CURRICULUM

Technical School Leaving Certificate

Medical Laboratory Technology

(18 months program)

Council for Technical Education and Vocational Training

Curriculum Development Division

Sanothimi, Bhaktapur

Developed in 1998

First Revision, 2008

Second Revision, 2016

Table of Contents

Introduction:

Nepal Government, Ministry of Education implemented the letter grading system in SLC from 2072 B.S. The door of TSLC programme is open for those students who have appeared in SLC exam and achieved any GPA and any grade in each subject. Focusing on such students the curriculum of TSLC of 29 months and 15 months have been converted into 18 months to create uniformity among different TSLC programme.

This curriculum is designed to produce basic level human resources in the field of human health laboratory services equipped with knowledge, skills and attitude necessary for this level of technicians so as to meet the demand of such technician in the country.

Title:

The title of the programme is TSLC in Medical Laboratory Technology

Aim:

The aim of the programme is to produce health lab assistant to provide health laboratory services to the people through established health institutions by performing all routine and some special laboratory procedures independently and accurately.

Objectives:

After completing this curricular program, the students will be able to:

- familiarize with medical laboratory procedures and practices applicable in diagnosing human health disorders
- perform basic haematological tests
- carryout clinical biochemical tests
- perform medical microbiological tests
- perform medical parasitological tests
- familiarize with communicable diseases
- assist to manage laboratory

Programme Description:

This programme is based on the job required to be performed by a health lab assistant. This course intends to provide knowledge and skills about medical laboratory procedures. It especially, provides the knowledge and skills focussing on various medical laboratory tests such as haematological tests, biochemical tests, microbiological tests and parasitological tests as provisioned by the government of Nepal. It also deals with blood banking, first aid and communicable diseases.

Course Duration:

This course will be completed within 18 months (40 hrs/week X 39 weeks a year = 1560 hrs.) class plus 6 months (40 hrs/week X 24 weeks = 960 hrs. on the job training (OJT).

Entry criteria:

Individuals with following criteria will be eligible for this program:

- SLC with any grade and any GPA (Since 2072 SLC).
- SLC appeared (Before 2072 SLC)
- Pass entrance examination administered by CTEVT

Group size:

The group size will be maximum 40 (forty) in a batch.

Medium of Instruction:

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

Pattern of Attendance:

The students should have minimum 90% attendance in theory classes and practical/performance to be eligible for internal assessments and final examinations.

Instructors' Qualification:

- Instructors should have bachelor degree in Medical Lab Technology (BMLT) or PCL in Medical Lab Technology with minimum 5 years practical based experiences.
- The demonstrator should have PCL in Medical Lab Technology with minimum 2 years practical based experiences.
- Good communicative/instructional skills

Teacher and Student Ratio:

- Overall at institutional level: 1:10
- Theory: 1:40
- Practical: 1:10
- Minimum 75% of the teachers must be fulltime

Instructional Media and Materials:

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

- Printed media materials (assignment sheets, handouts, information sheets, procedure sheets, performance check lists, textbooks, newspaper etc.).
- Non-projected media materials (display, models, photographs, flip chart, poster, writing board etc.).
- Projected media materials (multimedia/overhead transparencies, slides etc.).
- Audio-visual materials (films, videodiscs, videotapes etc.).
- Computer-based instructional materials (computer-based training, interactive video etc.)

Teaching Learning Methodologies:

The methods of teaching for this curricular program will be a combination of several approaches such as;

- Theory: lecture, discussion, assignment, group work, question-answer.
- Practical: demonstration, observation, simulation, guided practice and self-practice.

Evaluation Details:

- The marks distribution for theory and practical tests will be as per the marks given in the course structure of this curriculum for each subject. Ratio of internal and final evaluation is as follows:

S.N.	Particulars	Internal Assessment	Final Exam	Pass %
1.	Theory	50%	50%	40%
2.	Practical	50%	50%	60%

- There will be three internal assessments and one final examination in each subject. Moreover, the mode of assessment and examination includes both theory and practical or as per the nature of instruction as mentioned in the course structure.
- Every student must pass in each internal assessment to appear the final exam.
- Continuous evaluation of the students' performance is to be done by the related instructor/ trainer to ensure the proficiency over each competency under each area of a subject specified in the curriculum.
- The on-the-job training is evaluated in 500 full marks. The evaluation of the performance of the student is to be carried out by the three agencies; the concerned institute, OJT provider industry/organization and the CTEVT Office of the Controller of Examinations. The student has to score minimum 60% for successful completion of the OJT.

Grading System:

The grading system will be as follows:

Grading	Overall marks
Distinction	80% or above
First division	75% to below 80%
Second division	65% to below 75%
Third division	Pass aggregate to below 65%

Certificate Awarded:

The council for technical education and vocational training will award certificate in "**Technical School Leaving Certificate in Medical Laboratory Technology"** to those graduates who successfully complete the requirements as prescribed by the curriculum.

Job Opportunity:

The graduate will be eligible for the position equivalent to Non-gazetted 2nd class/level 4 (technical) as Health Lab Assistant or as prescribed by the Public Service Commission. The graduate is eligible for registration with the Nepal Health Professional Council in the grade as mentioned in the NHPC Act.

Course Structure

TSLC in Medical Lab Technology

S. N	Subjects	Nature	Hours /Week	Theory & Practical hours			Full Marks		
				T	P	Total (T+P)	T	P	Total
1.	Basic Anatomy and Physiology	T+P	2	78		78	50	0	50
2.	Hematology and Blood Banking	T+P	6	78	156	234	50	100	150
3.	Clinical Biochemistry	T+P	6	78	156	234	50	100	150
4.	Medical Microbiology	T+P	6	78	156	234	50	100	150
5.	Medical Parasitology	T+P	6	78	156	234	50	100	150
6.	First Aid and Communicable Diseases	T+P	3	78	39	117	50	30	80
7.	Laboratory Management and Quality Assurance	T+P	4	78	78	156	50	50	100
8.	Comprehensive Clinical Laboratory Practice (In clinical laboratory/ Hospital setting)	P	7	0	273	273		170	170
	Total		**40**	**546**	**1014**	**1560**	**350**	**650**	**1000**

On the Job Training

Subject	Nature of Instruction	Duration (Hrs.)	Full marks
On -the -Job Training (OJT)	Practical	960 (6 months)	500
Grand total		**2520**	**1500**

T = Theory, P = Practical

NOTE:

It is mandatory that classes for Applied Integrated Science should be carried out prior to Hematology and blood banking, Clinical Biochemistry, Medical Microbiology and Medical Parasitology.

Basic Anatomy & Physiology

Total: 2 hours /week
Theory: 2 hours/week
Practical: 0 hours/week

Course description:
This curriculum is designed to produce health laboratory personnel equipped with the basic knowledge and skills of anatomy and physiology which will help them to make a correlation in the field of medical laboratory science.

Course objectives:
After completion of this course students will be able to:

1. provide a basic knowledge of anatomy and physiology
2. Understand about anatomy and physiology of human body
3. Correlate the abnormal mechanism of the body in diseased condition.

Course Contents:

Unit 1: Basic terminologies; Types and Structure of cells and tissues [6 hrs]

1.1. Terminologies on anatomy and physiology

1.2. Introduction of cell

1.2.1. Types and Structure of cells

1.3. Cell organelles and their functions

1.4. Introduction of tissue

1.2.2. Types of tissues and their location

1.5. Observation of model/chart of a human cell.

Unit 2: Human Digestive system [10 hrs]

2.1. Structure and function of:

2.1.1. Oral cavity,

2.1.2. Pharynx,

2.1.3. Oesophagus,

2.1.4. Stomach,

2.1.5. Small intestine,

2.1.6. Large intestine

2.2. Accessory organs of Digestive system (Salivary gland, Pancreas and Liver)

2.3. Digestion and absorption of carbohydrate, protein and lipids

2.4. List of Gastrointestinal disorders

2.5. Observation of digestive tract model/chart.

2.6. Observation of model/chart of teeth

Unit 3: Human Respiratory system **[6 hrs]**

3.1. Basic concepts of structure and functions of respiratory system

3.2. Structure and function of nasal cavity, larynx, pharynx, trachea bronchi, alveoli and lungs.

3.3. Types of respiration

3.4. Physiology of respiration.

3.5. Pleural fluid

3.6. List of respiratory diseases.

3.7. Observation of respiratory tract model/chart

Unit 4: Human Renal system **[6 hrs]**

4.1. Basic concepts of structure and functions of the renal system

4.2. Structure and function of Kidney, ureters, urinary bladder, urethra.

4.3. Physiology of Urine formation and composition of urine.

4.4. List of renal diseases

4.5. Observation of model/chart of urinary system

Unit 5: Human Circulatory system **[12 hrs]**

5.1. Basic concept of structure and functions of circulatory system

5.2. Structure of Heart

5.3. Circulation of blood

5.4. Cardiac cycle

5.5. Blood pressure

5.6. Structure of Veins, Arteries, and capillaries

5.7. Functions of blood and its components

5.8. Introduction to haemopoiesis

5.9. Haemostasis

5.10. List of cardiac diseases

5.11. Observation of model/chart of heart

5.12. Observation of normal blood cells.

Unit 6: Human skeletal system **[5 hrs]**

6.1. Basic concept of structure and functions of human skeleton system

6.2. Bone and their functions

6.3. Classification of bones with examples

a. Bones of Axial skeleton

b. Bones of Appendicular skeleton

6.4. Joints, their functions and types.

6.5. Synovial fluid

6.6. Observation of skeleton model/chart.

Unit 7: Human muscular system **[5 hrs]**

7.1. Basic concepts of structure and functions of human muscular system

7.2. Introduction to muscle tissue

7.2.1. Voluntary muscle

7.2.2. Involuntary muscle

7.2.3. Cardiac muscle

7.3. List Muscles proteins and their functions

Unit 8: Human lymphatic system **[5 hrs]**

8.1. Basic concepts of structure and functions of lymphatic system

8.2. Lymphatic vessels and lymph nodes

8.3. Spleen, Thymus and Tonsils

8.4. Circulation of lymph

Unit 9: Human nervous system **[5 hrs]**

9.1. Basic concepts of structure and functions of nervous system:

9.2. Neurons and their types

9.2.1. Central nervous system

9.2.2. Peripheral nervous system

9.2.3. Autonomous nervous system

9.3. Lumbar puncture, CSF and its circulation

9.4. List of CNS disorders

9.5. Observation of model/chart of nervous system (brain, spinal cord)

Unit 10: Human reproductive system **[7 hrs]**

10.1. Basic concepts of structure and functions of reproductive system

10.2. Structure and function of Male and female reproductive organs

10.3. Menstruation cycle and fertilization

10.4. Semen collection and analysis

10.5. List the hormones of reproductive system

Unit 11: Human endocrine system **[5 hrs]**

11.1. Basic concepts of structure and functions of human endocrine system

11.2. List of hormones secreted by: Pituitary gland, Thyroid gland, Adrenal gland, Parathyroid gland, Pancreas, gonads.

Unit 12: Human special sense organs **[6 hrs]**

12.1. Introduction of special sense organs of human body

12.2. Structure and function of eye, ear, nose, tongue and skin

Note: *Students should maintain anatomy practical file covering all the above mentioned systems.*

References:

1. Anne Waugh, Allison Grant (2014), Ross and Wilson Anatomy Physiology in Health and Illness, Churchill Livingstone, Elsevier
2. B.D. Chaurasia (2015), Chaurasia's Human Anatomy (Volume 1, 2 and 3), 6th edition, CBS Publishers and Distributors.
3. Arthur Guyton, John E. Hall, Guyton and Hall Textbook of Medical Physiology, 12th edition, Elsevier.
4. Dr. C. K. Singh (2015), Principles of Anatomy and Physiology, 2nd edition, Highland Publication.
5. Tilak Pathak, R.K. Bhandari (2068), A handbook of Anatomy and Physiology and Medical Laboratory Technology, VidyarthiPustakBhandar.

Clinical Hematology and Blood Banking

Total: 6 hours/week
Theory: 2 hours/week
Practical:4 hours/week

Course description:
This course is designed to provide knowledge of hematopoiesis and function of blood. This course also provides skills on enumeration and identification of blood cells and knowledge about the conditions leading to alteration of normal values in health and in disease.

Course objectives:
After completion of this course students will be able to:

1. Describe the basic concepts of hematology: hematopoiesis, composition and function of blood.
2. Explain the basic knowledge on collection and processing of blood samples, morphology of the cells including abnormal cells, enumeration and identification of blood cells, normal values, and clinical significance of the hematological tests.
3. Carry out basic hematological tests
4. Know the basic knowledge on blood banking and its related tests

Course Contents:

Theory

Unit 1: Basic Hematology [2 hrs]

1.1. Introduction, scope, importance , history
1.2. Terminology and role of hematology in Clinical medicine,

Unit 2: Hematological Instrumentation [10 hrs]

2.1. Haemocyometers: Different Types of haemocytometers.
2.2. Neubauer counting chamber: structure, use and care, observation of chamber under microscope and calculation of WBC, RBC and platelet count (multiplication factor).
2.3. DLC counter – handling, care, and use.
2.4. Centrifuge- general and hematocrit, uses, care and precaution during handling, Separation, preservation and storage of plasma.
2.5. Colorimeter/Hemoglobinometer: Cuvette, Filter - introduction, care, handling and use, practice to properly handle

2.6. Pipettes- Graduated pipette , WBC and RBC pipettes, Micropipettes - introduction, care, proper handling (practice) and use
2.7. Microscope- introduction, care, handling and use (focus), observation of objects (smear)
2.8. Sahli's set- care, handling and use.
2.9. Wintrobe and Westergren ESR tubes and racks: care, handling and use.
2.10. Introduction, handling, cleaning, care and use of glassware and accessories:- Test tubes and Racks, Glass slide, Spreader, Beaker, Volumetric flask, Measuring Cylinder, Reagent bottle (Brown), Dropper, Capillary tube, Blood sample container (vials), Sealer, Timer, Pencil /marker, Graph paper, Calculator.
2.11. Practice of proper handling and cleaning of glass ware.
2.12. Be familiar with or basic knowledge about automation in hematology and short note on coulter counter

Unit 3: Blood and its Composition [2 Hrs]

3.1. Definition, types, Function, properties of blood
3.2. Plasma and its composition
3.3. Difference between plasma and serum
3.4. Normal value of blood cells and its components

Unit 4: Hematopoiesis [7Hrs]

4.1. Definition: Stem cell, Multipotent cells and unipotent cells
4.2. Steps and morphology of Erythropoiesis,Leukopoiesis, Thrombopoiesis
4.3. Factors affecting hematopoiesis

Unit 5: Morphology of blood cells [4 Hrs]

5.1. Normal and abnormal shape and size of red blood cells (anisocytosis, poikilocytosis, normocyte, macrocyte, microcyte, nucleated red blood cells, reticulocytes, normochromic, hypochromic etc.)
5.2. Normal and abnormal morphological features of WBC and platelets.
5.3. Normal values and clinical significance of blood cells and its components

Unit 6: Blood Collection technique [4 hrs]

6.1. Concept in selection of blood sample collection sites, aseptic technique during collection (swabbing), proper handling and disposal of needle/syringe, lancet (sharps).
6.2. Technique of venous blood sample collection, list of materials and chemicals required, procedure, sources of error and precautions.
6.3. Techniques of capillary blood sample collection: Site (Ear lobe, finger and heel) List of materials and chemicals required, procedure, sources of error and precautions.

6.4. Use of capillary and arterial blood sample
6.5. Vacutainer set; procedure for collecting of blood by vacutainer system and its advantages

Unit 7: Anticoagulants [3 hrs]

7.1. Definition of anticoagulants and their types.
7.2. Different anticoagulants used in haematology laboratory and blood banking (EDTA, oxalate, heparin, citrate, CPDA, ACD), their mode of action, advantages and disadvantages.

Unit 8: Hematological diluting fluid, Stain and solution [4 hrs]

8.1. Chemical/reagent and solutions used in hematology laboratory for different tests; use, storage, sources of error and precautions during handling.
  8.1.1. Types of WBC diluting fluids, composition and mode of action of Turk's fluid
  8.1.2. Types of RBC diluting fluids, composition and mode of action of Dacie's formal citrate solution
  8.1.3. Types of Platelet diluting fluids, composition and mode of action of 1% Ammonium oxalate
  8.1.4. Introduction, principle and compositions of Drabkin's fluid.
  8.1.5. Preparation and uses of N/10 HCl
8.2. Stains used in the hematology laboratory, their preparation, material requirement, mechanism of action, types, composition, source of error and precautions
  8.2.1. Romanowskystains: Wright's stain, Leishman's stain, May-Grunwald stain, Giemsa stain, field's stain
  8.2.2. Buffer used in Romanowsky stains and their preparation, importance of pH;
  8.2.3. Supravital Vital stains; New Methylene blue or Brillant Creysl blue

Unit: 9 Preparation of blood smear and staining [4 hrs]

9.1. Ideal thick and thin blood smear: Introduction, principle, list of materials and chemicals required, procedure, uses, sources of error and precautions (fixation and preservation)
9.2. Technique of staining of smear (thick and thin smear); Introduction, principle, list of materials and chemicals required, procedure, sources of error and precautions by Romanowsky stain.
9.3. Blood smear preparation for haemoparasite, list of blood parasites

Unit: 10 Cell count **[8 hrs]**

10.1. Introduction, principle, list of materials required, procedure, reference range, precautions, Sources of error and interpretation of the results during cell count

10.1.1. Differential Leukocyte Count (DLC); definition and causes of Neutrophilia, Neutropenia, Lymphopenia, Lymphocytosis, Eosinophilia etc.

10.1.2. Total leukocyte count (TLC); Basic concept of leukocytosis, leucopenia, leukemia, physiological and pathological variations.

10.1.3. RBC count ; Pathological conditions: Anemia and Polycythemia

10.1.4. Platelet count; Thrombocytosis and thrombocytopenia.

10.1.5. Basic knowledge on reticulocyte count and absolute eosinophil count

Unit: 11 Anaemia and its lab diagnosis **[6 hrs]**

11.1. Definition, and lab test used in diagnosis of anaemia

11.2. Haemoglobin : introduction, types and basic structure

11.3. Introduction, principle, list of materials and chemicals required procedure, reference range, precaution, demerits and merit and sources of error

11.1.1. Estimation of Hemoglobin by Sahli's method:

11.1.2. Estimate Hemoglobin concentration by colorimetric (cyanmethaemoglobin) method:

11.4. Prepare hemoglobin standard curve: Introduction, principle, list of materials and chemicals required, procedure, and precautions and uses in lab

Unit 12: ESR, PCV and Red cell Indices **[7 hrs]**

12.1. Introduction, principle, list of materials and chemicals required procedure, precautions and sources of error of the test. Different methods, reference range and pathological conditions

12.1.1. Packed cell volume estimation(PCV) :

12.1.2. Erythrocyte sedimentation rate (ESR) : Wintrobe and Westergren method:

12.2. Calculation of erythrocyte indices and its uses

Unit 13: Blood coagulation and Clotting factor **[5 hrs]**

13.1. Definition of coagulation and enlist blood clotting factors

13.2. Bleeding Time and Clotting Time (BT/CT): Introduction, principle, list of materials and chemicals required, different methods, procedure, reference range, precautions and sources of error of the test.

Unit 14: Blood bank and its related tests [12 hrs]

14.1. Blood banking: Introduction to blood bank, donor and recipient, selection of blood donor, basic concept of screening of blood bags (different tests).
14.2. Basic concept of blood bag and method of collection of blood, precaution during blood collection.
14.3. ABO and Rhesus blood groups: Introduction, Antigen, antibody, ABO and Rh system, Anti sera, Principle of ABO grouping and Rh Typing.
14.4. Blood grouping method- slide and tube; procedure and interpretation. List of materials and chemicals required, procedure, sources of error and precautions.
14.5. Define compatibility test and Coomb's test
14.6. Basic knowledge of Blood cell components and use in blood bank
14.7. Basic knowledge of Blood transfusion reactions

Practical: [156 hours]

List of Task/Skill/exercise

1. Observe and list different instruments used in hematology laboratory.
2. List the chemicals/reagents and solutions used in hematology laboratory
3. Observe operation of coulter counter
4. Collect blood sample by venous technique and capillary technique
5. Observe vacutainer system of blood collection
6. Prepare different chemicals/reagents and solutions used in hematology laboratory
7. Prepare WBC, RBC and Platelet diluting fluid
8. Prepare Wright's stain and Giemsa stain
9. Prepare Buffer used in Romanowsky stain
10. Prepare Anticoagulants vial and tubes
11. Prepare blood smear and stain
12. Prepare blood film/smear: thin and thick smears and
13. Perform dehaemoglobinization of thick smear
14. Stain smear using Wright and Giemsa stain
15. Identify the blood cells
16. Observe morphology of red blood cells, leukocytes and platelets
17. Perform Differential LeukocyteCount (DLC)
18. Perform Total leukocyte count (TLC)

19. Perform RBC count
20. Perform Platelet count
21. Estimate Hemoglobin concentration by colorimetric (cyanme thaemoglobin) and Sahli's method
22. Plot Hemoglobin standard curve
23. Perform Erythrocyte sedimentation rate (ESR); Wintrobe's and Westerngren method
24. Perform Packed cell volume (PCV)
25. Calculate erythrocyte indices
26. Perform Bleeding time by Duke's and Ivy method.
27. Perform Clotting Time by Capillary and Tube method
28. Perform ABO Blood grouping and Rhesus typing
29. Perform cleaning of Glassware,
30. Perform cleaning of work surface/work bench.

References:

1. Parajuli, Keshab, & Ghimire Prakash, (2072),A Text Book of Clinical Pathology (Laboratory Practical Hematology), 4rd edition Vidhyarthi Pustak Bhandar, Bhotahity, Kathmandu.
2. Manual of basic Technique for a health laboratory, Author WHO 1980 , Geneva
3. Dr. Maxwell m. Wintribe and John p. Greer ,13th edition, Clinical Hematology, Maxwell, M Wintrobe. Wilter Publisher
4. Monica Cheesbrough, (2007), District Laboratory Practice in Tropical Countries, and Part I, second and third edition Cambridge University Press.
5. Mukherjee, Kanai L (2010).Medical Laboratory Technology, A Procedure Manual for Routine Diagnostic Tests, Volume I, Volume II and Volume III, 4th edition Tata McGraw-Hill Publishing company , New Delhi
6. National Public Health Laboratory (1999), Standard Operating Procedure Manual on Bacteriology and Parasitology, Author, Teku, Kathmandu.

Clinical Biochemistry

Total: 6 hours /week
Theory: 2 hours/week
Practical: 4 hours/week

Course description:
This course is designed to provide students to develop knowledge and skill of clinical biochemical test procedures to improve skillful hands. The course provides students to explain various topics of basic science, various clinical biochemical tests, equipment, chemicals/reagents and kits used in clinical biochemistry. The course also provides knowledge and technique to prepare simple reagents, and assist to maintain quality control program in the laboratory.

Course objectives:
After completion of this course students will be able to:
1. Collect blood samples appropriately for various biochemical tests in clinical biochemistry.
2. Perform the various clinical biochemical tests from blood and body fluids samples.
3. Describe various equipment, glassware and chemical/reagents used in clinical biochemistry and respective uses.
4. Follow quality control assessment in clinical chemistry analysis.

Course Contents:

Theory

Unit 1: Introduction of Biochemistry [2 Hrs]

1.1 Definition, scope, role of clinical biochemistry in medicine
1.2 List of different instruments used in Biochemistry

Unit 2: Basic Chemistry [5 Hrs]

2.1 Basic concept on atom, atomic number, atomic weight, Molecules, weight, elements, compounds, valency, ionic and non-ionic bond, radicals and equivalent weight
2.2 Basic Concept of Acid, Base, Salt, Hydrogen ion concentration, Oxidation and reduction
2.3 Unit of measurement
2.3.1. Basic Concept of Metric System, S.I unit, IU, mEq and Somagyiunit

Unit 3: Definition, preparation, storage and stability of different solutions [2 Hrs]

3.1 Normal, Molar, Percentage(V/V, W/V), saturated, unsaturated, buffer solution

Unit 4: Instrumentation [11 Hrs]

4.1 Colorimeter and Spectrophotometer

- 4.1.2 Definition, Principle, Function, Operating procedures and maintenance
- 4.1.3 Definition of Blank, Standard, Control and Test
- 4.1.4 Beer and Lambert's Law
- 4.1.5 Reading of absorbance and Calculation of concentration
- 4.1.6 Preparation and importance of Standard Curve
- 4.1.7 Basic concept of semi auto analyzer

4.2 Definition, principle, Function, Operating procedures and maintenance

- 4.2.1 Water Bath
- 4.2.2 Refrigerator
- 4.2.3 Distillation plant
- 4.2.4 Hot Air Oven
- 4.2.5 Centrifuge
- 4.2.6 Balance
- 4.2.7 pH meter

Unit 5: Cleaning of Glassware [1Hr]

5.1. Universal precautions
5.2. Method of Cleaning
5.3. Preparation of Dichromate solution

Unit 6: Carbohydrates [6 Hrs]

6.1 Introduction, Definition, Classification (Mono, Di, Poly) and sources
6.2 Metabolism (Digestion and absorption)
6.3 Define and importance Glycolysis, TCA cycle, Glycogenolysis, Glycogenesis, Gluconeogenesis
6.4 Different Methods of Glucose estimation
6.5 Glucose Tolerance Test (GTT)

Unit 7: Protein and Amino acids [3 Hrs]

7.1. Introduction, Definition, Classification and sources
7.2. Metabolism (Digestion and absorption)
7.3. Introduction to Urea Cycle and significance

Unit 8: Lipids [4 Hrs]

8.1. Introduction, Definition, Classification and sources
8.2. Metabolism (Digestion and absorption)
8.3. Basic concept of Lipid Profile (Cholesterol, Triglycerides, Chylomicron, HDL,LDL, VLDL)

Unit 9: Enzyme [5 Hrs]

9.1 Introduction, Definition, Classification and sources
9.2 Factors affecting enzyme activity
9.3 Isoenzymes : LDH, CK, ALP
9.4 Clinical application of Enzymes

Unit 10: Hormones and Electrolytes [3 Hrs]

10.1. Introduction and Clinical Significance of Hormones
10.2. Introduction and Clinical Significance of Electrolytes (Na+, K+)

Unit 11: Collection of Blood Sample for biochemical tests [3 Hrs]

11.1. Introduction, Patient identification, preparation, procedure, labeling, Preservation, transportation, precautions and source of errors.

Unit 12: Blood Glucose Estimation [4 Hrs]

12.1. Principle, Materials required, reagent preparation, procedure, Precautions, interpretation and reference range
  12.1.1. O-Toluidine method
  12.1.2. GOD-POD method

Unit 13: Blood Urea Estimation [2 Hrs]

13.1. Principle, Materials required, reagent preparation, procedure, precautions, Interpretation and reference range.
  13.1.1. Diacetyl Monoxime Method (DAM)
  13.1.2. Enzymatic Method

Unit 14: Serum Creatinine Estimation [2 Hrs]

14.1. Principle, Materials required, reagent preparation, procedure, Precautions, Interpretation and reference ranges.

14.1.1. Alkaline Picrate Method (Jaffe's Reaction)

Unit 15: Serum Amylase Estimation [2 Hrs]

15.1 Principle, materials required, reagent preparation, procedure, Precautions, interpretation and reference ranges.

15.1.1 Starch Iodine Method

15.1.2 Calculation of Amylase Activity

Unit 16: Serum Uric Acid Estimation [3 Hrs]

16.1 Introduction to Uric Acid.

16.2 Principle, materials required, reagent preparation, procedure, Precautions, interpretation and reference ranges.

16.3 Phosphotungstic Method (Knowledge of refluxing)

16.4 Enzymatic Method

Unit 17: Estimation of Serum Bilirubin [4 Hrs]

17.1 Introduction, formation and metabolism of Bilirubin

17.2 Principle, materials required reagent preparation, procedure, Precautions, interpretation and reference ranges.

17.2.1 Malloy and Evelyn Method

17.2.2 Jendrasik Groff's method

Unit 18: Urine Chemistry and Sample Collection [3 Hrs]

18.1 Constituents of normal and abnormal urine

18.2 Concept of Renal threshold and GFR

18.3 Different types of urine sample: Random, timed collection, early morning

18.4 Storage, preservation and transportation

Unit 19: Preparation of reagent and solutions for urine biochemical test [2Hrs]

19.1 Preparation and uses of :

19.1.1. Benedict's reagent

19.1.2. 3% Sulphosalicyclic acid (SSA)

19.1.3. 3% Acetic acid

19.1.4. Rothera's reagent

19.1.5. Fauchet's reagent

19.1.6. Ehrlich's reagent

Unit 20: Perform Urine sugar test by Benedict's and strip method [1 Hr]

20.1. Principle, procedure, interpretation, materials required and precautions

20.1.1. Benedict's Method:

20.1.2. Strip Method (Uristix, multistix)

Unit 21: Perform Urine protein test [2Hrs]

21.1 Principle, procedure, interpretation, materials required and precautions

21.1.1 Heat and Acetic acid method

21.1.2 Strip method(Uristix,Multistix)

21.1.3 Sulphosalicylic Method

Unit 22: Perform Acetone Test in Urine (Rothera's Method) [2 Hrs]

22.1 Basic concept of ketone bodies

22.2 Principle, procedure, interpretation, materials required and precautions

Unit 23: Perform Bile pigment and Bile salts in urine [2 Hrs]

23.1. Basic concept of Bile pigments and bile salts

23.2. Principle, procedure, interpretation, materials required and precautions

Unit 24: Perform Urobilinogen test [2 Hrs]

24.1. Basic concept of urobilinogen

24.2. Principle, procedure, interpretation, materials required and precautions

Unit 25: Perform Chyle in Urine [2Hrs]

25.1 Basic concept of chyluria and Organic solvent

25.2 Principle, procedure, interpretation, materials required and precautions

Practical: [156 hours]

1. Observation of Clinical Biochemistry laboratory
2. Collect blood samples for biochemical tests
3. Perform basic mathematical calculation:
    - Molecular weight
    - Equivalent weight
    - Conversion to mole, mill mole, gram and milli gram
4. Prepare different solutions accurately, labeling and storage
    - Normal solution
    - Molar solution
    - Percentage solution
    - Saturated solution
    - Buffer solution
5. Observe different instruments and list their uses.
6. Demonstrate colorimeter, spectrophotometer, semi auto analyzer
7. List organ function test: LFT, RFT, Lipid profile
8. Estimate blood glucose by O-toluidine method
9. Estimate blood glucose by GOD-POD method
10. Estimate blood urea by DAM and enzymatic method
11. Prepare standard curve (glucose, Urea) and calculate concentration
12. Estimate serum uric acid by enzymatic method
13. Estimate serum creatinine by alkaline picrate method(Jaffe's reaction)
14. Estimate Serum Bilirubin
15. Estimate serum amylase
16. Prepare Benedict's, Sulphosalicylic acid, acetic acid, Rothera's, Fouchet's and Ehrlich's reagent.
17. Perform urine sugar test by Benedict's and strip method
18. Perform urine protein (Heat and acetic acid, Sulphosalicylic and strip method)
19. Perform acetone test by Rothera's Method
20. Perform Bile pigment, bile salts, urobilinogen in urine.

References:

1. Dr. keshav Parajuli, Dr. Prakash Ghimire (2070), Practical Clinical Biochemistry, Vidhyarthi Pustak Bhandar, Bhotahiti, Ktm.
2. Praful B. Godkar, Darshan P. Godkar, Textbook of Medical Laboratory Technology, 2nd Edition, Bhalani Publishing House, Mumbai.
3. Monica Cheesbrough, (2007), District Laboratory Practice in Tropical Countries, and Part II, second and third edition Cambridge University Press.
4. National Public Health Laboratory (1999), Standard Operating Procedure Manual, Author, Teku, Kathmandu.
5. Satyanarayan (2007), A text book of clinical Biochemistry, Books and allied (P) ltd.
6. Standard Operating Procedure Manual on Bacteriology and Parasitology, 1999, National Public Health Laboratory, Teku, Kathmandu.
7. Standard Operating Procedure Manual on Biochemistry and Biochemistry, 1999, National Public Health Laboratory, Teku, Kathmandu.

Medical Microbiology

Total: 6hours /week
Theory: 2 hours/week
Practical: 4hours/week

Course Description:
This course is designed to provide a basic concept of microbiology and microorganisms. This course provides basic knowledge on serology, pathogenic microorganisms and their identification by the process of staining, culture and serology. It provides basic knowledge on sterilization, culture media and antibiotic sensitivity profiles.

Course Objectives:
At the end of the course, the students will be able to:
1. Describe microorganism- bacteria, virus and fungi
2. Collect and process different types of microbiological/serological specimens.
3. Perform routine laboratory tests including staining, both cultural and non-cultural techniques, antimicrobial sensitivity test and serological test
4. Describe sterilization and disinfection methods.

Course Contents:

Theory **[78 Hours]**

Unit 1: Introductory Microbiology **[8Hrs]**
- 1.1 Introduction, definition and scope of microbiology and medical microbiology
- 1.2 Definition of the terms- Pathogenic/nonpathogenic, beneficial/harmful, commensals, normal flora, opportunistic, symbionts, carrier, infection/ nosocomial infection, exogenous/endogenous.
- 1.3 Introduction, definition and major characteristics of microorganisms
- 1.4 Classification on the basis of cell type (prokaryotes and eukaryotes), system and different groups

Unit 2: Instrumentation: **[10 Hrs]**
- 2.1 List of instrument used in microbiology
- 2.2 Principle, parts, working procedure, and maintenance of:
  - 2.2.1. Microscope
  - 2.2.2. Incubator
  - 2.2.3. Hot air oven
  - 2.2.4. Autoclave
  - 2.2.5. Safety cabinet

Unit 3: Sterilization and Disinfection **[6 Hrs]**
- 3.1 Introduction
- 3.2 Methods of sterilization- physical, chemical and mechanical
- 3.3 Introduction and preparation of disinfectant (static and cidal) and antiseptics, Lysol, cresol and hypochlorite solution

Unit 4: Bacteriology [15Hrs]

4.1 Morphology and classification of Bacteria

4.1.1 Basic cell structure of bacteria (cell wall, cell membrane, cytoplasm, ribosome, mesosome, nuclear chromatin, plasmid, pili, flagella, capsule and spore

4.1.2 Morphological classification of bacteria (cocci, bacilli, vibrio, spirilla and spirochetes)

4.2 Bacterial growth: Introduction, growth and factors affecting growth -nutrition, pH, moisture, oxygen requirement, time, temperature

4.3 Normal habitat and examples of possible pathogenic, commensal and normal flora

4.4 List of motile and non motile, common spore forming and capsule forming bacteria

Unit 5: Sample collection for microbiological tests [3 hrs]

5.1 Importance of proper sample collection

5.2 Types of sample, method, time and ideal sample (sputum, urine, blood, pus, body fluid, skin scraping, hair, nail)

5.3 Importance and use of sample container

5.4 Importance of proper labeling (name, age, sex, ID, patient history, indoor/outdoor, number, date and time of collection)

Unit 6: Bacteriological Procedures [15 hrs]

6.1 Staining

6.1.1 Types of staining: Simple, negative, differential and special

6.1.2 Introduction, principle, materials required, procedure, result interpretation, precautions of:

- Gram's staining (along with list of gram positive and negative bacteria)
- Ziehl-Neelson staining for AFB

6.2 Culture media and its types-

- Basic, enriched, selective, differential, enrichment
- solid, semi solid, liquid,
- transport and biochemical media

6.3 Preparation of culture media- principle, composition, procedure and precaution of:

6.3.1 Nutrient agar, Blood agar, Chocolate agar, Macconkey agar, BHI broth, Mueller Hinton agar, biochemical media, transport media basic concept on Culture technique

6.3.2 Type and quality of samples: urine blood pus throat swab

6.3.3 Technique :- stabbing, streaking, louon culture, pour plate

Unit 7: Fungi [6 Hrs]

7.1 Introduction and definition of the terminologies- fungi, mycology, medical mycology, mycoses, thallus, hypha, mycelium, germ tube, shape and size of fungi

7.2 Classification of fungi

7.3 Classification of Fungal diseases (mycosis)

7.4 KOH Preparation

Unit 8: Virus [5 Hrs]

8.1 General characters
8.2 Morphology of virus-shape and size, capsid, protein core, nucleic acid, virion
8.3 Classification of virus: based on shape and Nucleic acid
8.4 List of Common viral diseases and causative agents

Unit 9: Immunology [10Hrs]

9.1 Definition of the terms- immunity, antigen, antibody, antigen-antibody reactions (agglutination, precipitation, flocculation, ELISA, CFT, ICT)
9.2 Serological tests: Introduction, principle, procedure, interpretation, clinical significance of:
    9.1.1. VDRL test
    9.1.2. ASO test
    9.1.3. RA factor test
    9.1.4. Widal test
    9.1.5. CRP test
    9.1.6. Rapidtest: HIV, HBsAg, HCV
    9.1.7. Tuberculin skin test (Mantoux)

Practical: [156 Hrs]

1. List different instruments /chemicals used in microbiology laboratory.
2. Cleaning of glassware, tables and floors.
3. Collect sample for microbiological test: Blood, urine, sputum, pus, hair, nail, skin
4. Prepare culture media- BHI broth, Nutrient agar, Blood agar, Macconkey agar, Mueller Hinton agar, Chocolate agar, and biochemical media.
5. Prepare Gram's and ZiehlNeelson stain- Crystal violet, iodine, neutral red, carbol fuchsin, malachite green, methylene blue, decolourizing solutions:70% alcohol, 3% acid alcohol
6. Perform gram stain on pus, sputum,, urethral swab,HVS
7. Perform Ziehl- Neelson staining for AFB
8. Sterilization and disinfection of glassware, media, reagents and chemicals
9. Assist in inoculation and incubation for:
    - 9.1. Urine culture
    - 9.2. Blood culture
    - 9.3. Pus culture
    - 9.4. Throat swab culture
10. Perform serological tests
    - 11.1. VDRL test
    - 11.2. ASO test
    - 11.3. Widal test
    - 11.4. CRP test
    - 11.5. Rapidtest: HIV, HBsAg, HCV
    - 11.6. Tuberculin skin test (Mantoux)

References:

1. A Hand Book of Medical Laboratory Technology, Christian Medical College, Vellore.
2. A Laboratory Manual for Rural Developing Countries, Maurice King.
3. A Laboratory Manual for Rural Tropical Hospital, Volume I and Volume II - Monica Cheesbrough.
4. A Laboratory Manual for Rural Tropical Hospitals, A basic for Training Courses, Monica Cheesbrough.
5. A Text Book of Medical Microbiology, Dr. Prakash Ghimire, Keshab Parajuli, Vidhyarthi Pustak Bhandar, Bhotahity, Kathmandu
6. Text Book of Microbiology –Anantha Narayan and Paniker

Medical Parasitology

Total: 6Hrs /week
Theory: 2 Hrs
Practical: 4Hrs/week

Course description:
This course is designed to provide a basic concept of medical parasitology and human parasites prevalent in Nepal. The course provide skill to identify the intestinal and blood parasites from clinical samples.

Course objectives:
After completion of this course students will be able to:

1. Understand the fundamental of medical parasitology
2. Explain the common intestinal and blood parasites prevalent in Nepal
3. Describe mode of infection, life cycle, pathogenesis, diagnosis and prevention and control of common intestinal and blood parasites
4. Carryout basic laboratory procedures to diagnosis common parasites.

Course Contents:

Theory

Unit 1: Parasitology and parasites [4Hrs]

- 1.1 Definition, terminology and scope of medical parasitology
- 1.2 Classification of Parasites; Protozoa and Helminths
- 1.3 Definition of Ecto, endo, facultative, obligate, accidental and wandering parasites and vector
- 1.4 Definition and classification of Host
- 1.5 Host parasite relationship: symbiosis, synergism, mutualism, parasitism,
- 1.6 Antagonism, commensalism
- 1.7 Infection and infestation.

Unit 2: List the medically important parasites [1Hr]

- 2.1 Intestinal parasites
- 2.1 Blood and tissue parasites

Unit 3: Protozoal parasites [14 Hrs]

- 3.1 Mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of the intestinal protozoa
  - 3.1.1 Entamoeba histolytica.
  - 3.1.2 Giardia lamblia
  - 3.1.3 Trichomonas vaginalis

3.1.4 Leishmania donovani
3.1.5 Plasmodium spp.
3.1.6 Differences of E. histolytica and E.coli
3.1.7 Difference between amoebic and bacillary dysentery

3.2 Basic concept of Cyrptosporidium and Cyclospora

Unit 4: Helminthes parasites [20 Hrs]

4.1 Mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of the intestinal helminthes
4.1.1 Ascaris lumbricoides
4.1.2 Ancylostoma duodenale
4.1.3 Difference between Ancylostoma duodenale and Necator americanus
4.1.4 Enterobius vermicularis
4.1.5 Trichuris trichiura
4.1.6 Strongyloides stercoralis
4.1.7 Taenia saginata
4.1.8 Taenia solium
4.1.9 Difference between Taenia saginata and Taenia solium
4.1.10 Echinococcus granulosus
4.1.11 Hymenolepis nana
4.1.12 Wuchereria bancrofti

Unit 5: Sample collection in parasitology [3 Hrs]

6.6 Collection of sample, labeling, use of container, instruction, transportation/preservation, requisition and reporting form
5.1.1 Stool
5.1.2 Urine

Unit 6: Techniques in stool examination [20 Hrs]

6.1 **Preparation of Reagents:** Introduction, composition, procedure, uses, importance and precautions of:
6.1.1 Normal saline solution
6.1.2 Iodine solution: Lugol´s and Dobell's iodine method
6.1.3 Saturated saline solution,
6.1.4 ZnSO4 solution
6.1.5 Benzidine reagent
6.1.6 Benedict's solution

6.2 Description of routine and microscopic examination
6.2.1 Physical examination: Basic concept of color, consistency, blood and mucus, normal and Abnormal condition and causes
6.2.2 Microscopic examination:

- Smear preparation,
- Identification of characteristic of ova, larva, cyst and trophozoites of parasites,
- Blood Cells (Macrophage, WBC, RBC) and undigested food particles.

6.3 Stool concentration technique: Introduction, Principle, uses, procedure
- 6.3.1 Flotation techniques
- 6.3.2 Sedimentation techniques

6.4 Stool chemical examination: Introduction, principle, materials requirement, procedure, sources of error of:
- 6.4.1 Occult blood test: Benzidine and rapid test kit
- 6.4.2 Reducing substance (sugar)

Unit 7: Urine Analysis: [5 Hrs]

7.1 Physical examination: Basic concept of color, Transparency, volume, specific gravity, normal and Abnormal condition and causes

7.2 Dipstick test: pH, protein and sugar

7.3 Microscopic examination: Urinary deposit
- 7.3.1 Smear preparation,
- 7.3.2 Identification of cells, crystals, casts and urinary parasites

7.4 Urine chyle Test: Introduction, Principle, procedure, Interpretation and Precautions

Unit 8: Serum aldehyde Test [2 Hrs]

8.1. Introduction, Principle, procedure uses and importance, interpretation and precaution

Unit 9: Microscopic examination of blood parasites [6 Hrs]

9.1 Sample collection, smear preparation, staining, examination and reporting
- 9.1.1 Malarial parasites: Identification of Plasmodium spp
- 9.1.2 Microfilaria

Unit 10: Perform pregnancy Test from Urine Sample. [1 Hr]

10.1 Introduction, Sample collection, Principle, procedure, interpretation and precaution.

Unit 11: Perform Semen analysis [2 Hrs]

11.1 Introduction, collection, procedure, macroscopic and microscopic examination, sperm count, morphology of normal and abnormal spermatozoa.
- 11.1.1 Normal reference value
- 11.1.2 Preparation of diluting fluid.

Practical: **(156 hrs)**

1. **Materials used in Parasitological lab**
   - 1.1 Identify and list out different equipment/Glassware.
   - 1.2 Identify Chemicals, Reagent & solution used in clinical lab

2. **Prepare different solution and Reagent**
   - 2.1. Normal Saline
   - 2.2. Buffer Solution
   - 2.3. Iodine Solution
   - 2.4. Saturated Saline Solution,
   - 2.5. $ZnSO_4$ Solution
   - 2.6. Benedict's Reagent
   - 2.7. Benzidine solution
   - 2.8. 10% Formal Saline

3. **Perform Urine routine Examination**
   - 3.1. Physical Examination (colour, volume, specific gravity, Transparency, PH)
   - 3.2. Perform dipstick examination: pH, sugar, Protein
   - 3.3. Microscopic Examination
     - 3.3.1. Examine Pus cells, epithelial cells, RBC, Casts and Crystals, bacteria and others
     - 3.3.2. Identify Trichomonas vaginalis in Urine Sample.

4. **Perform Specific gravity in Urine: By Urinometer and Strip.**

5. **Perform Chyle Test in Urine**

6. **Perform Aldehyde Test from Blood Sample by Formalin**

7. **Identify Malaria Parasite (MP) on Blood Smear**
   - 7.1. Blood Sample Collection
   - 7.2. Thick and Thin Smear Preparation
   - 7.3. Fixation & Staining by Giemsa stain.
   - 7.4. Microscopic Observation and identification of different species of Plasmodium.
   - 7.5. By Rapid Kit Method.

8. **Identify Microfilaria (MF) on blood Smear**
   - 8.1. Wet Preparation
   - 8.2. Thick & Thin Smear Preparation
   - 8.3. Fixation & Staining
   - 8.4. Microscopic Observation, Identification and reporting.

9. Perform Stool Routine Examination

9.1. Stool Smear preparation by normal Saline and Lugol's iodine Method

9.2. Perform Physical Examination: color, consistency, mucus, blood and adult worm

9.3. Microscopic Examination

9.3.1. Identify pus cells, epithelial cells, RBC, Undigested Particles.

9.3.2. Identify ova, larva, Cyst, Trophozoites.

10. Stool Examination by Concentration Techniques

10.1 Flotation Method: Saturated salt solution

10.2 Sedimentation Method: Formal ether solution

11. Perform Occult blood Test in Stool by Benzidine reagent and Hemospot (Rapid Kit)

12. Detect the reducing Sugar in Stool by Benedict Solution

13. Perform Urine Pregnancy Test by paper Immuno chromatography method

14. Perform Semen Analysis

14.1. Sample collection

14.2. Macroscopic (colour, Viscocity, P^H, Volume , Liquefication time)

14.3. Microscopic Examination

14.3.1. Morphology of normal/abnormal Sperm

14.3.2. Sperm Count

14.3.3. Motility

14.3.4. Pus cell, RBC.

References:

1. Dr. keshav Parajuli, Dr. Prakash Ghimire (2070), Laboratory Parasitology, Vidhyarthi Pustak Bhandar, Bhotahiti, Ktm.
2. D.R. Arora,B. Arora (2008), Medical Parasitology 2nd Edition, CBS Publisher, New Delhi.
3. Praful B. Godkar, Darshan P. Godkar, Textbook of Medical Laboratory Technology, 2ndEdition,Bhalani Publishing House, Mumbai.
4. Subhash Chandra Parija, (2013), Textbook of Medical Parasitology 4th Edition, All India Publishers, New Delhi.

First Aid and Communicable Diseases

Total: 3 hours /week
Theory: 2 hours/week
Practical: 1 hour/week

Course description:
This course is designed to provide students with a basic concept of health and safe practice in the laboratory, first aid and communicable diseases. This course is developed for awareness of first aid and its techniques needed for primary treatment before going to the hospital for further management. Every day laboratory personnel work with acids, alkalis, electricity, sharp cuts etc. and there is always a chance of accidental events as well as infection with various disease causing agents.

Course objectives:
After completion of this course students will be able to:
1. Explain health and safe practice in the laboratory.
2. Minimize health laboratory risks and accidents.
3. Apply first aid and basic treatment during laboratory work.
4. Understand communicable and hospital borne diseases.

Course Contents:

Theory

Chapter-I: Laboratory Hazards/Accidents/Safety & Management

Unit 1: Health and related hazards [4 Hours]
- 1.1. Definition of Health and disease, infestation, infection, communicable diseases.
- 1.2. Definition of Hazards, Risk & risk factors, Accidents, Safety

Unit 2:Identification of common causes of accidents [5 Hours]
- 2.1. Basic concept on hazards and associated accidents:
  - 2.1.1. unsafe laboratory practice, naked flame, microbial hazard, chemical hazard, glassware hazard, equipment hazard, explosions, infestation by ants, rodents, cockroaches and unreliable water supply
  - 2.1.2. Control measures

Unit 3: Factors contributing to the occurrence of accidents [4 Hours]
- 3.1. Basic concept on factors associated with accidents: Lack of training, attitude, work load, untidy work, rush and loss of concentration, lack of safety precaution

Unit 4:code of safe laboratory practice and personal safety measures [4 Hours]
- 4.1. Introduction, unsafe laboratory practice, associated accidents, safety measures, safe working environment and practice, personal health/ hygiene and practice.
- 4.2. Use of safety signs and Biohazard symbols.

Unit 5: Identification of microbial hazard and preventive measures [6 Hours]

5.1. Basic concept on microbial hazard:
5.2. Classification of infective microorganisms, risk groups,
5.3. Safe working: safety cabinet, safe transport, safe pipetting and dispensing.
5.4. Method of decontamination of infectious materials and disposal of laboratory waste

Unit 6: Introduction to chemical and reagents [4 Hours]

6.1. Basic concepts on flammable chemicals, toxic, harmful and irritating chemicals oxidizing chemicals, corrosive chemicals, explosive chemicals,
6.2. Safe storage and uses

Unit 7: Identification of glassware and equipment related hazards and fire safety. [5 Hours]

7.1. Basic concepts on equipment related accidents
7.2. Prevention of accidents, safe handling of glassware and safe management after breakage.
7.3. Fire management, firefighting equipment, guidelines to reduce the risk of fire and preventive measures.

Chapter II: First Aid

Unit 8: Introduction of first aid [4 Hours]

8.1. Definition, aims, steps and treatment of first aid, factors influencing the skill development.

Unit 9: Management of first aid and emergency treatment [5 Hours]

9.1. Basic concepts on emergency first aid procedure:
9.2. Emergency management of cuts, bleeding, resuscitation, electric shock, and heat burns, and chemical burns, fainting and poisoning

Unit 10: First aid management for bites / burns (heat and chemical)/injuries (needle stick) cuts and wounds/ fracture/ frost bite and electric shock [5 Hours]

10.1. Introduction, definition, types of bites (insects, snake, dog), frost bite, and first aid treatment to victim
10.2. Injuries: cut and wound care, dressing and its types, procedures and special techniques of dressing.
10.3. Definition, aim, types, application types of bandage.
10.4. Fractures: types and first aid management

Unit 11: First aid management for epistaxis/ hemorrhage/ choking/ drowning [3 Hours]

11.1. Introduction, definition, first aid treatment of hemorrhage, epistaxis, choking, drowning and fainting.

Unit 12: First aid management for poisoning [3 Hours]

12.1. Definition, sign and symptoms and first aid for poisoning (chemical and gases).

Unit 13: First aid management of cardio pulmonary resuscitation [3 Hours]

13.1. Definition, purpose, and procedure of cardio pulmonary resuscitation

Chapter-III Community Health

Unit 14: Introduction to community health [2 Hours]

14.1. Definition of epidemiology, terms used in epidemiology (Case, control, vector, reservoir, endemic, epidemic, pandemic, sporadic, disease: control, elimination, eradication, zoonotic disease,)

Unit 15: Introduction to communicable diseases [3 Hours]

15.1. Definition, types, carrier, reservoir and source, mode of transmission and concept of diseases.

Unit 16: Agents as disease causing factors. [4 Hours]

16.1. Epidemiological triad (Agent, Host & Environment)
16.2. Differences between communicable and non-communicable diseases, community and hospital acquired microbial infections,
16.3. National Immunization schedule
16.4. Water borne disease (introduction, types, prevention)
16.5. Droplet infections

Unit 17: Communicable diseases of respiratory system [3 Hours]

17.1. Enlist viral, bacterial, protozoal and helminthes infections/diseases:
17.2. Common preventative measures
17.3. Common lab diagnosis methods with examples

Unit 18: Communicable diseases of digestive system [3 Hours]

18.1. Enlist viral, bacterial, protozoal and helminthes infections/diseases:
18.2. Common preventative measures
18.3. Common lab diagnosis methods with examples

Unit 19: Communicable diseases of other body systems [4 Hours]

19.1. General introduction to rabies, tetanus, TB, leprosy, sexually transmitted infections (STIs), typhoid fever: (Definition, causative agent, lab diagnosis method & preventive measures)

Unit 20: Measurement of blood pressure and body temperature [4 Hours]

20.1. General introduction to blood pressure: principle, procedure, normal values of systolic and, diastolic pressure and its variations.
20.2. Body temperature: - principle, procedure, temperature at different parts of body, physiological and pathological variations, application in health laboratory services

Practical: **[39 hours]**

List of Task/Skill/exercise

1. Prepare first aid box
2. Measure blood pressure
3. Perform hand washing steps
4. Demonstrate Post exposure prophylaxis chart
5. Identify hazardous sign and symbols
6. Segregate waste (color coding)
7. Dispose waste (use of disinfectants, autoclaving, incineration)
8. Apply personal protective equipment (PPE).

References:

1. K. Park (2011) Preventive and Social Medicine, Jabalpur : M/S Banarsidas Bhanot
2. Vivek Jain (2013) Review of Preventive & Social medicine, Jaypee Brothers Medical Publisher (P) LTD
3. Dr. Y.R Bhattarai (2016) Quick Review of Health science, Samiksha Publication
4. DK publishing (2011) ACEP First Aid manual, American College of Emergency Physicians
5. Rajesh Kumar Gupta and Rajiv Kumar Sharma "A Text book of Basic Pathology, First Aid and Basic public Health". 2nd edition 2016, Samiksha publication, Adwaitmarga, Bagbazar
6. Rajesh Kumar Gupta and Binod Kumar Yadav, "A Text book of Medical Laboratory Technology" Volume 1 and 2, Second edition 2069, Samiksha Publication, Adwaitmarga, Bagbazar

Laboratory Management and Quality Assurance

Total: 4 hours
Theory: 1 hour/week
Practical: 3 hours/week

Course Description:

This course is designed to provide basic knowledge and skill on laboratory management and quality assurance (QA) in laboratory practice. Good quality management and QA program plays a vital role to improve quality of laboratory services. This course provides the students with knowledge to develop confidence, effectiveness, efficiency, accountability in laboratory management and quality laboratory work.

Course Objectives:

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

1. Help implementation of appropriate quality assurance program.
2. Help in planning and designing of a functional laboratory.
3. Employ sound management practices for safe and healthy environment.
4. Proper implementation of bio-safety measures and waste management

Course Contents:

Theory **[39 hrs]**

Unit 1: Introduction to lab management and quality assurance **[4 hrs]**

1.1 Introduction, definition, purpose and objective of the laboratory management and quality assurance.

1.2 Introduction to network of laboratories in Nepal.

1.3 Code of conduct

Unit 2: Laboratory design **[3 hrs]**

2.1. Basic concept of laboratory organization: Location, space requirement, light, ventilation, temperature control, electrical supply, water supply, sanitation, noise control, Use of fume hood/safety hood

2.2. Partition of the section, floor management, standard size of working area

Unit 3: Introduction to different sections of lab **[3 hrs]**

3.1. list different labs and basic tests performed

3.2. list different instruments in each labs and their functions

Unit 4: Laboratory work flow **[2 hrs]**

4.1. Description of work flow in lab- Specimen collection, specimen organization, transport, testing and reporting of the results

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

5.1. Staff duty rotation

5.2. Importance of continued medical education/trainings

Unit 6: Standard operating procedures **[3 hrs]**

6.1. Introduction and importance of standard operating procedures (SOP)

6.2. Parts and Preparation of SOPs

Unit 7: Reporting and record keeping **[2 hrs]**

7.1. Reporting formats, units used

7.2. Record keeping and its importance

7.3. Use of computers in reporting and record keeping

Unit 8: Total quality management and quality assurance: **[6 hrs]**

8.1. Define TQM (Total quality management), QA (quality assurance) and QC (quality control)

8.2. Define accuracy, precision, sensitivity and specificity

8.3. Internal quality control, errors (pre analytical, analytical and post analytical), use of controls

8.4. External quality assurance scheme

Unit 9: Lab hazards and lab safety: [4 hrs]

9.1. Definition of laboratory hazards and description of its types eg. fire/ electrical / chemical / biological hazards

9.2. Laboratory Safety measures- personal protective equipment, health and safety of the staff, equipment safety

Unit 10. Medical ethics: [2 hrs]

10.1. Medical ethics and its principles

10.2. Confidentiality

10.3. Ethical consent.

Unit 11 Bio-safety and bio-security [6 hrs]

11.1. Introduction to bio-safety and bio-security

11.2. Risk group classification of micro-organisms

11.3. Concept of Bio-safety levels 1,2,3,4

11.4. Laboratory waste management: Segregation of waste, uses of color coded bins and disposal of waste

11.5. Concept of 3R (Reduce, Reuse and Recycle)

Unit 12: Inventory management [2 hrs]

12.1. Maintain stock inventory

12.2. Maintaining expiry charts

12.3. Logistics management

Practical: 117 hrs

A. Perform basic computer skills on word and excel. 40 hrs

B. Lab related practical 77 hrs

1. Observe different departments in lab (biochemistry, microbiology, hematology, parasitology, 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
9. Assist to prepare computerized reports
10. Maintain lab records,use of computers in record keeping
11. To 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 color coded bins and safe disposal of waste
15. Prepare and use expiry charts
16. Observe management of inventory and maintain stock records

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

Comprehensive Clinical Laboratory Practice

Total hours: 273 hours

Course Description

This field experience program is designed to help students to apply the comprehensive knowledge and skills on actual situation. The program is offered at the end of in house training but before placing for On-the-Job Training. This Comprehensive Laboratory Practice will play vital role in their future laboratory practice during OJT at different hospitals. Students should have proper documentation or record during their hospital posting at different clinical laboratory departments of the hospital.

Objectives

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

1. Acquire knowledge about laboratory procedures from health institutions/hospitals,
2. Assist/perform all routine and some special laboratory procedures independently and accurately,
3. Build confidence in laboratory procedures.

Placement schedule

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

S. No.	Subject Area/Sections	Duration
1	Sample collection, preservation, storage, transportation & organization of clinical laboratory	48 hours (6 days)
2.	Haematology and Blood banking lab	48 hours (6 days)
3.	Clinical Biochemistry lab	64 hours (8 days)
4.	Medical Parasitology lab / stool and urine analysis	48hours (6 days)
5.	Medical Microbiology(Bacteriology)/ Serology lab	64 hours (8 days)
	Total	**272hours (34 days)**

Tasks under Comprehensive Laboratory Practice:

Subject/Area: Sample Collection, Preservation, Storage, Transportation & Organization of Clinical laboratory

1. List the materials required in collection room
2. Prepare different laboratory chemicals/solutions and anticoagulants
3. Collect the blood sample
4. Collect the different samples for different tests (hematology, biochemistry, serology)
5. Collect the different samples for microbial tests
6. Clean the laboratory

Subject/Area: Hematology and Blood Banking Lab

1. List the chemicals/reagents and solutions used in hematology laboratory
2. Prepare different chemicals/ reagents and solutions used in hematology laboratory
3. Prepare blood smear and stain
4. Identify the blood cells
5. Count Differential Leukocyte
6. Enumerate Total leukocyte count (TLC)
7. Enumerate RBC count
8. Enumerate Platelet count
9. Estimate Hemoglobin concentration
10. Plot Hemoglobin standard curve
11. Perform Erythrocyte sedimentation rate (ESR)
12. Perform PCV
13. Calculate erythrocyte indices
14. Observe BT/CT
15. Perform Blood grouping
16. Observe/perform Compatibility test
17. Clean the laboratory

Subject/Area: Clinical Biochemistry Lab

1. List the different chemicals/reagents and solutions used in clinical biochemistry laboratory
2. Operate the equipment used in biochemistry laboratory
3. Assist/prepare different laboratory chemical/solutions
4. Assist to estimate blood glucose by O- Toluidine method
5. Assist to estimate blood glucose by GOD/POD method
6. Assist to estimate blood urea by DAM and Enzymatic method
7. Assist to estimate serum creatinine
8. Assist to estimate serum amylase
9. Observe estimation of serum uric acid
10. Observe/estimate of Serum Bilirubin
11. Clean the laboratory

Subject/Area: Medical Parasitology Lab / Stool and Urine Analysis

1. List the different Chemicals/reagents and solutions used in parasitology laboratory
2. Assist/prepare different laboratory chemical/solutions
3. Observe/perform Aldehyde test from blood sample
4. Observe/perform Malaria parasites (MP) on blood smear
5. Observe/perform Microfilaria (MF) on blood smear
6. Observe/perform Occult blood test in stool sample
7. Observe /perform detection of reducing substances in stool sample
8. Observe/perform Urine routine examination
9. Observe/perform Acetone test in urine
10. Observe/perform Specific gravity in urine
11. Observe/perform Bile pigment test
12. Observe/perform Chyle test in urine
13. Assist/perform Stool routine exam: physical examination and microscopic observation
14. Observe/perform Urine pregnancy test
15. Observe/perform Semen analysis
16. Clean the laboratory

Subject/Area: Medical Microbiology (Bacteriology) Lab / Serology lab

1. List the different chemicals/reagents and solutions used in microbiology and serology laboratory
2. assist/ prepare of Grams and Ziehl-Neelson stain
3. assist/prepare of culture media
4. Assist/perform Gram staining
5. Observe/perform Ziehl- Neelsen stain for AFB
6. Observe/perform Skin scraping smear for AFB
7. assist to sterilization of different glassware, media, reagents and chemicals
8. Disinfect different glassware/ media
9. Observe/perform Inoculation and incubation urine sample
10. Observe/perform Inoculation and incubation pus sample
11. Observe/perform Inoculation and incubation blood sample
12. Observe/perform Inoculation and incubation throat swab sample
13. Observe/perform Biochemical tests
14. Observe/perform Sensitivity Test
15. Observe/perform Serological test
16. Observe/perform Tuberculin test
17. Clean of Glassware, table and floor

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 records (logbook) signed periodically by their supervisor/instructor at the end of the posting in each subject.

1) During this postings college will send expertise to guide students from respective departments for better learning
2) College authorities should have cross check during this practice hour
3) After completing Comprehensive Laboratory Practice, students should have some kind of presentations in their college regarding the knowledge and skill gained during their practice.

Evaluation Scheme

Under this scheme students will have to observe/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 examination.

Distribution of marks for evaluation

Section	Evaluator/Paper	Distribution of marks			Total Marks
		Internal	Final	Time	
1	Related laboratory supervisor/teacher (continuous evaluation)				120
3	Related institute/school supervisor/teacher (evaluation based on logbook and presentation)				50
	Total				**170**

Important note: *Each student must pass in each of the section of the evaluation as presented above with a minimum of 60% marks.*

On the Job Training (OJT)

Full Marks: **500** **Practical: 24 weeks/960 Hrs**

Description:
On the Job Training (OJT) is a 6 months (24 weeks/144 working days) program that aims to provide trainees an opportunity for meaningful career related experiences by working fulltime in real organizational settings where they can practice and expand their classroom based knowledge and skills before graduating. It will also help trainees gain a clearer sense of what they still need to learn and provides an opportunity to build professional networks. The trainee will be eligible for OJT only after attending the final exam. The institute will make arrangement for OJT. The institute will inform the CTEVT at least one month prior to the OJT placement date along with plan, schedule, the name of the students and their corresponding OJT site.

Objectives:
The overall objective of the On the Job Training (OJT) is to make trainees familiar with firsthand experience of the real work of world as well as to provide them an opportunity to enhance skills. The specific objectives of On the Job Training (OJT) are to;

- apply knowledge and skills learnt in the classroom to actual work settings or conditions and develop practical experience before graduation
- familiarize with working environment in which the work is done
- work effectively with professional colleagues and share experiences of their activities and functions
- strengthen portfolio or resume with practical experience and projects
- develop professional/work culture
- broaden professional contacts and network
- develop entrepreneurship skills on related occupation

Activity:
In this program the trainees will be placed in the real work of world under the direct supervision of related organization's supervisors. The trainees will perform occupation related daily routine work as per the rules and regulations of the organization. The trainees must perform daily routine test in a well setup laboratory. In addition to the above the trainee must work in biochemistry, microbiology, hematology, parasitology unit.

Potential OJT Placement site:

The nature of work in OJT is practical and potential OJT placement site should be as follows;

- Public Health Center (PHC) with well set up laboratory,
- District hospital at 15 or above beds,
- Zonal hospital,
- National hospital,
- Medical college,
- Well set up laboratory with biochemistry, microbiology, hematology, parasitology unit including capacity of daily routine test.

Requirements for Successful Completion of On the Job Training:

For the successful completion of the OJT, the trainees should;

- submit daily attendance record approved by the concerned supervisor and minimum 144 working days attendance is required
- maintain daily diary with detail activities performed in OJT and submit it with supervisor's signature
- prepare and submit comprehensive final OJT completion report with attendance record and diary
- secured minimum 60% marks in each evaluation

Complete OJT Plan:

SN	Activities	Duration	Remarks
1	Orientation	2 days	Before OJT placement
2	Communicate to the OJT site	1 day	Before OJT placement
3	Actual work at the OJT site	24 weeks/144 days	During OJT period
4	First-term evaluation	one week (for all sites)	After 6 to 7 weeks of OJT start date
5	Mid-term evaluation	one week (for all sites)	After 15 to 16 weeks of OJT start date
6	Report to the parental organization	1 day	After OJT placement
7	Final report preparation	5 days	After OJT completion

- First and mid-term evaluation should be conducted by the institute.
- After completion of 6 months OJT period, trainees will be provided with one week period to review all the works and prepare a comprehensive final report.
- Evaluation will be made according to the marks at the following evaluation scheme but first and mid-term evaluation record will also be considered.

Evaluation Scheme:

Evaluation and marks distribution are as follows:

S.N	Activities	Who/Responsibility	Marks
1	OJT Evaluation (should be three evaluation in six months –one evaluation in every two months)	Supervisor of OJT provider	300
2	First and mid- term evaluation	The Training Institute	200
	Total		500

Note:

- Trainees must secure 60 percent marks in each evaluation to pass the course.
- If OJT placement is done in more than one institution, separate evaluation is required from all institutions.

OJT Evaluation Criteria and Marks Distribution:

- OJT implementation guideline will be prepared by the CTEVT. The detail OJT evaluation criteria and marks distribution will be incorporated in the guidelines.
- Representative of CTEVT, Regional offices and CTEVT constituted technical schools will conduct the monitoring & evaluation of OJT at any time during the OJT period.