCR). Automation in bacterial culture detection special reference to 16S RNA gene sequencing.

UNIT-3: Bacteriological Examination

Water: Collection and transportation of water sample, Presumptive coliform count, Eijkman test, Indicators of fecal contamination, Membrane filtration tests, Interpretation of results

Milk: Basic Concepts regarding gradation of milk, various tests for Bacteriological examination of milk

Food articles: Frozen food, canned food, raw food, cooked food. Various tests for Bacteriological examination with special reference to food poisoning bacteria

Air: Significance of air bacteriology in healthcare facilities, Settle plate method, Types of air sampling instruments, Collection processing and reporting of an air sample

Sterility testing of I/v fluids: Collection, transportation and processing of I/V fluids for bacterial contamination, Recording the result and interpretation

UNIT-4:

Nosocomial Infection: Introduction, sources and types of nosocomial infections. Surveillance of hospital environment for microbial load. Role of microbiology laboratory in control of nosocomial infections

Preservation of microbes: Why do we need to preserve bacteria? Basic concepts of preservation of microbes, Principle and procedures of various short term and long-term preservation methods with special reference to Lyophilization.

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Paniker & Satish Gupte
4. Medical laboratory Technology Vol. I ,II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Chees brough
6. Hospital Acquired Infections-Power strategies for clinical practice by Dr. V Muralidhar and Sumathi Murlidhar
7. Control of Hospital infection-A practical Handbook by GajAyliffe, A.P. Fraise, A.M. Geddes, K. Mitchell

Course Title / Subject Names: Applied Hematology-I

Course Code / Subject Code: BMLS 412

Course Objectives:

1. Students will be made aware of the methods of estimating different components of blood.
2. They will be able to learn the basic concepts of staining and coagulation in Hematology laboratory.
3. They will also learn about macroscopic and microscopic examination of different body fluids.

Course Outcomes:

1. Students will be able to **gain knowledge** about blood and immune cells disorders, including changes in their shapes.
2. Graduates will be able to **classify** cells of our body according to different basis.
3. Students will **carry out** different staining methods that will help to diagnosis blood cells disorder.
4. Graduates will **differentiate** blood cells disorder in respect of RBC and WBC.
5. Students will be able to **evaluate** different types of malignancy associated with blood disorder and their diagnosis.
6. Students will **design** work flow for diagnosis some of the acute and chronic diseases for accurate diagnosis.

UNIT-1:

Haemoglobinometry: Different methods to measure Hemoglobin with merits and demerits. Haemocytometry: Introduction, Principle, Reagent preparation, procedure, errors involved and means to minimize errors. RBC Count, Total leucocytes count (TLC), Platelet Count. Absolute Eosinophil count

UNIT-2

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 (PCV) /Hematocrit value, Preparation of blood films, Types, Methods of preparation (Thick and thin smear/film) and utility

UNIT-3

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.

UNIT-4

Differential leucocytes count (DLC), Normal and absolute values in Hematology, Physiological variations in Hb, PCV, TLC and Platelets

Sample collection, transportation, Preservation, Physical Examination, Biochemical Examination & Microscopic examination of Seminal fluid, CSF, Pleural, Peritoneal and Synovial fluid etc.

Suggested Readings:

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
4. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henry
5. Atlas of Haematology by G.A. Mc Donald
6. De Gruchy's Clinical Haematology in medical practice

Course Title / Subject Names: Analytical Clinical Biochemistry

Course Code / Subject Code: BMLS413

Course Objectives:

1. The students will learn basic principles/mechanisms, procedures and various types of spectrophotometry.
2. Students also learn the principle and procedure of various types of chromatography and electrophoresis techniques.

Course Outcomes:

1. Students will have **knowledge** to separation of biomolecules.
2. Students will able to **understand** about nucleic acids and protein separation with the help of electrophoresis.
3. Student will able to **apply or perform** photometric biochemical tests with the help of spectrophotometer and colorimeters.
4. Students will able to **explain** different methods separate small biomolecules with the help of chromatography.
5. Students will able to **evaluate** operating mechanism of spectrophotometer and colorimeters.
6. Students will able to **assemble** DNA & protein electrophoretic unit and flame photometer.

UNIT-1: Colorimetry, Spectrophotometry and Photometry

Introduction, Theory of spectrophotometry and Colorimetry, Lambert's law and Beer's law, Applications of Colorimetry and spectrophotometry. Photometry, Introduction, General principles of flame photometry, Limitations of flame photometry, Instrumentation, Applications of flame photometry, Atomic Absorption Spectroscopy (AAS) – Principle & applications. Tandem & Mass Spectroscopy (MALDI-TOF): Principle & Application

UNIT-2: Chromatography

History, 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. *Gas chromatography*: Introduction principle, instrumentation, application. *Column chromatography*: Introduction, principle column efficiency, application of column chromatography.

UNIT-3: High Performance Liquid Chromatography (HPLC)

Affinity chromatography: Introduction, principle, efficiency, application of affinity chromatography. *Ion exchange chromatography*: Introduction, Definition and principle, cation and anion exchangers, application. *Gel filtration Chromatography*: Introduction Principle and method, application and advantages

UNIT-4: Electrophoresis

Introduction, Principle, Instrumentation, Applications, Types of electrophoresis, Paper electrophoresis, Gel electrophoresis- Agarose, SDS-PAGE, Serum Protein Electrophoresis: Procedure & its Clinical Significance. Principle and applications of centrifugation, differential centrifugation, density gradient centrifugation, and ultracentrifugation.

Suggested Readings:

1. Practical Clinical Biochemistry by Harold Varley
2. Text book of Medical Laboratory Technology by P. B. Godker
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chatterjee, Shinde
7. Principal of Biochemistry by Lehninger
8. Biochemistry by Voet & Voet
9. Biochemistry by Stryer

Course Title / Subject Names: Applied Histopathology-I

Course Code / Subject Code: BMLS414

Course Objectives:

1. In this course, students will be made aware of terminology used in histotechnology, various instruments and their maintenance.
2. Students also learn the processing of various samples for histopathological samples towards investigations.

Course Outcomes:

1. Students will able to **describe** care laboratory and safety measures.
2. Students will able to **collect, carry out** and process the histological samples.
3. Students will able to **classify** histological samples on the basis of its processing and handling.
4. Graduates will able to handle **modern equipment** to perform fixation, decalcification, embedding and section cutting.
5. Graduates have knowledge to **determine** efficiency of histological instrument which are using in laboratory.
6. Students also enable to **design** histological protocol and **generate** diagnosis report.

UNIT-1: Collection & Fixation

Histotechnology, Care and maintenance of laboratory equipment used in histotechnology, Safety measures in a histopathology laboratory, Basic concepts about routine methods of examination of tissues. Collection and transportation of specimens for histological examination, 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

UNIT-2: Decalcification & Processing

Criteria of a good decalcification agent, Technique of decalcification followed with selection of tissue, fixation, and decalcification, neutralization of acid and thorough washing. Various types of decalcifying fluids: Organic & Inorganic Acid, chelating agents, Processing of various tissues for histological examination, Procedure followed by Dehydration, Clearing, Infiltration. Components & principles of various types of automatic tissue, Processors

UNIT-3 Embedding & Section Cutting

Definition, Various types of embedding media. Section Cutting: Introduction regarding equipment used for sectioning. Microtome Knives, Sharpening of Microtome Knives, Honing, Stropping, various types of microtome and their applications. Freezing Microtome and various types of Cryostats. Faults in paraffin section cutting with reason and remedy, spreading the sections and attachment or mounting of sections to glass slides.

UNIT-4 Staining, Impregnation and Mountants

Classifications of Stains & Dyes, Uses of Stains and Dyes. Chemical Staining Action, Mordants and Accentuators, Metachromasia, 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, Labeling and Cataloguing the Slides. ***Routine Staining Procedures:*** Haematoxylin and Eosin Staining, various types of Haematoxylins, Mallory's Phosphotungstic Acid Haematoxylin (PTAH)

Suggested Readings:

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

BMLS-415: Applied Clinical Bacteriology (Practical)

Code / Subject Code: BMLS415

Course Objectives:

1. This course will cover the laboratory strategy in the diagnosis of various infective syndromes.
2. This will also cover bacteriological examination of water, milk, food, air, I/V fluids and nosocomial infections.
3. Further it will make the candidate familiar to epidemiology, epidemiological markers and preservation of microbes.

Course Outcomes:

1. Student will have **gain knowledge** about organ specific infections and their diagnosis.
2. Student will **understand** mechanism of action of different antibiotic, and antibiotic susceptibility testing.
3. Student **carry out** different diagnosis method such as AST, nucleic amplification (NAAT) tests such as PCR & RT-PCR.
4. Graduates will able to **analyze** specimen and samples for choice of diagnosis methods for different disease.
5. Student will able to **evaluate** efficacy of different type of diagnosis methods available for a disease.
6. Graduates will able to **create and assemble** series of experiment that help in diagnosis of disease.

List of Practical:

1. Inoculation of bacteria into different culture media
2. Isolation of pure cultures from given bacterial culture plate
3. Processing of following clinical samples for culture and identification of bacterial pathogens:
 - 3.1. Blood
 - 3.2. Throat swab
 - 3.3. Sputum
 - 3.4. Pus
 - 3.5. Urine
 - 3.6. Stool
 - 3.7. C.S.F. and other body fluids
4. Demonstration of Polymerase Chain Reaction (PCR)
5. Perform antimicrobial susceptibility testing of given chemical compound/ plant extract
6. Perform antibiotic susceptibility test of given bacterial culture / isolated bacteria
7. Perform preparation and standardization of inoculum for AST
8. To determine MIC and MBC of known bacteria against a known antibiotic
9. To perform antibiotic susceptibility testing of clinical isolates by using Stokes method & Kirby-Bauer method
10. Perform collection, transportation and processing of following articles for bacteriological examination: Water, Milk, Food and Air

Course Title / Subject Names: Applied Hematology-I (Practical)

Course Code / Subject Code: BMLS416

Course Objectives:

1. Students will be made aware of the methods of estimating different components of blood.
2. They will be able to learn the basic concepts of staining and coagulation in Hematology laboratory.
3. They will also learn about macroscopic and microscopic examination of different body fluids.

Course Outcomes:

1. Students will be able to **gain knowledge** about blood and immune cells disorders, including changes in their shapes.
2. Graduates will be able to **classify** cells of our body according to different basis.
3. Students will **carry out** different staining methods that will help to diagnosis blood cells disorder.
4. Graduates will **differentiate** blood cells disorder in respect of RBC and WBC.
5. Students will be able to **evaluate** different types of malignancy associated with blood disorder and their diagnosis.
6. Students will **design** work flow for diagnosis some of the acute and chronic diseases for accurate diagnosis.

List of Practical:

1. Estimation Hb from following methods
 - 1.1. Sahli's method
 - 1.2. Cyanmetha haemoglobin method
 - 1.3. Oxyhaemoglobin method
2. Perform Total leukocyte count from given blood sample
3. Perform platelets count from given blood sample
4. Perform absolute Eosinophil count from given blood sample
5. Preparation of blood smear and staining with Giemsa and Leishman stain.
6. Estimate ESR (Wintrobe and Westergren method) of given blood sample
7. Estimate Packed cell volume (Macro & Micro)
8. Perform cytological examination of CSF and other body fluids
9. Perform Physical and Microscopic examination of seminal fluid including sperm count
10. Perform normal DLC
11. Perform BT, CT, Hess test, PT and APTT

Course Title / Subject Names: Analytical Clinical Biochemistry (Practical)

Course Code / Subject Code: BMLS417

Course Objectives:

1. The students will learn basic principles/mechanisms, procedures and various types of spectrophotometry.
2. Students also learn the principle and procedure of various types of chromatography and electrophoresis techniques.

Course Outcomes:

1. Students will have **knowledge** to separation of biomolecules.
2. Students will able to **understand** about nucleic acids and protein separation with the help of electrophoresis.
3. Student will able to **apply or perform** photometric biochemical tests with the help of spectrophotometer and colorimeters.
4. Students will able to **explain** different methods separate small biomolecules with the help of chromatography.
5. Students will able to **evaluate** operating mechanism of spectrophotometer and colorimeters.
6. Students will able to **assemble** DNA & protein electrophoretic unit and flame photometer.

List of Practical:

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. Perform paper chromatography of mixture of amino acids
5. Perform circular paper chromatography with amino acid mixtures.
6. To demonstrate the principle & procedure of Gas chromatography.
7. Perform TLC of mixture of amino acids/ serum/ biomolecules
8. To demonstrate the principle & procedure of column chromatography.
9. To demonstration of Hb Electrophoresis.
10. Perform electrophoresis for serum protein separation and quantification

Course Title / Subject Names: Applied Histopathology-I (Practical)

Course Code / Subject Code: BMLS418

Course Objectives:

1. In this course, students will be made aware of terminology used in histotechnology, various instruments and their maintenance.
2. Students also learn the processing of various samples for histopathological samples towards investigations.

Course Outcomes:

1. Students will able to **describe** care laboratory and safety measures.
2. Students will able to **collect, carry out** and process the histological samples.
3. Students will able to **classify** histological samples on the basis of its processing and handling.
4. Graduates will able to handle **modern equipment** to perform fixation, decalcification, embedding and section cutting.
7. Graduates have knowledge to **determine** efficiency of histological instrument which are using in laboratory.
8. Students also enable to **design** histological protocol and **generate** diagnosis report.

List of Practical:

1. Demonstration of instruments used for dissection
2. Perform labeling of histological specimens collected in histology laboratory
3. Preparation of various fixatives
 - 3.1. Helly's fluid
 - 3.2. Zenker's fluid
 - 3.3. Bouin's fluid
 - 3.4. Corney's fluid
 - 3.5. 10% Neutral formalin
 - 3.6. Formal saline
 - 3.7. Formal acetic acid
 - 3.8. Pereyn's fluid
4. Estimate melting point of paraffin wax used in histopathology laboratory
5. Perform embedding of given tissue in paraffin block
6. To perform section cutting of previously embedded tissue in paraffin block
7. Perform attachment of tissue sections to glass slides
8. To process a bone for decalcification
9. To prepare ascending and descending grades of alcohol from absolute alcohol
10. Processing of tissue by manual and automated processor method
11. To demonstrate various part and types of microtome
12. To learn sharpening of microtome knife (Honing and stropping technique), and types of disposable blades in use (High and Low Profile).
13. To learn using tissue floatation bath and drying of sections in oven (60°-65°C)
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

FIFTH SEMESTER

Course Title / Subject Names: Immunology and Bacterial Serology

Course Code / Subject Code: BMLS511

Course Objectives:

1. This course will cover basic aspects of immunity, antigens, antibodies, immune response and hypersensitive reactions.
2. This will also cover various serological reactions, techniques and their utility in laboratory diagnosis of human diseases.

Course Outcomes:

1. Student will have **knowledge** about human immune system and immunity.
2. Student will be able to **classify** different type of immune response during infections and disease.
3. Graduate will **perform** various serological tests in which detection of antigen and antibody interactions.
4. Graduates will be able to **differentiate** between antigen & antibody detection methods based on ELISA, also **differentiate** between immune disorder, genetic disorder and normal disease.
5. Graduates will **evaluate** the sensitivity of antigen and antibody detection kits, schedule vaccination and convince the patient of human to getting vaccination.
6. Students will be able to **assemble** different ELISA methods for serological detection.

UNIT-1: Introduction to Immunology

History, Overview of the Immune System, Immunity, Innate immunity: Anatomical barriers to infections, Phagocytosis, Inflammatory response, Natural Killer Cells, Acquired immunity: Basic concepts about their mechanisms, Cells of immune systems: T-Lymphocytes & B-Lymphocytes, Organ of immune system: Primary Lymphoid Organs, Secondary Lymphoid Organs

UNIT-2: Antigen & Antibody

Definition, types of antigens and determinants of antigenicity (Properties of antigens), Immunogenicity Versus Antigenicity, Factors that Influence Immunogenicity, Epitopes, Haptens, Definition, Types, Basic Structure of Antibodies, Properties of Antibodies (Immunoglobulins), Immunoglobulin Fine Structure, Opsonization

UNIT-3: Serology

Antigen-Antibody reactions: Definition, Classification, General features and mechanisms, Strength of Antigen-Antibody Interactions, Cross-Reactivity, Precipitation Reactions, Agglutination Reactions, Radioimmunoassay, Enzyme-Linked Immunosorbent Assay (ELISA), Immunofluorescence. Principle, procedure and interpretation of various serological tests: Widal, VDRL, ASO, CRP, Brucella tube agglutination, Automation in diagnostic serology

UNIT-4: Immune response

Introduction, Basic concepts of Humoral and Cellular immune responses, Complement system: Definition, Basic concepts about its components, Complement activation pathways (Types), Hypersensitivity: Definition, Types of hypersensitivity reactions, Type-I, II, III, & IV, Vaccines: Definition, Types, Vaccination schedule

Suggested Readings:

1. Practical Medical Microbiology by Mackie & McCartney Volume 1 and 2
2. Medical laboratory Technology Vol. I, II, III by Mukherjee
3. Medical Laboratory manual for tropical countries Vol II Microbiology by Monica Cheesbrough
4. Immunology by Riet
5. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
6. Kuby Immunology by Judith A. Owen, Jenni Punt, Sharon A. Stranford & Patricia P. Jones

Course Title / Subject Names: Applied Hematology-II

Course Code / Subject Code: BMLS512

Course Objectives:

1. The students will be made aware of the safety precautions in Hematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyotyping etc.
2. Students will learn about concepts such as safety precautions, quality assurance, biomedical waste management and automation in hematology.
3. It will also cover bone marrow examination, red cell anomalies, disorder of leucocytes, Lupus Erythrocytes cell phenomenon.

Course Outcomes:

1. Graduates will have **gain knowledge** about applied hematology for clinical laboratory and automated instruments used for hematological analysis.
2. Students will **perform** quantitative and qualitative assay for coagulation factor and other factors present in blood and bone marrow examination.
3. Students will also able to **classify & explain** WBC & RBC anomalies.
4. Graduates will also able to **differentiate** normal and disordered karyotyping with the help of cytological staining.
5. Students will able to **select** appropriate cytological chemicals stain for diagnosis hematological abnormalities.
6. Graduate will able to **generate and assemble** hematological clinical report after carry out diagnosis.

UNIT-1: Automation in Hematology

Automated Blood Cell Counter: Principle, Uses, Care, Maintenance & Calibration. Automated ESR analyzer, Automated Urine analyzer, Coagulometer

UNIT-2: Bone marrow examination

Composition and functions, Aspiration of bone marrow (Adults and children), Processing of aspirated bone marrow (Preparation & staining of smear), Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios). Processing and staining of trephine biopsy specimens

UNIT-3: Red Cells Indices

Red cell anomalies, Morphological changes such as variation in size shape & staining character. MCV, MCH, MCHC, & RDW. Reticulocytes: Definition, different methods to count, Absolute reticulocyte count and IRF (Immature reticulocyte fraction) and significance of reticulocytes.

UNIT-4: LE Cells & Factors Deficiency

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. Quantitative assay of coagulation factors: Principle, Procedure. Screening of inhibitors: Inhibitors against coagulation factors & APLA

Suggested Readings:

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KL Mukherjee 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 Hematology in medical practice

Course Title / Subject Names: Applied Clinical Biochemistry-I

Course Code / Subject Code: BMLS513

Course Objectives:

1. The students will be taught about Hazards & safety measures in a clinical biochemistry lab, Quality control and quality assurance, Laboratory organization, management.
2. Students will have knowledge about principles of assay procedures and Radioactivity.

Course Outcomes:

1. The students will be able to **recall** safety measures and managements of hazards in biochemistry lab.
2. Students will able to **understand** various diagnosis tests for organ specific.
3. Students will able to **perform** blood sugar, LFT, KFT and protein level diagnosis.
4. Students will able to **analyze** & assessment electrolytes level in human serum.
5. Graduates have ability to **determine** level of various enzymes, those are important metabolic compounds.
6. Students will also **generate** various biochemical diagnosis test report after those tests.

UNIT-1: Hazards & Safety

Hazards & safety measures in clinical Biochemistry laboratory, Introduction to laboratory principles and instrumentation in Clinical Biochemistry. Biological samples - types, collection, processing, stability and storage; phlebotomy; serum and serum separator devices; chemical composition of biological fluids - blood, urine and cerebrospinal fluid; reference ranges.

UNIT-2: Automation

Quality assurance; quality control, accuracy and precision; factors influencing the accuracy of results. POCT: Advantages & Disadvantages, Laboratory Information System (LIS), Six Sigma Principle. Brief knowledge about rapid techniques in clinical biochemistry, Automation: Type of Analyzers, Auto analyzer, Continuous flow analyzer & Discrete Flow Analyzer, Advantages and Limitations

UNIT-3: Assays & Normal Range

Principles of assay procedures, Normal range in blood, Serum, Plasma and Urine and reference values for: Glucose, Proteins, Urea, Uric acid, Creatinine, Bilirubin, and Lipids. Electrolytes, blood gases, respiration, acid-base balance and acid-base disorders, respiratory and renal mechanism of acid balance disorders.

UNIT-4: Disorders

Disorders of Metabolism: Diabetes mellitus; Ketone bodies; Glycogen storage diseases; Galactosemia. Diagnostic tests for apolipoproteins, HDL cholesterol, LDL-cholesterol and triglycerides disorders. Phenylketonuria, homocystinuria, tyrosinemia and related disorders, aminoaciduria's.

UNIT-5: Enzyme

Instruments for detection of Radioactivity, Applications of Radioisotopes in clinical biochemistry, Enzyme linked immune sorbent assay (ELISA), CLIA, ELIA (Procedure & Application)

Suggested Readings:

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
3. Practical Clinical Biochemistry by Harold Varley.
4. Biochemistry, U. Satyanarayan & U. Chakrapani.
5. Text book of Medical Biochemistry by Chatterjee & Shinde.
6. Principal of Biochemistry by Lehninger
7. Biochemistry by Voet & Voet
8. Biochemistry by Stryer

Course Title / Subject Names: Applied Histopathology-II

Course Code / Subject Code: BMLS514

Course Objectives:

1. Students will learn about various staining procedures for demonstration of different substances.
2. The students will learn about special staining procedures, its handling & testing of various histological specimens in addition to cryostat sectioning and electron microscopic procedures

Course Outcomes:

1. Students will **identify** minerals and pigments, removal of pigments/artifacts in tissue section.
2. Graduates will **classify or categorize** various type of samples of muscle fibers, elastic, reticulin fibers, collagen fibers etc.
3. Graduate have ability to **apply modern technology** for identifying carbohydrates, lipids, fat & fatlike substances in tissues sections.
4. Students will **analyze differentiate** tissues sections and process further for diagnosis.
5. Students will evaluate quantitative and qualitative assays of various types of enzymes.
6. Students will able to **maintain** log book and **generate** report of presence of biomolecule in tissues samples.

UNIT-1: Cryo-Sectioning

Cryostat sectioning, its applications in diagnostic histopathology. Special Staining Procedures for detection of connective tissue elements, Trichrome staining, muscle fibers, elastic, reticulin fibers, collagen fibers etc. Metachromatic staining such as Toluidine blue on frozen sections. Principles of metal impregnation techniques.

UNIT-2: Biomolecules in Tissues

Techniques/ Methods: Demonstration and identification of minerals and pigments, removal of Pigments/artifacts in tissue sections, Demonstration of Proteins & nucleic acids. Demonstration of Carbohydrates, lipids, fat & fatlike substances. Demonstration of bacteria and fungi in tissue section.

UNIT-3: Tissue requiring special treatment

Tissue requiring special treatment i.e. eye ball, bone marrow, and muscle biopsy, under calcified or unclarified bones, whole brain, and whole lungs including other large organs. Museum techniques.

UNIT-4: Enzyme Histochemistry

Introduction, Histochemical reaction of enzymes, Type of histochemical reactions, Factors that influence enzyme demonstration, Outlining the basic procedures for preparing muscle for enzyme Histochemistry Diagnostic applications and the demonstration of Phosphatases, Dehydrogenases, Oxidases, Acid phosphatase, Alkaline phosphatase & Peroxidases. Vital staining. Neuro-pathological techniques.

Suggested Readings:

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

Course Title / Subject Names: Immunology and Bacterial Serology (Practical)

Course Code / Subject Code: BMLS515

Course Objectives:

1. This course will cover basic aspects of immunity, antigens, antibodies, immune response and hypersensitive reactions.
2. This will also cover various serological reactions, techniques and their utility in laboratory diagnosis of human diseases.

Course Outcomes:

1. Student will have **knowledge** about human immune system and immunity.
2. Student will be able to **classify** different type of immune response during infections and disease.
3. Graduate will **perform** various serological tests in which detection of antigen and antibody interactions.
4. Graduates will be able to **differentiate** between antigen & antibody detection methods based on ELISA, also **differentiate** between immune disorder, genetic disorder and normal disease.
5. Graduates will **evaluate** the sensitivity of antigen and antibody detection kits, schedule vaccination and convince the patient of human to getting vaccination.
6. Students will be able to **assemble** different ELISA methods for serological detection.

List of Practical:

1. Preparation of Phosphate buffers saline, Verinol buffer, ASO buffer, Richardson's buffer, Buffers of different pH and Molarity, Tris buffer
2. Standardization of cell concentration by Spectrophotometer
3. Collection of blood sample by vein puncture
4. Perform separation and preservation of serum from given blood sample
5. Performing Hemolysin titration for Rose-Waaler test/ hemolysin assay
6. Performance of following Serological tests:
 - 6.1. Widal
 - 6.2. Brucella Tube Agglutination
 - 6.3. VDRL (including Antigen Preparation)
 - 6.4. ASO (Anti-Streptolysin 'O')
 - 6.5. C-Reactive Protein (Latex agglutination)
 - 6.6. Rheumatoid factor (RF) Latex agglutination
 - 6.7. Rose Waaler test,
7. Demonstration of antigen/antibody determination by Immuno fluorescence (IF), Immunodiffusion, precipitation in Agarose gel (Ouchterlony), ELISA

Course Title / Subject Names: Applied Hematology-II

Course Code / Subject Code: BMLS516

Course Objectives:

1. The students will be made aware of the safety precautions in Haematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyotyping etc.
2. Students will learn about concepts such as safety precautions, quality assurance, biomedical waste management and automation in hematology.
3. It will also cover bone marrow examination, red cell anomalies, disorder of leucocytes, Lupus Erythromatosus cell phenomenon.

Course Outcomes:

7. Graduates will have **gain knowledge** about applied hematology for clinical laboratory and automated instruments used for hematological analysis.
8. Students will **perform** quantitative and qualitative assay for coagulation factor and other factors present in blood and bone marrow examination.
9. Students will also able to **classify & explain** WBC & RBC anomalies.
10. Graduates will also able to **differentiate** normal and disordered karyotyping with the help of cytological staining.
11. Students will able to **select** appropriate cytological chemicals stain for diagnosis hematological abnormalities.
12. Graduate will able to **generate and assemble** hematological clinical report after carry out diagnosis.

List of Practical:

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

Course Title / Subject Names: Applied Clinical Biochemistry-I (Practical)

Course Code / Subject Code: BMLS517

Course Objectives:

1. The students will be taught about Hazards & safety measures in a clinical biochemistry lab, Quality control and quality assurance, Laboratory organization, management.
2. Students will have knowledge about principles of assay procedures and Radioactivity.

Course Outcomes:

1. The students will be able to **recall** safety measures and managements of hazards in biochemistry lab.
2. Students will able to **understand** various diagnosis tests for organ specific.
3. Students will able to **perform** blood sugar, LFT, KFT and protein level diagnosis.
4. Students will able to **analyze &** assessment electrolytes level in human serum.
5. Graduates have ability to **determine** level of various enzymes, those are important metabolic compounds.
6. Students will also **generate** various biochemical diagnosis test report after those tests.

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 Tri-Glyceride
10. Estimation of Creatinine in Blood
11. Estimation of serum calcium, Inorganic phosphate
12. To measure electrolytes Sodium, Potassium & Chloride.

Course Title / Subject Names: Applied Histopathology-II (Practical)

Course Code / Subject Code: BMLS518

Course Objectives:

1. Students will learn about various staining procedures for demonstration of different substances.
2. The students will learn about special staining procedures, its handling & testing of various histological specimens in addition to cryostat sectioning and electron microscopic procedures

Course Outcomes:

1. Students will **identify** minerals and pigments, removal of pigments/artifacts in tissue section.
2. Graduates will **classify or categorize** various type of samples of muscle fibers, elastic, reticulin fibers, collagen fibers etc.
3. Graduate have ability to **apply modern technology** for identifying carbohydrates, lipids, fat & fat like substances in tissues sections.
4. Students will **analyze differentiate** tissues sections and process further for diagnosis.
5. Students will evaluate quantitative and qualitative assays of various types of enzymes.
6. Students will able to **maintain** log book and **generate** report of presence of biomolecule in tissues samples.

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 section 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:
 - 10.1. Gram’s staining
 - 10.2. AFB staining (Ziehl Neelson’s staining) for *M. tuberculosis* and *M. leprae*
 - 10.3. Grocott’s stain for fungi
 - 10.4. Schmorl’s reaction for reducing substances (melanin)
11. To stain for nucleic acid (DNA and RNA)
 - 11.1. Feulgen Staining

11.2. Methyl Green-Pyronin Staining

11.3. Enzymatic methods



SIXTH SEMESTER

Course Title / Subject Names: Medical Parasitology and Entomology

Course Code / Subject Code: BMLS 611

Course Objectives:

1. Students will be taught about introduction, general, characteristics, life cycle and laboratory diagnosis of various medically important parasites.
2. They will be able to learn about the different terminologies used in the parasitology.
3. They will also be able to differentiate between infections caused by parasites and other microorganisms.

Course Outcomes:

1. Students will come to **know** about the severity of infection caused by the parasites and its clinical outcome.
2. Students will be able to **identify** these parasites and their morphological feature for laboratory diagnosis of protozoan disease.
3. Graduates will be able to **differentiate** between diseases caused by protozoan and helminthes.
4. Students will be able to **analyze** why parasitic infections are caused by poor hygiene, it creates awareness among the students to maintain proper hygiene.
5. Students will be able to **evaluate** probability of contamination of natural resources like food item, water and soil.
6. Students will be able to **design** diagnostic protocol for diagnosis of parasitic, and vector born disease.

UNIT-1: Medical Parasitology

Protozoology: General characteristics of protozoa. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of *Entamoeba* sp., Intestinal and vaginal flagellates i.e. *Giardia*, *Trichomonas* sp., Blood and tissue flagellates i.e. *Plasmodium* (*P. vivax* and *P. falciparum*) and *Toxoplasma* spp.

UNIT-2: Helminthology

Helminthic parasites: General characteristics of Cestodes, Trematodes and Nematodes. Geographical distribution, Habitat, Morphology, life cycle, Mode of infection and laboratory diagnosis of: *Taenia solium* and *saginata*, *Echinococcus granulosus*, *Hymenolepis nana*, *Schistosoma haematobium*, *Trichuris trichura*, *Strongyloides stercoralis*, *Ancylostoma duodenale*, *Enterobius vermicularis*, *Ascaris lumbricoides*, *Wuchereria bancrofti*

UNIT-3: Entomology

Pests of public importance and their control: Mosquitoes, House flies, Sand-fly, Tsetse fly

Insect borne diseases of Human: Yellow fever, dengue fever, encephalitis, leishmaniasis, sleeping sickness

UNIT-4: Diagnostic procedures:

Intestinal protozoan infections diagnosis: 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. **Helminthic infections diagnosis:** Introduction, direct smear preparation and examination, Concentration techniques i.e. Flotation and sedimentation techniques, Egg counting techniques. **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. Laboratory diagnosis of Ova, hydated cyst, cysticercosis (Principles and applications)

Suggested Readings

1. Parasitology in relation to Clinical Medicine by K D Chhatterjee
2. Medical Entomology by A.K. Hati, Pub. Allied Book Agency
3. Medical Parasitology by D.R. Arora
4. Clinical Parasitology by Paul Chester Beaver

Course Title / Subject Names: Advanced Hematology

Course Code / Subject Code: BMLS 612

Course Objectives:

1. To aware of the safety precautions in Hematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyotyping etc.
2. Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios).

Course Outcomes:

1. The students will have **knowledge** of different anemia, Leukemia, chromosomal studies, bleeding disorder.
2. The students will able to **understand** cause of different type anemia and its diagnosis.
3. They will be able to **operate or carry** out automate blood cell counter.
4. Graduates will be able to **differentiate** qualitative and quantitative blood cell disorder.
5. Students will able to **evaluate** risk of blood cell disorder cause and diagnosis.
6. Graduate will able to **generate or assemble** a series of diagnosis test for better diagnosis of blood cell disorder.

UNIT-1: Anemia

Introduction, causes, changes in blood morphology and diagnosis of various types of anemia: Iron deficiency anemia, Megaloblastic anemia, Pernicious anemia, Hemolytic anemia, Aplastic Anemia, Sideroblastic Anemia, Sickle Cell Anemia, Autoimmune Hemolytic Anemia, Hereditary Spherocytosis, G6PD Deficiency Anemia, and Thalassemia. Sickling test, Osmotic fragility test, Schilling test, Serum iron, Serum iron binding capacity

UNIT-2: Leukemia

Introduction, classification and laboratory diagnosis of Leukemia, Identification of various abnormal cells in common leukemia. Acute Leukemia: Acute Lymphocytic Leukemia (ALL), Acute Myeloid Leukemia (AML). Chronic Leukemia: Chronic Lymphocytic Leukemia (CLL), Chronic Myeloid Leukemia (CML)

UNIT-3: Chromosomal Study

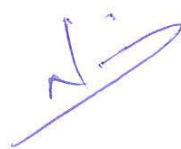
Chromosomal study of Bone Marrow and Blood Samples for diagnosis. Conventional Cytogenetics (Karyotyping), Complex Karyotyping, Fluorescence in Situ Hybridization (FISH), Array Comparative Genomic Hybridization (aCGH), Lymphoma, Detection of Thalassemia mutation using ARMS-PCR. Microsatellite markers for fragile-X syndrome.

UNIT-4: Radioisotopes

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, Disposal of radioactive material

Suggested Readings:

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KL Mukherjee 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
7. Postgraduate Haematology by Hoffbrand



Course Title / Subject Names: Applied Clinical Biochemistry- II

Course Code / Subject Code: BMLS 613

Course Objectives:

1. The students will learn how to analyze various clinical patients' samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers.
2. This subject gives information about various clinically important enzymes & automation techniques.

Course Outcomes:

1. Students will be able to **remember** various characteristics of different types of enzymes.
2. Students will be able to **understand** clinical significance various metabolic enzymes.
3. Graduates will have ability to **perform or carry out** various enzyme assays.
4. Students will be able to **differentiate** various types of enzymes as well as its assays methods.
5. Students will be able to **determine** level of T3, T4 and TSH in blood serum.
6. Students will be able to **generate** diagnosis report of biochemical tests, such as enzyme assay and hormone level.

UNIT-1: Clearance Test

Method of estimation and assessment for: Glucose tolerance test, Insulin tolerance test, Xylose excretion test. Biochemical analysis of Gastric. Clearance test for renal function (Creatinine, Urea, Inulin, Cystatin Clearance Test)

Qualitative & quantitative test for: Urobilinogens, Barbiturates, T3, T4 and TSH, Ketosteroids

UNIT-2: Enzymes

Clinical significance, Principles and Procedures for estimation of Acid phosphatase, Alkaline phosphatase, Lactate dehydrogenase, Aspartate transaminase (SGOT), Alanine transaminase (SGPT), Creatine phosphokinase, Creatine kinase, glucose-6-phosphate dehydrogenase (G6PD), Streptokinase, Angiotensin-converting enzyme (ACE) inhibitor

UNIT-3: Disorders of Mineral Metabolism

Hypercalcemia, hypocalcemia, hypophosphatemia, hyperphosphatemia. Qualitative analysis of renal calculi, Biochemical examination of Cerebrospinal fluid (CSF).

Principles, procedures for estimation & assessment of the following including errors involved and their corrections: Sodium, Potassium, Chloride, Iodine, Calcium, Phosphorous and Phosphates

UNIT-4: Biochemistry of Cancer

Definition of cancer, and types of cancer, Classification of cancer, Benign Vs. Malignant Tumor, Tumor microenvironment and angiogenesis, Oncogene & Protooncogene, Tumor

Suppressor Gene: p53, BRCA & Rb. Dysregulation of cell cycle in cancer cells, Biomarker of Cancer, Diagnosis of Cancers, Anti-Cancer Drugs

Suggested Readings:

1. Text book of Medical Laboratory Technology by P.B. Godkar.
2. Medical Laboratory Science, Theory & Practical by A. Kolhatkar.
3. Practical Clinical Biochemistry by Harold Varley.
4. Biochemistry, U. Satyanarayan & U. Chakrapani.
5. Text book of Medical Biochemistry by Chaterjee & Shinde.
6. Principal of Biochemistry by Lehninger
7. Biochemistry by Voet & Voet
8. Biochemistry by Stryer



Course Title / Subject Names: Cytopathology

Course Code / Subject Code: BMLS 614

Course Objectives:

1. The students will learn about various staining procedures for demonstration of different substances & various cytological investigations.
2. This will include special staining procedures & handling & testing of various cytological specimens.

Course Outcomes:

1. Students will **identify and recognize** samples for performing Cryostat sectioning of human tissues samples.
2. Graduates will have ability to **understand** sex chromatin and Barr bodies on a buccal smear.
3. Students will **apply and demonstrate** Phosphatases, Dehydrogenases, Oxidases & Peroxidases enzymes in tissues sections.
4. Students will have ability to **analyze** cytological findings of diagnosis.
5. Students will have to **evaluate** various types of assays and diagnosis for their sustainability efficacy.
6. Students will **generate and design** protocol for better cytological diagnosis.

UNIT-1 Cytopathology

Introduction, Branches of Cytopathology. Aspiration cytology: Principle, Indications & utility of the technique with special emphasis on role of cytotechnologist in FNAC clinics, Equipments used in FNAC clinics, Fine Needle Aspiration Cytology (FNAC): Principle Procedure, Reporting & Interpretation

UNIT-2: Diagnostic Cytopathology

Fixatives & Fixations: Types, uses, merits & demerits. Cell block preparation, Cryostat sectioning, its applications in diagnostic cytopathology, Vital staining for Sex Chromatin, Karyotyping: Chromosomal studies in hematological disorders (PBLC and Bone marrow)

UNIT-3: Enzyme Cytochemistry

Introduction, Diagnostic applications, Demonstration of Phosphatases, Dehydrogenases, Oxidases & Peroxidases in cells. Automation in cytology, Liquid based cytology: Principles and preparation, Cytocentrifuge, molecular cytology, Cell Block and Immune-cytochemistry

UNIT-4: Exfoliative Cytology

Papanicolaou technique for the staining of cervical smears. Cervical cytology. Sample collection, Processing, Smearing, of Cervical, Endometrial, Respiratory tract, Gastrointestinal tract, Urinary tract samples

Fluid Cytology: Sample collection, Processing, Smearing, Staining and Cytological analysis of Urine, CSF and Body Fluids (Pleural, Pericardial, Ascitic).

Suggested Readings:

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
5. Diagnostic Cytology by Koss Volume -II



Course Title / Subject Names: Medical Parasitology and Entomology (Practical)

Course Code / Subject Code: BMLS615

Course Objectives:

1. Students will be taught about introduction, general, characteristics, life cycle and laboratory diagnosis of various medically important parasites.
2. They will be able to learn about the different terminologies used in the parasitology.
3. They will also be able to differentiate between infections caused by parasites and other microorganisms.

Course Outcomes:

1. Students will come to **know** about the severity of infection caused by the parasites and its clinical outcome.
2. Students will be able to **identify** these parasites and their morphological features for laboratory diagnosis of protozoan disease.
3. Graduates will be able to **differentiate** between diseases caused by protozoan and Helminthes.
4. Students will be able to **analyze** why parasitic infections are caused by poor hygiene, it creates awareness among the students to maintain proper hygiene.
5. Students will be able to **evaluate** probability of contamination of natural resources like food item, water and soil.
6. Students will be able to **design** diagnostic protocol for diagnosis of parasitic, and vector born disease.

List of Practical:

1. Routine stool examination for detection of intestinal parasites with concentration methods:
 - 1.1. Saline preparation
 - 1.2. Iodine preparation
 - 1.3. Floatation method
 - 1.4. Centrifugation method
 - 1.5. Formal ether method
 - 1.6. Zinc sulphate method
2. Identification of adult worms from models/slides:
 - 2.1. Tapeworm
 - 2.2. Tapeworm segments
 - 2.3. Ascaris (Round worm)
 - 2.4. Hookworms
 - 2.5. Pinworms
3. Malarial parasite:
 - 3.1. Preparation of thin and thick smears
 - 3.2. Staining of smears
 - 3.3. Examination of smears for malarial parasites (*P. vivax* and *P. falciparum*)

Course Title / Subject Names: Advanced Hematology (Practical)

Course Code / Subject Code: BMLS616

Course Objectives:

1. To aware of the safety precautions in Hematology, basic concepts of Automation, quantitative assay of coagulation factors, Karyotyping etc.
2. Brief knowledge about examination of aspirated bone marrow (differential cell counts and cellular ratios).

Course Outcomes:

1. The students will have **knowledge** of different anemia, Leukemia, chromosomal studies, bleeding disorder.
2. The students will able to **understand** cause of different type anemia and its diagnosis.
3. They will be able to **operate or carry** out automate blood cell counter.
4. Graduates will be able to **differentiate** qualitative and quantitative blood cell disorder.
5. Students will able to **evaluate** risk of blood cell disorder cause and diagnosis.
6. Graduate will able to **generate or assemble** a series of diagnosis test for better diagnosis of blood cell disorder.

List of Practical:

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.

Course Title / Subject Names: Applied Clinical Biochemistry- II (Practical)

Course Code / Subject Code: BMLS617

Course Objectives:

1. The students will learn how to analyze various clinical patients' samples, for estimation of different components which are the cause of the disease or are the diagnostic/prognostic markers.
2. This subject gives information about various clinically important enzymes & automation techniques.

Course Outcomes:

1. Students will be able to **remember** various characteristics of different types of enzymes.
2. Students will be able to **understand** clinical significance various metabolic enzymes.
3. Graduates will have ability to **perform or carry out** various enzyme assays.
4. Students will be able to **differentiate** various types of enzymes as well as its assays methods.
5. Students will be able to **determine** level of T3, T4 and TSH in blood serum.
6. Students will be able to **generate** diagnosis report of biochemical tests, such as enzyme assay and hormone level.

List of Practical:

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

Course Title / Subject Names: Cytopathology

Course Code / Subject Code: BMLS618

Course Objectives:

1. The students will learn about various staining procedures for demonstration of different substances & various cytological investigations.
2. This will include special staining procedures & handling & testing of various cytological specimens.

Course Outcomes:

1. Students will **identify and recognize** samples for performing Cryostat sectioning of human tissues samples.
2. Graduates will have ability to **understand** sex chromatin and Barr bodies on a buccal smear.
3. Students will **apply and demonstrate** Phosphatases, Dehydrogenases, Oxidases & Peroxidases enzymes in tissues sections.
4. Students will have ability to **analyze** cytological findings of diagnosis.
5. Students will have to **evaluate** various types of assays and diagnosis for their sustainability efficacy.
6. Students will **generate and design** protocol for better cytological diagnosis.

List of Practical:

1. To perform Papnicolaou's stain on cervical smear
2. To perform Guard's staining for demonstration sex chromatin (Barr bodies on a buccal smear)
3. To perform Shorr's staining for Hormonal assessment
4. To cut frozen sections of Gynaec tissue
5. To perform CSF sample and body fluids by cytopspin
6. Should know the various stains used in Cytology lab: May Grunwald Giemsa, H&E, PAS, Grocott's.

SEVENTH SEMESTER

Course Title / Subject Names: Virology and Mycology

Course Code / Subject Code: BMLS 711

Course Objectives:

1. Students will be able to know the difference between viruses and fungus.
2. They will be able to differentiate the disease caused by these microorganisms.
3. They will also come to know about the preventive measures for different infectious disease.

Course Outcomes:

1. Students will have **knowledge** about the laboratory diagnosis of different infectious disease caused by viruses and fungus.
2. Graduates will **understand** mechanism of pathogenesis of disease caused by viruses and fungus.
3. Students will able to use **modern techniques** (Instruments) for diagnosis of viral disease such as COVID-19.
4. Students will able to **differentiate** pathogenesis and harmfulness amongst of bacterial, viral and fungal infections.
5. Students will able to **evaluate** sensitivity of different type detection method of viral infections.
6. Graduate will able **generate log book** for different types of diagnosis methods for viral and fungal disease.

Virology

UNIT-1: General

Introduction to medically important viruses, Structure and Classification of viruses. Collection, transportation and storage of sample for viral diagnosis. Staining techniques used in Virology, Processing of samples for viral culture (Egg inoculation and tissue culture), Modes of viral transmission: Persistent, Non-Persistent, Vertical & Horizontal, Multiplication and Replication strategies of viruses. Interaction of viral receptors and entry of viruses.

UNIT-2: Viruses

Characteristics, Symptoms, Mode of transmission, Prophylaxis, and Control of Poxviruses, Herpes viruses, Hepatitis viruses, Retroviruses- HIV, Rabies viruses, Dengue viruses, Influenza viruses, Ebola viruses, Corona viruses, Japanese Encephalitis. Prevention and Control of viral disease, Antiviral compound and their mode of action. Interferon and their mode of action.

Mycology

UNIT-3: General

Basic concepts about superficial and deep Mycoses. Taxonomy and classification and general characteristics of various medically important fungi, Normal fungal flora. Culture media used in mycology.

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

UNIT-4: Fungus

Morphology, Disease and Lab diagnosis of Candida, Dermatophytes, Mycetoma, Blastomyces, Coccidioidosis, Nocardia

Methods of identification of Yeasts & Moulds, Dimorphism in fungi, Antifungal susceptibility tests, Preservation of fungal cultures, Routine myco-serological tests and skin tests

Suggested Readings:

1. Practical Medical Microbiology by Mackie & MacCartney Volume 1 and 2
2. Text book of Microbiology by Ananthanarayanan
3. Medical Microbiology by Panikar & Satish Gupte
4. Medical laboratory Technology Vol. I, II, III by Mukherjee
5. Medical Laboratory manual for tropical countries Vol. II Microbiology by Monica Cheesbrough
6. Medical Mycology by Dr. Jagdish Chander

Course Title / Subject Names: Blood Banking and Genetics

Course Code / Subject Code: BMLS712

Course Objectives:

1. Blood banking will make students learn about blood grouping & blood transfusion.
2. Genetics will make students learn about Fundamentals of Heredity. The students will learn about the concept of inheritance in various genetic diseases.

Course Outcomes:

1. Graduates will able to **remember** complication related to blood transfusion and tissue typing.
2. The students will able to **understand** consequences of cross reaction after mismatched blood group transfusion.
3. Graduates will able to **carry out or perform** blood grouping and cross matching during blood transfusion.
4. Students will able to **differentiate** low risk patients and high risk patients during the blood transfusion and organ transplants.
5. The students will able to **evaluate** success rate of blood transfusion, organ transplantation and genetic compatibility of couples.
6. Students will able to **design and assemble** matching sheet of donor and recipients for blood transfusion and organ transplantation.

Blood Banking

UNIT-1: Blood Banking

Introduction, 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. Causes of discrimination between forward and reverse grouping, Quality control in blood bank

UNIT-2: Blood components

Introduction, Preparation, Labeling, Storage, Cell Separator. 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, Precautions while procurement and storage of grouping antisera

UNIT-3: Transfusion

Introduction, Classification, Causes, Complications and hazards of blood transfusion, Laboratory investigations of transfusion reactions and mismatched blood transfusion. 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. Transfusion transmissible disease screening methods. Various anticoagulants used to

collect blood for transfusion purposes, Selection of donor and procedure for collection of blood from a healthy donor

UNIT-4: Genetics

Continuity of life-heredity, Mendel's laws of inheritance: Dominance, Segregation & Independent Assortment. Extension of Mendelian Principles: Incomplete dominance, Codominance, Gene interaction, Chromosomes: Bacterial cell and eukaryotic cell, Linkage and Crossing over, Gene mapping, Recombination, **Human Genetics**: Pedgree analysis, Karyotype, Genetic disorders, Sex linked genes in humans, Variation in chromosome number & structure

Suggested Readings

1. Practical Haematology by J.B. Dacie
2. Transfusion Science by Overfield, Hamer
3. Medical Laboratory Technology by K.L. Mukherjee Volume-I
4. Mollison's Blood Transfusion in Clinical Medicine, 12th Edition by Harvey G. Klein
5. Genes X & Genes XII by Benjamin Lewin
6. Genetics by B.D. Singh
7. Principals of Genetics by Gardner
8. Instant Notes on Genetics by PC Winter, GI Hickey and HL Fletcher

Course Title / Subject Names: Immunopathology & Molecular Biology

Course Code / Subject Code: BMLS713

Course Objectives:

1. Immunopathology make students aware about immunological disease or diagnostic markers.
2. Molecular Biology make students knowledgeable about information pathway i.e. central dogma of biology.

Course Outcomes:

1. The students will **learn** how to **identify** various clinical patients' samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers & automation techniques.
2. The students will **understand** about various clinically important cells of immune system, lymphoid organs, antigen, antibody, Ag-Ab reactions.
3. Graduates will **apply** their diagnostic knowledge in transplant immunology for increase success rate of transplantation.
4. Graduate will **analyze** Molecular biology reports for identifying genes, antigens and microbial organisms.
5. Students will **evaluate and determine** efficacy of various instruments which are using in molecular biology diagnosis.
6. Students will **design or create** new protocol and experiments for immune-molecular diagnosis.

Immunopathology

UNIT-1

Humoral and Cellular immune responses, Complement system: Definition, Basic concepts about its components, Complement activation pathways: Classical, Lectin & Alternate. Hypersensitivity: Definition, Type-I, II, III, & IV, Mechanism

UNIT-2:

Major Histocompatibility complexes: Class I & Class II MHC molecules, HLA Typing & Cross matching, Transplant Immunology, Autoimmunity & Immune tolerance: Basic concepts, Organ-Specific Autoimmune Diseases: Autoimmune hemolytic anemia, Insulin-dependent diabetes mellitus, Addison's disease, Hashimoto's thyroiditis, Systemic Autoimmune Diseases: Multiple sclerosis, Rheumatoid arthritis, Systemic lupus erythematosus

Molecular Biology

UNIT-3

Cell Cycle, Central Dogma of Molecular Biology, Structure & Chemical composition of DNA, **DNA replication:** Enzymes & Mechanism, DNA damage and repair, **Transcription:** Prokaryotic RNA polymerase, role of factor, promoter, initiation, elongation & termination of RNA chains, Regulation of prokaryotic gene expression (Operon model), **Translation:** Genetic code, Enzymes & Mechanism

UNIT-4: Molecular Biology Techniques

Polymerase Chain Reaction (PCR), RT-PCR, Oligonucleotide Primer, Agarose gel electrophoresis, SDS-PAGE, Blotting Techniques: Southern, Northern & Western blotting, DNA Fingerprinting, Biosensors, Flow cytometry (FACS)

Suggested Readings:

1. Immunology by Ivan Roitt, Jonathaan Brostoff and David Male
2. Immunology by Kuby
3. Medical Immunology by Daniel P Stites
4. Basic & Clinical Immunology by P. Daniel Fudenberg. H. Hugh and Stites
5. Elements of Biotechnology by PK Gupta
6. Watson Molecular Biology of Gene
7. Advanced Molecular Biology by R Twyman
8. Principal of Biochemistry by Lehninger
9. Gene XII, Lewin

Course Title / Subject Names: Research Methodology and Biostatistics

Course Code / Subject Code: BMLS714

Course Objectives:

1. The objective of this course is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.
2. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

Course Outcomes:

1. Graduates will learn how to **identify** research problems and how statistics are useful in research.
2. Students will be able to **classify** the research problems, and which type of research is required.
3. Students will **apply modern** statistical tools for analyzing the research data.
4. Students will be able to **analyse** the data with the help of biostatistics, find correlation, variance.
5. The students will be able to **evaluate** various measurements of central tendency for collected data in MS Excel.
6. The students will **design the research methodology** and how it will be implemented in their research.

Research Methodology

UNIT-1

Introduction, Meaning of research, objectives of research, Motivation in research, Types of research & research approaches, Research methods vs. methodology. **Research problem:** Statement of research problem. Statement of purpose and objectives of research problem, Necessity of defining the problem. **Research design:** Meaning of research design, Need for research design, Features for good design, Different research designs, Basic principles of research design,

UNIT-2

Sampling Design: Criteria for selecting sampling procedure, Implications for sample design, steps in sampling design, characteristics of good sample design, Different types of sample design. **Methods of data collection:** collection of primary data, collection of data through questionnaires & schedules, Difference between questionnaires & schedules. Sampling fundamentals, need for sampling & some fundamental definitions, important sampling distributions. **Processing & analysis of data:** Processing operations, problems in processing, Types of analysis, Statistics in research, Measures of central tendency, Dispersion, Asymmetry, relationship.

Biostatistics

UNIT-3

Introduction: Meaning, definition, characteristics of statistics. Importance of the study of statistics, Branches of statistics, Statistics and medical & health science, Parameters and Estimates, Descriptive and inferential statistics, Variables and their types

Tabulation of Data: Basic principles of graphical representation, Types of diagrams: histograms, frequency polygons, smooth frequency polygon, cumulative frequency curve, and normal frequency curve.

UNIT-4: Measure of Central Tendency

Need for measures of central Tendency, **Mean:** Definition and calculation of mean of ungrouped and grouped, **Median:** Meaning, interpretation and calculation of median ungrouped and grouped data. **Mode:** Meaning and calculation of mode, Comparison of the mean, median and mode, Range, Standard Deviation (SD) & Standard Error (SE).

Probability and Standard Distributions: Meaning of probability of standard distribution, the binominal distribution, the normal distribution, Divergence from normality: skew ness, kurtosis.

Suggested Readings:

1. Research Methodology (Methods & Techniques) by C.R. Kothari
2. Statistical Methods by S.P. Gupta
3. Methods in biostatistics for medical students by B.K.Mahajan
4. RPG Biostatistics by HimanshuTyagi

Course Title / Subject Names: Virology and Mycology (Practical)

Course Code / Subject Code: BMLS715

Course Objectives:

1. Students will be able to know the difference between viruses and fungus.
2. They will be able to differentiate the disease caused by these microorganisms.
3. They will also come to know about the preventive measures for different infectious disease.

Course Outcomes:

1. Students will have **knowledge** about the laboratory diagnosis of different infectious disease caused by viruses and fungus.
2. Graduates will **understand** mechanism of pathogenesis of disease caused by viruses and fungus.
3. Students will able to use **modern techniques** (Instruments) for diagnosis of viral disease such as COVID-19.
4. Students will able to **differentiate** pathogenesis and harmfulness amongst of bacterial, viral and fungal infections.
5. Students will able to **evaluate** sensitivity of different type detection method of viral infections.
6. Graduate will able **generate log book** for different types of diagnosis methods for viral and fungal disease.

List of Practical:

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

Course Title / Subject Names: Blood Banking and Genetics (Practical)

Course Code / Subject Code: BMLS716

Course Objectives:

1. Blood banking will make students learn about blood grouping & blood transfusion.
2. Genetics will make students learn about Fundamentals of Heredity. The students will learn about the concept of inheritance in various genetic diseases.

Course Outcomes:

1. Graduates will able to **remember** complication related to blood transfusion and tissue typing.
2. The students will able to **understand** consequences of cross reaction after mismatched blood group transfusion.
3. Graduates will able to **carry out or perform** blood grouping and cross matching during blood transfusion.
4. Students will able to **differentiate** low risk patients and high risk patients during the blood transfusion and organ transplants.
5. The students will able to **evaluate** success rate of blood transfusion, organ transplantation and genetic compatibility of couples.
6. Students will able to **design and assemble** matching sheet of donor and recipients for blood transfusion and organ transplantation.

List of Practical:

1. To prepare Acid Citrate Dextrose (ACD) and Citrate Phosphate Dextrose (CPD) Solutions
2. Screening of blood donor: physical examination including medical history of the donor
3. Collection and preservation of blood for transfusion purpose
4. Screening of blood for Malaria, Microfilaria, HBs Ag, Syphilis and HIV
5. To determine the ABO & Rh grouping
 - 5.1. Direct or preliminary grouping
 - 5.2. Indirect or proof grouping
 - 5.3. Rh grouping and determination of Du in case of Rh negative
6. To perform Direct and Indirect Coomb's test
7. To perform cross matching
 - 7.1. Major cross matching
 - 7.2. Minor cross matching
8. Preparation of various fractions of blood.

Course Title / Subject Names: Immunopathology & Molecular Biology (Practical)

Course Code / Subject Code: BMLS717

Course Objectives:

1. Immunopathology make students aware about immunological disease or diagnostic markers.
2. Molecular Biology make students knowledgeable about information pathway i.e. central dogma of biology.

Course Outcomes:

1. The students will **learn** how to **identify** various clinical patients' samples, for estimation of different components which are the cause of the immune disease or are the diagnostic/prognostic markers & automation techniques.
2. The students will **understand** about various clinically important cells of immune system, lymphoid organs, antigen, antibody, Ag-Ab reactions.
3. Graduates will **apply** their diagnostic knowledge in transplant immunology for increase success rate of transplantation.
4. Graduate will **analyze** Molecular biology reports for identifying genes, antigens and microbial organisms.
5. Students will **evaluate and determine** efficacy of various instruments which are using in molecular biology diagnosis.
6. Students will **design or create** new protocol and experiments for immune-molecular diagnosis.

List of Practical:

1. Peripheral blood mononuclear cell (PBMC) isolation by gradient centrifugation
2. Demonstration of T and B cell separation
3. Immunofluorescence
 - 3.1. Anti- Nuclear Antibody (ANA)
 - 3.2. Anti- Neutrophil Cytoplasmic Antibody (ANCA)
4. Perform immunopathological test for AIDS
5. Demonstration Thyroid Microsomal antigen (TMA)- Agglutination reactions
6. Demonstration of Electrophoresis of DNA/ RNA
7. Demonstration of Gel diffusion for Antigen & antibody interaction
8. Identification of Human Leucocyte Antigen (HLA)
 - 8.1. Typing Serology & Cross match
 - 8.2. Molecular Typing
9. Perform Nitro blue Tetrazolium Chloride Test (NBT)
10. Demonstration of Fluorescence Activated Cell Sorting (FACS) for CD4 and CD8
11. Demonstration of Polymerase Chain Reaction and its advanced versions
12. Demonstration of Western blotting
13. Isolation of DNA and RNA
14. Estimation of DNA and RNA
15. Determination of molecular weight and quantification of DNA using agarose gel electrophoresis

Course Title / Subject Names: Research Methodology and Biostatistics (Practical)

Course Code / Subject Code: BMLS718

Course Objectives:

1. The objective of this course is to help the students understand the basic principles of research and methods applied to draw inferences from the research findings.
2. The students will also be made aware of the need of biostatistics and understanding of data, sampling methods, in addition to being given information about the relation between data and variables.

Course Outcomes:

1. Graduates will learn how to **identify** research problems and how statistics are useful in research.
2. Students will be able to **classify** the research problems, and which type of research is required.
3. Students will **apply modern** statistical tools for analyzing the research data.
4. Students will be able to **analyse** the data with the help of biostatistics, find correlation, variance.
5. The students will be able to **evaluate** various measurements of central tendency for collected data in MS Excel.
6. The students will **design the research methodology** and how it will be implemented in their research.

List of Practical:

1. Representation of Data through graph
2. To practice problems on various biostatistics tools in MS Excel
3. Demonstration of GraphPad Prism



Eighth Semester

BMLS-811 Internship:

The internship will span 6 months/ 1 semester. As a part of this, the students will maintain a work logbook which will be duly endorsed by the supervisor or trainer. At the end of internship, the candidate shall submit the work log book along with certificate from the training institute. Finally, the training of candidate shall be evaluated by the internal and external examiners deputed by University/Board in the form of practical / viva examination.

The internship time period provides the students the opportunity to continue to develop confidence and increased skill in clinical delivery of services. Students will demonstrate competence in beginning and intermediate procedures. Students will observe the advanced and specialized procedures. The student will complete the clinical training by practicing all the skills learned in classroom and clinical instruction. The students are expected to work for minimum 6 hours per day and this may be more depending on the need and the healthcare setting.

Skills Based Outcomes and Monitorable Indicators for Medical Laboratory Scientist

1. Demonstrate professional interpersonal, oral, and written communications skills sufficient to serve the needs of patients and the public including an awareness of how diversity may affect the communication process.
2. Perform pre-analytical, analytical, and post-analytical processes:
3. Demonstrate ability to understand investigation/test requisition.
4. Collecting the relevant clinical samples along with complete and accurate documentation with proper safety measures in relation to sample accountability.
5. To transport the samples with precautionary measures to the relevant lab section.
6. Demonstrate the ability to prepare clinical sample for processing.
7. To demonstrate the knowledge of accurate sample processing for the required lab investigation. Perform routine clinical laboratory tests in clinical chemistry hematology/ haemostasis, immunology, immunohematology, microbiology, Histopathology, Cytopathology, body fluid analysis, and laboratory operations.
8. Perform mathematical calculations related to all areas of the clinical laboratory
9. Ability to record the test results/data.
10. To demonstrate the ability to interpret the test reports and its documentation in lab records.
11. Demonstrate ability to release the report to the right person in minimum turn-around-time (TAT).
12. Perform problem solving and troubleshooting techniques for laboratory methodologies
Correlate laboratory test results with patient diagnosis and treatment.
13. To follow basic quality assessment protocol of clinical laboratory.
14. Demonstrate routine laboratory techniques sufficient to orient new employees within the clinical laboratory.
15. Apply basic scientific principles in learning new techniques/procedures; demonstrate application of principles and methodologies.
16. Utilize computer technology applications to interact with computerized instruments and laboratory information systems.

17. Demonstrate adequate knowledge of computer software as it applies to document production, spreadsheets, and presentations.
18. Demonstrate professional behavior with co-team mates.
19. Demonstrate sensitivity and compassion towards patients.

Rotatory Internship shall be of six months, means 6-8 hours integrated internship duty per day.

It will cover clinical branches concerned with Medical Laboratory Sciences as follows:

S. No.	Laboratory	Days
1	Hematology & Clinical Pathology	30 Days
2	Biochemistry	30 Days
3	Microbiology & Serology	30 Days
4	Histopathology & Cytopathology	30 Days
5	Blood Bank / Centre	30 Days
6	Blood Collection/ICU/WARD	30 Days
Total		180 days


10/05/25


10/05/2025

Dr. Anish Singh (OT)


10/05/25
Dr. Neeraj Kumar





