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

(September, 2024)

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.

Director
National Institute of Technical Teachers Training & Research, Chandigarh

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) 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.

Professor & Head
Curriculum Development Center
National Institute of Technical Teachers Training & Research, Chandigarh

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1. SALIENT FEATURES

1.	Name	:	**Diploma in Medical Laboratory Technology**
2.	Duration	:	**03 Years**
3.	Hours per week	:	**35**
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	:	**32 :68**
10.	Project Work	:	**3rd year full Practical Training**
11.	In-house/Industrial Training	:	**Mandatory after First and Second Year**

2. NSQF GUIDELINES

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 contextof 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:

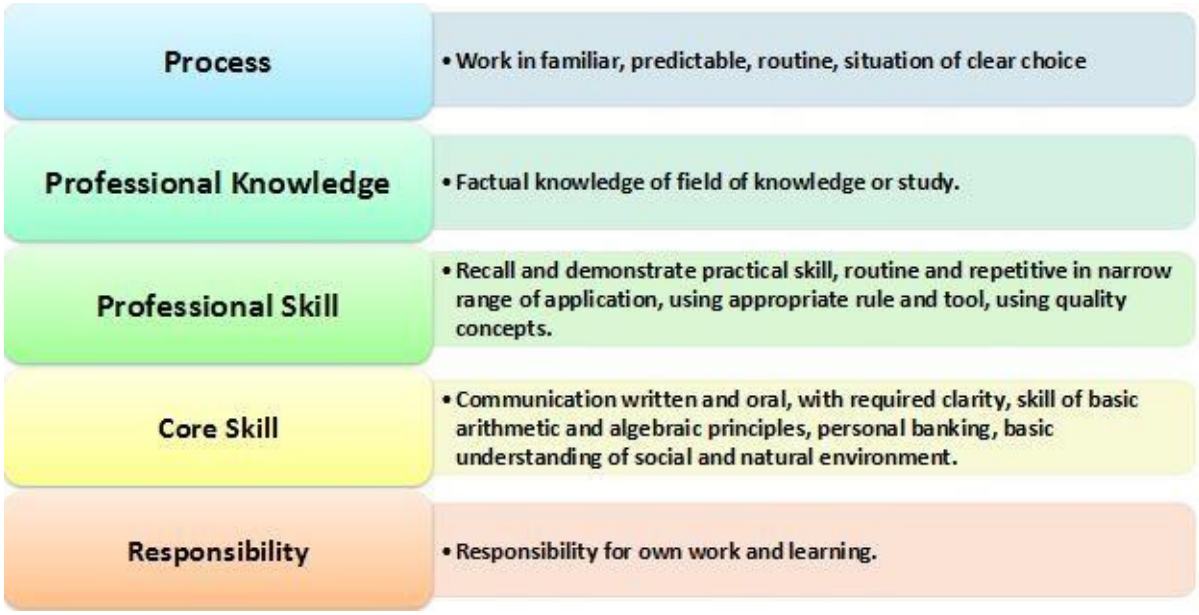

Fig 3: NSQF Level – 4 Descriptor

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 byselecting 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.

3. 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.

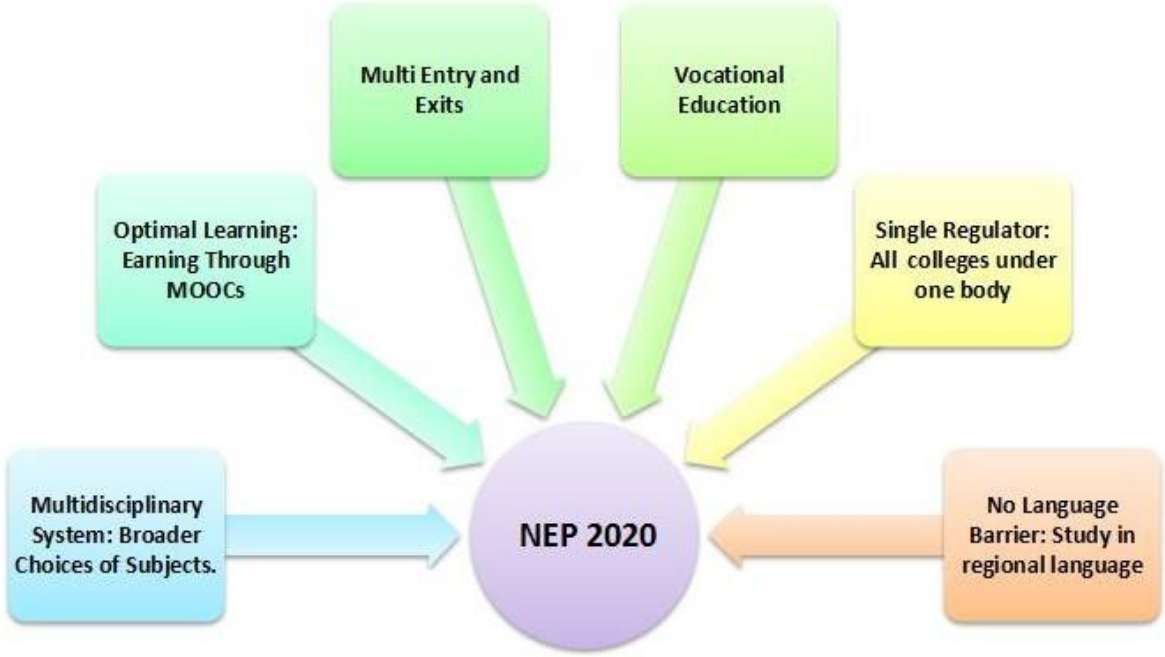

Fig 5: NEP 2020

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.

4. 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.

5. 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 • Industrial/In-house Training-I • Parasitology & Virology • Clinical Haematology-I • Applied Clinical Biochemistry • Histopathology • Transfusion Medicine
2.	Acquire knowledge of principles and processes in Medical Laboratory Technology related field.	• Anatomy and Physiology-II • Bacteriology • Applied Hematology • Clinical Biochemistry • Industrial/In-house Training-I • Parasitology & Virology • Clinical Haematology-I • Applied Clinical Biochemistry • Histopathology • Transfusion Medicine • Clinical Haematology-II • Immunology and Mycology • Analytical Clinical Biochemistry • Immunopathology & Cytology • Medical Laboratory Management

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 • Industrial/In-house Training-I • Parasitology & Virology • Clinical Haematology-I • Applied Clinical Biochemistry • Histopathology • Transfusion Medicine • Clinical Haematology-II • Immunology and Mycology • Analytical Clinical Biochemistry • Immunopathology & Cytology • Medical Laboratory Management
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 • English and Communication Skills - II • Industrial/In-house Training-I • Industrial Training-II • Project Oriented Professional Training – I • Project Oriented Professional Training – II
5.	Take the responsibility of own works and supervises others work.	• Industrial/In-house Training-I • Industrial Training-II • Project Oriented Professional Training – I • Project Oriented Professional Training – II
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

FIRST YEAR
6. STUDY CUM EVALUATION SCHEME

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					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**	**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 Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of
					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**	**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.

7. 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**

8. 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.)

9. 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.

10. 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

	• 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 Haemocytometery • 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. • 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.

11. SUBJECTS & DETAILED CONTENTS

FIRST SEMESTER

1.1 ENGLISH &COMMUNICATION SKILLS – I

L	P
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

1.1 Techniques of reading: Skimming and Scanning

1.2 Extensive and Intensive Reading: Textual Study

1.3 Homecoming – R.N. Tagore

1.4 Life Sketch of Sir MokshagundamVisvesvarayya

1.5 Life Sketch of Dr. Abdul Kalam

1.6 Narayan Murthy's speech at LBSNA, Dehradun

UNIT II

Fundamentals of Communication

2.1 Concept and Process of Communication,

2.2 Types of Communication (Verbal Communication)
2.3 Barriers to Communication
2.4 Speaking Skill: Significance and essentials of Spoken Communication
2.5 Listening Skill: Significance and essentials of Listening

UNIT III

Grammar and Usage

3.1 Nouns
3.2 Pronouns
3.3 Articles
3.4 Verbs(Main and Auxiliary)
3.5 Tenses

UNIT IV

Writing Skills

4.1 Significance, essentials and effectiveness of Written Communication
4.2 Notice Writing
4.3 Official Letters and E-mails.
4.4 Frequently-used Abbreviations used in Letter-Writing
4.5 Paragraph Writing
4.6 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. KavitaTyagi& Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
7. NiraKonar, "Communication Skills for professionals", PHI Learning Pvt. Ltd., New Delhi.
8. Krishna Mohan &MeeraBanerji, "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 Rutherfoord, "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 weight age.

1.2 BASIC CHEMISTRY

L	P
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 occuring 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. EngineeringChemistrybyShashiChawla.
4. ProgressiveAppliedChemistry–IbyDr.G.H.HugarEaglePrakashanJalandhar

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.

1.3 ANATOMY & PHYSIOLOGY –I

L	P
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

1.1 Introduction to Anatomy & Physiology.
-Levels of organization, parts of human body
-Major body divisions and sectional divisions
1.2 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

2.1 Gross structure, function and classification.
2.2 Bones of appendicular and axial skeleton
a) Bones of Pectoral girdle and upper limbs.

b) Bones of Pelvic girdle and lower limbs.

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

2.4Bones forming major synovial joints (Shoulder, Elbow, wrist, hip, knee, ankle and intervertebral joints).

UNIT III

Muscular System

3.1 Properties of muscular tissue.

3.2 Classification, structure and functions of muscles.

- Skeletal muscle
- Smooth muscle
- Cardiac muscle

UNIT IV

Cardiovascular System

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

4.2 Blood vessels attached to various chambers of heart, Coronary vessels & Major arteries andVeins of body.

4.3 Circulation of Blood: Pulmonary, Coronary and Portal circulation.

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

4.5 Methods and Apparatus for recording blood pressure.

4.6Introduction to ECG: Basic principles, normal electrocardiogram& grids of ECG paper, electrographic leads, cardiac cycle and Junctional tissues.

4.7Patient preparation for ECG recording &care and maintenance of ECG machine.

UNIT V

Respiratory System

5.1 Organs of respiration: Upper and lower respiratory tract.

a) Nose and Paranasal sinuses

b) Nasopharynx and larynx

c) Trachea, bronchi and lungs

5.2 Functions and mechanism of Respiratory system

5.3 Gas exchange in lungs.

5.4 Control of respiration.

5.5 Basal Metabolic Rate (BMR)

5.6 Respirometery: Procedure, clinical applications &Importance

PRACTICAL EXERCISES

1.Demonstration of different parts of body
1.1 Cranial cavity (Brain)
1.2 Thoracic cavity (Heart and lungs)
1.3 Abdominal cavity (Liver, Gallbladder, spleen, kidney, stomach & intestines)
1.4 Pelvic cavity (Reproductive organs)
2. Demonstration of basic tissues of the body
2.1 Epithelial tissue
2.2 Connective tissue
2.3 Muscular tissue
2.4 Nervous tissue
3.Demonstration of various parts of bones
3.1 Bones of upper limb - Humerus, radius, ulna, fibula and articulated hand - Scapula and clavicle
3.2 Bones of lower limb - Pelvic/hip bone and femur, tibia, fibula and articulated foot.
3.3 Bones of Skull and mandible
3.4 Sternum and ribs
3.5 Bones of vertebral column
4. Demonstration of major joints of the body
4.1 Joints of upper limb - Shoulder joint - Elbow joint - Wrist joint
4.2 Joints of lower limb - Hip (pelvic) joint - Knee joint - Ankle joint
4.3 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 Murugesh; 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 musuem 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

1.4 BASIC MICROBIOLOGY

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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 Cruckshiank 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.

1.5 INTRODUCTION TO HEMATOLOGY

L	P
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

1.1 Various glassware/plastic-ware used in Haematology Labs. (Hb. Tube, Hb. Pipette, RBC Pipette, WBC Pipette).
1.2 Introduction to blood.
1.3 Definition & Composition
1.4 Cells-WBC (Granulocytes-Neutrophils, Eosinophils& Basophils), (Agranulocytes-Lymphocytes & Monocytes), RBC, Platelets.
1.5 Plasma & its components
1.6 Function-cell functions & plasma functions.
1.7 Formation of blood (Erythropoiesis, Leukopoiesis&Thrombopoiesis)

UNIT II

Anticoagulants

2.1 Definition
2.2 Various types along with their mode of action, merit and demerit its of each Anticoagulant vials

2.3 Difference between Plasma and serum

UNIT III

Venous blood collection

3.1 Venipuncture : materials and equipment required for venipuncture
3.2 Preparation of patients for venipuncture
3.3 Applying tourniquet
3.4 Selection and preparing the venipuncture site
3.5 Performing venipuncture
3.6 Care of venipuncture site
3.7 Disposable of blood, syringes, needle and lancets.

UNIT IV

The capillary puncture

4.1 Capillary puncture site
4.2 Materials and equipment required for capillary puncture site
4.3 Selecting and preparing the puncture site
4.4 Techniques performing the puncture site
4.5 Collection of blood sample
4.6 Care of the capillary puncture site
4.7 Vacutainer system for blood collection

UNITIV

Romanowsky stains (Leishman, Giemsa)

5.1 Preparation and theory
5.2 Choice of slide and spreader
5.3 Preparation of blood film
5.4 Characteristics of good blood smear
5.5 Examination of blood smear
5.6 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

L	P
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

1.1 Basic ethics of Medical laboratory Technology

1.2 Training of clinical laboratory technicians.

1.3 Medical laboratory professional - professionalism in laboratory workers,

1.4 Code of conduct and communication between physician and lab technician

Common Lab accidents and ways for its prevention

1.5 First aid in the clinical laboratory

1.6 Storage and handling of dangerous chemicals

1.7 Common Laboratory hazards

1.8 Color coding of various Waste disposal containers in the labs

UNIT II

Introduction to Instrumentation in a Medical Laboratory

2.1Introduction to Basic Equipments in MLT

2.2 Different types of syringes used for blood collection.

2.3 Basic requirements of blood collection.

UNIT III

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

3.1 Centrifuge (routine - low and high speed -table top)
3.2 Water Bath
3.3 Hot Air Oven
3.4 Incubator
3.5 Colorimeter
3.6 Compound Microscope (Monocular and Binocular)

UNIT IV

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

4.1 pH Meter
4.2 Distillation unit
4.3 Balance (Physical and chemical)
4.4 Micro tom
4.5 Microbefilters (Seitz, GlassScintered& Membrane)

UNIT V

Principle, Care, Procedure and Application of the AdvancedInstruments

5.1 Refrigerated Centrifuge
Ultra Centrifuge
5.2 Specialised Incubator
B.O.D. Incubator
5.3 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

2.1 ANATOMY AND PHYSIOLOGY – II

L	P
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

1.1 Central nervous system (brain and spinal cord)

1.2 Peripheral nervous system (cranial and spinal nerves)

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

UNIT II

Circulatory system

1.1 Composition and functions of blood

1.2 Anatomy and physiology of Heart

1.3 Circulation of blood, Cardiac Cycle and Conducting System of Heart

1.4 The blood pressure

1.5 Arteries and viens

1.6 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

1.1 Organs of excretion (kidneys,ureter,bladder)

1.2 Formation of urine and its composition

1.3 Structure of nephron

UNIT V

Reproductive System

1.1 Male and female reproductive system

1.2 The ovarian cycle and ovulation

1.3 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 Murugesh; 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

L	P
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

DETAILEDCONTENTS

UNIT 1

Bacteriology

1.1 General characteristics of bacteria-morphology,staining,culture, biochemical
1.2 Characteristics, antibiotics related to Gram Positive bacteria and their distribution: Gram Positive
1.3 Staphylococci
1.4 Strep to cocci and pneumococci
1.5 Enter obacteriacae-(Ecoli,Salmonella,Shigella)

UNIT II

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

2.1 Pseudomonas
2.2 Proteus
2.3 VibrioCholerae
2.4 Neisseria
2.5 TreponemaPallidium
2.6 Myco bacterium tuberculosis and leprae

UNIT III

Bacterial pathogenicity

3.1 Introduction,pathogenicity & infection.
3.2 Sources of infection
3.3 Mode of spread of infection
3.4 Types of infection

UNIT IV

Nosocomial Infection

4.1 Introduction
4.2 Common types and source of nosocomia linfection
4.3 Control of nosocomial infections

UNIT V

Laboratory diagnosis of infectious diseases

5.1 Septicemia and bacteraemia
5.2 Respiratory tract infections (Throat Swab and Sputum sample)
5.3 Wound infections
5.4 Urinary tract infections
5.5 Enteric fever
5.6 Intestinal infection
5.7 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.

RECOMMENDEDBOOKS

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 Chees brough; Cambridge University Press;UK
7. Text Book of Microbiology by Ananthanarayan and Paniker; Orient Longman, Hyderabad
8. Textbook of Medical Microbiology by Cruckshi 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

INSTRUCTIONALSTRATEGY

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

L	P
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 Haemoglobinometery
CO2: Perform Haemocytometery
CO3: Identify Blood cell morphology in health and disease
CO4: Assure Quality in hematology

DETAILED CONTENTS

UNIT I
Haemoglobinometery
1.1 Formation of hemoglobin, function and its degradation
1.2 Types of hemoglobin
1.3 Various methods of estimation with specific reference to cyanmethaemoglobin method

UNIT II
Haemocytometery
2.1 Various counting chambers
2.2 Methods of counting of RBC, WBC and platelets, their calculation and reference values.
2.3 Errors involved in haemocytometery and means to minimize them

UNIT III
Differential leukocyte counting (DLC)
3.1 Preparation and staining of blood film
3.2 Performance of DLC
3.3 Normal values and significance of DLC

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

UNIT IV

Quality Assurance in hematology

4.1 Internal & External Quality Assurance

4.2 Define accuracy, precision& Standard Deviation.

UNIT V

Automation in hematology

5.1 Various types of Blood cell counter.

5.2 Principle and operation of the automated blood cell counters.

PRACTICAL EXERCISES

UNIT I

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

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 andgiemsa)
8. Preparation of thick and thin bloodsmear
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

L	P
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

DETAILEDCONTENTS

UNIT I

Introduction to biochemistry

1.1 Definition and Importance of biochemistry

1.2 Volume tricapparatus and their calibration Blood fractions

1.3 Separation of Serum

1.4 Separation of Plasma

1.5 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)

3.1 Principle and methods of estimation

3.2 Reference values

3.3 Renal threshold

UNIT IV

Clinical importance of blood sugars/GTT

4.1 Blood urea

4.2 Formation and excretion of urea

4.3 Principle and procedures of different methods of urea estimation

4.3 Reference values

4.5 Clinical Importance

UNIT V

Serum proteins

1.1 Introduction

1.2 Different methods of estimation including principles and procedures

1.3 Reference values

1.4 Clinical importance

Uric Acid

1.5 Introduction, principles and procedures of various stimation methods

1.6 Reference values

1.7 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 Separateserum and plasma from a given blood sample.
4. To Prepare different protein precipitating agents handoff
5. Preparation of reagents(stock and working)
6. Estimationofbloodglucose/sugar(O-toluidinemethodandenzymaticmethod)
7. To Performs/GTT using GOD-POD method
8. To estimate urea and creatnine in a given serum sample.
9. To estimate of 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. AText 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.

2.5 FUNDAMENTALS OF IT

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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 Office*Calc*, 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+…..+N
i. print multiplication Table of a number
j. generate first n Fibonacci terms 0,1,1,2,3,5…n (n>2)
k. sum and average of given series of numbers
l. Factorial of number n (n!=1x2x3x…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.

2.6 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT

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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

1.1 Basics of ecology, eco system- concept, and sustainable development, Sources, advantages, disadvantages of renewable and nonrenewable energy.
1.2 Rain water harvesting
1.3 Deforestation – its effects & control measures

UNIT II

Air and Noise Pollution

2.1 Air Pollution: Source of air pollution. Effect of air pollution on human health, economy, Air pollution control methods.
2.2 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

3.1 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.

3.2 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.

SECOND YEAR

NSQF LEVEL - 4

12. STUDY AND EVALUATION SCHEME

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
3.1	Industrial/In-house Training-I	-	2	0+1=1	-	40	40	-	60	60	100
3.2	Parasitology & Virology	3	4	3+2=5	40	40	80	60	60	120	200
3.3	Clinical Haematology-I	3	4	3+2=5	40	40	80	60	60	120	200
3.4	Applied Clinical Biochemistry	3	2	3+1=4	40	40	80	60	60	120	200
3.5	Histopathology	3	4	3+2=5	40	40	80	60	60	120	200
3.6	Transfusion Medicine	3	2	3+1=4	40	40	80	60	60	120	200
# Student Centered Activities(SCA)		-	2	-	-	-	-	-	-	-	-
	Total	**15**	**20**	**24**	**200**	**240**	**440**	**300**	**360**	**660**	**1100**

Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
4.1	*English and Communication Skills - II	2	2	2+1=3	40	40	80	60	60	120	200
4.2	Clinical Haematology-II	3	4	3+2=5	40	40	80	60	60	120	200
4.3	Immunology and Mycology	3	2	3+1=4	40	40	80	60	60	120	200
4.4	Analytical Clinical Biochemistry	3	2	3+1=4	40	40	80	60	60	120	200
4.5	Immunopathology & Cytology	3	4	3+2=5	40	40	80	60	60	120	200
4.6	Medical Laboratory Management	3	-	3+0=3	40	-	40	60	-	60	100
4.7	*Entrepreneurship Development and Management	3	-	3+0=3	40	-	40	60	-	60	100
# Student Centered Activities(SCA)		-	1	-	-	-	-	-	-	-	-
	Total	**20**	**15**	**27**	**280**	**200**	**480**	**420**	**300**	**720**	**1200**

* Common with other Diploma Courses

\# Student Centered Activities will comprise of co-curricular activities like extension lectures on Constitution of India, Electoral Literacy, Motor Vehicles (Driving) Regulations 2017 etc., games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities and self-study etc.

Industrial Training: After 4th Semester, students shall undergo 4 weeks Industrial training, who will be exiting after 2nd year. This training is not mandatory for the students who will be undergoing full 1 Year Professional Training after 2nd year. Details are given at the end of 4th semester.

13. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Third Semester	Fourth Semester
1.	Industrial/In-house Training-I	2	-
2.	Parasitology & Virology	7	-
3.	Clinical Haematology-I	7	-
4.	Applied Clinical Biochemistry	5	-
5.	Histopathology	7	-
6.	Transfusion Medicine	5	-
7.	English and Communication Skills - II	-	4
8.	Clinical Haematology-II	-	7
9.	Immunology and Mycology	-	5
10.	Analytical Clinical Biochemistry	-	5
11.	Immunopathology & Cytology	-	7
12.	Medical Laboratory Management	-	3
13.	Entrepreneurship Development and Management	-	3
14.	Student Centered Activities (SCA)	2	1
Total		**35**	**35**

14. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to Medical Laboratory Technology require **skilled workers** to work in familiar, predictable, routine situations of clear choice. They are expected to have factual knowledge of automation and robotics field. They shall be able to write and speak with required clarity. Students after passing level 4 shall have understanding of basic arithmetic, algebraic principles along with basic understanding of social and natural environment. They are expected to recall and demonstrate quality skill in narrow range of applications using appropriate rules and tools.

Skilled workers 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. They should know what constitutes quality in the occupation and should distinguish between good and bad quality in the context of their job roles. Skilled worker 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 should 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 might find work with various medical Laboratories

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.)

15. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 4 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Work in familiar, predictable, routine situation of clear choice.

PO2: Acquire factual knowledge in the field of Medical Laboratory Technology for employment.

PO3: Recall and demonstrate quality skills in routine and repetitive in narrow range of applications using appropriate rules and tools.

PO4: Write and speak with required clarity and show basic understanding of social and natural environment.

PO5: Perform tasks with responsibility for own work and learning.

16. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Work in familiar, predictable, routine situation of clear choice.	• Describe the processing of blood samples for various clinical diagnostic tests. • Perform clinical biochemistry tests for bilirubin/SGOT-SGPT/ALP-ACP/Calcium Potassium/Lipid Profile along with recording of data • Identify the LE Cell and Tart cell. • Analysis and cell count of various Biological body Fluids.
PO2: Acquire factual knowledge in the field of Medical Laboratory Technology for employment	• Explain classification, morphology &lab diagnosis of viruses & parasites. • Perform Laboratory investigations for diagnosis of viral & parasitic infection. • Discuss different types of parasitic infection of viral & human.
PO3: Recall and demonstrate quality skills in routine and repetitive in narrow range of applications using appropriate rules and tools	• Perform H & E, MGG and PAP staining methods. • Perform common serological tests. • Perform qualitative tests for urinary analysis. • Perform clinical biochemistry tests for renal function and renal clearance tests.

PO4: Write and speak with required clarity and show basic understanding of social and natural environment.	• Develop writing, speaking and presentations skills • Communicate effectively with an increased confidence; read, write and speak in English language fluently. • Comprehend special features of format and style of formal communication through various modes. • Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews • Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships. • Create writing and communication skills. • Develop Presentation skills.
PO5: Perform tasks with responsibility for own work and learning.	• Estimate Erythrocyte sedimentation rate (ESR) and packed cell volume (PCV). • Calculate Red Cell Indicies. • Reticulocyte count with the help of Supravital stain. • Classification and Lab diagnosis of different Anemias. • Red cell Fragility test for Haemolytic Anaemia.

17. SUBJECTS & CONTENTS

(SECOND YEAR)

THIRD SEMESTER

3.1 INDUSTRIAL / IN–HOUSE TRAINING-I

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RATIONALE

Industrial training / In – house training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Understand the working environment of industries
CO2: Take necessary safety precautions and measures.
CO3: Learn about present and future requirement of industries.
CO4: Work in team for solving industrial problems
CO5: Develop competencies and skills required by relevant industries.
CO6: Develop writing, speaking and presentations skills.

PRACTICALEXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answer to queries.

GUIDELINES

Students will be evaluated based on Industrial training / In – house training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation.

The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial / In-house assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

3.2 PARASITOLOGY AND VIROLOGY

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RATIONALE

The students undergoing training of medical laboratory technology will 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.

COURSE OUTCOMES

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

CO1: Explain classification, morphology &lab diagnosis of viruses & parasites.
CO2: Perform Laboratory investigations for diagnosis of viral & parasitic infection.
CO3: Discuss different types of parasitic infection of viral & human.

DETAILED CONTENTS

UNIT I

1.1 Introduction to medical parasitology
1.2 General characteristics, morphology, classification of Protozoa and Helminth

UNIT II

2.1 Laboratory Samples for detection of parasites
Collection, transportation, processing and preservation of samples for routine investigations – Blood, Stool.
2.2 Concentration techniques
Principle and application of concentration techniques of stool for demonstration of ova and cysts.

UNIT III

3.1 Morphology, Life cycle and Lab diagnosis of Giardia and Entamoeba histolytica

3.2 Morphology, Life cycle and Lab diagnosis of Ancylostoma and Ascaris lumbricoides

3.3 Morphology, Life cycle and Lab diagnosis of T .solium and T .saginata

UNIT IV

4.1 Morphology, Life cycle and Lab diagnosis of Malaria Parasite (P. Vivax and P. Falciparum)

UNIT V

5. 1 General Characteristics, Classification and Structure of viruses.

5.2 Collection, Transportation and Storage of Virological Samples.

5.3 Medically important viruses: Pathogenicity, Lab diagnosis and prevention of-

i. Hepatitis A virus
ii. HBV (Hepatitis B virus)
iii. Hepatitis E virus
iv. Hepatitis C virus
v. HIV
vi. Corona virus

PRACTICAL EXERCISES

1. Collection and routine stool examination for detection of intestinal parasites using Saline preparation.
2. Collection and routine stool examination for detection of intestinal parasites using Lugol's lodine preparation.
3. Concentration methods of stool examination
   a) Floatation method (saturated salt solution/zinc sulphate)
   b) Sedimentation methods
4. Identification of following adult w2orms/cyst from preserved specimen/ slides of Tapeworm.
5. Identification of following adult w2orms/cyst from preserved specimen/ slides of Roundworm.
6. Identification of following adult w2orms/cyst from preserved specimen/ slides of Hookworm
7. Identification of following adult w2orms/cyst from preserved specimen/ slides of Giardia

8. Identification of following adult w2orms/cyst from preserved specimen/ slides of Entamoeba histolytica, E. coli
9. Preparation of smear and identification of blood parasites
10. Preparation of Leishman stain
11. Preparation of Giemsa stain
12. Preparation of Field stain
13. Preparation of thin and thick smears
14. Staining of smears by Leishman, Giemsa, and Field stain.
15. Examination of smears for malarial parasite (P. vivax and P. falciparum)
16. Demonstration of various stages of malarial parasite from stained slides
17. PCR Test

RECOMMENDED BOOKS

1. KD Chatterjee, “Parasitology”, Chatterjee Medical Publishers, Kolkatta.
2. Arora & Arora, “Medical Parasitology”.
3. Satish Gupta, “Textbook of Microbiology”, JP Brothers, New Delhi.
4. Ananthanarayan and Panikar, “Textbook of Microbiology”, Orient Longman, Hyderabad.
5. Praful B Godkar, “Text Book of Medical Laboratory Technology”, Bhalani Publishing.
6. Satish Gupta, “Practical Book of Medical Microbiology”, JP Brothers, New Delhi.
7. J. ochie and Kolhatkar, “Medical Laboratory Science”, Tata McGraw Hill.
8. Kanai Lal Mukherjee, “Medical Laboratory Technology”, Tata McGraw Hill Publishers, New Delhi.

SUGGESTED WEBSITES

1. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7149825/
3. https://www.cdc.gov/ncird/dvd.html
4. https://www.cdc.gov/parasites/index.html

INSTRUCTIONAL STRATEGY

The teacher should lay emphasis on common names, morphology of helminith 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. This subject contains five units of equal weightage.

3.3 CLINICAL HAEMATOLOGY -I

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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.

COURSE OUTCOMES

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

CO1: Estimate Erythrocyte sedimentation rate (ESR) and packed cell volume (PCV).
CO2: Calculate Red Cell Indicies.
CO3: Reticulocyte count with the help of Supravital stain.
CO4: Classification and Lab diagnosis of different Anemias.
CO5: Red cell Fragility test for Haemolytic Anaemia.

DETAILED CONTENTS

UNIT I

ESR and PCV Estimation

1.1 Erythrocyte sedimentation rate (ESR) and packed cell volume (PCV) Introduction
1.2 Various methods of estimation of ESR and PCV.
1.3 Merits and demerits during the estimation of ESR and PCV.
1.4 Factors involved in ESR estimation.
1.5 Interpretation of results.

UNIT II

Red Cell Indices

2.1 Red Cell Indicies – Expand MCV, MCH, MCHC.

2.2 Definition, reference range, calculation and interpretation.

UNIT III

Reticulocte Count

3.1 Supravital stain and reticulocyte counting-Introduction.

3.2 Principle and procedure of staining and calculation
Reference values and interpretation.

3.3 Variation in Physiological Values such as Hb, PCV, T.L.C. and Platelet count.

UNIT IV

Anemias

4.1 Definition and classification

4.2 Laboratory diagnosis of:

(a) Iron deficiency anaemia

(b) Megaloblastic anaemia

(c) Haemolytic anaemias including sickle cell anaemia thallasseamia

(d) Aplastic anaemia

UNIT V

Red Cell Fragility Test

5.1 Define red cell fragility test.

5.2 Describe principle, procedure and clinical significance of red cell fragility test.

PRACTICAL EXERCISES

1. ESR estimations by Westergren method in blood sample.
2. ESR estimations by Wintrobe method in blood sample.
3. Determination of PCV in blood by Macrohematocrit Method.
4. Determination of PCV in blood by Microhematocrit Methood.
5. Calculate Red Cell Indicies – MCV, MCH, MCHC.
6. Counting of Reticulocyte in blood sample.
7. To perform Sickling test on blood.

8. Estimation of foetal haemoglobin by alkali denaturation test.
9. Estimation of plasma haemoglobin.
10. Estimation of G6PD by Methylene Blue Reduction Test).
11. To perform red cell fragility test on blood.

RECOMMENDED BOOKS

1. KL Mukherjee, "Medical Laboratory Technology Vol. 1", Tata McGraw Hill Publishing Company, New Delhi.
2. FJ Baker, "An Introduction to Medical Laboratory Technology", Butterworths Heinenmann, Oxford.
3. Monica Cheesbrough, "Medical Laboratory Manual for Tropical Countries", Cambridge University Press, UK.
4. Praful B Godkar, "Textbook of Medical Laboratory Technology", Bhalani Publishing House, Mumbai.
5. J.V Decie, "Practical Haematology", ELBS with Churchill Living Stone, UK.
6. Dr. Tejindar Singh, "Textbook of Haematology", Arya Publications.
7. Dr. Tejindar Singh, "Atlas and Text of Hematology", Avichal Publishing Company.
8. J. Ochei and Kolhatkar, "Medical Laboratory Science Theory and Practical, Tata McGraw Hill Publishing Company Ltd., New Delhi.

SUGGESTED WEBSITES

1. https://www.youtube.com/watch?v=Gltywytf5E0
2. https://www.youtube.com/watch?v=XyVJOIxOYE4
3. https://www.youtube.com/watch?v=s-8S0XKsbrQ
4. https://www.youtube.com/watch?v=5ipo6IPhKR8
5. https://www.youtube.com/watch?v=Vh1LZlLCfkU
6. https://www.youtube.com/watch?v=5ocinIvPZhw
7. https://www.youtube.com/watch?v=qhni0TDcYWs
8. https://www.youtube.com/watch?v=y3bIa4dwzOs

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.

3.4 APPLIED CLINICAL BIOCHEMISTRY

L	P
3	2

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.

COURSE OUTCOMES

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

CO1: Describe the processing of blood samples for various clinical diagnostic tests.

CO2: Perform clinical biochemistry tests for bilirubin/SGOT-SGPT/ALP-ACP/Calcium Potassium/Lipid Profile along with recording of data

CO3: Describe the normal and abnormal values for various diagnostic parameters.

CO4: Explain necessary procedure to perform the biochemical analysis.

DETAILED CONTENTS

UNIT I

Serum Bilirubin

1.1 Formation and excretion of bilirubin

1.2 Conjugated and unconjugated bilirubin

1.3 Principle and procedures of serum bilirubin estimation (Direct & Indirect)

1.4 Clinical significance of serum bilirubin estimation

UNIT II

SGOT and SGPT

2.1 Principle and procedure of estimation of SGOT

2.2 Principle and procedure of estimation of SGPT

2.3 Clinical significance of SGOT/SGPT estimation

UNIT III

Serum Amylase, ALP and ACP

3.1 Principle and procedure of estimation of serum amylase
3.2 Clinical significance of serum amylase estimation
3.3 Principle and procedure of estimation of ALP
3.4 Principle and procedure of estimation of ACP
3.5 Clinical significance of ALP/ACP estimation

UNIT IV

Serum Calcium and Potassium

4.1 Principle and procedure of estimation of serum calcium
4.2 Principle and procedure of estimation of serum potassium
4.3 Clinical significance of calcium/potassium estimation

UNIT V

Lipid Profile

5.1 Formation of cholesterol
5.2 High density and low density cholesterol
5.3 Principles and procedures of estimation of HDL/LDL
5.4 Principle and procedure of estimation of triglycerides
5.5 Clinical significance of HDL/LDL/triglycerides estimation
5.6 Importance of various ratios of HDL, LDL and VLDL

PRACTICAL EXERCISES

1. Serum total bilirubin estimation
2. Serum bilirubin estimation (Direct)
3. SGOT estimation
4. SGPT estimation
5. Serum amylase estimation
6. Serum ALP estimation
7. Serum ACP estimation
8. Serum calcium estimation
9. Serum potassium estimation

10. Serum total cholesterol estimation
11. Serum triglyceride estimation
11. Estimation of HDL
12. Estimation of LDL and VLDL

RECOMMENDED BOOKS

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

SUGGESTED WEBSITES

1. Collection and Preservation of Blood Sample:- https://www.youtube.com/watch?v=DXu37zP7hAU
2. Serum Bilirubin:- https://www.youtube.com/watch?v=q0niwNdgQ-E
3. SGOT/SGPT:- https://www.youtube.com/watch?v=kuzrZsSTbF4
4. Serum Amylase:- https://www.youtube.com/watch?v=Kuoqd7eZlXA
5. ALP:- https://www.youtube.com/watch?v=-xQ7DjJxHqc
6. ACP:- https://www.youtube.com/watch?v=DvT-4le6cWE
7. Serum Phosphorus:- https://www.youtube.com/watch?v=K4kc6SJR7Iw
8. Serum Calcium:- https://www.youtube.com/watch?v=1jwH6Fim-daA
9. Quality Assurance:- https://www.youtube.com/watch?v=-qwp-lgfVyw
10. Quality Assurance:- https://www.youtube.com/watch?v=cJacH3h3S7I

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. This subject contains five units of equal weightage.

3.5 HISTOPATHOLOGY

L	P
3	4

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.

COURSE OUTCOMES

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

CO1: Describe introduction of Histology and Theory of staining.
CO2: Prepare various fixatives
CO3: Apply the procedure involved in embedding and casting of blocks
CO4: Perform the sharpening of knife with section cutting
CO5: Perform H & E, MGG and PAP staining methods.

DETAILED CONTENTS

UNIT I

Introduction and definition of Histopathology

1.1 Histology, Histopathology, Biopsy, Autopsy, Autolysis, Putrefaction
1.2 Reception, recording, labeling and preservation of histological specimen
1.3 Various Terms associated with staining : Solvents, Mordants, Metachromasia, Accelerators, Progressive and regressive staining
1.4 Theory of staining (Routine), Use of controls in staining and their significance
1.5 Principle, mechanism and various steps of routine stain (Haematoxylin and Eosin): Deparaffinization, Hydration, Nuclear Staining, Differentiation, Blueing, Counterstaining, Dehydration, Clearing and Mounting, Results
1.6 Automation: Use of automatic stainer and coverslipper

UNIT II

Preparation of Tissue (Different Methods of Preparation of Tissue)

2.1 Unfixed Tissue preparations

2.1.1 Imprint methods – Impression Smears of frozen section

2.1.2 Teased preparation

2.1.3 Squashed preparation

2.1.4 Frozen section

2.2 Fixed Tissue preparations (introduction only)

2.2.1 Paraffin embedding

2.2.2 Celloidin embedding

2.2.3 Gelatin embedding

UNIT III

Fixation (Histological Specimens and Cytological Specimen)

3.1 Fixatives

3.1.1 Classification of fixatives

3.1.2 Composition of various fixatives

3.1.3 Advantages and disadvantages

3.2 Processing of Tissue (by Paraffin Technique)

3.2.1 Dehydration

3.2.2 Clearing/Dealcoholization

3.2.3 Infilteration and impregnation

3.2.4 Paraffin embedding

3.2.5 Mountants

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

UNIT IV

Microtomy

4.1 Microtome

4.1.1 Types

4.1.2 Advantages and disadvantages

4.1.3 Working principle, care and maintenance

4.1.4 Histokinete (automatic tissue processor) - its types, working, care and maintenance

4.2 Microtome Knives

4.2.1 Various types of knives

4.2.2 Sharpening of knives

- Honing technique
- Stropping technique
- Automation: Automatic knife sharpener – uses, care and maintenance
- Uses of abrasives and lubricants

4.2.3 Introduction

4.3 Section Cutting

4.3.1 Rough cutting

4.3.2 Fine cutting

4.3.3 Use of tissue floatation bath

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

4.3.5 Errors /cutting faults in sections and their remedies

UNIT V

Exfoliative Cytology

5.1 Introduction

5.2 Preparation of vaginal & cervical smears

5.3 Collection and Processing of specimen for cytology: Urine, Sputum, CSF (Cerebro Spinal Fluid) and Other fluids

5.4 Role of cytotechnician in cytology

5.5 Cytological Staining its Principle, Technique and interpretation of results in Papanicalaou staining (PAP) and May Grunwald & Giemsa staining (MGG)

PRACTICAL EXERCISES

1. Reception of specimen, labeling and preserving the specimen
2. Preparation of various smears by unfixed methods i.e.
   - 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. Performing H&E staining on sections and mounting of tissue sections
10. Demonstration of cell using buccal smear/urine sample
11. Processing of urine samples for malignant cells
12. Processing of sputum sample for malignant cytology
13. To perform PAP stain on given smear
14. To perform MGG stain on given smear
15. To perform H&E on given smear

RECOMMENDED BOOKS

1. FJ Baker, "An Introduction to Medical Laboratory Technology", Butterworths Scientific, London.
2. John D. Bancroft, "Theory and Practice of Histological Technique", Churchill Livingstone, London.
3. CFA Culling, "Cellular Pathology Techniques", Butterworths, London.
4. Dr. Ramnik Sood, "Medical Lab Technology", Maulana Azad College, New Delhi

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. This subject contains five units of equal weightage.

3.6 TRANSFUSION MEDICINE

L	P
3	-

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.

COURSE OUTCOMES

At the end of the open elective, the students will be able to:

CO1: Apply blood bank and blood transfusion knowledge to make appropriate and effective on-job professional decisions.
CO2: Perform and interpret commonly utilized procedures/Tests in blood bank.
CO3: Apply immune hematolgy laboratory techniques and procedures.
CO4: Explain separation and importance of various blood components and various types of transfusion reactions.

DETAILED CONTENTS

UNIT I
Historical introduction to Transfusion medicine (blood banking)

Definition of antigen and antibody
Classification of antigens and antibodies.

UNIT II
ABO Blood Group System
Antigens and antibodies involved
Principle and procedure of ABO blood grouping

The Rh Blood Group System, Antigen and antibody involved
Principle and procedure of Rh grouping

UNIT III

Anticoagulants used in blood bank, Types and composition of various anticoagulants
Advantages and disadvantages of various anticoagulants

UNIT IV

Criteria and characteristics of ideal blood donor, Blood Collection and storage.
Preparation, Preservation, Uses of Various blood components (Packed cells, Fresh Frozen plasma, Cryoprecipitate, PRP (Platelet rich plasma).

UNIT V

Test for blood transfusion

(a) Cross Matching
(b) Coombs Test
(c) Blood Transfusion reactions

PRACTICAL EXERCISES

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. Hbs Ag Test 10 HVC Test
10. Preparation of platelet rich plasma and platelet poor plasma

RECOMMENDED BOOKS

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

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. This subject contains five units of equal weightage.

FOURTH SEMESTER

4.1 ENGLISH AND COMMUNICATION SKILLS - II

L	P
2	2

RATIONALE

Communication II moves a step further from Communication Skills I and is aimed at enhancing the linguistic competency of the students. 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 make fresh ground in teaching of Communicative English as per the requirements of National Skill Quality Framework.

COURSE OUTCOMES

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

CO1: Communicate effectively with an increased confidence; read, write and speak in English language fluently.

CO2: Comprehend special features of format and style of formal communication through various modes.

CO3: Write a Report, Resume, make a Presentation, Participate in GDs and Face Interviews

CO4: Illustrate use of communication to build a positive self-image through self-expression and develop more productive interpersonal relationships.

DETAILED CONTENTS

UNIT I

Reading

1.1 Portrait of a Lady - Khushwant Singh

1.2 The Doctor's Word by R K Narayan

1.3 Speech by Dr Kiran Bedi at IIM Indore2007 Leadership Concepts

1.4 The Bet - by Anton Chekov

UNIT II

Effective Communication Skills

2.1 Modern means of Communication (Video Conferencing, e- mail, Teleconferencing)

2.2 Effective Communication Skills: 7 C's of Communication

2.3 Non-verbal Communication – Significance, Types and Techniques for Effective Communication

2.4 Barriers and Effectiveness in Listening Skills

2.5 Barriers and Effectiveness in Speaking Skills

Unit III

Professional Writing

3.1 Correspondence: Enquiry letters, placing orders, complaint letters

3.2 Report Writing

3.3 Memos

3.4 Circulars

3.5 Press Release

3.6 Inspection Notes and tips for Note-taking

3.7 Corrigendum writing

3.8 Cover Letter

UNIT IV

Grammar and Vocabulary

4.1 Prepositions

4.2 Conjunctions

4.3 Punctuation

4.4 Idioms and Phrases: A bird of ill omen, A bird's eye view, A burning question, A child's play, A cat and dog life, A feather in one's cap, A fish out of water, A shark, A snail's pace, A snake in the grass, A wild goose chase, As busy as a bee, As faithful as dog, Apple of One's eye, Behind one's back, Breath one's last, Below the belt, Beat about the bush, Birds of a feather flock together, Black Sheep, Blue blood, By hook or crook, Chicken hearted, Cut a sorry figure ,Hand in glove, In black and white, In the twinkling, In full swing ,Is blind as a bat, No rose without a thorn, Once in a blue moon, Out of the frying pan in to the fire, know no bounds ,To back out, To bell the cat, To blow one's trumpet, To call a spade a spade, To cut one's coat according to one's cloth, To eat humble pie, To give ear to, To have a thing on one's finger tips, To have one's foot in the grave, To hold one's tongue, To kill two birds

with one stone, To make an ass of oneself, To put two and two together, To the back bone, Turn coat, ups and downs.

4.5 Pairs of words commonly misused and confused: Accept-except, Access-excess, Affect-effect, Artificial- artful, Aspire-expire, Bail-bale, Bare-bear, Berth-birth, Beside-besides, Break-brake, Canvas-canvass, Course- coarse, Casual-causal, Council-counsel, Continual-continuous, Coma-comma, Cue- queue, Corpse- corps-core, Dairy-diary, Desert-dessert, Dual-duel, Dew- due, Die-dye, Draft- draught-drought, Device-devise, Doze-dose, Eligible-illegible, Emigrant- immigrant, Envelop-envelope, Farther-further, Gate-gait, Goal-goal, Human-humane, Honorable-honorary, Hail-hale, Hair-heir-hare, Industrial-industrious, Impossible- impassable, Idle-idol-ideal, Lose-loose, Later-latter, Lesson-lessen, Main-Mane, Mental-mantle, Metal-mettle, Meter-metre, Oar-ore, Pray- prey, Plain-plan, Principal - principle, Personal- personnel, Roll- role, Route-rout- roote, Stationary-stationery, Union-unity, Urban- urbane, Vocation- vacation, Vain- vein-vane, Vary- very.

4.6 Translation of Administrative and Technical Terms in Hindi or Mother tongue: Academy, Abandon, Acting in official capacity, Administrator, Admission, Aforesaid, Affidavit, Agenda, Alma Master, Ambiguous, Appointing Authority, Apprentice, Additional, Advertisement, Assistant, Assumption of charge, Assurance, Attested copy, Bonafide, Bond, Cashier, Chief Minister, Chief Justice Clerical error, Commanding ,Officer, Consent, Contractor, corruption, Craftsman, Compensation, Code, Compensatory allowance, Compile, Confidential letter, Daily Wager, Data, Dearness allowance, Death - Cum Retirement, Dispatch, Dispatch Register, Disciplinary, Disciplinary Action, Disparity Department, Dictionary, Director, Director of Technical Education, Earned Leave, Efficiency Bar, Estate, Exemption, Executive Engineer, Extraordinary, Employment Exchange, Flying Squad, General Body, Head Clerk, Head Office, High Commission, Inconvenience, Income Tax, Indian Assembly Service, Justify, Legislative Assembly, Negligence, Officiating ,Office Record, Office Discipline, On Probation, Part Time, Performance, Polytechnic, Proof Reader Precautionary, Provisional, Qualified, Regret, Responsibility, Self-Sufficient, Senior, Simultaneous ,Staff, Stenography ,Superior, Slate, Takeover, Target Data Technical Approval, Tenure, Temporary, Timely Compliance, Under Investigation, Under Consideration, Verification, Viva-voce, Write off, Working Committee, Warning, Yours Faithfully , Zero Hour.

UNIT V

Employability Skills

5.1 Presentation Skills: How to prepare and deliver a good presentation

5.2 Telephone Etiquettes

5.3 Importance of developing employable and soft skills

5.4 Resume Writing: Definition, Kinds of Resume, Difference between Bio-data and Curriculum Vitae and Preparing a Resume for Job/ Internship

5.5 Group discussions: Concept and fundamentals of GD, and learning Group Dynamics.

5.6 Case Studies and Role Plays

PRACTICAL EXERCISES

1. Reading Practice of the above lessons in the Lab Activity classes.
2. Comprehension exercises of unseen passages along with the given lessons.
3. Vocabulary enrichment and grammar exercises based on the above selective readings.
4. Situational Conversation: Requesting and responding to requests; Expressing sympathy and condolence.
5. Warning; Asking and giving information.
6. Getting and giving permission.
7. Asking for and giving opinions.
8. A small formal and informal speech.
9. Seminar.
10. Debate.
11. Interview Skills: Preparing for the Interview and guidelines for success in the Interview and significance of acceptable body-language during the Interview.
12. Written Drills will be undertaken in the class to facilitate a holistic linguistic competency among learners.
13. Participation in a GD, Functional and Non-functional roles in GD, Case Studies and Role Plays
14. Presentations, using audio-visual aids (including power-point).
15. Telephonic interviews, face to face interviews.
16. Presentations as Mode of Communication: Persuasive Presentations using multi-media aids.
17. Practice of idioms and phrases on: Above board , Apple of One's eye , At sea, At random, At large, A burning question, A child's play, A wolf in sheep's clothing, A deal, Breath one's last, Bid fair to, Beat about the bush, Blue Blood, Big Gun, Bring to Book, Cut a sorry figure, Call names, Carry weight, Dark Horse, Eat Humble pie, Feel small, French leave, Grease the palm, Go against the grains, Get One's nerves, Hard and Fast, Hue and Cry, Head and ears, In full swing, Jack of all trades, know no bounds, kiss the dust, Keep an eye on, Lion's share, learn by rote, Null and void, on the cards, Pull a long face, Run amuck, Right and Left, Rain on Shine, Small talk, Take to one's heels, Tooth and nail, to take by storm, , Wet blanket, Yearn for.

RECOMMENDED BOOKS

1. Alvinder Dhillon and Parmod Kumar Singla, "Text Book of English and Communication Skills Vol – 1, 2", M/s Abhishek Publications, Chandigarh.
2. J Sethi, Kamlesh Sadanand & DV Jindal, "Course in English Pronunciation", PHI Learning Pvt. Ltd., New Delhi.
3. Wren and Martin, "High School English Grammar and Composition" .
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", (4th Edition), by Tata MC Graw Hills, New Delhi.
6. Varinder Kumar, Bodh Raj & NP Manocha, "Business Communication Skills", Kalyani Publisher, New Delhi.
7. Kavita Tyagi & Padma Misra, "Professional Communication", PHI Learning Pvt. Ltd., New Delhi.
8. Nira Konar, "Communication Skills for Professionals", PHI Learning Pvt. Ltd., New Delhi.
9. Krishna Mohan & Meera Banerji, "Developing Communication Skills", (2nd Edition), Macmillan Publishers India Ltd., New Delhi.
10. M. Ashraf Rizwi, "Effective Technical Communication", Tata MC Graw Hills, New Delhi.
11. 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. Emphasis should be given on practicing of communication skills. This subject contains five unit of equal weightage.

4.2 CLINICAL HAEMATOLOGY -II

L	P
3	4

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 haematological techniques with adequate knowledge of various principles. The training in laboratory safety is also provided.

COURSE OUTCOMES

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

CO1: Describe the principle and mechanism of Haemostasis.
CO2: Describe the composition and aspiration of Bone Marrow.
CO3: Describe the Leukemia's and their Lab. Diagnosis.
CO4: Identify the LE Cell and Tart cell.
CO5: Analysis and cell count of various Biological body Fluids.

DETAILED CONTENTS

UNIT I

Haemostasis

1.1 Introduction to normal haemostasis.
1.2 Theories of blood coagulation.
1.3 Platelets and their role in haemostasis including count.
1.4 Bleeding disorders and related diseases.
1.5 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).

UNIT II

Bone – marrow

2.1 Composition and function of bone-marrow.

2.2 Aspiration of bone-marrow by various methods.

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

2.4 Iron staining (Perls' reaction).

2.5 Significance of bone-marrow examination.

UNIT III

Leukemia

3.1 Definition of leukemias.

3.2 (FAB) Classification.

3.3 Laboratory diagnosis of various leukemias.

UNIT IV

LE Cell Phenomenon

4.1 Phenomenon of LE cell, its differentiation from tart cell.

4.2 Demonstration of LE cell by various methods.

4.3 Clinical significance.

UNIT V

Biological Body Fluids

5.1 Semen Analysis in detail.

5.2 Cell counts of various biological fluids.

PRACTICAL EXERCISES

1. Determination of bleeding time by lvy's and Dukes method
2. Determination of clotting time by Lee and White method
3. Demonstration of Hess test
4. Performance of Clot retraction test
5. Demonstration of Bone marrow Aspiration.
6. Demonstration of Preparation, staining and examination of bone-marrow smears.
7. Demonstration of Laboratory diagnosis of various leukemias.
8. Demonstration of LE Cell.
9. Cell counts of biological fluids.

10. Semen analysis.

RECOMMENDED BOOKS

1. KL Mukherjee, "Medical Laboratory Technology Vol. 1", Tata McGraw Hill Publishing Company, New Delhi.
2. Dr. Tejindar Singh, "Atlas and Text of Hematology", Avichal Publishing Company.
3. Dr. Tejindar Singh, "Textbook of Haematology", Arya Publications.
4. FJ Baker, "An Introduction to Medical Laboratory Technology", Butterworths Heinenmann, Oxford.
5. Monica Cheesberg, "Medical Laboratory Manual for Tropical Countries", Cambridge University Press; UK.
6. Praful B Godkar, "Textbook of Medical Laboratory Technology", Bhalani Publishing House, Mumbai.
7. J.V Decie, "Practical Haematology", ELBS with Churchill Living Stone, UK.
8. JO Chei and Kolhatkar, "Medical Laboratory Science Theory and Practical", Tata McGraw Hill Publishing Company Ltd., New Delhi.
9. Charles F. Seiverd, "Haematology for Medical Technologists", Lea & Febigue Philadalphiae.
10. Nanda Maheshwari, "Clinical Pathology HematologyBlood Banking for DMLT Student"
11. Nayak &Rai "Essentials of Haematology & Clinical Pathology"

SUGGESTED WEBSITES

1. https://www.youtube.com/watch?v=EGIic92dqec
2. https://www.youtube.com/watch?v=TSlHOCPrKIo
3. https://www.youtube.com/watch?v=eXRSv4DjPMc
4. https://www.youtube.com/watch?v=dOihPmHA6BE
5. https://www.youtube.com/watch?v=VKKZzpM4FpU
6. https://www.youtube.com/watch?v=a9YntDRKxm4
7. https://www.youtube.com/watch?v=xxYzAO5Ogsc
8. https://www.youtube.com/watch?v=OH9qjKStU6Q
9. https://www.youtube.com/watch?v=tvPFHQfAKic
10. https://www.youtube.com/watch?v=P6sOfurf7aw

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. This subject contains five units of equal weightage.

4.3 IMMUNOLOGY AND MYCOLOGY

L	P
3	2

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

COURSE OUTCOMES

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

CO1: Describe the basics of Medical Mycology.
CO2: Apply lab techniques to correctly identify the fungal pathogens.
CO3: State the basics of human Immunological system.
CO4: Discuss Antigens, Antibodies & Antigen Antibody reaction.
CO5: Perform common serological tests.

DETAILED CONTENTS

UNIT I

1.1 Introduction to Mycology
1.2 Characteristics and classification of medically important fungi

UNIT II

2.1 Collection, processing of sample for fungal infection in Skin, Nail and Hair
- KOH preparation
- LCB (Lactophenol cotton blue)
- India ink

2.2 Fungal Culture media
SDA (Sabouraud's dextrose agar) with and without antibiotics

CMA (Com meal agar)
BHI (Brain Heart Infusion)

UNIT III

3.1 Fungal Cultivation
Medicaly important fungi - Candida, Dermatophytes
3.2 Laboratory Contaminants - Penicillium, Rhizopus, Mucor, Aspergillus

UNIT IV

4.1 Antigen-Antibody Reactions
4.2 Principle and applications of agglutination, precipitation and flocculation reactions

UNIT V

5.1 Principle, techniques and application of ELISA (direct and indirect)
5.2 Principle, techniques and interpretation of
i) Widal - Tube method/ Titre slide method
ii) Anti streptolysin O
iii) C-reactive protein
iv) VDRL/RPR
v) Rheumatoid factor (RF)

PRACTICAL EXERCISES

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 using KOH
3. To perform wet mount using LCB .
4. To study characteristics of common laboratory fungal contaminants.
5. Collection and processing of samples for diagnosis of fungal infections in skin, hair, nail scrapings.
6. To perform Widal test by slide and tube method.
7. To perform ASO titre test.
8. To perform CRP test.
9. To perform Rheumatoid factor test.
10. To perform VDRL Test.
11. To perform HIV Screening test.
12. To perform HBsAg Screening test.

RECOMMENDED BOOKS

1. Kanai Lal Mukherjee, “Medical Laboratory Technology”, Tata McGraw Hill Publishers, New Delhi.
2. Ananthanarayan and Panikar, “Textbook of Microbiology”, Orient Longman, Hyderabad.
3. Satish Gupta, “Practical Book of Medical Microbiology”, JP Brothers, New Delhi.
4. Satish Gupta, “Text Book of Medical Microbilogy”, JP Brothers, New Delhi.
5. Praful B Godkar, “Text Book of Medical Laboratory Technology”, Bhalani Publishing House; Mumbai.
6. J Ochei and A Kolhatkar, “Medical Lab Science Theory and Practice”.

SUGGESTED WEBSITES

1. https://www.who.int/news-room/fact-sheets/detail/soil-transmitted-helminth-infections
2. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7149825/
3. https://www.cdc.gov/ncird/dvd.html
4. https://www.cdc.gov/parasites/index.html

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. This subject contains five units of equal weightage.

4.4 ANALYTICAL CLINICAL BIOCHEMISTRY

L	P
3	2

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

COURSE OUTCOMES

After completing this subject, the students will be able to

CO1: Perform qualitative tests for urinary analysis.
CO2: Perform clinical biochemistry tests for renal function and renal clearance tests.
CO3: Explain principle and procedure of chromatography and electrophoresis.
CO4: Identify various biochemistry analyzers and operate them.
CO5: Describe necessary procedure to perform thyroid function tests.

DETAILED CONTENTS

UNIT I

Urine Analysis

1.1 Normal composition of urine
1.2 Qualitative analysis of proteins, sugar, ketone bodies, bilirubin and blood.
1.3 Detailed discussion on glycosuria and albuminuria
1.4 Clinical significance of urine analysis

UNIT II

Renal Function Tests (Renal clearance Tests)

2.1 Urea clearance Test
2.2 Creatinine clearance test

2.3 Clinical significance of Renal Function Test (RFT)

UNIT III

Stool Chemistry

3.1 Physical characteristics and chemical composition of stool

3.2 Detection of occult blood and excess fat in stool

3.3 Significance of presence of blood and excess fat in stool

UNIT IV

Electrophoresis and Chromatography

4.1 Principle and Theory of Electrophoresis

4.2 Types of Electrophoresis

4.3 Clinical significance / applications of Electrophoresis

4.4 Principle and Theory of Chromatography

4.5 Types of Chromatography

4.6 Clinical significance / applications of Chromatography

UNIT V

Thyroid function tests and Automation in Biochemistry

5.1 Clinical Significance of T_3, T_4 and TSH

5.2 Anti-Thyroid Peroxidase (TPO) Test

5.3 Free Thyroid Profile Tests (Free T_3, T_4 and TSH Test)

5.4 Definition and introduction of auto analyzers in clinical biochemistry

5.5 Classification and types of Auto analyzers

PRACTICAL EXERCISES

1. Analysis of urine for glucose.
2. Analysis of urine for bilirubin.
3. Analysis of urine for proteins.
4. Detection of ketone bodies in urine.
5. Detection of urinary creatinine.
6. Urea clearance test.
7. Creatinine clearance test.
8. Occult blood test for stool specimen.
9. Fecal fat test.
10. Demonstration of electrophoresis.

11. Demonstration of chromatography.
12. Anti-Thyroid Peroxidase (TPO) Test
13. Thyroid Profile Tests.

RECOMMENDED BOOKS

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

SUGGESTED WEBSITES

1. Urinary Protein:- https://www.youtube.com/watch?v=n4rf2LGU0zg
2. Urinary Creatinine:- https://www.youtube.com/watch?v=8Z8rbj0-PIA
3. Renal Function Test (Creatinine Clearance):- https://www.youtube.com/watch?v=-vtqnArbDC8
4. Renal Function Test (Urea Clearance):- https://www.youtube.com/watch?v=KuudBGSEhGM
5. Role of Computers in Clinical Lab:- https://www.youtube.com/watch?v=mhUJ4eO2V9s

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. This subject contains five units of equal weightage.

4.5 IMMUNOPATHOLOGY AND CYTOLOGY

L	P
3	4

RATIONALE

This course 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 by cryostat from frozen tissue and facilitate visualization using various stains and dyes. Cytology part aims at exposing the students to the Exfoliative cytology. Also in this section students will be made aware of terminology used in Histopathology and Fine Needle Aspiration Cytology (FNAC) techniques and will get to know about the various staining procedures and also learn the processing of various samples for histopathological investigations.

COURSE OUTCOMES

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

CO1: Perform processing of tissue for frozen section
CO2: Perform the procedure involved for staining of various pigments
CO3: Describe the various parts and types of cryostats
CO4: Perform the iron (Perl's stain), AFB and Periodic Acid Schiffs staining method
CO5: Perform decalcified paraffin embedded section for the presence of calcium salts

DETAILED CONTENTS

UNIT I

Special stains

1.1 Principle, significance and interpretation of different types of stains
- PAS (Periodic Acid Schiff's Reagent)
- Silver impergnation stain – Reticulin fibre
- Ziehl Neelson's – for AFB and Leprae
- Masson's trichrome stain
- Oil Red O – fat
- Gram's stain – Gram +ve and Gram –ve

1.2 Definition of Decalcification

1.3 Process of decalcification

1.4 Various types of decalcifying methods, Their mechanism, advantage, disadvantage and applications

1.5 Assessment of decalcification

UNIT II

Handling of fresh histological tissues (Frozen Section)

2.1 Reception and processing of frozen tissue

2.2 Freezing microtome and cryostat

2.3 Advantages and dis-advantages of freezing microtome and cryostat

2.4 Working, care, maintenance of freezing microtome and cryostat

2.5 Frozen section cutting

2.6 Staining

- Rapid H&E
- Fat stain

2.7 Mounting of frozen section

UNIT III

Museum Techniques

3.1 Introduction to museum with emphasis on importance of museum

3.2 Reception, fixation and processing of various museum specimens

3.3 Cataloguing of museum specimen

3.4 Introduction to autopsy technique

3.5 Care and maintenance of autopsy area, autopsy instruments,

3.6 handling of dead bodies and various use of autopsy

UNIT IV

Aspiration Cytology

4.1 Principle of FNAC (Fine Needle Aspiration Cytology)

4.2 Procedure of FNAC

4.3 Indications of FNAC

4.4 Uses of FNAC

UNIT V

Cytological Special Stains

5.1 Principle, Technique & Interpretation of PAS (Periodic Acid Schiffs reagent Stain)

5.2 Principle, Technique & Interpretation of Zeihl Neelson's (ZN) Stain (AFB)

5.3 Advancements in Cytology, Automation in Cytology, Use of Cytospin

5.4 Harmonal Assessment , Importance of HCG

5.5 Use of Harmonal Assessment (Pregnancy Test)

PRACTICAL EXERCISES

1. Demonstration of cryostat (brochures and charts can be used)
2. Processing of tissue for frozen section
3. Staining and mounting of frozen section using H&E stain (rapid method).
4. To stain paraffin embedded section for the demonstration of reticulin fibers by Silver impergnation stain.
5. To stain paraffin embedded section using Oil Red "O" stain.
6. Preparation of Kaiserling's solution I and II for museum specimens.
7. Preparation of various mounting reagents for museum specimens
8. Processing and Labeling of various museum specimens
9. Demonstration and care of autopsy instruments
10. Preparation of dry smear and wet smear
11. To perform PAP stain
12. Fixation of smears and staining with MGG
13. To perform Harmonal Assessment
14. To perform PAS staining method of cytological sample.
15. To perform ZN staining method of cytological sample.

RECOMMENDED BOOKS

1. FJ Baker, "An Introduction to Medical Laboratory Technology", Butterworths Scientific, London.
2. John D. Bancroft, "Theory and Practice of Histological Technique", Churchill Livingstone, London.
3. CFA Culling, "Cellular Pathology Techniques", Butterworths, London.
4. Dr. Ramnik Sood, "Medical Lab Technology", Maulana Azad College, New Delhi.
5. Leo Pold G.Koss, "Diagnostic Cytology and its Histopathology Basis", JB Lupein, Philladelphia.

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. This subject contains five units of equal weightage.

4.6 MEDICAL LABORATORY MANAGEMENT

L	P
3	-

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.

COURSE OUTCOMES

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

CO1: Describe the concepts of Medical Lab Management.
CO2: Organise a Clinical Laboratory and learn inventory control.
CO3: Adopt the safety measures while working in Labs.
CO4: Apply the proper methods of disposal of Biomedical Waste in Lab.
CO5: Follow Medical Ethics and code of conduct.

DETAILED CONTENTS

UNIT I

Introduction and importance of Medical Laboratory Management, layout of clinical laboratory, Facility in clinical Laboratory. Role of Medical Laboratory in total health care.

UNIT II

Material management in clinical Laboratory (procurement, financial resources, importing, inventory, inspection, storage). Quality Assurance (Analytical control, Internal and external quality assurance in clinical laboratories important terms; precision, accuracy, standard deviation as per national standards)

UNIT III

Safety Precautions

Safety measures in clinical laboratories .Disposal of Biomedical waste.

First Aid in Clinical Laboratory:

(Acid burn/Alkali burn, Accidental trauma, Gas/Toxic inhalation).

Laboratory Equipment - Care and Maintenance.

UNIT IV

Introduction to Laboratory Accreditation and its importance.

Introduction and importance of Medical Ethics and Code of Conduct

Ethics and code of conduct - legal aspects – confidentiality malpractice/ negligence, law suits, consumer protection and insurance for professional health hazards

UNIT V

Role of Computer in Lab services

Storage and retrieval of laboratory data manually and with help of computer software and QR Code

RECOMMENDED BOOKS

1. Praful B Godkar, “Medical Laboratory Technology”, Bhalani Publishing House, Mumbai (India).
2. FJ Baker, “Text Book of Medical Laboratory Technology”, Butterworths Heinmann Publishers, Oxford.
3. KL Mukherjee, “Text Book of Medical Laboratory Technology - Vol I, II and III”, Tata McGraw Hill Publishers, New Delhi.
4. Ramnik Sood, “Medical Lab Technology”, Jay Pee Brothers, New Delhi.
5. Monica Chesbrough, “District Laboratory Practice in Tropical Countries”, Churchill Livingstone.
6. Puthwilliams, “Laboratory Management”.
7. V.H Talib “A Handbook of Medical LaboratoryTechnology”

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. This subject contains five units of equal weightage.

4.7 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

L	P
3	-

RATIONALE

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

COURSE OUTCOMES

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

CO1: Comprehend the importance of entrepreneurship and its role in nation's development.
CO2: Classify the various types of business and business organizations.
CO3: Identify the various resources / sources and / or schemes for starting a new venture.
CO4: Explain the principles of management including its functions in an organisation.
CO5: Conduct market survey and prepare project report.

DETAILED CONTENTS

UNIT I

Entrepreneurship: Concept and definitions, classification and types of entrepreneurs, entrepreneurial competencies, Traits / Qualities of entrepreneurs, manager v/s entrepreneur, role of Entrepreneur, barriers in entrepreneurship, Sole proprietorship and partnership forms of business organisations, small business vs startup, critical components for establishing a start-up, Leadership: Definition and Need, Manager Vs leader, Types of leadership

UNIT II

Definition of MSME (micro, small and medium enterprises), significant provisions of MSME Act, importance of feasibility studies, technical, marketing and finance related problems faced by new enterprises, major labor issues in MSMEs and its related laws, Obtaining financial assistance

through various government schemes like Prime Minister Employment Generation Program (PMEGP) Pradhan Mantri Mudra Yogna (PMMY) , Make in India, Start up India, Stand up India , National Urban Livelihood Mission (NULM); Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

UNIT III

NATURE AND FUNCTIONS OF MANAGEMENT: Definition, Nature of Management, Management as a Process, Management as Science and Art, Management Functions, Management and Administration, Managerial Skills, Levels of Management; Leadership.

PLANNING AND DECISION MAKING: Planning and Forecasting - Meaning and definition, Features, Steps in Planning Process, Approaches, Principles, Importance, Advantages and Disadvantages of Planning, Types of Plans, Types of Planning, Management by Objective. Decision Making-Meaning, Characteristics.

UNIT IV

ORGANISING AND ORGANISATION STRUCTURE: Organising Process - Meaning and Definition, Characteristics Process, Need and Importance, Principles, Span of Management, Organisational Chart - Types, Contents, Uses, Limitations, Factors Affecting Organisational Chart.

STAFFING: Meaning, Nature, Importance, Staffing process. Manpower Planning, Recruitment, Selection, Orientation and Placement, Training, Remuneration.

CONTROLLING AND CO-ORDINATION Controlling - Meaning, Features, Importance, Control Process, Characteristics of an effective control system, Types of Control. Co-ordination - characteristics, essentials.

UNIT V

Market Survey and Opportunity Identification, Scanning of business environment, Assessment of demand and supply in potential areas of growth, Project report Preparation, Detailed project report including technical, economic and market feasibility, Common errors in project report preparations, Exercises on preparation of project report.

RECOMMENDED BOOKS

1. BS Rathore and Dr JS Saini, "A Handbook of Entrepreneurship", Aapga Publications, Panchkula (Haryana).
2. Entrepreneurship Development, Tata McGraw Hill Publishing Company Ltd., New Delhi.
3. CB Gupta and P Srinivasan, "Entrepreneurship Development in India", Sultan Chand and Sons, New Delhi.
4. Poornima M Charantimath, "Entrepreneurship Development - Small Business Enterprises", Pearson Education, New Delhi.
5. David H Holt, "Entrepreneurship: New Venture Creation", Prentice Hall of India Pvt. Ltd., New Delhi.
6. PM Bhandari, "Handbook of Small Scale Industry".
7. L M Prasad, "Principles and Practice of Management", Sultan Chand & Sons, New Delhi.

SUGGESTED WEBSITES

1. https://ipindia.gov.in/

INSTRUCTIONAL STRATEGY

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided. In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised. This subject contains five units of equal weightage.

INDUSTRIAL TRAINING - II

RATIONALE

Industrial training will help the students to understand the working environment of relevant industries. The student will learn to work in team to solve the industrial problems. It will also give exposure about the present and future requirements of the relevant industries. This training is very important for development of required competencies and skills for employment and start– ups.

COURSE OUTCOMES

After undergoing the training, the students will be able to:

CO1: Understand the working environment of industries

CO2: Take necessary safety precautions and measures.

CO3: Learn about present and future requirement of industries.

CO4: Work in team for solving industrial problems.

CO5: Develop competencies and skills required by relevant industries.CO6: Develop writing, speaking and presentations skills.

PRACTICAL EXERCISES

1. Report writing based on industrial training.
2. Preparation of Power Point Slides based on industrial training and presentation by the candidate.
3. Internal Evaluation based on quality of Report, PPT preparation, PPT presentation and answerto queries.
4. External Evaluation based on quality of Report, PPT preparation, PPT presentation and answerto queries.

GUIDELINES

Students will be evaluated based on Industrial training training report and their presentation using Power Point about the knowledge and skills gained during the training. The Head of the Department will depute faculty coordinators by assigning a group of students to each. The coordinators will mentor and guide the students in preparing the PPTs for final presentation. The following performance parameters are to be considered for assessment of the students out of 100 marks:

	Parameter	**Weightage**
i	Industrial assessment of the candidate by the trainer	40%
ii	Report Writing	20%
iii	Power Point Presentation	20%
iv	Viva-voce	20%

THIRD YEAR

NSQF LEVEL - 5

18. STUDY AND EVALUATION SCHEME

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
5.1	Project Oriented Professional Training-I	-	35	0+18=18	-	200	200	-	300	300	500
# Student Centered Activities(SCA)		-	-	-	-	-	-	-	-	-	-
	Total	**-**	**35**	**18**	**-**	**200**	**200**	**-**	**300**	**300**	**500**

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week		Credits (C) L+P=C	MARKS IN EVALUATION SCHEME						Total Marks of Internal & External
					INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT			
		L	P		Th	Pr	Tot	Th	Pr	Tot	
6.1	Project Oriented Professional Training-II	-	35	0+18=18	-	200	200	-	300	300	500
# Student Centered Activities (SCA)		-	-	-	-	-	-	-	-	-	-
	Total	**-**	**35**	**18**	**-**	**200**	**200**	**-**	**300**	**300**	**500**

19. HORIZONTAL AND VERTICAL SUBJECTS ORGANISATION

Sr. No.	Subjects/Areas	Hours Per Week	
		Fifth Semester	Sixth Semester
2.	Project Oriented Professional Training-I	35	-
3.	Project Oriented Professional Training-II	-	35
Total		**35**	**35**

20. COMPETENCY PROFILE & EMPLOYMENT OPPORTUNITIES

Government and private sectors related to **Medical Laboratory Technology** require **supervisors** having well developed skills with clear choice of procedures. They are expected to have complete knowledge and practical skills related to Medical Laboratory Technology field. They shall be able to communicate clearly with others. Diploma holders after passing level 5 shall have understanding of desired mathematical skills and understanding of social and natural environment. They are expected to collect, organize and communicate information effectively.

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.

Medical Laboratory Technology diploma pass out students 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. They are expected have good theoretical and practical knowledge of various medical lab processes to work efficiently in Medical Laboratories. They might find work with various medical labs organisations.

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.)

21. PROGRAMME OUTCOMES

The program outcomes are derived from five domains of NSQF Level – 5 namely Process, Professional Knowledge, Professional Skill, Core Skill, Responsibility. After completing this level, the student will be able to:

PO1: Perform task that require well developed skills with clear choice of procedures.

PO2: Acquire knowledge of facts, principles and processes related to medical lab technology.

PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.

PO4: Develop skills to collect, organize and communicate information.

PO5: Accomplish own work and supervise others work.

22. ASSESSMENT OF PROGRAMME AND COURSE OUTCOMES

Programme Outcomes to be Assessed	Assessment Criteria for the Course Outcomes
PO1: Perform task that require well developed skills with clear choice of procedures.	• Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project. • Apply the communication skills in writing and presenting the technical report.
PO2: Acquire knowledge of facts, principles and processes related to medical lab technology.	• Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project. • Apply the communication skills in writing and presenting the technical report.
PO3: Demonstrate cognitive and practical skills to complete tasks and solve problems.	• Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project. • Apply the communication skills in writing and presenting the technical report.

PO4: Develop skills to collect, organize and communicate information.	• Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project. • Apply the communication skills in writing and presenting the technical report.
PO5: Accomplish own work and supervise others work.	• Understand the working environment of industries. • Take necessary safety precautions and measures. • Learn about present and future requirement of industries. • Work in team for solving industrial problems. • Develop competencies and skills required by relevant industries. • Develop writing, speaking and presentations skills. • Define the problem statement of the Industrial training as per industry need. • Develop the problem-solving skills in finding solutions to the problems in the world of work. • Acquire interpersonal skills and work as a team member. • Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project. • Apply the communication skills in writing and presenting the technical report.

23. SUBJECTS & DETAILED CONTENTS

FIFTH SEMESTER

5.1	Project Oriented Professional Training-I	120-125

5.1 PROJECT ORIENTED PROFESSIONAL TRAINING – I

L	P
-	35

RATIONALE

Project Oriented Professional Training is aimed at the application of knowledge and competencies gained in the previous semesters in an integrated manner towards addressing an issue in the industry/field, as per the interest and choice of both the industry and student. It also provide opportunities to the students to work relatively independently over extended and comprehensive periods of time. It is expected from the students to get acquainted with desired attributes for industrial/field environment. For this purpose, students are required to work in different establishments of world of work, and develop competencies.

COURSE OUTCOMES

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

CO1: Define the problem statement of the Industrial training as per industry need.
CO2: Develop the problem-solving skills in finding solutions to the problems in the world of work.
CO3: Acquire interpersonal skills and work as a team member.
CO4: Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
CO5: Apply the communication skills in writing and presenting the technical report.

GUIDELINES

The purpose of this project oriented professional training is to expose the students to the world of work and provide professional experience in real life situation. It is suggested that during the training, the student should remain attached with the various sections of industry/field for 3-4 weeks. The student will have to maintain a daily/weekly/monthly diary/work book and submit detailed reports of their activities periodically to their supervisor/teacher. These reports will be certified by the

concerned/ authorized officer of the organization where the student is undergoing professional training and doing his/her

project. Each student is required to undergo one Professional Oriented Project according to his/her area of interest and the project report is to be submitted at the end of project.

The concerned teacher will guide and supervise the students on work stations (as far as possible) at regular intervals. A systematic plan of action is required to be prepared, well in advance, by the polytechnic in consultation with the organizations where professional training and project is going to be executed. The teacher should clearly specify the expected learning outcomes and schedule on periodic basis, preferably weekly or fortnightly basis, for the whole of the professional project/training period of students. Performa may be developed by the polytechnic Training and Placement Officer in consultation with the teachers and personnel from industry to monitor the progress of the students. The performa should be filled by the students on daily, weekly and monthly basis, and should be duly countersigned by the personnel from industry and concerned teacher/supervisor attached to the particular student. Each teacher is supposed to guide and supervise about 5 – 8 students, depending upon the strength of the students and teachers in the department.

A criteria for assessing student performance by the internal examiner (personnel from industry and supervisor) and external examiner (teachers and experts) are given in table below:

S. No.	Performance criteria for Internal Assessment	Weightage of marks (in %age)
1.	Punctuality and regularity	10%
2.	Initiatives taken by the student in learning at training workplace	10%
3.	Defining problem statement, approach and schedule (Planning)	20%
4.	Level /proficiency of new practical skills acquired	20%
5.	Preliminary Action Plan and Report	40%
TOTAL		**100**

S. No.	Performance criteria for External Assessment	Weightage of marks (in %age)
1.	Project Report	60%
2.	Presentation & Viva voce	40%
Total marks		**100**

Important Notes:

1. This criteria must be followed by the faculty and they may see the daily, weekly and monthly progress/reports, while awarding awards as per the above criteria.
2. Students may visit websites as their learning tool during industrial training, Search videos, animations, text material on internet for preparation of training report during the training period.
3. The external examiner, preferably, may be the person from different industry/organization/institution, who is well versed with the discipline/branch of project-oriented professional training of the students, so that she/he can properly evaluate the students on the above criteria.

PRACTICAL EXERCISES

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 exercises is suggested below which should be carried out during 5th semester.

5.1 Haematology/Transfusion Medicine

1. Preparation of various anticoagulants/containers EDTA, Tri sodium citrate, double oxalate
   i. ACD (Acid Citrate Dextrose)
   ii. CPD (Citrate Phosphate Dextrose)
   iii. CPDA (Citrate Phosphate Dextrose Adenine)
2. Collection of various clinical samples e.g. blood and urine
3. Haemoglobin estimation
4. Demonstration of TLC, DLC, ESR and PCV
5. Absolute Eosinophil Count
6. To perform BT & CT and APTT/PTTK
7. Determination of Prothrombin Time & calculation of INR
8. Performing ABO blood grouping by following method:
   i. Direct
   ii. Tube test
9. Performing –Rh grouping by following techniques:
   i. Slide
   ii. Tube technique
10. Performance of Coombs Test
    i. Direct
    ii. Indirect
11. Cross Matching (compatibility testing)
    i. Major
    ii. Minor
12. Staining of blood film

5.2 Biochemistry/Basic Instruments

1. To estimate Blood Sugar – Random/Fasting/PP and HbA1C
2. To estimate GTT/ST
3. Bio Medical waste management (use of bags)
4. Urine – Complete examination and 24 hr
5. Stool – Complete examination
6. Cleaning of glassware

7. The principle and procedure of common lab instruments / equipment's like autoclave, pH meter, balance, water bath, hot air oven, incubator, centrifuge, colorimeter, microscope, glucometer, distillation plant/deionizer
8. To estimate urea and creatnine in a given serum sample.
9. To estimate of uric acid in a given serum sample.
10. To estimate Plasma and serum protein in given sample
11. Serum total bilirubin estimation
12. Serum bilirubin estimation (Direct)

5.3 Microbiology/Molecular Immunology

1. Widal test
2. VDRL test
3. Procedure of AFB and Gram Staining method.
4. HIV tri dot test
5. KOH test
6. Hepatitis C virus card test
7. Malaria card test
8. Preparation of culture media: Nutrient agar, blood agar, chocolate agar, and MacConkey agar
9. Demonstration of bacterial motility by hanging drop technique.
10. Collection, transportation of clinical samples, processing including culture of following clinical samples for identification of pathogens–
    i. Urine,
    ii. Stool,
    iii. Sputum,
    iv. Throat swabs,
    v. Pus and Pus swabs,
    vi. Blood,
11. Concentration methods of stool examination.
    i. Floatation method (saturated salt solution/zinc sulphate)
    ii. Sedimentation methods
12. Preparation of thin and thick smears

5.4 Histology/Cytology

1. Handling of microtome
2. Types of different Microtome
3. Types of Knife
4. Process of Section Cutting
5. Sharpening of microtome knives
6. Preparation of various smears by unfixed methods i.e. Imprint smears, Teased smears and Squashed smears
7. Preparation of different fixatives with special emphasis on preparation of formaline based fixatives
8. Preparation of paraffin blocks from various tissue pieces and labeling with emphasis on orientation
9. Preparation of blocks for fine cutting, Rough cutting and Trimming
10. Performing H&E staining on sections and mounting of tissue sections
11. Demonstration of cell using buccal smear/urine sample
12. To perform PAP stain on given smear

SIXTH SEMESTER

6.1 PROJECT ORIENTED PROFESSIONAL TRAINING – II

L	P
-	35

RATIONALE

Project Oriented Professional Training is aimed at the application of knowledge and competencies gained in the previous semesters in an integrated manner towards addressing an issue in the industry/field, as per the interest and choice of both the industry and student. It also provide opportunities to the students to work relatively independently over extended and comprehensive periods of time. It is expected from the students to get acquainted with desired attributes for industrial/field environment. For this purpose, students are required to work in different establishments of world of work, and develop competencies.

COURSE OUTCOMES

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

CO1: Define the problem statement of the Industrial training as per industry need.
CO2: Develop the problem-solving skills in finding solutions to the problems in the world of work.
CO3: Acquire interpersonal skills and work as a team member.
CO4: Demonstrate the competence to apply knowledge and skills learnt earlier in the context of the project.
CO5: Apply the communication skills in writing and presenting the technical report.

GUIDELINES

The purpose of this project oriented professional training is to expose the students to the world of work and provide professional experience in real life situation. It is suggested that during the training, the student should remain attached with the various sections of industry/field for 3-4 weeks. The student will have to maintain a daily/weekly/monthly diary/work book and submit detailed reports of their activities periodically to their supervisor/teacher. These reports will be certified by the concerned/ authorized officer of the organization where the student is undergoing professional training and doing his/her

project. Each student is required to undergo one Professional Oriented Project according to his/her area of interest and the project report is to be submitted at the end of project.

The concerned teacher will guide and supervise the students on work stations (as far as possible) at regular intervals. A systematic plan of action is required to be prepared, well in advance, by the polytechnic in consultation with the organizations where professional training and project is going to be executed. The teacher should clearly specify the expected learning outcomes and schedule on periodic basis, preferably weekly or fortnightly basis, for the whole of the professional project/training period of students. Performa may be developed by the polytechnic Training and Placement Officer in consultation with the teachers and personnel from industry to monitor the progress of the students. The performa should be filled by the students on daily, weekly and monthly basis, and should be duly countersigned by the personnel from industry and concerned teacher/supervisor attached to the particular student. Each teacher is supposed to guide and supervise about 5 – 8 students, depending upon the strength of the students and teachers in the department.

A criteria for assessing student performance by the internal examiner (personnel from industry and supervisor) and external examiner (teachers and experts) are given in table below:

S. No.	Performance criteria for Internal Assessment	Weightage of marks (in %age)
1.	Punctuality and regularity	10%
2.	Initiatives taken by the student in learning at training workplace	10%
3.	Defining problem statement, approach and schedule (Planning)	20%
4.	Level /proficiency of new practical skills acquired	20%
5.	Preliminary Action Plan and Report	40%
TOTAL		**100**

S. No.	Performance criteria for External Assessment	Weightage of marks (in %age)
1.	Project Report	60%
2.	Presentation & Viva voce	40%
Total marks		**100**

Important Notes:

1. This criteria must be followed by the faculty and they may see the daily, weekly and monthly progress/reports, while awarding awards as per the above criteria.
2. Students may visit websites as their learning tool during industrial training, Search videos, animations, text material on internet for preparation of training report during the training period.

The external examiner, preferably, may be the person from different industry/organization/institution, who is well versed with the discipline/branch of project-oriented professional training of the students, so that she/he can properly evaluate the students on the above criteria

PRACTICAL EXERCISES

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 exercises is suggested below which should be carried out during 6th semester.

6.1 Haematology/Transfusion Medicine

1. Principle and working of the automated blood cell counter. Its function and care.
2. ESR estimations by Westergren and Wintrobe method in blood sample.
3. Determination of PCV in blood by Macrohematocrit Method and Microhematocrit Methood.
4. Counting of Reticulocyte in blood sample. Calculate Red Cell Indicies – MCV, MCH, MCHC.
5. To perform Sickling test on blood.
6. Estimation of foetal haemoglobin by alkali denaturation test.
7. Estimation of G6PD by Methylene Blue Reduction Test).
8. To perform red cell fragility test on blood.
9. Determination of bleeding time by lvy's and Dukes method and clotting time by Lee and White method.
10. Demonstration of Hess test
11. Performance of Clot retraction test
12. Demonstration of Aspiration, Preparation, staining and examination of bone-marrow smears.
13. Demonstration of Laboratory diagnosis of various leukemias.
14. Demonstration of LE Cell.
15. Semen analysis.

6.2 Biochemistry/Advanced Instruments

1. To Performs/GTT using GOD-POD method
2. To estimate urea and creatnine in a given serum sample.
3. Principal and procedure of RT-PCR and biochemistry analyzer used in respective labs.
4. Serum Direct and total bilirubin estimation
5. SGOT and SGPT estimation
6. Serum amylase estimation
7. Serum ALP and ACP estimation
8. Serum calcium and potassium estimation
9. Serum triglyceride and total cholesterol estimation
10. Estimation of HDL, LDL and VLDL
11. Detection of ketone bodies in urine.
12. Detection of urinary creatinine.

13. Liver function test
14. Renal function test
15. Stool for occult blood

6.3 Microbiology/Molecular Immunology

1. Blood and Urine for culture and sensitivity
2. Staining of smears by Leishman, Giemsa, and Field stain.
3. Examination of smears for malarial parasite (P. vivax and P. falciparum)
4. Perform wet mount using LCB.
5. Collection and processing of samples for diagnosis of fungal infections in skin, hair, nail scrapings.
6. Perform Widal test by slide and tube method.
7. Perform ASO titre test.
8. Perform CRP test.
9. Perform Rheumatoid factor test.
10. Perform VDRL Test.
11. Perform HIV by ELISA test.
12. Perform HBsAg ELISA test.
13. Pregnancy (hCG) test
14. Identification of following adult worms/cyst from preserved specimen/ slides of Tapeworm, Roundworm, Hookworm and Entamoeba histolytica
15. Perform RT- PCR test for COVID 19

6.4 Histopathology/Cytology

1. Demonstration of cryostat and Processing of tissue for frozen section
2. Staining and mounting of frozen section using H&E stain (rapid method).
3. To stain paraffin embedded section for the demonstration of reticulin fibers by Silver impergnation stain.
4. To stain paraffin embedded section using Oil Red “O” stain.
5. Preparation of Kaiserling's solution I and II for museum specimens.
6. Preparation of various mounting reagents for museum specimens
7. Processing and Labeling of various museum specimens
8. Demonstration and care of autopsy instruments

9. Preparation of dry smear and wet smear
10. To perform PAP stain
11. Fixation of smears and staining with MGG
12. To perform Harmonal Assessment
13. To perform PAS staining method of cytological sample.
14. To perform ZN staining method of cytological sample.
15. Demonstration of automatic tissue processor.

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 free of cost 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 **free** 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 centers to monitor the progress of the students and students have to visit their respective institutes for internal/sessional practical exams in every two months as per schedule fixed by HSBTE board or institute.

24. ASSESMENT TOOLS & CRITERION

The assessment is carried out by conducting:

1. Formative assessments
2. Summative assessments

1. FORMATIVE ASSESSEMENT

The formative assessment will be evaluated on the basis of the internal assessments for theory subjects and practical by the concerned teachers for evaluating the knowledge and skill acquired by students and the behavioral transformation of the students. This internal assessment is primarily carried out by collecting evidence of competence gained by the students by evaluating them at work based on assessment criteria, asking questions and initiating formative discussions to assess understanding and by evaluating records and reports, and sessional marks are awarded to them.

2. SUMMATIVE ASSESSMENT

The summative assessment will include end semester examination for theory part for each candidate and practical examination with viva voice. Each Performance Criteria will be assigned marks proportional to its importance and proportion of marks for Theory and Skills Practical for each subject should be laid down. The following assessment tools are used for effective student evaluation:

1. Theory
2. Practical
3. Minor & Major Project
4. Massive Open Online Courses (MOOCs)
5. Viva Voce
6. Summer Industrial / In House Training
7. Professional Industrial Training

1. Theory Assessment

Evaluation in theory aims at assessing students' understanding of concepts, principles and procedures related to a course/subject, and their ability to apply learnt principles and solve problems.

The formative evaluation for theory subjects may be caused through

i. Sessional /class-tests,
ii. Quizzes,
iii. Assignments,
iv. Seminars / Presentations
v. Attendance
vi. Case Studies

For Summative evaluation of theory, the question paper may comprise of three sections.

i. It should contain objective type question and multiple choice questions. The objective type items should be used to evaluate students' performance in knowledge, comprehension and at the most application domains only.

ii. It should contain short answer questions.

iii. Descriptive type questions, with some internal choice of the questions set may be given in this section

2. Practical Assessment

Evaluation of students performance in practical work (Laboratory experiments, Workshop practical /field exercises) aims at assessing students ability to apply or practice the concepts, principles and procedures, manipulative skills, ability to observe and record, ability to interpretand draw conclusions and work related attitudes. This will comprise of a creation of mock environment, wherever applicable in the skill lab which is equipped with all required equipmentfor development of desired skills. Candidate's soft skills, communication, aptitude, safety consciousness, quality consciousness etc. will be ascertained by observation and will be marked in observation checklist along with the assessment of Job carried out in labs and maintenance of Lab Record Files.

Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject. The end product will be measured against the specified dimensions and standards to gauge the level of skill achievements

3. Minor and Major Project Assessment

The purpose of evaluation of project work is to assess student's ability to apply, in an integrated manner, knowledge and skills in solving real life problems, manipulative skills, ability to observe, record, creativity and communication skills. The project work assigned should be of relevance to the core skill, state of the art topics and the project areas that are pertaining to enhance job skill and enhance occupational opportunities. For both, minor and major project, Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, nature and relevance of project and general behavior.

The formative assessment should include the continuous assessment based on the work allocated and mid semester viva voice or presentation. The final assessment will be the combination of the project undertaken, report submission and should be followed by viva-voce of the relevant subject.

In case of the assessment of this component, the team of examiners should be constituted and half of the examiners in the team should be invited from outside of the institute as expert for conducting the examination.

4. Massive Open Online Courses (MOOCs) Assessment

Open Elective and Multi-Disciplinary Elective may be covered through Massive Open Online Courses (MOOCs) to promote self learning. These platforms promise open, online courses to massive numbers of students as they are free to join; they provide a wide range of courses. They allow for space and time flexibility and their participants can benefit from various online communication tools and access to quality content.

The coordinating Department/Centre/Office shall monitor every student to adopt the courses online of their choice and preference on Swayam portal. The duration of courses will vary depending on the level and credit points. Courses offered in the duration of 4-10 weeks for 2 to 3 credits at diploma level are to be opted. Students can get a certificate after registering and attending the classes and submitting the assignments/quizzes and qualifying nationwide conducted written exam.

On successful completion of each course, the institution offering the MOOCs course would issue the certificate, along with the number of credits and grades, through which the student can get credits transferred into his marks certificate issued by the parent institution. There may be standard norms for the host Institution to conduct the course that may include continuous evaluation through assignments, online quizzes, case studies, online writing exercises, term examinations, student feedback, online forum management, etc. The coordinating Department/Centre/Office of the respective department shall monitor every student and submit to the Office of Examinations, a score sheet before the close of the even semester.

5. Viva Voce Assessment

This tool will be used to assess the conceptual understanding and the behavioral aspects as regards the job role and the specific task at hand. It will also include questions on safety, quality, environment and equipment's etc. Ask questions on non-prescribed tasks to ensure that the learners have complete knowledge on the assessment

6. Summer / In-house Training Assessment

The two mandatory internships after First and Second Year of are to be assessed in 3rd and 5th semester subsequently. The trainng should be preferably done in the industry but can also be in house depending upon the stream and availability of resources in and around the institute. Faculty should be assigned each student and made responsible for the evaluation and assessment of the training. Formative assessment should be taken from the industry/institute/ department on the basis of performance, behavior and learning capabilities. Summative evaluation may comprise of weight ages on the basis of report submission / presentation followed by viva-voce of the relevant subject.

7. Professional Industrial Training Assessment

Evaluation of professional industrial training report and viva-voce/ presentation aims at assessing students' understanding of industrial processes, practices in the industry/field and their ability to engage in activities related to problem-solving in industrial setting as well as understanding of application of learnt knowledge and skills in real life situation. Formative and summative evaluation may comprise of weight ages to performance on task, quality of product, general behavior and it should be followed by viva-voce of the relevant subject.The formative assessment should include the evaluation from the employer where the student is doing his training in the ratio of 40:60. The final assessment will be the combination of the

employer assessment and evaluation by the faculty of the institute which shall include report submission/ presentation/ seminar followed by viva-voce of the relevant subject.

SGPA AND CGPA ASSESSMENT

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The SGPA is the ratio of sum of the product of the number of credits with the marks scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e

$$SGPA\ (Si) = \sum(Ci \times Gi) / \sum Ci$$

where Ci is the number of credits of the ith course and Gi is the marks scored by the student in the ith course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

$$CGPA = \sum(Ci \times Si) / \sum Ci$$

where Si is the SGPA of the ith semester and Ci is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

25. TEACHING LEARNING TOOLS FOR EFFECTIVE IMPLEMENTATION

For effective implementation of curriculum, the faculty and staff of institutions have to play a vital role in planning instructional experiences for the courses in four different environments viz. class-room, laboratory, library and field and execute them in right perspective. It is emphasized that only a proper mix of different teaching methods in all these places of instruction can bring the changes in students behaviour as stipulated in the curriculum document. It is important to understand curriculum document holistically and further be aware of intricacies of Teaching- Learning Tools for achieving curriculum objectives. Given below are certain recommendations which may help in carrying out teaching-learning effectively:

PROGRAMME LEVEL RECOMMENDATIONS

1. Curriculum implementation takes place at programme, course and class-room level respectively and synchronization among them is required for its success. The first step towards achieving synchronization is to read curriculum document holistically and understand its rationale andphilosophy.

2. An academic plan needs to be prepared at institute level. The Head of the institute has a great role to play in its dissemination and percolation up to grass-root level.

3. Heads of Department are required to prepare academic plan at department level referring to institutional academicplan.

COURSE LEVEL RECOMMENDATIONS

Teachers are educational managers at class room level and their success in achieving course level objectives lies in using course plan and their judicious execution which is very important for the success of programme by achieving its objectives. Teachers are required to plan various instructional experiences viz. theory lecture, expert lectures, lab/workshop practical's, guided library exercises, field visits, study tours, camps etc. In addition, they have to carry out progressive assessment of theory, assignments, library, practical's and field experiences. Teachers are also required to do all these activities within a stipulated period

which is made available to them in the academic plan at Board level. With the amount of time to their credit, it is essential for them to use it judiciously by planning all above activities properly and ensure execution of the plan effectively. Following is the gist of suggestions for subject teachers for effective utilization of Teaching Learning Tools to achieve the course objectives:

1. Teachers need to ensure attainment of course outcomes so as to help the students achieve program outcomes and also meet the desired learning outcomes in five domains of NSQF i.e. Process, Professional knowledge, Professional skills, Core skills and Responsibility.

2. Teachers are required to prepare a course plan, taking into account number of weeks available and courses to be taught.

3. Teachers are required to prepare lesson plan for every theory class. This plan may comprise of contents to be covered, learning material for execution of a lesson plan.

4. Teachers are required to plan for expert lectures from field/industry. For this, necessary steps need to be taken such as planning in advance, identifying field experts, making correspondence to invite them, taking necessary budgetary approval etc.

5. Teachers are required to plan for guided library exercises by identification of course specific experience requirement, setting time, assessment, etc. The assignments and seminars can be thought of as terminal outcome of library experiences.

6. Concept based industrial/field visits may be planned and executed for such contents of course which are abstract in nature and no other requisite resources are readily available in institute to impart them effectively.

7. Lot of focus needs to be laid on skill development. There is need for planning practical experiences in right perspective. These slots in a course are the avenues to use problem based learning and experiential learning effectively. The development and use of lab manuals will enable the institutes to provide lab experiences effectively.

8. Emphasis should to laid on developing soft skills like communication skills, personality Development, self-learning, inter personal skills, problem solving, and creativity etc.

9. Where ever possible, it is essential to use activity based learning rather than relying on delivery based conventional teaching all the time. While teaching, the teacher should make extensive use of audio visual aids such as video films, power point presentations and IT tools.

10. Teachers may take an initiative in establishing liaison with industries and field organizations for imparting field experiences to thestudents.

11. To enhance digital learning, open electives andmulti-disciplinary electives have been provided in the curriculum to be taken up in the form of MOOCs. For Open electives, some courses may be identified out of the prescribed list given in the curriculum keeping in mind the interest of students. Similarly, for multi-disciplinary electives, courses to be offered may be identified by considering their relevance and utility. Every year SWAYAM is notifying the list of courses which are going to be offered in forthcoming even and odd semester. The institute needs to select the courses that are offered on SWAYAM platform or any other onlineplatform.

12. For effective implementation of Massive Open Online Courses (MOOCs), a faculty member in the department may be identified and given the responsibility to coordinate various activities related to MOOCs. The concerned faculty member will facilitate in registration of students for MOOCs. The faculty member will also be responsible for compiling the result of students on the completion of MOOCs and pass on the information to the concerned authority.

13. Flexibility has been provided in the curriculum for the students to choose a course related to the discipline as per their interest. For effective implementation of discipline-specific electives, the institute should identify some courses from the list of courses prescribed in the curriculum. The courses should be selected and offered keeping in mind the interest of students, infrastructure and expertise available in and around the institute related to the courses. Option for discipline-specific elective may be taken from students through a form and a course, with more than 10 students opting for it, may be run.

14. Students should be made aware about issues related to ecology and environment, safety, concern for wastage of energy and other resources etc.

15. Any relevant contents beyond the syllabus may be covered by the teacher or experts in extra time.

16. Minor project should be identified and allocated taking into consideration the inputs from industry stake-holders, and departmental faculty. The minor project work should be such that it enhances the fundamental skill-sets of the students from industry perspective and subsequently helps them to handle major project.

17. For major project work, students may be given relevant and well thought out problems, which are purposeful and develop practical skills. This will help the students in developing creativity and confidence for their gainful employment.

18. A Project bank may be developed in consultation with related industry, research institutes and other relevant field organizations. It may be ensured that that the students take up some live problems being faced by industry as part of project work.

26. LIST OF EXPERTS

1. Controller of Examination, Haryana State Board of Technical Education, Panchkula.
2. Controller of Admn. & Finance, Haryana State Board of Technical Education, Panchkula.
3. Joint Secretary, Haryana State Board of Technical Education, Panchkula.
4. Deputy Secretary, Training & Placement, Haryana State Board of Technical Education, Panchkula.
5. Deputy Secretary, Examination, Haryana State Board of Technical Education, Panchkula.
6. Deputy Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
7. Assistant Secretary, Academic, Haryana State Board of Technical Education, Panchkula.
8. Ms. Rachna Yadav, Senior Lecturer, Department of Medical Laboratory Technology, Government Polytechnic, Lisana
9. Mr. Amitender Singh, Senior Lecturer, HOD, Department of Medical Laboratory Technology, Government Polytechnic, Hathnikund.
10. Dr. Ashwani Bhardwaj, Lecturer, Department of Medical Laboratory Technology, Government Polytechnic, Ambala.
11. Mr. Paramjit Bhoria, Lecturer, Government Polytechnic, Department of Medical Laboratory Technology, Ambala.
12. Dr.Surender Kumar Sharma, Post Graduate Institute of Medical Education& Research, Chandigarh
13. Mr. Harpreet Singh, Assistant Professor, Department of Medical Laboratory Technology, Lovely Professional University, Phagwara.
14. Mr. Ashwinder Raina, Post Graduate Institute of Medical Education & Research, Chandigarh.
15. Ms. Shalini Bajaj, HOD, Department of Medical Laboratory Technology, SGGS Khalsa College of Pharmacy, Sector 26, Chandigarh.
16. Dr. Vikas Gaur, Lecturer, Department of Medical Laboratory Technology, Meera Bai Polytechnic, Delhi

17. Ms. Seema Nain, Laboratory Technologist, Department of Virology, Post Graduate Institute of Medical Education & Research, Chandigarh

18. Ms. Sazia, Post Graduate Institute of Medical Education & Research, Chandigarh

19. Dr.Nidhi Aggarwal, Deputy Secretary (Academic), Haryana State Board of Technical Education,Panchkula.

20. Smt. Pushpa Rani, Senior Lecturer, Applied Science Department, Government Polytechnic, Sonipat, Haryana.

21. Smt. Krishna Bhoria, Lecturer, Applied Science Department, Government Polytechnic, Ambala, Haryana.

22. Smt. Preetpal Kaur, Guest Faculty, Applied Science Department, Government Polytechnic, Ambala, Haryana.

23. Ms. Monika, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla, Haryana.

24. Dr Neena Sharma, English Department, MCM College, Chandigarh.

25. Prof. KG Srinivasa, Professor, Information Management & Emerging Engineering, NITTTR, Chandigarh.

26. Dr. Vidhi Grover, Lecturer, Applied Science Department, Seth Jai Parkash Polytechnic, Damla.

27. Mr. Tavinder Singh, Lecturer, Applied Science Department, Government Polytechnic, Sirsa.

28. Ms. Sunita Rani, Lecturer, Applied Science Department, Government Polytechnic, Ambala.

29. Dr. Rajesh Mehra, Professor and Head, Curriculum Development Centre, NITTTR, Chandigarh.

30. Dr. AB Gupta, Professor and Head, Education & Educational Management Department, NITTTR, Chandigarh.

31. Sh. PK Singla, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

32. Dr. SK Gupta, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh. Coordinator

33. Dr. Meenakshi Sood, Associate Professor, Curriculum Development Centre, NITTTR, Chandigarh.

27. APPENDIX

Sr. No.	LIST OF EQUIPMENT	Quantity
a) REQUIREMENTS FOR MICROBIOLOGY LAB		
Discs (Commercial)		
1	Antibiotic Discs (Commercial)/ Combidiscs IMVIC kit	Adequate Adequate
2	Oxidase discs	Adequate
Kits (Commercial)		
1.	Widal Test kit	2 No
2	RA Test Kit	2 No
3.	VDRL Kit	2 No
4.	ASO	2 No
5.	CRP	2 No.
6.	Hbs Ag (strips)	Adequate
7.	HIV Tridot test cards	Adequate
8.	Pregnancy Cards	Adequate
9.	Pan malaria Cards	Adequate
EQUIPMENTS		
1.	Binocular optical microscopes with 100x , 40x and 10x	5
2.	Monocular Microscopes	15
3.	Autoclave (vertical)	2
4.	Hot air oven	2
5.	Water bath	1
6.	Vacuum pump	1
7.	Anaerobic jar	2
8.	Colony counter	2
9.	VDRL Rotator	1
10.	Laminar air flow	1
11.	Incubator	2
12.	Autopippette 10 µl, 100 µl, 1ml	2each
13.	pH meter (electronic)	1
14.	Bunsen Burner	10
15.	Chemical balance (electronic/digital)	1
16	Single Pan balance	1
17	Membrane filter (metal)	1
18	Centrifuge machine (medium)	2

19	Magnetic stirrer with heater	1
20	Vortex Mixer	1
21	Refrigerator	
TEACHING AIDS		
1.	Charts – related to Microbiology	Adequate
2.	Preserved specimen /Preserved slides - Tapeworm - Round worm - Hook worm - Giardia - E. histolytica	Adequate
LAB EQUIPMENTS FOR HISTOPATHOLOGY AND CYTOLOGY		
1	Hot air oven	2 Nos.
2	Moulds (Leuckart's) assorted & base steel moulds	15 pairs & 15 pieces
3	Incubators for paraffin wax (37 – 100^{o} C)	1 No.
4	Diamond Pencils	15
5	Automatic Tissue Processor	1 No.
6	Microtome knives/disposable Microtome blades	15 each
7	Plastic embedding rings	1 dozen each
8	Senior Rotary microtomes	2 Nos.
9	Tissue floatation bath	2 Nos.
10	Hones (Belgium and plate glass)	15 Nos. each
11	Automatic knife sharpner	1 No.
12	Strop horse (leather)	15 Nos. each
13	Binocular Microscopes (with 4x,10x, 40x and 100x)	10 Nos.
14	Refrigerator (165 Lt)	1 Nos.
15	Slide warmer (upto 100 C) (Cu-plate) rectangular	1 No.
16	Bone cutter (hand saw stainless steel)	2 Nos.
17	Centrifuge (12 tubes) – Remi; Max speed: 5000 rpm-6000 rpm	2 Nos.
18	Magnetic stirrer	1
19	Cryostat	1
20	Paraffin Wax Dispensor	1
21	Electronic Balance	1 each
22	Timer	15 Nos.
23	Wax Block Cabinets Card board boxes for storage	1 No.
24	Tissue Capsules small and medium or cassettes	1 dozen
REQUIREMENTS FOR BIOCHEMISTRY		
Kits (Commercial)		
1.	Renal Function Kit	Adequate
2.	Liver Function Kit	Adequate

3.	Lipid Profile Kit	Adequate
4.	Calcium and Phosphorus estimation Kit	Adequate
5.	Total Protein and Albumin estimation Kit	Adequate
6.	Electrolytes estimation kit	Adequate
7.	Serum Amylase estimation kit	Adequate
8.	Serum Lipase estimation kit	Adequate
9.	Serum Glucose estimation kit	Adequate
REQUIREMENT OF EQUIPMENT (BIOCHEMISTRY)		
1.	Centrifuge Machine (Remi)	03
2.	Photoelectric colorimeter	01
3.	Water bath electric (Boiling water)	01
4.	Incubator 37^{o}C	01
5.	Hot air oven	01
6.	Flame photometer	01
7.	Electrophoretic apparatus	01
8.	Complete equipment for the thin layer chromatography	01
9.	UV-Spectrophotometer	01
10.	Digital Electronic Balance	01
11.	Urinometer	03
12.	Distillation plant	01
13.	Refrigerator (300 litre)	01
14.	Auto/Semi Auto Analyser for Biochemistry	01
15.	pH meter	02
16.	Glucometer	01
17.	AC (Air Conditioner 2.0 Ton)	01
18.	Microscope Binocular	02
19.	Automatic pipette (20 µl, 50 µl and 100 µl)	05
20.	Microcentrifuge	01
21.	Vortex Mixer	02
22.	Hot plate	01
23.	Lab Microwave Oven (100 liters)	01
REQUIREMENTS FOR HAEMATOLOGY		
Kits (Commercial)		
1.	Haemoglobin estimation Kit	Adequate
2.	PT/INR Kit	Adequate
3.	APTT Kit	Adequate

REQUIREMENT OF EQUIPMENTS FOR HAEMATOLOGY LABORATORY		
1.	Centrifuge Machine (Remi)	2
2.	Microscope Monocular	10
3.	Microscope Binocular	10
4.	Hot air Oven (Tem. Range 0-200° C)18” x 18” x18”	2
5.	Incubator (medium size)	2

6.	Digital or Electronic Balance (Single pan)	2
7.	Refrigerator	1
8.	Sahli's Haemoglobinometer	20
9.	Westergren pipette with stand	30
10.	Wintrobe tube with stand	30
11.	Water Bath 12"x10"x10", Temp 0°C-100° C	2
12.	Colorimeter (Digital) or Photo electric colorimeter	2
13.	Improved Neubauer counting chamber	10
14.	Automatic pipette (20 µl, 50 µl and 100 µl)	5 each
15.	Fuchs Rosenthal Counting Chamber	1
16.	Microcentrifuge/Hematocrit centrifuge machine with hematocrit reader	01
17.	Sphygmomanometer(BP apparatus)	4
18.	Table Lamp	2
19.	Vortex Mixer	2
20.	Stop watch	5
21.	Hot plate	1
22.	Distillation plant	1
23.	Hand tally counter 24. Blood cell counter semi automatic/automatic 1	5
Kits (Commercial)		
1.	Blood Group estimation kit	Adequate
LAB EQUIPMENTS FOR BLOOD BANK		
1.	Hot air oven	1
2.	Refrigerator (165 Lt)	1
3.	Centrifuge (12 tubes) – Remi; Max speed: 5000 rpm-6000 rpm	2
4.	Electronic Balance	1
5.	Incubator	1
6.	Water bath	1
7.	Blood Mixer	1
8.	Plasma Expressor	1
9.	Binocular Microscope	2
10	Monocular Microscope	10
REQUIREMENT OF EQUIPMENT FOR ANATOMY AND PHYSIOLOGY LABORATORY		
1.	Skelton (Human) Articulated and disarticulated	1 set each
2.	Microscopes Monocular	10
3.	Sphygmomanometer with stethoscope	5 each
4.	Overhead projector	1
5.	Slide Projector	1
6.	ECG machine	1
7.	ECG Table and Trolley for machine	As required
8.	ECG Gel	As required

9.	Models	
	Brain and spinal cord, Heart, Kidney, liver, Stomach, Eye, Ear, Lungs, Male and female reproductive system, Skin	1 set each
10	Charts	
	Cardiovascular system, Reproductive system, Urinary system, endocrine system, CN, Tissues of body, Skeletal system. Digestive system, Respiratory system.	1 set each

Note:

- All the glasswares to be of Borosil make
- The chemicals may be purchased of reputed make.
- Adequate number of glassware commonly used in the laboratory should be provided in each laboratory.
- Stains/Reagents/Culture Media/Consumable items should be procured as per requirement. Readymade stains/media/reagents from reputed manufacturer can also be used where ever available.


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