

COMPETENCY BASED CURRICULUM

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY

(Duration 03 Years)
NSQF Level – 5



Under
Haryana State Board of Technical Education



Developed By

Curriculum Development Center
National Institute of Technical Teachers Training & Research
(Ministry of Education, Government of India)
Sector - 26, Chandigarh, UT, India

TABLE OF CONTENTS

Sr. No.	Description	Page No.
1	Preface	i – i
2	Acknowledgement	ii – ii
3	Salient Features	iii – iii
4	NSQF Compliance	iv – vii
5	NEP 2020	viii– ix
6	Diploma Programme Outcomes	x– x
7	Diploma Programme Study and Evaluation Scheme	xi – xvii
8	Diploma Programme Horizontal and Vertical Organization of Subjects	xviii– xviii
9	Deriving Curriculum Subject Areas from Diploma Programme Outcomes	xix – xix
FIRST YEAR NSQF LEVEL – 3		
10	Competency Profile and Employment Opportunities	1 - 1
11	Programme Outcomes	2 - 2
12	Study and Evaluation Scheme	3 - 4
13	Horizontal and Vertical Organization of Subjects	5 - 5
14	Assessment of Programme and Course Outcomes	6 - 8
15	Subjects & Detailed Contents	9 - 48
SECOND YEAR NSQF LEVEL – 4		
16	Competency Profile and Employment Opportunities	
17	Programme Outcomes	
18	Study and Evaluation Scheme	
19	Horizontal and Vertical Organization of Subjects	
20	Assessment of Programme and Course Outcomes	
21	Subjects & Detailed Contents	
THIRD YEAR NSQF LEVEL – 5		
22	Competency Profile and Employment Opportunities	
23	Programme Outcomes	
24	Study and Evaluation Scheme	

25	Horizontal and Vertical Organization of Subjects	
26	Assessment of Programme and Course Outcomes Subject Contents	
27	Subjects & Detailed Contents	
EFFECTIVE IMPLEMENTATION & EVALUATION TOOLS		
28	Assessment Tools & Criterion	xx - xxiv
29	Teaching Learning Tools for Effective Implementation	xxv - xxviii
30	List of Experts and Reviewers	xxix - xxx

1. PREFACE

Learning and learning experience are the foundation of any education system. Appropriateness of education and its useful implications stand on the platform of knowledge and skill. But the knowledge and skill cannot be quantified qualitatively without ensuring learning experience. Curriculum is the pathway to select and organise learning experience. It helps the teachers to provide tangible resources, goals and objectives to learners. Curriculum acts as a catalyst to stimulate creativity, innovation, ethics, values, responsibility and many human factors. Curriculum embodies rigour and high standards and creates coherence to empower learner to meet the industrial and societal needs. Curriculum is a central guide for a teacher to plan a standard based sequence for the instructional delivery.

The industrial revolution 4.0 has forced the technical education system to reinvent the curriculum to meet the human resource requirement of the industry. The data driven systems relying on the subjects like machine-learning, Artificial Intelligence, Data Science etc. are literally forcing the technical education system to offer different subjects differently to address the emerging challenges. The non-linear way of learning now facilitates students to choose path of knowledge to skill or vice-versa. The bi-directional process requires innovative curriculum design and revision. Diploma programme is now more challenging than ever. The level of skill and knowledge demanded by industry from diploma holders are highly interdisciplinary at the same time address special need. Hence, there is a need to align the curriculum to National Skill Qualification Framework (NSQF).

National Education Policy, NEP-2020 has now opened up diversities for the education system to explore and exploit to make the education relevant. The policy emphasises to inculcate value, ethics, respect to culture and society etc along with industry ready knowledge and skill among the students. The interdisciplinary nature of curriculum, academic bank of credits and integration of technology in teaching- learning envisaged in NEP-2020 make it more challenging for curriculum development. NITTTR, Chandigarh has developed the art of curriculum development over 54 years of its existence. The expertise and experience available in the institute follow time-tested and acclaimed scientific methods to design/revise curriculum. The experienced faculty members entrusted with the curriculum development or revision activities are well-versed with NSQF, NEP and Outcome based education. I am happy to note that **Haryana State Board of Technical Education, Panchkula, Haryana** reposed their confidence on this expertise to develop **AICTE/NSQF/NEP 2020** aligned curriculum for the state. This documented curriculum is an outcome of meticulous planning and discussions among renowned experts of the subject through series of workshops. The effective implementation of this curriculum supported with quality instructional resources will go a long way in infusing the learning experience among learners to make them industry ready.

Prof. (Dr.) S. S. Pattnaik

Director

National Institute of Technical Teachers Training & Research, Chandigarh

2. ACKNOWLEDGEMENT

We gratefully acknowledge the assistance and guidance received from the following persons:

- i) Principal Secretary Technical Education-cum-Chairman, Haryana State Board of Technical Education, Panchkula, Haryana for initiating this project on designing of AICTE/NSQF/NEP 2020 aligned curriculum.
- ii) Director General, Technical Education, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.
- iii) Secretary, Haryana State Board of Technical Education, Panchkula, Haryana for his untiring assistance and support in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.
- iv) Management Officials of Haryana State Board of Technical Education, Panchkula, Haryana for taking keen interest in the design of this AICTE/NSQF/NEP 2020 aligned curriculum.
- v) Director, National Institute of Technical Teachers' Training and Research, Chandigarh for his support and academic freedom provided to Curriculum Development Centre.
- vi) All the participants from Industry / field Organizations, Academic Institutions, State Technical Universities / Polytechnics for their professional & academic inputs during curriculum workshops.
- vii) Head, Faculty and staff of Curriculum Development Centre, NITTTR, Chandigarh for their dedicated contribution and support in design of NSQF aligned curriculum.
- viii) Faculty from different departments of NITTTR, Chandigarh for their valuable inputs in design of NSQF aligned curriculum.

Prof. (Dr.) Rajesh Mehra
Project Coordinator & Head Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

3. SALIENT FEATURES

1. Name : ***Diploma in Medical Laboratory Technology***
2. Duration : **03 Years**
3. Hours per week : **35 –40**
4. Entry Qualification : **10thPass**
5. Student Intake : **As per sanctioned strength**
6. Pattern : **Semester**
7. Scheme : **Multi Pont Entry and Exit**
8. NSQF Level : **5**
9. Theory Practical Ratio : **30 :70**
10. Project Work : **3rd year full Practical Training**
11. In-house/Industrial Training : **Mandatory after First and Second Year**

4. NSQF COMPLIANCE



National Skill Qualification Framework has defined total Ten Levels. Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Fig1: NSQF Domains

NSQF LEVEL - 3 COMPLIANCE

The NSQF level - 3 descriptor is as follows:

Process	Person may carry out a job which may require limited range of activities routine and predictable.
Professional Knowledge	Basic facts, process and principle applied in trade of employment.
Professional Skill	Recall and demonstrate practical skill, routine and repetitive in narrow range of application.
Core Skill	Communication written and oral, with minimum required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	Under close supervision. Some responsibility for own work within defined limit.

Fig 2: NSQF Level – 3 Descriptor

Work requiring knowledge, skills and aptitudes at level 3 will be routine and predictable. Job holders will be responsible for carrying out a limited range of jobs under close supervision. Their work may require the completion of a number of related tasks. People carrying out these job roles may be described as “Semi skilled workers”. Individuals in jobs which require level 3 qualifications will normally be expected to be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation and should know the basic facts, processes and principles applied in the trade for which they are qualified and be able to apply the basic skills of the trade to a limited range of straightforward jobs in the occupation.

They will be expected to understand what constitutes quality in their job role and more widely in the sector or sub-sector and to distinguish between good and bad quality in the context of the jobs they are given. Job holders at this level will be expected to carry out the jobs they are given safely and securely. They will work hygienically and in ways which show an understanding of environmental issues. This means that they will be expected to take responsibility for their own health and safety and that of fellow workers and, where appropriate, customers and/or clients. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social environment. They should be able to make a good contribution to team work.

NSQF LEVEL - 4 COMPLIANCE

The NSQF level-4 descriptor is given below:

Process	• Work in familiar, predictable, routine, situation of clear choice
Professional Knowledge	• Factual knowledge of field of knowledge or study.
Professional Skill	• Recall and demonstrate practical skill, routine and repetitive in narrow range of application, using appropriate rule and tool, using quality concepts.
Core Skill	• Communication written and oral, with required clarity, skill of basic arithmetic and algebraic principles, personal banking, basic understanding of social and natural environment.
Responsibility	• Responsibility for own work and learning.

Fig 3: NSQF Level – 4 Descriptor

Work requiring knowledge, skills and aptitudes at level 4 will be carried out in familiar, predictable and routine situations. Job holders will be responsible for carrying out a range of jobs, some of which will require them to make choices about the approaches they adopt. They will be expected to learn and improve their practice on the job. People carrying out these jobs may be described as “skilled workers”. Individuals in jobs which require level 4 qualifications should be able to communicate clearly in speech and writing and may be required to use arithmetic and algebraic processes. They will be expected to have previous knowledge and skills in the occupation in which they are employed, to appreciate the nature of the occupation and to understand and apply the rules which govern good practice. They will be able to make choices about the best way to carry out routine jobs where the choices are clear.

They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their job roles. Job holders at this level will be expected to carry out their work safely and securely and take full account of the health and safety on colleagues and customers. They will work hygienically and in ways which show an understanding of environmental issues. In working with others, they will be expected to conduct themselves in ways which show a basic understanding of the social and political environment. They should be able to guide or lead teams on work within their capability.

NSQF LEVEL - 5 COMPLIANCE

The NSQF level-5 description is given below:

Process	• Job that requires well developed skill, with clear choice of procedures in familiar context.
Professional Knowledge	• Knowledge of facts, principles, processes and general concepts, in a field of work or study.
Professional Skill	• A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.
Core Skill	• Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.
Responsibility	• Responsibility for own work and learning and some responsibility for others' works and learning

Fig 4: NSQF Level – 5 Descriptor

Work requiring knowledge, skills and aptitudes at level 5 will also be carried out in familiar situations, but also ones where problems may arise. Job holders will be able to make choices about the best procedures to adopt to address problems where the choices are clear. Individuals in jobs which require level 5 qualifications will normally be responsible for the completion of their own work and expected to learn and improve their performance on the job. They will require well developed practical and cognitive skills to complete their work. They may also have some responsibility for others' work and learning. People carrying out these jobs may be described as “fully skilled workers” or “supervisors”.

Individuals employed to carry out these jobs will be expected to be able to communicate clearly in speech and writing and may be required to apply mathematical processes. They should also be able to collect and organize information to communicate about the work. They will solve problems by selecting and applying methods, tools, materials and information. They will be expected to have previous knowledge and skills in the occupation, and to know and apply facts, principles, processes and general concepts in the occupation. They will be expected to understand what constitutes quality in the occupation and will distinguish between good and bad quality in the context of their work. They will be expected to operate hygienically and in ways which show an understanding of environmental issues. They will take account of health and safety issues as they affect the work they carry out or supervise.

In working with others, they will be expected to conduct themselves in ways which show an understanding of the social and political environment.

5. NATIONAL EDUCATION POLICY (NEP) -2020

NEP 2020 aims at a comprehensive holistic education to develop all capacities of human beings - intellectual, aesthetic, social, physical, emotional, and moral - in an integrated manner. A holistic arts education will help develop well-rounded individuals that possess: critical 21st century capacities in fields across the arts, humanities, languages, sciences, social sciences, and professional, technical, and vocational fields; an ethic of social engagement; soft skills, such as communication, discussion and debate; and rigorous specialization in a chosen field or fields. Such a holistic education shall be, in the long term, the approach of all undergraduate programmes, including those in professional, technical, and vocational disciplines.

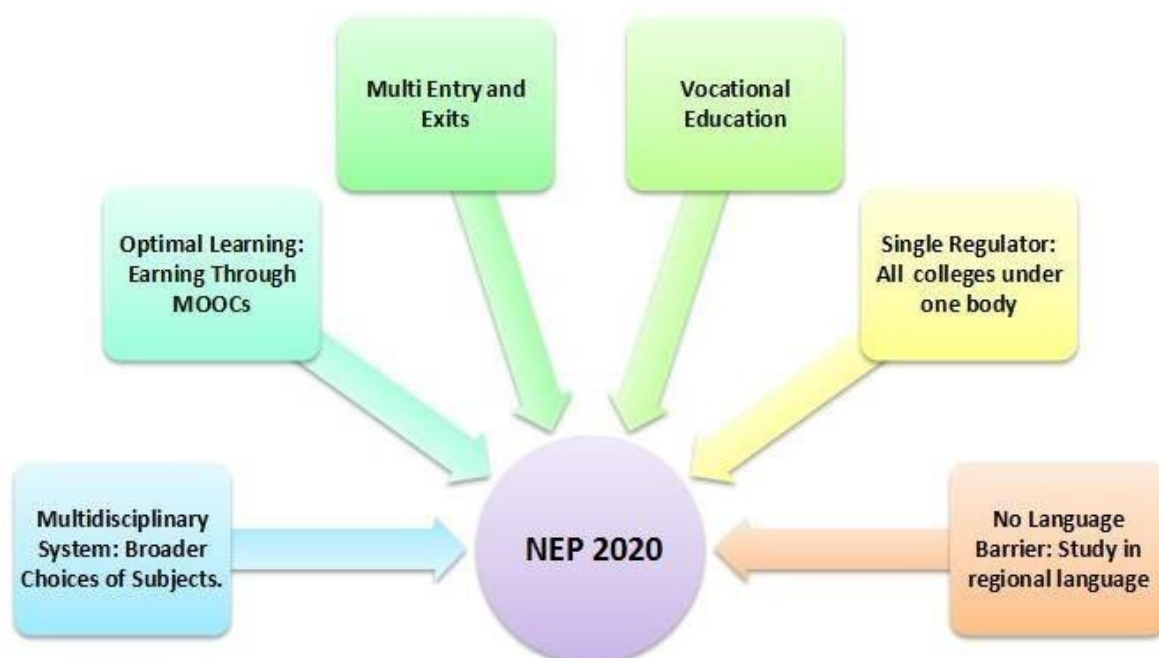


Fig 5: NEP 2020

Flexibility in curriculum and novel and engaging course options will be on offer to students, in addition to rigorous specialization in a subject or subjects. Pedagogy for courses will strive for significantly less rote learning and an increased emphasis on communication, discussion, debate, research, and opportunities for cross-disciplinary and interdisciplinary thinking. The flexible and innovative curriculum shall emphasize on offering credit-based courses and projects in the areas of community engagement and service, environmental education and value-based education. as part of a holistic education, students will be provided with opportunities for internships with local industry,

businesses, artists, crafts persons, villages and local communities, etc. as well as research internships with faculty and researchers at their own or other HEIs or research institutions, so that students may actively engage with the practical side of their learning and, as a by-product, further improve their employability.

Effective learning requires relevant curriculum, engaging pedagogy, continuous formative assessment and adequate student support. The curriculum must be updated regularly aligning with the latest knowledge requirements and shall meet specified learning outcomes. High-quality pedagogy is then necessary to successfully impart the curricular material to students; pedagogical practices determine the learning experiences that are provided to students - thus directly influencing learning outcomes. The assessment methods have to be scientific and test the application of knowledge. Higher Education Institutes should move to a criterion-based grading system that assesses student achievement based on the learning goals for each programme, making the system fairer and outcomes more comparable. HEIs should also move away from high-stakes examinations towards more continuous and comprehensive evaluation.

6. DIPLOMA PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this programme, the student will be able to:

PO1: Perform tasks in limited range of activities, familiar situation with clear choice of procedures.

PO2: Acquire knowledge of principles and processes in the field of Medical Laboratory Technology

PO3: Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Take the responsibility of own works and supervises others work.

PO6: Select multidisciplinary and open subjects of own interest and perform self learning through Massive Open Online Courses.

7. DIPLOMA PROGRAMME STUDY AND EVALUATION SCHEME FIRST

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME		Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
		Periods/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
1.1	* English & Communication Skills - I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	Basic Chemistry	2	2	2+1=3	40	40	80	60	60	120	200
1.3	Anatomy and Physiology-I	3	2	3+1=4	40	40	80	60	60	120	200
1.4	Basic Microbiology	3	4	3+2=5	40	40	80	60	60	120	200
1.5	Introduction to Hematology	3	4	3+2=5	40	40	80	60	60	120	200
1.6	Fundamentals of MLT	3	2	3+1=4	40	40	80	60	60	120	200
	#Student Centered Activities	-	3								
Total		16	19	16+8=24	240	240	480	360	360	720	1200

* Common with other diploma programmes

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation contests, Educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME		Credits	MARKS IN EVALUATION SCHEME						Total Marks of
		Periods/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
2.1	Anatomy and Physiology-II	3	2	3+1=4	40	40	80	60	60	120	200
2.2	Bacteriology	3	2	3+1=4	40	40	80	60	60	120	200
2.3	Applied Hematology	3	4	3+2=5	40	40	80	60	60	120	200
2.4	Clinical Biochemistry	3	4	3+2=5	40	40	80	60	60	120	200
2.5	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
2.6	*Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
#Student Centered Activities		-	3								
Total		16	19	16+8=24	240	200	440	360	300	660	1100

* Common with other diploma programmes

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India contests, Educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

Summer Internship/In-house Training: After 2nd semester, students shall undergo Summer Internship of 4 Weeks.

THIRD SEMESTER (MEDICAL LABORATORY TECHNOLOGY)

Sr. No	Subject	STUDY SCHEME HOURS / WEEK L T P			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
3.1	Clinical Microbiology- III	3	-	3	25	25	100	3	50	3	200
3.2	Haematology-III	3	-	3	25	25	100	3	50	3	200
3.3	Clinical Biochemistry-III	3	-	3	25	25	100	3	50	3	200
3.4	Histopathology & Cytology-I	3	-	3	25	25	100	3	50	3	200
3.5	Transfusion Medicine (Blood Banking)	3	-	2	25	25	100	3	50	3	200
3.6	*Employability Skills – I	-	-	2	-	25	-	-	50	3	75
# Student Centered Activities including Entrepreneurial Awareness Camp		-	-	4	-	25	-	-	-	-	25
Total		15	-	20	125	175	500	-	300		1100

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures, library studies, games, hobby clubs e.g. photography, painting, singing, seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, Civil Defence/Disaster Management activities etc.

Sr. No	Subject	STUDY SCHEME HOURS / WEEK L T P			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
4.1	Clinical Microbiology-IV	3	-	3	25	25	100	3	50	3	200
4.2	Haematology-IV	3	-	3	25	25	100	3	50	3	200
4.3	Clinical Biochemistry-IV	3	-	3	25	25	100	3	50	3	200
4.4	Histopathology & Cytology-II	4	-	3	25	25	100	3	50	3	200
4.5	Medical Laboratory Management	4	-	-	50	-	100	3	-	-	150
4.6	*Employability Skills - II	-	-	2	-	25	-	-	50	3	75
# Student Centered Activities including Personality Development Awareness Camp		-	-	4	-	25	-	-	-	-	25
Total		17	-	18	150	150	500	-	250	-	1050

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures, library studies, games, hobby clubs e.g. photography, painting, singing, seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, Civil Defence/Disaster Management activities etc.

Sr. No	Subject	STUDY SCHEME HOURS / WEEK L T P			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
5.1	Practical Professional Training-1 (Structured and Supervised)	-	-	35	-	300	-	-	500	3	800
	Total	-	-	35	-	300	-	-	500	3	800

SIXTH SEMESTER (MEDICAL LABORATORY TECHNOLOGY)

Sr. No	Subject	STUDY SCHEME HOURS / WEEK L T P			EVALUATION SCHEME						Total Marks
					Internal Assessment		External Assessment (Examination)				
					Theory	Practical	Written Paper		Practical		
					Max. Marks	Max. Marks	Max. Marks	Hrs	Max. Marks	Hrs	
6.1	Practical Professional Training-1 (Structured and Supervised)	-	-	35	-	300	-	-	500	3	800
	Total	-	-	35	-	300	-	-	500	3	800

8. DIPLOMA PROGRAMME HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects/Areas	Hours Per Week	
		First Semester	Second Semester
1.	English & Communication Skills - I	4	-
2.	Basic Chemistry	4	-
3.	Anatomy and Physiology-I	5	-
4.	Basic Microbiology	7	-
5.	Introduction to Hematology	7	-
6.	Fundamentals of MLT	5	-
7.	Anatomy and Physiology-II	-	5
8.	Bacteriology	-	5
9.	Applied Hematology	-	7
10.	Clinical Biochemistry	-	7
11.	Fundamentals of IT	-	6
12.	Environmental Studies and Disaster Management	-	2
13.	Student Centered Activities	3	3
Total		35	35

9. DERIVING CURRICULUM SUBJECT AREAS FROM DIPLOMA PROGRAMME OUTCOMES

The following curriculum areas have been derived from Diploma Programme Outcomes:

Sr. No.	Programme Outcomes	Curriculum Subjects / Areas
1.	Perform tasks in limited range of activities, familiar situation with clear choice of procedures.	• Basic Chemistry • Anatomy and Physiology-I • Basic Microbiology • Introduction to Hematology • Fundamentals of MLT
2.	Acquire knowledge of principles and processes in Medical Laboratory Technology related field.	• Anatomy and Physiology-II • Bacteriology • Applied Hematology • Clinical Biochemistry
3.	Develop skills to accomplish quality tasks and solve problems using methods, tools, materials and information.	• Basic Microbiology • Introduction to Hematology • Clinical Biochemistry • Applied Hematology • Bacteriology
4.	Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• English & Communication Skills – I • Fundamentals of IT • Environmental Studies and Disaster Management
5.	Take the responsibility of own works and supervises others work.	• Summer Internship/In-house Training
6.	Select multidisciplinary and open subjects of own interest and perform self learning through Massive Open Online Courses.	• Multidisciplinary Elective • Open Elective

FIRST YEAR NSQF LEVEL - 3

10. COMPETENCY PROFILE AND EMPLOYMENT OPPORTUNITIES

In government and private sectors related to Medical Laboratory Technology, “**Semi Skilled workers**” are required to carry out a limited range of predictable tasks under close supervision. They are normally expected to communicate clearly in speech. They should know the basic facts, processes and principles applied in limited area of Medical Laboratory Technology.

Medical Laboratory Technology NSQF Level – 3 pass out students are expected to recall and demonstrate practical routine and repetitive skills, in narrow range of related applications. They should have the basic knowledge of principles of medical laboratory technology. They should demonstrate general testing skills along with awareness of dignity of labour, safety at work place, team working and right attitude. They should have good knowledge of physical principles and analysis in various technical fields. They are expected to handle wide variety of instruments while testing, trouble shooting, calibration etc. along with the knowledge of working principles and operation of different instruments.

He/she may be employed in the following organizations:

1. Government Hospitals/Private Hospitals/ Primary Health Centres/Private Nursing Homes/Private Diagnostic Centres/Clinics/National Institute of Communicable diseases
2. Medical Colleges/Dental Colleges (Clinical Laboratories)
3. Medical Research Laboratories/Reference laboratories/R&D biotechnology Laboratories
4. Pharmaceutical Firms (analytical kits, instruments etc.)

11. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 3 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Carry out a task which may require limited range of predictable activities.

PO2: Acquire knowledge of Basic facts, process and principles related to medical laboratory technology for employment.

PO3: Demonstrate practical skill in narrow range of medical laboratory technology applications.

PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.

PO5: Perform task under close supervision with some responsibility for own work within defined limit.

FIRST YEAR
12. STUDY CUM EVALUATION SCHEME

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME		Credits	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
		Periods/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
1.1	* English & Communication Skills - I	2	2	2+1=3	40	40	80	60	60	120	200
1.2	Basic Chemistry	2	2	2+1=3	40	40	80	60	60	120	200
1.3	Anatomy and Physiology-I	3	2	3+1=4	40	40	80	60	60	120	200
1.4	Basic Microbiology	3	4	3+2=5	40	40	80	60	60	120	200
1.5	Introduction to Hematology	3	4	3+2=5	40	40	80	60	60	120	200
1.6	Fundamentals of MLT	3	2	3+1=4	40	40	80	60	60	120	200
	#Student Centered Activities	-	3								
Total		16	19	16+8=24	240	240	480	360	360	720	1200

* Common with other diploma programmes

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation contests, Educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME		Credits	MARKS IN EVALUATION SCHEME						Total Marks of
		Periods/Week			INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Total	Th	Pr	Total	
2.1	Anatomy and Physiology-II	3	2	3+1=4	40	40	80	60	60	120	200
2.2	Bacteriology	3	2	3+1=4	40	40	80	60	60	120	200
2.3	Applied Hematology	3	4	3+2=5	40	40	80	60	60	120	200
2.4	Clinical Biochemistry	3	4	3+2=5	40	40	80	60	60	120	200
2.5	*Fundamentals of IT	2	4	2+2=4	40	40	80	60	60	120	200
2.6	*Environmental Studies and Disaster Management	2	-	2+0=2	40	-	40	60	-	60	100
#Student Centered Activities		-	3								
Total		16	19	16+8=24	240	200	440	360	300	660	1100

* Common with other diploma programmes

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Games, Yoga, Human Ethics, Knowledge of Indian System, Hobby clubs e.g. Photography etc., Seminars, Declamation contests, Educational field visits, N.C.C., NSS, Cultural Activities and self study etc.

Summer Internship/In-house Training: After 2nd semester, students shall undergo Summer Internship of 4 Weeks.

13. HORIZONTAL AND VERTICAL ORGANISATION OF SUBJECTS

Sr. No.	Subjects/Areas	Hours Per Week	
		First Semester	Second Semester
1.	English & Communication Skills - I	4	-
2.	Basic Chemistry	4	-
3.	Anatomy and Physiology-I	5	-
4.	Basic Microbiology	7	-
5.	Introduction to Hematology	7	-
6.	Fundamentals of MLT	5	-
7.	Anatomy and Physiology-II	-	5
8.	Bacteriology	-	5
9.	Applied Hematology	-	7
10.	Clinical Biochemistry	-	7
11.	Fundamentals of IT	-	6
12.	Environmental Studies and Disaster Management	-	2
13.	Student Centered Activities	3	3
Total		35	35

14. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be assessed	Assessment criteria for the Course Outcomes
PO1: Carry out a task which may require limited range of predictable activities.	• Identify the elements performing essential work in humans. • Identify macro- molecules of importance in humans. • Use necessary standards to perform the biochemical analysis. • Explain the principle behind colorimetric analysis. • Prevent the various hazards possible while performing work in lab. • Identify basic tissues of the body • Explain skeletal system in humans. • Describe the muscular system. • Explain the cardiovascular system and respiratory system.
PO2: Acquire knowledge of Basic facts, process and principles related to medical laboratory technology for employment.	• Explain Microscopy and staining techniques • Describe the principle of Morphology and physiology of Bacteria • Describe the principle of blood Composition • Identify and use various Anticoagulants • Identify and use various stains. • Select appropriate equipment for a given type of analysis. • Operate various equipments following standard operating procedures. • Maintain various equipments in functional condition. • Explain nervous system in humans. • Discuss the circulatory system. • Describe Endocrine system and Reproductive system. • Explain General characteristics of bacteria

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY		NSQF LEVEL-3
	• Identify Nosocomial Infection • Describe the principle of Bacterial pathogenic it.	
PO3: Demonstrate practical skill in narrow range of medical laboratory technology applications.	• Collect blood samples. • Identify and use Culture Media and culture techniques • Perform sterilization work in lab. • Perform Haemocytometry • Identify Blood cell morphology in health and disease • Perform all clinical biochemistry tests along with recording of data • Use necessary standards to perform the biochemical analysis • Perform Laboratory diagnosis of infectious diseases.	
PO4: Demonstrate skill of communication, basic mathematics, collecting and organizing information along with knowledge of social, political and natural environment.	• Identify the nuances of Communication, both Oral and Written. • Acquire knowledge of the meaning of communication, communication process and speaking skills. • Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication. • Communicate effectively with an increased confidence to read, write and speak in English language fluently. • Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers. • Handle the Computer / Laptop / Mobiles / Internet Utilities and Install/Configure OS. • Assemble a PC and connect it to external devices. • Manage and Use Office practiced Automation Tools. • Develop worksheets and Prepare presentations.	

DIPLOMA IN MEDICAL LABORATORY TECHNOLOGY	NSQF LEVEL-3
	• Comprehend the importance of sustainable ecosystem • Demonstrate interdisciplinary nature of environmental issues • Implement corrective measures for the abatement of pollution. • Identify the role of non-conventional energy resources in environmental protection. • Manage various types of disasters
PO5: Perform task under close supervision with some responsibility for own work within defined limit.	• Identify basic tissues of the body • Identify Blood cell morphology in health and disease • Perform all clinical biochemistry tests along with recording of data • Use necessary standards to perform the biochemical analysis • Select appropriate equipment for a given type of analysis. • Operate various equipments following standard operating procedures. • Maintain various equipments in functional condition.

15. SUBJECTS & DETAILED CONTENTS

FIRST SEMESTER

FIRST SEMESTER

1.1	* English & Communication Skills - I	09-11
1.2	Basic Chemistry	12-14
1.3	Anatomy and Physiology-I	15-18
1.4	Basic Microbiology	19-22
1.5	Introduction to Hematology	23-26
1.6	Fundamentals of MLT	27-29

1.1 ENGLISH & COMMUNICATION SKILLS – I

<i>L</i>	<i>P</i>
2	2

RATIONALE

Language as the most commonly used medium of self-expression remains indispensable in all spheres of human life –personal, social and professional. This course is intended to break fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework. This course is designed to help students to acquire the concept of communication and develop an ability or skills to use them effectively to communicate with the individuals and community.

COURSE OUTCOMES

After undergoing this course, the students will be able to:

- CO1: Identify the nuances of Communication, both Oral and Written.
- CO2: Acquire knowledge of the meaning of communication, communication process and Speaking skills.
- CO3: Acquire enhanced vocabulary and in-depth understanding of Grammatical Structures and their usage in the communication.
- CO4: Communicate effectively with an increased confidence to read, write and speak in English language fluently.

DETAILED CONTENTS

UNIT I

Reading

Techniques of reading: Skimming and Scanning
Extensive and Intensive Reading: Textual Study
Homecoming – R.N. Tagore
Life Sketch of Sir Mokshagundam Visvesvarayya
Life Sketch of Dr. Abdul Kalam
Narayan Murthy's speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

Concept and Process of Communication,

Types of Communication (Verbal Communication)

Barriers to Communication

Speaking Skill: Significance and essentials of Spoken Communication

Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

Nouns

Pronouns

Articles

Verbs(Main and Auxiliary)

Tenses

UNIT IV

Writing Skills

Significance, essentials and effectiveness of Written Communication

Notice Writing

Official Letters and E-mails.

Frequently-used Abbreviations used in Letter-Writing

Paragraph Writing

Netiquettes

PRACTICAL EXERCISES

1 Reading

Reading Practice of lessons in the Lab Activity classes.

- i. Comprehension exercises of unseen passages along with the lessons prescribed.
- ii. Vocabulary enrichment and grammar exercises based on the selected readings.
- iii. Reading aloud Newspaper headlines and important articles.

2 *Fundamentals of Communication*

- i. Introducing oneself, others and leave- taking(talking about yourself)
- ii. Just a minute (JAM) sessions: Speaking extempore for one minute on given topics
- iii. Situational Conversation: Offering-Responding to offers; Congratulating; Apologising and Forgiving; Complaining; Talking about likes and dislikes, Self-introduction Mock Interviews.

3 *Grammar and Usage*

- i. Written and Oral Drills will be undertaken in the class to facilitate holistic linguistic competency among learners.

- ii. Exercises on the prescribed grammar topics.

4 Writing Skills

- i. Students should be given Written Practice in groups so as to inculcate team-spirit and collaborative learning .
- ii. Group exercises on writing paragraphs on given topics.
- iii. Opening an e-mail account, receiving and sending emails

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, “Text Book of English and Communication Skills Vol – 2”, M/S Abhishek Publications, Chandigarh.
2. V Sasikumar & PV Dhamija, “Spoken English”, Tata MC Graw Hills, New Delhi, Second Edition.
3. JK Gangal, “A Practical Course in Spoken English”, PHI Learning Pvt. Ltd., New Delhi.
4. NK Aggarwal and FT Wood, “English Grammar, Composition and Usage”, Macmillan Publishers India Ltd., New Delhi.
5. RC Sharma and Krishna Mohan, “Business Correspondence & Report writing”, Tata MC Graw Hills, New Delhi, Fourth Edition.
6. Kavita Tyagi & Padma Misra, “Professional Communication”, PHI Learning Pvt. Ltd., New Delhi.
7. Nira Konar, “Communication Skills for professionals”, PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan & Meera Banerji, “Developing Communication Skills”, Macmillan Publishers India Ltd., New Delhi, Second Edition
9. M. Ashraf Rizwi, “Effective Technical Communication”, Tata MC Graw Hills, New Delhi.
10. Andrea J Rutherford, “Basic Communication Skills for Technology”, Pearson Education, New Delhi.

INSTRUCTIONAL STRATEGY

This is practice based subject and topics taught in the class should be practiced in the Lab regularly for development of required communication skills in the students. This subject contains four units of equal weightage.

BASIC CHEMISTRY

<i>L</i>	<i>P</i>
2	2

RATIONALE

The role of chemistry and chemical products in every field of life is expanding greatly. Now a days various products of chemical industries are playing important role in the medical field and the number of such products is increasing. Chemistry is one of the important subjects for diploma students in Medical Lab. Technology for developing in them scientific temperament and understanding other subjects in their profession efforts should be made to teach the subject through demonstration and with the active involvement of students.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify the elements performing essential work in humans.

CO2: Identify macro- molecules of importance in humans.

CO3: Use necessary standards to perform the biochemical analysis.

CO4: Explain the principle behind colorimetric analysis.

CO5: Prevent the various hazards possible while performing work in lab.

DETAILED CONTENTS***UNIT I***

1. Biologically important elements, study of their atomic number, mass number, atomic mass, equivalent weight & molecular weight. Importance of Basic chemistry in medical laboratory technology.
2. Importance of Water quality and Glasswares in clinical laboratory: different types of glassware's, use, cleaning, standardization of volumetric glassware & maintenance. Pipettes - various types and different pipetting techniques.
3. Biochemical importance of distilled water and deionised water in clinical analysis. Solution and colloids – importance of colloids in biological system. Surface tension, osmosis and viscosity their importance in biological system.

UNIT II

Definition of organic and inorganic compounds. Importance of organic compounds – in Biological system. Basic chemistry of carbohydrates, proteins and lipids - Their nutritional effect in humans.

UNIT III

Physiological importance of Acid & Bases and role of pH in human system. Oxidation and Reduction reactions –Definition. Preparation of various standard solutions – definition of primary & secondary standards, SI units and their uses.

UNIT IV

Principles of photometry, Laws of photometry, its importance - quantification of biomolecules in micro concentration. Principles used in determining concentration of molecules with no known weight - preparation of standard graph.

UNIT V

Blood collection for biochemical analysis, changes occurring in blood after collection, management of its disposal. Different types of Hazards- Biological, Chemical, fire, apparatus. Safety measures needed in Basic chemistry and clinical biochemistry laboratory. Assuring Good Laboratory Practices (GLP) in Basic chemistry.

PRACTICAL EXERCISES**UNIT I**

- a) Glassware Identification - different types, cleaning and preparation of cleaning solution.
- b) Standardization, rechecking of volumetric glasswares.

UNIT II

- a) Determination of pH of different solutions.
- b) Titration of Acid and Base.

UNIT III

- a) Performing confirmatory tests for
 - a. Carbohydrate –Molisch,
 - b. Protein- Biuret.

UNIT IV

- a) Identification of Parts of Colorimeter & Spectrophotometer.
- b) Preparation of different types of standards solution.

UNIT V

Determination of Absorption maximum of a coloured solution.

RECOMMENDED BOOKS

1. A Procedure Manual for Routine Diagnostic Tests Vol. I and III by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. A Textbook of Medical Laboratory Technology by P Godkar; Bhalani Publishing House, Mumbai
3. Engineering Chemistry by Shashi Chawla.
4. Progressive Applied Chemistry – by Dr. G. H. Hugar Eagle Prakashan Jalandhar

INSTRUCTIONAL STRATEGY

Teacher may take help of various models and charts while giving instructions to make the concepts clear. More stress may be laid on practical applications of various chemical processes and reactions. In addition, students should be encouraged to study those processes in details, which may find practical applications in their future life. This subject contains five units of equal weightage.

ANATOMY & PHYSIOLOGY –I

<i>L</i>	<i>P</i>
3	2

RATIONALE

The students of Medical Laboratory Technology (MLT) dealt with the life of human body either by direct contact or indirect contact, either through blood or other body fluids. They come in direct contact with patients a number of times and occasions. Hence they are supposed to have the basic knowledge of different parts of human body, their anatomical parts, structures and physiological functions.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Identify basic tissues of the body

CO2: Explain skeletal system in humans.

CO3: Describe the muscular system.

CO4: Explain the cardiovascular system and respiratory system.

DETAILED CONTENTS***UNIT I*****General Anatomy**

Introduction to Anatomy & Physiology.

-Levels of organization, parts of human body

-Major body divisions and sectional divisions

Basic tissues of the body (Gross structure and functions)

a) Epithelial tissue

b) Connective tissue

c) Muscular tissue

d) Nervous tissue

UNIT II**Skeletal System**

Gross structure, function and classification.

Bones of appendicular and axial skeleton

a) Bones of Pectoral girdle and upper limbs.

b) Bones of Pelvic girdle and lower limbs.

Joints & Articulations: Types of joints (Structural and functional classification).

Bones forming major synovial joints (Shoulder, Elbow, wrist, hip, knee, ankle and intervertebral joints).

UNIT III

Muscular System

Properties of muscular tissue.

Classification, structure and functions of muscles.

- Skeletal muscle
- Smooth muscle
- Cardiac muscle

UNIT IV

Cardiovascular System

Anatomy of heart: External & Internal features of heart, Chambers of heart.

Blood vessels attached to various chambers of heart, Coronary vessels & Major arteries and Veins of body.

Circulation of Blood: Pulmonary, Coronary and Portal circulation.

Blood Pressure: Definition of blood pressure, various terms used in Blood pressure, Factors affecting & controlling Blood pressure.

Methods and Apparatus for recording blood pressure.

Introduction to ECG: Basic principles, normal electrocardiogram & grids of ECG paper, electrographic leads, cardiac cycle and Junctional tissues.

Patient preparation for ECG recording & care and maintenance of ECG machine.

UNIT V

Respiratory System

Organs of respiration: Upper and lower respiratory tract.

- a) Nose and Paranasal sinuses
- b) Nasopharynx and larynx
- c) Trachea, bronchi and lungs

Functions and mechanism of Respiratory system

Gas exchange in lungs.

Control of respiration.

Basal Metabolic Rate (BMR)

Respirometry: Procedure, clinical applications & Importance

PRACTICAL EXERCISES

1. Demonstration of different parts of body
 - Cranial cavity (Brain)
 - Thoracic cavity (Heart and lungs)
 - Abdominal cavity (Liver, Gallbladder, spleen, kidney, stomach & intestines)
 - Pelvic cavity (Reproductive organs)
2. Demonstration of basic tissues of the body
 - Epithelial tissue
 - Connective tissue
 - Muscular tissue
 - Nervous tissue
3. Demonstration of various parts of bones
 - Bones of upper limb - Humerus, radius, ulna, fibula and articulated hand - Scapula and clavicle
 - Bones of lower limb - Pelvic/hip bone and femur, tibia, fibula and articulated foot.
 - Bones of Skull and mandible
 - Sternum and ribs
 - Bones of vertebral column
4. Demonstration of major joints of the body
 - Joints of upper limb - Shoulder joint - Elbow joint - Wrist joint
 - Joints of lower limb - Hip (pelvic) joint - Knee joint - Ankle joint
 - intervertebral joints
5. Demonstration of structural differences between: - Skeletal muscle - Smooth muscle and - Cardiac muscle
6. Demonstration of heart
7. Demonstration of Radial pulse examination.
8. Demonstration of Blood pressure Estimation
9. Demonstration of ECG recording
10. Demonstration of various parts of respiratory system

RECOMMENDED BOOKS

1. Anatomy and Physiology by Pears; JP Brothers, New Delhi
2. Anatomy and Physiology by Sears; ELBS, London
3. Basic Anatomy and Physiology by N Muruges; Sathya Publishers, Madurai
4. Ross and Wilson Anatomy and Physiology by Anne Waugh and Kathleen JW Wilson; Churchill Living Stone; London

NOTE:

1. There should be Anatomy & Physiology lab. Human skeleton (articulated or disarticulated), Anatomical Charts and models should be there for demonstration purposes.
2. Apparatus, instruments and relevant equipment must be there for recording Blood pressure as well as ECG machine for demonstration of ECG recording.
3. Anatomy museum should be set up.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audio-visual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage

BASIC MICROBIOLOGY

<i>L</i>	<i>P</i>
3	4

RATIONALE

The candidates undergoing training in Clinical Microbiology are made to learn the basic techniques of microbial culture, preliminary processing, examination and identification of various pathogens like bacteria etc.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Explain Microscopy and staining techniques

CO2: Identify and use Culture Media and culture techniques

CO3: Describe the principle of Morphology and physiology of Bacteria

CO4: Perform sterilization work in lab.

DETAILED CONTENTS***UNIT 1*****Introduction to Microbiology with special reference to medical microbiology**

- i. Definition, history, relationship of microorganisms to man.
- ii. Safety guideline in a microbiology laboratory. Universal precautions.
- iii. Bio-safety cabinets: principle, types of bio-safety cabinets and their applications.

UNIT II**Morphology and physiology of Bacteria**

- i. Classification of micro-organisms
- ii. Morphology of Bacteria
- iii. Bacterial cell wall
- iv. Cell wall structures
- v. Physiology of bacteria
- vi. Bacterial growth and nutrition

UNIT III**Sterilization- definition and types of sterilization.**

- i. Physical methods of sterilization: Equipments used for sterilization, operation of autoclave and hot air oven, sterilization control and sterilization indicators. Sterilization by radiation and filtration (membrane).
- ii. Chemical methods of Sterilization: Antiseptics and disinfectants- Definition, types, properties and uses of common disinfectants and disinfectants (e.g. Formaldehyde, Ethylene oxide, phenol compounds, Alcohol, hypochlorite). Definition of Phenol coefficient and determination Phenol coefficient by Rideal Walker method.

UNIT IV**Microscopy and staining techniques**

- i. Handling of a compound microscope. Care and maintenance of different parts of a compound microscope. Principle of working of fluorescent microscope.
- ii. Staining techniques: Method of smear preparation. Differential staining methods: Gram staining, AFB staining, Albert's staining, staining of capsule. Preparation of staining solutions and their storage.

UNIT V**Culture Media and culture techniques**

- i. Definition, synthetic and non-synthetic media. Types of culture media: liquid, and solid media, routine laboratory media (Basal. Enriched, selective, enrichment, indicator, transport, and storage) with two examples of each type.
- ii. Different types of inoculating loops, different types of swabs and their uses. Types of bacterial culture: broth culture, stab culture, slant culture. Culture techniques: streak plate, pour plate, spreading/ lawn culture, .Aerobic and anaerobic culture, Isolation of pure cultures and disposal of cultures.

PRACTICAL EXERCISES**UNIT I**

1. Demonstration of safety rules (Universal precautions) in a microbiology laboratory.
2. Preparation of cleaning agents and techniques of cleaning glasswares.

UNIT II

1. Preparation of materials for sterilization in an autoclave and hot air oven.
2. Sterilization in autoclave and hot air oven and placing of the sterilization indicators.

UNIT III

1. Sterilization by filtration by membrane method.
2. Handling and care of different types of microscopes.

UNIT IV

1. Staining techniques: Gram, Albert's staining, ZiehlNeelsonstaining, Capsule and bacterial spore staining.
2. Demonstration of bacterial motility by hanging drop technique.

UNIT V

1. Preparation of culture media: Nutrient agar, blood agar, chocolate agar, MacConkey agar, DCA, XLD and Peptone water. Inoculation of bacteria on these culture media by aerobic / anaerobic culture method.
2. Isolation of organisms in pure culture, study of colony characteristics and demonstration of haemolysis on blood agar.

RECOMMENDED BOOKS

1. Textbook of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
2. Practical Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
3. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth – Heinemann; Oxford
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai
5. Medical Laboratory Technology by Kanai Lal Mukherjee; Tata McGraw Hill, New Delhi
6. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Cheesbrough; Cambridge University Press; UK
7. Text Book of Microbiology by Ananthanarayan and Paniker; Orient Longman, Hyderabad
8. Text book of Medical Microbiology by Cruickshank Vol. I
9. Textbook of Medical Microbiology by Greenwood, ELBS
10. Medical Laboratory Science by Jockie and Kolhatkar, Tata McGraw Hill.
11. Text book of Microbiology by A. Chakraborty

INSTRUCTIONAL STRATEGY

The teacher should lay stress on general characteristics of bacteria, morphological features, nomenclature of bacterial for common use. The students should be made familiar with common names of bacteria and stress on correct use of bacterial pronunciation and spellings. The students should be taught with illustrations/audio-visual aids. This subject contains five units of equal weightage.

INTRODUCTION TO HEMATOLOGY

<i>L</i>	<i>P</i>
3	4

RATIONALE

The training in this subject is imparted to enable the students to carry out routine clinical laboratory investigations. He/she should be able to provide technical head for selected sophisticated haematological techniques with adequate knowledge of various principles. The training in laboratory safety is also provided.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Describe the principle of blood Composition

CO2: Collect blood samples.

CO3: Identify and use various Anticoagulants

CO4: Identify and use various stains.

DETAILED CONTENTS

UNIT I

Introduction to haematology

Various glassware/plastic-ware used in Haematology Labs. (Hb. Tube, Hb. Pipette, RBC Pipette, WBC Pipette).

Introduction to blood.

Definition & Composition

Cells-WBC (Granulocytes-Neutrophils, Eosinophils& Basophils), (Agranulocytes-Lymphocytes & Monocytes), RBC, Platelets.

Plasma & its components

Function-cell functions & plasma functions.

Formation of blood (Erythropoiesis, Leukopoiesis&Thrombopoiesis)

UNIT II

Anticoagulants

Definition

Various types along with their mode of action, merit and demerit its of each

Anticoagulant vials

Difference between Plasma and serum

UNIT III

Venous blood collection

Venipuncture : materials and equipment required for venipuncture

Preparation of patients for venipuncture

Applying tourniquet

Selection and preparing the venipuncture site

Performing venipuncture

Care of venipuncture site

Disposable of blood, syringes, needle and lancets.

UNIT IV

The capillary puncture

Capillary puncture site

Materials and equipment required for capillary puncture site

Selecting and preparing the puncture site

Techniques performing the puncture site

Collection of blood sample

Care of the capillary puncture site

Vacutainer system for blood collection

UNIT V

Romanowsky stains (Leishman, Giemsa)

Preparation and theory

Choice of slide and spreader

Preparation of blood film

Characteristics of good blood smear

Examination of blood smear

Identification of blood cell

PRACTICAL EXERCISES

UNIT I

1. Parts of microscope (Monocular & Binocular): Its function and care.
2. Parts of centrifuge: Its function and care.
3. Parts of Blood Mixer: Its function and care
4. Cleaning and drying of glassware.

UNIT II

1. Estimation of Differential Leukocyte count.

UNIT III

1. Preparation of various anticoagulants.

UNIT IV

1. Collection of blood sample by venipuncture.
2. Collection of blood sample by capillary puncture

UNIT V

1. Preparation of peripheral blood film (PBF).
2. Preparation of stain.

RECOMMENDED BOOKS

- 1) Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
- 2) An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth Heinmann, Oxford
- 3) Medical Laboratory Manual for Tropical Countries by Monica Cheesbrough; Cambridge University Press, UK
- 4) Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai
- 5) Practical Haematology by JV Decei; ELBS with Curchill Living Stone; UK
- 6) Medical Laboratory Science Theory and Practical by J Ochei and A Kolhatkar, Tata McGraw Hill Publishing Company Ltd., New Delhi 2000 Ed.

SUGGESTED WEBSITES

1. <https://www.slideshare.net/rajud521/introduction-to-hematology>
2. www.fch.vut.cz/~fiserova/down/laboratory%20equipment.ppt
3. www.biologydiscussion.com/hematology.../laboratory-hematology.../equipments-used
4. <https://www.slideshare.net/rimbiosraju/haemopoiesis-45250369>
5. <https://www.slideshare.net/peddanasunilkumar/anticoagulant>
6. <https://www.slideshare.net/globalsoin/blood-collection-and-preservation>
7. https://www.slideshare.net/kps_senthil/rbcwbc-count
8. <https://www.youtube.com/watch?v=-tzNsaCrUMw>

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audio-visual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage.

1.6 FUNDAMENTALS OF MLT

<i>L</i>	<i>P</i>
3	2

RATIONALE

In Medical laboratory many types of equipments are used for analysis of samples. Students of MLT are required to learn the proper handling of various equipments. In addition they need to be made aware of risk involved and safety precautions to be followed.

COURSE OUTCOMES

After undergoing this subject the students will able to:

CO1: Select appropriate equipment for a given type of analysis.

CO2: Operate various equipments following standard operating procedures.

CO3: Maintain various equipments in functional condition.

DETAILED CONTENTS

UNIT 1

Basic Training of laboratory technicians

Basic ethics of Medical laboratory Technology

Training of clinical laboratory technicians.

Medical laboratory professional - professionalism in laboratory workers,

Code of conduct and communication between physician and lab technician

Common Lab accidents and ways for its prevention

First aid in the clinical laboratory

Storage and handling of dangerous chemicals

Common Laboratory hazards

Color coding of various Waste disposal containers in the labs

UNIT II

Introduction to Instrumentation in a Medical Laboratory

Introduction to Basic Equipments in MLT

Different types of syringes used for blood collection.

Basic requirements of blood collection.

UNIT III**Principle, Care, Procedure and Application of the Basic Instruments Part-I**

Centrifuge (routine - low and high speed -table top)

Water Bath

Hot Air Oven

Incubator

Colorimeter

Compound Microscope (Monocular and Binocular)

UNIT IV**Principle, Care & Safe Operating Procedure and Application of the Basic Instruments Part-II**

pH Meter

Distillation unit

Balance (Physical and chemical)

Micro tom

Microbe filters (Seitz, GlassScintered& Membrane)

UNIT V**Principle, Care, Procedure and Application of the Advanced Instruments**

Refrigerated Centrifuge

Ultra Centrifuge

Specialised Incubator

B.O.D. Incubator

Special Microscopes

1. Dark Field Microscope

2. Phase Contrast Microscope

3. Florescence Microscope

4. Electron Microscope

5.4Tissue Processing Unit

5.5BiochemistryAnalyzer

5.6Laminar Air Flow Hood& their Different Types

5.7Haematology Cell Counter

PRACTICAL EXERCISES

1. The Principal and procedure of autoclave and identify their parts– water bath, hot air oven, incubator
2. To demonstrate basic internal organization identifies their parts. Centrifuge colorimeter

3. To demonstrate basic internal organization of compound microscope identify their parts.
4. To demonstrate basic internal organization of identify their parts.pH meter chemical balance
5. To demonstrate basic internal organization & identify their parts. Microtome Tissue Processing Unit Hematology Cell Counter

RECOMMENDED BOOKS

1. Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth Heinmann, Oxford
3. Medical Laboratory Manual for Tropical Countries by Monica Cheesbrough; Cambridge University Press, UK
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audio-visual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage.

SECOND SEMESTER

SECOND SEMESTER

2.1	Anatomy and Physiology-II	30-32
2.2	Bacteriology	33-35
2.3	Applied Hematology	36-38
2.4	Clinical Biochemistry	39-41
2.5	*Fundamentals of IT	42-45
2.6	*Environmental Studies and Disaster Management	46-48

2.1 ANATOMY AND PHYSIOLOGY – II

<i>L</i>	<i>P</i>
3	2

RATIONALE

The students are supposed to have basic knowledge of structure of body, their anatomical parts, physiological functions. After studying this subject, the students shall be able to understand various parts of body and their anatomical positions along with functions.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Explain nervous system in humans.

CO2: Discuss the circulatory system.

CO3: Describe Endocrine system and Reproductive system.

DETAILED CONTENTS

UNIT I

Nervous system

Central nervous system (brain and spinal cord)

Peripheral nervous system (cranial and spinal nerves)

The sense organs (eye, ear, tongue and nose); structure and functions

UNIT II

Circulatory system

Composition and functions of blood

Anatomy and physiology of Heart

Circulation of blood, Cardiac Cycle and Conducting System of Heart

The blood pressure

Arteries and veins

Lymph and lymphatic system

UNIT III

Endocrine system

Description of each endocrine gland its secretions and their effect on the body

UNIT IV**Excretory System**

Organs of excretion (kidneys, ureter, bladder)

Formation of urine and its composition

Structure of nephron

UNIT V**Reproductive System**

Male and female reproductive system

The ovarian cycle and ovulation

Fertilization

PRACTICAL EXERCISES

1. Study of various parts of nervous system (brain and spinal cord) (demonstration from model)
2. Study of structure of eye and ear (demonstration from models)
3. Study of structural differences between skeletal, smooth and cardiac muscles (permanent mounts) through demonstration.
4. Study of various parts of circulatory system through demonstration.
5. Examination of stained blood film for blood cells
6. Estimation of blood pressure
7. Study of various parts of reproductive system (male and female demonstration from models and charts)
8. Study of various parts of Excretory system

RECOMMENDED BOOKS

1. Anatomy and Physiology by Pears; JP Brothers, New Delhi
2. Anatomy and Physiology by Sears; ELBS, London
3. Tutorial Human Anatomy and Physiology by Dr Pramila Singh; Tutor Trait, Ambala
4. Basic Anatomy and Physiology by N Muruges; Sathya Publishers, Madurai
5. Ross and Wilson Anatomy and Physiology by Anne Waugh and Kathleen JW Wilson; Churchill Living Stone; London.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audio-visual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage.

2.2 BACTERIOLOGY

<i>L</i>	<i>P</i>
3	2

RATIONALE

The students undergoing training of medical laboratory technology learn the knowledge of basic morphology, staining, culture, biochemical characteristics and lab-diagnosis of pathogenic bacteria. In addition to this, they are also made aware about the examination of bacteria present in milk and water.

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Explain General characteristics of bacteria

CO2: Identify Nosocomial Infection

CO3: Describe the principle of Bacterial pathogenicity

CO4: Perform Laboratory diagnosis of infectious diseases

DETAILED CONTENTS

UNIT 1

Bacteriology

General characteristics of bacteria-morphology, staining, culture, biochemical

Characteristics, antibiotics related to Gram Positive bacteria and their distribution:

Gram Positive

Staphylococci

Strep to cocci and pneumococci

Enterobacteriaceae-(E.coli, Salmonella, Shigella)

UNIT II

Characteristics, antibiotics related to Gram Negative bacteria and their distribution:-

Pseudomonas

Proteus

Vibrio Cholerae

Neisseria

Treponema Pallidum

Mycobacterium tuberculosis and leprae

UNIT III**Bacterial pathogenicity**

Introduction, pathogenicity & infection.

Sources of infection

Mode of spread of infection

Types of infection

UNIT IV**Nosocomial Infection**

Introduction

Common types and source of nosocomial infection

Control of nosocomial infections

UNIT V**Laboratory diagnosis of infectious diseases**

Septicaemia and bacteraemia

Respiratory tract infections (Throat Swab and Sputum sample)

Wound infections

Urinary tract infections

Enteric fever

Intestinal infection

Meningitis

PRACTICAL EXERCISES

1. Collection, transportation of clinical samples, processing including culture of following clinical samples for identification of pathogens–

- Urine,
- Stool,
- Sputum,
- Throat swabs,
- Pus and Pus swabs,
- Blood,
- Skin,
- Eye and Ear swabs and
- CSF

2. Identification of known bacterial cultures of common pathogens.

RECOMMENDED BOOKS

1. Text book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
2. Practical Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
3. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth–Heinemann; Oxford
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai.
5. Medical Laboratory Technology by Kanai Lal Mukherjee; Tata Mc Graw Hill, New Delhi.
6. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Cheesbrough; Cambridge University Press;UK
7. Text Book of Microbiology by Ananthanarayan and Paniker; Orient Longman, Hyderabad
8. Textbook of Medical Microbiology by Cruickshank and Vol. I
9. Text book of Medical Microbiology by Greenwood, ELBS
10. Medical Laboratory Science by Jockie and Kolhatkar, Tata McGraw Hill.
11. Text book of Microbiology by A.Chakraborty

INSTRUCTIONAL STRATEGY

The teacher should lay stress on general characteristics of bacteria, morphological features, and nomenclature of bacterial for common use. The students should be made familiar with common names of bacteria and stress on correct use of bacterial pronunciation and spellings. The students should be taught with illustrations/audio-visual aids.

2.3 APPLIED HAEMATOLOGY

<i>L</i>	<i>P</i>
3	4

RATIONALE

The training in haematology is imparted to enable the students to know the principle of tests, methodology of routine as well as advanced procedures being carried out in the laboratory by using routine as well as sophisticated instruments. Stress is also given in use of safety measures in the laboratory

COURSE OUTCOMES

After undergoing this subject, the students will be able to:

CO1: Explain the principle of Haemoglobinometry

CO2: Perform Haemocytometry

CO3: Identify Blood cell morphology in health and disease

CO4: Assure Quality in hematology

DETAILED CONTENTS

UNIT I

Haemoglobinometry

Formation of hemoglobin, function and its degradation

Types of hemoglobin

Various methods of estimation with specific reference to cyanmethaemoglobin method

UNIT II

Haemocytometry

Various counting chambers

Methods of counting of RBC, WBC and platelets, their calculation and reference values.

Errors involved in haemocytometry and means to minimize them

UNIT III

Differential leukocyte counting (DLC)

Preparation and staining of blood film

Performance of DLC

Normal values and significance of DLC

Blood cell morphology in health and disease (Peripheral blood film)

UNIT IV

Quality Assurance in hematology

Internal & External Quality Assurance

Define accuracy, precision & Standard Deviation.

UNIT V

Automation in hematology

Various types of Blood cell counter.

Principle and operation of the automated blood cell counters.

PRACTICAL EXERCISES

UNIT I

1. Hemoglobin Estimation by Sahli's method.
2. Hemoglobin Estimation by Oxy-Hemoglobin and Cyanmethaemoglobin method

UNIT II

3. Counting of RBC
4. Counting of WBC
5. Platelet counting

UNIT III

6. Preparation of peripheral blood film.
7. Preparation and standardization of stains (Leishman and Giemsa)
8. Preparation of thick and thin blood smear
9. Absolute eosinophil counting

UNIT IV

10. Study of morphology of normal RBC and WBC with the help of stained slide
11. To study abnormal morphology of RBC with the help of stained slide
12. To study abnormal morphology of WBC with the help of stained slide
13. To study abnormal morphology of platelet with the help of stained slide

UNIT V

14. Parts of blood cell counter: Its function and care.
15. Principle and working of the automated blood cell counter

RECOMMENDED BOOKS

1. Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth Heinmann, Oxford
3. Medical Laboratory Manual for Tropical Countries by Monica Cheesbrough; Cambridge University Press, UK
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai
5. Practical Haematology by JV Decei; ELBS with Curchill Living Stone; UK
6. Medical Laboratory Science Theory and Practical by J Ochei and A Kolhatkar, Tata McGraw Hill Publishing Company Ltd., New Delhi 2000Ed.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage

2.4 CLINICAL BIOCHEMISTRY

<i>L</i>	<i>P</i>
3	4

RATIONALE

The students are imparted basic training of theoretical and practical aspects in the field of clinical biochemistry. The students 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

COURSE OUTCOMES

After undergoing this subject, the students will be able to

CO1: Describe technique of collection of clinical samples and their processing

CO2: Perform all clinical biochemistry tests along with recording of data

CO3: Use necessary standards to perform the biochemical analysis.

CO4: Assure Quality in clinical biochemistry

DETAILED CONTENTS

UNIT I

Introduction to biochemistry

Definition and Importance of biochemistry

Volume tricapparatus and their calibration Blood fractions

Separation of Serum

Separation of Plasma

Different protein precipitating reagents, Preparation of proteinfreefiltrate(PFF)

UNIT II

Collection and preservation of clinical specimens for bio-chemical analysis of

1.1 Blood

1.2.Urine

1.3.Stool

2.5 Other Body Fluids

UNIT III**Blood glucose estimation, screening test and glucose tolerance test (GTT)**

Principle and methods of estimation

Reference values

Renal threshold

UNIT IV**Clinical importance of blood sugars/GTT**

Blood urea

Formation and excretion of urea

Principle and procedures of different methods of urea estimation

4.3 Reference values

4.5 Clinical Importance

UNIT V**Serum proteins**

Introduction

Different methods of estimation including principles and procedures

Reference values

Clinical importance

Uric Acid

Introduction, principles and procedures of various estimation methods

Reference values

Clinical Importance

PRACTICAL EXERCISES

1. Handling and maintenance of Balance, Centrifuge, Colorimeter, Ion Selective electrode and glucometer, distillation plant/deionizer
2. Collection of blood by various methods including vacutainer system
3. To Separate serum and plasma from a given blood sample.
4. To Prepare different protein precipitating agents handoff
5. Preparation of reagents(stock and working)
6. Estimation of blood glucose/sugar (O-toluidine method and enzymatic method)
7. To Perform GTT using GOD-POD method
8. To estimate urea and creatinine in a given serum sample.
9. To estimate uric acid in a given serum sample.
10. To estimate Plasma and serum protein in given sample

RECOMMENDED BOOKS

1. A Procedure Manual for Routine Diagnostic Tests Vol.I by KL Mukherjee; Tata Mc Graw Hill Publishers, New Delhi
2. Biochemistry Estimations by F.J.Baker
3. A Text book of Medical Laboratory Technology by P Godkar; Bhalani Publishing House, Mumbai

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audio-visual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences. This subject contains five units of equal weightage.

FUNDAMENTALS OF IT

<i>L</i>	<i>P</i>
2	4

RATIONALE

Information technology has great influence on all aspects of life. Almost all work places and living environment are being computerized. In order to prepare diploma holders to work in these environments, it is essential that they are exposed to various aspects of information technology such as understanding the concepts of information technology and its scope, operating a computer: use of various office management tools, using internet and mobile applications etc. This course is intended to make new students comfortable with computing environment - Learning basic computer skills, learning basic application software tools, Understanding Computer Hardware, Cyber security awareness.

COURSE OUTCOMES

At the end of the course student will be able to

- CO1: Explain the basic components of Computers, Internet and issues of abuses/ attacks on information and computers
- CO2: Handle the computer/laptop/mobiles/Internet Utilities and Install/Configure OS
- CO3: Assemble a PC and connect it to external devices
- CO4: Manage and Use Office practiced Automation Tools
- CO5: Develop worksheets and Prepare presentations

DETAILED CONTENTS***UNIT I*****Basics of Computer**

Brief history of development of computers, Definition of Computer, Block diagram of a Computer, Hardware, Software, Booting: Cold and Hot Booting, Interaction between the CPU and Memory with Input/Output devices, Function of CPU and major functional parts of CPU.

Memory, Bit, Nibble, Byte, KB, MB, GB, TB, PB, Functions of memory, Use of storage devices in a Computer, List types of memory used in a Computer, Importance of cache memory, CPU speed and CPU word length

UNIT II**Basic Internet Skills**

Understanding browser, Introduction to WWW, efficient use of search engines, awareness about Digital India portals (state and national portals) and college portals. Advantages of Email, Various email service providers, Creation of email id, sending and receiving emails, attaching documents with email and drive.

Effective use of Gmail, G-Drive, Google Calendar, Google Sites, Google Sheets, Online mode of communication using Google Meet & WebEx.

Unit III**Basic Logic building**

Introduction to Programming, Steps involved in problem solving, Definition of Algorithm, Definition of Flowchart, Steps involved in algorithm development, differentiate algorithm and flowchart, symbols used in flowcharts, algorithms for simple problems, flowcharts for simple problems, Practice logic building using flowchart/algorithms

Unit IV**Office Tools**

Office Tools like LibreOffice/Open Office/MsOffice.

Open Office Writer – Typesetting Text and Basic Formatting, Inserting Images, Hyperlinks, Bookmarks, Tables and Table Properties in Writer

Introducing LibreOffice/Open OfficeCalc, Working with Cells, Sheets, data, tables, using formulae and functions, using charts and graphics.

OpenOffice Impress – Creating and Viewing Presentations, Inserting Pictures and Tables, Slide Master and Slide Design, Custom Animation.

Unit V**Use of Social Media**

Introduction to Digital Marketing – Why Digital Marketing, Characteristics of Digital Marketing, Tools for Digital Marketing, , Effective use of Social Media like LinkedIn, Google+, Facebook, Twitter, etc.: Features of Social media, Advantages and Disadvantages of Social Media.

PRACTICAL EXERCISES

1. Browser features, browsing, using various search engines, writing search queries
2. Visit various e-governance/Digital India portals, understand their features, services offered

3. Read Wikipedia pages on computer hardware components, look at those components in lab, identify them, recognize various ports/interfaces and related cables, etc.
4. Using Administrative Tools/Control Panel Settings of Operating Systems
5. Connect various peripherals (printer, scanner, etc.) to computer, explore various features of peripheral and their device driver software.
6. Explore features of Open Office tools and MS-Office, create documents, create presentation, create spread sheet, using these features, do it multiple times
7. Working with Conversion Software like pdfToWord, WordToPPT, etc.
8. Working with Mobile Applications – Searching for Authentic Mobile app, Installation and Settings, Govt. of India Mobile Applications
9. Creating email id, sending and receiving mails with attachments.
10. Using Google drive, Google calendar
11. Create Flow chart and Algorithm for the following
 - a. Addition of n numbers and display result
 - b. To convert temperature from Celsius to Fahrenheit
 - c. To find Area and Perimeter of Square
 - d. Swap Two Numbers
 - e. find the smallest of two numbers
 - f. Find whether given number is Even or Odd
 - g. To print first n even Numbers
 - h. find sum of series $1+2+3+\dots+N$
 - i. print multiplication Table of a number
 - j. generate first n Fibonacci terms $0,1,1,2,3,5\dots n$ ($n>2$)
 - k. sum and average of given series of numbers
 - l. Factorial of number n ($n!=1\times2\times3\times\dots n$)
 - m. Armstrong Number
 - n. Find whether given number is Prime or not

RECOMMENDED BOOKS

1. R.S. Salaria, “Computer Fundamentals” Khanna Publishing House
2. Ramesh Bangia, “PC Software Made Easy – The PC Course Kit” Khanna Publishing House
3. Online Resources, Linux man pages, Wikipedia
4. Mastering Linux Shell Scripting: A practical guide to Linux command-line, Bash scripting, and Shell programming, by Mokhtar Ebrahim, Andrew Mallett
5. Vikas Gupta, “Comdex Hardware and Networking Course Kit” Dream Tech press, New Delhi, 2008

6. Sumitabha Das, “UNIX concepts and applications” Tata McGraw Hill, New Delhi, 4th Edition, 2008

SUGGESTED WEBSITES

1. <https://nptel.ac.in/courses/106/106/106106222/> - NPTEL Course on Modern Application Development
2. https://onlinecourses.swayam2.ac.in/aic19_de01/preview -
3. <https://spoken-tutorial.org/> - Tutorials on Introduction to Computers, HTML, LibreOffice Tools, etc.
4. NOTEPAD++
5. <https://tms-outsource.com/blog/posts/web-development-ide/>

INSTRUCTIONAL STRATEGY

This is a skill based subject and topics taught in the class should be practiced in the Lab regularly for development of required skills in the students. This subject contains five units of equal weightage.

ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

<i>L</i>	<i>P</i>
2	-

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industrial and construction activities so that he/she may help in balancing the ecosystem and controlling pollution by various control measures. The course is intended to provide a general concept in the dimensions of environmental pollution and disasters caused by nature beyond the human control as well as the disasters and environmental hazards induced by human activities with emphasis on disaster preparedness, response and recovery.

COURSE OUTCOMES

After undergoing the subject, the student will be able to:

CO1: Comprehend the importance of sustainable ecosystem

CO2: Demonstrate interdisciplinary nature of environmental issues

CO3: Implement corrective measures for the abatement of pollution.

CO4: Identify the role of non-conventional energy resources in environmental protection.

CO5: Manage various types of disasters

DETAILED CONTENTS***UNIT I*****Introduction**

Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.

Rain water harvesting

Deforestation – its effects & control measures

UNIT II**Air and Noise Pollution**

Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.

Noise Pollution: Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimizing noise pollution.

UNIT III**Water and Soil Pollution**

Water Pollution: Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of DO, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.

Soil Pollution :Sources of soil pollution, Effects and Control of soil pollution, Types of Solid waste- House hold, Industrial, Agricultural, Biomedical, Disposal of solid waste, Solid waste management E-waste, E – waste management

UNIT IV**Impact of Energy Usage on Environment**

Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings, Concept of Carbon Credit & Carbon footprint.

UNIT V**Disaster Management****A. Different Types of Disaster:**

Natural Disaster: such as Flood, Cyclone, Earthquakes and Landslides etc.

Man-made Disaster: such as Fire, Industrial Pollution, Nuclear Disaster, Biological Disasters, Accidents (Air, Sea Rail & Road), Structural failures(Building and Bridge), War & Terrorism etc.

B.Disaster Preparedness:

Disaster Preparedness Plan

Prediction, Early Warnings and Safety Measures of Disaster

Psychological response and Management (Trauma, Stress, Rumour and Panic)

RECOMMENDED BOOKS

1. Environmental Studies by S.C. Sharma & M.P. Poonia, Khanna Publishing House, New Delhi
2. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
5. Environmental Engineering and Management by Suresh K Dhamija; S K KatariaandSons, New Delhi.

6. E-books/e-tools/relevant software to be used as recommended by AICTE/BTE/NITTTR, Chandigarh.
7. Disaster Management by Dr. Mrinalini Pandey, Wiley India Pvt. Ltd.
8. Disaster Science and Management by Tushar Bhattacharya, McGraw Hill Education(India) Pvt. Ltd.

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies and Disaster Management like expert lectures, seminars, visits etc. may also be organized. This subject contains five units of equal weightage.

THIRD SEMESTER

CLINICAL MICROBIOLOGY- III (Parasitology and virology)

L T P
3 - 3

RATIONALE

The students undergoing training of medical laboratory technology learn the techniques of collection of samples, their processing and identification of various pathogens like parasites and viruses by using different techniques. In addition to the above, students are given training in the use of safety measures while handling infected material. The training is aimed at making the students competent to identify the causative parasites and viruses for microbial infections.

DETAILED CONTENTS

Theory

1. Introduction to medical parasitology (02 hrs)
2. General characteristics, morphology, classification (02 hrs)
 - Protozoa
 - Helminthes
3. Laboratory Samples for detection of parasites (02 hrs)
 - Collection, transportation, processing and preservation of samples for routine investigations – Blood, stool
4. Concentration techniques (06 hrs)
 - Principle and application of concentration techniques of stool for demonstration of ova and cysts
5. Giardia and Entamoeba histolytica (05 hrs)
 - Morphology
 - Life cycle
 - Lab diagnosis
6. Ancylostoma and Ascaris lumbricoides (06 hrs)
 - Morphology
 - Life cycle

-
- Lab diagnosis
7. T solium, T saginata (05 hrs)
 - Morphology
 - Life cycle
 - Lab diagnosis
 8. Malarial Parasite (P. Vivax and P. Falciparum) (06 hrs)
 - Morphology
 - Life cycle
 - Lab diagnosis
 9. Virology (04 hrs)
 - Introduction
 - General Characteristics, Classification Structure of viruses.
 10. Medically important viruses (06 hrs)

Pathogenicity, Lab diagnosis and prevention of –

 - Rabies
 - Polio
 - HIV
 - HBV (Hepatitis ‘B’ virus)
 11. Virological Samples (04 hrs)
 - *Collection*
 - Transportation
 - Storage

LIST OF PRACTICALS

1. Collection and routine stool examination for detection of intestinal parasites
 - Saline preparation
 - Lugol’s Iodine preparation
 - Concentration methods
 - a) Floatation method (saturated salt solution/zinc sulphate)
 - b) Sedimentation method (formal ether)
2. Identification of following adult worms/cyst from preserved specimen/slides
 - Tapeworm
 - Roundworm
 - Hookworm
 - Giardia

- Entamoeba . histolytica, E. coli
3. Preparation of smear and identification of blood parasites
- Preparation of stains (Leishman, Giemsa, Field)
 - Preparation of thin and thick smears
 - Staining of smears by Leishman, Giemsa, Field
 - Examination of smears for malarial parasite (P. vivax and P. falciparum)
 - Demonstration of various stages of malarial parasite from stained slides

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on common names, morphology of helminth and blood parasites. The students should be shown diagrams/illustration/permanent fixed slides and audio-visual aids. The students should be made aware about medically important viruses, collection and cultivation of viruses.

RECOMMENDED BOOKS

1. Parasitology by KD Chatterjee; Chatterjee Medical Publishers, Kolkatta
2. Medical Parasitology by Arora & Arora
3. An introduction to Medical Laboratory Technology by FJ Baker; Butterworth Heinemann Oxford
4. Text Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
5. Textbook of Microbiology by Ananthanarayan and Panikar; Orient Longman, Hyderabad
6. Text Book of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House; Mumbai
7. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Cheesbrough; Cambridge University Press; UK
8. Practical Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
9. Medical Laboratory Science Theory and Practice by J Ochei and A Kolhatkar
10. Medical Laboratory Science by J. Achie and Kolhatkar, Tata McGraw Hill
11. Medical Laboratory Technology by Kanai Lal Mukherjee; Tata McGraw Hill Publishers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	02	04
2	02	06
3	02	06
4	06	08
5	05	06
6	06	14
7	05	10
8	06	14
9	04	08
10	06	12
11	04	12
Total	48	100

HAEMATOLOGY - III

L	T	P
3	-	3

RATIONALE

This subject aims to enable the students to carry out routine clinical laboratory investigation (blood, urine etc). He/she 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.

DETAILED CONTENTS**Theory**

1. Erythrocyte sedimentation rate (ESR) and packed cell volume (PCV) (12 hrs)
 Introduction
 Various methods of estimation of ESR and PCV and their merits and demerits
 Factors involved in ESR
 Interpretation of results
2. Red Cell Indices – MCV, MCH, MCHC (05 hrs)
 Definition, reference range, calculation and interpretation
3. Supravital stain and reticulocyte counting (07 hrs)
 Introduction
 Principle and procedure of staining and calculation
 Reference values and interpretation
 Variation in Physiological Values such as Hb, PCV, T.L.C. and Platelet count
4. Anemias (16 hrs)
 Definition and classification
 Laboratory diagnosis of:
 - (a) Iron deficiency anaemia
 - (b) Megaloblastic anaemia
 - (c) Haemolytic anaemias including sickle cell anaemia thalassaemia
 - (d) Aplastic anaemia
5. Red cell fragility test (08 hrs)
 Principle and procedure

Clinical significance

LIST OF PRACTICALS

1. ESR estimations (wintrobe and westergren) in blood sample
2. Determination of PCV (wintrobe and capillary) in blood by Macro and Micro Methods
3. Counting of Reticulocyte in blood
4. To perform red cell fragility test on blood
5. To perform Sickling test on blood
6. Estimation of foetal haemoglobin by alkali denaturation test
7. Estimation of plasma haemoglobin
8. Estimation of and G₆PD by Methylene Blue Reduction Test)

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision.

Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lectures on specific topics and share their experiences.

RECOMMENDED BOOKS

1. Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishing Company, New Delhi
2. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworths Heinemann, Oxford
3. Medical Laboratory Manual for Tropical Countries by Monica Cheesbrough; Cambridge University Press; UK
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai
5. Practical Haematology by J.V Decie; ELBS with Churchill Living Stone, UK
6. Medical Laboratory Science Theory and Practical by J. Ochei and Kolhatkar; Tata McGraw Hill Publishing Company Ltd., New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	12	30
2	05	08
3	07	15
4	16	35
5	08	12
Total	48	100

3.3 CLINICAL BIOCHEMISTRY- III

L	T	P
3	-	3

RATIONALE

The students are imparted basic training of theoretical and practical aspects in the field of clinical biochemistry. The students are made to learn the techniques 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

DETAILED CONTENTS**Theory**

1.	Serum Bilirubin	(06 hrs)
----	-----------------	----------

Formation of bile pigments
 Formation and excretion of bilirubin
 Conjugated and unconjugated bilirubin
 Principle and procedures of serum bilirubin estimation (Direct & Indirect)
 Reference values
 Clinical significance

2.	SGOT and SGPT	(06 hrs)
----	---------------	----------

Principle and procedures of estimation
 Reference values
 Clinical significance

3.	ALP and ACP	(06 hrs)
----	-------------	----------

Principle and procedures of estimation
 Reference values
 Clinical significance

4.	Serum Amylase	(03 hrs)
----	---------------	----------

Principle and procedures of estimation
 Reference values
 Clinical significance

5. Serum Calcium and Phosphorus (04 hrs)

Principle and procedures of estimation

Reference values

Clinical significance

6. Lipid Profile (10 hrs)

Formation of cholesterol

High density and low density cholesterol

Principles and procedures of estimation

Reference value

Clinical significance

Triglycerides, principle and procedure of estimation

6.7. Importance of various ratios of HDL, LDL and VLDL

7 Urinary Proteins and Creatinine (04 hrs)

24 hr. urinary proteins and creatinine estimation

Reference values

Clinical significance

8. Renal Function Tests (Renal clearance Tests) (09 hrs)

Urea clearance Test

8.2. Creatinine clearance test

8.3 Their Clinical significance

LIST OF PRACTICALS

1. Serum bilirubin estimation
2. Phosphorus estimation
3. Calcium estimation
4. Renal clearance tests
5. SGOT estimation
6. SGPT estimation
7. ALP estimation
8. ACP estimation
9. Total cholesterol estimation
10. Triglyceride estimation
11. Estimation of HDL and calculation of VLDL and LDL

12. Urinary protein and creatinine estimation (24 hr)
13. Estimation of serum amylase

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision.

RECOMMENDED BOOKS

1. A Procedure Manual for Routine Diagnostic Tests Vol. I, II and III by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. Practical Clinical Biochemistry by H. Varley; Heinmann Publishers, Oxford
3. A Text Book of Medical Laboratory Technology by P Godkar; Bhalani Publishers, Mumbai
4. Medical Laboratory Science, Theory and Practice by J Ochaie and A Kolhatkar, Tata McGraw Hill

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	06	12
2	06	12
3	06	12
4	03	06
5	04	08
6	10	22
7	04	08
8	09	20
Total	48	100

HISTOPATHOLOGY AND CYTOLOGY- I

L	T	P
3	-	3

RATIONALE

This part of the subject is aimed at introducing the students to the various types of tissue preparations and developing expertise in the students to cut very thin tissue sections from tissue blocks and facilitate visualization using various stains and dyes. Cytology part aims at exposing the students to the latest advancements in cytological investigations.

DETAILED CONTENTS**Theory**

1. Introduction and definition of: (01 hr)

Histology
Histopathology
Biopsy
Autopsy
Autolysis
Putrefaction

2. Preparation of Tissue (Different Methods of Preparation of Tissue) (02 hrs)

Unfixed Tissue preparations

Imprint methods – Impression Smears
Teased preparation
Squashed preparation
Frozen section

Fixed Tissue preparations (introduction only)

Paraffin embedding
Celloidin embedding
Gelatin embedding

3. Reception of Specimen (01 hr)

Reception, recording, labeling and preservation of histological specimen

4. Fixation (Histological Specimens) (06 hrs)
Classification of fixatives

Composition of various fixatives

Advantages and disadvantages

5. Processing (by Paraffin Technique) (06 hrs)

Dehydration

Clearing/Dealcoholization

Infiltration and impregnation

Paraffin embedding

Automation: Histokinete (automatic tissue processor)

- its types, working, care and maintenance

6. Microtomy (07 hrs)

Microtome

Types

Advantages and disadvantages

Working principle, care and maintenance

Microtome Knives

Various types of knives

Sharpening of knives

- Honing technique

- Stropping technique

- Automation: Automatic knife sharpener – uses, care and maintenance

- Uses of abrasives and lubricants

6.2.3. Introduction to disposable blades - their advantages and disadvantages.

Section Cutting

Rough cutting

Fine cutting

Use of tissue floatation bath

Use of various adhesive media and lifting of sections to the slide

Errors /cutting faults in sections and their remedies

7. Theory of staining (Routine) (05 hrs)

Principle and mechanism of routine stain (Haematoxylin and Eosin)

Various steps of staining (Haematoxylin and Eosin)

- Deparaffinization
- Hydration
- Nuclear Staining
- Differentiation
- Blueing
- Counterstaining
- Dehydration
- Clearing and Mounting
- Results

Automation: Use of automatic stainer and coverslipper

8. Mountants (02 hrs)

Various types of mounting media (aqueous, resinous)
Advantages and Disadvantages

9. Various Terms associated with staining (04 hrs)

Solvents
Mordants
Metachromasia
Accelerators
Progressive and regressive staining
Use of controls in staining and their significance

10. Cell (02 hrs)

Definition and function
Structure
Multiplication (Mitosis and Meiosis)

11. Exfoliative Cytology (04 hrs)

Introduction
Preparation of vaginal & cervical smears
Collection and Processing of specimen for cytology

- Urine
- Sputum
- CSF (Cerebro Spinal Fluid)
- Other fluids

12. Fixation (Cytological Specimen) (02 hrs)

Definition

Various types of Cytological fixatives

Advantages and Disadvantages

13. Cytological Staining (0 4 hrs)

Principle, Technique and interpretation of results in

- Papanicalaou staining
- May Grunwald & Giemsa staining
- Haematoxylin and Eosin staining

14 Role of Laminar airflow and cytotechnician in cytology (02 hrs)

LIST OF PRACTICALS

1. Reception of specimen, labeling and preserving the specimen
2. Preparation of various smears by unfixed methods
 - Imprint smears
 - Teased smears
 - Squashed smears
3. Preparation of different fixatives with special emphasis on preparation of formaline based fixatives
4. Preparation of paraffin blocks from various tissue pieces and labeling with emphasis on orientation
5. Handling of microtome
6. Sharpening of microtome knives
7. Preparation of blocks for fine cutting
 - Rough cutting
 - Trimming
8. Practice of fine section cutting
9. Practice of lifting of sections on the slides
10. Performing H&E staining on sections and mounting of tissue sections
11. Demonstration of cell using buccal smear/urine sample
12. Processing of urine samples for malignant cells
13. Processing of sputum sample for malignant cytology
14. To perform PAP stain on given smear
15. To perform MGG stain on given smear
16. To perform H&E on given smear
17. To demonstrate various automation by use of brochures, charts etc.

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworths Scientific, London
2. Carleton's Histological Technique by RAB, Drury, MADM (OXON), FRC Path, Northwick Paru Hospital, Harrow, Middlesex
3. Theory and Practice of Histological Technique by John D. Bancroft, Churchill Livingstone, London
4. Cellular Pathology Techniques by CFA Culling, Butterworths, London
5. Medical Lab Technology by Dr. Ramnik Sood, MD, Maulana Azad College, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	01	02
2	02	04
3	01	02
4	06	13
5	06	13
6	07	14
7	05	12
8	02	04
9	04	08
10	02	04
11	04	08
12	02	04
13	04	08
14	02	04
Total	48	100

TRANSFUSION MEDICINE (Blood Banking)

L T P
3 - 2

RATIONALE

Blood transfusion has become a life saving procedure in modern medical sciences. To avoid any mistake, the students must understand to learn the blood bank procedures, such as ABO & Rh blood grouping carefully and accurately. He must also have an adequate knowledge of cross matching both major and minor procedures as well as selection of a suitable donor. He should be competent enough to collect blood and its long-term preservation for safe blood transfusion.

DETAILED CONTENTS

- | | | |
|----|---|----------|
| 1. | Historical introduction to Transfusion medicine (blood banking) | (02 hrs) |
| 2. | Antigen and Antibody
Definition of antigen and antibody
Classification of antigens and antibodies. | (03 hrs) |
| 3. | ABO Blood Group System
Antigens and antibodies involved
Principle and procedure of ABO blood grouping
Various blood sub groups (A ₁ , A ₂ , A ₁ B, A ₂ B) | (04 hrs) |
| 4 | The Rh Blood Group System
Antigen and antibody involved
Principle and procedure of Rh grouping
Variant of D antigen (Du) | (04 hrs) |
| 5. | Anticoagulants used in blood bank
Types and composition of various anticoagulants
5.2. Advantages and disadvantages of various anticoagulants | (04 hrs) |
| 6 | Criteria for selection of Donor | (02 hrs) |
| 7 | Blood Collection and storage | (03 hrs) |
| | Screening of blood donor and characteristics of ideal blood donor. | |
| | 7.2 Blood collection procedure | |
| | 7.3. Transportation and storage | |

-
- | | | |
|-----|---|----------|
| 8. | Screening of blood donors for:
MP
VDRL
HIV
HbsAg
HCV | (10 hrs) |
| 9. | Cross Matching

Types of cross matching
Various methods and their procedures | (02 hrs) |
| 10. | Coombs Test

Direct coombs test (principle, procedure, importance and application)
Indirect coombs test (principle, procedure, importance and application) | (04 hrs) |
| 11. | Various blood components (Packed cells, Fresh frozen plasma, Cryoprecipitate, PRP(Platelet rich plasma))

Preparation
Preservation
Uses | (04 hrs) |
| 12. | Blood Transfusion reactions | (06 hrs) |

LIST OF PRACTICALS

1. Performing ABO blood grouping by following method:
 - Direct
 - Tube Test
 - Indirect (reverse)
 - Subgroup
2. Performing-Rh grouping by following techniques:
 - Slide
 - Tube technique
3. Performance of Coombs Test
 - Direct
 - Indirect

4. Cross Matching (compatibility testing)
 - Major
 - Minor
5. Preparation of anticoagulants
 - ACD (Acid Citrate Dextrose)
 - CPD (Citrate Phosphate Dextrose)
 - CPDA (Citrate Phosphate Dextrose Adenine)
- 6 Malarial Parasite test by Thick and Thin smear preparation
- 7 VDRL Test
- 8 HIV Test
- 9 HbsAg Test
- 10 HCV Test
- 11 Preparation of platelet rich plasma and platelet poor plasma

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually.

Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. Introduction to Modern Lab Technology by FJ Baker, Butterworth, Heinemann Publishers Oxford
2. Text book of Modern Lab Technology by Praful and Godker, Bhalani Publisher, Mumbai
3. Modern Lab Technology – A Procedure Manual for Routine Diagnostic Test by Kanai L. Mukerjee, Volume 1, Tata McGraw Hill Publishing, New Delhi
4. Modern Blood Banking and Transfusion Practices by Denise M Harmering, Jay Pee Brothers, New Delhi

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	02	04
2	03	06
3	04	08
4	04	08
5	04	08
6.	02	04
7	03	06
8	10	22
9	02	04
10	04	08
11	04	08
12	06	14
Total	48	100

3.6 EMPLOYABILITY SKILLS – I

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS

1. Writing skills (08 hrs)
 - i) Official and business correspondence
 - ii) Job application - covering letter and resume
 - iii) Report writing - key features and kinds

2. Oral Communication Skills (20 hrs)
 - i) Giving advice
 - ii) Making comparisons
 - iii) Agreeing and disagreeing
 - iv) Taking turns in conversation
 - v) Fixing and cancelling appointments

3. Generic Skills (04 hrs)
 - i) Stress management
 - ii) Time management
 - iii) Negotiations and conflict resolution
 - iv) Team work and leadership qualities

FOURTH SEMESTER

CLINICAL MICROBIOLOGY- IV
(Immunology and Mycology)

L	T	P
3	-	3

RATIONALE

The students undergoing training of medical laboratory technology learn the techniques of collection of samples, their processing and identification of various fungal infections and diagnosis of microbial infections by serological methods. In addition to the above, students are given training in the use of safety measures while handling infected materials. The training is aimed to make the students competent to isolate and identify fungi and do serological tests for various microbial infections.

DETAILED CONTENTS

- | | | |
|----|---|----------|
| 1. | Mycology | (04 hrs) |
| - | Characteristics and classification of medically important fungi | |
| 2 | Fungal Culture media | (02 hrs) |
| - | SDA (Sabouraud's dextrose agar) with and without antibiotics | |
| - | CMA (Corn meal agar) | |
| - | BHI (Brain Heart Infusion) | |
| 3 | Collection and processing of sample for fungal infection in Skin, Nail and Hair | (02 hrs) |
| - | KOH preparation | |
| - | LCB (Lactophenol cotton blue) | |
| - | India ink | |
| 4 | Fungal Cultivation | (06 hrs) |
| - | Medically important fungi - Candida, Dermatophytes | |
| - | Laboratory Contaminants – Penicillium, Rhizopus, Mucor, Aspergillus | |
| 5. | Introduction to Immunology | (06 hrs) |

	- Immunity: - Innate and - Acquired	
Antigens		(04 hrs)
	- Definition, types and properties	
7	Antibodies	(04 hrs)
	- Definition, types and properties	
8	Antigen – Antibody Reactions	(06 hrs)
	– Principle and applications of agglutination, precipitation and flocculation reactions	
9	Serological tests	(14 hrs)
	a) Principle, techniques and interpretation of	
	- Widal - Tube method/ Titre slide method - Anti streptolysin O - C-reactive protein - VDRL/RPR - Rheumatoid factor (RF)	
	b) Principle, techniques and application of	
	- ELISA (direct and indirect)	

LIST OF PRACTICALS

1. Preparation of different culture media used in mycology - Sabouraud's dextrose agar with and without antibiotics, Corn meal agar, BHI (Brain, Heart Infusion)
2. To perform wet mount techniques – KOH and LCB
3. To study characteristics of common laboratory fungal contaminants
4. Collection and processing of samples for diagnosis of fungal infections in skin, hair, nail scrapings

5. To perform serological tests
 - Widal test (Both slide and tube method)
 - ASO titre
 - CRP
 - Rheumatoid factor
 - VDRL Test
 - HIV Screening
 - HBsAg Screening

INSTRUCTIONAL STRATEGY

The teacher should describe the morphology of important pathogenic and non-pathogenic fungi. The students should be taught to collect and process samples for isolation and identification of fungi. The teacher should emphasize on antigen and antibody tests and quality control in microbiology. The students should be taught with illustrations/audio-visual aids.

RECOMMENDED BOOKS

1. Medical Laboratory Technology by Kanai Lal Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. An introduction to Medical Laboratory Technology by FJ Baker; Butterworth Heinemann Oxford
3. Textbook of Microbiology by Ananthanarayan and Panikar; Orient Longman, Hyderabad
4. Practical Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
5. Text Book of Medical Microbiology by Satish Gupta; JP Brothers, New Delhi
6. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Cheesberg; Cambridge University Press; UK
7. Text Book of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House; Mumbai
8. Medical Lab Science Theory and Practice by J Ochei and A Kolhatkar
9. Text Book of Medical Microbiology by Greenwood, ELBS

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	04	08
2	02	06
3	02	06
4	06	12
5	06	12
6	04	08
7	04	08
8	06	12
9	14	28
Total	48	100

HAEMATOLOGY - IV

L	T	P
3	-	3

RATIONALE

This subject aims to enable the students to carry out routine clinical laboratory investigation (blood, urine etc). He/she should be able to provide technical help for sophisticated hematological techniques with adequate knowledge of various principles. The training in laboratory safety is also provided.

DETAILED CONTENTS

1. Introduction to normal haemostasis (22 hrs)

Theories of blood coagulation

Platelets and their role in haemostasis including count

Bleeding disorders and related diseases

Principles, clinical importance, reference values and methods of: prothrombin time, prothrombin time index (PTI) International normalized ratio (INR), Activated Partial Thromboplastin time (APTT), Thrombin Time (TT), bleeding time (BT), Hess test, clotting time (CT), and clot retraction test (CRT)

2. Bone – marrow (05 hrs)

Composition and function of bone-marrow

Aspiration of bone-marrow by various methods

Preparation, staining and examination of bone-marrow smears for myelogram including M.E. Ratio

Iron staining (Perls' reaction)

Significance of bone-marrow examination

3. Leukemia (10 hrs)

Definition of leukemias

(FAB) Classification

Laboratory diagnosis of various leukemias

4. LE Cell phenomenon (03hrs)

Phenomenon of LE cell, its differentiation from tart cell

Demonstration of LE cell by various methods

Clinical significance

- | | | |
|----|--|----------|
| 5. | Semen Analysis in detail | (04 hrs) |
| 6. | Cell counts of various biological fluids | (04 hrs) |

LIST OF PRACTICALS

1. Determination of bleeding time by Ivy's and Dukes method
2. Determination of clotting time by Lee and White method
3. Determination of prothrombin time, index and INR (International Normalised Ratio)
4. Determination of Activated Partial thrombo plastin time (APTT)
5. Demonstration of Hess test
6. Performance of Clot retraction test
7. Demonstration of LE Cell
8. Cell counts of biological fluids
9. Semen analysis

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually. Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. Medical Laboratory Technology Vol. 1 by KL Mukherjee; Tata McGraw Hill Publishing Company, New Delhi
2. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworths Heinemann, Oxford
3. Medical Laboratory Manual for Tropical Countries by Monica Cheesberg; Cambridge University Press; UK
4. Textbook of Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai
5. Practical Haematology by J.V Decie; ELBS with Churchill Living Stone, UK
6. Medical Laboratory Science Theory and Practical JO Chei and Kolhatkar, Tata McGraw Hill Publishing Company Ltd., New Delhi
7. Haematology for Medical Technologists by Charles F. Seiverd 5th Ed. 1983, Lea & Febigue Philadelphia

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	22	46
2	05	10
3	10	21
4	03	6
5	04	09
6	04	08
Total	48	100

CLINICAL BIOCHEMISTRY- IV

L	T	P
3	-	3

RATIONALE

The students are imparted basic training of theoretical and practical aspects in the field of clinical biochemistry. The students 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 different tests is obtained. The students are also given basic training in safety measures, quality control and automation

DETAILED CONTENTS**Theory****1. Urine Analysis (11hrs)**

Normal composition of urine

Clinical importance of urine analysis

Qualitative analysis of proteins, sugar, bile salts, bile pigments, urobilinogen and blood.

Detailed discussion on glycosuria and albuminuria

Ketone bodies

Urinary electrolytes estimation (Na, K and Cl)

2. Stool Chemistry (08 hrs)

Physical characteristics and chemical composition of stool

Significance of presence of blood and excess fat in stool

Occult blood detection

3. Cerebrospinal Fluid (05 hrs)

Composition of CSF and its functions

Methods of determination of proteins, sugar and chloride in CSF

Reference Values

Clinical importance

4. Biological fluids (05 hrs)

Formation, composition and significance of biological fluids (peritoneal, pleural, synovial, ascitic fluid)

5. Electrophoresis (04 hrs)

Theory

Principle and procedure of paper, gel electrophoresis, method of elution

Clinical importance

6. Chromatography (04 hrs)

Theory of Chromatography, separation between stationary and mobile phases

Principle and procedure of Paper chromatography

Importance of chromatography

7. Automation in Biochemistry (05 hrs)

Classification and types of Auto analyzers

8. Thyroid function tests (04 hrs)

Clinical importance of T₃, T₄ and TSH

9 Introduction to Tumor markers (02hrs)

Commonly used Tumor Markers (Cancer Markers)

LIST OF PRACTICALS

1. Analysis of urine for sugar and proteins (qualitative and quantitative)
2. Detection of ketone bodies in urine
3. Detection of haematuria
4. Detection of bile pigments, bile salts and urobilinogen
5. Occult blood test for stool specimen
6. Estimation of glucose in CSF
7. Estimation of total proteins and globulins in CSF
8. Estimation of chloride in CSF
9. Titration for acidity determination and qualitative analysis of gastric juice
10. Demonstration of electrophoresis (Paper electrophoresis)
11. Demonstration of chromatography (Paper chromatography)

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually.

Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. A Procedure Manual for Routine Diagnostic Tests, Vol. I, II and III by KL Mukherjee; Tata McGraw Hill Publishers, New Delhi
2. Practical Clinical Biochemistry by Varley; Heinmann Publishers, Oxford
3. A Text Book of Medical laboratory Technology by P Godkar; Bhalani Publishers, Mumbai
4. Medical Laboratory Science Theory and Practice by J Ochaie and A Kolhatkar, Tata McGraw Hill

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	11	20
2	08	16
3	05	10
4	05	10
5	04	10
6	04	10
7	05	10
8	04	10
9	02	04
Total	48	100

HISTOPATHOLOGY AND CYTOLOGY - II

L	T	P
4	-	3

RATIONALE

This part of the subject is aimed at exposing the students to the latest advancements and automation in the field of histopathology and cytology.

DETAILED CONTENTS**Theory**

1. Light Microscope (11 hrs)

Principles of light microscope

Various parts of microscope

Uses of microscope

Cleaning and maintenance of microscope

Various attachments of compound microscope (principle only)

- Polarizing microscopy
- Dark field microscopy
- Phase contrast microscopy
- Fluorescent microscopy
- Electron microscopy

2. Special stains (12 hrs)

Principle, significance and interpretation of different types of stains

- PAS (Periodic Acid Schiff's Reagent)
- Silver impregnation stain – Reticulin fibre
- Ziehl Neelson's – for AFB and Lepae
- Masson's trichrome stain
- Oil Red O – fat
- Gram's stain – Gram +ve and Gram –ve

3. Decalcification (06 hrs)

Process of decalcification

Various types of decalcifying methods

Their mechanism, advantage, disadvantage and applications

Assessment of decalcification

4. Handling of fresh histological tissues (Frozen Section) (07 hrs)

Reception and processing of frozen tissue
Freezing microtome and cryostat
Advantages and dis-advantages of freezing microtome and cryostat
Working, care, maintenance of freezing microtome and cryostat
Frozen section cutting
Staining
 - Rapid H&E
 - Fat stain

Mounting of frozen section

5. Museum Techniques (10 hrs)

Introduction to museum with emphasis on importance of museum
Reception, fixation and processing of various museum specimens
Cataloguing of museum specimen

6. Autopsy (02 hrs)

Introduction to autopsy technique (Care and maintenance of autopsy area,
autopsy instruments, handling of dead bodies)
Use of autopsy

7. Malignant Cells (02 hrs)

Characteristics
Differences from normal cell

8. Harmonal Assessment (02hrs)

Importance of HCG
Use of Harmonal Assessment (Pregnancy Test)

9. Aspiration Cytology (06 hrs)

- 9.1. Principle of FNAC (Fine Needle Aspiration Cytology)
- 9.2. Indications of FNAC
- 9.3. Uses of FNAC
- 9.4. Staining Techniques
 - PAP Stain
 - MGG (May-Grunwald – Giemsa)

- H&E (Haematoxylin & Eosin Stain)

10. Cytological special stains (04 hrs)

Principle, Technique & Interpretation of :

PAS (Periodic Acid Schiffs reagent Stain)

Zeihl Neelson's(ZN) Stain (AFB)

11. Advancements in Cytology (02 hrs)

- Automation in Cytology, Use of Cytospin

LIST OF PRACTICALS

1. Demonstration of various parts of light microscope (Mechanical & Optical)
2. Demonstration of cryostat (brochures and charts can be used)
3. Processing of tissue for frozen section
4. Staining and mounting of frozen section using H&E stain (rapid method), Oil Red "O".
5. Preparation of various mounting reagents for museum specimens
6. Demonstration and care of autopsy instruments
7. Demonstration of malignant cell
8. Preparation of dry smear and wet smear
9. To perform Pap stain
10. Fixation of smears and staining with MGG

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually.

Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworths Scientific, London
2. Carleton's Histological Technique by RAB, Drury, MADM (OXON), FRC Path, Northwick Paru Hospital, Harrow, Middlesex

3. Theory and Practice of Histological Technique by John D. Bancroft, Churchill Livingstone, London
4. Cellular Pathology Techniques by CFA Culling, Butterworths, London
5. Medical Lab Technology by Dr. Ramnik Sood, MD, Maulana Azad College, New Delhi
6. Diagnostic Cytology and its Histopathology Basis by Leo Pold G.Koss; JB Lupein, Philadelphia

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	11	18
2	12	20
3	06	08
4	07	08
5	10	16
6	02	04
7	02	04
8	02	04
9	06	08
10	04	06
11	02	04
Total	64	100

MEDICAL LABORATORY MANAGEMENT

L	T	P
4	-	-

RATIONALE

The students are taught techniques of planning a clinical laboratory. They are also supposed to be taught how to procure chemicals, reagents and equipment. The students are imparted special training in maintaining laboratory equipment, the preventive maintenance and daily up keeping. They are also given training for the maintenance of stocks and inventory. They are also given knowledge of recording results, interpretation, quality control and reproducibility. Students also learn how to communicate effectively.

DETAILED CONTENTS

1. Introduction, Layout, Facility of clinical Laboratory (08 hrs)
 Role of medical laboratory technology in total health care, principles of management, techniques of planning, physical facilities/equipments – layout and design
2. Laboratory Organization and Layout (08 hrs)
 Laboratory organization, operation, job description, evaluation, performance
 Layout of clinical laboratories
 Lay out of Blood Bank
3. Material Required (06 hrs)
 Material management, procurement, financial resources, importing, inventory, control and analysis, inspection, storage etc
4. Quality Assurance (10 hrs)
 Analytical control, Internal and external quality assurance in clinical laboratories, precision, accuracy, standard deviation as per national standards
5. Safety Precautions (05 hrs)
 Safety measures in clinical laboratories (microbiology, haematology, biochemistry, histopathology and cytology, transfusion medicine), Disposal of Biomedical waste.
6. First Aid in Clinical Laboratory: (09 hrs)

-
- a) Acid burn/Alkali burn
 - b) Accidental trauma
 - c) Gas/Toxic inhalation
 - d) Spillage
7. Medical Ethics and Code of Conduct (08 hrs)
- Ethics and code of conduct - legal aspects – confidentiality malpractice/ negligence; legal implications, law suits, consumer protection and insurance for professional health hazards
- 8 Laboratory Equipment - Care and Maintenance (05 hrs)
- Preventive maintenance and care of various laboratory equipment
- 9 Role of Computer in Lab services (03 hrs)
- Storage and retrieval of laboratory data manually and with help of computers
- 10 Laboratory Accreditation – Introduction (02 hrs)

INSTRUCTIONAL STRATEGY

Teachers should lay emphasis on concepts and principles while covering the subject contents. In the practical work, the students should be given opportunity to do practical work individually but under supervision.

Visits to hospital/medical colleges should be planned to demonstrate the processes. It is important to make use of models and audiovisual aids to show specific processes. Experts should be invited to deliver lecture on specific topics and share their experiences.

RECOMMENDED BOOKS

1. Medical Laboratory Technology by Praful B Godkar; Bhalani Publishing House, Mumbai (India)
2. Text Book of Medical Laboratory Technology by FJ Baker; Butterworths Heinmann Publishers, Oxford
3. Text Book of Medical Laboratory Technology by KL Mukherjee Vol I, II and III; Tata McGraw Hill Publishers, New Delhi
4. Medical Lab Technology by Ramnik Sood, Jay Pee Brothers, New Delhi

5. District Laboratory Practice in Tropical Countries by Monica Chesbrough, Churchill Livingstone.
6. Laboratory Management by Puthwilliams.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time allotted (Hrs)	Marks Allotted (%)
1	08	12
2	08	12
3	06	10
4	10	14
5	05	08
6	09	16
7	08	14
8	05	07
9	03	05
10	02	02
Total	64	100

EMPLOYABILITY SKILLS – II

L	T	P
-	-	2

RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject to prepare students for employability in job market and survive in cut throat competition among professionals.

DETAILED CONTENTS**1. Oral Practice**

- | | | |
|------|-------------------------------------|----------|
| i) | Mock interview | (05 hrs) |
| ii) | Preparing for meeting | (05 hrs) |
| iii) | Group discussion | (05 hrs) |
| iv) | Seminar presentation | (05 hrs) |
| v) | Making a presentation | (12 hrs) |
| a) | Elements of good presentation | |
| b) | Structure and tools of presentation | |
| c) | Paper reading | |
| d) | Power point presentation | |

PERSONALITY DEVELOPMENT CAMP

This is to be organized at a stretch for two to three days during fifth or sixth semester. Extension Lectures by experts or teachers from the polytechnic will be delivered on the following broad topics. There will be no examination for this subject.

1. Communication Skills
2. Correspondence and job finding/applying/thanks and follow-up
3. Resume Writing
4. Interview Techniques: In-Person Interviews; Telephonic Interview' Panel interviews; Group interviews and Video Conferencing etc.
5. Presentation Techniques
6. Group Discussions Techniques
7. Aspects of Personality Development
8. Motivation
9. Leadership
10. Stress Management
11. Time Management
12. Interpersonal Relationship
13. Health and Hygiene

FIFTH SEMESTER

&

SIXTH SEMESTER

**5. PRACTICAL PROFESSIONAL TRAINING – I
(Structured and Supervised)
AND
6. PRACTICAL PROFESSIONAL TRAINING – II
(Structured and Supervised)**

L T P
- - 35

OBJECTIVE

The objective of providing professional training is to:

1. Provide real life experience by creating necessary awareness regarding use of various types of diagnostic equipment, particularly sophisticated ones which are used in the field of medical laboratory technology.
2. Create confidence in the students to work in world of work by developing practical skills pertaining to laboratory management and diagnostic skills in the field of clinical haematology, transfusion medicine blood banking, clinical biochemistry, clinical microbiology, histopathology and cytology and ensuring laboratory safety and quality assurance.
3. Develop appreciation regarding size and scale of operations, environment and other related aspects like value of team work, interpersonal relations and professional ethics in the field of medical laboratory technology.
4. Develop necessary traits for starting small clinical laboratories as per requirements.

SELECTION OF TRAINING PLACES

The institute offering diploma programme in Medical Laboratory Technology should establish contact/rapport by personal visit to following types of organizations:

1. Medical Colleges/Research institutions
2. Civil Hospitals at District Headquarters having well equipped laboratory
3. Hospitals in private sector
4. Well established clinical laboratories being run by a qualified person

LIST OF PRACTICALS

List of exercises is suggested below which should be carried out during 5th semester and 6th semester.

During 5th Semester

1. Preparation of various anticoagulants/containers
2. Collection of various clinical samples
3. Haemoglobin estimation
4. TLC, DLC, ESR, PCV, BT & CT
5. Absolute Eosinophil Count

6. APTT/PTTK
7. Prothrombin Time & calculation of INR
8. Blood Sugar – Random/Fasting/PP
9. GTT/ST
10. Urine – Complete examination
11. Stool – Complete examination
12. RA/RF factor
13. ABO and Rh blood grouping
14. Widal test
15. VDRL test
16. Cleaning of glassware
17. Disposal of Medical wastes (use of bags)
18. Staining of blood film
19. H&E staining
20. Spotting

During 6th Semester

1. Reticulocyte count
2. Platelet count
3. Peripheral blood film examination
4. Sputum examination for AFB
5. Serum calcium
6. CSF examination
7. Lipid profile
8. Liver function test
9. Renal function test
10. Stool for occult blood
11. Urine for culture and sensitivity
12. Blood for culture and sensitivity
13. Semen culture
14. Pus culture and sensitivity
15. Staining of smears by various staining procedures
16. Biochemical testing
17. HIV Test
18. Hbs Ag test
19. ASO
20. CRP
21. Pregnancy test
22. Spotting

In addition to the above, students are expected to learn various tests being conducted at the training centre, where ever they are undergoing training.

Note:

1. The Principal of the institute where diploma programme in Medical Laboratory Technology is being offered, with the help of Directorate of Technical

Education/Secretary, Technical Education may approach Director, Health Services/Director, Medical Education/Secretary, Health to collaborate in offering structured and supervised project work/practical training of students in above organizations. It will be worthwhile to sign a "Memorandum of Understanding" regarding the involvement of students in undergoing practical training

2. The Principal of the institute may also approach Regional Apprenticeship Adviser (Northern Region), Kanpur to provide training seats under Apprenticeship Act to the students

METHODOLOGY OF ORGANIZING PROFESSIONAL TRAINING

Each concerned teacher will be responsible for a group of minimum 10 students in respective speciality to plan, supervise and monitor the progress when placed in different organizations for practical training for minimum 8 hrs/week. For this purpose, necessary recurring expenditure for making payment of TA/DA to the faculty of institute and the experts may be worked out by respective institutes, keeping in view, number of visits and the distances involved in such travelling. The concerned teacher will have to continuously interact with training centres to monitor the progress of the students

EVALUATION OF STUDENTS FOR PROFESSIONAL TRAINING

Professional training will have 800 marks. Out of which 300 marks will be awarded by the organization in consultation with concerned teacher where placed for practical/professional training and 500 marks are for (Board) external examination. The criteria for internal assessment will be as under:

a) Criteria for internal assessment by organization where placed for practical/professional training	Weightage (%)
1. Attendance/Punctuality	10
2. Proficiency in conducting laboratory test	30
3. Preparation of portfolio based on day to day work done in various laboratories	20
4. Initiative/responsibility exhibited	10
5. Interpersonal relations	10
6. Behaviour/attitude	10
7. Maintenance of equipment and work place	10

GENERAL GUIDELINES

- (i) The students are expected to prepare practical record book as per given list of the experiments. Besides, they can also add other experiments as well.
- (ii) External examiner along with internal faculty should evaluate the student's performance through viva voice/spotting/performance and synopsis.