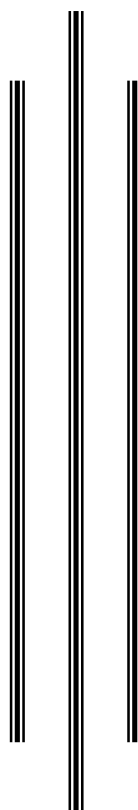


CURRICULUM
for
CERTIFICATE
in
MEDICAL LABORATORY TECHNOLOGY
(CLMT)

(Second and Third Years)



Council for Technical Education and Vocational Training
Curriculum Development Division
Sanothimi, Bhaktapur

First Revision, 2010

(Revision initiative taken by NHPC in collaboration with WHO)

1. Program Description

This course is based on the academic requirements to enter into bachelor level health sciences as well as able to provide diagnostic laboratory services as a middle level human health resource. After completion of the course the graduate is expected to perform laboratory procedures as per assigned by Nepal Health Professional council independently at different level health institutions in Nepal and abroad. The program is three academic years' duration. The first year course focuses on basic science and foundational subjects, the second year course focuses on basic laboratory subject theory/practical simultaneously and the third year is given to the application of learned skills and knowledge within the comprehensive practical settings, in hospitals and medical laboratory.

2. Program aims and objectives

The course aims to produce middle level medical laboratory technology personnel with sound academic knowledge equipped with perfect technical skills who can face real life situation at the level they are aimed at. The course enables students to:

- Perform routine and special laboratory investigations on clinical and non-clinical samples independently.
- 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 centre and district level.
- Practice quality control system in medical laboratory to deliver quality laboratory service.
- Perform middle level laboratory management works, supervision of subordinates and preparation of reports.
- Assist in research works.

3. Target group

SLC and T SLC (Lab assistant) pass youths

4. Group size

30 students (Thirty) in a batch/yea (*Man be increased to the maximum of 40 forty provided all NHPC prescribed requirements are fulfilled*)

5. Entry criteria

The entry criteria are:

- SLC with 45% in aggregate with English, Science and Mathematics as compulsory subjects and TSLC in Lab Technology with first division
- Passed entrance examination administered by CTEVT
- Applicant should submit the following documents at the time of application
 - SLC pass certificate
 - Character certificate
 - Citizenship certificate (for the name, parents name, age, date of birth and address verification purpose only)
 - Physical fitness certificate (at the time of admission)
- Student quota for different category of students as per the policy of CTEVT

6. Medium of instruction

The languages of instruction are:

- English
- Nepali

7. Course duration

The CMLS program extends to over three academic years. One academic year consists of 39 academic weeks and one academic week consists of 32 to 37 hours.

8. Pattern of attendance

Minimum of 80% attendance is required to appear in final examination.

9. Teacher and student ratio

The teacher student ratio is:

- ❖ Overall all ratio of teacher and student must be 1:10 (at the institution level)
- ❖ Teacher and student ratio for practical demonstration 1:10
- ❖ Teacher and student ratio for bench work 1:5
- ❖ 75% of the teachers must be fulltime.

10. Program coordinator, teacher and demonstrator

The qualifications of the program coordinator, teacher and demonstration are as per minimum requirements of NHPC.

11. Instructional media and materials

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

- **Printed Media Materials** (Assignment sheets, Case studies, Handouts, Information sheets, Individual training packets, Procedure sheets, Performance Check lists, Textbooks etc.)
- **Non-projected Media Materials** (Display, Models, Flip chart, Poster, Writing board etc.)
- **Projected Media Materials** (Opaque projections, Overhead transparencies, Slides etc.)
- **Audio-Visual Materials** (Audiotapes, Films, Slide-tape programs, Videodiscs, Videotapes etc.)
- **Computer-Based Instructional Materials** (Computer-based training, Interactive video etc.)

1. Professional practice / field visit provision

The details of professional practice and field visit are as follows:

- Consists of 6 months duration at the end of the course.
- Professional practice (Field practice) should be conducted in hospital Laboratories or research centres recognised by Ministry of Health or concerned government authority.
- Provision of at least one teacher in the institution where field visit is conducted- either from the concerned institute or the hospital/centre itself.

2. Teaching learning methodology

The methods of teachings in the CHLS (Certificate in Health Laboratory Science) programme will be a combination of several approaches. Such approaches can be Illustrated Lecture, Group Discussion, Demonstration, Simulation, Guided practice, Practical experiences, Fieldwork, Laboratory, Observation, Hospital visit, Term paper presentation, Case analysis, Tutoring, Role playing, Heuristic and Other Independent learning.

- Theory: Lecture, Discussion, Assignment, Group work
- Practical: Demonstration, observation and Self practice,

3. Disciplinary and ethical requirements

Intoxication, insubordination or rudeness to peers will result in immediate suspension followed by review by the disciplinary review committee of the school.

Dishonesty in academic or practice activities will result in immediate suspension followed by administrative review, with possible expulsion.

Illicit drug use, bearing arms on campus, threats or assaults to peers, faculty or staff will result in immediate suspension, followed by administrative review with possible expulsion.

15. Methods of evaluation

- ❖ Internal assessment
 - There shall be a transparent evaluation system for each subject both in theory and practical
 - Internal assessment every 4 months with feedback to the students

- Clinical assessment with formative evaluation system
- Weightage of theory and practical marks will be according to the course structure
- Internal assessment carries 20% of the total marks.
- ❖ Final Examination: Written exam, Practical exam and Viva voce
 - Weightage of theory and practical marks will be according to the course structure
 - Final exam carries 80% of the total marks.
 - Must pass internal assessment exams (both theory and practical) to appear in the final examination
 - Provision of re-examination as per CTEVT policy.
 - Provision for administering practical examination by Laboratory Medicine Technologists/ Scientists and expert in respective subjects.
 - One examiner in one setting can evaluate not more than 20 students per day for final practical examination
 - Practical examination should be administered in actual situation on relevant subject with provision of at least one external examiner from the concerned or affiliating institute.
 - Maintain practical log book duly sign by supervisor

16. Pass marks

The pass marks for theory and practical examinations are:

- ❖ 40% in theory examination
- ❖ 60% in practical examination

17. Grading system

The following grading system will be adopted:

- ❖ Pass division: Pass aggregate to below 65%
- ❖ First division: 65% or above
- ❖ Distinction: 80% or above

18. Certificate award

The council for technical education and vocational training will award certificate in "**Certificate Level in Medical Health Laboratory Science**" to the candidate who successfully completes the requirements as prescribed by the council.

19. Career path

The graduates will be eligible for the position equivalent to Non-gazetted 5th level (technical) as Medical Lab Technician 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 Nepal Health Professional Council Act.

Course structure of Certificate in Medical Laboratory Technology

First year

S.No.	Subject	Mode		Weekly Hours	Distribution of Marks						Total Marks
		T	P		Theory			Practical			
					Internal	Final	Time (Hrs)	Internal	Final	Time (Hrs)	
1	English	3	-	3	20	80	3	-	-	-	100
2	Nepali	3	-	3	20	80	3	-	-	-	100
3	Social Studies	3	-	3	10	40	3	-	-	-	50
4	Anatomy & Physiology	3	2	5	16	64	3	8	12	3	100
5	Physics	3	1	4	16	64	3	8	12	3	100
6	Chemistry	3	2	5	16	64	3	8	12	3	100
7	Zoology	3	2	5	16	64	3	8	12	3	100
8	Botany	3	1	4	16	64	3	8	12	3	100
9	Mathematics, BioStatistics & Computer Application	3	2	5	16	64	3	8	12	3	100
	Total	27	10	37	146	584		48	72		850

Second year

S.No.	Subject	Mode		Weekly Hours	Distribution of Marks						Total Marks
		T	P		Theory			Practical			
					Internal	Final	Time (Hrs)	Internal	Final	Time (Hrs)	
1.	Microbiology, Immunology	4	2	6	20	80	3	40	60	3	200
2.	Haematology and Blood Banking	4	2	6	20	80	3	40	60	3	200
3.	Clinical Biochemistry	4	2	6	20	80	3	40	60	3	200
4.	Medical Parasitology	2	2	2	8	32	3	4	6	3	50
5.	Basic Pathology & First Aid	2	2	4	16	64	3	8	12	3	100
6.	Basic Public Health	2	2	4	16	64	3	8	12	3	100
	Total	22	14	36	124	496		152	228		850

Third year

S.No.	Subject	Mode		Weekly Hours	Distribution of Marks						Total Marks
		T	P		Theory			Practical			
					Internal	Final	Time (Hrs)	Internal	Final	Time (Hrs)	
1	Histotechnology & Cytology	2	2	4	16	64	3	8	12	3	200
3	Instrumentation and Automation	2	1	3	8	32	1.5	4	6	2	50
4	Field Practice in Hospital Labs & Community (Last SIX months)	1	16	16				200	200	1.5	500 50*
	Total	0	32	32				400	400		800

*Details on the distribution of marks for field practice evaluation are mentioned in the Field Practice section of the curriculum.

Second Year

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

1. Subject: **Microbiology and Immunology**

Total hours: 234; Full marks: 200

Course description

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

Course objectives

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

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

THEORY

Unit 1

General concept (90 Hours)

1. Scope of Microbiology.
2. Differences between eukaryotic and prokaryotic cells.
3. Classification of microorganisms
4. General biological characters of bacteria, virus, protozoa and fungi.
5. Describe historical background of medical microbiology in relation to Anton Van Leuwenhock, Louis Pasteur and Robert Koch.

Bacteriology

1. Explain Bacterial cell structure
2. Explain morphological classification of bacteria.
3. Explain bacterial growth requirements.
4. Describe the principles of various staining techniques and (Gram's stain, Albert's stain, Ziehl-Neelsen's stain).
5. Describe normal bacterial flora of human body.
6. Classification of culture media. (basic, enriched, differential, selective, broth, semisolid, solid and firm media, transport media).
7. Explain bacterial culture techniques, streak, stroke, stab, lawn, anaerobic culture.
8. Explain controlling microbial growth, sterilization, (autoclaving, hot air sterilization, red heat, filtration, radiation and using various chemicals), disinfection and antiseptics.
9. Describe various methods for the identification of bacteria
10. Explain antimicrobial susceptibility testing by disc diffusion methods and minimum inhibitory concentration (MIC).
11. Describe various quality control methods in bacteriology laboratory.
12. Describe safety precautions and disposal of contaminated materials.
13. Describe classification, culture characteristic, morphology, identification and antibiotics/sensitivity of the following common bacteria from clinical samples. Explain their preventive measures (in brief):
 - *Staphylococcus aureus*
 - *Streptococcus pyogenes*, *S. pneumoniae* and *S. viridans*, etc.
 - *Haemophilus influenzae*
 - *Neisseria meningitidis*, *N. gonorrhoeae*
 - *Mycobacterium tuberculosis*
 - *Mycobacterium leprae*
 - *Brucella spp.*
 - *E. coli*

- *Klebsiella spp.*
- *Pseudomonas spp.*
- *Proteus spp*
- *Clostridia spp*
- *Treponema pallidum*
- *Salmonella typhi, S. paratyphi -A , B*
- *Shigella spp.*
- *Vibrio spp.*

Unit 2 Mycology (17 Hours)

1. Classify the medically important fungi on the basis of their morphology.
2. Define terminology used in mycology (mycelium, hypha, conidiophore, conidia, pseudomycelium and germ tube).
3. Describe briefly superficial/cutaneous, systemic mycosis and aetiological agents.
4. Describe the collection techniques of various clinical samples for the diagnosis of fungal infection (skin/nail/hair sample, corneal scraping, sputum and biopsy materials).
5. Describe fungal culture media (SDA, RSA, DTM),

Unit 3 Virology (22 Hours)

1. Describe cultivation of virus and terminology used in virology (inclusion body, bacteriophage, egg inoculation, cell-culture and neutralization test).
2. Explain multiplication process of viruses (with an example of bacteriophage).
3. Describe common and emerging viral diseases.
4. Describe basic laboratory procedure used in the diagnosis of viral diseases.

Unit 4 Immunology (27 Hours)

1. Describe immunity, antigen/ hapten, antibody.
2. Explain the innate and acquired defence mechanism.
3. Describe classification of antigen antibody reactions (agglutination, precipitation, CFT, ELISA, RIA and IFA) including hypersensitivity reactions.
4. Describe vaccine. List out the common vaccine against vaccine preventable diseases in Nepal.

PRACTICAL

Unit 1 Bacteriology (40 Hours)

1. Use microscope and carry out its maintenance.
2. Clean, decontaminate and sterilize glassware by using autoclave, hot air oven, direct flaming and chemical disinfectants.
3. Prepare Gram's stain, Albert's stain and Ziehl Neelson stain.
4. Prepare various culture media (nutrient broth, nutrient agar, blood agar, chocolate agar, McConkey agar, thioglycolate broth, buffer glycerol saline).
5. Prepare basic biochemical media (peptone water, glucose phosphate broth, citrate, TSI and SIM medium and urea agar).
6. Prove universal presence of microbes by settle plate method.
7. Process various clinical samples received in bacteriology lab.
8. Perform antimicrobial susceptibility testing of isolated organism in pure form (disc diffusion method).
9. Perform catalase, coagulase, oxidase, motility and biochemical tests.
10. Dispose various contaminated materials.

Unit 2 Mycology (12 Hours)

1. Prepare KOH solution and SDA medium.
2. Perform skin/nail/hair-scraping , KOH preparation and inoculation in SDA.
3. Perform India ink preparation and identify *cryptococcus neoformans* in CSF.
4. Perform germ tube test.

Unit 3 Virology (12 Hours)

1. Clean and sterilize glassware used in virology laboratory.
2. Perform Giemsa staining for viral inclusion bodies.

3. Prepare samples for virus culture/investigation.
4. Demonstration of ELISA and Western blot for the diagnosis of HIV infection.
5. Prepare media for transporting virus culture and its storage.

Unit 4 Immunology (14 Hours)

1. Perform intradermal skin test (Mantoux Test).
2. Perform VDRL, ASO titre, RA factor, CRP, Widal and Brucella agglutination Test

Textbooks

1. District laboratory Manual for developing Countries (Volume I and II) - Monica Cheesberg
2. Parasitology (Helminthology & Pratozoology) in relation to Clinical Medicine (Latest edition) - K.D. Chatterjee MD
3. Practical Medical Microbiology - Mackie and McCortney
4. Text Book of Microbiology -R.Anantnarayan &C.K.J.Panikar

Reference Books

- 1 Diagnostic Medical Microbiology -Baily & Scoots
- 2 Medical Microbiology Volume I & II - Robert Cruishank
- 3 Review of Medical Microbiology - Zawet et al
- 4 Lynch's Medical Laboratory Technology - Stanley S Raphael, Igaku-Shoinl
- 5 Quality Control in Clinical Laboratory - David Tonks
- 6 Guide to Medical Laboratory Instruments - Clifford D Fervis
- 7 Clinical Microbiology - American Society for Microbiology (ASM)

2. Subject: **Haematology and Blood Banking**

Total hours: 234; Full marks: 200

Course description

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

Course objectives

After being familiar with the concept of haematology the students will be able to;

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

THEORY

Unit 1 Introduction (8 Hours)

1. Recall the description of the circulatory system mentioning the functions of heart, arteries, veins and capillaries.
2. Describe the composition of whole blood and explain the functions of the blood cells and the liquid portion plasma.
3. Define haematology and its branches.
4. Describe history, scope and importance of haematology.

Unit 2 Haematopoiesis (12 Hours)

1. Describe the site of blood formation.
2. Describe development of blood cells
 - a. Describe the process of erythropoiesis.
 - i. Erythron concept
 - ii. Stages of cell development
 - iii. Control of erythropoiesis (erythropoietin)
 - iv. Ineffective erythropoiesis
 - b. Describe the process of leucopoiesis
 - i. Myloid series- stages of cell development
 - ii. Lymphocytic series- stages of cell development
 - iii. Monocytic series- stages of cell development
 - iv. Control of leucopoiesis
 - c. Describe the process of thrombopoiesis.
 - i. Stages of cell development
 - ii. Control platelet formation
3. Describe normal structure, shapes, sizes, life span and normal reference (values) of blood cells
4. Describe physiology and metabolism of the blood cells.

Unit 3: Red Cell Disorders (20 Hours)

1. Describe the erythrocytic disorder
2. Define haemoglobin, its structure and function.
3. List normal and abnormal haemoglobins.
4. Describe Haemoglobinopathies and thalassemia.
5. Describe polycythaemia.
6. Define and classify anaemia
7. Explain different types of anemia.

Unit 4: White Blood Cell Disorders (10 Hours)

1. Describe Morphological and functional disorders of white blood cells.
 - a) Define and classify Leucocytes disorders
 - b) Define and classify leukaemia

Unit 5: Coagulation mechanisms (10 hours)

1. Describe the process of haemostasis and coagulation.
2. Describe coagulation factor and arrest the bleeding.
3. Describe bleeding time, coagulation time, prothrombin time, activated partial thrombin time
4. Describe the thrombocytic disorders and bleeding disorder

Unit 6: Haematological Techniques (56 Hours)

1. Describe various haematological instruments, glassware and chemicals.
2. Define anticoagulant; describe various anticoagulants and state their mechanism of action.
3. Describe the blood sample collection
 - a) Site of blood sample collection
 - Capillary blood sample collection
 - Venous blood sample collection
 - b) Precaution during sample collection
4. Describe defibrination technique and state its importance.
5. Define stain, principle, preparation and mechanism by Romanowsky stain
6. (Wright's, Leishman's, and Giemsa stain).
7. Describe the blood smear: thick and thin.
8. Describe various method of total blood cell count (WBC, RBC and platelet).
9. Discuss the errors in differential leukocyte count
10. State various method of enumeration of erythrocytes, leukocytes, and thrombocytes.
11. State the principle and importance of dilution methods for WBC, RBC and Platelets.
12. Discuss the sources of errors in enumeration of blood cells.
13. Describe the principle and methods of erythrocyte sedimentation rate, and describe the influencing factor to ESR and interpret the results
14. Define the principles and estimation of various methods of haemoglobin including
 - i) colorimetric method
 - ii) specific gravity method
15. Describe principle and importance of packed cell volume (PCV) and state the various methods.
16. Describe the blood indices (MCV, MCH, and MCHC) and explain their significance.
17. Describe the reticulocyte count
18. Staining of Bone marrow smears.
19. Discuss errors and precaution on haematological work
 - a) Errors due to anticoagulants.
 - b) Errors in the enumeration of different cells,
 - c) Errors in differential count, Choice of stains,
20. Describe various methods on quality control measures.

Unit 8: Blood Parasites (10 Hours)

1. Describe blood parasites with special reference to Nepal.
2. Describe thick and thin blood smears, dehaemoglobinization and staining process for identification of malarial parasites and differentiation of their species.
3. Describe the preparation of blood smears, staining and identification of microfilaria by various methods.
4. Describe the preparation of smears from various samples and staining of LD bodies.

Unit 9: Blood Bank (30 Hours)

1. Describe the scope, importance and principle of blood banking.
2. Describe blood grouping system and various blood groups.
3. Explain blood donors and preparation of blood donors.
4. State the principle and procedures of the proper storage of blood.
5. Describe the various method for compatible blood for recipient and understand the risk of incompatible blood,
6. Identify antiserum, blood bags and transfusion sets of delivery of safe blood for transfusion
7. Describe principal, procedure and precaution on
 - a) ABO and Rh. blood grouping
 - b) Cross-matching
 - c) Direct and indirect Coomb's tests.
 - d) Anti-d antibody titration.

- e) Screening of blood bags
- 8. Describe transfusion reaction and counter check blood transfusion reaction
- 9. Describe the erythroblastosis foetalis.

PRACTICAL

Unit 1 Haematology and Immunohaematology (78 Hours)

1. Handle and care of various haematological equipments; (instrument), apparatus and glassware (new and old) and its.
2. Handle microscope and clean various glassware (new and old), laboratory room, floor, working bench, table, sterilization of various instrument, glassware, syringes and needles
3. Collect blood sample for various haematological test:
 - a. Skin method; Capillary puncture; (fingertip, ear lobe, toe and heel)
 - b. Vein puncture as many times as possible.
4. Prepare various anticoagulant tubes and vials.
 - a. EDTA
 - b. Oxalate
 - c. Citrate
 - d. Heparin
5. Prepare chemicals, reagents and solution, and stain
 - a. Preparation of stains- Wright's stain, Giemsa stain, Leishmania stain
 - b. Cytochemical and bone marrow stain.
 - c. Preparation of diluting fluid (Turk's fluid) for WBC, RBC.
 - d. Preparation of diluting fluid for platelet count
 - e. Supra-vital stain.
6. Prepare smear stain by various method
 - a. Thin blood smears
 - b. Thick blood smear and dehaemoglobinization
 - c. Staining by Wright stain Giemsa stain, Leishman stain
7. Identify normal and abnormal erythrocyte, platelet and leucocytes: (neutrophils, lymphocytes, monocytes, eosinophils and basophils) and comment them.
8. Perform differential leucocytes on a blood smear.
9. Prepare blood-diluting fluids.
10. Count total cells
 - a. Total WBC count
 - b. Total RBC count
 - c. Total platelet count
11. Estimate haemoglobin by various method
 - a. Shali's method
 - b. Cyanmethaemoglobin method
 - c. Microcell counter
12. Perform ESR test:
 - a. Wintrobe method
 - b. Westergren method
13. Prepare Supravital stain and perform reticulocyte count.
14. Perform bleeding time and whole blood coagulation time by various method.
15. Perform prothrombin time test
16. Prepare bone marrow smears, staining and microscopic examination.
17. Find out blood indices values.
18. Identify the parasites.
 - a) Malaria
 - b) Microfilaria
19. Perform aldehyde test.
20. Perform complete blood counts (Hb, WBC, RBC, Platelet, DLC, ESR)
21. Perform haematocrit (PCV) estimation:
 - a. Wintrobe
 - b. Microhaematocrit method.
22. Perform blood grouping and Rh typing
23. Perform cross matching.

24. Perform Coomb's test
25. Perform anti D antibody titration
26. Identify false agglutination.
27. Prepare bone marrow smears and stain them with different cytochemical stains
28. Prepare calibration curve for haemoglobin estimation by Cyanthemoglobin method

Recommended books

- | | | | |
|----|---|---|--------------------------------------|
| 1. | Practical haematology | - | J V Dacie |
| 2. | Practical Haematology | | -Wintrobe |
| 8 | Manual for Medical Laboratory Technology, Volume I & II | | - Monica Cheeselburgh |
| 9 | A hand book of Medical Laboratory Technology | | - Christian Medical College, Vellore |
| 10 | Medical laboratory Manual for Tropical Volume I | | - British Government |
| 11 | Medical Laboratory Technology, Volume I, II, III | | - Kanai L Mukherjee |
| 12 | Manual of basic techniques for a health laboratory | | - WHO Academic Publishers Calcutta |
| 13 | Text Book of Medical Laboratory Technology | | - M. Nakanishi et.al. |
| 14 | Organisation of a Blood Transfusion service | | - W.N. Gibbs & AFH. Britton |
| 15 | Viva in voce in Pathology, Bacteriology and Haematology | | - Dr. K.N. Schev |
| 16 | Laboratory Practical Haematology | | -K. Parajuli |

3. Subject: **Clinical Biochemistry**

Total hours: 234; Full marks: 200

Course description

The course is designed to provide basic but comprehensive knowledge on basic chemistry and biochemistry, which has direct application in clinical biochemistry. This course consists of relevant chapters from pure sciences (recall), which has got direct application on this subject. It also provides good theoretical background in field with the practical experience hand in hand. This will be tested in practical & theory during the process of teaching. Since each student will have to work in close association with each other. This course is based more on practical work.

Course objectives

After completing this course the student will be able to;

1. Acquaint with elementary and physical chemistry
2. Make biochemical estimation
3. Handle different equipments for biochemical analysis
4. Preserve chemical reagents for biochemistry laboratory.

THEORY

Unit 1 Elementary chemistry (40 Hours)

1. Define atom, molecule, mixture, atomic number, atomic weight, molecular weight, equivalent weight, valency, ionic bond, non-ionic bond and chemical equation (oxidation and reduction)
2. Define solution, types of solutions: saturated, unsaturated, supersaturated, buffer, normal, molar, and percentage solutions.
3. Define acid, base, salt, neutralization.
4. Describe the use of detergents & chromic acid in the cleaning of glassware.
5. Enumerate the principle, functions, process and maintenance of: Water bath, Incubator, Centrifuges, Balances, Colorimeters and pH meter.
6. List the laboratory hazards and precautions to be taken while working in the biochemical lab.

Unit 2 Physical chemistry (30 Hours)

1. Define theory of lights waves.
2. State the functions of filters & other monochromometers.
3. Describe triangle law of light and concept of complimentary colours

4. State and explain Beer's & Lambert's law.
5. Conceptualise Transmittance and absorbance (Optical density)
6. State the theories behind the use of common anticoagulants and preservatives.
7. Enumerate the changes occurring in the blood after collection,
8. Store blood and take precautions during blood storage.

Unit 3 Biomolecules, Metabolisms and Estimations (40 Hours)

1. Describe different kinds of carbohydrates & their source, blood glucose level maintenance in the body including hormonal regulations.
2. Describe diabetes mellitus & abnormalities of metabolism of carbohydrates
3. Define and classify amino acid and protein.
4. Define, classify and enumerate the function of lipid.
5. Define, classify and enumerate the properties of enzymes.
6. Enumerate the function of plasma proteins, identify the plasma protein abnormalities.
7. Describe units of enzyme, (IU & common units), enzyme reaction and enzyme substrate reactions and effects of various factors.
8. Describe Carbohydrates, fat and protein metabolism
9. State the principle, procedure, precautions, calibration of graph & normal value in the estimation of: Sugar, Urea, Amylase, GPT, GOT, Acid phosphatase, Alkaline phosphatase
10. State the principle, precaution, procedure and normal value in the estimation of: calcium, phosphorus, Creatinine, Cholesterol, Triglycerides, HDL, LDL, uric acid, protein, and bilirubin.
11. Define and classify hormones and list different biochemical tumour markers.

Unit 4 Modern Equipments (26 Hours)

1. Describe the principles and use of: Paper chromatography, Electrophoresis, Spectrophotometer, Flame photometer, semiauto analyser, Dispensers and Auto-pipettes.

Unit 5 Preservation of Chemical Reagents (20 Hours)

1. Discuss the effects of time, pH, temperature and light on reagents.
2. Describe procedure of preserving chemicals used in biochemistry laboratory.
3. Quality Control in biochemistry laboratory.

PRACTICAL

Biochemistry (78 Hours)

1. Prepare solutions of different concentrations (Normal, Molar and Percentage).
2. Perform titration of acid & bases.
3. Estimate organic constituents of blood, urine & CSF including sugar, urea, creatinine, bilirubin, albumin, total proteins, uric acid, Cholesterol, Triglycerides, HDL, LDL
4. Estimate enzymes: amylase, GPT, GOT, acid & alkaline phosphatases.
5. Estimate inorganic constituents of serum, urine & other body fluids: sodium, potassium, calcium, phosphorus and chloride.
6. Prepare the calibration of standard graph for various tests.

Textbooks

- | | |
|---|-------------------|
| 1. Biochemistry | - U. Satyanarayan |
| 2. Fundamental Biochemistry | - A.C. Deb |
| 3. Varley's Practical Clinical Biochemistry | - Goweklook |

Reference books

- | | |
|---|----------------------------|
| 1. Quality Control in Clinical Laboratory | - David Tonks |
| 2. An Introduction to Medical Laboratory Technology | - F J Baker, R E Silverton |
| 3. An Introduction to Medical Technology | - F J Baker |
| 4. A biologist's guide to principals and techniques of practical biochemistry | - Bryn & Keith |
| 5. Harper's Biochemistry | - Harper |
| 6. A Text book of Clinical Chemistry | - Teitz |

4. Subject: **Medical Parasitology**

Total hours: ; Full marks: 50

Course description

The course is designed for CHLS program focussing on medical parasites in reference to parasites prevalent in the regions, particularly in Nepal. This course deals especially, with Protozoa, Helminths and related laboratory procedures.

Course objectives

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

1. Explain the common parasites found in Nepal,
2. Perform basic laboratory procedures carried out in order to diagnose the common parasitic diseases and
3. Explain defence mechanism of the body to the medical parasites.

THEORY

Unit 1: Introduction (12 Hours)

1. Define Host definitive host, intermediate host,
2. Define Parasite; ectoparasite, endoparasite, temporary parasite, permanent parasite, obligatory parasite, facultative parasite.
3. Host parasite relationship; commensalism, mutualism, pathogenic. Infection and infestation, Classify medically important parasites and explain intestinal, urine, blood and tissue parasites.
4. Classification of medical parasites: protozoa, Helminths.

Unit 2: Protozoa (10 Hours)

1. Explain the prevalence, geographical distribution, mode of infection, habitat, life cycle, pathogenesis, laboratory diagnosis, prevention and control of:
 - a) *Entamoeba histolytica* and *E. coli*, *E. hartmanni*, *Endolimax nana* *Iodamoeba buetschlii*,
 - b) *Giardia lamblia*,
 - c) *Trichomonas vaginalis* and *T. hominis*,
 - d) Leishmania: *L. donovani*, *L. tropica*, *L. mexicana* and *L. braziliensis*
 - e) Plasmodium: *P. vivax*, *P. ovale*, *P. falciparum*, and *P. malariae*
 - f) *Toxoplasma gondii*.
 - g) *Cryptosporidium parvum*:
 - h) *Cyclospora cayetanensis*,
 - i) *Isospora belli*
 - j) *Balantidium coli*

Unit 3: Helminths, (21 Hours)

A. Nematodes

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

1. Hookworm: *Necator americanus* and *Ancylostoma duodenale*
2. *Ascaris lumbricoidea*
3. *Enterobius vermicularis*
4. *Trichuris trichiura*
5. *Strongyloides stercoralis*
6. Microfilaria: *Wuchereria bancrofti*, *Brugia malayi*, and *Loa loa*.

B. Cestodes (Tape worms)

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

1. Taenia: *Taenia solium* and *Taenia saginata*,
2. *Echinococcus granulosus* and
3. *Hymenolepis nana*.

C. Trematodes (Flukes, intestinal, hepatic, pulmonary and blood)

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

1. *Fasciola hepatica*,
2. *Faciolopsis buski*
3. *Paragonimus westermani*
4. *Schistosoma haematobium*, *S. mansoni*, and *S. japonicum*

Unit 4: Laboratory techniques (15 Hours)

1. Explain the procedure for clinical specimens collection for parasitic investigations (stool, urine, blood, sputum, exudates, swabs and aspirates).
2. Explain the 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).
3. Describe various laboratory technique:
 - a) Feacel (stool) examination: physical, chemical-reducing substances and occult blood, and microscopic.
 - b) Blood examination by wet and stained smears preparation for blood parasites.
 - c) Urine, sputum examination for urinary and respiratory tract parasites.
 - d) Various concentration methods (floatation and sedimentation) to detect the blood and intestinal parasites.

Unit 5: Miscellaneous (20 Hours)

1. Describe the mechanism of formation of urine and list the organs involved in the urine formation and explain the renal thrust hold.
2. Explain the collection, preservation and transportation of urine.
3. Describe the method of examination of urine samples: physical, chemical and microscopic.
4. Describe urine albumin, sugar, bile salt, urobilinogen, porphobilinogen, chyle and Benze-John's protein.
5. Describe the cerebrospinal fluid (CSF); constituents, normal reference values, method of sample collection and examination (CSF protein, sugar cells and microorganisms,
6. Describe the body fluids: transudets and exudets, normal reference value, method of sample collection and examination (body fluid protein, sugar and cells and microorganisms.
7. Describe the defense mechanism of the body to the medical parasite (non-specific and specific); antigen, antibody and their reaction and use of immuno-serological tests (agglutination, precipitation, CFT and ELISA) in diagnosing of parasitic diseases.

PRACTICAL

Unit 1 Parasitology (78 Hours)

1. Collect various samples (stool, urine, blood, sputum, CSF and body fluid) by different methods for the detection of parasites.
2. Prepare various reagents (iodine solution, brine solution, 33% zinc sulphate solution, normal saline solution, Stoll's reagent, Giemsa and Leishman's stain and benzidine solution).
3. 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.
4. Identify Scotch tape technique for ova of pin worm.
5. Detect parasites by Concentration Technique present on stool samples
 - a) Brine solution, (sucrose solution.) flotation method
 - b) Zinc sulphate and sucrose floatation methods
 - c) Formal-ether sedimentation method.
6. Examine reducing sugar and occult blood in the stool.
7. Examine and identify malaria parasites by thick and thin smears.
8. Examine and identify microfilaria by wet mount.
9. Perform routine examination of urine (physical, chemical -albumin and sugar and microscopic),
10. Perform chemical examination of urine by various method; bilirubin, bile salt, urobilinogen, porphobilinogen, chyle and Benze-John's protein
11. Examine CSF (protein, sugar and cell counting).
12. Examine body fluids (protein, sugar and cell counting).

Recommended Books

1. Medical Parasitology - K.D. Chatterjee MD
2. Medical Parasitology - N.C. Dey and T. K. Dey
3. Illustrated Medical Microbiology - Satish Gupte
4. Medical Bacteriology Medical Mycology and AIDS - Prof. N C Dey & T K Dey
5. Viva voce in Pathology, Bacteriology and Haematology - Dr. K.N. Schadev
६. मानव परजिवी विज्ञान - शिव कुमार राई

5. Subject: **Basic Pathology & First Aids**

Total hours: 156; Full marks: 100

Course Description

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

Course objectives

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

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

THEORY

A. Basic Pathology

Unit 1 Introduction to General Pathology

1. Understanding of Pathology
2. Field of pathology
3. Importance of Pathology
4. Scope and method
5. Application of in Laboratory investigation in Pathology diagnosis

Unit 2 Basics of cell injury

1. Introduction
2. Types and its causes
3. Common terminology used in cell injury
4. Clinical diagnosis and laboratory interpretation
5. Screening laboratory investigation.

Unit 3 Infection and inflammation

1. Causative organisms and its types in infection and inflammation.
2. Terminology used in Benign clinical interpretation
3. (Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Necrosis, Apoptosis, Hypoxia, Ischemia, Oedema, exudates and transudates etc.
4. Laboratory investigation and interpretation
5. Immunological investigation

Unit 4 Neoplasia

1. Introduction
2. Benign and malignant tumours
3. Terminology used in Malignant clinical interpretation
4. (carcinoma, sarcoma, lymphoma, dysgerminoma, etc)
5. Laboratory investigation and interpretation
6. Application of Immunological investigations
7. Essential Histo and cytochemical investigations
8. Introduction of tumour marker.

Unit 5 Hi-tech instruments used for Laboratory diagnosis

1. **Semi or Auto analyzer:** Introduction, Application, Advantages and disadvantages
2. **ELISA** (Enzyme linked Immunosorbent Assay): Introduction, Application, Advantages and disadvantages
3. **Polymerase Chain Reaction (PCR):** Introduction, Application, Advantages and disadvantages
4. **Fluorescent and Electron microscopy:** Introduction, Application, Advantages and disadvantages
5. **Flow cytometry:** Introduction, Application, Advantages and disadvantages
6. **Networking System for Diagnosis:** Introduction, Application, Advantages and disadvantages

PRACTICAL

Unit 1 Basic General Pathology

- a) Apply the terminology in various practical classes of other subjects.
- b) Evaluate the clinical history of various patients during sample collection in Hospital practice.

Unit 2 Methods and media (25 Hours)

- a) Use following General Pathology learning method effectively
 - i) Communication exercise
 - ii) Group discussion
 - iii) Role play
 - iv) Counselling
 - v) Lecture
 - vi) Demonstration and
 - vii) Exhibition
- b) Collect health education materials from different organisation.
- c) Prepare simple media for health education like
 - i) Poster
 - ii) Flannel graph
 - iii) Models
 - iv) Charts and graphs
 - v) Puppets
 - vi) Pamphlets

B. First Aids

THEORY

First Aid (28 Hrs.)

1. Introduce first aid, manage on the site and make decision for referral and management during transfer.
2. Define shock, list the causes of shock, and identify first aid measures to the patient in shock.
3. Identify first aid measures in cases of poisoning (insecticides, rodenticides, drugs and alcohol)
4. Conceptualize ABC (Airway, Breathing, Circulation) and describe the procedure of cardio-pulmonary resuscitation.
5. Identify foreign body in ear, nose, throat and eye and provide first aid treatment.
6. Classify type of injuries and identify measures to provide first aid.
7. Classify types of haemorrhage and identify measures to provide first aid to arrest external bleeding.
8. Classify burns, calculate its percentage and state the first aid measures to thermal and chemical burns.

9. Identify measures to management of a case of frostbite.
10. Identify heat stroke and its first aid.
11. Identify measures to provide first aid measures in case of acute mountain sickness.
12. Identify the broken bones and dislocation and its first aid measures.
13. List the dangers of rabid animal bite and identify first aid measures.
14. Identify the measures to be taken in case of snakebite and insect bite.

First Aid Practical (18 Hrs.)

1. Measure temperature, pulse, respiration and blood pressure.
2. Apply dressing, bandages and splint.
3. Perform cardio-pulmonary resuscitation.
4. Put patient in different positions and transfer patient from one place to other.
5. Remove foreign body from eye, ear nose and throat.

Recommended Books

1. Text book of Pathology – Harshmohan
2. Basic Pathology – Robbins
3. First Aid - St. John Ambulance
4. First Aid –ICRC
5. First Aid and Emergency Nursing - N N.Yalayaswamy

6. Subject: Basic Public Health

Total hours: 156; Full marks: 100

Course Description

This course is designed to help students to acquaint knowledge and skills on basic public health and health care delivery system of Nepal in broader perspectives. This course is designed to help students to acquaint knowledge and skills on hygiene, sanitation and health cares system of Nepal in broader perspectives. This course deals with water and its contamination; waste its types and disposal methods, food hygiene and sanitary housing principle. This course also focuses on to the principles of laboratory management, leadership skills, personnel management, quality control and health care delivery system. This course deals with basic epidemiology, hygiene and sanitation, waste disposal methods, basics of nutrition. This course also deals on medical ethics and introduction on Biostatistics and research.

Course objectives

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

1. Define public health, state the importance and scope of public health
1. Define epidemiology, identify modes of disease transmission
2. Identify the sources of water and methods of purifications,
3. Enumerate types of solid wastes and methods of its disposal,
4. Identify food borne infections and food poisoning,
5. Describe the effects of poor housing and ways for improved housing, and
6. Familiarize with health care delivery system in Nepal,
7. Comprehend health care data system,
8. Orient with ethical aspects and professional standard.

THEORY

Unit 1 Introduction to public health

(10 Hours)

- a) Public health
- b) Community health
- c) Scope and method
- d) Importance of public health
- e) Application of public health in diagnosis

Unit 2 Basic Epidemiology (10 Hours)

- a) Introduction
- b) Epidemiologic triad
- c) Epidemiologic measurements
- d) Epidemiologic measurements
- e) Disease transmission, prevention and control
- f) Immunization
- g) Screening

Unit 3 Basic hygiene and sanitation (15 Hours)

- a) Water and health
- b) Air pollution
- c) Noise pollution
- d) Housing & ventilation
- e) Water purification
- f) Sterilization

Unit 4 Health education and health promotion (10 Hours)

- a) Introduction
- b) Communication process
- c) Health education methods and media
- d) Importance of health education

Unit 5 Nutrition (10 Hours)

- a) Introduction
- b) Classification of foods
- c) Carbohydrates, Proteins, fats, minerals, vitamins
- d) Mal-nutrition
- e) Food security and food hygiene

Unit 6 Health care delivery system (10 Hours)

- a) National health policy
- b) Concept of health care
- c) Health system
- d) Levels of health care
- e) Concept of health planning and management
- f) Millennium Development Goal (MDG)

Unit 7 Primary Health Care (8 Hrs.)

1. Identify the national health policy and health care delivery system.
2. Identify national health strategy for fulfilling basic minimum needs of health.
3. Define primary health care.
4. Enumerate the elements of primary health care and indicator of improvement in the health care.
5. State principles and strategy for primary health care.
6. Identify the role of health worker in primary health care.
7. Review health for all by the year 2000' and its impact.

Unit 8 Maternal and Child Health (8 Hrs.)

1. Enumerate six target diseases and immunisation schedule given to prevent them.
2. Enlist advantages of breast-feeding and disadvantages of bottle-feeding.
3. Identify weaning food and the advantages of sarbottam pitho.
4. Identify causes of child hood diarrhoea in Nepal and its management.
5. Enlists signs and symptoms of dehydration.
6. Identify causes and basic management of acute respiratory infection.
7. Enlist essential components of maternal health (antenatal care, intranatal care and postnatal care)
8. Enlist types of family planning methods available in Nepal.

Unit 9 Waste disposal system (8 Hours)

- a) Solid waste
- b) Methods of disposal
- c) Excreta disposal
- d) Hospital waste management

Unit 10 Medical and professional ethics (5 Hours)

- a) Introduction to ethics
- b) Medical ethics
- c) Professional ethics
- d) Principles of ethics
- e) National professional ethics

Unit 11 Introduction to Biostatistics (5 Hours)

- a) Definition of biostatistics
- b) Application of biostatistics
- c) Measure of central tendency
- d) Measure of dispersion

Unit 10 Health Research (2Hrs)

- a) Introduction
- b) Types of research
- c) Methods of research

PRACTICAL

Basic Hygiene and Sanitation (15 Hours)

- a) Analyse the existing drinking water source, waste disposal system, food preparation, preservation technique and measures to control rodent and insects.
- b) Identify the needs of the community regarding personal hygiene and environmental sanitation.
- c) Educate the community for safe hygienic practices and maintenance of sanitary latrine.
- d) Cooperate with other team members in sanitary activities in the community.

Health education needs, methods and media (15 Hours)

- d) Conduct educational diagnosis survey to identify the health education need of a selected community.
- e) Prepare a modular health education plan for deliberation of health education in selected community or health post.
- f) Use following health education method effectively
Communication exercise, Group discussion, Role play, Counselling, Lecture, Demonstration and Exhibition
- g) Collect health education materials from different organisation.
- h) Prepare simple media for health education like
Poster, Flannel graph, Models, Charts and graphs, Puppets and Pamphlets

Health care system (5 Hours)

- a) Observation of health care delivery system in Nepal at different level health institutions.

Textbooks

1. Park's Textbook of Preventive and Social Medicine - K Park

Reference books:

1. Basic Principles of Management - Shrestha, B.M.. Akshyulak Publication, Nepal. 2039B.S.
2. Inventory Control and Basic Logistics Procedure Manual on Store Management for PHC/HP and SHP Personnel. HMG/JSI. 2054B.S.
3. Textbook of Preventive and Social Medicine - Park, K. B. Bhanot, Jabalpur, India. 2000.
4. Health Logistics Procedure Manual. - NHTC/LMD/USAID JSI, Nepal 2057.
5. Health Statistics and EPI Cold Chain Management Procedure Manual. -NHTC/LMD/USAID JSI, Nepal 2057.

6. A Handbook of Hygiene and Public Health - Y.P. Bedi.
7. W.H.O. Excreta disposal
8. Environmental Health and Sanitation - Shatrughna Ojha..
9. Annual Report of Department of Health Services, Ministry of Health
10. Textbook of Health Education - Hari Bhakta Pradhan; Educational Resource for Health, Kathmandu, 1997.
11. A Text Book of Health Education, - L. Ramachandran and T Dharmalingam, Vikas Publishing House Pvt. Ltd., New Delhi, 2001
12. Text Book of Health Education – A Process of Human Effectiveness - David Bedworth & Albert Bedworth, Harper and Row, NY, 1978
13. Introduction to Health Education, - Water H. Green and Bruce G. Simons- Morton, Macmillan Publishing Company, NY

Third Year

1. Histopathology and Cytology Techniques
2. Instrumentation and Automation
3. Field Practice (Hospital/Diagnostic Labs & Community)

7. Subject: **Histopathology and Cytology Techniques**

First SIX months of THIRD Year (But, while doing this course, students must be posted in all Departments/Section of diagnostic laboratory on rotation basis either in first half or second half of the working day)

Total hours: 156; Full marks: 100

Course Description

This course is designed to provide basic knowledge and skills on histotechnology and cytological techniques performed on biopsy, autopsy and aspirated materials.

Course Objectives

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

1. Develop the concept on histotechnology and cytology techniques.
2. Perform histopathology and cytology techniques on biopsy, autopsy and aspirated materials

THEORY

Unit 1 Histopathology (53 Hours)

1. Describe different types of tissues and their function.
2. Describe preservatives and fixatives.
3. Explain and prepare simple and compound fixatives (10% formalin, 10% normal saline and Zenker's fluid).
4. Define principle of basic histological stain: Hematoxylin and Eosin.
5. Describe histokinette and its principle.
6. Define principle of processing of histopathological tissues (fixation, dehydration, clearing, embedding, trimming and labelling).
7. Enlist the different types of microtomes including cryostat, and cut the sections of desired thickness.
8. Describe various types of microtome knives and sharpening procedures.
9. Explain principle of following special stains: PAS, Alcian Blue, Ziehl-Neelsen and Congo Red stains.
10. Describe the decalcification of bone and different types of decalcifying agents.
11. Describe mounting media (DPX, glycerine).
12. Maintain equipments.
13. Maintain record and prepare the charts of investigation.

Unit 2 Cytological Procedures (25 Hours)

1. Collect various types of cytological specimens (sputum, urine, effusion fluids, tissue fluids)
2. Describe principle and techniques of sample processing: Uniform smear, thick and thin smear, fish-fail smear.
3. Describe smear preparation of cytological specimens (sputum, urine, effusion fluids, various body fluids).
4. Describe Papanicolaou stain.
5. Describe Giemsa stain.
6. Describe methods of sex chromatin detection.
7. Explain semen analysis.

PRACTICAL

Unit 1 Histotechnology and cytological techniques (78 Hours)

1. Handle microscope.
2. Prepare fixatives and fixation of tissues.
3. Collect, transport & fix samples for histotechnological & cytological studies.
4. Process the grossed tissues.
5. Cut sections.

6. Prepare reagents & stains used for Hematoxylin & Eosin stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
7. Prepare reagents & stains used for Giemsa and Papanicolaou stains.
8. Stain sections by H/E stain, PAS stain, Alcian Blue stain and Ziehl-Neelsen stain.
9. Prepare cytological fixatives and fixation of cells.
10. Prepare cytological smears and stain with pap method.
11. Stain FNAC smears by Giemsa and Papanicolaou methods.
12. Mount stained smears/section.
13. Perform semen analysis.
14. Perform Aceto-Orcein staining for Barr body.

Recommended 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. Gradwohl's clinical Laboratory methods and diagnosis. Edited by Alex C. Sonnenwirth and Leonard Jenett.
4. Quarterly, annual and special Publications of the International Union for Health Education and Health Promotion and Victoria Health Foundation
5. Cytology Technical Manual- Cytology Research Center ICMR (India)
6. The "Pap Smear" – M.E. Boon
7. Practical Cytology – Ron Bowdich
8. Comprehensive Cytopathology – Marluce Bibbo, Second Edition.

Program: CMLT
Instrumentation and Automation

Hour per week: 3 **Subject:**
Total hours:
Full marks: 50

Course Description

This course is designed to provide basic knowledge and skills on instrumentation and automation in clinical pathology laboratory. This course is designed to develop basic but comprehensive knowledge of commonly used instruments in laboratory, their uses, principles, procedures, maintenance and precautions during analysis of various tests.

Course Objectives

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

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

Course content

THEORY

Unit 1 Instrumentation and Automation (Hours)

1. Describe types of automatic analyzers:
 - a. Continuous flow systems
 - b. Discrete analyzers
 - c. Centrifugal analyzers
 - d. Thin film analyzers
 - e. Automated electrolyte analyzers
2. Describe the use of blood cell analyzers.
3. Describe the use of ELISA reader and washer.
4. Describe blood gas and acid-base analytical systems. Explain the main features of automated blood gas analyzers.
5. Describe laboratory computer aids.
6. Describe the photometric system used in peripheral laboratory.
7. Describe the essential features of centrifugal analyzers.
8. Describe the maintenance of laboratory instruments.
9. Explain laboratory management with reference to placing of instruments and bio-safety zones.

PRACTICAL

Unit 1 Instrumentation and Automation (Hours)

1. Handling and care of various automated equipment:
 - a. Fully automated analyzers
 - b. Semi-automated analyzers
 - c. Automated electrolyte analyzers
 - d. Blood cell analyzers
 - e. ELISA reader and washer
 - f. Blood gas and acid-base analyzers
 - g. Fully and semi-automated autoclaves/sterilizers.
2. Analyze various specimens and compare the results with non-automated machines.
3. Perform result interpretation from various automated instruments.
4. Perform laboratory management with available instruments.

Recommended Books

1. Lynch's Medical laboratory technology by Raphael.
Gradwohl's clinical laboratory methods and diagnosis Volume 1 & 2 by Garrett.

8. Subject: **Field Practice (Hospital/Diagnostic Labs & Community)**

SIX months at the end of course (i.e. in third year). For this, students must be posted in all Departments/Section of diagnostic laboratory on rotation basis)

Total hours:1248; Full marks: 550

Course Description

This field experience program is designed to help students apply the comprehensive knowledge and skills on actual situation. The program is offered after completing second 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, and
2. Build confidence on laboratory procedures.

Placement schedule

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

No.	Subject Area / Sections	Duration	Paper
1.	Histology & Cytology lab	1 months	I
2.	Haematology and blood banking lab	1.5 months	
3.	Biochemistry lab	1 months	II
4.	Microbiology lab	1.5 months	
5.	Parasitology	1 months	

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

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

Evaluation Scheme

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

Distribution of marks for evaluation

No	Evaluator/Paper	Distribution of marks			Total Marks
		Internal	Final	Time	
1	Related laboratory supervisor/teacher (continuous evaluation) Paper I Paper II	100 100			200
2	Related institution supervisor/teacher (continuous evaluation) Paper I Paper II	100 100			200
3	CTEVT appointed examiner (at the end of the field practice) Paper I Paper II		200 200	3 hrs 3 hrs	400

Important note: *Each student must pass in each of the section of the evaluation as presented above with a minimum of 60% marks. This means they must secure 120 each in section 1 and 2 and 240 marks in section 3.*

Experts Involved in FIRST Revision (December 2008)
Two-day Curriculum Revision Workshop organized by NHPC in support of WHO
Hotel Araniko, Dhulikhel, Kabhre

1. Prof. Dr. Shiba Kumar Rai (Parasitology), Expert & Chairman, NHPC
2. Prof. Chitra Kumar Gurung (Public Health) Expert & Member, NHPC
3. Mr. Ajay Yadav (Physiotherapy) Member, NHPC
4. Mr. AP Shrestha (Pharmacy) Member, NHPC
5. Mr. Ganesh Prasad Acharya (Pathology with cytology), Expert & Coordinator, Diagnostic Subject Committee, NHPC
6. Assoc. Prof. Birendra Raj Tiwari (Microbiology), Expert & President, NAMLS
7. Mr. Jayabind Singh (Biochemistry) Expert
8. Mr. Shravan Kumar Mishra (Biochemistry) Expert & Vice-President, NAMLS
9. Mr. Dhan Prasad Poudyal (Health Lab), Ex-Registrar, NHPC
10. Mr. Ram Bahadur Chand, (Imaging Technology) Expert & Member, NHPC
11. Mr. Bhaktiman Subba (Imaging Technology) Member, NHPC
12. Mr. Ganesh Pokhrel (Imaging Technology) Expert
13. Assoc. Prof. Shant Lal Shrestha (Imaging Technology) Expert
14. Mr. Sita Ram Pandit (Imaging Technology) President, Radiological Society
15. Mr. DP Neupane, (Imaging Technology) Subject Committee Member, NHPC
16. Mr. Om Prakash Mehta, Registrar, NHPC
17. Dr. Devi Prasad Ghimire, Vice-Chairman, CTEVT
18. Mr. Kamal Ahamad, Member-Secretary, CTEVT
19. Mr. Krishna Rijal, Director, Curriculum Division, CTEVT
20. Mr. Umesh Mishra, Director, Accreditation Division, CTEVT
21. Mr. Shiva Shanker Ghimire, CTEVT
22. Mr. Jeeban Chandra Dahal, Curriculum Expert, CTEVT
23. Mr. Mister Kant Mainali, Curriculum Expert, CTEVT
24. Mr. Keshab Adhikari, Admin Officer, NHPC
25. Ms. Menuka Prasai, Accountant, NHPC
26. Mr. Ajay Shanker Sah, President, Radiological Student Society
Mr. Rajan Dahal, President, Med Lab Student Society