

**Curriculum for  
Diploma Programme in  
MEDICAL LAB TECHNOLOGY  
(BATCH 2018)**

**For the State of Haryana**



Prepared by:

**Curriculum Development Centre  
National Institute of Technical Teachers  
Training and Research  
Sector 26, Chandigarh - 160 019**

**Haryana State Board of Technical  
Education  
Bays 7-12, Sector 4  
Panchkula-134 112**

**July, 2018**

**FIRST YEAR (MEDICAL LAB TECHNOLOGY)**

Sr. No.	SUBJECTS	STUDY SCHEME HOURS / WEEK			CREDIT	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
1.1*	English	2	-	2	6	40	25	65	60	3	50	3	110	175	
1.2	Anatomy and Physiology	3	-	2	8	40	25	65	60	3	50	3	110	175	
1.3	Basic Chemistry	2	-	2	6	40	25	65	60	3	50	3	110	175	
1.4	Clinical Micro-Biology	3	-	2	8	40	25	65	60	3	50	3	110	175	
1.5	Haematology	3	-	2	8	40	25	65	60	3	50	3	110	175	
1.6*	Environmental Studies	2	-	1	5	40	25	65	60	3	50	3	110	175	
1.7	Clinical Biochemistry	3	-	2	8	40	25	65	60	3	50	3	110	175	
1.8*	Information Technology	-	-	2	2	-	50	50	-	-	50	3	50	100	
#	Student Centered Activities (SCA)	-	-	2	2	-	25	25	-	-	-	-	-	25	
<b>Total</b>		18	-	17	53	280	250	530	420	-	400	-	820	1350	

\* Common with other Diploma Programmes

# SCA will comprise of co-curricular activities like extension lectures, games, hobby clubs, seminars, declamation contests, educational field visits, N.C.C., N.S.S., Cultural Activities and Disaster management etc.

### THIRD SEMESTER (MEDICAL LABORATORY TECHNOLOGY)

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

\* Common with other diploma programmes

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

**FOURTH SEMESTER (MEDICAL LABORATORY TECHNOLOGY)**

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

\* Common with other diploma programmes

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

**FIFTH SEMESTER (MEDICAL LABORATORY TECHNOLOGY)**

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

**SIXTH SEMESTER (MEDICAL LABORATORY TECHNOLOGY)**

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

**FIRST YEAR**  
**(Annual System)**

## 1.1 ENGLISH

L T P  
2 - 2

### RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

### LEARNING OUTCOMES

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

- Understand the importance of good communication
- Describe process of communication.
- Explain, Compare and re-write the types of communication
- Identify and match the parts of speech
- Rewrite sentences correctly
- Modify sentences and relate them with real life situations.
- Reproduce and match words and sentences in a paragraph.
- Re-write the sentences according to given situation.
- Relate and use various words using proper vocabulary and grammar.
- Write the various types of paragraphs, notices and composition on picture with appropriate format.

### DETAILED CONTENTS

- |  |            |
|--|------------|
| <b>1. Basics of Communication</b>  | <b>(06</b> |
| <b>Hrs)</b>  |            |
| 1.1. Definition and process of communication   |            |
| 1.2. Types of communication – Verbal (Listening, Speaking, Reading and Writing) and Non-verbal |            |
| <br>   |            |
| <b>2. Functional Grammar</b>   | <b>(22</b> |
| <b>Hrs)</b>  |            |
| 2.1. Noun and Pronoun  |            |
| 2.2. Punctuation   |            |
| 2.3. Preposition   |            |
| 2.4. Conjunction   |            |
| 2.5. Tenses (verb (Main verb and Auxiliary verb)   |            |
| <br>   |            |
| <b>3. Reading Skills</b>   | <b>(12</b> |
| <b>Hrs)</b>  |            |



- 3.1. Unseen passage for comprehension. Based upon the passage, following aspects may be covered
- Questions from the passage
  - One-word substitution
  - Prefixes and Suffixes
  - Antonyms and Synonyms etc.

**4. Writing skills  
Hrs)**

**(30**

- 4.1. Correspondence – Business and official
- 4.2. Notice, including Press Releases
- 4.3. Memos
- 4.4. Circular
- 4.5. Basics of Report Writing
- 4.6. Resume Writing
- 4.7. Writing E-mail
- 4.8. Paragraph writing
- 4.9. Picture composition

**LIST OF PRACTICALS**

1. Listening Exercises
2. Self and Peer Introduction
3. Debate
4. Situational Conversations: Offering - Responding to offers; Requesting – Responding to requests; Congratulating; Expressing sympathy and condolence; Apologizing and Forgiving; Complaining; Warning; Asking and giving information; Getting and giving permission; Asking for and giving opinions; Talking about likes and dislikes
5. Just a minute sessions – Extempore
6. Group Discussion
7. Newspaper reading
8. Mock Interviews: Telephonic and Personal

**INSTRUCTIONAL STRATEGY**

Student should be encouraged to participate in role play and other student centered activities in class room and actively participate in listening exercises

## MEANS OF ASSESSMENT

- Assignments and quiz/class tests, mid-term and end-term written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

## RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S.Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/HSBTE/NITTTR.

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1.1, 2.1, 4.1	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
B	20%	Unit 2.2, 4.2, 4.3	2 <sup>nd</sup> Internal		
C	60%	Unit 1.2, 2.3 to 2.5 , 3, 4.4 to 4.9	FINAL		

## 1.2 ANATOMY AND PHYSIOLOGY

**L T P**  
**3 - 2**

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.

### DETAILED CONTENTS

1. Introduction to human body, anatomy and physiology definition, structure and functions of animal cell. (06 hrs)
2. Elementary tissues of body and their classification along with brief description (06 hrs)
3. Skin (Structure and functions) (04 hrs)
4. Skeletal system (08 hrs)
  - 4.1 The skeleton, important bones and their brief description
  - 4.2 Articulation of bones – joints
5. Digestive system (14 hrs)
  - 5.1 Various organs of digestion and their functions (stomach, small intestine) and accessory organs (liver, pancreas and salivary glands)
  - 5.2 Process of digestion of food
  - 5.3 Absorption and assimilation of food
  - 5.4 Vitamins and minerals
6. Respiratory system (07 hrs)
  - 6.1 Organs of respiration and their histology
  - 6.2 Respiration (definition and mechanism)
  - 6.3 Gas exchange in the lungs
  - 6.4 Regulation of respiration
  - 6.5 Basal metabolic rate
7. Excretory System (07 hrs)
  - 7.1 Organs of excretion (kidneys, ureter, bladder)
  - 7.2 Formation of urine and its composition
  - 7.3 Structure of nephron
8. Nervous system ( 8 hrs)
  - 8.1 Central nervous system (brain and spinal cord)
  - 8.2 Peripheral nervous system (cranial and spinal nerves)
  - 8.3 The sense organs (eye, ear, tongue and nose); structure and functions

9. Muscular system (12hrs)
  - 9.1 Brief description of skeletal, smooth and cardiac muscles
  - 9.2 Muscle fatigue
  
10. Circulatory system (14 hrs)
  - 10.1 Composition and functions of blood
  - 10.2 Anatomy and physiology of Heart
  - 10.3 Circulation of blood, Cardiac Cycle and Conducting System of Heart
  - 10.4 The blood pressure
  - 10.5 Arteries and veins- differences
  - 10.6 Lymph and lymphatic system
  
11. Endocrine system (10 hrs)
 

Description of each endocrine gland its secretions and their effect on the body
  
12. Reproductive System (12 hrs)
  - 12.1 Male and female reproductive system
  - 12.2 The ovarian cycle and ovulation
  - 12.3 Fertilization

### **LIST OF PRACTICALS**

1. Study of various parts of body through demonstration
2. Study of tissues of body through demonstration
3. Study of various parts of skin (demonstration from models)
4. Study of various bones and joints through demonstration
5. Study of parts of digestive & respiratory system through demonstration
6. Study of various parts of nervous system (brain and spinal cord) (demonstration from model)
7. Study of structure of eye and ear (demonstration from models)
8. Study of structural differences between skeletal, smooth and cardiac muscles (permanent mounts) through demonstration.
9. Study of various parts of circulatory system through demonstration.
10. Examination of stained blood film for blood cells
11. Estimation of blood pressure
12. Study of various parts of excretory and reproductive system (male and female demonstration from models and charts)

### **RECOMMENDED BOOKS**

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

<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1 to 4	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 5 to 7	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 08 to 12	FINAL	60%	

## 1.3 BASIC CHEMISTRY

L T 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.

### DETAILED CONTENTS

1. Basic concepts (08 hrs)
  - 1.1 S.I. units of pressure, volume, temperature, density, specific gravity
  - 1.2 Matter, element, compound and mixtures, atom, molecule, ion, symbols and formulae (recapitulation only)
  - 1.3 Atomic mass (A), molar mass, mole concept and its applications.
  - 1.4 Solution, strength of solutions, molarity (M), molality (m), normality (N), mass fraction, mole fraction and parts per million.
  
2. Water (07 hrs)
  - 3.1 Sources of water
  - 3.2 Hard and soft water, types of hardness, action of soap on hard water
  - 3.3 Disadvantages of hard water in domestic and industrial uses
  - 3.4 Qualities of drinking water and purification of available water for drinking purposes
  
3. Equilibrium, Acids and Bases. (07 hrs)
  - 3.1 Equilibrium state, equilibrium constant
  - 3.2 Ionization of electrolyte in aqueous solution, ionic equilibrium, degree of ionization, self-ionization of water and ionic product of water ( $K_w$ )
  - 3.3 Concept of pH and pH scale
  - 3.4 Various concept of acids/bases; strong acids/bases, weak acids/bases, dissociation constants of acids/bases. Neutralization, acid base titration, choice of indicators for acid base titration
  - 3.5 Hydrolysis of salts, common ion effect, buffer solutions (acidic and basic), Buffering action of a buffer solution, applications of buffers
  
4. Electrochemistry. (09 hrs)
  - 4.1 Electronic concept of oxidation, reduction and redox reactions
  - 4.2 Electrolytes and non electrolytes
  - 4.3 Conductors and their types.

- 4.4 Electrolysis
- 4.5 Applications of electrolysis
5. Surfaces and Colloids (05 hrs)
- 5.1 Adsorption and its types
- 5.2. Applications of adsorption
- 5.3. Colloidal state and types of colloids
- 5.4. Preparation and purification of colloids in brief
- 5.5. Gels and solution, emulsions
- 5.6. Cleaning action of soaps
6. Organic chemistry (04 hrs)
- 6.1 Introduction and importance of organic compounds
- 6.2 Comparison of organic and inorganic compounds
- 6.3 Properties of carbon and Hydrogen
7. Hydrocarbons (06 hrs)
- 7.1 Preparation, properties and uses of saturated hydrocarbons
- 7.2 Preparation, properties and uses of unsaturated hydrocarbons
- 7.3 Sources of hydrocarbons
- 7.4 Preparation, properties and uses of Halogen derivatives of hydrocarbons
8. Alcohols and ethers (08 hrs)
- General introduction, classification, preparation and properties and uses of:
- 8.1 Methyl alcohol, Ethyl alcohol and glycerol
- 8.2 Diethyl ether
9. Aldehydes and ketones (08 hrs)
- General introduction, classification, properties and uses of:
- 9.1 Methanal and ethanal
- 9.2 Amines:
- a) Structure of amines groups (primary, secondary and tertiary)
- b) Important methods, preparation and properties
10. Carbohydrates (08 hrs)
- 10.1. Definition
- 10.2. Composition, sources its importance
- 10.3. Classification
- 10.4. Estimation
- 10.5. Important monosaccharides, disaccharides, polysaccharides
11. Lipids (08 hrs)
- 11.1. Definition
- 11.2. Classification
- 11.3. Introduction to fatty acids, phospholipids, triglycerides,Cholesterol

- 11.4. Clinical importance of lipids
12. Proteins (10 hrs)
- 12.1. Definition
  - 12.2. Classification
  - 12.3. Composition, molecular weight and hydrolysis
  - 12.4. Name of various amino acids
  - 12.5. Structure and properties of proteins
  - 12.6. Clinical importance of proteins
13. Enzymes (10 hrs)
- 13.1 Definition
  - 13.2 Classification
  - 13.3 Chemical nature of enzymes
  - 13.4 Properties of Enzymes
  - 13.5 Factors affecting enzyme activity
  - 13.6 Clinical Importance of Enzym

#### **LIST OF PRACTICALS**

1. Preparation of standard solutions.
2. To prepare N/10 Sodium carbonate
3. To prepare M/10 oxalic acid solution
4. To prepare 5N HCl from given 12 N HCl, N/10 HCL
5. Iodometric titrations
6. Oxidation reduction titrations
7. Acid-base titrations
8. Estimation of carbohydrates by benedicts methods
9. Estimation of proteins by acitic acid & Salphosalicylic acid test
10. Estimation of lipids by direct method

#### **RECOMMENDED BOOKS**

1. Chemistry in Engineering by J.C. Kuricose And J. Rajaram, Tata McGraw Hill, Publishing Company Limited, New Delhi.
2. Engineering Chemistry byt P.C.Jain and Monika Jain, Dhanapat Rai Publishing Company New Delhi.
3. Engineering Chemistry by Shashi Chawla.
4. Progressive Applied Chemistry – I by Dr. G.H. Hugar Eagle Prakashan Jalandhar



<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1 to 3	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 4 to 7	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 08 to 13	FINAL	60%	

## 1.4 CHEMICAL MICROBIOLOGY (I & II)

L T P  
3 - 2

The students undergoing training of medical laboratory technology are given the knowledge of basic morphological features of bacteria, their staining characters, sterilization methods, preparation of culture media, biochemical test for identification of bacteria and their anti-microbial sensitivity tests. They are also taught safety measures in microbiology.

### DETAILED CONTENTS

1. Microbiology- Introduction, history, importance of microbiology (04 hrs)
2. Anatomical structure of a bacterial cell including spores, flagella and capsules (4hrs)
3. Bacterial growth curve and bacterial nutrition (04hrs)
4. Morphological Classification of bacteria (06 hrs)
5. Microscopy - principle and care, working of compound microscope (04 hrs)  
Principle of (i) dark field microscope (ii) fluorescent microscope  
(iii) phase contrast microscope and (iv) electron microscope
6. Sterilization (06 hrs)
  - Introduction
  - By dry heat,
  - Moist heat,
  - Autoclave & hot air oven- their structure, functioning, controls and sterilization indicators,
  - By filtration
7. Antiseptics and disinfectants- Introduction, types, use of disinfectants and antiseptic ( 04 hrs)
8. Culture media (06 hrs)  
  
Ideal culture media and its types (Liquid and Solid media, Defined and Synthetic media, Enriched, Selective, Indicator, and Transport media)
9. Staining techniques (06 hrs)  
  
Methods of smear preparation, Procedure of Gram stain, Ziehl-Neelson's (Z-N) stain, Albert Stain

10. Identification & characteristics of bacteria by (12 hrs)
- i) Microscopic examination
  - ii) Colony characteristics
  - iii) Motility demonstration methods
  - iv) Biochemicals such as –
    - a) Carbohydrate utilization tests (Glucose, Lactose, Sugar, Manitol)
    - b) Catalase, Oxidase, Coagulase
    - c) Indole
    - d) MR & VP
    - e) Citrate utilization
11. Antibiotic sensitivity (06 hrs)
- Disc Diffusion method – principle, procedure and precautions
12. Bacteriology (20 hrs)
- General characteristics of bacteria - morphology, staining, culture, biochemical
  - Characteristics and distribution of :-
    - 12.1 Staphylococi
    - 12.2 Streptococci and pneumococci
    - 12.3 Enterobacteriaceae - (E coli, Salmonella, Shigella)
    - 12.5 Proteus
    - 12.6 Vibrio Cholerae
    - 12.8 Treponema Pallidium
    - 12.9 Mycobacterium tuberculosis
13. Bacterial pathogenicity (06hrs)
- 13.1 Introduction of pathogenicity & infection.
  - 13.2 Sources of infection
  - 13.3 Mode of spread of infection
  - 13.4 Types of infection
14. Nosocomial Infection (06 hrs)
- 14.1 Introduction
  - 14.2 Common types and source of nosocomial infection
  - 14.3 Control of nosocomial infections
15. Laboratory diagnosis of infectious diseases (16 hrs)
- 15.1 Respiratory tract infections (Throat Swab and Sputum sample)
  - 15.2 Wound infections
  - 15.3 Urinary tract infections
  - 15.4 Enteric fever
  - 15.5 Intestinal infection

## LIST OF PRACTICALS

1. Demonstration of safety rules (universal precautions) in a microbiology laboratory
2. Preparation of cleaning agents and techniques of cleaning of glass and plastic ware.
3. Sterilization by autoclave and hot air oven
4. Handling and use of compound microscope
5. Staining techniques: Gram, Albert's, Ziehl – Neelson's
6. Demonstration of motility (Hanging drop method)
7. Preparation and sterilization of various culture media ( Nutrient agar, Nutrient broth, Blood agar, Chocolate agar, Mac-Conkey agar, Lowenstein-Jensen Media
8. Antimicrobial susceptibility testing by Stokes disc diffusion method
9. Biochemical testing (Carbohydrate utilization tests, Catalase, Oxidase, Coagulase, Indole, MR & VP, Citrate
10. 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
11. Identification of known bacterial cultures of common pathogens.

## RECOMMENDED BOOKS

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

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
A	20%	Unit 1 to 5	1 <sup>st</sup> Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
B	20%	Unit 6 to 9	2 <sup>nd</sup> Internal		
C	60%	Unit 10 to 15	FINAL	60%	

## 1.5 HAEMATOLOGY (I & II)

**L T P**  
**3 - 2**

### 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

### DETAILED CONTENTS

#### THEORY

1. Introduction to haematology (08 hrs)
  - 1.1 Various glassware/ plasticware used in haematology labs.(Hb tube, Hb pipette, RBC pipette, WBC pipette)
  
2. Apparatus and Instruments used in hematology lab. (08 hrs)
  - 2.1. Water bath
  - 2.2. Blood cell counter
  - 2.3. Blood Mixer
  - 2.4. Centrifuge
  
3. Haemopoiesis (09 hrs)
  - 3.1 Erythropoiesis, leucopoiesis, thrombopoiesis
  - 3.2 Definition, composition and functions of blood
  
4. Anticoagulants (05 hrs)

Definition and various types of anticoagulants alongwith their mode of action and their preparation with merits and demerits of each
  
5. Collection and preservation of blood (08 hrs)
  - 5.1 Collection of blood; venous and capillary
  - 5.2 Various equipment used for collection of blood samples
  - 5.3. Safety measures at the time of sampling and collection
  - 5.4 Preservation of processed blood samples in hematology

- |    |   |          |
|----|---|----------|
| 6  | Diluting fluid (Hb, TLC, Platelets, RBC count)<br>- Uses, preparation and composition.      | (06 hrs) |
| 7. | Romanowsky stains   | (08 hrs) |
|    | 7.1. Theory and preparation   |          |
|    | 7.2. Choice of slide and spreader and preparation of blood film                             |          |
|    | 7.3. Characteristics of good film preparation   |          |
|    | 7.4. Staining procedure   |          |
|    | 7.5. Effects of pH on staining  |          |
| 8  | Haemoglobinometry   | (12 hrs) |
|    | 8.1. Formation of haemoglobin, function and its degradation                                 |          |
|    | 8.2. Types of haemoglobin   |          |
|    | 8.3. Various methods of estimation with specific reference to cyanmethaemoglobin method     |          |
| 9  | Haemocytometry  | (18 hrs) |
|    | 9.1. Various counting chambers  |          |
|    | 9.2. Methods of counting of RBC, WBC and platelets, their calculation and reference values. |          |
|    | 9.3. Errors involved in haemocytometry and mean to minimize them                            |          |
| 10 | Differential leucocyte counting (DLC)   | (10hrs)  |
|    | 10.1. Preparation and staining of blood film  |          |
|    | 10.2. Performance of DLC  |          |
|    | 10.3. Normal values and significance of DLC   |          |
|    | 10.4. Blood cell morphology in health and disease (Peripheral blood film)                   |          |
| 11 | Quality Assurance in haematology such as accuracy, precision etc.                           | (08hrs)  |
| 12 | Automation in haematology   | (10 hrs) |
|    | 12.1. Various types of Blood cell counter   |          |
|    | 12.2. Principle and operation of the automated blood cell counters                          |          |

### **LIST OF PRACTICALS**

1. Demonstration of various parts of centrifuge; its functioning and care
2. Demonstration of various parts of microscope its functioning and care

3. Preparation of various anticoagulants
4. Collection of venous and capillary blood
5. Preparation of peripheral blood film (PBF)
6. To stain a peripheral blood film by Romanowsky stain
7. Preparation and standardization of stains (leishman and giemsa)
8. Preparation of thick and thin blood smear
9. Haemoglobin Estimation by Sahli's method, Oxy-Haemoglobin and Cyanmethaemoglobin method
10. Counting of RBC, WBC, Platelets
11. Absolute eosinophil counting
12. To study abnormal morphology of RBC, WBC and Platelets with the help of stained slide

**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.
7. Medical Lab. Technology by Satish Gupte, JP Publishers

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
<b>A</b>	20%	Unit 1 to 3	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 4 to 7	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 8 to 12	FINAL	60%	

## 1.6 ENVIRONMENTAL STUDIES

L T P  
2 - 1

### RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

### LEARNING OUTCOMES

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

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

### DETAILED CONTENTS

1. Introduction (4 Hrs)
  - Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.
2. Air Pollution (12 Hrs)
  - Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.
3. Water Pollution (16 Hrs)
  - Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O<sub>2</sub>, BOD, COD.



Prevention of water pollution- Water treatment processes, Sewage treatment.  
Water quality standard.

4. Soil Pollution (14 Hrs)
  - Sources of soil pollution
  - Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
  - Effect of Solid waste
  - Disposal of Solid Waste- Solid Waste Management
  
5. Noise pollution (8 Hrs)
  - Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.
  
6. Environmental Legislation (10 Hrs)
  - Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).
  
7. Impact of Energy Usage on Environment (6 Hrs)
  - Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

#### **LIST OF PRACTICALS**

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.

12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

### **INSTRUCTIONAL STRATEGY**

In addition to theoretical instructions, different activities pertaining to Environmental Studies like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

### **MEANS OF ASSESSMENT**

- Assignments and quiz/class tests, mid-term and end-term written tests

### **RECOMMENDED BOOKS**

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.

<b>Section</b>	<b>Percentage of syllabus to be covered</b>	<b>Units to be covered</b>	<b>Type of assessment</b>	<b>Weightage of Marks</b>	<b>Pass Percentage</b>
<b>A</b>	20%	Unit 1,2	1 <sup>st</sup> Internal	40%	40%(Combined in internal & final assessment)with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 3	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 4,5,6,7	FINAL	60%	

## 1.7 CLINICAL BIOCHEMISTRY (I & II)

L T 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 the different tests is obtained. The students are also given basic training in safety measures, quality control and automation

### DETAILED CONTENTS

1. Introduction to biochemistry (04 hrs)
  - 1.1 Definition
  - 1.2 Importance of biochemistry
  - 1.3 SI Units and their use
  - 1.4 Volumetric apparatus and their calibration
  
2. Cleaning and storage of laboratory, glass and plastic ware (06 hrs)
  - 2.1 Cleaning and care of laboratory glass and plastic ware
  - 2.2 Different cleaning agents (soaps, detergents, chromic acid)
  - 2.3 Methods of cleaning and storage
  
3. Important instruments; principle, working, handling and care of (16 hrs)
  - 3.1 Balance (Analytical, electrical/electronic)
  - 3.2 Centrifuge
  - 3.3 Colorimeter
  - 3.4 Spectrophotometer
  - 3.5 Ion selective electrodes, concept of flame photometer
  - 3.6 Glucometer
  - 3.7 Distillation Plant/Deionizer apparatus
  
4. Blood fractions (06 hrs)
  - 4.1 Separation of Serum
  - 4.2. Separation of Plasma
  - 4.3. Different protein precipitating reagents
  - 4.4. Preparation of protein free filtrate (PFF)
  
5. Collection and preservation of clinical specimens for bio-chemical analysis of: (08 hrs)

- Blood
  - Urine
  - Stool
  - Other Body Fluids
6. Blood glucose/ sugar estimation, screening test and glucose tolerance test (GTT) (10 hrs)
    - 6.1 Principle and methods of estimation
    - 6.2 Reference values
    - 6.3 Renal threshold
    - 6.4 Clinical importance of blood sugar, ST/GTT
  7. Blood urea (8 hrs)
    - 7.1 Formation and excretion of urea
    - 7.2 Principle and procedures of different methods of urea estimation
    - 7.3 Reference values
    - 7.4 Clinical Importance
  8. Serum Creatinine (10 hrs)
    - 8.1 Introduction, principle and procedure of various estimation methods
    - 8.2 Reference values
    - 8.3 Clinical importance
  9. Serum proteins (10 hrs)
    - 9.1 Introduction
    - 9.2 Different methods of estimation including principles and procedures
    - 9.3 Reference values
    - 9.4 Clinical importance
  10. Electrolytes and trace elements (8 hrs)
    - 10.1 Introduction, principles and procedures of estimation of  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Cl}^-$ .
    - 10.2 Reference values and Clinical importance
  11. Uric Acid (8 hrs)
    - 11.1 Introduction, principles and procedures of various estimation methods
    - 11.2 Reference values
    - 11.3 Clinical Importance
  12. Quality Assurance in Biochemistry as per National Standards (12 hrs)
    - 12.1. Internal quality assurance
    - 12.2. External quality assurance

## LIST OF PRACTICALS

1. Cleaning of glass ware
2. Handling and maintenance of Balance, Centrifuge, Colorimeter, Ion Selective electrode and glucometer , distillation plant/deionizer
3. Collection of blood by various methods including vacutainer system
4. Separation of serum and plasma
5. Preparation of different protein precipitating agents, PFF preparation
6. Preparation of reagents (stock and working)
7. Estimation of blood glucose/sugar (O-toluidine method and enzymatic method)
8. Performance of ST/GTT
9. Serum urea and creatinine estimation
10. Serum uric acid estimation
11. Plasma and serum protein estimation
12. Estimation of electrolyte levels of Na<sup>+</sup>, K<sup>+</sup> and Cl<sup>-</sup> by colorimetric method

## RECOMMENDED BOOKS

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

Section	Percentage of syllabus to be covered	Units to be covered	Type of assessment	Weightage of Marks	Pass Percentage
<b>A</b>	20%	Unit 1 to 3	1 <sup>st</sup> Internal	40%	40% (Combined in internal & final assessment) with minimum 25% marks in final assessment)
<b>B</b>	20%	Unit 4 to 6	2 <sup>nd</sup> Internal		
<b>C</b>	60%	Unit 07 to 12	FINAL		

## 1.8 INFORMATION TECHNOLOGY

L T P  
- - 2

### RATIONALE

Information technology has great influence on all aspects of life. Primary purpose of using computer is to make the life easier. Almost all work places and living environment are being computerized. The subject introduces the fundamentals of computer system for using various hardware and software components. 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 concept of information technology and its scope; operating a computer; use of various tools using MS Office/Open Office/Libre Office using internet etc.,. This exposure will enable the students to enter their professions with confidence, live in a harmonious way and contribute to the productivity.

### Note:

Explanation of Introductory part should be demonstrated with practical work. Following topics may be explained in the laboratory along with the practical exercises. There will not be any theory examination.

### LEARNING OUTCOMES

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

- Identify Computer hardware components, network components and peripherals.
- Explain the role of an operating System.
- Install system and application software.
- Explain the function of the system components including processor, motherboard and input-output devices.
- Use Word Processing software to prepare document.
- Use spreadsheet software to create workbooks and automate calculation.
- Use presentation software to create interactive presentation.
- Perform fundamental tasks common to most application software including print, save, edit, cut, copy, paste, format, spell and grammar check.
- Find and evaluate information on the Web.
- Install antivirus.
- Safeguard against online frauds, threats and crimes.

## **TOPICS TO BE EXPLAINED THROUGH DEMONSTRATION**

### 1. Basic Concepts of IT and Its Application

Information Technology concept and scope, applications of IT. in office, Air and Railway Ticket reservation, Banks financial transactions, E-Commerce and E- Governance applications etc., Ethics of IT, concept of online frauds, threats of IT crimes.

### 2. Computer Hardware:

Block diagram of a computer, components of computer system, CPU, Memory, Input devices; keyboard, Scanner, mouse etc; Output devices; VDU, LCD, Printers etc. Primary and Secondary Memory: RAM, ROM, magnetic disks – tracks and sectors, optical disk (CD, DVD & Blue Ray Disk.), USB/Flash Drive.

### 3. Software Concepts:

System software, Application software, Virtualization software and Utility software, Introduction of Operating System, Installation of Window / linux, Features of OPEN OFFICE/MS\_OFFICE(MS word, Excel, PowerPoint) .

### 4. Internet Concepts:

Basics of Networking – LAN, WAN, Wi-Fi technologies and sharing of printers and other resources, Concept of IP addresses, DNS, introduction of internet, applications of internet like: e-mail and browsing, concept of search engine and safe searching. Various browsers like Internet explorer/Microsoft Edge, Mozilla Firefox, use of cookies and history, WWW (World Wide Web), hyperlinks, introduction to Anti-virus.

## **LIST OF PRACTICAL EXERCISES**

1. Given a PC, name its various components and peripherals. List their functions .
2. Installing various components of computer system and installing system software and application software
3. Installation of I/O devices, printers and installation of operating system viz. Windows/BOSS/ LINUX
4. Features of Windows as an operating system
  - Start
  - Shut down and restore
  - Creating and operating on the icons
  - Opening, closing and sizing the windows and working with windows interfacing elements (option buttons, checkbox, scroll etc.)

- Using elementary job commands like – creating, saving, modifying, renaming, finding and deleting a file and folders
- Changing settings like, date, time, colour (back ground and fore ground etc.)
- Using short cuts
- Using on line help

5. Word Processing (MS Office/Open Office)

a) File Management:

- Opening, creating and saving a document, locating files, copying contents in some different file(s), protecting files, giving password protection for a file

b) Page set up:

- Setting margins, tab setting, ruler, indenting

c) Editing a document:

- Entering text, cut, copy, paste using tool- bars

d) Formatting a document:

- Using different fonts, changing font size and colour, changing the appearance through bold/italic/underlined, highlighting a text, changing case, using subscript and superscript, using different underline methods
- Aligning of text in a document, justification of document, inserting bullets and numbering
- Formatting paragraph, inserting page breaks and column breaks, line spacing
- Use of headers, footers: Inserting footnote, end note, use of comments, autotext
- Inserting date, time, special symbols, importing graphic images, drawing tools

e) Tables and Borders:

- Creating a table, formatting cells, use of different border styles, shading in tables, merging of cells, partition of cells, inserting and deleting a row in a table
- Print preview, zoom, page set up, printing options
- Using find, replace options

f) Using Tools like:

- Spell checker, help, use of macros, mail merge, thesaurus word content and statistics, printing envelopes and labels
- Using shapes and drawing toolbar,
- Working with more than one window .

6. Spread Sheet Processing (MS Office/Open Office)

- a) Starting excel, open worksheet, enter, edit, data, formulae to calculate values, format data, save worksheet, switching between different spread sheets



- b) Menu commands:  
Create, format charts, organise, manage data, solving problem by analyzing data. Programming with Excel Work Sheet, getting information while working
- c) Work books:  
Managing workbooks (create, open, close, save), working in work books, selecting the cells, choosing commands, data entry techniques, formula creation and links, controlling calculations  
Editing a worksheet, copying, moving cells, pasting, inserting, deletion cells, rows, columns, find and replace text, numbers of cells, formatting worksheet, conditional formatting
- d) Creating a chart:  
Working with chart types, changing data in chart, formatting a chart, use chart to analyze data  
Using a list to organize data, sorting and filtering data in list
- e) Retrieve data with query:  
Create a pivot table, customizing a pivot table. Statistical analysis of data
- f) Exchange data with other application:  
Embedding objects, linking to other applications, import, export document.

## 7. PowerPoint Presentation (MS Office/Open Office)

- a) Introduction to PowerPoint
  - How to start PowerPoint
  - Working environment: concept of toolbars, slide layout & templates.
  - Opening a new/existing presentation
  - Different views for viewing slides in a presentation: normal, slide sorter.
- b) Addition, deletion and saving of slides
- c) Insertion of multimedia elements
  - Adding text boxes
  - Adding/importing pictures
  - Adding movies and sound
  - Adding tables and charts etc.
  - Adding organizational chart
  - Editing objects
  - Working with Clip Art
- d) Formatting slides
  - Using slide master
  - Text formatting
  - Changing slide layout
  - Changing slide colour scheme
  - Changing background
  - Applying design template

- e) How to view the slide show?
    - Viewing the presentation using slide navigator
    - Slide transition
    - Animation effects, timing, order etc.
  - f) Use of Pack and Go Options.
8. Internet and its Applications
- a) Establishing an internet connection.
  - b) Browsing and down loading of information from internet.
  - c) Sending and receiving e-mail
    - Creating a message
    - Creating an address book
    - Attaching a file with e-mail message
    - Receiving a message
    - Deleting a message
  - d) Assigning IP Addresses to computers and use of domain names.
9. Functioning of Antivirus
- a) Installation and updation of an antivirus.
  - b) How to scan and remove the virus.

## **INSTRUCTIONAL STRATEGY**

Since this subject is practice oriented, the teacher should demonstrate the capabilities of computers to students while doing practical exercises. The students should be made familiar with computer parts, peripherals, connections and proficient in making use of MS Office/Open Office in addition to working on internet. The student should be made capable of working on computers independently.

## **RECOMMENDED BOOKS**

1. Fundamentals of Computer by V Rajaraman; Prentice Hall of India Pvt. Ltd., New Delhi
2. Computers Fundamentals Architecture and Organisation by B Ram, revised Edition, New Age International Publishers, New Delhi
3. Computers Today by SK Basandara, Galgotia publication Pvt Ltd. Daryaganj, New Delhi.
4. A First Course in Computer by Sanjay Saxena; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
5. Computer Fundamentals by PK Sinha; BPB Publication, New Delhi
6. Fundamentals of Information Technology by Leon and Leon; Vikas Publishing House Pvt. Ltd., Jungpura, New Delhi
7. Fundamentals of Information Technology by Vipin Arora, Eagle Parkashan, Jalandhar

**THIRD SEMESTER**

### 3.1 CLINICAL MICROBIOLOGY- III (Parasitology and virology)

L T P  
3 - 3

#### RATIONALE

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

#### DETAILED CONTENTS

##### Theory

1. Introduction to medical parasitology (02 hrs)
2. General characteristics, morphology, classification (02 hrs)
  - 2.1 Protozoa
  - 2.2 Helminthes
3. Laboratory Samples for detection of parasites (02 hrs)

Collection, transportation, processing and preservation of samples for routine investigations – Blood, stool
4. Concentration techniques (06 hrs)

- Principle and application of concentration techniques of stool for demonstration of ova and cysts
5. Giardia and Entamoeba histolytica (05 hrs)
  - Morphology
  - Life cycle
  - Lab diagnosis
6. Ancylostoma and Ascaris lumbricoides (06 hrs)
  - Morphology
  - Life cycle

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

Pathogenicity, Lab diagnosis and prevention of –

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

## LIST OF PRACTICALS

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

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

### **INSTRUCTIONAL STRATEGY**

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

### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

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

## 3.2 HAEMATOLOGY - III

L T P  
3 - 3

### RATIONALE

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

### DETAILED CONTENTS

#### Theory

1. Erythrocyte sedimentation rate (ESR) and packed cell volume (PCV) (12 hrs)
  - 1.1 Introduction
  - 1.2 Various methods of estimation of ESR and PCV and their merits and demerits
  - 1.3 Factors involved in ESR
  - 1.4 Interpretation of results
  
2. Red Cell Indices – MCV, MCH, MCHC (05 hrs)

Definition, reference range, calculation and interpretation
  
3. Supravital stain and reticulocyte counting (07 hrs)
  - 3.1 Introduction
  - 3.2 Principle and procedure of staining and calculation
  - 3.3 Reference values and interpretation
  - 3.4 Variation in Physiological Values such as Hb, PCV, T.L.C. and Platelet count
  
4. Anemias (16 hrs)
  - 4.1 Definition and classification
  - 4.2 Laboratory diagnosis of:
    - (a) Iron deficiency anaemia
    - (b) Megaloblastic anaemia
    - (c) Haemolytic anaemias including sickle cell anaemia thalassaemia
    - (d) Aplastic anaemia
  
5. Red cell fragility test (08 hrs)
  - 5.1 Principle and procedure



## 5.2 Clinical significance

### **LIST OF PRACTICALS**

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

### **INSTRUCTIONAL STRATEGY**

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

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

### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

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

### 3.3 CLINICAL BIOCHEMISTRY- III

L T P  
3 - 3

#### RATIONALE

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

#### DETAILED CONTENTS

##### Theory

1. Serum Bilirubin (06 hrs)
  - 1.1 Formation of bile pigments
  - 1.2 Formation and excretion of bilirubin
  - 1.3 Conjugated and unconjugated bilirubin
  - 1.4 Principle and procedures of serum bilirubin estimation (Direct & Indirect)
  - 1.5 Reference values
  - 1.6 Clinical significance
  
2. SGOT and SGPT (06 hrs)
  - 2.1 Principle and procedures of estimation
  - 2.2 Reference values
  - 2.3 Clinical significance
  
3. ALP and ACP (06 hrs)
  - 3.1 Principle and procedures of estimation
  - 3.2 Reference values
  - 3.3 Clinical significance
  
4. Serum Amylase (03 hrs)
  - 4.1 Principle and procedures of estimation
  - 4.2 Reference values
  - 4.3 Clinical significance

5. Serum Calcium and Phosphorus (04 hrs)
- 5.1 Principle and procedures of estimation
  - 5.2 Reference values
  - 5.3 Clinical significance
6. Lipid Profile (10 hrs)
- 6.1 Formation of cholesterol
  - 6.2 High density and low density cholesterol
  - 6.3. Principles and procedures of estimation
  - 6.4. Reference value
  - 6.5 Clinical significance
  - 6.6 Triglycerides, principle and procedure of estimation
  - 6.7. Importance of various ratios of HDL, LDL and VLDL
- 7 Urinary Proteins and Creatinine (04 hrs)
- 7.1. 24 hr. urinary proteins and creatinine estimation
  - 7.2. Reference values
  - 7.3. Clinical significance
8. Renal Function Tests (Renal clearance Tests) (09 hrs)
- 8.1 Urea clearance Test
  - 8.2. Creatinine clearance test
  - 8.3 Their Clinical significance

### **LIST OF PRACTICALS**

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

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

### **INSTRUCTIONAL STRATEGY**

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

### **RECOMMENDED BOOKS**

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

### **SUGGESTED DISTRIBUTION OF MARKS**

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

### 3.4 HISTOPATHOLOGY AND CYTOLOGY- I

L T P  
3 - 3

#### RATIONALE

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

#### DETAILED CONTENTS

##### Theory

1. Introduction and definition of: (01 hr)
  - 1.1 Histology
  - 1.2 Histopathology
  - 1.3 Biopsy
  - 1.4 Autopsy
  - 1.5 Autolysis
  - 1.6 Putrefaction
2. Preparation of Tissue (Different Methods of Preparation of Tissue) (02 hrs)
  - 2.1 Unfixed Tissue preparations
    - 2.1.1. Imprint methods – Impression Smears
    - 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
3. Reception of Specimen (01 hr)
  - 3.1 Reception, recording, labeling and preservation of histological specimen
4. Fixation (Histological Specimens) (06 hrs)
  - 4.1 Classification of fixatives

- 4.2 Composition of various fixatives
- 4.3 Advantages and disadvantages
- 5. Processing (by Paraffin Technique) (06 hrs)
  - 5.1 Dehydration
  - 5.2 Clearing/Dealcoholization
  - 5.3 Infiltration and impregnation
  - 5.4 Paraffin embedding
  - 5.5 Automation: Histokinete (automatic tissue processor)
    - its types, working, care and maintenance
- 6. Microtomy (07 hrs)
  - 6.1 Microtome
    - 6.1.1 Types
    - 6.1.2 Advantages and disadvantages
    - 6.1.3 Working principle, care and maintenance
  - 6.2 Microtome Knives
    - 6.2.1 Various types of knives
    - 6.2.2 Sharpening of knives
      - Honing technique
      - Stropping technique
      - Automation: Automatic knife sharpener – uses, care and maintenance
      - Uses of abrasives and lubricants
    - 6.2.3. Introduction to disposable blades - their advantages and disadvantages.
  - 6.3 Section Cutting
    - 6.3.1 Rough cutting
    - 6.3.2 Fine cutting
    - 6.3.3 Use of tissue floatation bath
    - 6.3.4 Use of various adhesive media and lifting of sections to the slide
    - 6.3.5 Errors /cutting faults in sections and their remedies
- 7. Theory of staining (Routine) (05 hrs)
  - 7.1 Principle and mechanism of routine stain (Haematoxylin and Eosin)
  - 7.2 Various steps of staining (Haematoxylin and Eosin)

- Deparaffinization
  - Hydration
  - Nuclear Staining
  - Differentiation
  - Blueing
  - Counterstaining
  - Dehydration
  - Clearing and Mounting
  - Results
- 7.3 Automation: Use of automatic stainer and coverslipper
8. Mountants (02 hrs)
- 8.1 Various types of mounting media (aqueous, resinous)
- 8.2 Advantages and Disadvantages
9. Various Terms associated with staining (04 hrs)
- 9.1 Solvents
- 9.2 Mordants
- 9.3 Metachromasia
- 9.4 Accelerators
- 9.5 Progressive and regressive staining
- 9.6 Use of controls in staining and their significance
10. Cell (02 hrs)
- 10.1 Definition and function
- 10.2 Structure
- 10.3 Multiplication (Mitosis and Meiosis )
11. Exfoliative Cytology (04 hrs)
- 11.1 Introduction
- 11.2 Preparation of vaginal & cervical smears
- 11.3 Collection and Processing of specimen for cytology
- Urine
  - Sputum
  - CSF (Cerebro Spinal Fluid)
  - Other fluids
12. Fixation (Cytological Specimen) (02 hrs)



- 12.1 Definition
  - 12.2 Various types of Cytological fixatives
  - 12.3 Advantages and Disadvantages
13. Cytological Staining (0 4 hrs)
- Principle, Technique and interpretation of results in
- Papanicalaou staining
  - May Grunwald & Giemsa staining
  - Haematoxylin and Eosin staining
- 14 Role of Laminar airflow and cytotechnician in cytology (02 hrs)

### **LIST OF PRACTICALS**

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

## INSTRUCTIONAL STRATEGY

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

## RECOMMENDED BOOKS

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

## SUGGESTED DISTRIBUTION OF MARKS

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

### 3.5 TRANSFUSION MEDICINE (Blood Banking)

L T P  
3 - 2

#### RATIONALE

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

#### DETAILED CONTENTS

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

8. Screening of blood donors for: (10 hrs)  
8.1 MP  
8.2 VDRL  
8.3 HIV  
8.4 HbsAg  
8.5 HCV
9. Cross Matching (02 hrs)  
9.1 Types of cross matching  
9.2 Various methods and their procedures
10. Coombs Test (04 hrs)  
10.1 Direct coombs test (principle, procedure, importance and application)  
10.2 Indirect coombs test (principle, procedure, importance and application)
11. Various blood components (Packed cells, Fresh frozen plasma, Cryoprecipitate, PRP(Platelet rich plasma)) (04 hrs)  
11.1 Preparation  
11.2 Preservation  
11.3 Uses
12. Blood Transfusion reactions (06 hrs)

### **LIST OF PRACTICALS**

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

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

### **INSTRUCTIONAL STRATEGY**

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

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

### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

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

### 3.6 EMPLOYABILITY SKILLS – I

L T P  
- - 2

#### RATIONALE

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

#### DETAILED CONTENTS

1. Writing skills (08 hrs)
  - i) Official and business correspondence
  - ii) Job application - covering letter and resume
  - iii) Report writing - key features and kinds
  
2. Oral Communication Skills (20 hrs)
  - i) Giving advice
  - ii) Making comparisons
  - iii) Agreeing and disagreeing
  - iv) Taking turns in conversation
  - v) Fixing and cancelling appointments
  
3. Generic Skills (04 hrs)
  - i) Stress management
  - ii) Time management
  - iii) Negotiations and conflict resolution
  - iv) Team work and leadership qualities

# **FOURTH SEMESTER**



**4.1 CLINICAL MICROBIOLOGY- IV**  
**(Immunology and Mycology)**

L T P  
3 - 3

**RATIONALE**

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

**DETAILED CONTENTS**

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

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

### **LIST OF PRACTICALS**

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

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

### **INSTRUCTIONAL STRATEGY**

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

### **RECOMMENDED BOOKS**

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

### SUGGESTED DISTRIBUTION OF MARKS

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

## 4.2 HAEMATOLOGY - IV

L T P  
3 - 3

### RATIONALE

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

### DETAILED CONTENTS

1. Introduction to normal haemostasis (22 hrs)
  - 1.1 Theories of blood coagulation
  - 1.2 Platelets and their role in haemostasis including count
  - 1.3 Bleeding disorders and related diseases
  - 1.4 Principles, clinical importance, reference values and methods of: prothrombin time, prothrombin time index (PTI) International normalized ratio (INR), Activated Partial Thromboplastin time (APTT), Thrombin Time (TT), bleeding time (BT), Hess test, clotting time (CT), and clot retraction test (CRT)
  
2. Bone – marrow (05 hrs)
  - 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 myelogram including M.E. Ratio
  - 2.4 Iron staining (Perls' reaction)
  - 2.5 Significance of bone-marrow examination
  
3. Leukemia (10 hrs)
  - 3.1 Definition of leukemias
  - 3.2 (FAB) Classification
  - 3.3 Laboratory diagnosis of various leukemias
  
4. LE Cell phenomenon (03hrs)
  - 4.1 Phenomenon of LE cell, its differentiation from tart cell
  - 4.2 Demonstration of LE cell by various methods
  - 4.3 Clinical significance

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

### **LIST OF PRACTICALS**

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

### **INSTRUCTIONAL STRATEGY**

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

### **RECOMMENDED BOOKS**

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

**SUGGESTED DISTRIBUTION OF MARKS**

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

### 4.3 CLINICAL BIOCHEMISTRY- IV

L T P  
3 - 3

#### RATIONALE

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

#### DETAILED CONTENTS

##### Theory

1. Urine Analysis (11hrs)
  - 1.1 Normal composition of urine
  - 1.2 Clinical importance of urine analysis
  - 1.3 Qualitative analysis of proteins, sugar, bile salts, bile pigments, urobilinogen and blood.
  - 1.4 Detailed discussion on glycosuria and albuminuria
  - 1.5 Ketone bodies
  - 1.6 Urinary electrolytes estimation (Na, K and Cl)
  
2. Stool Chemistry (08 hrs)
  - 2.1 Physical characteristics and chemical composition of stool
  - 2.2 Significance of presence of blood and excess fat in stool
  - 2.3 Occult blood detection
  
3. Cerebrospinal Fluid (05 hrs)
  - 3.1 Composition of CSF and its functions
  - 3.2 Methods of determination of proteins, sugar and chloride in CSF
  - 3.3 Reference Values
  - 3.4 Clinical importance
  
4. Biological fluids (05 hrs)

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



5. Electrophoresis (04 hrs)
- 5.1 Theory
  - 5.2 Principle and procedure of paper, gel electrophoresis, method of elution
  - 5.3 Clinical importance
6. Chromatography (04 hrs)
- 6.1 Theory of Chromatography, separation between stationary and mobile phases
  - 6.2 Principle and procedure of Paper chromatography
  - 6.3 Importance of chromatography
7. Automation in Biochemistry (05 hrs)
- Classification and types of Auto analyzers
8. Thyroid function tests (04 hrs)
- Clinical importance of T<sub>3</sub>, T<sub>4</sub> and TSH
9. Introduction to Tumor markers (02hrs)
- Commonly used Tumor Markers (Cancer Markers)

### **LIST OF PRACTICALS**

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

### **INSTRUCTIONAL STRATEGY**

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

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

### RECOMMENDED BOOKS

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

### SUGGESTED DISTRIBUTION OF MARKS

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

## 4.4 HISTOPATHOLOGY AND CYTOLOGY - II

L T P  
4 - 3

### RATIONALE

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

### DETAILED CONTENTS

#### Theory

1. Light Microscope (11 hrs)
  - 1.1 Principles of light microscope
  - 1.2 Various parts of microscope
  - 1.3 Uses of microscope
  - 1.4 Cleaning and maintenance of microscope
  - 1.5 Various attachments of compound microscope (principle only)
    - Polarizing microscopy
    - Dark field microscopy
    - Phase contrast microscopy
    - Fluorescent microscopy
    - Electron microscopy
  
2. Special stains (12 hrs)
  - 2.1 Principle, significance and interpretation of different types of stains
    - PAS (Periodic Acid Schiff's Reagent)
    - Silver impregnation stain – Reticulin fibre
    - Ziehl Neelson's – for AFB and Leprae
    - Masson's trichrome stain
    - Oil Red O – fat
    - Gram's stain – Gram +ve and Gram –ve
  
3. Decalcification (06 hrs)
  - 3.1 Process of decalcification
  - 3.2 Various types of decalcifying methods
  - 3.3 Their mechanism, advantage, disadvantage and applications
  - 3.4 Assessment of decalcification

4. Handling of fresh histological tissues (Frozen Section) (07 hrs)
  - 4.1 Reception and processing of frozen tissue
  - 4.2 Freezing microtome and cryostat
  - 4.3 Advantages and dis-advantages of freezing microtome and cryostat
  - 4.4 Working, care, maintenance of freezing microtome and cryostat
  - 4.5 Frozen section cutting
  - 4.6 Staining
    - Rapid H&E
    - Fat stain
  - 4.7 Mounting of frozen section
5. Museum Techniques (10 hrs)
  - 5.1 Introduction to museum with emphasis on importance of museum
  - 5.2 Reception, fixation and processing of various museum specimens
  - 5.3 Cataloguing of museum specimen
6. Autopsy (02 hrs)
  - 6.1 Introduction to autopsy technique (Care and maintenance of autopsy area, autopsy instruments, handling of dead bodies)
  - 6.2 Use of autopsy
7. Malignant Cells (02 hrs)
  - 7.1 Characteristics
  - 7.2 Differences from normal cell
8. Harmonal Assessment (02hrs)
  - 8.1. Importance of HCG
  - 8.2. Use of Harmonal Assessment (Pregnancy Test)
9. Aspiration Cytology (06 hrs)
  - 9.1. Principle of FNAC (Fine Needle Aspiration Cytology)
  - 9.2 Indications of FNAC
  - 9.3 Uses of FNAC
  - 9.4 Staining Techniques
    - PAP Stain
    - MGG (May-Grunwald – Giemsa)

- H&E (Haematoxylin & Eosin Stain)

10. Cytological special stains (04 hrs)

Principle, Technique & Interpretation of :

10.1. PAS ( Periodic Acid Schiff's reagent Stain)

10.2. Zeihl Neelson's(ZN) Stain (AFB)

11. Advancements in Cytology (02 hrs)

- Automation in Cytology, Use of Cytospin

### **LIST OF PRACTICALS**

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

### **INSTRUCTIONAL STRATEGY**

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

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

### **RECOMMENDED BOOKS**

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

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

#### **SUGGESTED DISTRIBUTION OF MARKS**

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

## 4.5 MEDICAL LABORATORY MANAGEMENT

L T P  
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### RATIONALE

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

### DETAILED CONTENTS

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

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

### **INSTRUCTIONAL STRATEGY**

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

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

### **RECOMMENDED BOOKS**

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



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

**SUGGESTED DISTRIBUTION OF MARKS**

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

## 4.6 EMPLOYABILITY SKILLS – II

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- - 2

### RATIONALE

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

### DETAILED CONTENTS

#### 1. Oral Practice

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

## **PERSONALITY DEVELOPMENT CAMP**

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

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

**FIFTH SEMESTER**

**&**

**SIXTH SEMESTER**

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

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- - 35

**OBJECTIVE**

The objective of providing professional training is to:

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

**SELECTION OF TRAINING PLACES**

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

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

**LIST OF PRACTICALS**

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

During 5<sup>th</sup> Semester

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

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

During 6<sup>th</sup> Semester

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

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

**Note:**

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

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

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

## **METHODOLOGY OF ORGANIZING PROFESSIONAL TRAINING**

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

## **EVALUATION OF STUDENTS FOR PROFESSIONAL TRAINING**

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

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

## **GENERAL GUIDELINES**

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