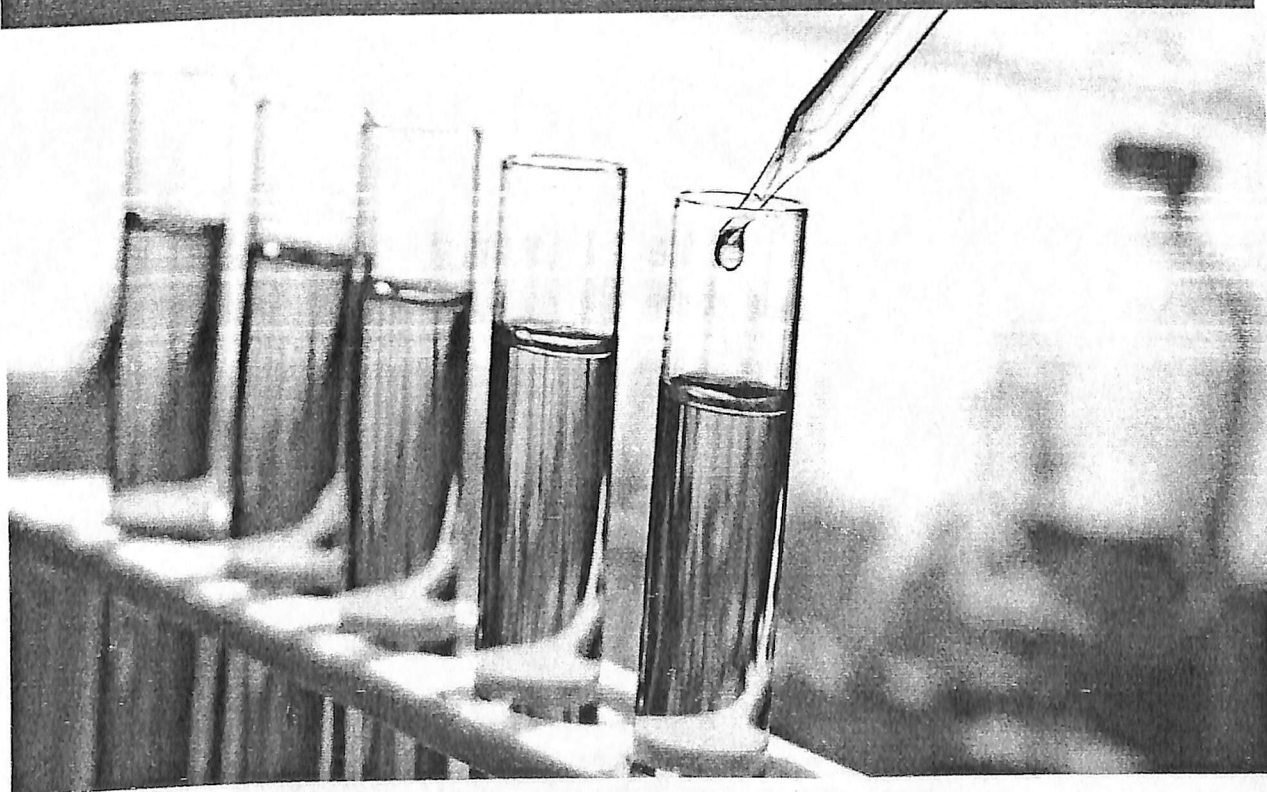


Ministry of Health and Family Welfare

Allied Health Section 2015-16



Model Curriculum Handbook
**MEDICAL LABORATORY
SCIENCE**



4.1 Diploma in Medical Laboratory Science (DMLS)

Diploma in Medical Laboratory Science (DMLS)

Introduction:

Learning objectives:

1. To have theoretical and practical knowledge about principles, procedures, interpretation and preparation of reagents for routine clinical laboratory investigations performed for laboratory diagnosis of various human diseases, so that after completion of the course the candidate may be able to perform routine clinical laboratory investigations in any clinical laboratory.
2. To have theoretical and practical know-how in advanced newer techniques so that trained personnel can apply these wherever facilities exist.

Expectation from the future Diploma holder in providing patient care:

At the end of the course the student should be able to:

1. Perform routine clinical laboratory testing
2. Make specimen-oriented decisions on predetermined criteria including working knowledge of critical values
3. Communicate with other members of the healthcare team, alongwith customers and patients in an effective manner
4. Process information and ensure quality control as appropriate to routine laboratories
5. Train students in routine laboratory procedure
6. Upgrade knowledge and skills in a changing healthcare scenario

Eligibility for admission:

Selection procedure:

1. Candidate should have passed 10 + 2 with biology or vocational course in MLS/MLT at 10+2 level
2. Minimum percentage of marks: 50% aggregate.
3. Separate entrance exam should be incorporated for students who wish to pursue allied health courses

Provision of Lateral Entry:

No provision of lateral entry is needed at Diploma level, as this is the basic entry level for professionals

Duration of the course:

4 semesters/ 2 Years + six months internship

Minimum of 720 hours of internship should be completed by the candidate to be awarded a Diploma

Total number of hours – 2896 for the total course

Medium of instruction:

English shall be the medium of instruction for all the subjects of study and for examination of the course

Attendance:

A candidate has to secure minimum -

- 75% attendance in theoretical
- 80% in skills training (practical) to be able to appear for the final examination

No relaxation, whatsoever, will be permissible to this rule under any ground including indisposition, etc.

**Model Curriculum Outline
First Semester– Foundation Course**

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
DMLS-101	Introduction to National Healthcare Delivery System in India	1	-	-	15	35	50	1
DMLS-102	Basic computers and information Science	2	-	-	15	35	50	2
DMLS-103	Communication and soft skills	2	-	-	15	35	50	2
DMLS-104	Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)	2	-	-	15	35	50	2
DMLS-105	Medical Law and Ethics	2	-	-	15	35	50	2
DMLS-106	Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)	2	1	-	15	35	50	2
DMLS-107	Professionalism and values	1	-	-	15	35	50	1
DMLS-108	Environmental Science	1	-	-	15	35	50	1
DMLS-109	Principals of Management with special reference to Medical Laboratory Science (MLS) management	2	1	-	15	35	50	2
DMLS-110	Community orientation and clinical visit	1	-	-	15	35	50	1
DMLS-111	Basic computers and information Science - Practical	-	-	4	15	35	50	2
DMLS-112	Communication and soft skills – Practical	-	-	2	15	35	50	2
DMLS-113	Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS) – Practical	-	-	2	15	35	50	2
DMLS-114	Introduction to Quality and Patient safety- Practical	-	-	4	15	35	50	2
DMLS-115	Environmental Science – Practical	-	-	2	15	35	50	1
DMLS-116	Principals of Management with special reference to Medical Laboratory Science (MLS) management-Practical	-	-	2	15	35	50	1
TOTAL		16	2	16	240	560	800	26
Total Hours in Semester		544						

NOTE:

1. Abbreviations: L - Lecture, T - Tutorials and P - Practical

- Teaching resources should be made available at every institute for all basic subjects
- Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

Second Semester

SNo.	Course Name	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
DMLS-201	Human Anatomy & Physiology	4	-	-	30	70	100	4
DMLS-202	Basics of Medical Microbiology	4	-	-	30	70	100	4
DMLS-203	Basics of Haematology	4	-	-	30	70	100	4
DMLS-204	Basics of Clinical Biochemistry	4	-	-	30	70	100	4
DMLS-205	Human Anatomy & Physiology -Practical	-	-	4	30	70	100	2
DMLS-206	Basics of Medical Microbiology -Practical	-	-	4	30	70	100	2
DMLS-207	Basics of Haematology-Practical	-	-	4	30	70	100	2
DMLS-208	Basics of Clinical Biochemistry -Practical	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/visit to any medical research/ Medical institution	-	2	-	-	-	-	2
TOTAL		16	2	16	300	700	1000	26
Total Hours in Semester		544						

NOTE:

- Abbreviations: L - Lecture, T - Tutorials and P - Practical
- Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

Third Semester

SNo.	Course Name	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
DMLS-301	Applied Bacteriology, Mycology and Basic Immunology	4	-	-	30	70	100	4
DMLS-302	Applied Haematology	4	-	-	30	70	100	4
DMLS-303	Applied Clinical Biochemistry-I	4	-	-	30	70	100	4
DMLS-304	Histopathology	4	-	-	30	70	100	4
DMLS-305	Applied Bacteriology, Mycology and Basic Immunology -Practical	-	-	4	30	70	100	2
DMLS-306	Applied Haematology-Practical	-	-	4	30	70	100	2
DMLS-307	Applied Clinical Biochemistry-I—Practical	-	-	4	30	70	100	2
DMLS-308	Histopathology -Practical	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/visit to any medical research/ Medical institution	-	2	-	-	-	-	2
TOTAL		16	2	16	300	700	1000	26
Total Hours in Semester		544						

NOTE:

- Abbreviations: L - Lecture, T - Tutorials and P - Practical
- Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

Fourth Semester

SNo.	Course Name	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
DMLS-401	Medical Parasitology & Virology	4	-	-	30	70	100	4
DMLS-402	Immuno-Haematology/ Blood Banking	4	-	-	30	70	100	4
DMLS-403	Applied Biochemistry-II	4	-	-	30	70	100	4
DMLS-404	Immuno-Pathology and Cytopathology	4	-	-	30	70	100	4
DMLS-405	Medical Parasitology & Virology –Practical	-	-	4	30	70	100	2
DMLS-406	Immuno-Haematology/ Blood Banking-Practical	-	-	4	30	70	100	2
DMLS-407	Applied Biochemistry-II—Practical	-	-	4	30	70	100	2
DMLS-408	Immuno-Pathology and Cytopathology -Practical	-	-	4	30	70	100	2
	Guest Lecture/Tutorial/visit to any medical research/ Medical institution	-	2	-	-	-	-	2
TOTAL		16	2	16	300	700	1000	26
Total Hours in Semester		544						

NOTE:

- Abbreviations: L - Lecture, T - Tutorials and P – Practical
- Considering four months per semester as working months, total contact hour hours per semester shall be 544 (Five hundred and forty four)

Fifth Semester

Subject Code	Course Titles	Hours per week			Marks			CR
		L	T	P	Internal	External	Total	
DMLS-501	MLS Internship	-	-	720	50	150	200	26
	Total	-	-	720	50	150	200	26

NOTE:

- Abbreviations: L - Lecture, T - Tutorials and P – Practical

INTERNSHIP – After completion of four semesters of Diploma MLS, the candidates shall undergo six months' internship in a Government recognized hospital/Institution completing minimum of 720 hours training, as partial fulfillment for the award of Diploma in MLS as per government norms

First Semester – Foundation course

DMLS-101: Introduction to National Healthcare Delivery System in India

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

- Introduction to healthcare delivery system
 - Healthcare delivery system in India at primary, secondary and tertiary care
 - Community participation in healthcare delivery system

- c. Health system in developed countries.
- d. Private Sector
- e. National Health Mission
- f. National Health Policy
- g. Issues in Health Care Delivery System in India
2. National Health Programmes – Background objectives, action plan, targets, operations, achievements and constraints in various National Health Programmes.
3. Introduction to AYUSH system of medicine
 - a. Introduction to Ayurveda
 - b. Yoga and Naturopathy
 - c. Unani
 - d. Siddha
 - e. Homeopathy
 - f. Need for integration of various systems of medicine
4. Health scenario of India – past, present and future. Public health in India (epidemiology and demography)
5. Demography & Vital Statistics
 - a. Demography – its concept
 - b. Vital events of life & its impact on demography
 - c. Significance and recording of vital statistics
 - d. Census & its impact on health policy
6. Epidemiology
 - a. Principles of epidemiology
 - b. Natural history of disease
 - c. Methods of epidemiological studies
 - d. Epidemiology of communicable & non-communicable diseases, disease transmission, host defense immunizing agents, cold chain, immunization, disease monitoring and surveillance.

DMLS-102: Basic computers and information science

Rationale: The students will be able to appreciate the role of computer technology. The course deals with computer organization, computer operating system and software, and MS windows, Word processing, Excel data worksheet and PowerPoint presentation. Topics to be covered under the subject are as follows:

1. Introduction to computers: Introduction, characteristics of computers, block diagram of computers, generations of computers, computer languages
2. 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)
3. Processor and memory: Central Processing Unit (CPU), main memory
4. Storage Devices: Sequential and direct access devices, magnetic tape, magnetic disk, optical disk, mass storage devices
5. Introduction of windows: History, features, desktop, taskbar, icons on the desktop, operation with folder, creating shortcuts, operation with windows (opening, closing, moving, resizing, minimizing and maximizing, etc.)
6. 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
7. Introduction to Excel: Introduction, about worksheet, entering information, saving workbooks and formatting, printing the worksheet, creating graphs
 8. Introduction to PowerPoint: Introduction, creating and manipulating presentation, views, formatting and enhancing text, slide with graphs
 9. Introduction of Operating System: Introduction, operating system concepts, types of operating system
 10. Computer networks: Introduction, types of network (LAN, MAN, WAN, Internet, Intranet), network topologies (star, ring, bus, mesh, tree, hybrid), components of network
 11. 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
 12. Application of Computers in clinical settings

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

DMLS-103: Communication and soft skills

Rationale: Emphasizing on building basic language skills, this course introduces elements of communication skills using topics like business communication, public speaking, health communication, etc.

Major topics to be covered under Communication course²⁸ –

1. Basic language skills: Grammar and Usage
2. Business communication skills: With focus on speaking - conversations, discussions, dialogues, short presentations, pronunciation
3. Teaching the different methods of writing (like letters, e-mails, reports, case studies, basic compositions, journals, collecting and reporting patient data, etc.) with a focus on paragraph form and organization
4. Basic concepts & principles of good communication
5. Special characteristics of health communication
6. Types & process of communication
7. Barriers of communication & how to overcome them

DMLS-104: Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)

Rationale: This subject introduces the elements of medical terminology. Emphasis is placed on building familiarity with medical words through knowledge of roots, prefixes and suffixes. Topics include: origin, word building, abbreviations and symbols, terminology related to the human anatomy, reading medical orders and reports, and terminology specific to the student's field of study. Spelling is critical and will be counted when grading tests. The students will be oriented to the role of a medical laboratory professional in the healthcare system, and the scope, purpose and career opportunities in the field of medical laboratory science.

Topics to be covered under the subject are as follows:
Medical Terminology, Record keeping

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

Orientation to Medical Laboratory Science (MLS)

1. Medical Lab Science – Introduction
2. Career opportunities in MLS
3. Role of a Medical lab. professional in Health care system
4. Common laboratory associated hazards and biosafety measures including radiation hazards
5. Subject specific role of a Medical lab. professional:
 - a. Microbiology
 - Role of microbes in human health
 - Overview of the role of Medical Laboratory Professionals in Medical Microbiology
 - Bio-safety in Microbiology
 - b. Haematology
 - Introduction to Haematological diseases
 - Overview of the role of Medical lab. professional in Haematology
 - Bio-safety in Haematology
 - c. Histopathology
 - Introduction to Tumor pathology
 - Overview of the role of Medical lab. professional in Histopathology
 - Bio-safety in Histopathology
 - d. Biochemistry
 - Introduction to metabolic disorders
 - Overview of the role of Medical lab. professional in Clinical Biochemistry
 - Bio-safety in Clinical Biochemistry

Suggested reading: An introduction to Med. Lab. Technology by F.J. Baker & R.E. Silverton, Pb. London Butterworth and Co. Ltd.

DMLS-105: Medical Law and Ethics

Rationale: Legal and ethical considerations are firmly believed to be an integral part of medical practice in planning patient care. Advances in medical Science, growing sophistication of the modern society's legal framework, increasing awareness of human rights and changing moral principles of the community at large, now result in frequent occurrences of healthcare professionals being caught in dilemmas over aspects arising from daily practice.²⁷

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Medical ethics has developed into a well based discipline which acts as a "bridge" between theoretical bioethics and the bedside. The goal is "to improve the quality of patient care by identifying, analyzing, and attempting to resolve the ethical problems that arise in practice".²⁷ Physicians are bound by, not just moral obligations, but also by laws and official regulations that form the legal framework to regulate medical practice. Hence, it is now a universal consensus that legal and ethical considerations are inherent and inseparable parts of good medical practice across the whole spectrum. Few of the important and relevant topics that need to focus on are as follows:

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

DMLS-106: Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Bio-medical waste management, Disaster management and Antibiotic resistance)

Rationale: The subject will introduce the students to understand the basic concepts of quality in health Care and develop skills to implement sustainable quality assurance program in the health system. It will sensitize students in basic emergency care, Infection prevention & control with knowledge of Bio-medical waste management and Antibiotic resistance.

1. Quality assurance and management -
 - a. Concepts of Quality of Care
 - b. Quality Improvement Approaches
 - c. Standards and Norms
 - d. Quality Improvement Tools
 - e. Introduction to NABH guidelines
2. Basics of emergency care and life support skills - Basic life support (BLS) is the foundation for saving lives following cardiac arrest. Fundamental aspects of BLS include

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

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

At the end of this topic, focus should be to teach the students to perform the maneuvers in simulation lab and to test their skills with focus on airway management and chest compressions. At the end of the foundation course, each student should be able to perform and execute/ operate on the above mentioned modalities.

3. Bio medical waste management and environment safety- The aim of this section will be to help prevent harm to workers, property, the environment and the general public. Topics to be covered under the subject are as follows:
 - a. Definition of Biomedical Waste, Types of waste generated from Health Care Facility
 - b. Waste minimization
 - c. BMW – Segregation, collection, transportation, treatment and disposal (including color coding)
 - d. Liquid BMW, Radioactive waste, Metals/ Chemicals/ Drug waste
 - e. BMW Management & methods of disinfection
 - f. Modern Technology for handling BMW
 - g. Use of Personal protective equipment (PPE)
 - h. Monitoring & controlling of cross infection (Protective devices)
4. Infection prevention and control - The objective of this section will be to provide a broad understanding of the core subject areas of infection prevention and control and to equip AHPs with the fundamental skills required to reduce the incidence of hospital acquired infections and improve health outcomes. Concepts taught should include –
 - a. Evidence-based infection control principles and practices [such as Sterilization, Disinfection, Effective hand hygiene and use of Personal Protective Equipment (PPE)],
 - b. Prevention & control of common healthcare associated infections,
 - c. Components of an effective infection control program, and
 - d. Guidelines (NABH and JCI) for Hospital Infection Control
5. Antibiotic Resistance-
 - a. History of Antibiotics
 - b. How Resistance Happens and Spreads
 - c. Types of resistance- Intrinsic, Acquired, Passive
 - d. Trends in Drug Resistance
 - e. Actions to Fight Resistance
 - f. Bacterial persistence
 - g. Antibiotic sensitivity

- h. Consequences of antibiotic resistance
- i. Antimicrobial Stewardship- Barriers and opportunities, Tools and models in hospitals
- 6. Disaster preparedness and management- The objective of this section will be to provide knowledge on the principles of on-site disaster management. Concepts to be taught should include-
 - a. Fundamentals of emergency management,
 - b. Psychological impact management,
 - c. Resource management,
 - d. Preparedness and risk reduction,
 - e. Key response functions (including public health, logistics and governance, recovery, rehabilitation and reconstruction), information management, incident command and institutional mechanisms.

DMLS-107: Professionalism and Values

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

1. Professional values- Integrity, Objectivity, Professional competence and due care, Confidentiality
2. Personal values- ethical or moral values
3. Attitude and behavior- professional behavior, treating people equally
4. Code of conduct , professional accountability and responsibility, misconduct
5. Differences between professions and importance of team efforts
6. Cultural issues in the healthcare environment

Suggested Readings

1. R. R. Gaur, R Sangal, GP 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, JeevanVidyaakParichay, 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

DMLS-108: Environmental Science

Rationale: The student will be made aware of our environment in general, Natural Resources, Ecosystems, Environmental Pollution, and Social issues related to environment, Human Population and the Environment and understanding the Hospital Environment.

1. Introduction: Definition and scope and importance of multidisciplinary nature of environment. Need for public awareness
2. Natural Resources: Natural Resources and associated problems, use and over exploitation, case studies of forest resources and water resources

3. Ecosystems: Concept of Ecosystem, Structure, interrelationship, producers, consumers and decomposers, ecological pyramids-biodiversity and importance. Hotspots of biodiversity
4. Environmental Pollution: Definition, Causes, effects and control measures of air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards
 - 4.1 Solid waste management: Causes, effects and control measure of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies
 - 4.2 Social blemishes and the Environment From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, water shed management Resettlement and rehabilitation of people; its pros and concerns
 - 4.3 Case studies, Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.
 - 4.4 Case studies, Wasteland reclamation.
 - 4.5 Consumerism and waste products, 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
 - 4.6 Human Population and the Environment, Population growth, variation among nations. Population explosion—Family Welfare Programme. Environment and human health, Human Rights, Value Education, HIV/ AIDS. Women and child Welfare. Role of Information Technology in Environment and human health. Case studies
5. Understanding the Hospital Environment
6. Understanding the environment in the following clinical laboratories
 - 6.1 Microbiology
 - 6.2 Biochemistry
 - 6.3 Histopathology
 - 6.4 Haematology
7. Clinical laboratory hazards to the environment from the following and means to prevent:
 - 7.1 Infectious material
 - 7.2 Toxic Chemicals
 - 7.3 Radioactive Material
 - 7.4 Other miscellaneous wastes

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 & Engg. By Meenakshi.
10. Elements of environment Engg. by Duggal.

DMLS-109: Principals of Management with special reference to Medical Laboratory Science (MLS) Management

Rationale: The course is intended to provide knowledge about the basic principles of Management.

1. Introduction to management
2. Strategic Management
3. Foundations of Planning
4. Planning Tools and Techniques
5. Decision Making, conflict and stress management
6. Managing Change and Innovation
7. Understanding Groups and Teams
8. Leadership
9. Time Management
10. Cost and efficiency

Medical Laboratory Science Management

Rationale: The students will be made aware of the basic ethics, good lab practices including awareness/ safety in a clinical lab. In addition they will be made to understand Sample accountability, Quality Management system, biomedical waste management, Calibration and Validation of Clinical Laboratory instruments, Laboratory Information system (LIS), Hospital Information system (HIS) and financial Management.

1. Ethical Principles and standards for a clinical laboratory professional
 - 1.1. Duty to the patient
 - 1.2. Duty to colleagues and other professionals
 - 1.3. Duty to the society
2. Good Laboratory Practice (GLP) Regulations and Accreditation
 - 2.1. Introduction to Basics of GLP and Accreditation
 - 2.2. Aims of GLP and Accreditation
 - 2.3. Advantages of Accreditation
 - 2.4. Brief knowledge about National and International Agencies for clinical laboratory accreditation
3. Awareness/ Safety in a clinical laboratory
 - 3.1. General safety precautions
 - 3.2. HIV: pre- and Post-exposure guidelines
 - 3.3. Hepatitis B & C: pre- and Post-exposure guidelines
 - 3.4. Drug Resistant Tuberculosis
4. Patient management for clinical samples collection, transportation and preservation, sample accountability
 - 4.1. Purpose of accountability
 - 4.2. Methods of accountability
5. Sample analysis
 - 5.1. Introduction
 - 5.2. Factors affecting sample analysis
6. Reporting results: Awareness about the following;
 - 6.1. Basic format of a test report

- 6.2. Reported reference range
- 6.3. Clinical Alerts
- 6.4. Abnormal results
- 6.5. Turnaround time
- 6.6. Results from referral laboratories
- 6.7. Release of examination results
- 6.8. Alteration in reports
7. Quality Management system
 - 7.1. Introduction
 - 7.2. Quality assurance
 - 7.3. Quality control system
 - 7.4. Internal and External quality control
8. Biomedical waste management in a clinical laboratory
9. Introduction and importance of calibration and Validation of Clinical Laboratory instruments
10. Introduction to Laboratory Information system (LIS), Hospital Information system (HIS) and financial management
11. Ethics in Medical laboratory Practice
 - 11.1. Understanding the term 'Ethics'
 - 11.2. Ethics in relation to the following:
 - 11.2.1. Pre-Examination procedures
 - 11.2.2. Examination procedures
 - 11.2.3. Reporting of results
 - 11.2.4. Preserving medical records
 - 11.2.5. Access to Medical laboratory Records
12. Inventory Control

Suggested reading: Medical Laboratories Management- Cost effective methods by Sangeeta Sharma, Rachna Agarwal, Sujata Chaturvedi and Rajiv Thakur

DMLS-110: Community Orientation and Clinical Visit

Rationale: The objective of this particular section of the foundation course is to sensitize potential learners with essential knowledge; this will lay a sound foundation for their learning across the under-graduate program and across their career. Innovative teaching methods should be used to ensure the attention of a student and make them more receptive such as group activities, interactive fora, role plays, and clinical bed-side demonstrations.²⁹

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

DMLS-111: Basic computers and Information Science-Practical

Practical on fundamentals of computers -

1. Demonstration of basic hard ware of the computers and laptops
2. Learning to use MS office: MSword, MS PowerPoint, MS Excel.
3. To install different software.

4. Data entry efficiency

DMLS-112: Communication and Soft Skills-Practical

1. Précis writing and comprehension of simple passages from a prescribed text book. The passage should be at least 100 words and students should answer a few questions based on it.
2. To practice all forms of communication i.e. drafting reports, agendas, notes, précis writing, telegrams, circulars, presentations, press releases, telephonic communication, along with practice on writing resumes and applications for employment.

DMLS-113: Medical Terminology, Record keeping (including anatomical terms) and Orientation to Medical Laboratory Science (MLS)-Practical

1. General discussion/ Sensitization on career opportunities and role of MLS in Hospital Care
2. Visit to Central Sterile Supply Department (CSSD)
3. Visit to incinerator complex
4. Visit to Immunization section
5. Visit to working Microbiology, Haematology, Biochemistry and Histopathology laboratories

DMLS-114: Introduction to Quality and Patient safety (including Basic emergency care and life support skills, Infection prevention and control, Biomedical waste management, Disaster management and Antibiotic resistance)-Practical

1. Biomedical waste management:
 - 1.1. Types of the waste generated
 - 1.2. Segregation
 - 1.3. Treatment
 - 1.4. Disposal

Suggested readings:

1. Text book of Preventive Medicine by Par and Park for infection prevention and control
2. Text book of Microbiology by Ananthanaryanan for Antibiotic Resistance

DMLS-115. Environmental Science-Practical

1. Any Activity related to public awareness about the environment:
 - 1.1. Preparation of Charts/ Models
 - 1.2. Visit to any effluent treatment plant
 - 1.3. Seeding a plant/ s and take care of it/ them.
2. Preparation of models/ charts in relation to natural resources of drinking water.
3. Preparation of Models of Ecosystem on biodiversity.
4. Effects of environmental pollution on humans through poster presentation.
5. Any Activity related to wild life preservation.
6. Visit to any hospital/ clinical laboratory and understanding the environment therein.
7. Visit to an incinerator.
8. Any activity related to biomedical waste management in a hospital or clinical laboratory

DMLS-116: Principals of Management with special reference to Medical Laboratory Science (MLS) Management: Practical

1. Clinical sample collection e.g.
 - 1.1. Blood
 - 1.2. Urine
 - 1.3. Stool
 - 1.4. Saliva
 - 1.5. Sputum
 - 1.6. Semen analysis
2. Sample accountability
 - 2.1. Labeling of sample
 - 2.2. Making entries in Laboratory records
3. Reporting results
 - 3.1. Basic format of a test report
 - 3.2. Release of examination results
 - 3.3. Alteration in reports
4. Quality Management system
 - 4.1. Quality assurance
 - 4.2. Internal and External quality control
 - 4.3. Quality improvement
5. Biomedical waste management in a clinical laboratory - Disposal of used samples, reagents and other biomedical waste
6. Calibration of Clinical Laboratory instruments
7. Ethics in Medical Laboratory Practice in relation to the following (Role models will be displayed while working in a clinical laboratory during):
 - 7.1. Pre-Examination procedures
 - 7.2. Examination procedures
 - 7.3. Reporting of results
 - 7.4. Preserving medical records
 - 7.5. Access to Medical laboratory Records

Second Semester

DMLS-201: Anatomy and Physiology

Rationale: The students are supposed to have basic knowledge of structure of human body, its anatomical parts and physiological functions

1. Introduction to human body, its anatomy and physiology
2. Elementary tissues of body and their classification along with brief description.
3. Digestive System:
 - 3.1. Organs of digestion, histology of the digestive organs (stomach, small intestine, liver, pancreas), Process of digestion
 - 3.2. Absorption and assimilation of food
4. Respiratory System
 - 4.1. Organs of respiration and their histology (lungs and trachea)
 - 4.2. Respiration (Definition and Mechanism)
5. The skin (Structure and functions)

6. The excretory system
 - 6.1. Organs of excretion (kidneys, ureter, bladder)
 - 6.2. Histology of kidney and its functions
 - 6.3. Formation of urine and its composition
 - 6.4. Structure of nephron
7. Circulatory system
 - 7.1. Composition and functions of blood
 - 7.2. The heart anatomy and physiology
 - 7.3. The chambers of heart, various vessels and valves
 - 7.4. Circulation of blood
 - 7.5. The blood pressure
 - 7.6. Arteries and veins
 - 7.7. Lymph and lymphatic system
8. Nervous System
 - 8.1. Central nervous system (Brain and Spinal cord)
 - 8.2. Peripheral nervous system (cranial and spinal nerves)
 - 8.3. The reflex action and reflex arc
 - 8.4. The transmission of nerve impulse
 - 8.5. The sense organs (eye, ear, tongue and nose); structure and functions
9. Muscular System
 - 9.1. Brief description of skeletal, smooth and cardiac muscles
 - 9.2. Muscular contraction
 - 9.3. Muscle Fatigue
 - 9.4. Some important muscles of body
10. Skeletal System
 - 10.1. The skeleton, important bones and their brief description
 - 10.2. Articulation of Bones - joints
11. Endocrine System
 - 11.1. Short description of various endocrine glands and their functions
12. Reproductive System
 - 12.1. Male and female reproductive system
 - 12.2. Histology of Gonads
 - 12.3. The ovarian cycle and ovulation
 - 12.4. Fertilization
 - 12.5. Fertility control

Suggested Readings:

1. Anatomy & Physiology by 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 Sears
5. Anatomy and Physiology for nurses by Pearson
6. Anatomy and Physiology by N Murgesh

DMLS-202: Basic of Medical Microbiology

Rationale: The candidates undergoing training in medical laboratory technology will learn the techniques of collection of samples, their processing and identification of various pathogens like bacteria, parasites, viruses using different techniques. In addition, the candidates are given training in the use of standard safety measures while handling infective materials. The basic knowledge of different diseases caused by various micro-organisms is also imparted. The training is aimed at making the students competent to isolate and identify the causative micro-organisms.

Theory

1. Introduction to Microbiology: Definition, history, relationship of microorganisms to man, safety in a microbiology laboratory.
2. Morphology of Bacteria: Anatomy of a bacterial cell including spores, flagella and capsules
3. Growth and Nutrition of Bacteria: A typical growth curve and bacterial nutrition
4. Classification of micro-organisms with special reference to bacteria – general classification, biological classification
5. Sterilization: Definition, sterilization by dry heat, moist heat (below, at and above 100°C) Autoclave, its structure and functioning, autoclave controls and sterilization indicators, sterilization by radiation and filtration
6. Antiseptics and Disinfectants: Definitions, types, properties and uses of disinfectants and antiseptics, In-use test
7. Microscopy: Structure and working of simple and compound microscope. Principles of dark field, fluorescent, phase contrast and electron microscope
8. Staining Techniques: Methods of smear preparation, fixation, simple stains, gram's stain, AFB staining, Albert's stain, Neisser's stain, staining of spores, capsules
9. Culture Media: Definition, Purpose, classification of culture media. Liquid and solid media, defined and synthetic media, routine laboratory media (Basal, enriched, selective, enrichment, indicator, transport and storage or preservation)
10. Bacterial Culture: Inoculation of culture media, aerobic and anaerobic culture, isolation of pure cultures and disposal of cultures
11. Morphological and biochemical identification of bacteria by:
 - 11.1. Microscopic morphology
 - 11.2. Colony characteristics
 - 11.3. Biochemicals
 - 11.3.1. Carbohydrate Utilization test
 - 11.3.2. Catalase, oxidase, urease, coagulase
 - 11.3.3. Indole, citrate, MR, VP, TSA, Nitrate Reduction
 - 11.3.4. Motility
12. Morphological, cultural, biochemical characteristics and laboratory diagnosis of:
 - 12.1. Staphylococci and Micrococci
 - 12.2. Streptococci and pneumococci
 - 12.3. Corynebacterium diphtheria
 - 12.4. Enterobacteriaceae-I (E. Coli, Klebsiella, Enterobacter)
 - 12.5. Enterobacteriaceae-II (Salmonella, Shigella, Proteus)
 - 12.6. Pseudomonas
 - 12.7. Vibrio Cholerae
 - 12.8. Neisseria

- 12.9. Mycobacteria
- 12.10. Clostridia
- 12.11. Treponema pallidum

Suggested readings:

1. Practical Medical Microbiology by Mackie and Mac. Cartney 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. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Cheesbrough
6. Text book of Microbiology by Prescott

DMLS-203: Basics of Haematology

Rationale: The training in this subject is imparted to enable the students to carry out routine clinical laboratory investigation (blood, urine etc.). They should be able to provide technical help for selected sophisticated hematological techniques with adequate knowledge of various principles. The training in laboratory safety is also provided

1. Introduction to Haematology
2. Apparatus and Instruments: Parts, functions principles and working of compound microscope, centrifuge, water bath and cell counter
3. Cleaning of Glass Ware: General and volumetric apparatus cleaning
4. Introduction to Blood
 - 4.1. Erythropoiesis, Leucopoiesis, formation of platelets (Thrombopoiesis)
 - 4.2. Definition, composition and functions of blood
5. Anticoagulants: Definition and various types along with their mode of action, merits and demerits of each
6. Collection of Blood;
 - 6.1. Collection of blood; venous and capillary
 - 6.2. Various equipment used for collection of blood samples
7. Romanowsky Stains
 - 7.1. Preparation and theory
 - 7.2. Choice of slide and spreader and preparation of blood film.
 - 7.3. Characteristics of good film preparation.
8. Haemoglobinometry
 - 8.1. Types of Hemoglobin and its function
 - 8.2. Various methods of estimation
 - 8.3. Formation of Hemoglobin and its breakdown
9. Differential Leucocyte Counting: Blood Cell Morphology in Health and Disease
10. Preparation of Blood Smear
 - 10.1. For malarial parasite (thick and thin smear)
 - 10.2. Study of life cycle of malarial parasite and its laboratory diagnosis
11. Haemo-cytometry
 - 11.1. Various counting chambers (Neubauer, Burker, Fuch-Rosenthal)
 - 11.2. Methods of counting of RBC, WBC and platelets
 - 11.3. Errors involved

12. Physiological Variation in the Normal Values of Tests (HB, TLC, DLC, PCV/ESR, Platelets Etc.)
13. Routine Examination of Urine (Microscopic, Macroscopic and Chemical)

Suggested reading:

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by K.L. Mukherjee Volume-I
3. Haematology for students Practitioners by RamnikSood
4. Hand book of Medical Laboratory Technology (IInd edition) by V.H. Talib
5. Haematology (International edition) Emmanuel C. BesaHarwal Publisher
6. Practical Haematology by J.B. Dacie
7. Practical Haematology (8th edition) by Sir John
8. Clinical Haematology by Christopher A. Ludlam
9. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard Henary
10. Medical Laboratory Technology Methods & Interpretation (5th edition) by RamnikSood
11. Atlas of Haematology (5th edition) by G.A. McDonald
12. A Manual of Laboratory & Diagnostic Tests (6th edition) by Frances Fischbach
13. Haematology (Patho-physiological basis for clinical practice) by Stephen M. Robinson

DMLS-204: Basics of Clinical Biochemistry

Rationale: The candidates are imparted basic training of theoretical and practical in the field of Clinical biochemistry. They are taught the technique of collection of clinical samples and their processing along with recording of data. The students will also be given the basic knowledge of chemistry and metabolism of various metabolites which are routinely estimated in different diseases so that a clear understanding of the different tests is obtained, in addition to basic training in safety measures, quality control and automation.

THEORY

1. Introduction to Biochemistry
 - 1.1. Definition
 - 1.2. Importance of bio-chemistry
 - 1.3. SI units and their use
 - 1.4. Volumetric apparatus and their calibration
2. Cleaning of Laboratory Glass Ware
 - 2.1. Cleaning and care of glass-ware
 - 2.2. Different cleaning agents (soaps detergents, chromic acid)
 - 2.3. Methods of cleaning
3. Important Instruments: Principle working and care of:
 - 3.1. Balance (Analytical, electrical/ electronic)
 - 3.2. Centrifuge
 - 3.3. Colorimeter
 - 3.4. Spectrophotometer
 - 3.5. Flame photometer
4. Blood Chemistry
 - 4.1. Composition of blood and its functions
 - 4.2. Use of various anticoagulants

- 4.3. Separation of serum and plasma
- 4.4. Process of sterilizing blood collecting equipment
- 4.5. Different protein precipitation agents
- 4.6. Preparation of Protein Free Filtrate (PFF) and uses
5. Collection and Preservation of Biological Specimens:
 - 5.1. Blood - Sputum
 - 5.2. Body fluids - Stool

Suggested readings:

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Medical Laboratory Technology by KL Mukherjee volume III
3. Practical Clinical Biochemistry by Harold Varley
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by ChaterjeeShinde

DMLS-205: Anatomy and physiology – Practical

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

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

DMLS-206 Basic of Medical Microbiology - Practical

1. Demonstration of safety rules in a microbiology laboratory
2. Preparation of cleaning agents and techniques of cleaning glassware
3. Preparation of material for sterilization in an autoclave and hot air oven
4. Sterilization by an autoclave and hot air oven
5. Sterilization by filtration
6. In-use test
7. Handling and care of different types of microscopes

8. Staining techniques: Gram's stain, Z.N stain, Albert's stain, Spore and capsule staining
9. To demonstrate the instruments used to seed culture media
10. To learn techniques for Inoculation of bacteria on culture media
11. Demonstration of motility
12. Preparation of culture media
13. Aerobic and anaerobic culture methods
14. To isolate specific bacteria from a mixture of organisms
 - 14.1. Preparing media for different biochemical and
 - 14.2. Inoculations and incubation biochemical,
 - 14.3. Reporting bio-chemicals
15. Testing antimicrobial susceptibility of bacteria by Stoke's disc diffusion method
16. To prepare the reagent and demonstrate following biochemical tests with positive and negative control bacteria
 - 16.1. Catalase
 - 16.2. Coagulase
 - 16.3. Indole
 - 16.4. Methyl Red (MR)
 - 16.5. VogesProskauer (VP)
 - 16.6. Urease
 - 16.7. Citrate
 - 16.8. Oxidase
 - 16.9. TSA
 - 16.10. Nitrate reduction
 - 16.11. Carbohydrate fermentation
 - 16.12. Demonstration and motility
17. Demonstration of Morphological and Biochemical identification of bacteria
 - 17.1. Staphylococcus
 - 17.2. Streptococcus & Pneumococcus
 - 17.3. Corynebacterium
 - 17.4. Escherichia coli
 - 17.5. Klebsiella
 - 17.6. Citrobacter
 - 17.7. Enterobacter
 - 17.8. Proteus
 - 17.9. Salmonella
 - 17.10. Shigella
 - 17.11. Vibrio cholera
 - 17.12. Pseudomonas

DMLS-207: Basics of Haematology- Practical

1. Parts of microscope; its functioning and care
2. Parts of centrifuge; its functioning and care
3. Cleaning and drying of glassware
4. Preparation of various anticoagulants
5. Collection of venous and capillary blood

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

DMLS-208: Basics of Clinical Biochemistry - Practical

1. Cleaning of glass ware
2. Sterilization of glass ware
3. Standardization of glass ware
4. Handling and Maintenance of each instrument
5. Preparation of various anticoagulants and specimen collection bottle
6. Collection of blood
7. Separation of serum and plasma
8. Preparation of different protein precipitating gents, PFF preparation

Third Semester

DMLS-301: Applied Bacteriology, Mycology & Basic Immunology

Rationale: The candidates undergoing training in medical laboratory technology will learn the applications of bacteriology, Mycology and basics of immunology in a clinical laboratory. In addition the candidates are given training about the laboratory strategies of sample processing for lab diagnosis of various bacterial and fungal infections. The training is aimed at making the students competent to isolate and identify the causative micro-organisms from clinical samples.

1. Laboratory Diagnosis of Infectious Diseases
 - 1.1. Septicemia and bacteremia
 - 1.2. Respiratory tract infections
 - 1.3. Wound and skin infections
 - 1.4. Urinary tract infections
 - 1.5. Genital tract infections
 - 1.6. Meningitis
 - 1.7. Gastro intestinal infections
 - 1.8. Enteric fever
2. Bacteriological examination of water, milk and air
3. Nosocomial Infections
 - 3.1. Introduction
 - 3.2. Common types of Nosocomial infections
 - 3.3. Sources of infections

- 3.1. Introduction
- 3.2. Various methods
- 3.3. Clinical importance
4. Reticulocyte counting
 - 4.1. Introduction
 - 4.2. Various methods of counting
 - 4.3. Clinical importance
5. LE cell phenomenon
 - 5.1. Theory of formation of LE cell, its differentiation from tart cell
 - 5.2. Preparation and staining of smear and its examination
 - 5.3. Clinical importance
6. Anaemias
 - 6.1. Definition and types of anemia; factor causing anemia
 - 6.2. Plasma hemoglobin and fetal hemoglobin estimation
 - 6.3. Laboratory diagnosis of hemolytic anemia
7. Red cell fragility test
 - 7.1. Principle and setting up the test
 - 7.2. Clinical importance
8. Coagulation
 - 8.1. Theories
 - 8.2. Coagulation defects
 - 8.3. Principles and methods of Prothrombin Time (PT), Prothrombin Time Index (PTI), Prothrombin Time with Kaolin (PTTK) – Bleeding Time (BT) Clotting Time (CT), and Clot Retraction Test
9. Bone-marrow examination
 - 9.1. Structure and function of bone-marrow
 - 9.2. Collection of bone-marrow
 - 9.3. Preparation, staining and examination of bone-marrow smears
 - 9.4. Significance of bone-marrow examination
10. Leukemia's- Classification (FAB)
11. Automation in haematology
12. Quality control in haematology

Suggested reading:

1. Text book of Medical Laboratory Technology by Paraful B. Godkar
2. Medical laboratory Technology by KL Mukherjee Volume-I
3. Haematology for students Practitioners by Ramnik Sood
4. Hand book of Medical Laboratory Technology (11nd edition) by V.H. Talib
5. Haematology (International edition) Emmanuel C. BesaHarwal Publisher
6. Practical Haematology by J.B. Dacie
7. Practical Haematology (8th edition) by Sir John
8. Clinical Haematology by Christopher A. Ludlam
9. Clinical Diagnosis & Management by Laboratory methods (20th edition) by John Bernard
10. Medical Laboratory Technology Methods & Interpretation (5th edition) by Ramnik Sood
11. Atlas of Haematology (5th edition) by G.A. McDonald

12. A Manual of Laboratory & Diagnostic Tests (6th edition) by Frances Fischbach

DMLS-303: Applied Clinical Biochemistry-I

Rationale: The candidates are imparted basic training (both theoretical and practical) in the field of clinical biochemistry. They are made to learn the technique of collection of clinical samples and their processing along with recording of data. The student will also obtain the basic knowledge of chemistry and metabolism of various metabolites which are routinely estimated in different diseases so that a clear understanding of the different tests is obtained. The students are also given basic training in safety measures, quality control and automation.

1. Blood sugar estimation and G.T.T
 - 1.1. Principle and methods of estimation
 - 1.2. Normal and abnormal values
 - 1.3. True and apparent sugar
 - 1.4. Metabolism of sugar
 - 1.5. Precautionary measures
 - 1.6. Renal threshold
 - 1.7. Importance and performance of GTT
 - 1.8. Clinical importance of blood sugar and GTT
2. Serum urea
 - 2.1. Formation and excretion of urea
 - 2.2. Principles and procedures of different methods of urea estimation
 - 2.3. Normal and abnormal levels
 - 2.4. Clinical importance
3. Plasma and serum proteins
 - 3.1. Definition
 - 3.2. Formation of plasma proteins
 - 3.3. Different methods of estimation including principles and procedures
 - 3.4. Normal and abnormal values
 - 3.5. Clinical importance
4. Serum cholesterol
 - 4.1. Formation and estimation of cholesterol
 - 4.2. Various methods of estimation including principles and procedures
 - 4.3. Normal and abnormal values
 - 4.4. Clinical importance
5. Serum bilirubin
 - 5.1. Formation and excretion of bilirubin
 - 5.2. Metabolism of bile pigments
 - 5.3. Conjugated and unconjugated bilirubin
 - 5.4. Principles and procedures of serum bilirubin estimation
 - 5.5. Normal and abnormal values
 - 5.6. Clinical importance
6. Inorganic phosphorus
 - 6.1. Principles and procedures of estimation
 - 6.2. Normal and abnormal values
 - 6.3. Clinical importance
7. Creatinine estimation

- 7.1. Principles and procedures of estimation
- 7.2. Normal and abnormal/ values
- 7.3. Clinical importance
8. Serum calcium
 - 8.1. Principles and procedures estimation
 - 8.2. Normal and abnormal values
 - 8.3. Clinical importance
9. Uric acid estimation
 - 9.1. Principles and procedures estimation
 - 9.2. Normal and abnormal values
 - 9.3. Clinical importance
10. Electrolytes and trace elements
 - 10.1. Functions of electrolytes like Na^+ , K^+ and Cl^- . Other essential trace elements like Ca^{2+} , Fe^{2+} etc. Metabolism of these ions
 - 10.2. Principles and procedures of estimation
 - 10.3. Normal and abnormal values
11. Clinical importance of radioisotopes. Their brief description and use.
12. Quality control in clinical bio-chemistry

Suggested readings:

1. Text book of Medical Laboratory Technology by P. B. Godker
2. Medical Laboratory Technology by K.L. Mukherjee volume III
3. Practical Clinical Biochemistry by Harold Varley
4. Principal of Biochemistry by M. A. Siddiqi
5. Instrumental Analysis by Chatwal Anand
6. Text book of Medical Biochemistry by Chaterjee Shinde

DMLS-304: Histopathology

Rationale: The training is aimed at preparing the students to prepare tissue sections of various types (paraffin/ frozen) and stain them. Candidates will be able to provide special stains for detailed information. Candidates should be able to display specimens for museum and help in performing autopsies.

1. Definitions, sources and types of histological specimen (Biopsy), histological preservations
2. Labeling, fixation, properties, classification and composition of fixatives
3. Paraffin embedding, dehydration, clearing, impregnation and casting
4. Cutting of Tissue Sections Care and use of microtomes, microtome knives: honing and stropping techniques, attachment of block to block holder, trimming, section cutting, errors in sectioning and remedies, collection of sections to slide from tissue floatation bath
5. Principles and staining techniques of ;
 - 5.1. Routine - Haemotoxylin and Eosin
 - 5.2. Special
 - 5.2.1. Reticulin
 - 5.2.2. PAS

- 5.2.3. Iron
- 5.2.4. PTAH
- 5.2.5. AFB
- 5.2.6. Calcium
- 5.2.7. Fat (Lipid)
- 6. Decalcification of bones
 - 6.1. Process of decalcification and methods
 - 6.2. Reagents used for decalcification
- 7. Bone cutting without decalcification
- 8. Frozen sections
 - 8.1. Freezing microtome and cryostat- its care and uses
 - 8.2. Technique of cutting frozen section
 - 8.3. Principles of special stains used and their preparation
- 9. Preparation of museum specimen
 - 9.1. Care of Museum specimen
 - 9.2. Preparation of fixatives and mounting solutions
 - 9.3. Mounting and after care of mounted specimen
 - 9.4. Cataloguing of museum specimen
- 10. Cataloguing of slides and blocks, dispatch of reports, maintenance of records.
- 11. Autopsy
 - 11.1. Care of instruments
 - 11.2. Preparation and performance of autopsy in brief

Suggested reading:

1. An introduction to Med. Lab. Technology by F.J. Baker & R.E. Silverton, Pb. London Butterworth and Co. Ltd.
2. Handbook of Histopathological Techniques by C.F.A Culling
3. Medical Lab. Technology by Lynch
4. Theory & Practice of Histological Techniques by Jhan D Bancroft & Gamble
5. Handbook of Histopathological & Histochemical Techniques by CFA Culling

DMLS-305: Applied Bacteriology, Mycology & Basic Immunology - Practical

1. Processing and identification of pure bacterial culture
2. Processing of following clinical samples for culture and identification of pathogens
 - 2.1. Blood
 - 2.2. Throat swab
 - 2.3. Sputum
 - 2.4. PUS
 - 2.5. Urine
 - 2.6. Stool
 - 2.7. C.S.F. and other body fluids
3. Processing of water, milk, food and air samples for bacteriological examination
4. To prepare different culture media used in mycology
5. Staining techniques
 - 5.1. KOH Preparation
 - 5.2. LCB

- 5.3. India Ink preparation
6. To observe characteristics of common laboratory contaminants (Fungal)
7. Collection and processing of samples for diagnosis of fungal infections
 - 7.1. Skin
 - 7.2. Nail
 - 7.3. Hair
 - 7.4. Body fluids and secretions
8. To perform;
 - 8.1. Widal test
 - 8.2. VDRL test
 - 8.3. Rose Waller
 - 8.4. ASO and CRP
9. Antimicrobial susceptibility testing
10. To perform antibiotic susceptibility testing of clinical isolates by using
 - 10.1. Stokes method and
 - 10.2. Kirby-Bauer method
11. Collection, transportation and processing of water and air
12. To learn How to dispose of bacterial cultures

DMLS-306: Applied Haematology - Practical

1. ESR estimations (Wintrobe and Westergreen)
2. PCV (Wintrobe and capillary)
3. Absolute Eosinophil counting
4. Reticulocyte counting
5. Red cell fragility test
6. Plasma haemoglobin estimation
7. Fetal haemoglobin test
8. Examination of colorindices
9. Bleeding time and clotting time, PT, PTI, PTTK
10. Clot retraction test
11. Examination of Bone-marrow (from stained slide)
12. Demonstration of LE Cell Smear and its examination (from stained slide)
13. Recognition of various types of blast cells and leukemia (from stained slide)

DMLS-307: Applied Clinical Biochemistry-I - Practical

1. Estimation of blood Sugar (Folin-Wu method, enzyme methods etc.)
2. Performance of GTT
3. Serum Urea estimation
4. Plasma and serum protein estimation
5. Serum cholesterol estimation
6. Estimation of electrolyte level (Na^+ , K^+ and Cl by flame photometer and kit methods)
7. Preparation all types of reagents
8. Estimation of Serum bilirubin
9. Estimation of Phosphorous
10. Estimation of Serum calcium

11. Estimation of Serum creatinine
12. Estimation of Serum uric acid

DMLS-308: Histopathology - Practical

1. Receiving specimen, labeling and cataloguing
2. Preparation of fixatives, fixing of specimen
3. Dehydrating, making solution of various reagents, clearing, impregnation and casting
4. Embedding and cutting of sections
5. Preparation of stains
6. Routine (H & E) and special staining
7. Preparation of various reagents
8. Decalcification
9. Demonstrating of cataloguing of slides blocks
10. Demonstration of dispatching reports and maintenance of records
11. Demonstration of freezing microtone
12. Examination of stained frozen section slides
13. Preparation of museum fixatives

Fourth Semester

DMLS-401: Medical Parasitology and Virology

Rationale: The candidates undergoing training medical laboratory technology are made to learn the techniques of collection of samples, their processing and identification of various parasitic and viral pathogens, using different procedures with special reference to their habitat, morphology, life cycle and their isolation for diagnostic purpose.

1. Introduction to Medical Parasitology
2. General characteristics of protozoa and helminthes
3. Collection, transport, processing and preservation of samples for routine parasitological investigations
4. Morphology, life cycle and lab-diagnosis of Giardia and Entamoeba
5. Morphology, Life cycle and lab-diagnosis of Roundworms and Hookworms
6. Morphology, life cycle and lab-diagnosis of T. solium and T. saginata
7. Morphology, life cycle and lab-diagnosis of malarial parasite with special reference to P.vivax and P. falciparum
8. Laboratory diagnosis of hydrated cyst and cysti-cercoosis
9. Concentration techniques for demonstration of Ova and cysts (principles and applications)
10. Introduction to medical virology
11. Classification of viruses
12. Classification of medically important viruses (Rabies, Polio, HIV, Influenza)
13. Collection, transportation and storage of samples for viral diagnosis
14. Processing of samples for viral diagnosis (Egg inoculation and tissue culture)

Suggested Readings:

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1. Practical Medical Microbiology by Mackie and MacCartney 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. District Laboratory Practice in tropical countries Vol II Microbiology by Monica Cheesbrough
6. Parasitology in relation to Clinical Medicine by K.D. Chatterjee
7. Medical Entomology by A.K. Hati Pub. Allied Book Agency

DMLS-402: Immuno-Haematology/ Blood Banking

Rationale: The candidates are taught the skill of blood collection from donors and preventive measures against communicable diseases. They should be able to perform different investigations, preservation and interpretation.

1. Historical introduction to blood grouping
2. Antigen and antibodies – role in blood grouping
3. Blood collection, preservation of blood in blood bank, anticoagulants used in blood banking
4. Preparation of donor, criteria of an ideal blood donor, history of donor.
5. ABO grouping and its subgroups
6. Rh grouping
7. Cleaning and care of glassware in blood banking.
8. Cross matching - major and minor cross matching, preparation of working antiglobulin, serum, principle and importance of cross matching
9. Preparation and preservation of various blood components for transfusion
10. Coomb's test - preparation of antisera, principle, types and importance of Coomb's test
11. Transfusion reactions - brief introduction
12. Screening of blood for
 - 12.1. AIDS
 - 12.2. Hepatitis
 - 12.3. Syphilis

Suggested readings:

1. Introduction to Medical Laboratory Technology – FJ Baker
2. Medical Laboratory Technology (Volume I & II) by Kanai, L Mukherjee, Swarajit Ghosh
3. Lynch's Medical Lab. Technology by Stanley S. Raphael
4. Practical Haematology by JB Dacie
5. Transfusion Science by Overfield, Hamer
6. Mollison's Blood Transfusion in Clinical Medicine, 12th Edition by Harvey G. Klein

DMLS-403: Applied Clinical Biochemistry- II

Rationale: The candidates are imparted specialized training of theory and practical in the field of clinical biochemistry. The candidates are made to learn special biochemical investigations e.g. LFT, RFT, Electrophoresis chromatography and automation in Clinical Biochemistry etc.

1. SGOT and SGPT
 - 1.1. Principles and procedures of estimation

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- 1.2. Normal and abnormal values
- 1.3. Clinical importance
2. ALP and ACP (Alkaline and Acid Phosphatase)
 - 2.1. Principles and procedures of estimation Normal and abnormal values
 - 2.2. Clinical importance
3. Serum amylase
 - 3.1. Principles and procedures of estimation
 - 3.2. Normal and abnormal values
 - 3.3. Clinical importance
4. Renal Functions Test (RFT)
 - 4.1. Functions of kidney
 - 4.2. Renal clearance tests
 - 4.3. Clinical importance
5. Urine analysis
 - 5.1. Normal composition of urine and its properties
 - 5.2. Clinical importance of urine analysis
 - 5.3. Presence of abnormal constituents like protein, sugar, bile salts and bile pigments
 - 5.4. Quantitative estimation for protein and sugar
 - 5.5. Identification of sugar
 - 5.6. Detailed discussion on glycosuria and albuminuria
 - 5.7. Ketone bodies
6. Stool Chemistry
 - 6.1. Physical characteristics and chemical composition of stool
 - 6.2. Significance of presence of blood and excess fat in stool
 - 6.3. Occult blood – Detection
7. Renal calculi
 - 7.1. Formation, composition and properties of renal calculi
 - 7.2. Principle of procedure for identifying types of renal calculi
8. Cerebro-spinal fluid
 - 8.1. Composition and functions of CSF
 - 8.2. Methods of determination of sugar, chloride, and proteins in CSF
 - 8.3. Normal and abnormal levels
9. Biological fluids: Formation and composition of different biological fluids like peritoneal, pleural, synovial, ascetic fluids
10. Blood gases: Different blood gases and their functions, principles and procedure of determination of CO₂ combining power and oxygen saturation
11. Electrophoresis
 - 11.1. Theory
 - 11.2. Principle and procedure of paper, gel electrophoresis, method of elution
12. Chromatography
 - 12.1. Theory of chromatographic separation between stationary and mobile phases
 - 12.2. Different chromatographic methods like paper, column and thin layer chromatography.
 - 12.3. Method of separation
13. Automation in biochemistry

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

DMLS-404: Immunopathology and Cytopathology

Rationale: The candidates are imparted basic training of theoretical and practical in the field of Immunopathology. The candidates are made to learn the technique of collection of clinical samples and their processing along with recording of data. The student will also obtain the basic knowledge of Immunity and the cells involved, which are routinely estimated in different diseases so that a clear understanding of the different tests is obtained. The students are also given basic training in safety measures quality control and automation. In addition the training in Cytology is aimed at preparing the students for preparing exfoliate smears/ sections of various types and stain them. Candidate will able to provide special stain for detailed information. Candidate should be able to collect exfoliate cytology smears, carry out routine and special staining procedures.

[A] Immunopathology

1. Cells and organs of the immune system.
2. Antigens, antibodies and humeral immune response.
3. Allergy
4. Rheumatological diseases and investigations
5. Infection and the immune system.
6. Cancer Immunology.
7. Tissue typing for kidney transplant.

Suggested Readings:

1. Immunology by Ivan Roitt, Jonathan Brostoff and David Male
2. Medical Immunology by Daniel P Sites
3. Basic & Clinical Immunology by P. Daniel Fudenberg, H. Hugh and Sites

[B] Cytopathology

1. Exfoliative cytology
 - 1.1. Preparation of vaginal and cervical smears
 - 1.2. PAP smears and its fixation
 - 1.3. Preparation of PAP stains, cell blocks
 - 1.4. Staining techniques (PAP, H&E and Giemsa)
 - 1.5. Interpretation of results
 - 1.6. Various body fluid processing like Urine, Sputum, Fluids (Pleural, Pericardial and Peritoneal), CSF etc.
2. Aspiration Cytology principles, indications & utility of the technique with special emphasis on role of cytotechnologist in FNAC clinics
3. Barr body analysis

Suggested readings:

1. Introduction to Medical Laboratory Technology – F.J. Baker

2. Medical Laboratory Technology (Volume I & II) by Kanai, L. Mukherjee, Swarjit Ghosh
3. Lynch's Medical Lab. Technology by Stanley S. Raphael

DMLS-405: Medical Parasitology and Virology - 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 segments
 - 2.2. Ascaris
 - 2.3. Hookworms
 - 2.4. Pinworms
3. Malarial parasite
 - 3.1. Preparation of thin and thick blood smears
 - 3.2. Staining of smears
 - 3.3. Examination of smears for malarial parasites (*P. vivax* and *P. falciparum*)
 - 3.4. Demonstration of various stages of life cycle of malarial parasites from stained slides
4. To demonstrate structure of viruses and their multiplication from charts etc.
5. To perform Giemsa's stain, Saller's stain.
6. Demonstration of fertilized hen egg
7. Demonstration of various inoculation routes in fertilized hen egg

DMLS-406: Immuno-Haematology/ Blood Banking - Practical

1. Demonstration of equipment/ material for blood collection
2. Cleaning of glassware
3. ABO and Rh grouping
4. Cross match - Major and Minor
5. Preparation of ACD and CPO anticoagulants

DMLS-407: Applied Clinical Biochemistry- II -Practical

1. Various methods employed for:
 - 1.1. Renal clearances tests
 - 1.2. SGOT estimation
 - 1.3. SGPT estimation
 - 1.4. ALP estimation
 - 1.5. ACP estimation
2. Analysis of urine for sugar and proteins (Qualitative and quantitative)
3. Occult blood test using stool specimen
4. Qualitative analysis of renal calculi
5. Estimation of sugar proteins, chlorides in CSF
6. Serum amylase estimation

7. Titration for acidity determination and qualitative analysis of gastric juice
8. Demonstration of electrophoresis and chromatography
8. Preparation of buffers strips, gels, column etc.

DMLS-408: Immunopathology and Cytopathology - Practical

1. Cell separation by density gradient
2. ELISA
3. Serum electrophoresis
4. Immuno-electrophoresis
5. Pregnancy test for HCGH
6. PAP staining and interpretation of results
7. To perform Papnicolaou's stain on cervical smear
8. To process samples using cytospin
9. To perform Guard's staining for demonstration sex chromatin (Barr bodies on a buccal smear)
10. Liquid based Cytology : Principle and Preparation

Fifth Semester

Internship:

The internship will be for a span of 6 months/ 1 semester. This will include 6 hours of practice a day, totaling to 720 hours during internship 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 Technologists

Skills based outcomes and monitorable indicators for DMLS:

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:
 - 2.1. Demonstrate ability to understand investigation/ test requisition.
 - 2.2. Collecting the relevant clinical samples alongwith complete and accurate documentation with proper safety measures in relation to sample accountability.
 - 2.3. To transport the samples with precautionary measures to the relevant lab section.
 - 2.4. Demonstrate the ability to prepare clinical sample for processing.

- 2.5. To demonstrate the knowledge of accurate sample processing for the required routine lab investigation.
- 2.6. Perform routine clinical laboratory tests in Clinical chemistry, Hematology/ haemostasis, Immunology, Immunopathology, Immunohaematology, Microbiology, Histopathology, Cytopathology, body fluid analysis, and laboratory operations.
- 2.7. Ability to record and report the test results/ data
3. Apply basic scientific principles in learning new techniques/ procedures; demonstrate application of principles and methodologies
4. Utilize computer technology applications to interact with computerized instruments and laboratory information systems
5. Demonstrate adequate knowledge of computer software as it applies to document production, spreadsheets, and presentations
6. Demonstrate professional behavior with co-team mates
7. Demonstrate sensitivity and compassion towards patients