TWO YEARS POST MATRIC TEACHING PROGRAM OF PARAMEDICS

F. Sc. (Medical Laboratory Technology)

CURRICULUM WING
MINISTRY OF EDUCATION, ISLAMABAD

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Contents

PREFACE

All Educational Policies of Pakistan formulated from time to time have stressed that Curriculum Development should remain a continuous process. The policies also lay great stress on shift towards purposeful scientific and Technological Education. Consequently Various Curriculum reforms were introduced which lay emphasis on learning of different concepts and skills by observation, exploration, experimentation and practical work i.e. learning by doing be encouraged and opportunities for creative expression be provided to the younger generation.

With the above directions in view, National institute of Health, Islamabad has prepared Curriculum of Medical Technology at H.S.S.C. level.

Inclusion of medical technology in the existing scheme of studies of Higher Secondary School Certificate as separate science group, will make the course comparable with similar programmes in the country and it will also help to prepare the students to become efficient medical Technicians, well versed with the Techniques in the relevant field.

The national Bureau of Curriculum and Textbooks deeply acknowledges the contributions made by the national Institute of Health and other experts who helped us in developing the curriculum.

(M. H. ABBAI)
(Joint Educational advisor)
Ministry of Education
(Curriculum Wing)
ISLAMABAD

SCHEME OF STUDIES

Intermediate Science (Medical Technology) Course

I. Compulsory Subjects

1. English	2 Papers	200 Marks
2. Urdu	2 "	200 "
OR		
Urdu Salees/Pakistan Culture-I for foreign students only. and Urdu Salees-II/Pakistan Culture-II for foreign students only.	1 "	100 "
	1 "	100 "
3. Islamiat.	1 "	50 "
4. Pakistan studies.	1 "	50 "

II. Technical Subject

1. Elementary Anatomy and Microtechniques.	1 "	100 "
2. Haematology and blood Banking	1 "	100 "
3. Microbiology-I	1 "	100 "
4. Microbiology-II	1 "	100 "
5. Clinical Pathology and Serology	1 "	100 "
6. Elementary Chemistry and Chemical Pathology.	1 "	100 "
		Total: 1100 "

SCHEDULE TRAINING FOR INTERMEDIATE SCIENCE (MED TECH)

S.No.	Subject	Theoretical	Practical	Total Working Hours
Compulsory Subjects				
1.	English	150 x 1 Hours	-	150 Hours
2.	Urdu	150 x 1 Hours	-	150 Hours
3.	Islamic Studies	100 x 1 Hours	-	100 Hours
4.	Pakistan Studies	100 x 1 Hours	-	100 Hours
Technical Subject (Medical Lab. Technology)				
1.	Elementary Anatomy & Microtechniques	40 x 1 Hours 40 x 1 Hours	25 x 2 Hours 60 x 2 Hours	250 Hours
2.	Haematology and Blood Banking	50 x 1 Hours 20 x 1 Hours	70 x 2 Hours 20 x 2 Hours	250 Hours
3.	(Microbiology-I) Bacteriology & Virology	55 x 1 Hours 25 x 1 Hours	70 x 2 Hours 20 x 2 Hours	250 Hours
4.	Microbiology-II) Parasitology and Mycology	50 x 1 Hours 20 x 1 Hours	50 x 2 Hours 20 x 2 Hours	210 Hours
5.	Clinical Pathology & Serology	50 x 1 Hours 30 x 1 Hours	70 x 2 Hours 20 x 2 Hours	260 Hours
6.	Elementary Chemistry & Chemical Pathology	40 x 1 Hours 60 x 1 Hours	25 x 2 Hours 60 x 2 Hours	270 Hours
Grand Total		**970**	**1020**	**1990 Hours**

N.B.:

1. Hours are calculated after excluding Fridays and Holidays.
2. In addition to above schedule the students have in-service training of one month.
3. the duration of course is two years.

ELEMENTARY ANATOMY AND MICROTECHNIQUES

Theoretical - 80 x 1 hrs.
Practical - 85 x 2 hrs.

Anatomy:

1. **Introduction to Anatomy** - General organisation of human body-division into systems-descriptive terms used in anatomy-cell and tissue-cell growth-cell metabolism.

2. **Respiratory System**-Description of the system as a whole-Larynx, Trachea, bronchi-Main pulmonary vessels and lobes of lungs-Function of the system as a whole-Short anatomical description of each organ-brief microscopic picture of organs.

3. **Digestive system**-Description of the system as a whole-liver, spleen, pancreas-function of the system as a whole-Short anatomical description of each organ-brief microscopic pictures.

4. **Urinary system**.-Description of the system as a whole-function of the system as a whole-Short anatomical description of each organ-Brief microscopic picture of organs.

5. **Circulatory system**.-Description of the system as a whole-identification of gross components-function of the system as a whole-short anatomical description of heart, major arteries and veins-brief microscopic pictures.

6. **Nervous system**-Description of the system as a whole with relationship with one another-function of the system as a while-short anatomical description of each organ-brief microscopic pictures.

7. **Reproductive system**-Description of the system as a whole-Parts of the male and female reproductive system-function of the system as a whole-short anatomical description of each organ-brief microscopic pictures.

8. **Muscular and Skeletal system**.-Name and anatomical positions of bones-types of bones and joints function of skeleton-identification of important bones-types of muscles-description of important group of muscles-brief microscopic pictures.

9. **Endocrine system**.-Location of various endocrine glands and their recognition.

Microtechniques:

10. Introduction to microtechnique-scope-relatioship with other-branches of-pathology.

11. **Identification of tissues**.

12. **Routine histopathological techniques**-fixation-fixatives-advantages and-disadvantages of-common fixatives.

13. **Section Cutting**;- Microtome-types-principle of operation-operation and care of microtomes.

14. **Routine Staining**.-Object of staining-classification of stains-Common stain used-properties-principle of H & E stain-The rational of various steps in this procedure.

15. **Mounting stained slide**.-Utility-substance used-technique of permanent mounting.

16. Decalcification and staining of bone.

ELEMENTARY ANATOMY AND MICROTECHNIQUES

Topics	Weight %
1. Introduction to Anatomy	4 %
2. Respirator System.	6 %
3. Digestive system	6 %
4. Urinary system.	6 %
5. Circulatory system.	6 %
6. Nervous system.	6 %
7. Reproductive system	6 %
8. Muscular and skeletal system	6 %
9. Endocrine system.	4 %
10. Introduction to microtechnique	4 %
11. Identification of tissues	10 %
12. Routine histopathological techniques	8 %
13. Section cutting.	7 %
14. Routine staining.	8 %
15. Mounting of slides.	6 %
16. Decalcification and staining of bone.	6 %
	Total % 100 %

ELEMENTARY ANATOMY AND MICROTECHNIQUE

PRACTICAL ACTIVITIES CLASS XI AND XII

Activities	Number of Laboratory Periods
1	2

Elementary Anatomy

1. Demonstration of general organisation of human body by charts and models..... 2

2. Demonstration of respiratory system of human body-short anatomical description of larynx, trachea, main bronchi and on models/chart..... 3

3. Demonstration of digestive system of human body-short anatomical description of stomach, intestines, liver, spleen pancreas on charts and models..... 3

4. Demonstration of urinary system of human body-Short anatomical description of kidney, urinary bladder and nephron on charts and models..... 3

5. Demonstration of circulatory system of human body-short anatomical description of heart and blood circulation on charts and models..... 3

6. Demonstration of nervous system of human body-short anatomical description of brain and spinal cord on charts and models..... 3

7. Demonstration of reproductive system of male and female-short anatomical description of tests, penis, ovary, uterus and vagina..... 4

8. Demonstration of skeletal system of human body on skeleton-identification of important bones..... 3

9. Demonstration and identification of endocrine glands thyroid, adrenals, pituitary, parathyroid etc..... 1

Microtechnique

10. Dissection of frog and Rabbit/Guinea pig to identify various organs-Distribution of tissues to students

	for processing.....	4
11.	Identification of various tissues-macroscopically and microscopically-selection of tissues.....	8
12.	Microtomes-types-operation of microtomes.....	4
13.	Cleaning and care of microtomes.....	2
14.	Types of knives used in microtomes demonstration and identification-Mounting of knife on microtomes	3
15.	Sharpening of knives of microtomes.....	3
16.	Preparation of routine fixatives.....	4
17.	Fixation of tissues.....	2
18.	Routine histopathological technique: dehydration clearing-embedding-moulds-trimming of block.....	5
19.	Cutting of sections on microtomes-procedure-difficulties and how to overcome.....	4
20.	Mounting and fixing of tissue ribbon on slides.....	2
21.	Staining-preparation of common stains used in histopathology(Harris haematoxyline eosin stain)...	4
22.	H & E staining of various samples-rationale of various steps in this procedure.....	7
23.	Procedure of permanent mounting of stained slide...	4
24.	Bone-decalcification-routine staining.....	4
	Total:-	85

LABORATORY REQUIREMENTS FOR ELEMENTARY ANATOMY AND MICROTECHNIQUE

A. ELEMENTARY ANATOMY

Charts

1. Showing respiratory route larynx, trachea, bronchi, bronchioles and alveoli.
2. Showing G.I.T. spleen, liver, pancreas.
3. Showing excretory system, i.e. kidney, urinary bladder and detailed structure of nephron.
4. Showing anatomy of heart, arterial and venous circulation, portal circulation, coronary circulation and fatal circulation.
5. Showing circulation of C.S.F., layers of menninges, microscopic structure of cerebellum, cerebrum, spinal cord, kinds of neurones.
6. Showing anatomical description of male and female reproductive organs i.e. testes, penis, ovary, uterus and vagina.
7. Showing complete human skeleton.
8. Showing location of endocrine glands.

Models

1. Showing respiratory route from the external nostrils up to alveoli.
2. G.I.T. & associated glands.
3. Showing dissected kidney, detailed structure of nephron & glomerulus.
4. Showing internal structure of heart and directly attached blood vessels.
5. Brain and spinal cord along with cranial and spinal nerves.
6. Showing male reproductive organs.
7. Showing Female reproductive organs.
8. Complete human skeleton (original).

B. MICROTECHNIQUE

Fixed Slides Showing the Following Tissues

I. EPITHELIAL TISSUE

I. Squamous Epithelium

a. Simple squamous epithelium
b. Stratified squamous epithelium keratinized and non-keratinized.

II. Cuboidal Epithelium

a. Simple cuboidal epithelium.
b. Stratified cuboidal epithelium.

III. Columnar Epithelium

a. Simple columnar epithelium.
b. Stratified columnar epithelium.
c. Psecudo stratified columnar epithelium.

IV. Transitional Epithelium

2. MUSCULAR TISSUE

a. Striated muscle.
b. Non striated muscle.
c. Cardiac muscle.

3. NERVOUR TISSUE

a. Cerebrum.
b. Cerebellum.
c. Spinal cord.
d. Multipolar neurone.

Equipments

1. Sliding microtome.
2. Rotary microtome.
3. rocking microtome.
4. Freezing microtome.
5. ultra microtome.
6. Embeding bath and moulds.
7. Tissue bath/floating water bath.

Glass wares

1. Coplin jars.
2. Staining jars.
3. measuring Flasks.
4. Measuring cylinders.
5. Beakers.
6. Pipettes.
7. Slides.
8. Cover slips.

Chemicals

1. Commercial formaline.
2. Sod. dihydrogen phosphate.
3. Disod. Hydrogen phosphate.
4. Sod. Chloride.
5. Ethyl alcohol.
6. Xylene.
7. Paraffin wax.
8. Haematoxylin stain powder.
9. Eosin Stain.
10. Canada Balsam.
11. Ammonium or potassium alum.
12. Mercuric oxide (red or yellow).
13. Glacial acetic acid.
14. Glycerol.
15. Ammonia.
16. Conc. HCL.

HAEMATOLOGY AND BLOOD BANKING

Theoretical-70 x 1 hrs.
Practical -90 x 2 hrs.

1. **Introduction**

   a. Definition and scope of haematology and blood banking-subject to be taught-relation ship with other branches of pathology.

   b. Circulation of blood in body-formation of blood-origin, development and nomenclature of different blood cells.

   c. Morphological characters of blood cells including those in different stages of development-composition of blood.

2. **White Blood Cell**

   a. Origin and development of leucocytes: granulocytes, lymphocytes, monocytes.

   b. Morphological study of red blood cells-macrocytes-microctes-normocytes-spherocytes-hypochromia-normochromia-polychromasia-target cell-sickle cell, etc.

   c. Reticulocyte count-normal values-abnormal values and interpretation.

   d. R.B.C. osmotic fragility test-significance.

4. **Haemoglobin**

   a. Mode of formation-Definition of terms-normal values-composition-various types of haemoglobins.

   b. Anaemia: definition-classification-causes-investigations-prevention.

5. **Erythrocyte Sedimentation Rate**

   What is E.S.R-normal values-factors affection E.S.R.-abnormal values-significance.

6. **Blood parasites**

   Parasites in blood-procedure for detection-characteristics of malarial parasite, filarial parasite, leishmania body etc.

7. **Coagulation Mechanism**

Mechanism of coagulation-haemostasis tests-screening tests-bleeding diseases-short description.

8. **Bone Marrow Study**

General methods to obtain bone marrow.

9. **Leukaemia's**

Different types-brief introduction.

10. **Blood Banking**

a. Introduction-importance of blood bank-organisation-recording and documentation.
b. Introduction to A.B.O. Groups: A.B. AB & O Groups, Sub groups of A.
c. Introduction of Rh Factor-significance.
d. Cross matching; definition-purpose-cross matching problems.
e. Coomb's Test: direct test-indirect test-utility-sources of error.
f. Donors-selection of donor-registration-collection of donors blood-storage and transportation-processing of blood.
g. General idea about transfusion and its dangers.

HAEMOATOLOGY AND BLOOD BANKING

Topics	Wieghtage %
1. Introduction.	08 %
2. White blood cells	10 %
3. Red blood cells	12 %
4. Haemoglobin	10 %
5. Erythrocyte sedimentation rate	06 %
6. Blood parasites.	07 %
7. Coagulation mechanisms.	11 %
8. Bone marrow study.	06 %
9. Leukaemia's.	05 %
10. blood banking.	25 %
Total %	100 %

HAEMATOLOGY AND BLOOD BANKING
PRACTICAL ACTIVITIES CLASS SI AND XII

Activities	No. of Laboratory Periods
1	2

Haematology

1.	Introduction and general requirement for haematological laboratory.....	1
2.	Methods of collection of sample for haematoglogical tests.....	2
3.	Anticoagulants used in haematology-preparation of anticoagulants.....	2
4.	Study of haemocytometer-Neubaur chamber-W.B.C and R.B.C. pippette.....	2
5.		
5.	Total leucocyte count-different procedures-reagents used-preparation of regents-estimation of total leucocyte count-precautions.....	4
6.	Differential leucocyte count-preparation of blood film-different stains used-advantages and disadvantages of different stains-preparation of stains-staining of blood film-morphological characters of different white blood cells-D.L.C.....	6
7.	Total eosinophil count.-procedure.....	2
8.	Total erythrocyte count-different procedures regents used-preparation of regents-estimation of total erythrocyte count.....	4
9.	Haemoglobin-various methods of estimation-Sahli's method-cynmethaemoglobin method-normal values-interpretation.....	5
10.	Haematocrit-test procedures-equipment used-macro method-normal values.....	4
11.	Erythrocyte sedimentation rate-various methods-Wintrobe method-Westergreen method-factors affecting E.S.R.-normal values-significance.....	5
12.	Preparation of blood film for red cell morphology-study of morphology of red blood cells.....	5
13.	Reticulocyte count-general consideration-preparation of stains-procedure-normal values significance.....	4
14.	R.B.C. osmotic fragility test-procedure.....	2

15.	Blood parasites-sampling-thick film-thin film-study of malaria parasite, filaria, leishmania, tepanosoma etc....	4
16.	L.E. cells-demonstration of L.F. cells-significance.....	3
17.	Capillary resistance test (Hess test)-procedure-significance.....	2
18.	Bleeding time-procedures-significance.....	2
19.	Coagulation time procedure significance.....	2
20.	Prothrombin time procedure significance.....	2
21.	Platelet count-procedure-significance.....	2
22.	Clot retraction test-procedure-significance.....	2
23.	Bone Marrow-general description of methods to obtain bone marrow-preparation of bone marrow smears routine staining.....	5

Blood Banking

24.	General introduction, equipment, diagnostic sera and chemicals used in blood banks.....	2
25.	Collection of blood-anticogulants used.....	1
26.	ABO blood grouping-slide method-tube method-reverse grouping.....	4
27.	Rh blood grouping-slide method-tube method-Du factor signifacance.....	3
28.	Methods of cross match.....	4
29.	Coomb's test-direct and indirect test.....	3
30.	Selection of donor-registration-collection of donor's blood-storage and tranportion.....	3
	Total:	90

LABORATORY REQUIREMENTS FOR HAEMATOLOGY SECTION

Equipments

1. Microscope.
2. Centrifuge.
3. Incubator.
4. Water bath
5. Spectrophotometer/colorimeter.
6. Sahli's haemoglbinometer.
7. hematocrit centrifuge.
8. Balance.
9. Mechanical Shaker.
10. Apparatus for defibrillation of blood
11. Stands for E.S.R.
12. Haemocy tometer.
13. bone marrow biopsy apparatus.
14. Thoma white and red blood cell pipettes.
15. Water distillation apparatus.
16. Convex mirror.
17. Alarm watch.
18. Refrigerator.
19. Tube Racks.

Glass Ware

1. Valumetic Flasks.
2. Concal Flasks.
3. Beakers.
4. Pippetes.
5. Glass slides.
6. Test tubes.
7. Centrifuge tubes.
8. Blood collecting bottles.
9. Glass beads.
10. Reagent bottles.
11. Droping bottles.
12. Funnels.
13. Screw Capped bottles.
14. Pestals and Mortars.
15. Glass cylenders.

Chemical

1. Sodium chloride.
2. Ammonium oxalate.
3. Potassium oxalate.
4. Sodium citrate.
5. E.D.T.A
6. Sodium fluoride.
7. Ethyl alcohol.
8. Methyl alcohol.
9. sylene.
10. Acetic acid (glacial).
11. Formaline.
12. Trisodium citrate.
13. Disodium citrate.
14. Sodium dihydrogen phosphate.
15. Disodium hydrogen phosphate.
16. Acetone.
17. Brilliant creyl blue.
18. Hydrochloric acid
19. Sodium bicarbonate.
20. Sodium carbonate.
21. potassium cynide.
22. Potassium ferricynide.
23. Leishman's stain (Powder)
24. Wright's stain (Powder).
25. Giemsa's stain solution.
26. Fields stain A and B.
27. Sodium Hydroxide.
28. Sodium metabisulfite.
29. Eosin.
30. Phenol.
31. Anti A Sera.
32. Anti b Sera.
33. Anti AB Sera.
34. anti D Sera.
35. Coomb's Sera.
36. Bovine Albumin (22 %)
37. Sodium chloride.

Projector Slides and Transparencies

Transparencies for the following blood cells.

1. **White blood cell:**

    1) Neutrophils.
    2) Eosinophils.
    3) Basophils.
    4) Lymphocytes, large and small.
    5) Monocyts.
    6) L.E. cells.

2. **Red blood cell:**

    1) Normal Red Blood C
    2) Abnormal Red Blood Cells.

        a. Macrocytes
        b. Microcytes.
        c. Schistocytes.
        d. Hypochromic R.B.C.
        e. Target cell.
        f. Stickle cells.
        g. Howell jolly bodies/cabot's rings.
        h. Basophilic stippling.
        i. Malarial parasites, ring stage, schizont, gametocyte etc.

MICROBIOLIGY I
(Bacteriology and Virology)

Theoretical-70 x 1 hrs.
Practical-90 x 1 hrs.

1. **Introduction**-Introduction to clinical microbiology-its scope-relationship with other branches of medical sciences.
2. **Microscope**.-Brief history of microscope-theory of light microscope-nature of light-concept of amplitude, wave length and phase-perception of colour and brightness-refraction-formation of immages-simple and compound microscope-lenses of microscope-objectives-types of objectives, eye pieces-magnification of eye pieces magnification, resulution, numerical aperture etc.
3. **Sterilization**-Definition-principle-different methods of sterilization i.e. autoclave, hot air sterilizer, water bath, Seitz Filter, inspissation etc-sterilization of different articles and materials-tests for efficiency of sterilization-antisepsis, bacteriostatic, bacteriocidal methods of destruction of bacteria.
4. **Stains**-What are stains? Principle, classification of stains-staining methods.
5. **Cultural Medium**-Nutritional, temperature and atmospheric requirement of bacteria-cultural medium-classification of culture media-composition and use of important media for use in microbiology.
6. **Identification of Bacteria**.-Morphological classification of bacteria-growth characteristics of clinically important bacteria-enzymic activity of bacteria-methods to measure this-antigens as tools for identification.
7. **Study of common pathogens**.-in blood, urine, throat, eye, stool, ear and C.S.F. etc.
8. **Sensitivity of antibiotic**-Principles of action of antibiotics on microorganisms-resistance-methods of determination of sensitivity of antibiotics.
9. **Virology**.-(a) Broad classification and characteristics of viruses and diseases caused by them.
   (b) Limitation of light microscopy in virology-examination of viruses.
   (c) Routine procedure for isolation of virus: Collection, transport and storage of viruses.

TOPICS	WEIGHTAGE %
1. Introduction	05 %
2. Microscope	05 %
3. Sterilization	15 %
4. Stain	05 %
5. Cultural	10 %
6. Identification of Bacteria	17 %
7. Study of Common pathogens	15 %
8. Sensitivity to antibiotics	08 %
9. Virology	20 %
Total:	100 %

MICROBIOLOGY-I
PRACTICAL ACTIVITIES CLASS XI AND XII.

Activities	No. of Laboratory Periods
1	2

Bacteriology

1. Introduction, general requirement for microbiology lab…	1
2. Cleaning and washing of new and infected glass wares used in microbiology laboratory……	2
3. Handling and disposal of infected material……	1
4. Sterilization and disinfection-different methods for sterilisation……..	4
5. Microscope-introduction-different parts and their functions……..	2
6. Correct use of microscope……..	2
7. Care of microscope……..	1
8. Common stains used in microbiology-preparation of stains-preparation of film-fixing and staining-Gram's staining-Ziehl Neelson staining. Sensitivity to antibiotics..	5
9. Culture media-classification-composition and uses of important media-preparation of common media…….	5 2
10. adjustment of PH of media-methods……..	
11. Culture techniques-preparation and uses of wire loop-innoculation on plates and slopes-stab streaking-pour plate-shake culture-incubation……	3 2
12. Anaerobic and aerobic culture techniques……..	
13. Examination of culture for growth-types of colonies with characteristics……..	4
14. Microscopic examination of bacterial smear-identification of bacteria under microscope……..	3
15. Morphological characters of important and common organisms……	2
16. Study of common organisms-important tests-cogulase test, catlase test, oxidase test, motility test etc……	4
17. blood culture-sampling media used-procedure-identification of organisms-bacteria commonly isolated..	3
18. Urine culture-sampling-media used-procedure-bacteria commonly isolated……..	3

19. Throat swab culture-sampling-media used-procedure-bacteria commonly isolated.....	3
20. Eye swab culture-sampling-media used-procedure-bacteria commonly isolated.....	3
21. Nasal and ear swab culture-sampling-media used-procedure-bacteria commonly isolated.....	3
22. Stool culture-sampling-media used-procedure-bacteria commonly isolated.....	3
23. Vaginal swab culture-sampling-media used-procedure-bacteria commonly isolated.....	3
24. C.S.F. and other body fluids culture.....	3
25. Method of determination of sensitivity of antibiotics.....	3
Virology	
26. Precautions to be observed in virology lab.....	2
27. Collection, transportation and storage of specimen for virological examination.....	3
28. Examination of virus under microscope.....	3
29. Staining procedures for viruses.....	3
30. Procedures isolation of viruses.....	5
31. Diagnostic tests for viral diseases.....	4
Total:	90

LABORATORY REQUIREMENTS FOR BACTERIOLOGY AND VIROLOGY

Equipment

1. Microscope.
2. Incubator.
3. Autoclave.
4. Colourimeter.
5. Hot air oven.
6. Refrigerator.
7. Lovi-bond comparator.
8. $_{p}$H meter.
9. Desicator.
10. Wire loops.
11. Candling box.
12. anaerobic Jar.

Glassware

1. Glass slides.
2. Screw cap tubes.
3. Test tubes.
4. Petri dishes.
5. Pipettes.
6. Pasteur pipettes.
7. Flasks.
8. Reagent bottles.
9. Dropping bottles.
10. Beakers.
11. Cylenders.
12. Durhams tubes.

Fixes Slides

1. Staphylococci.
2. Streptococci.
3. Pnemococci.
4. Gonococci.
5. Meningococci.
6. Acid fast bacilli.
7. Vibrios.
8. Grams + ve bacilli.
9. Grams-ve bacilli.

Culture Media/Stains

1. Nutrient broth.
2. Nutrient agar.
3. Mac-Conkey's agar.
4. S.S. agar.
5. T.C.B.s. agar.
6. Peptone.
7. Tellurite agar.
8. Tryptone soya broth.
9. Glucose broth.
10. Lactose broth.
11. Staurt's transport media.
12. Agar base.
13. Gelatin.
14. Crystal violet powder.
15. Safranin.
16. Iodine.
17. Methylene blue.
18. Carbol fuchsin.
19. Lacto-phenol blue.
20. Basic fuchsin.

Chemicals

1. Sodium chloride.
2. Potassium Hydroxide.
3. Potassium Iodide.
4. Ethanol.
5. Phenol.
6. Hydrogen per oxide.
7. Sodium citrate.
8. Urea.
9. Glucose.
10. Hydro chloric acid.
11. P. dimethyle aminobenzaldehyde.
12. Amyl alcohol.
13. Ether.
14. methyl red.
15. sodium hydroxide.
16. Phenol red.
17. Tetramethyl p.phenylence diamine-hydrochloride.
18. Dipotassium hydrogen phosphate.
19. Ammonia.
20. Phosphoric acid.
21. Creatine.
22. Naphthol.
23. Citric acid.

MICOROBIOLOGY-II
(PARASITOLOGY AND MYCOLOGY)
Theoretical-70 x 1 hrs.
Practical -70 x 2 hrs.

1. **Introduction**-Definitions and terms used-scope-relationship with other branches-host parasite relationship.

2. **Microscope**-Brief history of microscope-theory of light microscope-nature of light-concept of amplitude, wavelength and phase-perception of colour and brightness-formation of immages-simple and compound microscope-lenses of microscope-objectives-types of objectives, eye pieces-magnification of eye pieces-magnification, resulution, numerical aperature, etc.

3. Classification and life cycle of parasites:

   a) General classification of protozoa and helminths.
   b) Characteristics of common medical protozoa and helminths and brief life cycle of following.

Entamaeba histolytica-Entamaeba coli-Leishmania donovani-Trypanosome-Trichmoans vaginalis-Giardia lambia-Malarial parasite-Taenia saginata and T.solium-Hymenolepis nana-Echinococcus granulosus-Schistosome-Ascaris lumbricoides-Trichuris trichura-Enterobius vermicularis-Ancylostoma duodenale and N.americans-Strougloides stercoralis.

4. **Entomology**.-Morphology and brief life cycle of house fly and mosquitoes.

5. **Mycology**.-Should read "Parasitology & Mycology"

Definition-scope-name and classification of fungus with disease produced-routine mycological techniques-cultural characteristics of fungus.

PARACYTOLOGY AND MYCOLOGY

Topics	Weight age %
1. Introduction.	05 %
2. Microscope.	20 %
3. Classification and life cycle of parasites.	45 %
4. Entomology.	10 %
5. Myclolgy.	20 %
Total: %	100 %

PARASITOLOGY AND MYCLOLGY

PRACTICAL ACTIVITIES CLASS XI AND XII

Activities	Number of Laboratory Period
Parasitology	
1. Introduction and requirements of parasitology lab.....	2
2. Microscope-introduction-different parts and their functions.....	2
3. Microscope-correct use of condenser iris diaphragm, objectives and eye pieces.....	2
4. Microscope illumination-dark field illumination.....	1
5. Care and cleaning of mcroscop.....	2
6. Study of Common laboratory objects under microscope...	2
7. Methods of collection of stool.....	1
8. Physical examination of stool.....	2
9. Saline and iodine preparation-preparation of stool film for examination under microscope.....	2
10. Particles to be studied under microscope-their identifying points.....	2
11. Examination of uncysted and cysted forms of E. histolytica and E. Coli.....	2
12. Examination of uncysted and cysted forms of Giadia lamblia.....	2
13. Examination of Trichomonas vaginalis.....	2
14. Examination of ova of Taenia saginata, Taenia solium H. nana, E. granulosis, Schistosomes, Ascaris lumbricoides, Ancylostoma duodenale, Trichuris trichura etc.....	10

15. Concentration methods of stool-why required-different procedures..... 3

16. Examination of blood for parasites-sampling-blood smear-thick and thin film-staining..... 3

17. Examination of film for malarial parasite-Leishmania, filaria, trypanosomes etc..... 4

18. Examination of occult blood in stool by different methods..... 3

19. Demonstration of life cycle of house fly and mosquitoes.. 3

Micology

20. Routine mycological techniques..... 2

21. Collection of sample for mycological examination..... 2

22. Preparation of film for direct microscopic examination.... 2

23. Staining methods-stains used..... 4

24. Culture of fungus-general aspects..... 2

25. Media used for culture of fungus..... 4

26. culture and identification of fungus..... 4

Total: 90

LABORATORY REQUIREMENTS FOR PARASITOLOGY AND MYCOLOGY

Chemicals:

1. Neutral red.
2. Iodine.
3. Potassium iodide.
4. Enthyl alcohol.
9. Ether.
10. Sodium chloride.
11. Sodium hydroxide.
12. Zinc sulphate.

Specimens slides:

1. E. histolytica cyst.
2. E. coli. cyst.
3. Diardia cyst.
4. Taenea saginata egg.
5. H. nana egg.
6. Ancylostoma doudenale egg.
7. Trichuris trichura egg.
8. Ascaris lumbricoides egg.
9. S. mansoni egg.
10. S. japanicum egg.
11. S. haemafobium egg.

Equipments:

1. Microscope.
2. Over head projector.
3. Slide projector.

Stains:

1. Field stain powder A.
2. Field Stain Powder B.
3. Lactophenol cotton blue.

Culture Medium:

1. Sabouraud's medium
2. N.N.N. Medium

Glass wares:

1. Glass slides
2. Cover slips.
3. Test tubes, beakers, funnels, flasks, etc.
4. Museum jars.
5. Reagent bottles.
6. Petri dishes.
7. Dropping bottles.
8. Graduated cylinders.

CLINICAL PATHOLOGY AND SEROLOGY
Theoretical-70 x 1 hrs.
Practical -90 x 2 hrs.

1. Introduction to Medical Laboratory Technology

a) **Sampling**-Collection and forwarding of different samples for laboratory investigations-storage of sample-preparation and instructions to patients-sample recording-processing of results-sources of error.

b) **Laboratory management**-Role of laboratory technician-general rules of behaviour and ethics for laboratory workers-sections of clinical pathology and their functions-organisation and management of laboratory-reagents, equipment and other basic items required for setting up a laboratory-basic service like gas, water, electricity etc.-record keeping of chemical reagents and equipment's.

c) **Glass wares and water**-Laboratory glass wares-types-uses-cleaning of glass wares for different purposes.

Kind of water used in medical laboratory-preparation and quality control.

d) **Quality Control**-Quality control in different branches of pathology-aim and objectives-significance-different methods.

2. Urine Analysis

a) Brief review of composition, formation and function of urine-methods of collection of urine for laboratory investigation-transpotation-24 hours specimen of urine.

b) Physical examination of urine-amount, odour, colour, appearance, reaction, $_{p}$H, specific gravity.

c) Qualitative examination of urine.

1) Proteins in urine: general consideration-Bence Jones proteins-clinical significance of protein, urea.
2) Glucose in urine: general consideration-significance.
3) Ketone bodies in urine: general consideration-significance.
4) Bile salts and bile pigments in urine: general consideration-significance.
5) Haemoglobin in urine: general consideration.

d) urinary sediments-General consideration-significance-The Addis sediment count-calculation-normal values.

3. C.S.F. Examination

Composition, formation and function of C.S.F-collection of material-physical examination-chemical examination-cytological examination-bacteriological examination-significance of results.

4. **Gastric Juice Examination**

Composition, formation and function of gastric juice-analysis of gastric juice material used-preparation of patient-test meal and stimulants-technique obtaining juice-composition of juice-factors which effect the character and amount of gastric secretions-normal findings and significance of pathological finding.

5. **Pregnancy Test**

General consideration-brief introduction of biological pregnancy tests Immunological pregnancy test.

6. **Semen Analysis**

General consideration-collection-gross examination-microscopic examination-other tests of semen-significance.

7. **Glucose Tolerance Text**

General consideration-preparation of patient-preparation of curve-significance.

8. **Serology**

a) Definition-scope and limitation-relationship with other branches of pathology.
b) Antigen-Antibody-Antigern/Antibody reaction-types principle
c) Utilisation of antigen/antibody reaction-principles and mechanism of agglutinaion, precipitation and complement fixation test-uses of these mechanisms in diagnosis of diseases.

d) brief account of Widal test, kahn test, Wassermann test, A.S.O.T. R.A Test. V.D.R.L test, pregnancy test.

CLINICAL PATHOLOGY AND SEROLOGY

Topics	Weightage %
1. Introduction to medical laboratory technology.	30 %
2. Urine analysis.	15 %
3. C.S.F Examination.	08 %
4. Gastric juice examination.	07 %
5. Pregnancy test.	07 %
6. Semen analysis.	06 %
7. Glucose tolerance test.	07 %
8. Serology.	20 %
Total:	100 %

CLINICAL PATHOLOGYAND SEROLOGY

PRACTICAL ACTIVITIES CLASS XI AND XII

Activities	No. of Laboratory Periods
1	2

Clinical Pathology

1. Collection and forwarding of different samples for laboratory investigations.	
2. Organisation and management of laboratory.	2
3. Storage of reagents and equipment.	2
4. Cleaning of glassware for different purpose.	2
5. Preparation of distilled water and deionised water for laboratory.	2
6. Methods of collection of urine laboratory investigation.	2
7. Physical examination of urine-colour, amount, odour, appearance, reaction, specific gravity etc.	1
8. Tests for proteins in urine-general consideration-heat denaturation test-sulfosalicylic acid test-commercial strips and tablets method.	1
9. 24 hours urine estimation (Esback's Method)	3
10. Bence jones proteins detection in urine	2
11. Test for reduction substances in urine-general consideration-Benedicts test (qualitative and quantitative)Feh'ing test-commercial strips and tablets.	1
12. Tests for ketone bodies in urine-general consideration-Rothera's test-Gerherdt's test-hart's test-Acetest and ketoxtix.	4
13. Tests for bile salts and bile pigments in urine-general consideration-foam test-sulphur test-Fouchet test-Icto test.	3
14. Tests for haemoglobin in urine-general consideration-Benzidine test-Gualc test-commercial tablets and strips method.	3
15. Tests for urobilinogen in urine.	3
16. Examination for urinary sediments-general consideration-preparation of specimen for microscopic examination.	2
17. Examination of erythocytes, leucocytes epithelial cells in urine and their significance.	2
18. Examination of different urinary casts in urine and their significance.	2
	2

19. Examination of different urinary crystals and their significance. 2
20. Miscellaneous findings in urinary sediments. 2
21. C.S.F.-sampling. 1
22. C.S.F-Physical examination: colour, turbidity, appearance etc. 1
23. C.S.F.-Total cell count. 2
24. C.S.F.-chemical examination for glucose, proteins, globulin, chloride. 7
25. C.S.F-Cytological examination. 2
26. C.S.F.-Bacteriological examination. 2
27. Gastric juice examination-method of collection-qualitative and quantitative examination. 3
28. Pregnancy test - general consideration - Immunochemical tests. 2
29. Semen analysis - general consideration - significance. 2
30. Glucose tolerance test - general consideration - preparation of patient - fasting samples - glucose load - after load samples. 2
31. Preparation of glucose tolerance curve-significance. 2

Serology

32. Widal test - mechanism - reagent required - antigen preparation serum preparation - test procedure - reading of result - interpretation. 4
33. Kahn test - mechanism - reagents required - apparatus required - test procedure - reading of test - interpretation. 2
34. Wasermann test - procedure - reading of test. 3
35. A.S.O.T. - procedure - reading of test. 3
36. R.A. test - procedure - reading of test. 3
37. V.D.R.L. test - procedure - reading of test. 2
38. Pregnancy test - procedure - reading of test. 2

LABORATORY REQUIREMENTS FOR CLINICAL PATHOLOGY AND SEROLOGY

Equipment

1. Microscope
2. Thermostatic water bath.
3. Spectrophotometer.
5. Centrifuge
6. Analytical balance.

Culture Media

1. L.J. medium
6. Sabouraud's medium

KITS

1. Pregnancy test.
2. Widal test.
3. R.A test.
4. A.S.O. titre.
5. V.D.R. test.
6. Wassermann test.
7. Multistix.
8. Ketostix.

Glass wares

1. Slides
2. Cover slips
3. Beakers
4. Graduated cylinder
5. Measuring flasks
6. Reagent bottles
7. Dropping bottles.
8. Pipettes
9. Dropers
10. Pasteur pipettes
11. Petri dishes
12. Measuring cylinders

Chemicals

1. Suphuric acid
2. Hydrochloric acid
3. Nitric acid
4. Acetic acid
5. Sulfosalicylic acid
21. Hydrogen peroxide.
22. Guaic resin
23. Crystal violet.
24. Ammonium oxalate.
25. Safranin - O.

4. Urinometer.
6. Methyl alcohol
7. Sodium carbonate (Anhydrous)
8. Sodium citrate (Hydrated)
9. Copper sulphate

10. Trichloracetic acid
11. Ferric chloride
12. Sodium nitroprusside
13. Ammonium sulphate.
14. Ammonium hydroxide.
15. Barium chloride
16. Iodine
17. Zinc acetate.
18. Sodium acetrate trihydrate
19. Glacial acetic acid
20. Benzidine

Miscellaneous

1. Toyle's Tube
2. Millipore filter type SM pore size 5.0 + 1.2 u
3. Nichrome loop

26. Toluidine blue.
27. thiourea.
28. O.Toludine
29. Benzoic acid
30. Phenol
31. Mercurric nitrate nonehydrate.
32. S-diphencylcarbozone
33. Sodium tungstate.
34. Potassium dichromate.
35. Gold chloride.
36. I- Proponol.
37. Topfer's reagent (Mechylenninoazo benzone)
38. Phenolphthalein.
39. sodium hydroxide.

ELEMENTARY CHEMISTRY AND CHEMICAL PATHOLOGY

Theoretical - 100 x 1 hrs.
Practical - 85 x 2 hrs.

ELEMENTARY CHEMISTRY

1. **Introduction to Chemistry**
   Definition - Division of chemistry - utility of each branch.

2. **Element**
   Definition- atomic structure - periodic tables -vlaency properties - classification - symbols - metals and nonmetals - Brief description of important elements.

3. **Compound and mixture**
   Definition - properties - difference between mixture and compound - separation of mixture - formulae of common compounds.

4. **Units of measurement**
   Metric system - imperial system - conversion from Forenhiet to Centigrade and vice versa - measurement of weight, volume, heat, energy, length etc.

5. **Solution.**
   Definition - compounds and solutions - classification of solution -solubility - factors influencing solubility - concentration of solution - molar, molal, normal and saturated solution - preparation of solution.

6. **Acid, base and salt.**
   Definition of acid, base, salt and alkali - measurement of strength of acidity and alkalinity - titration -hydrogen ion concentration - measurement of hydrogen ion concentration - indicators - $_{p}H$ - Henderson Hassel Bach equation.

7. **Various chemical process.**

   Definition - Procedure - Utilisation

Filteration	Destilation
Cryśtalisation	Fractional distillation
Decantation	Hydrolysis
Precipitation	Centrifugation
Evaporation	Oxidation and reduction
Titration	Catalysis.
Sublimation	

8. **Chemical reactions**
   Introduction brief description of chemical reactions and its types.
9. **Introduction of chemical pathology**

Definition and scope of chemical pathology - subjects to be taught - relatioship with other branches of pathology - apparatus and reagents to be used - description. Principle of operation of calorimeter, flame photometer, blances, $_{p}$H meter and centrifuge.

10. **Carbohydrates, lipids, proteins, enzymes and vitmins.**

Brief account of sources, classification, metabolism and importance.

11. **Blood/chemistry**

Normal values - short description of metabolism - interpretation of findings of following in blood.

Sugar, cholesterol, urea, uric acid, bilirubin, alkaline and acid phosphate, creatinine. Total protein, S.G.P.T, S.G.O.T., thymol turbidity.

12. **Electrolytes and water**

Important electrplytes in human body. Brief account of functions and metabolism of Na. K.Ca and Fe in blood - distribution of body fluid - dehydration and oedema.

13. **Significance of** quantitative analysis of urine for calcium, creatinine urea, sugar, albumin chloride.

ELEMENTARY CHEMISTRY AND CHEMICAL PATHOLOGY

Topics	Wight age %
1. Introduction to chemistry.	02 %
2. Element.	03 %
3. compound and mixture.	04 %
4. Units of measurement.	04 %
5. Solutions.	05 %
6. acid, base and salts.	07 %
7. Various chemical process.	12 %
8. Chemical reactions.	04 %
9. Introduction to chemical pathology.	07 %
10. Carbohydrates, lipids, proteins, enzymes and vitamins.	20 %
11. Blood chemistry.	20 %
12. Electrolytes and water.	06 %
13. Significance of quantitative analysis of urine.	06 %
Total :	100 %

ELEMENTARY CHEMISTRY AND CHEMICAL PATHOLOGY
PRACTICAL ACTIVITIES CLASS XI AND XII

Activities	Number of Laboratory Periods
1	2
Elementary Chemistry	
1. Measurement of weight in different units.	1
2. Measurement of volume in different units.	1
3. measurement of length in different units.	1
4. Measurement of heat in different units.	1
5. Use and maintenance of electrical balances.	1
6. Solubility - demonstration of factors affecting solubility.	1
7. preparation concentrated solution.	1
8. Preparation of Molar solution of different compounds.	2
9. Preparation of Molal solution of different compounds.	2
10. Preparation of Normal solution of different compounds.	2
11. preparation of saturated solution of different compounds.	1
12. Measurement of strength of acdity and alkalinity - titration of acid, bases and other solutions.	3
13. Measurement of pH of solutions by different methods.	2
14. Demonstration of following procedures: filtration. - Crystallisation - decantation - distillation - fractional distillation - centrifugation - Hydrolysis - oxidation - reduction etc.	8
Chemical Pathology	
15. Introduction - apparatus and reagents used in chemical pathology laboratory.	2
16. Description, principle and operation of colorimeters - different types.	2
17. Description and operation of flame photometer.	2
18. Description and operation of pH meters.	2
19. Description and operation of balances.	2
20. Description and operation of centrifuge.	2
21. Sampling of blood and urine for chemical examination - Separation of plasma and serum.	1
22. Preparation of anticogulant and preservatives used in chemical pathology	2
23. Estimation of glucose in blood - interpretation of results.	3
24. Estimation of cholesterol in blood.	3
25. Estimation of urea in blood.	3
26. Estimation of creatinine in blood.	3
27. Estimation of uric acid in blood.	3
28. Estimation of bilirubiun in blood.	3
1	**2**

29. Estimation of total protein in blood.	3
30. Estimation of Acid phosphatase in blood.	2
31. Estimation of Alkaline phosphatase in blood.	2
32. Estimation of S.G.P.T in blood.	2
33. Estimation of S.G.O.T in blood.	2
34. Demonstration of Thymol turbidity test.	1
35. Estimation of sodium and potasium in serum by flame photometer.	4
36. Estimation of calcium in blood.	2
37. Quantitative analysis of urine for calcium, creatinine, urea, sugar, albumin and chloride.	8
Total:-	85

LABORATORY REQUIREMENT FOR CHEMICAL PATHOLOGY

Equipment

1. Balance.
2. Incubator.
3. Water bath.
4. Calorimeter/Spectrophotometer.
5. Flame Photometer.
6. $_{P}$H meter.
7. Centrifuge.
8. Refrigerator.
9. Hot Plate.

Glass Ware

1. Volumetric flask.
2. Conical flask.
3. Beakers.
4. Pippettes.
5. Test tubes.
6. Centrifuge tubes.
7. Reagent bottles.
8. Dropping bottles.
9. Wash bottles.
10. Funnesl.
11. Cylenders.
12. Pestle and mortor.
13. Pasteur pipettes.
14. Cuvettes.
15. Burettes.
16. Follin Wu tubes.

Chemicals

1. Copper sulphate.
2. Sodium chloride.
3. Sodium carbonate.
4. Tartaric acid.
5. Molybdic acid.
6. Sodium tungstate.
7. Sodium hydro - oxide.
8. Phosphoric acid.
9. Glucose.
10. Benzoic acid.
27. Cholesterol Powder.
28. Potassium sodium tartarate.
29. Potassium iodide.
30. Sodium sulphate.
31. Sulfosalicylic acid.
32. Sodium citrate.
33. Trisodium citrate.
34. Potassium dichromate.
35. Sodium nitroprusside.
36. Nitric acid.

11. Trichlor acetic acid.
12. O. toluidine.
13. Acetic acid (glaciall)
14. thio - urea.
15. Silver nitrate.
16. Potassium chromate.
17. Sodium barbital.
18. Barbital.
19. Thymol.
20. Barium chloride.
21. Sulphuric acid.
22. Chloroform.
23. Ether.
24. Acetic anhydride.
25. Ethanol.
26. Methanol.
37. Sulphur powder.
38. Ammonium sulphate.
39. Ammonium hydroxide.
40. Ferrix chloride.
41. Zinc acetate.
42. Picric chloride.
43. Ammonium sulfate.
44. Urease Powder.
45. Nesseler's reagent.
46 Sulfuric acid.
47. Sodium nitrite.
48. Ortho phosphoric acid.
49. Lithium sulphate.
50. Formaline.
51. Uric acid.

SYLLAABUS TO BE TAUGHT TO F.Sc. MED: LAB: TECHNOLOGY (THEORY)

S.No.	Subject	Class	Topic No.l	
			From	To
1.	Haematology	First Year. 2nd Year.	1 6	5 10
2.	Chemical Pathology	First Year. 2nd Year.	1 9	8 13
3.	Elementary Anatomy	First Year. 2nd Year.	1 10	9 16
4.	Microbiology (Bacteriology/Virology)	First Year. 2nd Year.	1 6	5 9
5.	Microbiology II (Parasitology/Virology	First Year. 2nd Year.	1 3 B	3(A) 5 (B)
6.	Clinical Pathology/Serology	First Year. 2nd Year.	1 4	3 8

SYLLABUS TO BE TAUGHT TO F.Sc. MED: LAB: TECHNOLOGY (PRACTICAL)

S.No.	Subject	Class	Topic No.l	
			From	To
1.	Elementary, Anatomy/Microtechniques	First Year. 2nd Year.	1 10	9 24
2.	Haematology and Blood Banking	First Year. 2nd Year.	1 16	15 30
3.	Microbiology I (Bacteriology/Virology)	First Year. 2nd Year.	1 14	13 31
4.	Microbiology II (Parasitology/Mycology)	First Year. 2nd Year.	1 15	14 16
5.	Clinical Pathology and Serology	First Year. 2nd Year.	1 27	26 38
6.	Elementary Chemistry & Chemical Pathology	First Year. 2nd Year.	1 15	14 37