

# **CURRICULUM**

## **CERTIFICATE IN MEDICAL LABORATORY TECHNOLOGY**

### **CMLT**

**(Three Years Programme – Yearly System)**



Council for Technical Education and Vocational Training

## **Curriculum Development Division**

**Sanothimi, Bhaktapur**

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**Second revision 2019**

**Approved By**

**Curriculum Committee on June 17, 2019**

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**Second and Third Year Revised Curriculum is Effective from the  
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## Introduction

This curriculum of 3 years Certificate in Medical Laboratory Technology is designed to produce middle level skilled laboratory personnel equipped with knowledge, skills and attitudes of medical laboratory with a view to provide diagnostic, curative, preventive and promotive laboratory services to the community. Such technicians collect specimens, process, and perform tests to analyze body fluids, tissue, and other substances. The graduates perform lab procedures and maintain instruments. The graduates are expected to perform tests that help other healthcare professionals such as physicians to detect, diagnose, and treat diseases.

The program extends over three academic years. The first year course focuses on basic science and foundational subjects, the second year course focuses on theory and practical parts of basic medical laboratory subjects. Simultaneously the third year is given to the application of learned skills and knowledge in the comprehensive practical settings, in hospitals and medical laboratory. The graduates will have career opportunities in hospitals, diagnostic laboratories, clinics, industry and physicians' offices, research centers, blood bank, crime investigating laboratories etc. It is based on the code of conduct of Nepal Health professional Council.

## Rational

Certificate in Medical Laboratory Technology curriculum was last revised in 2010. This is the second revision after the implementation of its first revision. The rationales behind its revision are as follows:

- It crossed the 5 years maturity period of its implementation after the 1<sup>st</sup> revision and similarly the implementing agencies/college have requested to revise this curriculum based on their teaching experiences.
- The year-wise re-adjustments of the existing subjects are felt necessary.
- It is needed to revisit its weightage in both theory and practical marks contents to make it more practical oriented.
- The 27 weeks long clinical practice in 3<sup>rd</sup> year seems complicated and needs to be specified.
- The technologies invented in the field of medical laborator are necessary to incorporated.

Furthermore, Technicians are projected to grow faster than the average for all occupations. Jobs for MLTs are projected to increase at a faster-than-average rate. As the population ages and medical issues arise in the elderly, this will lead to a greater need to diagnose medical conditions, MLT's have to compile, categorize, code and calculate their findings to help doctors determine a diagnosis. MLTs may draw blood, instruct patients on how to properly collect body fluid or conduct other bedside tests. With the advent in technology, the onset of multiple and complicated diseases growing in the world, and expansion of research works trained technicians are needed throughout the world.

All over the world, trained technicians are needed throughout the industry. To cope with the national and international demand, the contents and the skills should be updated to make the skills relevant and pertinent to the industry.

## Curriculum Title

Certificate in Medical Laboratory Technology (CMLT)

## Aim

The program aims to produce middle level technical personnel with sound academic knowledge equipped with perfect technical skills that can be faced in real life situation.

## Program Objectives

After the completion of this program, students will be able to:

- Perform routine and special laboratory investigations on clinical and non-clinical samples.
- Interpret the results and explain underlying principles in each investigation.
- Prepare reagents required for routine and special investigations.
- Set up clinical laboratory in primary health center.
- Establish quality control system in medical laboratory to deliver quality laboratory service.
- Perform laboratory management.
- Supervise subordinates and prepare reports.
- Conduct research on lab works.

## Group Size

The group size will be maximum 30 students in a batch.

## Entry Criteria

- SLC Pass or SEE with minimum GPA 2.0 and C grade in Compulsory Mathematics, English & Science.
- TSLC in Medical Laboratory Technology with minimum 67%.
- Should pass entrance examination as administered by CTEVT.

## Course Duration

The total duration of this curricular program is three academic years. The program is based on yearly system. Moreover, one academic year consists up to 39 weeks and one academic week consists up to 40 hours excluding evaluation period.

## Medium of Instruction

The medium of instruction will be in English and/or Nepali.

## Pattern of Attendance

Minimum of 90% attendance in each subject is required to appear in the respective final examination.

## Teacher and Student Ratio

The ratio between teachers and students must be:

- Overall ratio of teacher and student must be 1:10 (at the institution level)
- 1:30 for theory and tutorial classes
- 1:10 for practical classes
- 75% of the teachers must be full timer.

## Qualification of Teachers and Instructors

- The program coordinator should be a master's degree holder in the related area.
- The foundational subject related teacher should be master degree holder in the related area.
- The disciplinary subject related teacher and demonstrators should be a bachelor's degree holder in the related area.

## Instructional Media and Materials

The following instructional media and materials are suggested for the effective instruction and demonstration.

- **Printed Media Materials** (assignment sheets, handouts, information sheets, individual training packets, performance checklists, textbooks etc.).
- **Non-projected Media Materials** (display, models, flip chart, poster, writing board etc.).
- **Projected Media Materials** (opaque projections, multimedia projector, slides etc.).
- **Audio-Visual Materials** (audiotapes, slide-tape programmes, videodiscs, videotapes etc.).
- **Computer-Based Instructional Materials** (computer-based training, interactive video etc.).

## Teaching Learning Methodologies

The methods of teachings for this curricular program will be a combination of several approaches such as; illustrated lecture, group discussion, demonstration, simulation, guided practice, fieldwork, block study, industrial practice, report writing, term paper presentation, experiment and other independent learning exercises.

**Theory:** Lecture, discussion, interaction, illustrated talks, assignment, group discussion, demonstration, group work etc.

**Practical:** Demonstration, observation, simulation, guided practice, self-practice, project work, field work, industrial practice, report writing, term paper presentation, experiment, etc.

## Mode of Instruction

There will be inductive and deductive mode of education.

## Evaluation Scheme

### a. Internal assessment

- There will be written and practical exam for each subject both in theory and practical.
- Each subject will have 3 internal assessment in each year at regular intervals and students must get the feedback about it.
- Weightage of theory and practical marks are mentioned in course structure.
- Continuous assessment format will be developed and applied by the evaluators for evaluating student's performance in the subjects related to the practical experience.

### b. Final examination

- Weightage of theory and practical marks are mentioned in course structure.
- Students must pass in all subjects both in theory and practical for certification. If a student becomes unable to succeed in any subject, s/he will appear in the re-examination administered by CTEVT.
- Students will be allowed to appear in the final examination only after completing the internal assessment requirements.

### c. Requirement for final practical examination

- Professional of relevant subject instructor must evaluate final practical examinations.
- One evaluator in one setting can evaluate not more than 20 students.
- Practical examination should be administered in actual situation on relevant subject with the provision of at least one internal evaluator from the concerned or affiliating institute led by external evaluator nominated by CTEVT.
- Provision of re-examination will be as per CTEVT policy.

### d. Final practicum evaluation will be based on:

- Institutional practicum attendance - 10%
- Logbook/Practicum book maintenance - 10%
- Spot performance (assigned task/practicum performance/identification/arrangement preparation/measurement) - 40%

- Viva voce :
  - Internal examiner - 20%
  - External examiner - 20%

**e. Pass marks:**

- The students must secure minimum 40% marks in theory and 50% marks in practical. Moreover, the students must secure minimum pass marks in the internal assessment and in the semester final examination of each subject to pass the subject.

### **Provision of Back Paper**

There will be the provision of back paper but a student must pass all the subjects of all year within six years from the enrollment date; however there should be provision of chance exam for final year students as per CTEVT rules.

### **Disciplinary and Ethical Requirements**

- Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by the review of the disciplinary review committee of the institute.
- Dishonesty in academic or practical activities will result in immediate suspension followed by administrative review, with possible expulsion.
- Illicit drug use, bearing arms in institute, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

### **Grading System**

The following grading system will be adopted:

- Distinction: 80% and above
- First division: 65% to below 80%
- Second division: 50 % to below 65%
- Pass division: Pass marks to Below 50%

## Certification and Degree Awards

- Students who have passed all the components of all subjects of all 3 years are considered to have successfully completed the program.
- Students who have successfully completed the program will be awarded with a degree of "Certificate in Medical Laboratory Technology".

## Career Opportunity

The graduates will be eligible for the position equivalent to Non-gazette 1<sup>st</sup> class/Level 5 (technical) as prescribed by the Public Service Commission of Nepal and other related agencies. The graduate will be eligible for registration with the related health professional council in the grade as provisioned in the related Council Act (if any).

## Question Patterns for Final Written Exam

The question patterns for written exam are suggested as follows;

### A. For subject with full marks 80

S. N.	Type of question	No of question	Weightage marks	Full marks	Time distribution	Optional questions
1	Long	3	8	24	54 min	1
2	Short	8	4	32	72 min	2
3	Very short	12	2	24	54 min	2
	<b>Total</b>	<b>23</b>		<b>80</b>	<b>180 min</b>	

### B. For subject with full marks 60

S. N.	Type of question	No of question	Weightage marks	Full marks	Time distribution	Optional questions
1	Long	3	6	18	54 min	1
2	Short	8	3	24	72 min	2
3	Very short	9	2	18	54 min	2
	<b>Total</b>	<b>20</b>		<b>60</b>	<b>180 min</b>	

### C. For subject with full marks 40

	Type of question	No of question	Weightage marks	Full marks	Time distribution	Optional questions
1	Long	2	6	12	27 min	1
2	Short	4	4	16	36 min	1
3	Very short	6	2	12	27 min	1
	<b>Total</b>	<b>12</b>		<b>40</b>	<b>90 min</b>	

## Course Structure

### Certificate in Medical Laboratory Technology

#### First year

SN	Subject	Mode		Weekly Hours	Distribution of Marks						Total Marks
		T	P		Theory			Practical			
					Int	Fin	Exam Hour	Int	Fin	Exam Hour	
1	English	3	0	3	20	80	3	-	-	-	100
2	Nepali	3	0	3	20	80	3	-	-	-	100
3	Social Studies	2	0	2	10	40	1.5	-	-	-	50
4	Anatomy & Physiology	4	1	5	20	60	3	10	10	3	100
5	Physics	4	2	6	20	60	3	10	10	3	100
6	Chemistry	4	2	6	20	60	3	10	10	3	100
7	Zoology	3	2	5	20	60	3	10	10	3	100
8	Botany	3	2	5	20	60	3	10	10	3	100
9	Mathematics & Statistics	4	1	5	20	60	3	10	10	3	100
<b>Total</b>		<b>30</b>	<b>10</b>	<b>40</b>	<b>170</b>	<b>560</b>		<b>60</b>	<b>60</b>		<b>850</b>

#### Second year

S. N.	Subject	Mode		Weekly Hours	Distribution of Marks						Total Marks
		T	P		Theory			Practical			
					Int	Fin	Exam Hour	Int	Fin	Exam Hour	
1.	Clinical Microbiology and Immunology	4	4	8	20	80	3	40	60	4	200
2.	Hematology and Blood Banking	4	4	8	20	80	3	40	60	4	200
3.	Clinical Biochemistry	4	4	8	20	80	3	40	60	4	200
4.	Medical Parasitology	2	2	4	10	40	1.5	20	30	3	100
5.	Clinical Pathology	3	1	4	20	60	3	10	10	3	100
6.	Public Health & First Aid	3	1	4	20	60	3	10	10	3	100
Total		20	16	36	110	400		160	230		900

### Third Year

S. N.	Subjects	Mode		Weekly Hours	Distribution of Marks						Total marks
		T	P		Theory			Practical			
					Int	Fin	Exam Hour	Int	Fin	Exam Hour	
<b>Institute Based Class: 12 Weeks</b>											
1	Histopathology & Cytopathology	8	6	14	10	40		20	30	3	100
2	Instrumentation and Automation	8	6	14	10	40		20	30	3	100
3	Clinical Laboratory Management	6	5	11	10	40		20	30	3	100
	<b>Sub Total</b>	<b>22</b>	<b>17</b>	<b>39</b>	<b>30</b>	<b>120</b>		<b>60</b>	<b>90</b>		<b>300</b>
<b>Clinical Practice: 27 Weeks</b>											
4	Clinical Practice I (Microbiology and Parasitology) (Hospital/Laboratory Based)*		13	13				100	100	4	200
5	Clinical Practice II (Hematology and Blood Banking) (Hospital/Blood bank Based)*		13	13				100	100	4	200
6	Clinical Practice III (Biochemistry, Histopathology and Cytopathology) (Hospital/Laboratory Based)*		14	14				100	100	4	200
	<b>Sub Total</b>		<b>40</b>	<b>40</b>				<b>300</b>	<b>300</b>		<b>600</b>
	<b>Grand total</b>				<b>30</b>	<b>120</b>		<b>360</b>	<b>390</b>		<b>900</b>

Note:

T: Theory

P: Practical

Int: Internal Exam

Fin: Final Exam

Practical: Should be two hours per period

\* Details on the distribution of marks for clinical practice evaluation are mentioned in the clinical practice section of the curriculum.

## **First Year**

**See Separate Curriculum for Health Science First Year All**

## Second Year

### **Second Year Subjects**

1. Clinical Microbiology and Immunology
2. Hematology and Blood Banking
3. Clinical Biochemistry
4. Medical Parasitology
5. Clinical Pathology
6. Public Health & First Aid

# Clinical Microbiology and Immunology

## Year: II

**Total hrs: 234 hrs (8 hrs /week)**

**Theory: 156 hrs (4 hrs/week)**

**Practical: 156 hrs (4 hrs/week)**

## Course Description

This course provides knowledge and skills on microbiology and immunology. It is designed to develop basic but comprehensive knowledge of common microorganisms, the diseases they cause and the skills of laboratory procedures adopted in bacteriology, mycology and virology.

## Course Objectives

After the completion of this course the students will be enabled to:

1. Explain historical background of medical microbiology and identify common bacteria.
2. Classify the medically important fungi and identify the fungal culture media.
3. Diagnose viral diseases.
4. Explain the defense mechanism including humeral and cell-mediated immunity.

## Theory

### Unit 1: General concept of Microbiology

**6 hrs**

1. Scope of Microbiology.
2. Differences between eukaryotic and prokaryotic cells.
3. Classification of microorganisms
4. General biological characters of bacteria, virus, protozoa and fungi.
5. Brief history of Medical Microbiology:
  - a. Early years of microbiology in relation to theory of Spontaneous generation, and contribution of Antony van Leeuwenhoek
  - b. Golden age of microbiology in relation to Louis Pasteur and Robert Koch
  - c. Modern age of microbiology in relation to molecular biology

### Unit 2: Bacteriology

**84 hrs**

#### 2.1: Bacterial cell structure:

- a. External structures - Glycocalyces, Flagella, Fimbriae and Pili
- b. Cell walls – Gram-positive cell walls, Gram-negative cell walls, bacteria without cell walls
- c. Cytoplasmic membranes- Structure and function
- d. Cytoplasm- Cytosol (including nucleoid), inclusions, endospores, nonmembranous organelles (ribosomes, cytoskeleton)

#### 2.2: Morphological classification of bacteria.

- a. Cocci, Bacilli, Actinomycetes, Mycoplasma, Spirochaetes, Rickettsia, Chlamydia

#### 2.3: Arrangements of bacteria

- a. Singles, Pairs, Clusters (including tetrads and sarcinae), Chains, Palisades, Chinese letter patterns

## **2.4: Bacterial Growth**

- a. Bacterial generation time
- b. Bacterial growth requirements
- c. Bacterial growth curve

## **2.5: Staining**

### 2.5.1 Introduction, types

- a. Simple stain
- b. Differential stain
- c. Negative stain

### 2.5.2 Clinical significance, Principle, requirements, procedure, result and precautions involved of following staining techniques-

- a. Gram's stain
- b. Ziehl-Neelsen's stain
- c. Albert's stain
- d. Capsule stain (India ink)

## **2.6: Normal bacterial flora of human body.**

- a. Beneficial roles
- b. Harmful roles
- c. Examples of normal microbiota in different body sites

## **2.7: Sample collection for the diagnosis of bacterial infections**

## **2.8: Culture media**

### a. Definition

### b. Classification, based on

- I. Consistency (solid, semisolid, liquid) including their advantages and limitations
- II. Constituents (simple, complex)
- III. Function (special media)
  - Enriched media
  - Enrichment media
  - Selective media
  - Indicator media
  - Differential media
  - Sugar media
  - Transport media
  - Biochemical test media
  - Anaerobic culture media

## **2.9: Bacterial culture techniques**

- a. Definition of Inoculum and Colony
- b. Streak, stroke, stab and lawn

## **2.10: Controlling microbial growth in the environment**

- a. Definition, types, principle, advantages and limitations of sterilization

- b. Method of sterilization
  - Physical method
    - Sunlight
    - Heat
      - Dry heat (Red heat, Flaming, Hot air oven)
      - Moist heat
    - Filtration
    - Radiation
  - Chemical method (Phenol and phenolics, alcohols, halogens, oxidizing agents, heavy metals, aldehydes, gaseous agents)
- c. Difference between sterilization, disinfection and antisepsis
- d. Brief about safety precautions and disposal of contaminated materials.

### **2.11: Controlling bacterial growth in the body**

- a. Antibiotics- Definition
- b. Examples of antibiotics based on following modes of action
  - Inhibition of cell wall synthesis
  - Inhibition of protein synthesis
  - Disruption of cytoplasmic membrane
  - Inhibition of metabolic pathways
  - Inhibition of nucleic acid synthesis
- c. Prudent use of antibiotics

### **2.12: Various methods for the identification of bacteria**

- a. Phenotypic methods
  - i. Staining
  - ii. Culture
  - iii. Biochemical test,
  - iv. Serological test,
- b. Genotypic method (Polymerase chain reaction-PCR)

### **2.13: Antimicrobial susceptibility testing by**

- a. Disc diffusion methods
  - i. Kirby-Bauer method
  - ii. Stokes' method
- b. Tube dilution method

### **2.14: Quality control in microbiology laboratory**

### **2.15: Morphology, cultural characteristics, disease caused & laboratory diagnosis, and antibiotics sensitivity of the following common bacteria from clinical samples, their preventive measures (in brief):**

- a. Staphylococcus aureus
- b. Streptococcus pyogenes, S. pneumoniae and Enterococcus faecalis
- c. Haemophilus influenzae
- d. Neisseriae meningitidis, N. gonorrhoeae

- e. Clostridia spp
- f. Corynebacterium
- g. Mycobacterium tuberculosis
- h. Mycobacterium leprae
- i. Escherichia coli
- j. Klebsiella pneumoniae.
- k. Pseudomonas aeruginosa.
- l. Proteus spp
- m. Treponema pallidum
- n. Salmonella Typhi, S. Paratyphi A
- o. Shigella spp.
- p. Vibrio cholerae.

## 2.16: Hospital acquired Infection

### Unit 3: Mycology

17 hrs

1. Classification of medically important fungi on the basis of their morphology and systemic.
2. Common terminologies used in mycology (mycelium, hypha, conidiophore, conidia, pseudohyphae, germ tube and mycoses).
3. Brief description:
  - *Candida albicans*
  - *Cryptococcus neoformans*
  - Dermatophytes
4. Collection techniques of various clinical samples for the diagnosis of fungal infection (skin/nail/hair sample, corneal scraping, sputum and biopsy materials).
5. Laboratory diagnosis of fungal infection
  - *KOH Mount*
  - *India ink preparation*
  - *Culture (SDA, DTM)*
  - *Germ tube test*
  - *Lacto Phenol Cotton Blue (LPCB) Mount*

### Unit 4: Virology

22 hrs

1. Structure and classification of viruses
2. Properties of viruses
3. Replication of viruses
4. Cultivation of virus
  - Egg inoculation
  - Tissue culture
  - Animal inoculation
5. Common terminologies used in virology (inclusion body, bacteriophage, paired sera, cytopathic effect and viral transport medium).
6. List the common viral diseases.
7. Basic laboratory procedure used in the diagnosis of viral diseases.
  - Electron microscopy, Egg inoculation, Cell culture, Serological tests.

**Unit 5: Immunology****27 hrs**

1. Immunity, antigen/ hapten, antibody.
2. Innate and acquired defense mechanism.
3. Classification of antigen antibody reactions
  - Agglutination
  - Precipitation
  - ELISA
4. Definition and classification of Hypersensitivity reactions.

**PRACTICAL****156 hours (78 x 2 hrs/period)****Unit 1: Bacteriology****80 hrs (40 x 2 hrs/period)**

1. Learn code of practice in clinical microbiology laboratory
2. Use light microscope and carry out its maintenance.
3. Clean, decontaminate and sterilize glassware by using autoclave, hot air oven, direct flaming and chemical disinfectants.
4. Prepare stains used in Gram's staining method, Albert's method and Ziehl Neelsen method. Perform above mentioned staining, report your findings and interpret.
5. Prepare various culture media (nutrient broth, nutrient agar, blood agar, chocolate agar, MacConkey agar, cystine-lactose-electrolyte-deficient medium, Robertson's cooked meat medium, buffered glycerol saline).
6. Prepare basic biochemical media (peptone water, Simmon's citrate, TSI agar, SIM medium and Christensen's urea agar).
7. Demonstrate normal flora of human body by culturing skin swab or stool
8. Process various clinical samples received in bacteriology lab.
9. Perform antimicrobial susceptibility testing of isolated organism in pure form (disc diffusion method).
10. Perform catalase, coagulase, oxidase, motility and common biochemical tests.
11. Dispose various contaminated materials.

**Unit 2: Mycology****24 hrs (12 x 2 hrs/period)**

1. Prepare 10% KOH solution and SDA medium.
2. Perform skin/nail,/hair-scraping , KOH preparation and inoculation in SDA.
3. Perform India ink preparation.
4. Perform germ tube test.
5. Perform LPCB Mount.

**Unit 3: Virology****24 hrs (12 x 2 hrs/period)**

1. Demonstration of viral inclusion bodies.
2. Perform serological tests based on immuno chromatography technique for HIV, HBV & HCV infections
3. Demonstration of ELISA for the diagnosis of HIV infection.

**Unit 4: Immunology****14 hrs (7 x 2 hrs/period)**

1. Perform intradermal skin test (Mantoux test).
2. Perform RPR, ASO titre, RA factor, CRP, Widal tests

## Reference Books

1. District laboratory Manual for developing Countries (Volume I and II) - Monica Cheesbrough
2. Practical Medical Microbiology - Mackie and McCortney
3. Text Book of Microbiology -R. Anantnarayan & C.K.J. Panikar
4. Diagnostic Medical Microbiology -Baily & Scoots
5. Medical Microbiology Volume I & II - Robert Cruishank
6. Review of Medical Microbiology - Jawetz et al
7. Lynch's Medical Laboratory Technology - Stanley S Raphael, Igaku-Shoinl
8. Quality Control in Clinical Laboratory - David Tonks
9. Guide to Medical Laboratory Instruments - Cliffordd D Fervis
10. Clinical Microbiology - American Society for Microbiology (ASM)

# Hematology and Blood Banking

**Year: II**

**Total hours: 312 (4 hrs/wk)**

**Theory hours: 156 (4hrs/wk)**

**Practical hours: 156 (4 hrs/wk)**

## Course Description

This course is designed to help trainees to develop knowledge and skills on hematopoietic, enumeration and identification of cells and conditions leading to alteration of normal values in health and diseases for routine hematological tests. This course also imparts knowledge to the students on anemia, blood disorders and blood parasites along with the principle of blood banking.

## Course Objectives

After completion of this course of hematology the students will be able to;

1. Perform routine and special laboratory procedures.
2. Identify blood and blood cells disorders.
3. Apply Blood Banking and Immunohematology techniques.

## Theory

**156 hrs**

### Unit 1: Introduction to Hematology

**10 hrs**

1. History, scope and importance of haematology.
2. Review of circulatory system mentioning the functions of heart, arteries, veins and capillaries.
3. Blood: definition, properties, composition, functions of each cells.
4. Normal structure, shapes, sizes, life span and normal reference (values) of blood cells.
5. Physiology and metabolism of the blood cells.

### Unit 2: Haematopoiesis

**12 hrs**

1. Sites of blood formation.
2. Development of blood cells
  - a. Erythropoiesis.
    - i. Erythron concept
    - ii. Stages of cell development
    - iii. Control of erythropoiesis (erythropoietin)
    - iv. Ineffective erythropoiesis
  - b. Leucopoiesis
    - i. Myeloid series- stages of cell development
    - ii. Lymphocytic series- stages of cell development
    - iii. Monocytic series- stages of cell development
    - iv. Control of leucopoiesis
  - c. Thrombopoiesis.
    - i. Stages of cell development
    - ii. Control of platelet formation

- Unit 3: Hemoglobin** **8 hrs**
1. Hemoglobin: Definition, structure and function.
  2. List of normal and abnormal haemoglobins.
  3. Haemoglobinopathies and thalassemia.
- Unit 4: Red Cell Disorders** **12 hrs**
1. Qualitative, quantitative and morphological abnormalities of red cells.
  2. Anaemia: Definition, classification; Causes, laboratory diagnosis and treatment.
  3. Polycythemia: Definition, causes, symptoms, diagnosis, and treatment.
- Unit 5: White Blood Cell Disorders** **8 hrs**
1. Morphological and functional disorders of white blood cells.
    - a) Leucocytes disorders: Definition and classification.
    - b) Leukemia: Definition, causes, classification, lab diagnosis
- Unit 6: Coagulation mechanism** **6 hrs**
1. Coagulation factors
  2. Process of haemostasis and blood coagulation.
  3. Thrombolytic disorders and bleeding disorder
- Unit 7: Hematological Techniques** **60 hrs**
1. Introduction to Haematology laboratory instruments and glassware
  2. Anticoagulant: Definition, types, mechanism of their action ,uses advantage and disadvantage.
  3. Phlebotomy technique
    - a) Anatomical sites of blood sample collection
    - b) Methods of blood sample collection
      - Capillary blood sample collection
      - Venous blood sample collection
    - c) Precaution during sample collection.
  4. Blood smear preparation: thick and thin.
  5. Hemocytometry : Principle, requirements, procedure, calculation, normal values, Clinical significance and precaution of
    - Total RBC Count
    - Total WBC Count
    - Platelet count
  6. Definition of stain. Principle, composition, Preparation, uses, procedure of Romanowsky stains (Wright's, Leishman's, and Giemsa stain).
  7. Differential leukocyte count (DLC): principle, requirements, procedure, reference range, clinical significance and precaution.
  8. Absolute Eosinophil Count; Principle, requirements, procedure, reference range, clinical significance and precaution.
  9. Bone marrow: Sites of sample collection smear preparation and staining (Giemsa stain)
  10. Erythrocyte Sedimentation Rate (ESR): Definition, principle, requirements, procedure, normal value, clinical significance and influencing factors of;
    - a. Wintrobe's method

- b. Westergren method
- 11. Packed cell volume (PCV): Definition, Principle, Clinical Significance, methods of estimation, Normal value, result interpretation.
- 12. Haemoglobin estimation:
  - a. Normal value and clinical significance of Hemoglobin estimation
  - b. Methods of Hemoglobin estimation:
  - c. Principle, requirements and procedure: Colorimetric method (Cyanmethaemoglobin) and Acid haematin method (Sahli's)
- 13. Red cell indices (MCV, MCH, and MCHC) calculation, Normal value and their clinical significance.
- 14. Supra vital stain; Introduction, Preparation of commonly used supra vital stains and uses.
- 15. Reticulocyte count: Introduction, Principle, Clinical significance, procedure , Normal value and Result interpretation.
- 16. Introduction, Principle, Clinical significance, procedure , Normal value and Result interpretation for following tests; Bleeding time, clotting time, prothrombin time, activated partial thromboplastin time
- 17. Automated blood cell analyzer; Working principle and application.
- 18. Other Hematological techniques- LE Cell preparation, Osmotic Fragility Test, Sickling test.
- 19. Quality control on Hematology Laboratory.

#### **Unit 8: Blood Parasites**

**10 hrs**

- 1. Blood parasites with special reference to Nepal.
- 2. Thick and thin blood smears, dehaemoglobinization and staining procedures for identification of malarial parasites and differentiation of their species.
- 3. Preparation of blood smears, staining and identification of microfilaria.
- 4. Preparation of smears from various samples and staining for LD bodies demonstration.

#### **Unit 9: Blood Banking**

**30 hrs**

- 1. Introduction. History, scope, importance.
- 2. Blood grouping systems and various blood groups.
- 3. Blood donor selection and preparation for donation.
- 4. Anticoagulants used in blood banking.
- 5. Appropriate Storage and transport conditions of blood bags and transfusion sets for delivery of safe blood for transfusion.
- 6. Blood components; their uses and storage.
- 7. Theory, procedure and precaution on
  - a) ABO and Rh blood grouping
  - b) Cross-matching
  - c) Direct and indirect Coomb's tests.
- 8. Transfusion transmissible infections and their screening.
- 9. Post transfusion reactions.
- 10. Erythroblastosis fetalis , haemolytic disease of new borne: Introduction, etiological factor, pathogenesis clinical feature, its lab diagnosis and management.

**Practical:****156 hrs (78 x 2 hrs/period)**

Perform the following tasks:

1. Handle and care of various hematological equipment and apparatus.
2. Collect blood sample for various hematological tests:
  - a. Capillary puncture (fingertip, ear lobe, toe and heel)
  - b. Venipuncture (using syringes and vacutainer)
3. Preparation of various anticoagulant vials and their selection for different tests. (EDTA, Oxalate, Citrate, and Heparin)
4. Prepare chemicals, reagents and solution and stain
  - a. Preparation of stains- Wright's stain, Giemsa stain, Leishmania stain, Supra-vital stain.
  - b. Preparation of diluting fluid for WBC, RBC and platelets.
5. Prepare thin and thick blood smears and stain by various method (Wright stain, Giemsa stain, Leishman stain )
6. Identify normal and abnormal blood cells in stained blood smear.
7. Perform Differential Leukocyte Count on blood smear.
8. Perform
  - a. Total WBC count
  - b. Total RBC count
  - c. Total platelet count
9. Estimate haemoglobin by Sahli's and Cyanmethaemoglobin method.
10. Perform ESR test by Wintrobe's and Westergren method .
11. Perform haematocrit (PCV) estimation: (Wintrobe, Microhaematocrit method)
12. Perform reticulocyte count.
13. Demonstrate Sickling test and LE phenomenon.
14. Perform following tests for blood coagulation disorders:
  - a. Bleeding Time (BT)
  - b. Clotting Time(CT )
  - c. Prothrombin Time (PT)
  - d. Activated Partial Thromboplastin Time (APTT)
15. Estimate blood cell indices values.
16. Identify the blood parasites. (Plasmodium spp, Microfilaria)
17. Perform ABO blood grouping and Rh typing
18. Perform cross matching.
19. Perform Coomb's test
20. Prepare calibration curve for haemoglobin estimation by Cyanethemoglobin method

**Reference books**

1. Practical haematology - J V Dacie
2. Practical Heamatology -Wintrobe
3. Manual for Medical Laboratory Technology, Volume I & II - Monica Cheeselburgh
4. A hand book of Medical Laboratory Technology - Christian Medical College, Vellore
5. Medical laboratory Manual for Tropical Volume I - British Government
6. Medical Laboratory Technology , Volume I, II, III - Kanai L Mukherjee
7. Manual of basic techniques for a health laboratory - WHO Academic Publishers Calcutta
8. Text Book of Medical Laboratory Technology - M. Nakanishi et.al.
9. Organisation of a Blood Transfusion service - W.N. Gibbs & AFH. Britton
10. Viva in voce in Pathology, Bacteriology and Haematology - Dr. K.N. Schev
11. Laboratory Practical Haematology -K. Parajuli

# Clinical Biochemistry

**Year: II**

**Total hrs: 234 hrs (8 hrs/week)**

**Theory: 156 hrs (4 hrs/week)**

**Practical: 156 hrs (4 hrs/week)**

## Course Description

The course is designed to provide basic but comprehensive knowledge on basic chemistry and biochemistry, which has direct application in clinical biochemistry. This course consists of relevant chapters from pure sciences (recall), which has got direct application on this subject. Clinical biochemistry including the biochemical processes of - digestion & absorption of foods, metabolism of different kinds of foods & their disturbance effects in our body together with the physiological roles of different kinds of vitamins & enzymes. It also provides good theoretical background in field with the practical experience hand in hand. This will be tested in practical & theory during the process of teaching. Since each student will have to work in close association with each other. This course is based more on practical work.

## Course Objectives

After completing this course the student will be able to;

1. Acquaint with elementary and physical chemistry.
2. Describe the biochemical processes of different kinds of foods in our body.
3. Identify the role of vitamins & enzymes in our body.
4. Make biochemical estimation.
5. Handle different equipment for biochemical analysis.
6. Preserve chemical reagents for biochemistry laboratory.

## Unit 1: Introduction to Biochemistry

**4 hrs**

- 1.1 Definition
- 1.2 Scope and Importance of biochemistry
- 1.3 Fields of biochemistry
- 1.4 Milestones in history of biochemistry

## Unit 2: Elementary chemistry

**10 hrs**

- 2.1 Definition of atom, molecule, atomic number, atomic weight, molecular weight, equivalent weight and chemical equation (oxidation and reduction).
- 2.2 Solution
  - Solution, types of solutions: saturated, unsaturated, supersaturated, normal, molar, and percentage solutions.
  - Preparation of different concentration of normal, molar, and percentage solutions.
  - Buffer and standard solutions.
  - Osmosis and diffusion.

## Unit 3: Physical chemistry

**15hrs**

- 3.1 Principle, functions, handling and maintenance of:
  - Water bath
  - Centrifuge

- Analytical balances
  - Colorimeters
  - Spectrophotometers
  - Micro-pipettes and pH meter
- 3.2 Use of glasswares and their cleaning with detergents & chromic acid.
- 3.3 Theories behind the use of common anticoagulants and preservatives.
- 3.4 Changes occurring in the blood after collection,
- 3.5 Blood Storage and precautions during storage.
- 3.6 Laboratory hazards and precautions to be taken while working in the clinical chemistry laboratory.

## **UNIT 4: Bio-molecules and Metabolisms**

**92 hrs**

### **4.1 Bio-molecules**

**47 hrs**

4.1.1 Introduction, Types and importance of Biomolecules

4.1.2 Carbohydrate:

- Introduction, Definition, Functions.
- Classifications of Carbohydrates in detail.
- Monosaccharides: Types with it's examples and its importance, Physical and Chemical Properties.
- Disaccharides: Definition, importance and Types (Sucrose, Maltose & Lactose).
- Oligosaccharides: Definition with examples
- Polysaccharides: Definition, importance and Types (Homo & Heteropolysaccharides)

4.1.3 Proteins:

- Introduction, Definition and Functions of Proteins.
- Amino Acids: Introduction, structure and properties
  - Classifications of amino acids: based on the structure, nutritional requirement and metabolic fate.
- Classifications of Proteins:
  - Functional classification
  - Classification based on chemical nature and solubility and
  - Nutritional classification
- Properties of Proteins
- Structures of Proteins
- Denaturation: Definition, Agents and characteristics of denaturation.
- Coagulation and Flocculation of protein

4.1.4 Lipids:

- Introduction, Definition, Functions and Classifications of Lipids.
- Triglycerides: Introduction, structure and properties (Hydrolysis, Saponification, Rancidity and Lipid Peroxidation).
- Fatty Acids: Definition and classification (Saturated & unsaturated)
- Essential fatty acids: Definition, functions, examples and deficiency manifestation.

- Phospholipids: Introduction, types and functions.
- Cholesterol: Introduction, structure, properties and functions.

#### 4.1.5 Plasma Proteins:

- Introduction and types.
- Enumerate the functions with normal range of different plasma proteins.
- Abnormalities of Plasma Proteins.
- Electrophoretic pattern of plasma proteins in normal and abnormal conditions.

#### 4.1.6 Enzymes:

- Introduction, Definition and Classification of Enzymes.
- Factors affecting enzyme activity in detail.
- Salient features of active site.
- Enzyme Inhibition in brief.
- Mechanism of Enzyme Action
- Regulation of enzyme activity in the living system
- Units and It's applications
- Diagnostic Importance of Enzymes
- Coenzymes: Introduction, definition & function with examples.
- Isoenzymes: Introduction, definition and it's features. Isoenzymes of LDH, CPK & ALP in detail.
- Enzyme Pattern in Diseases.

#### 4.1.7 Vitamins:

- Define vitamins
- Classify vitamins – fat-soluble and water-soluble.
- List dietary sources and RDA of each of the vitamins.
- Describe physiological roles of all vitamins.
- Deficiency manifestations of each vitamins.

4.1.8 Minerals: Introduction, biochemical functions and Deficiency manifestations of principal elements (macroelements) and trace elements (microelements).

4.1.9 Hormones: Introduction, definition, functions and classifications.

4.1.10 Tumor Markers: Introduction, Different biochemical tumor markers & their significance

### **4.2 Digestion and absorption of Biomolecules 5 hrs**

4.2.1 Digestion and Absorption of Carbohydrates.

4.2.2 Digestion and Absorption of Proteins.

4.2.3 Digestion and Absorption of Lipids.

### **4.3 Metabolism of Biomolecules 40 hrs**

4.3.1 Introduction to Metabolism: Introduction, purpose, Types and stages of metabolism.

4.3.2 Metabolism of Carbohydrates:

- Major pathways of carbohydrate metabolism and Entry of glucose into the cells.
- **Glycolysis:** Introduction, Salient features, pathway, Energetics, Regulation and Clinical Significance.
- **Rapaport-Leubering Cycle:** pathway for biosynthesis & significance of 2,3-BPG.
- **Citric Acid Cycle:** Introduction, pathway, Energetics, Regulation and Clinical Significance.
- **Gluconeogenesis:** Introduction, Importance & Pathway
- **Cori's Cycle:** Introduction & pathway
- **Glycogen Metabolism:** Glycogenesis and Glycogenolysis pathway.
- **Hexose Monophosphate Shunt:** Introduction, Pathway and Significance.
- Regulation of Blood Glucose Level inside the body including hormonal regulation.
- **Diabetes Mellitus:** Introduction, Types, Cardinal symptoms, Complications, Lab. Diagnosis and Management.
- **Glucose Tolerance Test:** Patient preparation, Procedure and Interpretation.
- Enlist **inborn errors** of carbohydrate metabolism.

#### 4.3.3 Metabolism of Proteins:

- Introduction, Amino Acid Pool, Overview of amino acid metabolism.
- Protein Catabolism
  - Transamination: Introduction, salient features & mechanism.
  - Deamination: Oxidative & Non-oxidative
  - Urea Cycle: Introduction, pathway, energetics, Regulation and clinical significance of blood urea. Blood Urea Nitrogen(BUN).
- Non Protein Nitrogenous substances (Creatine, Creatinine, Uric Acid, Bilirubin)
- Inborn errors of protein metabolism.

#### 4.3.4 Metabolism of Lipids:

- Fatty acid oxidation and its various methods.
- $\beta$ -oxidation of fatty acids: Introduction, pathway, Energetics, regulation and clinical significance
- Ketone bodies: Introduction, Ketogenesis(synthesis), Ketolysis(utilization) & clinical significance.
- Ketoacidosis and Ketosis.
- Fatty Liver and associated health risks.
- Inborn errors of lipid metabolism.

### Unit 5: Estimations of different biochemical analytes

**30 hrs**

5.1 Principle, Procedure, Reference Range, Clinical significance, precautions in the estimation of:

- Sugar (Ortho Toluidine and GOD/POD)
- Urea (DAM, Berthelot)

- Creatinine
- Uric Acid
- Serum Bilirubin
- Total Protein
- Albumin
- SGPT/ALT
- SGOT/AST
- Alkaline phosphatase (ALP)
- Lipid Profile Tests : ( Triglycerides, Total Cholesterol, HDL, LDL, VLDL)
- Amylase
- Serum Calcium and Phosphorous
- Serum Electrolytes (Na , K)

#### 5.2 Organ Function Tests:Introduction and interpretation

- Liver Function Tests (LFT)
- Renal Function Tests (RFT)
- Pancreatic Function Tests (PFT)
- Cardiac Function Tests (CFT)
- Thyroid Function Tests (TFT)

### **UNIT 6: Quality control in clinical chemistry laboratory**

**5 hrs**

6.1 Effects of time, pH, temperature and light on chemical reagents.

6.2 Preservation of chemicals used in biochemistry laboratory.

6.3 Quality Control(QC) in biochemistry laboratory

### **Practical**

**156 hrs (78 x 2 hrs/period)**

#### **Perform the following tasks:**

1. Prepare normal and percentage solution of NaCl.
2. Perform separation of Serum and Plasma.
3. Perform blood glucose by GOD-POD method.
4. Perform blood urea by Berthelot method.
5. Prepare calibration curve for blood glucose and blood urea estimation.
6. Perform serum creatinine by Alkaline picrate method.
7. Demonstrate clearance tests ( Urea and Creatinine)
8. Perform serum uric acid by enzymatic method.
9. Perform serum total protein by Biuret method.
10. Perform serum albumin by Bromocresol Green method.
11. Perform bilirubin by modified Jendrassik&Grof method.
12. Perform serum Total cholesterol by CHOD-PAP method.
13. Perform serum Triglyceride by GPO-PAP method.
14. Perform HDL-Cholesterol by PEG/CHOD/PAP method.
15. Perform serum SGPT by UV-kinetic method.
16. Perform serum SGOT by UV-kinetic method.
17. Perform serum alkaline phosphatase (ALP).
18. Perform serum amylase.
19. Perform serum calcium O-Cresolphathaleincomplexon (OCPC) method.

20. Perform serum inorganic phosphorus by Gommorris method.
21. Perform serum sodium/potassium by flamephotometer or ISE.
22. Demonstrate estimation of Total Creatine Phosphokinase (CPK).
23. Demonstrate estimation of Glycatedhaemoglobin (HbA<sub>1c</sub>).

### Reference books

1. Clinical Biochemistry- Tapeswar Yadav, Highland Publication, Pvt. Ltd., Bhotahity, Kathmandu
2. Biochemistry – U. Satyanarayan.
3. Fundamental Biochemistry -A.C.Dev
4. Varley’s Practical Clinical Biochemistry –Goweklook.
5. Quality control in clinical laboratory - David Tonks
6. An introduction to medical laboratory technology - F J Baker, R E Silvert
7. An introduction to Medical Technology - F J Baker
8. Harper’s Biochemistry - Harper
9. A Text Book of Clinical Chemistry - Teitz
10. A biologist guide to principles and techniques of practical biochemistry -Bryn & Keith
11. A Text Book of Clinical Biochemistry - S. Baral, N. Parajuli, P. Hamal & K. Poudel

# Medical Parasitology

**Year: II**

**Total hours: 156 (4 hrs/wk)**

**Theory hours: 78 (2 hrs/wk)**

**Practical hours: 78 (2 hrs/wk)**

## **Course Description:**

The course focuses on medical parasites in reference to parasites prevalent in the regions, particularly in Nepal. This course deals especially, with Protozoa, Helminthes and related laboratory procedures including mode of infection, pathogenicity, laboratory diagnosis & preventive measures of important intestinal as well as blood & tissue parasites of man including different kinds of defense mechanisms of a body. This course also deals with study of different body fluids of a body.

## **Course Objectives**

At the end of the course, the students will be able to:

1. Explain the common parasites found in Nepal.
2. Carry out basic laboratory procedures in order to diagnose the common parasitic diseases.
3. Explain defense mechanism of the body to the medical parasites.
4. Perform different body fluids analysis.

## **THEORY**

### **Unit 1: Introduction**

**10 hrs**

- 1.1 Host: definitive host, intermediate host.
- 1.2 Parasite; ectoparasite, endoparasite, temporary parasite, permanent parasite, obligatory parasite, facultative parasite.
- 1.3 Host parasite relationship; commensalism, mutualism, pathogenic. Infection and infestation, Classify medically important parasites and explain intestinal, urine, blood and tissue parasites.
- 1.4 Classification of medical parasites: protozoa, helminthes.

### **Unit 2: Protozoa**

**18 hrs**

- 2.1 Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:
  - a) Entamoeba histolytica
  - b) Giardia lamblia,
  - c) Trichomonas vaginalis
  - d) Leishmania: L. donovani
  - e) Plasmodium: P. vivax, P. ovale, P. falciparum, and P. malariae
  - f) Toxoplasma gondii.
  - g) Cryptosporidium parvum:
  - h) Cyclospora cayetanensis,
  - i) Balantidium coli

### **Unit 3: Helminths**

#### **3.1 Nematodes**

**10 hrs**

Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:

- Hookworm: *Necator americanus* and *Ancylostoma duodenale*
- *Ascaris lumbricoidea*
- *Enterobius vermicularis*
- *Trichuris trichiura*
- *Strongyloides stercoralis*
- Microfilaria: *Wuchereria bancrofti*

#### **3.2 Cestodes (Tape worms)**

**10 hrs**

Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:

- Taenia: *Taenia solium* and *Taenia saginata*,
- *Echinococcus granulosus* and
- *Hymenolepis nana*.

#### **3.3 Trematodes (Flukes, intestinal, hepatic, pulmonary and blood)**

**10 hrs**

Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:

- *Fasciola hepatica*,
- *Paragonimus westermani*
- *Schistosoma hematobium*

### **Unit 4: Laboratory techniques**

**20 hrs**

4.1 The procedure for clinical specimen collection for parasitic investigations (stool, urine, blood, sputum, exudates, swabs and aspirates).

4.2 Preparation of reagents required for routine diagnostic purposes (, iodine solution, brine solution, 33% zinc sulphate solution, normal saline solution, Stoll's reagent, Giemsa and Leishman's stain and benzidine solution).

4.3 Various laboratory technique:

- Feacel (stool) examination: physical, chemical-reducing substances and occult blood, and microscopic.
- Blood examination by wet and stained smears preparation for blood parasites.
- Urine, sputum examination for urinary and respiratory tract parasites.
- Various concentration methods (floatation and sedimentation) to detect the blood and intestinal parasites.

### **PRACTICAL**

#### **Unit 1: Parasitology**

**78 hrs (39 x 2 hrs/period)**

3.1 Collect various samples (stool, urine, blood, sputum, CSF and body fluid) by different methods for the detection of parasites.

- 3.2 Prepare various reagents (iodine solution, brine solution, 33% zinc sulphate solution, normal saline solution, Stoll's reagent, Giemsa and Leishman's stain and benzidine solution).
- 3.3 Conduct physical, chemical and microscopic examination of stool samples: naked eye examination, preparation of wet mount smear (saline and iodine) and observation of smear under the microscope for parasites.
- 3.4 Identify Scotch tape technique for ova of pin worm.
- 3.5 Detect parasites by Concentration Technique present on stool samples
- 3.6 Brine solution, (sucrose solution.) flotation method
- 3.7 Zinc sulphate and sucrose floatation methods
- 3.8 Formal-ether sedimentation method.
- 3.9 Examine reducing sugar and occult blood in the stool.
- 3.10 Examine and identify malaria parasites by thick and thin smears.
- 3.11 Examine and identify microfilaria by wet mount.

### References

- |  |                                |
|--|--------------------------------|
| Medical Parasitology                             | - K.D. Chatterjee MD           |
| Medical Laboratory Manual for Tropical Countries | - Monica Cheesbrough           |
| Text Book of Medical Laboratory Technology       | - HG Shrestha and M. Nakanishi |
| Textbook of Medical Parasitology                 | -Paniker, C.K.                 |

# Clinical Pathology

**Year: II**

**Total: 156 hours (4 hrs/wk)**

**Theory: 117 hours (3 hrs/wk)**

**Practical: 39 hours (1 hrs/wk)**

## Course Description

This course is designed to help students to acquaint knowledge and skills on General Introductory Pathology and health care delivery system of Nepal in broader perspectives. This course deals with basics of subject, commonly used terminology, types and causes of human pathology, correlation between clinical diagnosis and pathological interpretation.

## Course Objectives

After the completion of the course, the student will be able to:

1. Introduce pathology and explain its importance.
2. Define the terminology used in pathology.
3. Apply of different pathological investigation.
4. Apply Hi-tech instruments in diagnostic procedures
5. Provide emergency first aid to the needy people.
6. Identify the national health policy and strategy, health care delivery, elements of primary health care, indicator of improvement in the health care and the role of health worker in primary health care.
7. Provide basic maternal, childcare and family planning guidance to the needy people.

## Theory

### A. Basic Pathology

#### Unit 1: General Pathology

**10 hrs**

1. Introduction to Pathology
2. Fields of pathology
3. Importance of Pathology
4. Application of Pathology in Laboratory diagnosis

#### Unit 2: Cell injury and cellular adaptation

**28 hrs**

1. Introduction
2. Common terminologies used in cell injury and adaptation (necrosis, trauma, hypoxia, Ischemia, homeostasis, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Dysplasia, Aplasia, Apoptosis)
3. Causes and Types of cell injury
4. Mechanism of cell injury
  - Ischemic and Hypoxic cell injury
  - Free radical induced cell injury
  - Immune induced cell injury
    - Hypersensitivity
    - Transplant rejection
    - Autoimmune diseases
5. Clinical diagnosis of reversible and irreversible cell injury.

6. Necrosis and its Types.
7. Autoimmune diseases and their laboratory investigation.
8. Cellular adaptation to injury
9. Forms of cellular adaptation
  - Atrophy
  - Hypertrophy
  - Hyperplasia
  - Metaplasia

**Unit 3: Inflammation**

**12 hrs**

1. Introduction
2. Terminology (Oedema, Erythema, vasodilation, granuloma, acute, chronic, Abscess, exudates and transudates )
3. Types, causes and mechanism of
  - Acute inflammation
  - Chronic Inflammation
4. Chemical mediators of inflammation

**Unit 4: Infection**

**25**

**hours**

1. Introduction
2. Classification of Infection
3. Mechanism of Infection
4. Terminologies; Agent, Host, Vector, symptoms, Signs, Diagnosis, Prognosis, Therapy, Prophylaxis, Incubation Period, Window Period
5. Introduction, Etiological agent, Route of transmission, Pathogenesis, Clinical manifestation, Laboratory diagnosis and Treatment of following Infectious diseases in Nepalese context
  - a. Cholera
  - b. Tuberculosis
  - c. Enteric Fever
  - d. Scrub typhus
  - e. Malaria
  - f. HIV/AIDS
  - g. Infectious hepatitis
  - h. Japanese encephalitis

**Unit 5: Neoplasia**

**14 hrs**

1. Introduction
2. Terminologies ( benign, malignant, metastasis, carcinoma, lymphoma, sarcoma, papilloma, adenoma, Anaplasia, Pleomorphism)
3. Difference between Benign and malignant tumours
4. Etiology of cancer ( Carcinogenic agents)
5. Tumour markers; definition, applications and types.
6. Laboratory diagnosis of cancer.

7. Mutation and its types.

**Unit 6: Specific specimen examination for Laboratory diagnosis**

**28 hrs**

1. Examination of effusions ( synovial, pleural, pericardial, peritoneal fluids)
  - Physical, Chemical, Microscopic and Microbiological investigation
2. Examination of urine ;
  - Composition of normal urine
  - Specimen collection
  - Physical, Chemical , Microscopic and Microbiological investigations
3. Examination of cerebrospinal fluid ;
  - Composition of normal CSF
  - Physical, chemical, Microscopic and microbiological changes during diseases
4. Examination of semen ;
  - Normal characteristics
  - Specimen collection
  - Laboratory investigation
    - Measuring volume and appearance
    - Estimation of fructose and measurement of pH
    - Estimation of percentage of motile and viable spermatozoa
    - Performing Sperm Count
    - Estimation of Percentage of spermatozoa with normal morphology

**PRACTICAL**

**39 hrs (19 x 2 hrs/period)**

1. Perform urine specimen collection and its preservation.
2. Perform routine and microscopic examination of urine (Urine RE/ME)
3. Prepare essential chemical reagents and perform urine examination for following analytes ;
  - Sugar
  - Protein
  - Bilirubin
  - Bile salt
  - Ketone bodies
  - Urobilinogen
  - Chyle
  - Bence-John's protein
4. Demonstrate urinary crystals and casts.
5. Examine CSF, Ascitic fluid, Pleural fluid, Synovial fluid (protein, sugar, cell count)
6. Collect appropriate specimen of semen and perform semen analysis.

**Recommended Books**

1. Text book of Pathology – Harshmohan
2. Basic Pathology – Robbins
3. First Aid and Emergency Nursing – N. N. Yalayaswamy

## Public Health and First Aid

**Year: II**

**Total hrs: 156 hrs (4 hrs/week)**

**Theory: 117 hrs (3 hrs/week)**

**Practical: 39 hrs (1 hrs/week)**

### Course Description

This course is designed to help students to acquire knowledge and skills on basic public health education health care service delivery system of Nepal and first aid practice in broader perspectives. This deals with concept of health and disease and its environmental aspects, dynamics of infectious disease transmission along with their control and management, National health care delivery system to demonstrate overall healthcare service distribution throughout the nation as well as different aspects of environmental pollution ,their adverse effects on human health and the approaches to combat them . It also encompasses the maternal and child health education which relates to the healthcare need and associated risks during pregnancy, delivery and even after delivery along with their management skills. Beside all these, this subject is also intended to give learners an opportunity to have foundation skills on biostatistics and health research. Moreover, health education tools and techniques and contents on professional ethical code of a lab technician as per assigned by Nepal Health Professional's Council are anticipated to have very good impact on developing responsible and qualified laboratory professionals in the nation.

First aid treatment to the victims of different incidental health aberrations is another key to the learners to achieve lifetime skills on how to response on any such accidental encounter. This helps turn learners into laboratory professionals with enriched skills and knowledge on accidental and emergency health care service delivery to save lives until getting approach to the proper clinical intervention.

### Course Objectives

After the completion of the course, the student will be enabled to:

1. Define health and disease,
2. Explain the spectrum of health, community health, components and scopes and apply them.
3. Define epidemiology and explain its components.
4. Describe the dynamics of disease transmission, their prevention and control.
5. Identify modes of disease transmission.
6. Identify the sources of environmental pollution, their effects on health and preventive measures.
7. Manage wastes along with hospital waste management approaches.
8. Introduce food security, food hygiene, food adulteration, and food borne illness and infections and appropriate food preservation techniques.
9. Describe current health care delivery system in Nepal and updated health policy
10. Conduct basic statistical approaches in healthcare service related data analyses and health research
11. Orient with ethical aspects of laboratory medicine and professional standard.

## **THEORY**

### **Unit 1: Introduction to public health**

**5 hrs**

1. Concepts of Health and Disease, Spectrum of health
2. Community health
3. Public health
4. Scope of public health and its approaches
5. Important public health practices in Nepal.
6. Application of public health education in diagnosis.

### **Unit 2: Basic Epidemiology**

**14 hrs**

1. Introduction
2. Epidemiological Terminologies :Isolation, Quarantine, Vaccine, Zoonosis, Epidemic, Endemic Pandemic, Sporadic, Vector, Host, Reservoir, Agent , Incubation Period, Window period, Incidence, Surveillance, Prevalence
3. Epidemiological triad
4. Epidemiological measurements
5. Dynamics of infectious disease transmission
6. Infection prevention and control measures.
7. Immunity and its types, Active and Passive Immunization, National Programme on Immunization
8. Screening of diseases, Iceberg phenomenon, Screening types and their application.

### **Unit 3: Basic hygiene and sanitation**

**10 hrs**

1. Water pollution and its causes, Water borne diseases. Water purification techniques
2. Air pollution and its causes, Air pollution borne effects on health. Preventive measures for air pollution
3. Noise (Sound Pollution) and its causes, Effects of Noise on human health, Preventive measures of Noise.
4. Proper Housing, its importance and effects of poor housing on human health.
5. Sterilization and disinfection techniques

### **Unit 4: Health education and health promotion**

**10 hrs**

1. Introduction
2. Communication process and its importance.
3. Health education; methods and media
4. Importance of health education

### **Unit 5: Nutrition**

**10 hrs**

1. Introduction
2. Classification of foods
3. Bio molecules [Carbohydrates, Proteins, fats, minerals, vitamins] and their importance in human body
4. Mal-nutrition, its causes, types and prevention
5. Food security, food hygiene, food adulteration, food fortification and food preservation techniques.

- Unit 6: Health care delivery system** **6 hrs**
1. Concept of health care
  2. Levels of health care
  3. Current health Care Delivery System of Nepal
  4. Concept of health planning and management
  5. Sustainable Development Goals (SDGs)
  8. Some traditional health care systems ( Unani/Aayurveda/Homeopathy/Acupuncture/ Naturopathy )
- Unit 7: Primary Health Care** **6 hrs**
1. Summarize national health policy
  2. National health strategy for ensuring achievement of targeted health goals.
  3. Concept on primary health care
  4. Elements of primary health care
  5. Discussion on principles and strategy for primary health care.
  6. Role of health worker in primary health care services.
- Unit 8: Maternal and Child Health** **10 hrs**
1. Maternal and Child Health Education and its importance
  2. Essential components of MCH (antenatal, intra natal and postnatal care), major complications and clinical management.
  3. Breast-feeding, its importance as well as indications and disadvantages of bottle-feeding
  4. Weaning period, weaning food along with the preparation and advantages of sarbottam pitho.
  5. Causes of childhood diarrhoea in Nepal and its management.
  6. Causes and basic management of acute respiratory infection in children
  7. Family planning, its objectives and different methods of family planning available in Nepal.
- Unit 9: Waste disposal system** **10 hrs**
1. Discussion about waste, their sources and their types.
  2. Methods of solid waste management.
  3. Excreta disposal techniques.
  4. Measures of vector control. (mosquito borne diseases, measures to control mosquito/ rodent borne diseases, control measures of rodents)
  5. Hospital borne infections, Hospital waste Management.
- Unit 10: Introduction to Biostatistics** **7 hrs**
1. Definition of biostatistics
  2. Application of biostatistics, Limitations of biostatistics
  3. Data, types of data and data collection techniques.
  4. Measure of central tendency : definition, importance, calculation
  5. Measure of dispersion: definition, importance and calculation.
- Unit 11: Health Research** **4 hrs**
1. Introduction and importance of health research

2. Types of research
3. Basic concept on research methodology

**Unit 12: First Aid**

**25 hrs**

1. First aid treatment and its importance.
2. Basic qualities and responsibilities of a first aider.
3. Terminologies : Casualty / Victim/ First aider/ refer/ Trauma/ Antiseptic/ immobilization / cyanosis/ hemorrhage/Stroke
4. CAB (Circulation, Airway, and Breathing) and the procedure of cardio-pulmonary resuscitation (CPR).
5. Following medical emergencies, their causes, symptoms and first aid management:
  - a) Shock
  - b) Intoxication/ Poisoning ( insecticides/rodenticides/drugs/alcohol )
  - c) Introduction of foreign bodies in ear, nose, throat and eyes.
  - d) Road traffic accidents (RTAs)
  - e) Hemorrhage
  - f) Burns
  - g) Frostbite
  - h) Strokes
  - i) Acute mountain sickness
  - j) Broken bones and dislocation
  - k) Rabid animal bite
  - l) Snake and insect bite

**PRACTICAL**

**39 hrs (19 x 2 hrs/period)**

**Perform the following tasks:**

- 1. Basic Hygiene and Sanitation** **6 hrs**
  - a) Analyze the quality of drinking water in microbiology lab.
  - b) Perform standard hand washing techniques.
  - c) Cooperate with other team members in sanitary activities in the community.
  
- 2. Health education needs, methods and media** **8 hrs**
  - a) Conduct a health problem related survey in nearby community by means of questionnaire.
  - b) Prepare a modular health education plan for deliberation of health education in selected community or health post.
  - c) Use following health education method effectively:
  - d) Perform Communication exercise, Group discussion, and Role play, Counselling, Lecture, Demonstration and Exhibition.
  - e) Collect and compile health education materials from different organisation.
  - f) Prepare simple media for health education like Poster, Flannel graph, Models, Charts and graphs, Puppets and Pamphlets
  
- 3. Field Visits: (at least three among following visits are compulsory)** **15 hrs**
  - a) Observe hospital waste disposal techniques in the clinical laboratory of Tertiary

- care hospital or NPHL.
- b) Observe water purification process on large scale (Industrial level) to the nearby water purification plant.
- c) Observe current health care delivery system through national health facility.
- d) Observe milk processing (pasteurization, safe packaging and transport) in a nearby firm.
- e) Observe waste disposal technique

#### 4. First Aid

10 hrs

- a) Measure temperature, pulse, respiration, blood pressure and Body mass index (BMI).
- b) Demonstration of injection, application of dressing, bandages and splint.
- c) Perform cardio-pulmonary resuscitation.
- d) Role play by learners on different medical emergencies.

#### Reference Books

1. Park's Textbook of Preventive and Social Medicine - K Park
2. Basic Principles of Management - Shrestha, B.M Akshyulak Publication, Nepal. 2039B.S.
3. Inventory Control and Basic Logistics Procedure Manual on Store Management for PHC/HP and SHP Personnel. HMG/JSI. 2054B.S.
4. Textbook of Preventive and Social Medicine - Park, K. B. Bhanot, Jabalpur, India. 2000.
5. Health Logistics Procedure Manual. - NHTC/LMD/USAID JSI, Nepal 2057.
6. Health Statistics and EPI Cold Chain Management Procedure Manual. - NHTC/LMD/USAID JSI, Nepal 2057.
7. A Handbook of Hygiene and Public Health - Y.P. Bedi.
8. W.H.O. Excreta disposal
9. Environmental Health and Sanitation - Shatrughna Ojha.
10. Annual Report of Department of Health Services, Ministry of Health
11. Textbook of Health Education - Hari Bhakta Pradhan; Educational Resource for Health, Kathmandu, 1997.
12. A Text Book of Health Education, - L. Ramachandran and T Dharmalingam, Vikas Publishing House Pvt. Ltd., New Delhi, 2001
13. Text Book of Health Education – A Process of Human Effectiveness - David Bedworth & Albert Bedworth, Harper and Row, NY, 1978
14. Introduction to Health Education, - Water H. Green and Bruce G. Simons- Morton, Macmillan Publishing Company, NY
15. First Aid - St. John Ambulance
16. First Aid –ICRC
17. First Aid and Emergency Nursing - N N. Yalayyaswamy

## Third Year

### Subjects

1. Histopathology and Cytopathology technique
2. Instrumentation and Automation
3. Clinical Laboratory Management, Quality Assurance & Laboratory practices
4. Clinical Practice I, Microbiology and Parasitology (Hospital Based)
5. Clinical Practice II, Hematology and Blood Banking (Hospital/Blood bank Based)
6. Clinical Practice III, Biochemistry, Histopathology and Cytopathology (Hospital Based)

# Histopathology and Cytopathology

**Year: III**

**Total hrs: 168 hrs (14 hrs/wk for 12 wk)**

**Theory: 96 hrs (8 hrs/wk)**

**Practical: 72 hrs (6 hrs/wk)**

## Course Description

This course is designed to provide basic knowledge and skills on diagnostic histopathological and Cytopathological techniques performed on biopsy, autopsy, exfoliated and aspirated materials. It also help learners to establish and conduct an organized histopathology and cytopathology laboratory with minimum risks and hazards as well as allows learners for troubleshooting on frequent faults and instrumental errors.

## Course Objectives

After the completion of this course, the students will be able to:

1. Develop the concept on histopathology and Cytopathology techniques.
2. Perform proper reception, fixation and storage of histological and cytological specimens.
3. Prepare solid tissue blocks through tissue processing of gross sections and their molding.
4. Orient on decalcification techniques for calcified tissue materials.
5. Familiarize with microtome procedure, its types and importance of each with major troubleshooting.
6. Stain tissue sections and cytological smears for microscopy.

## Course Contents

### Unit 1: Histopathology

**10 hrs**

- Introduction
- General concept of Histology, Histopathology.
- Role of Histopathology in the diagnosis of disease.
- Basic requirement of Histopathology Laboratory.
- General organization of Histopathology laboratory.
- Receiving and Labeling the specimens
- Grossing technique and Specimen management
- Hazards of biological specimen and disposal of specimen.

### Unit 2: Fixation

**10 hrs**

- Introduction
- Properties of fixatives
- Function of fixatives
- Classification of fixatives.
- Modes of actions.
- Indications
- Preparation of various fixatives (10 % formalin , 10 % formal-saline , Zenker's fluid , Bouin's Fluid, Clark's Fluid)

- Unit 3: Tissue Processing** **10 hrs**
- Fixation
  - Dehydration
  - Clearing
  - Infiltration and Impregnation
  - Embedding: Different types of embedding media, Advantage and Disadvantage
  - Automated Tissue Processor
    - Working Principle
    - Components
    - Operation and Maintenance
- Unit 4: Decalcification** **10 hrs**
- Introduction and importance
  - Selection of tissues for Decalcification
  - Decalcification methods
  - Factors affecting decalcification
  - Determination of end point
  - Neutralization of acid
  - Washing
  - Treatment of hard tissue
- Unit 5: Microtomy** **12 hrs**
- Introduction
  - Use of Microtome
  - Types of Microtome
  - Advantage and Disadvantage
  - Tissue section cutting using rotary microtome
  - Care and maintenance
  - Microtomeknives
    - Selections of knives
    - Sharpening of knives
    - Automatic Knife sharpener
    - Care and Maintenance
- Unit 6: Frozen Sections / Cryostat** **6 hrs**
- Overview
  - Technique of Frozen section using cryostat
  - Staining of frozen section ( Rapid Staining)
- Unit 7: Staining Technique** **12 hrs**
- Introduction and Terminology (Mordant, Dye, blueing, differentiation, accelerator)
  - Hematoxylin and its types.
  - Eosin and its types.
  - H & E staining: Principle, reagent preparation, procedure, observation,
  - Principle, requirements, procedure and results of :

- PAS
- Alcian blue
- ZeihlNeelson
- Congo Red
- Sudan Black

**Unit 8: Mounting Media** **4 hrs**

- Introduction and importance
- Types of mounting media
- Mounting of specimen.

**Unit 9: Basic concept of Immuno-histo-chemistry.** **8 hrs**

**Unit 10: Cyto-pathology** **14 hrs**

- Introduction
- Scope and importance of Cytopathology
- Cytopathology Technique
  - Exfoliative cytology
  - Specimen collection of Gyanecological and Non -Gyanecologicalspecimen.
  - Preparation of Cytosmear (Viscid secretion,Cerebro Spinal Fluid (CSF) and other body fluids, Sputum, urine, Bronchial aspiration)
  - Fixation of cytology specimen – various fixatives, Advantage and Disadvantages.
  - Principle, requirements, procedure and results of :
    - Papanicolaou (PAP) stain
    - May Grunwald-Giemsa (MGG) stain
  - Fine Needle Aspiration Cytology (FNAC):Importance, requirement, Procedure, advantage and disadvantage
- Sampling, staining and Demonstration of Barr body.

**Practical** **72hrs (36 x 2 hrs/period)**

1. Handle microscope.
2. Prepare fixatives and fixation of tissues.
3. Collect, transport & fix samples for histotechnological & cytological studies.
4. Process the grossed tissues.
5. Cut sections using rotary microtome to get ribbons of tissue sections.
6. Prepare reagents & stains used for Hematoxylin & Eosin stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
7. Prepare reagents & stains used for Giemsa and Papanicolaou stains.
8. Stain sections by H/E stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
9. Prepare cytological fixatives and fixation of cells.
10. Prepare cytological smears and stain with pap method.
11. Stain FNAC smears by Giemsa and Papanicolaou methods.
12. Mount stained smears/section.
13. Perform semen analysis.
14. Demonstrate Barr body by Aceto-Orcein staining method.

## Reference Books

1. Theory and Practice of Histological Techniques. 5<sup>th</sup> Edition. - John D. Bancroft, Alans Stevens and David R. Turner
2. Diagnostic Cytology and its histologic bases- L.G. Koss, Fourth Edition.
3. Gradwohl's clinical Laboratory methods and diagnosis. Edited by Alex C. Sonnenwirth and Leonard Jenett.
4. Quarterly, annual and special Publications of the International Union for Health Education and Health Promotion and Victoria Health Foundation
5. Cytology Technical Manual-Cytology Research Center ICMR (India)
6. The "Pap Smear" – M.E. Boon
7. Practical Cytology – Ron Bowdich
8. Comprehensive Cytopathology – Marluce Bibbo, Second Edition.

# Instrumentation and Automation

**Year: III**

**Total hrs: 168 hrs (14 hrs/wk for 12wk)**

**Theory: 96 hrs (8 hrs/wk)**

**Practical: 72 hrs (6 hrs/wk)**

## Course Description

This course is designed to provide basic knowledge and skills on instrumentation and automation in clinical laboratory. It helps develop basic but comprehensive knowledge of commonly used instruments and techniques in clinical laboratory, their uses, working principle, procedure, maintenance and precautions during performance of various laboratory tests.

## Course Objectives

After the completion of this course, the student will be able to:

1. Explain the need of instrumentation and automation for the diagnosis of the diseases.
2. Classify the medically important instruments for the diagnosis of specific diseases.
3. Describe the care, handling and maintenance of instruments.
4. Discuss the load of samples and need for automation.

## Course Content

### THEORY

**96 hrs**

#### Unit 1: Instrumentation:

**20 hrs**

1.1 Introduction, principle, types, importance, operation, applications, advantages, disadvantages and maintenance of following biomedical instruments:

- Microscopes
- Centrifuge
- Micropipettes
- Photometric system used in peripheral laboratory (Colorimeter, Spectrophotometer and Flame photometer)
- pH meter
- Ion selective electrode (ISE)
- Analytical balance.
- Bio-safety Cabinets

#### Unit 2: Hi-Tech Instruments and Technology

**16 hrs**

2.1 Introduction, Principle, applications of following biomedical instruments:

- Chromatography set,
- Electrophoresis set,
- Polymerase Chain Reaction (PCR)
- Flow Cytometry
- High Performance Liquid Chromatography (HPLC)
- Fluorescent and Electron microscopy

**Unit 3:Immunochemical Techniques:** **20 hrs**

3.1 Introduction, Principle and applications of following technologies:

- Enzyme linked immunosorbent assay (ELISA)
- Radioimmunoassay (RIA)
- Chemiluminescence immunoassay (CLIA)
- Electrochemiluminescent immunoassay (ECLIA)

**Unit 4: Automation** **40 hrs**

4.1 Automatic analyzers: Introduction, working principle, components, applications, advantages and disadvantages of:

- Continuous flow systems
- Discrete analyzers (Semi and fully automated)
- Centrifugal analyzers
- Dry Chemistry analyzers
- Robotic analyzers

4.2 Blood cell analyzer: Introduction, working principle, components, applications.

4.3 ELISA reader and washer.

4.4 Automated electrolyte analyzers

4.5 Arterial blood gas analyzer and its applications.

4.6 Applications of computer in automation.

**PRACTICAL** **72 hrs (36 x 2 hrs/period)**

**Unit 1: Instrumentation and Automation**

**1.1 Handle the following instruments with quality control assurance in diagnostic lab:**

- a. Colorimeter and Spectrophotometer,
- b. Centrifuge,
- c. Water bath
- d. Microscope
- e. Micropipettes

**1.2 Demonstrate:**

- a. Chromatography set
- b. Electrophoresis set

**1.3 Demonstrate automated equipment:**

- a. Fully automated analyzers
- b. Semi automated analyzers
- c. Automated electrolyte analyzers
- d. Blood cell analyzers
- e. ELISA reader and washer
- f. Blood gas analyzer

**Recommended Books**

1. Lynch's Medical Laboratory Technology by Raphael
2. Gradwohl's Clinical laboratory methods and diagnosis; Volume I & II by Garett.

# Clinical Laboratory Management

**Year: III**

**Total hrs: 132 hrs (11 hrs/wk for 12 wk)**

**Theory: 72 hrs (6 hrs/wk)**

**Practical: 60 hrs (5 hrs/wk)**

## Course Description:

This course is designed to provide basic knowledge and skills on laboratory management, quality assurance (QAs) in laboratory practice & Laboratory Practices. Good quality management, QAs & lab practice plays a vital role to improve quality of lab services and safety to community as well as operators. This course provides the students with knowledge to develop confidence, effectiveness, efficiency, accountability in laboratory management and quality work.

## Course Objectives:

At the end of the course, the students will be able to:

1. Implement appropriate quality assurance program
2. Design a functional laboratory.
3. Ensure safe & healthy laboratory management.
4. Perform all routine and some special laboratory procedures independently and accurately,
5. Implement bio-safety and waste management measures.
6. Build confidence on laboratory procedures before OJT.

## Theory

### Unit 1: Introduction to clinical laboratory management 8 hrs

- 1.1 Introduction and objective of the laboratory management
- 1.2 Laboratory management framework
- 1.3 National health care delivery system of Nepal in regard to Laboratory profession
- 1.4 Code of conduct of medical laboratory profession.
- 1.7 Level of clinical laboratories according to complexity and National guidelines

### Unit 2: Department /section of clinical laboratory 5 hrs

- 2.1 Different sections of clinical laboratory, corresponding services and their uses.
  - a. Patient communication (Delivery of information and reports)
  - b. Sample collection
  - c. Haematology
  - d. Blood banking
  - e. Clinical biochemistry
  - f. Microbiology
  - g. Serology/immunology
  - h. Parasitology
  - i. Histopathology & Cytopathology
  - j. Emergency lab
  - k. Molecular Laboratory
- 2.2 Services (range of tests done by CMLT or lab technician level)

**Unit 3: Laboratory design:** **5 hrs**

3.1 Basic concept of laboratory organization:

- Location,
- Space requirement,
- Light,
- Ventilation,
- Temperature control,
- Humidity,
- Electrical supply,
- Water supply,
- Sanitation,
- Noise control,
- Use of fume hood/safety hood

3.2 Human resource in different levels of laboratory

**Unit 4: Laboratory work flow** **6 hrs**

4.1 Description of work flow

- Appropriate specimen collection,
- Specimen organization and transport,
- Laboratory investigation
- Report preparation and patient communication.

**Unit 5: Personnel management** **2 hrs**

5.1. Staff duty rotation

5.2. Importance of continued medical education/training

**Unit 6: Standard operating procedures (SOPs):** **4 hrs**

6.1 Introduction to standard operating procedures (SOP)

6.2 Essential components of SOPs

6.3 Significance of SOPs in clinical practices

**Unit 7: Clinical laboratory Inventory Management:** **6 hrs**

7.1 Clinical laboratory records

7.2 Requisition slips (Test request form/TRF)

7.3 Lab reports format of different section

7.4 Record keeping and its importance

7.5 Maintain stock inventory

7.6 Maintaining expiry charts

7.7 Important of instrument maintenance sheet (Refrigerator, Incubator)

7.8 Important of daily cleaning record sheet

7.9 Logistics management

7.10 Important of computer in lab

7.11 Local information system (LIS) in modern lab

**Unit 8: Lab hazards and lab safety:****10 hrs**

- 8.1 Lab hazards and lab safety
- 8.2 Important and uses of safety and protection in clinical laboratory practices
- 8.3 Important 0.5-1% hypochlorite
- 8.4 Use and how to prepare spilt kit
- 8.5 Management of needle stick injury, spillages accident in laboratory and their first aid
- 8.6 Common accident in lab and their first aid
- 8.7 Material safety data sheet and hazardous chart symbols.
- 8.8 Common laboratory hazards in clinical laboratory:
  - Unsafe premises,
  - Naked flames/fire,
  - Microbial hazards/biological,
  - Chemical and explosions,
  - Sharp and glass ware
  - Unreliable water supply,
  - Infestation by ants, rodents, etc.
- 8.9 Laboratory Safety measures
  - Personal protective equipment (PPE)
  - Health and safety of the staff
  - Equipment and procedural safety

**Unit 9: Total quality management (TQM) and Quality Assurance & QAs****9 hrs**

- 9.1 Introduction,
- 9.2 Total Quality Management Framework.
  - Quality Assessment
  - Quality Assurance
  - Quality Laboratory Procedures
  - Quality Control
- 9.3 Internal Quality Control
- 9.4 External Quality Control
- 9.5 Quality Control charts – L-J chart
- 9.6 Phases in IQC
  - Preventive phases
  - Retrospective phases
- 9.7 Terminologies used in Quality Assurance program/ Selection of analytical methods
  - Accuracy
  - Precision
  - Sensitivity
  - Specificity
  - Standard
  - Control ( Positive , Negative , High, normal , low sera)
  - Standard deviation ( SD)
  - Coefficient of variation(CV)

- Mean
- Use of control and calibration in laboratory in practices

#### 9.8 Sources of error

- Pre-analytical
- Analytical
- Post-analytical

#### 9.9 Method of improving laboratory reports

### **Unit 10: Bio-safety and bio-security:**

**6 hrs**

#### 10.1 Introduction to bio-safety and bio-security

#### 10.2 Risk group classification of micro-organisms: risk group 1 to risk group 4

#### 10.3 Concept of Bio-safety levels: BSL 1 to BSL 4

#### 10.4 Laboratory waste management:

- Segregation of waste
- Uses of color coded bins: red, blue, yellow, green, black, white bins, Sharp bins
- Treatment & disposal of waste

#### 10.5 Concept of 3R (Reduce, Reuse and Recycle)

### **Unit 11: Medical ethics**

**5 hrs**

#### 11.1 Medical ethics and its principles

#### 11.2 Confidentiality

#### 11.3 Ethical consent

#### 11.4 Accreditation: Brief introduction to:

- National Public Health Laboratory(NPHL) Teku, Nepal
- International standardization organization (ISO-in lab)
- National Accreditation Board for Testing and Calibration Laboratories (NABL)
- The College of American Pathologists (CAP's) & Clinical laboratory improvement Amendment (CLIA)

#### 11.5 Nepal health provisional council (NHPC) code of conduct for laboratory practices

### **Unit 12: Clinical Lab Practices:**

**6 hrs**

#### 12.1 Specimen collection, preservation and its significant

#### 12.2 Bar-coding /labelling and its significant

#### 12.3 Separation of serum and Plasma and its uses

#### 12.4 List of tests and significant interpretation of:

- RFTs/KFTs (Renal function tests)
- LFTs (Liver function tests)
- Lipid Profiles
- Pancreatic profiles test
- TFTs (Thyroid Function test)
- HbA1c
- Blood sugar F/PP/R

- Urine R/E, stool R/E, occult blood
- Semen analysis
- Rapid kit screening test by ICT (Immuno-chromatography)
- Acid fast bacilli stain
- Grams stain
- CBC

<b>Practical:</b>	<b>60 hrs (30 x 2 hrs/period)</b>
<b>A. Perform basic computer skills on word and excel.</b>	<b>22 hrs (11 x 2 hrs/period)</b>
<b>B. Lab related practical:</b>	<b>38 hrs (19 x 2 hrs/period)</b>

1. Observe different departments in lab (biochemistry, microbiology, hematology, parasitological, collection etc)
2. List out the instruments, glassware, accessories used, along with their uses.
3. Observe and practice specimen collection
4. Perform coding of sample received/collected.
5. Transport and process specimen
6. Assist to prepare duty rotation
7. Prepare SOPs for different tests (Glucose, hemoglobin, gram stain, urine routine examination)
8. Collect different report formats and daily maintain sheet
9. Assist to prepare computerized reports
10. Maintain lab records, use computers in record keeping.
11. Observe use of IQC materials
12. Identify different hazards in lab and use of those hazard symbols
13. Use personal protective equipment in lab and follow safety measures
14. Segregate waste, use proper colour coded bins and safe disposal of waste
15. Prepare and use expiry charts
16. Observe management of inventory and maintain stock records
17. Practice on vacationer system for blood sample collection
18. Prepare 0.5 & 1 % hypochloride solution
19. Calculate Mean, CV, SD value

#### **References:**

1. Carl A Burtis, Edward R Ashwood, David E Bruns, Teitz (2008) Text book of clinical chemistry and molecular diagnostics, Elseviers
2. Cheesbrough M, (2004) District laboratory practice in tropical countries, Cambridge University press
3. Bharucha C. et al (1970), A handbook of medical laboratory technology, Christian Medical College, vellore
4. Henry JB (2006), Clinical diagnosis and management by laboratory methods, W.B. Saunders
5. Mukherjee KL, (2013), Medical laboratory technology (volumes I-III), Mcgraw Hill professional
6. World health organization (WHO) (2005), laboratory biosafety manual

7. Barbara H. Estridge, Anna P. Reynolds, Norma J. Walters, (2000), Basic Medical Laboratory Techniques, Cengage Learning
8. Praful B. Godkar, Darshan P. Godkar, (2014), Textbook of Medical Laboratory Technology (volume I-II), Bhalani Publishing House
9. NPHL (2063 BS), health laboratory establish and opening protocol, National public health laboratory, Teku, Nepal.

## **Clinical Practice I (Microbiology and Parasitology)** **(Hospital/Laboratory Based)**

Students will be posted in hospital/laboratory with microbiology and parasitology facilities for 9 weeks at the end of course (i.e. in third year) for clinical practice. For this, students must be posted in all related Departments/Section of diagnostic laboratory on rotation basis.

### **Course Description**

This clinical practice program is designed to help the students to apply the comprehensive knowledge and skills learned in the training institute on actual situation. The program is offered after completing twelve weeks institution based training in third year.

### **Course Objectives**

At the end of the course, the students will be able to:

1. Perform all routine and some special laboratory procedures independently and accurately as mentioned below, and
2. Build confidence on laboratory procedures.

### **Placement schedule**

The whole class of students will be divided into five groups and placed for the following sections of the pathology department.

<b>S.N.</b>	<b>Practical Areas</b>	<b>Duration</b>
1.	Microbiology Lab.	5 Weeks
2.	Parasitology Lab	4 Weeks
	<b>Total Duration</b>	<b>9 Weeks</b>

### **Skills to be performed during the clinical practice**

Each student should perform the following skills independently and accurately during the clinical practice.

#### **A. Bacteriology**

1. Microscope
2. Sample collection
3. Sterilization and safety precautions
4. Gram stain
5. AFB stain ( Tuberculosis/ leprosy )
6. Urin culture/ sensitivity
7. Blood C/S for Salmonella
8. Pus culture/ sensitivity
9. Stool C/S
10. Throta swab C/S
11. Body fluid C/S
12. Wound swab C/S

## **B. Immunology/Serology**

1. Salmonella agglutination test (Widal test)
2. RPR (VDRL) test
3. Rheumatoid Arthritis factor (RA factor) test
4. Antistreptolysin 'O' (ASO) test
5. C-Reactive Protein (CRP) test
6. Aldehyde test
7. HIV I-2 antibody spot (Quick) test
8. HBs Ag spot (Quick) test
9. Anti HCV spot (Quick) test
10. TPHA (Treponema pallidum Hemagglutination test)

## **C. Parasitology**

### **Urine Analysis**

1. Routine/Microscopic examination
2. Albumin
3. Glucose (sugar)
4. Specific gravity
5. Bile salt Bile pigment
6. Reducible substance
7. Acetone/Ketone
8. Urine pregnancy test (Qualitative and quantitative)
9. Chyle
10. Urobilinogen.

### **Stool Examination**

1. Routine/Microscopic Examination
2. Occult blood test
3. Reducing Substances
4. Concentration method for parasitic ova & cysts

## **D. Miscellaneous:**

1. Perform semen analysis.
2. KOH & germ tube test for fungal study.
3. CSF/body fluid for:
  - Cell count (TLC & DLC)
  - Sugar estimation.
  - Protein estimation.

Students should be present in the departments at least 90% of the allotted days to be eligible to sit in the final examination. Students will have to perform all tests under the supervision of departmental staffs and may be allowed to perform tests independently if the supervisor finds them

perfect. Students should keep their practical record (logbook) signed periodically by their supervisor/instructor at the end of the posting in each subject.

### Evaluation Scheme

Under this scheme students will have to perform a prescribed number of tests in each department. At the end of the term the teacher or supervisor closely evaluates their performance for accuracy and precision according to the evaluation sheet proposed. At the end of the course there will be a final practical and oral examination.

### Distribution of marks for evaluation

S.N.	Evaluator/Paper	Distribution of marks			Total Marks
		Internal	Final	Exam Time	
1	Related laboratory supervisor/teacher (continuous evaluation)	100			100
2	CTEVT appointed examiner (at the end of the field practice)		100	4 Hrs	100
<b>Total</b>		<b>100</b>	<b>100</b>		<b>200</b>

**Important note:** *Each student must pass in each of the section of the evaluation as presented above with a minimum of 50% marks.*

## **Clinical Practice II (Hematology and Blood Banking)** **(Hospital/Blood Bank Based)**

Students will be posted in hospital/blood bank with hematology and blood banking facilities for 9 weeks at the end of course (i.e. in third year) for clinical practice. For this, students must be posted in all related Departments/Section of diagnostic laboratory and blood bank on rotation basis.

### **Course Description**

This clinical practice program is designed to help the students to apply the comprehensive knowledge and skills learned in the training institute on actual situation. The program is offered after completing twelve weeks institution based training in third year.

### **Course Objectives**

At the end of the course, the students will be able to:

1. Perform all routine and some special laboratory procedures independently and accurately as mentioned below, and
2. Build confidence on laboratory procedures.

### **Placement schedule**

The whole class of students will be divided into five groups and placed for the following sections of the pathology department.

<b>S.N.</b>	<b>Practical Areas</b>	<b>Duration</b>
1.	Hematology and Blood Banking Lab	9 Weeks
	<b>Total Duration</b>	<b>9 Weeks</b>

### **Skills to be performed during the clinical practice**

Each student should perform the following skills independently and accurately during the clinical practice.

#### **A. Haemmatology and Blood banking**

1. Total leucocyte count (TLC)
2. Differential leucocyte count (DLC)
3. Erythrocyte sedimentation rate (ESR)
4. Packed cell volume (PCV)
5. Hemoglobin (HB)
6. Bleeding time (BT)
7. Clotting Time (CT)
8. Prothrombin Time (PT)
9. Platelet Count
10. RCB Count
11. Reticulocyte Count
12. Blood grouping (ABO)
13. Rh typing
14. Cross matching

15. Coombs tests
16. Haematological indices ( MCV, MCH & MCHC)
17. Haemoparasites (M.P, MF)

Students should be present in the departments at least 90% of the allotted days to be eligible to sit in the final examination. Students will have to perform all tests under the supervision of departmental staffs and may be allowed to perform tests independently if the supervisor finds them perfect. Students should keep their practical record (logbook) signed periodically by their supervisor/instructor at the end of the posting in each subject.

### Evaluation Scheme

Under this scheme students will have to perform a prescribed number of tests in each department. At the end of the term the teacher or supervisor closely evaluates their performance for accuracy and precision according to the evaluation sheet proposed. At the end of the course there will be a final practical and oral examination.

#### Distribution of marks for evaluation

S.N.	Evaluator/Paper	Distribution of marks			Total Marks
		Internal	Final	Exam Time	
1	Related laboratory supervisor/teacher (continuous evaluation)	100			100
2	CTEVT appointed examiner (at the end of the field practice)		100	4 Hrs	100
<b>Total</b>		<b>100</b>	<b>100</b>		<b>200</b>

**Important note:** *Each student must pass in each of the section of the evaluation as presented above with a minimum of 50% marks.*

## **Clinical Practice III (Biochemistry, Histopathology and Cytopathology) (Hospital/Laboratory Based)**

Students will be posted in hospital/laboratory with Biochemistry, Histopathology and Cytopathology facilities for 10 weeks at the end of course (i.e. in third year) for clinical practice. For this, students must be posted in all related Departments/Section of diagnostic laboratory and blood bank on rotation basis.

### **Course Description**

This clinical practice program is designed to help the students to apply the comprehensive knowledge and skills learned in the training institute on actual situation. The program is offered after completing twelve weeks institution based training in third year.

### **Course Objectives**

At the end of the course, the students will be able to:

1. Perform all routine and some special laboratory procedures independently and accurately as mentioned below, and
2. Build confidence on laboratory procedures.

### **Placement Schedule**

The whole class of students will be divided into five groups and placed for the following sections of the pathology department.

<b>S.N.</b>	<b>Practical Areas</b>	<b>Duration</b>
1.	Biochemistry Lab	5 Weeks
2.	Histopathology & Cytopathology Lab	5 Weeks
	<b>Total Duration</b>	<b>10 Weeks</b>

### **Skills to be performed during the clinical practice**

Each student should perform the following skills independently and accurately during the clinical practice.

#### **A. Biochemistry**

Preparation of different types of solution of acid and bases, blood /Urine/CSF and other body fluids for.

1. Glucose
2. Urea
3. Creatinine
4. Uric acid
5. Total Protein
6. Albumin Globulin
7. Albumin Globulin ratio
8. Amylase, Lipid profile
9. Bilirubin
10. ALT (SGPT)

11. AST (SGOT)
12. Alkaline phosphates
13. Sodium, potassium
14. Chloride and Calcium

**Note: Prepare standard graph of various test.**

## **B. Histopathology & Cytopathology:**

1. Handle Microscope
2. Prepare fixatives and fixation of tissue
3. Collect, transport and fix histopathological and cytopathological specimens.
4. Process the grossed tissue
5. Cut sections
6. Prepare reagents and stains used for Heamatoxylin & eosin stains, PAS/Alcian blue and ziehl- Neelsen stain.
7. Prepare reagents and stains used for Giemsa and Papanicolaou stain
8. Stain the section by H/E and Ziehl-neelsen stain
9. Prepare cytological fixative and fixation of cells
10. Prepare cytological smears and stain with pap method
11. Stain FNAC smears by Giemsa and pap method.
12. Mount stained smears/sections
13. Perform Aceto-orcein staining for Barr bodies.

Students should be present in the departments at least 90% of the allotted days to be eligible to sit in the final examination. Students will have to perform all tests under the supervision of departmental staffs and may be allowed to perform tests independently if the supervisor finds them perfect. Students should keep their practical record (logbook) signed periodically by their supervisor/instructor at the end of the posting in each subject.

### **Evaluation Scheme**

Under this scheme students will have to perform a prescribed number of tests in each department. At the end of the term the teacher or supervisor closely evaluates their performance for accuracy and precision according to the evaluation sheet proposed. At the end of the course there will be a final practical and oral examination.

### **Distribution of marks for evaluation**

S.N.	Evaluator/Paper	Distribution of marks			Total Marks
		Internal	Final	Exam Time	
1	Related laboratory supervisor/teacher (continuous evaluation)	100			100
2	CTEVT appointed examiner (at the end of the field practice)		100	4 Hrs	100
<b>Total</b>		<b>100</b>	<b>100</b>		<b>200</b>

**Important note:** *Each student must pass in each of the section of the evaluation as presented above with a minimum of 50% marks.*

## Experts Involved in Second Revision

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