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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Contents

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 comprehensive practical settings, in hospitals and medical laboratories. 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.

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 situations.

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 laboratories to deliver quality laboratory service.
- Perform laboratory management.
- Supervise subordinates and prepare reports.
- Conduct research on lab work.

Group Size

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

Entry Criteria

- SLC or SEE or Equivalent Pass with minimum GPA 2.0 and graded in Compulsory Mathematics, English & Science.
- TSLC in Medical Laboratory Technology with minimum 68.33%.
- 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 a yearly system. Moreover, one academic year consists of up to 35 weeks and one academic week consists of up to 40 hours excluding evaluation period.

Medium of Instruction

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

Pattern of Attendance

A 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-timers.

Qualification of Teachers and Instructors

- The program coordinator should have a bachelor's degree in the related area or as per minimum requirements of NHPC & CTEVT.
- The disciplinary subject related teacher should be a bachelor's degree holder in the related area or as per minimum requirements of NHPC & CTEVT.
- The demonstrators should have a bachelor's degree in the related area with two years' experience in training activities or as per minimum requirements of NHPC & CTEVT.
- The foundational subject related to teaching should be a master's degree in the related area.

Instructional Media and Materials

The following instructional media and materials are suggested for 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.

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

Mode of Instruction

There will be an inductive and deductive mode of education.

Evaluation Scheme

a. Internal assessment

- There will be written and practical exams for each subject both in theory and practical.
- Each subject will have 3 internal assessments each year at regular intervals and students must get feedback about it.
- The 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

- The 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 a minimum of 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 a degree of **"Certificate in Medical Laboratory Technology"**.

Career Opportunity

The graduates will be eligible for the position equivalent to non-gazette 1st 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 the written exam are suggested as follows.

A. For subject with full marks 80

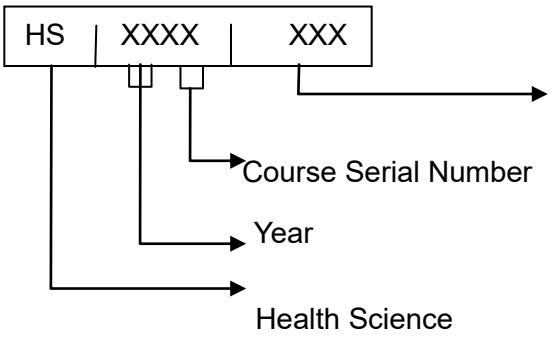
S.N.	Type of question	No of Question	Weightage marks	Full marks	Time distribution	Optional questions
1	Long	2	10	20	60.min	1
2	Short	4	5	20	60. min	2
3	Very short	10	2	20	40. min	2
4	Multiple	20	1	20	20min	
	Total	36		80	180min	

B. For subject with full marks 40

	Type of question	No of Question	Weightage marks	Full marks	Time distribution	Optional questions
1	Long	1	10	10	30 min	1
2	Short	2	5	10	30 min	1
3	Very short	5	2	10	20 min	1
	Multiple	10	1	10	10 min	
	Total	18		40	90 min	

Subjects Codes

Each subject is coded with a unique number preceded and followed by certain letters as mentioned in following chart



Offering Departments:

- G.M: General Medicine (H.A.)
- P:Pharmacy
- LT:Certificate in Medical Lab Technology
- DR:Diagnostic Radiography
- OS:Ophthalmic science
- A:Ayurveda
- AAM:Acupuncture Acupressure and Moxibustion
- DP:Physiotherapy
- DH:Dental Hygienist
- YN:Yog and Naturopathy
- N:Nursing
- AP:Ayurveda Pharmacy
- DL:Dental Laboratory
- M:Midwifery

Curriculum Structure

Certificate In medical Laboratory Technology

Year: II (35 Weeks)

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours	Credit Hours	Theory			Practical				
										Final			Final			
			L	T	P	L /C			Assmt. Marks	Marks	Time (Hrs.)	Assm. Marks	Marks	Time (Hrs.)		
1	HS2101 LT	Clinical Microbiology and Immunology	4			4	8	6	20	80	3	60	40	3	200	*Continuous assessment
2	HS2102 LT	Hematology and blood banking	4			4	8	6	20	80	3	60	40	3	200	
3	HS2103 LT	Clinical Biochemistry	4			4	8	6	20	80	3	60	40	3	200	
4	HS2104 LT	Medical Parasitology	2			2	4	3	10	40	1.5	30	20	1.5	100	
5	HS2105 LT	Clinical Pathology	4			2	6	5	20	80	3	30	20	1.5	150	
6	HS2106 LT	Public Health and first Aid	4			2	6	5	20	80	3	30	20	1.5	150	
		Total	**22**			**18**	**40**	**31**	**110**	**440**		**270**	180		**1000**	

Curriculum Structure

Year: III (11 Weeks+ 24 Weeks)

S.N.	Code No.	Subject	Teaching Scheme						Examination Scheme						Total Marks	Remarks
			Mode				Weekly Hours Credit Hours		Theory			Practical				
									Assemt. Marks	Final		Assemt. Marks	Final			
			L	T	P	L/C				Marks	Times (Hrs)		Marks	Time (Hrs)		
1	HS3101 LT	Histopathology and Cytopathology	8			6	14	11	10	40	1.5	30	20	1.5	100	*Continuous assessment
2	HS3102 LT	Automation in Clinical Laboratory	6			6	12	9	10	40	1.5	30	20	1.5	100	
3	HS3103 LT	Clinical Laboratory Management	8			6	14	11	10	40	1.5	30	20	1.5	100	
		Total	22			18	40	31	30	120		90	60		300	
												Health Facility Supervi ser	Internal	Final Evaluation		
4	HS3104 LT	Clinical Practicum I(Microbiology and Parasitology)	Total Duration 8 weeks									50	50	100	200	
5	HS3105 LT	Clinical Practicum II (Hematology and Blood Banking)	Total Duration 8 weeks									50	50	100	200	
6	HS3106 LT	Clinical Practicum III (Biochemistry, Histopathology and Cytopathology)	Total Duration 8 weeks									50	50	100	200	
	Total											150	150	300	600	
	Grand Total														900	

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.

Master Plan

Master Plan for Second Year

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
Study Block															Practical (Institute Based)			Hospital Practice (Microbiology)			Hospital Practice (Haematology)			Hospital Practice (Parasitology / Basic Pathology	
27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Hospital Practice Clinical Biochemistry			Vacation						Study Block						Revision									Final exam	

Master Plan for Third Year

1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**
Study Block										Microbiology + Parasitology								Hematology+ Blood Banking							
27	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**
Vacation								Study	Biochemistry+ Histopathology+ Cytopathology								Revision / Internal Exam						Final exam		

See Separate Curriculum for Health Science First Year All

Second Year

Clinical Microbiology and Immunology (Theory)

Total: 8hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 4 hours/week
Lab: 0 hours/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, virology and Immunology.

Course Objectives
After the completion of this course the students will be enabled to:
- Explain historical background of medical microbiology and identify common bacteria.
- Classify the medically important fungi and identify the fungal culture media.
- Study about different viral diseases.
- Explain the defense mechanism including humoral and cell-mediated immunity.

Course Content

Part 1: Microbiology

Unit 1: General concept of Microbiology **5hrs**

- Introduction to Microbiology and microorganisms.
- Scope of Microbiology.
- Classification of microorganisms
- Units in department of Microbiology
- General biological characteristics of bacteria, viruses, protozoa and fungi.
- Brief history of Medical Microbiology:
    - Early years of microbiology in relation to theory of Spontaneous generation, and contribution of Antony van Leeuwenhoek
    - Golden age of microbiology in relation to Louis Pasteur and Robert Koch
    - Modern age of microbiology in relation to molecular biology

Unit 2: Bacteriology
Bacterial cell structure: **2hrs**

- External structures - Flagella, Fimbriae and Pili
- COVERING: Structure, Composition, and function of i) cell wall ii) cytoplasmic membrane iii) capsule
- Cytoplasm- nucleoid (chromosomal DNA and plasmid), inclusions, ribosomes, mesosomes

Unit 3: Morphological classification of bacteria. **2hrs**

- Cocci, Bacilli, Spirillum, Vibrio, Spirochaetes

Unit 4: Arrangements of bacteria **2hrs**

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

Unit 5: Bacterial Growth **2hrs**

- Bacterial generation time
- Bacterial growth requirements
- Bacterial growth curve

Unit 6: Staining **4hrs**

- Introduction, types
  - Simple stain
  - Differential stain
  - Negative stain
- Principle, requirements, procedure, result, clinical significance, reporting and precautions involved in following staining techniques-
  - Gram's stain
  - Ziehl-Nelsen's stain
  - Albert's stain
  - Capsule stain (India ink)

Unit 7: Normal bacterial flora of human body. **2hrs**

- Beneficial roles
- Harmful roles
- Examples of normal microbiota in different body sites

Unit 8: Sample collection for the diagnosis of bacterial infections **1hrs**

- Blood, CSF,Urine, Fluid,stool, Sputum, Pus, catheter tip

Unit 9: Media Preparation **10hrs**

- **Culture media**
  - Definition
  - Classification, based on
    - Consistency (solid, semisolid, liquid) including their advantages and limitations
    - Function
- **Simple or basal media**
- **Special media**
  - Enriched media
  - Enrichment media
  - Selective media

- Indicator media
- Differential media
- Transport media
- Anaerobic culture media

- **Bacterial culture techniques**
  - Definition of Inoculum and Colony
  - Streak, stroke, stab and law

Unit 10: Controlling microbial growth in the environment **10hrs**

- Definition, types, principle, advantages and limitations of sterilization
- 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)
- Difference between sterilization, disinfection and antisepsis
- Standard safety precautions
- Disposal of biological wastes

Unit 11: Controlling bacterial growth in the body **4hrs**

- Antibiotics- Definition
- Classification 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

Unit 12: Various methods for the identification of bacteria **4hrs**

- Phenotypic methods
  - Staining
  - Culture
  - Biochemical test
  - Serological test
- Genotypic method (Polymerase chain reaction-PCR)

Unit 13: Antimicrobial susceptibility testing by **4hrs**

- Disc diffusion methods
  - Stokes' method
  - Kirby-Bauer method
- Tube dilution method

- E-Test method

Unit 14: Quality control in microbiology laboratory **18hrs**

- **Biochemical test**
  - Indole test
  - Simmons Citrate test
  - Urease test
  - Catalase test
  - Oxidase test
  - Coagulase test
  - Triple sugar iron (TSI) test
  - Hanging drop preparation
  - SIM medium
- Bacterial culture
  - Aerobic culture
  - Microaerophilic/Capnophilic culture
  - Anaerobic culture

Unit 15: Morphology, cultural characteristics, disease caused & laboratory diagnosis, and antibiotics sensitivity of the following common bacteria from clinical samples, their preventive measures (in brief): **10hrs**

- Staphylococcus aureus
- Streptococcus pyogenes, and S. pneumoniae
- Hemophilus influenzae
- Neisseria meningitides, N. gonorrhoeae
- Mycobacterium tuberculosis
- Mycobacterium leprae
- Escherichia coli
- Klebsiella pneumoniae.
- Pseudomonas aeruginosa.
- Proteus spp.
- Treponema pallidum
- Salmonella spp.
- Shigella spp.
- Vibrio cholerae.

Part 2:

Unit 16: Mycology **15 hrs**

- Classification of medically important fungi based on their morphology.
- Common terminologies used in mycology (mycelium, hypha, conidiophore, conidia, pseudo hyphae, germ tube and mycoses).
- Brief description:
  - Candida albicans
  - Cryptococcus neoformans
- General classification of dermatophytes

- Collection techniques of various clinical samples for the diagnosis of fungal infection (Skin, Nail, Hair and Sputum sample).
- Laboratory diagnosis of fungal infection
  - KOH Mount
  - India ink preparation
  - Culture (SDA, DTM)
  - Germ tube test
  - Lactophenol Cotton Blue (LPCB) Mount

Part 3:

Unit 17: Virology **20 hrs.**

- Common terminologies used in virology (inclusion body, bacteriophage, paired sera, cytopathic effect and viral transport medium).
- Properties of viruses
- Structure and classification of viruses
- Replication of viruses
- List the common viral diseases**.**
  - Describe structure, mode of infection, pathogenicity and Laboratory diagnosis of HIV and viral hepatitis
- Introduction to basic laboratory procedure used in the diagnosis of viral diseases.
  - Viral Culture, Serological tests, Immunofluorescence, Electron microscopy

Part 4:

Unit 18: Immunology **24 hrs**

- Introduction (Immunity, antigen/ hapten, antibody, epitopes, adjuvants, Cells of immune system, MHC, Complement)
- Innate and acquired defense systems
- Primary and Secondary immune response
- Adaptive Immune System- Humoral and Cell mediated.
- Properties of Antigen-antibody reaction
- Classification of antigen antibody reactions
  - Agglutination
  - Precipitation
  - Neutralization
  - Complement Fixation
  - ELISA
- Introduction to Hypersensitivity reactions.

Unit19: Hospital acquired Infection **1hrs**

Unit20: Quality control in Microbiology **2hrs**

Reference Books

- District laboratory Manual for developing Countries (Volume I and II) - Monica Cheesbrough
- Practical Medical Microbiology,Mackie and McCortney
- Textbook of Microbiology, R. Anantnarayan & C.K.J. Panikar
- Diagnostic Medical Microbiology,Baily & Scoots
- Medical Microbiology Volume I & II,Robert Cruishank
- Review of Medical Microbiology, Jawetz et al
- Lynch's Medical Laboratory Technology, Stanley S Raphael, Igaku-Shoinl
- Quality Control in Clinical Laboratory, David Tonks
- Guide to Medical Laboratory Instruments, Cliffortd D Fervis

Final written exam marking scheme

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**Total**
Unit Hours	5	2	2	2	2	2	2	1	10	10	4	4	4	18	10	15	20	24	1	2	140
Marks	3	1	1	1	1	1	1	1	6	6	2	2	2	10	6	8	12	14	1	1	80

Clinical Microbiology and Immunology(Practical)

Practical: 140hrs

Bacteriology

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

Mycology

- Prepare 10% KOH solution and SDA medium.
- Perform skin/Nail, /hair-scraping, KOH preparation and inoculation in SDA.
- Perform India ink preparation.
- Perform germ tube test.
- Perform LPCB Mount.

Virology

- Demonstration of viral inclusion bodies.
- Perform serological tests based on immunochromatography technique for HIV, HBV & HCV infections.
- Demonstration of ELISA for the diagnosis of HIV infection.

Immunology

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

Hematology and Blood Banking (Theory)

Total: 8hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 4 hours/week
Lab: 0 hours/week

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;
- Perform routine and special laboratory procedures.
- Identify blood and blood cells disorders.
- Apply Blood Banking and Immunohematology techniques.

Course Content

Unit 1: Introduction to Hematology **6hrs**
- History, scope and importance of haematology.
- Review of circulatory system mentioning the functions of heart, arteries, veins and
- capillaries.
- Blood: definition,properties, composition, functions of each cells.
- Normal structure, shapes,sizes, life span and normal reference (values) of blood cells.

Unit 2: Haematopoiesis **10hrs**
- Definition; sites of blood formation.
- Development of blood cells
  - Erythropoiesis.
    - Stages of cell development
    - Regulation of erythropoiesis
    - Fate of RBC
  - Leucopoiesis
    - Myeloid series- stages of cell development
    - Lymphocytic series- stages of cell development
    - Monocytic series- stages of cell development
    - Regulation of leucopoiesis
  - Thrombopoiesis.
    - Stages of cell development
    - Regulation of platelet formation

Unit 3: Hemoglobin **9hrs**

- Hemoglobin: Definition, structure, function and normal range
- List of normal and abnormal haemoglobins.
- Haemoglobinopathies: Definition, examples
- Sickle cell anemia: Definition, cause and lab diagnosis
- Thalassemia: Definition, cause, types and lab diagnosis

Unit 4: Red Cell Disorders **13 hrs**

- Introduction to Qualitative, quantitative and morphological abnormalities of red cells.
- Anaemia: Definition, classification
- Definition, causes, symptoms, laboratory diagnosis and treatment of: Iron deficiency anemia; Megaloblastic anemia; Hemolytic anemia
- Polycythemia: Definition, causes, symptoms, diagnosis, and treatment.

Unit 5: White Blood Cell Disorders **8 hrs**

- Introduction to Morphological and functional disorders of white blood cells.
  - Introduction to Leucocytes disorders (Qualitative and Quantitative).
  - Leukemoid reaction: Definition, causes and lab diagnosis
  - Leukemia: Definition, causes, classification and lab diagnosis
  - Difference between Leukemoid reaction and Leukemia.

Unit 6: Platelet disorders **2hrs**

- Introduction, Definition and classification of platelet disorders

Unit 7: Coagulation mechanism **6 hrs**

- Haemostasis: Definition and components
- Coagulation factors
- Process of haemostasis and blood coagulation.
- Introduction to Bleeding disorders- Thrombocytopenia, Hemophilia

Unit 8: Hematological Techniques **55hrs**

- Introduction to Haematology laboratory instruments, equipments and glassware
- Anticoagulant: Definition, types based on mechanism of action, uses, advantage and disadvantages.
- Phlebotomy technique
  - Anatomical sites of blood sample collection
  - Methods of blood sample collection
    - Capillary blood sample collection
    - Venous blood sample collection
    - Arterial blood sample collection
  - Precaution during sample collection.

- Blood smear preparation: thick and thin.
- Hemocytometry: Principle, requirements, procedure, calculation, normal values,
- Clinical significance and precaution of
    - Total RBC Count
    - Total WBC Count
    - Platelet count
- Definition of stain. Principle, composition, Preparation, uses, procedure of
- Romanowsky stains (Wright's, Leishman's, and Giemsa stain).
    - Differential leukocyte count (DLC): principle, requirements, procedure, reference range, clinical significance and precaution.
- Absolute Eosinophil Count; Principle, requirements, procedure, reference range, clinical significance and precaution.
- Bone marrow examination: Sites of sample collection, smear preparation and staining (Giemsa stain)
- Erythrocyte Sedimentation Rate (ESR): Definition, principle, requirements, procedure, normal value, clinical significance and influencing factors of;
    - Wintrobe's method
    - Westergren method
- Packed cell volume (PCV):Definition, Principle, Clinical Significance, methods of estimation, Normal value, result, interpretation.
- Haemoglobin estimation:
    - Various methods of Hemoglobin estimation
    - Principle, requirements and procedure: Colorimetric method (Cyanmethaemoglobin) and Acid haematin method (Sahli's)
    - Clinical significance of Hemoglobin estimation
- Red cell indices (MCV,MCH, and MCHC) calculation, Normal value and their clinical significance.
- Reticulocyte count: Introduction, Principle, Procedure, Normal value, Clinical significance
- Introduction, Principle, Procedure, Normal values, Clinical significance for following tests; Bleeding time, clotting time, prothrombin time, activated partial thromboplastin time
- Automated blood cell analyzer; Working principle and application.
- Other Hematological techniques- LE Cell preparation, Osmotic Fragility Test, Sickling test, Hemoglobin electrophoresis
- Quality control in Hematology Laboratory.

Unit 9: Blood Parasites **6hrs**

- List out the Blood parasites with special reference to Nepal.
- Smear preparation, staining and identification of malarial parasite, microfilaria and LD bodies.

Unit 10: Immunohematology and Blood Banking **25hrs**

- Introduction. History, scope, importance.
- Instruments used in blood banking.

- Anticoagulants used in blood banking
- Blood grouping systems and various blood groups.
- Selection/rejection criteria for blood donor
- Blood donation: Donor preparation and procedure of blood collection, transport, processing and storage of blood.
- Blood components; their uses and storage.
- Theory, procedure, precaution and significance of
    - ABO and Rh blood grouping
    - Cross-matching
    - Direct and indirect Coomb's tests.
- Transfusion transmissible infections and their screening.
- Post transfusion reactions.
- Haemolytic disease of new born (Introduction, etiological factor, pathogenesis, clinical feature, lab diagnosis and management).

Reference books

- District Laboratory Practice in Tropical Countries- Monica Cheesburough, 2nd edition, Part 2
- Oxford handbook of Clinical Medicine- 10th edition
- Dacie and Lewis Practical haematology - 11th edition, Churchill Livingstone.
- De Gruchys clinical hematology in medical practice , 6th edition, Wiley India Pvt Ltd
- A hand book of Medical Laboratory Technology - V.H Talib,2nd edition, CBS Publisher
- Essentials of Hematology- Shirish M Kawthalkar, 3 rd edition, Jaypee
- Textbook of Pathology- Harsh Mohan. 8th edition, Jaypee
- Textbook of Medical Laboratory Technology, Clinical laboratory Science And Molecular Diagnosis-Praful B. Godkar,3rd edition, vol,2
- Manual of basic techniques for a health laboratory - WHO
- National blood Policy 2061- Government of Nepal, Ministry of Health
- National blood Transfuion Policy 2071- Government of Nepal, Ministry of
- HealthLaboratory Practical Haematology -K. Parajuli

Final written exam marking scheme

Unit	1	2	3	4	5	6	7	8	9	10	Total
Unit Hours	6	10	9	13	8	2	6	55	6	25	140
Marks	3	6	5	8	5	1	3	31	3	15	80

Hematology and Blood Banking (Practical)

Practical: 140hrs

- Perform the following tasks:
- Handling of various hematological equipment and apparatus.
- Collect blood sample for various hematological tests:
  - Capillary puncture (fingertip, ear lobe, toe and heel)
  - Venipuncture (using syringes and vacutainer)
- Prepare chemicals, reagents and solution and stain
  - Preparation of stains- Wright stain, Giemsa stain, Leishman's stain, Supra-vital stain.
  - Preparation of diluting fluid for WBC, RBC and platelets.
- Prepare thin and thick blood smears and stain by various method (Wright stain, Giemsa
- stain, Leishman stain)
- Identify normal and abnormal blood cells in stained blood smear.
- Perform Differential Leukocyte Count on blood smear.
- Perform
  - WBC count
  - RBC count
  - Platelet count
- Estimate haemoglobin by Sahli's and Cyanmethaemoglobin method.
- Perform ESR test by Wintrobe's and Westergren method.
- Perform Haematocrit (PCV) estimation: (Wintrobe method)
- Perform reticulocyte count.
- Demonstrate Sickling test, Hb electrophoresis.
- Perform following tests for blood coagulation disorders:
  - Bleeding Time (BT)
  - Clotting Time (CT)
  - Prothrombin Time (PT)
  - Activated PartialThromboplastin Time (APTT)
- Estimate blood cell indices values.
- Perform complete blood cell count using automated hematology analyzer
- Identify the blood parasites. (Plasmodium spp, Microfilaria)
- Perform ABO bloodgrouping and Rh typing
- Perform cross matching.
- Perform Coomb's test
- Prepare calibration curve for haemoglobin estimation by Cyanethemoglobin method.
- Manage waste from hematology lab

Clinical Biochemistry (Theory)

Total: 8hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 4 hours/week
Lab: 0 hours/week

Course Description

The course is designed to provide basic but comprehensive knowledge of 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 includes 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 the field with the practical experience hand in hand. This will be tested in practical & theory during the process of teaching. 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.

- Familiarize with elementary and physical chemistry.
- Describe the biochemical processes of different kinds of foods in our body.
- Identify the role of vitamins & enzymes in our body.
- Make biochemical estimation.
- Handle different equipment for biochemical analysis.
- Prepare chemical reagents for biochemistry laboratory.

Course Content

Unit 1: Introduction to Biochemistry **2 hrs**

- Definition
- Scope, fields and importance of biochemistry
- History of biochemistry

Unit 2: Elementary chemistry **12 hrs**

- Definition of atom, molecule, atomic number, atomic weight, molecular weight, equivalent weight, specific gravity and chemical equation (oxidation and reduction).
- Solution
    - Solution, types of solutions: saturated, unsaturated, supersaturated, normal, molar, molal 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**

- Principle, functions, handling and maintenance of:
  - Water bath
  - Centrifuge
  - Analytical balances
  - Colorimeters
  - Spectrophotometers
  - Micro-pipettes
- Glasswares (Composition and use) and their cleaning.
- Changes occurring in the blood after collection
- Laboratory hazards and precautions to be taken while working in the clinical chemistry laboratory.

Unit 4: Biomolecules and Metabolisms

Bio-molecules **40 hrs**

- Introduction, Types and importance of Biomolecules
- 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 & Hetero-polysaccharides)

- Proteins:
  - Introduction, Definition and Functions of Proteins.
  - Amino Acids: Introduction 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

- Lipids:
  - Introduction, Definition, Functions and Classifications of Lipids.
  - Triglycerides: Introduction 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, properties and functions.

- 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.

- 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
  - Units and It's applications
  - Coenzymes: Introduction, definition & function with examples.
  - Isoenzymes: Introduction, definition and it's features. Isoenzymes of LDH, CPK & ALP
  - Diagnostic Importance of Enzymes and their pattern in diseases.

- 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.

- Minerals:
  - Introduction & Classification.
  - Biochemical functions and deficiency manifestations of Iron, Calcium, Phosphorus, Sodium, Potassium and Iodine.

- Hormones:Introduction, definition, functions and classifications.

- Tumor Markers: Introduction, Classification & their significance.
- Basic concept of nucleic acid.
  - Define nucleoside,nucleotide and nucleic acid.
  - Differentiate between DNA/RNA.

Unit 5: Metabolism of Biomolecules **35hrs**

- Introduction to Metabolism
- 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..
- Clinical Significance.
- Gluconeogenesis: Introduction, Importance & Pathway
- Brief introduction to Cori's Cycle, Rapaport Luebering Cycle, HMP shunt pathway, Glycogen Metabolism and their 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.
- Introduction to Glucose Challenge test.
- Enlist inborn errors of carbohydrate metabolism.

- 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)
  - Enlist inborn errors of protein metabolism.

- Metabolism of Lipids:
  - Introduction to Fatty acid oxidation and its various pathways.
  - β-oxidation of fatty acids: Introduction , pathway, Energetics, regulation and clinical significance
  - Ketone bodies: Introduction, Ketogenesis(synthesis), Ketolysis(utilization) & clinical significance.
  - Fatty Liver and associated health risks.
  - Enlist inborn errors of lipid metabolism.

Unit 6: **Estimations of different biochemical analytes** **30 hrs**

- Various methods, Principle, Procedure, Reference Range, Clinical significance, precautions in the estimation of:
  - Sugar
  - Urea
  - Creatinine
  - Uric Acid
  - Serum Bilirubin(Total & Direct)
  - Total Protein
  - Albumin

- A/G Ratio
- 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)

- Organ Function Tests: Introduction and interpretation of
  - Liver Function Tests (LFT)
  - Renal Function Tests (RFT)
  - Pancreatic Function Tests (PFT)
  - Cardiac Function Tests (CFT)
  - Thyroid Function Tests (TFT)

Unit 7: Quality control in clinical chemistry laboratory **6 hrs**

- Effects of time, pH, temperature and light on chemical reagents.
- Preservation of chemicals used in biochemistry laboratory.
- Quality Control(QC) in biochemistry laboratory

Reference books

- Clinical Biochemistry- Tapeshwar Yadav, Highland Publication, Pvt. Ltd., Bhotahity, Kathmandu
- Biochemistry U. Satyanarayan.
- Fundamental Biochemistry -A.C.Dev
- Varley´s Practical Clinical Biochemistry Goweklook.
- Quality control in clinical laboratory David Tonks
- An introduction to medical laboratory technology F J Baker, R E Silverto
- An introduction to Medical Technology F J Baker
- Harper´s Biochemistry Harper
- A Text Book of Clinical Chemistry Teitz
- A biologist guide to principles and techniques of practical biochemistry Bryn & Keith
- A Text Book of Clinical Biochemistry S. Baral, N. Parajuli, P. Hamal & K. Poudel

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**Total**
Unit Hours	2	12	15	40	35	30	6	140
Marks	1	7	9	23	20	17	3	80

Clinical Biochemistry (Practical)

Hours140:

Perform the following tasks:

- Prepare normal and percentage solution of NaCl.
- Perform separation of Serum and Plasma.
- Perform blood glucose by GOD-POD method.
- Perform blood urea by Berthelot method.
- Prepare calibration curve for blood glucose and blood urea estimation.
- Perform serum creatinine by Alkaline picrate method.
- Demonstrate clearance tests (Urea and Creatinine)
- Perform serum uric acid by enzymatic method.
- Perform serum total protein by Biuret method.
- Perform serum albumin by Bromocresol Green method.
- Perform bilirubin by modified Jendrassik&Grof method.
- Perform serum Total cholesterol by CHOD-PAP method.
- Perform serum Triglyceride by GPO-PAP method.
- Perform HDL-Cholesterol by PEG/CHOD/PAP method.
- Perform serum SGPT by UV-kinetic method.
- Perform serum SGOT by UV-kinetic method.
- Perform serum alkaline phosphatase (ALP).
- Perform serum amylase.
- Perform serum calcium O-Cresolphathaleincomplexon (OCPC) method.
- Perform serum inorganic phosphorus by Gommorris method.
- Perform serum sodium/potassium by ISE.
- Demonstrate estimation of Total Creatine Phosphokinase (CPK).
- Demonstrate estimation of Glycated haemoglobin (HbA_1c).

Medical Parasitology (Theory)

Total: 4 hours /week
Lecture: 2 hours/week
Tutorial: 0 hour/week
Practical: 2 hours/week
Lab: 0 hours/week

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 the 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.

Course Content

Unit 1: Introduction **5 hrs**

- Host: definitive host, intermediate host.
- Parasite; ectoparasite, endoparasite, temporary parasite, permanent parasite, obligatory parasite, facultative parasite.
- Host parasite relationship; commensalism, mutualism, pathogenic. Infection and infestation
- Classify medically important parasites and explain intestinal, urine, blood and tissue parasites.

Unit 2: Protozoa **20 hrs**

- Introduction
    - Rhizopoda-Pathogenic, non-pathogenic and free living
    - Ciliates
    - Flagellates
    - Kinetoplastida
    - Sporozoa
- Introduction, Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:

- Entamoeba histolytica
- Giardia lamblia
- Trichomonas vaginalis
- Leishmania: L. donovani
- Plasmodium: P. vivax, P. falciparum
- Toxoplasma gondii.
- Cryptosporidium parvum:
- Cyclospora cayetanensis,
- Balantidium coli

Unit 3: Helminthes **30hrs**

- Nematodes
  - Introduction
  - Introduction, Prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:
- Cestodes (Tape worms)
  - Introduction
  - Introduction, 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.
- Trematodes (Flukes, intestinal, hepatic, pulmonary and blood)
  - Introduction
  - Introduction, 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 **15 hrs**

- The procedure for clinical specimen collection for parasitic investigations (stool, urine, blood, sputum, exudates, swabs and aspirates).
- 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).
- Various laboratory technique:
  - Feacal (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.

References Books

- 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

Unit	**1**	**2**	**3**	**4**	**Total**
Unit Hours	5	20	30	15	70
Marks	3	11	17	9	40

Medical Parasitology (Practical)

Practical 70hrs

- Collect various samples (stool, urine, blood, sputum, CSF and body fluid) by different methods for the detection of parasites.
- 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).
- 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.
- Identify Scotch tape technique for ova of pin worm.
- Detect parasites by Concentration Technique present on stool samples
- Brine solution floatation method
- Zinc sulphate and sucrose floatation methods
- Formal-ether sedimentation method.
- Examine reducing sugar and occult blood in the stool.
- Examine and identify malaria parasites by thick and thin smears.
- Examine and identify microfilaria by wet mount.

Clinical Pathology(Theory)

Total: 6hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 2 hours/week
Lab: 0 hours/week

Course Description
This course is designed to help students to acquire knowledge and skills on General Introductory Pathology 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:

- Introduce pathology and explain its importance.
- Define the terminology used in pathology.
- Identify the underlining pathophysiology in various disease processes.
- Apply pathological investigation in disease screening, diagnosis and prognosis.
- Explain the prevalence, pathology, clinical symptoms and diagnosis of various common infectious disease in Nepal.
- Explain the basic concept of neoplasia and tumor markers.
- Correlate the results of body fluid examination to various disease processes.

Course Content
A. Basic Pathology
Unit 1: General Pathology **10 hrs**

- Introduction to Pathology
- Fields of pathology
- Importance of Pathology
- Diagnostic technique used in Pathology

Unit 2: Cell injury and cellular adaptation **35 hrs**

- Introduction
- Definition of common terminologies used in cell injury and adaptation (Necrosis, Trauma, Hypoxia, Ischemia, Homeostasis, Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Dysplasia, Aplasia, Apoptosis)
- Causes and Types of cell injury
- Mechanism of cell injury on biochemical basis
    - Decreased production of adenosine Triphosphate
    - Mitochondrial damage
    - Influx of Calcium and Calcium homeostasis
    - Accumulation of Oxygen derived free radicles
- Reversible and irreversible cell injury
- Necrosis and its Types.

- Cellular adaptation to injury
- Forms of cellular adaptation
    - Atrophy
    - Hypertrophy
    - Hyperplasia
    - Metaplasia
- Transplant rejection (Introduction and classification)
- Autoimmune diseases
    - Definition
    - Classification of autoimmune diseases
    - Pathogenesis
    - Laboratory findings

Unit 3: Inflammation **15 hrs**

- Introduction
- Common terminologies (Oedema, Erythema, Vasodilation, Granuloma, Acute, Chronic, Abscess, Exudates and Transudates)
- Types, causes and mechanism of
    - Acute inflammation
    - Chronic Inflammation
    - Chemical mediators of inflammation

Unit 4: Infection **30 hrs**

- Introduction
- Classification of Infection
- Mechanism of Infection
- Common terminologies (Agent, Host, Vector, symptoms, Signs, Diagnosis, Prognosis, Therapy, Prophylaxis, Incubation Period, Window Period)
- Introduction, Etiological agent, Route of transmission, Pathogenesis, Clinical manifestation, Laboratory diagnosis and Treatment of following Infectious diseases in Nepalese context
    - Candidiasis
    - Leprosy
    - Enteric Fever
    - Cholera
    - Scrub typhus
    - HIV/AIDS
    - Infectious hepatitis
    - Japanese encephalitis

Unit 5: Neoplasia **15 hrs**

- Introduction
- Common terminologies (Benign, Malignant, Metastasis, Carcinoma, Lymphoma, Sarcoma, Papilloma, Adenoma, Anaplasia, Pleomorphism)
- Difference between Benign and malignant tumours
- Etiology of cancer (Carcinogenic agents)
- Tumour markers; Definition, Classification and Applications.
- Laboratory diagnosis of cancer.

Unit 6: Specific specimen examination for Laboratory diagnosis **35 hrs**

- Examination of effusions (synovial, pleural, pericardial, peritoneal fluids)
    - Indications, Specimen collection, Physical, Chemical, Microscopic and Microbiological investigation
- Examination of urine
    - Composition of normal urine
    - Specimen collection
    - Physical, Chemical, Microscopic and Microbiological investigations
- Examination of cerebrospinal fluid
    - Composition of normal CSF
    - Specimen collection
    - Physical, chemical, Microscopic, and microbiological changes during diseases
- Examination of semen
    - Introduction
    - Specimen collection
    - Laboratory investigation
        - Measuring volume and appearance, Liquefaction time
        - 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

Reference Books

- Textbook of Pathology Harshmohan
- Basic Pathology Robbins
- Urinalysis and Body Fluids Susan King Strasinger, Marjorie Schaub Di Lorenzo
- General and Systemic Pathology Ramadas Nayak

Unite	1	2	3	4	5	6	Total
Unite Hours	10	35	15	30	15	35	140
Marks	5	20	9	17	9	20	80

Clinical Pathology (Practical)

Practical: 70 hrs

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

Public Health and First Aid(Theory)

Total: 6 hours /week
Lecture: 4 hours/week
Tutorial: 0 hour/week
Practical: 2 hours/week
Lab: 0 hours/week

Course Description:

This course is designed to help provide the students with 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 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.

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 completion of this course students will be able to:

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

Course Contents

Unit 1: Public Health **10 hrs**

- Health, Community health
  - Concept
  - Definition
  - Spectrum of health

- Concept and definition of Public health
- Functions and goals of Public Health
- Scope of public health and its approaches
- Important public health practices in Nepal.
- Application of public health education in diagnosis.

Unit 2: Basic Epidemiology **15 hrs**

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

Unit 3: Nutrition: **(15 hrs)**

- Definition and Concept of Nutrition
- Nutrients
- Classification of Food
- Definition, function, daily requirement, Deficiency disorder of Protein, Carbohydrates, Fats, Vitamins, Minerals
- Concept and characterize Balanced Diet
- Malnutrition
  - Definition
  - Causes
  - Types
  - Prevention
- Food security, food hygiene, food adulteration, food fortification and food preservation techniques

Unit 4: Maternal and Child Health (MCH): **(20 Hrs)**

- Definition and Concept of MCH
  - Concept and scope of Safe motherhood
  - Explain ANC and PNC

- Define Obstetric referral
- Concept, Definition, scope of Reproductive Health
- Define Breast feeding
- Describe and explain breast milk and technique and its storage
- Enlist Advantages of breast feeding and disadvantages of bottle feeding
- Identify Common problems related to breast feeding
- Concept of Immunization and current immunization schedule of Nepal
- Family planning, its objectives and different methods of family planning available in Nepal.

Unit 5: Basic hygiene and sanitation **20 hrs**

- Water pollution
  - Introduction
  - Causes
  - Water borne diseases.
  - Water purification techniques
- Air pollution
  - Introduction
  - Causes
  - Air pollution borne effects on health
  - Preventive measures for air pollution
- Noise (Sound Pollution)
  - Introduction
  - Causes
  - Effects of Noise on human health,
  - Preventive measures of Noise pollution
- Sterilization and disinfection techniques

Unit 6: Health education and health promotion **7 hrs**

- Introduction
- Communication process and its importance.
- Health education; methods and medium
- Importance of health education

Unit 7: Primary Health Care **8 hrs**

- National health policy
- National health strategy for ensuring achievement of targeted health goals.
- Concept on primary health care
- Elements of primary health care
- Discussion on principles and strategy for primary health care.
- Role of health worker in primary health care services.

Unit 8: Waste disposal system **20hrs**

- Biodegradable and non-biodegradable solid wastes.
    - Minimizing waste 3R concept:
        - Reduce waste
        - Reuse waste
        - Recycle waste
- Disposal of waste
    - Collection
    - Storage
    - Transportation
    - Ultimate disposal
        - Sanitary land filling
        - Dumping
        - Composting
        - Incineration
        - Burial
- Methods of solid waste management.
- Excreta disposal techniques.
- Measures of vector control. (mosquito borne diseases, measures to control mosquito/ rodent borne diseases, control measures of rodents)
- Hospital borne infections,
- Hospital waste Management.
    - Hospital waste
    - Hazards of hospital waste
    - Management of hospital waste
        - separation of waste
        - using incineration
        - management of mercury
    - Hospital waste management guideline according to WHO
- Sources and components of liquid waste
    - Liquid waste management:

Unit 9: First Aid **25 hrs**

- First aid treatment and its importance.
- Basic qualities and responsibilities of a first aider.
- Terminologies : Casualty / Victim/ First aider/ Refer/ Trauma/ Antiseptic/ Immobilization / Cyanosis/ Hemorrhage/Stroke
- CAB (Circulation, Airway, and Breathing) and the procedure of cardio-pulmonary resuscitation (CPR)
- Following medical emergencies, their causes, symptoms and first aid management:
    - Shock
    - Intoxication/Poisoning (insecticides/rodenticides/drugs/alcohol)
    - Introduction of foreign bodies in ear, nose, throat and eyes.
    - Road traffic accidents (RTAs)

- Hemorrhage
- Burns
- Frostbite
- Strokes
- Acute mountain sickness
- Broken bones and dislocation
- Rabid animal bite
- Snake and insect bite

Reference Books

- Park's Textbook of Preventive and Social Medicine K Park
- Basic Principles of Management Shrestha, B.M Akshyulak Publication, Nepal. 2039B.S.
- Inventory Control and Basic Logistics Procedure Manual on Store Management for PHC/HP and SHP Personnel. HMG/JSI. 2054B.S.
- Textbook of Preventive and Social Medicine Park, K. B. Bhanot, Jabalpur, India. 2000.
- Health Logistics Procedure Manual NHTC/LMD/USAID JSI, Nepal 2057.
- Health Statistics and EPI Cold Chain Management Procedure Manual. - NHTC/LMD/USAID JSI, Nepal 2057.
- A Handbook of Hygiene and Public Health Y.P. Bedi.
- W.H.O. Excreta disposal
- Environmental Health and Sanitation Shatrughna Ojha.
- Annual Report of Department of Health Services, Ministry of Health
- A Textbook of Health Education, L. Ramachandran and T Dharmalingam, Vikas Publishing House Pvt. Ltd., New Delhi, 2001
- Introduction to Health Education, Water H. Green and Bruce G. Simons Morton, Macmillan Publishing Company, NY
- First Aid ICRC

Unit	1	2	3	4	5	6	7	8	9	Total
Unit Hours	10	15	15	20	20	7	8	20	25	140
Marks	6	9	9	11	11	4	5	11	14	80

Public Health and First Aid (Practical)

Practical: 70hrs

Perform the following tasks:

- Analyze the quality of drinking water in microbiology lab.
- Perform standard hand washing techniques.
- Cooperate with other team members in sanitary activities in the community.
- Conduct a health problem related survey in nearby community by means of questionnaire.
- Prepare a modular health education plan for deliberation of health education in selected community or health post.
- Use following health education method effectively:
- Perform Communication exercise, Group discussion, and Role play, Counselling, Lecture, Demonstration and Exhibition.
- Collect and compile health education materials from different organisation.
- Prepare simple media for health education like Poster, Flannel graph, Models, Charts and graphs, Puppets and Pamphlets
- Observe hospital waste disposal techniques in the clinical laboratory of Tertiary care hospital or NPHL.
- Observe water purification process on large scale (Industrial level) to the nearby water purification plant.
- Observe current health care delivery system through national health facility.
- Observe milk processing (pasteurization, safe packaging and transport) in a nearby firm.
- Observe waste disposal technique
- Measure temperature, pulse, respiration, blood pressure and Body mass index (BMI).
- Demonstration of injection, application of dressing, bandages and splint.
- Perform cardio-pulmonary resuscitation.
- Role played by learners on different medical emergencies.

Third Year

Histopathology and Cytopathology (Theory)

Total: 14 hours /week
Lecture: 8 hours/week
Tutorial: 0 hour/week
Practical: 6 hours/week
Lab: 0 hours/week

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 helps 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:

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

Course Contents

Unit 1: Histopathology **8 hrs**

- Introduction
- General concept of Histology, Histopathology. Common terminologies (Autopsy, Excisional biopsy, Incisional biopsy)
- 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 **6 hrs**

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

Unit 3: Tissue Processing **10 hrs**

- Fixation
  - Factors affecting Fixation.
- Dehydration and common dehydrating agents.
- Clearing and common Clearing agents
- Infiltration and Impregnation
- Embedding: Different types of embedding media, Advantage and Disadvantage
- Automated Tissue Processor
  - Types
  - Working Principle
  - Components
  - **Procedure**
  - Operation and Maintenance

Unit 4: Decalcification **10 hrs**

- Introduction and importance
- Examples and composition of common decalcifying agents
- Decalcification methods
- Factors affecting decalcification
- Assessment of decalcification
- Neutralization of acid

Unit 5: Microtomy **12 hrs**

- Introduction
- Use of Microtome
- Types of Microtome
- Advantage and Disadvantage
- Tissue section cutting using rotary microtome
- Care and maintenance
- Microtome knives
  - Selections of knives
  - Honing and stropping of microtome knives
  - Automatic Knife sharpener
  - Care and Maintenance

Unit 6: Frozen Sections / Cryostat **6 hrs**

- Define cryostat and write its clinical importance.
- 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
    - Zeihl Nelson
    - Congo Red
    - Sudan Black
    - Perl's Stain
    - MPO stain

Unit 8: Mounting Media **4 hrs**

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

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

- Introduction
- Principle
- Steps/Procedure
- Clinical significance
- examples

Unit 10: Cyto-pathology **12 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
        - Giemsa stain
        - May Grunwald-Giemsa (MGG) stain
    - Fine Needle Aspiration Cytology (FNAC):Importance, requirement, Procedure, advantage and disadvantage
- Sampling, staining and Demonstration of Barr body.

Reference Books

1. Theory and Practice of Histological Techniques. 5th Edition.John D. Bancroft, Alans Stevens and David R. Turner
2. Diagnostic Cytology and its histologic bases L.G. Koss, Fourth Edition.
3. Cytology Technical Manual Cytology Research Center ICMR (India)
4. The "Pap Smear" M.E. Boon
5. Practical Cytology Ron Bowdich
6. Comprehensive Cytopathology Marluce Bibbo, Second Edition
7. Basic and Advanced Laboratory Techniques in Histopathology and Cytology Pranab Dey

Unit	1	2	3	4	5	6	7	8	9	10	Total
Unit Hours	8	6	10	10	12	6	12	4	8	12	88
Marks	7	5	9	9	11	5	11	5	7	11	80

Histopathology and Cytopathology(Practical)

Practical: 66hrs

Perform the following tasks:

- Handle microscope.
- Prepare fixatives and fixation of tissues.
- Collect, transport & fix samples for histological & cytological studies.
- Process the grossed tissues.
- Cut sections using rotary microtome to get ribbons of tissue sections.
- Prepare reagents & stains used for Hematoxylin & Eosin stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
- Prepare reagents & stains used for Giemsa and Papanicolaou stains.
- Stain sections by H/E stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
- Prepare cytological fixatives and fixation of cells.
- Prepare cytological smears and stain with pap method.
- Stain FNAC smears by Giemsa and Papanicolaou methods.
- Mount stained smears/section.
- Demonstrate Barr body by Aceto-Orcein staining method.

Instrumentation and Automation (Theory)

Total: 12 hours /week
Lecture: 6 hours/week
Tutorial: 0 hour/week
Practical: 6 hours/week
Lab: 0 hours/week

Course Description

This course is designed to provide basic knowledge and skills on instrumentation and automation in the clinical laboratory. It helps to 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 the need for automation.

Course Content

Unit 1: Instrumentation: **15hrs**

- 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
    - Vertical laminar flow
    - Autoclave
    - Fumigator
    - Vortex mixer
    - Automatic Blood culture system

Unit 2: Hi-Tech Instruments and Technology **10hrs**

- Introduction, Principle, applications of following biomedical instruments:
    - Chromatography

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

Unit 3: Immunochemical Techniques: **15 hrs**

- Introduction, Principle and applications of following technologies:
    - Enzyme linked immunosorbent assay (ELISA)
    - Radioimmunoassay (RIA)
    - Chemiluminescence immunoassay (CLIA)
    - Electrochemiluminescent immunoassay (ECLIA)

Unit 4: Automation **26 hrs**

- 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
- Blood cell analyzer: Introduction, working principle, components, applications.
- Arterial blood gas analyzer and its applications.
- Applications of computer in automation.

References Books

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

Unit	**1**	**2**	**3**	**4**	**Total**
Unit Hours	**15**	**10**	**15**	**26**	66
Marks	**19**	**12**	**19**	**30**	**80**

Instrumentation and Automation (Practical)

Practical: 66hrs

Instrumentation and Automation

- **Handle the following instruments with quality control assurance in diagnostic lab:**
    - Colorimeter and Spectrophotometer,
    - Centrifuge,
    - Water bath
    - Microscope
    - Micropipettes
    - Autoclave
    - Fumigator
    - Dispensor

- **Demonstrate:**
    - Chromatography set
    - Electrophoresis set

- **Demonstrate automated equipment:**
    - Fully automated analyzers
    - Semi automated analyzers
    - Automated electrolyte analyzers
    - Blood cell analyzers
    - ELISA
    - Blood gas analyzer

Clinical Laboratory Management (Theory)

Total: 14 hours /week
Lecture: 8 hours/week
Tutorial: 0 hour/week
Practical: 6 hours/week
Lab: 0 hours/week

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 in improving 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:

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

Course Content

Unit 1: Introduction to clinical laboratory management **10 hrs**

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

Unit 2: Department /section of clinical laboratory **6hrs**

- Different sections of clinical laboratory, corresponding services and their uses.
    - Patient communication (Delivery of information and reports)
    - Sample collection
    - Haematology
    - Blood banking
    - Clinical biochemistry
    - Microbiology

- Serology/immunology
- Parasitology
- Histopathology & Cytopathology
- Emergency lab
- Molecular Laboratory

- Services (range of tests done by CMLT or lab technician level)

Unit 3: Laboratory design: **6 hrs**

- 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
- Human resource in different levels of laboratory

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

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

Unit 5: Personnel management **4 hrs**

- Staff duty rotation
- Importance of continued medical education/training

Unit 6: Standard operating procedures (SOPs): **5 hrs**

- Introduction to standard operating procedure(SOP)
- Essential components of SOPs
- Significance of SOPs in clinical practices

Unit 7: Clinical laboratory Inventory Management: **10 hrs**

- Clinical laboratory records
- Requisition slips Test request form(TRF)
- Lab reports format of different section
- Record keeping and its importance
- Maintain stock inventory
- Maintaining expiry charts
- Important of instrument maintenance sheet Refrigerator Incubator
- Important of daily cleaning record sheet
- Logistics management

- Important of computer in lab
- Local information system LIS in modern lab

Unit 8: Lab hazards and lab safety: 10 hrs

- Lab hazards and lab safety
- Importance and uses of safety and protection in clinical laboratory practices
- of Preparation 0.5-1% hypochlorite
- Use and how to prepare spill kit
- Management of needle stick injury, spillages accident in laboratory and their first aid
- Common accident in lab and their first aid
- Material safety data sheet and hazardous chart symbols.
- 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.
- 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 15 hrs

- Introduction,
- Total Quality Management Framework.
    - Quality Assessment
    - Quality Assurance
    - Quality Laboratory Procedures
    - Quality Control
- Internal Quality Control
- External Quality Control
- Quality Control charts – L-J chart
- 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

- Sources of error
  - Pre-analytical
  - Analytical
  - Post-analytical
- Method of improving laboratory reports

Unit 10: Bio-safety and bio-security: 10 hrs

- Introduction to bio-safety and bio-security
- Risk group classification of micro-organisms: risk group 1 to risk group 4
- Concept of Bio-safety levels: BSL 1 to BSL 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
- Concept of 3R (Reduce, Reuse and Recycle)

Unit 11: Medical ethics 6 hrs

- Medical ethics and its principles
- Confidentiality
- Ethical consent
- 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) & Clinical laboratory improvement Amendments (CLIA)
- Nepal health provisional council (NHPC)
- International Certification boards

References Books

- Carl A Burtis, Edward R Ashwood, David E Bruns, Teitz (2008) Text book of clinical chemistry and molecular diagnostics, Elseviers
- Cheesbrough M, (2004) District laboratory practice in tropical countries, Cambridge University press
- Bharucha C. et al (1970), A handbook of medical laboratory technology, Christian Medical College, vellore

Unit	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**Total**
Unit Hours	10	6	6	6	4	5	10	10	15	10	6	88
Marks	9	5	5	5	4	5	9	9	15	9	5	80

Clinical Laboratory Management (Practical)

Practical: 66hrs

- **Perform basic computer skills on word and excel.**
- **Lab related practical:**
    - Observe different departments in lab (biochemistry, microbiology, hematology, parasitological, collection etc)
    - List out the instruments, glassware, accessories used, along with their uses.
    - Observe and practice specimen collection
    - Perform coding of sample received/collected.
    - Transport and process specimen
    - Assist to prepare duty rotation
    - Prepare SOPs for different tests (Glucose, hemoglobin, gram stain, urine routine examination)
    - Collect different report formats and daily maintenance sheet
    - Assist to prepare computerized reports
    - Maintain lab records, use computers in record keeping.
    - Observe use of IQC materials
    - Identify different hazards in lab and use of hazard symbols
    - Use personal protective equipment in lab and follow safety measures
    - Segregate waste, use proper color coded bins and safe disposal of waste
    - Prepare and use incidence report charts
    - Observe management of inventory and maintain stock records
    - Practice on vacutainer system for blood sample collection
    - Prepare 0.5 & 1 % hypochlorite solution
    - Calculate Mean, CV, SD value

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

Students will be posted in hospital/laboratory with microbiology and parasitology facilities for 8 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 situations. The program is offered after completing twelve weeks institution-based training in the 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 in laboratory procedures.

Placement schedule

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

S.N.	Practical Areas	Duration
1.	Microbiology Lab.	5 Weeks
2.	Parasitology Lab	4 Weeks
	Total Duration	**9 Weeks**

Skills to be performed during the clinical practice

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

A. Bacteriology

- Microscopy
- Sample collection
- Sterilization and safety precautions
- Gram stain
- AFB stain (Tuberculosis/ leprosy)
- Urine culture/ sensitivity
- Blood C/S
- Pus culture/ sensitivity
- Stool C/S
- Throat swab C/S
- Body fluid C/S
- Wound swab C/S

B. Immunology/Serology

- Widal test
- RPR (VDRL)test
- Rheumatiod Arthritis factor (RA factor) test
- Antistreptolysin 'O' (ASO)test
- C-Reactive Protin (CRP) test
- Aldehyde test
- HIV I-2 antibody spot (Quick) test
- HBs Ag spot (Quick) test
- Anti HCV spot (Quick) test
- TPHA (Treponema pallidum Hemagglutination) test

C. Parasitology

- **Urine Analysis**
  - Routine/Microscopic examination
  - Protein
  - Glucose (sugar)
  - Specific gravity
  - Bile salt Bile pigment
  - Reducing substances
  - Acetone/Ketone
  - Urine pregnancy test (Qualitative)
  - Chyle
  - Urobilinogen
  - Benedict test
  - Sulfosalicylic acid test

- **Stool Examination**
  - Routine/Microscopic Examination
  - Occult blood test
  - Reducing Substances
  - Concentration method for parasitic ova & cysts
  - H. pylori antigen test

D. Miscellaneous:

- Perform semen analysis.
- KOH & germ tube test for fungal study.
- 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 staff 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.

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 8 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 situations. 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:

- Perform all routine and some special laboratory procedures independently and accurately as mentioned below, and
- 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.

S.N.	Practical Areas	Duration
1.	Hematology and Blood Banking Lab	9 Weeks
	Total Duration	**9 Weeks**

Skills to be performed during the clinical practice

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

A. Hematology and Blood banking

- Total leucocyte count (TLC)
- Differential leucocyte count (DLC)
- Erythrocyte sedimentation rate (ESR)
- Packed call volume (PCV)
- Hemoglobin (HB)
- Bleeding time (BT)
- Clotting Time (CT)
- Prothrombin Time (PT)
- Activated Partial thromboplastin time (APTT)
- Platelet Count
- RBC Count

- Reticulocyte Count
- Blood grouping (ABO)
- Rh typing
- Cross matching
- Coombs tests
- RBC indices (MCV, MCH & MCHC)
- Hemoparasites (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 staff 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.

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

Students will be posted in hospital/laboratory with Biochemistry, Histopathology and Cytopathology facilities for 8 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 situations. 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:

- Perform all routine and some special laboratory procedures independently and accurately as mentioned below, and
- 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.

S.N.	Practical Areas	Duration
1.	Biochemistry Lab	5 Weeks
2.	Histopathology & Cytopathology Lab	5 Weeks
	Total Duration	**10 Weeks**

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 reagents for the estimation of
  - Glucose
  - Urea
  - Creatinine
  - Uric acid
  - Total Protein
  - Albumin Globulin
  - Albumin Globulin ratio
  - Amylase
  - Lipid profile
  - Bilirubin
  - ALT (SGPT)

- AST (SGOT)
- Alkaline phosphates
- Sodium
- Potassium
- Chloride
- Calcium

Note: Prepare standard graph of various test.

B. Histopathology & Cytopathology:

- Microscopy
- Prepare fixatives and fixation of tissue
- Collect, transport and fix histopathological and cytopathological specimens.
- Process the grossed tissue
- Cut sections
- Prepare reagents and stains used for Hematoxylin &eosin stains, PAS/Alcian blue and ziehl- Neelsen stain.
- Prepare reagents and stains used for Giemsa and Papanicolaou stain
- Stain the section by H/E and Ziehl-neelsen stain
- Prepare cytological fixative and fixtion of cells
- Prepare cytological smears and stain with pap method
- Stain FNAC smears by Giemsa and pap method.
- Mount stained smears/sections
- 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 staff 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.

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