

**PARA MEDICAL GROUP**  
**1: MEDICAL LABORATORY TECHNICIAN (P1, P2, P3)**

**Scheme of Examination**  
**Std. XI**

Paper	Title of the Paper	Theory		Practicals		Term work	Project work	I.V.	Total Marks
		Marks	Time (Hrs)	Marks	Time (Hrs)				
1	Anatomy & Physiology	80	3	80	3	20	10	10	200
2	Laboratory Management & Ethics	80	3	80	3	20	10	10	200
3	Microbiology	80	3	80	3	20	10	10	200

\* IV = Industrial Visit. Visit to minimum five labs or diagnostic centers and blood banks (Any one blood bank)

**Std. XII**

Paper	Title of the Paper	Theory		Practicals		Term work	Project work	I.V. *	OJT **	Total Marks
		Marks	Time (Hrs)	Marks	Time (Hrs)					
1	Clinical Pathology, Hematology & Blood Bank	80	3	80	3	10	10	10	10	200
2	Histotechnology	80	3	80	3	10	10	10	10	200
3	Clinical Biochemistry	80	3	80	3	10	10	10	10	200

\*\* OJT = On Job Training

\* IV = Industrial Visit. Visit to minimum five labs or diagnostic centers and blood banks (Any one blood bank)

## **INTRODUCTION**

Diagnostics play prominent role in the field of Medicine. Without proper diagnosis, proper conclusions regarding Medical treatment cannot be given. Thus Medical Lab Technician Course is gaining importance. This course is designed to train manpower to carry out medical laboratory technical work in various departments in medical and pharmacy colleges, peripheral laboratories, research and diagnostic centers, etc.

The healthcare industry is always changing, so as the Laboratory Medicine. The old manual methods used before are replaced by modern technologies. Automation has become an integral part of every laboratory. The diseases which were common before are obsolete now. At the same time many new diseases are emerging. There are new pieces of equipment or new tests to deliver better care. Hence it was absolutely essential to update the syllabus so as to make the students knowledgeable and efficient to work in the advanced laboratories.

## **OBJECTIVES**

This course aims to educate and train students who have passed Std. 10th or equivalent examination.

1. To fulfill the manpower need of the health service in the country.
2. To carry out routine laboratory test on blood, urine, stool, sputum, etc. and various bacteriological, serological and biochemical tests.
3. To assist physician in the diagnosis and prognosis of a disease.
4. To carry out technical work in various departments of medical colleges, peripheral laboratories, research and diagnostic centers.
5. To understand principles of Laboratory Management and Ethics.
6. To handle, use and care of various laboratory equipments.
7. To develop expertise to perform and interpret various tests.
8. To understand organization of hospitals, research institutes, manufacturing companies of various reagents, laboratories of Primary Health Centers and District Hospitals to avail employment opportunities.

## **JOB OPPORTUNITIES**

1. Lab technician in Biochemistry, microbiology, pathology, blood banking department.
2. Lab Assistant in Municipal hospitals.
3. Lab technician in Home science teaching college laboratory.
4. Lab technician/lab assistant in Dental college, Pharmacy college, Veterinary college, Fisheries college.
5. Laboratory technician in primary health center.

6. Laboratory technician in district hospitals.
7. Laboratory technician in private hospitals, nursing homes and diagnostic labs.
8. Technicians in various firms manufacturing vaccines, antisera and diagnostic kits.
9. Technician in dairy industries.
10. Technician in Municipal water labs.
11. Technician in Pharmaceutical labs.

### SELF EMPLOYMENT

1. Diagnostic laboratory /collection center after completing govt. norms.
2. Preparation and sale of ready-made reagents/kit/media.
3. Distributor of laboratory chemicals.
4. Distributor of laboratory wares, equipment and spare parts.

### FURTHER EDUCATION:

If student desires, he can take admission to First year of Bachelor of Science (B.Sc.) with Chemistry, Botany and Zoology.

## Std. XI Paper I: Anatomy and Physiology (P1) Theory

Sr. No.	Unit	Sub-Unit	Periods
1	Introduction to Anatomy	a) Different Parts of Human Body. b) Anatomical Position & Planes. c) Common Anatomical terms.	04
2	Human Cell	a) Structure. b) Functions.	04
3	Tissue	a) Classification b) Functions of different tissues.	04
4	Skeletal System	a) Definition and Classifications of Bones. b) Location of Bones in human body. c) Skull	06
5	Blood	a) Composition and General Functions of Blood. b) Haemopoiesis. c) Different types of Blood Cells and their functions. d) Compositions of Lymph e) Blood group	16

6	Cardio Vascular System.	a) Heart – Anatomy and functions. b) Circulation-Systemic, pulmonary and Portal. c) Cardiac Cycle. d) Definition of cardiac output, pulse, Blood Pressure, ECG. e) Explanation of Types of Blood vessels and their functions.	16
7	Respiratory System	a) Anatomy of respiratory system and functions. b) Definition of External & internal respiration. c) Mechanism of respiration and lungs. d) Definition of Respiratory rate, Tidal Volume, vital capacity, cyanosis, hypoxia, PCO <sub>2</sub> . e) Blood Gas Analysis.	12
8	Digestive System	a) Definition of Digestion. b) Parts of Digestive System i. Mouth and pharynx. ii. Salivary Glands. iii. Oesophagus and stomach. iv. Intestine – Small & large. v. Liver, Gall bladder and Pancreas. c) Process of Digestion.	16
9	Excretory System	a) Urinary system –Anatomy and functions of Kidneys, Ureter, Urinary Bladder and Urethra. b) Skin – Structure and Function	12
10	Reproductive System	a) Anatomy and functions of Male reproductive System. b) Anatomy and functions of Female reproductive System	12
11	Endocrinology	a) Definition of Endocrine glands, b) Name of Glands and their hormones. c) Functions and Significance of different Hormones.	12
12	Nervous system	a) Anatomy of Brain, Spinal cord and nerves and their Functions. b) C.S.F.-formation and its Functions.	06
		<b>Total</b>	<b>120</b>

### Practicals

Sr. No.	List of Practicalss	Periods
	<b>A) ANATOMAY PRACTICALS (Charts and Models)</b> (Practicals notebook, Drawing Diagrams, Labeling). Demonstration of parts of	

<b>body and bony landmarks on body surface.</b>		
1.	Identification of cells and basic tissues.	8
2	Respiratory System.	8
3.	Heart and Great vessels.	8
4.	Digestive System	16
5.	Hepato biliary system	12
6.	Urinary System.	8
7.	Male Genital System.	10
8.	Female Genital system.	10
9.	Central Nervous System.	10
<b>Practicals may be by</b>		
1.	Demonstration of specimen	
2.	Drawing diagram and labeling.	
3.	Demonstration of models.	
<b>B) PHYSIOLOGY PRACTICALS.</b>		
1.	Microscope- Use, maintenance, cleaning and types.	14
2.	Identification of Blood cells focused under microscope and report writing. 10 Samples - a) RBCs, b) WBCs-Different types, c) Platelets, d) Reticulocytes.	20
3.	Blood Collection – 10 subjects. (Patients)	12
4.	Obtaining Sample of Plasma and serum (10-Samples)	6
5.	Behaviour of RBC in Isotonic, Hypertonic and Hypotonic solutions.	16
6.	Preparation of Anticoagulants-Double Oxalate, Sodium Citrate, EDTA, Fluoride, Heparin bulbs.	18
7.	Haematocrit (PCV) determination, methods, Normal values and Significance.	16
8.	Identification of ruling areas in Neubauer's chamber- RBC and WBC diluting pipette, Westergreen's pipette.	20
9.	Hb. Estimation by Sahli's method and Drabkin's method with its normal range and significance.	20
10.	Demonstration of blood Pressure recording and Pulse. (10 Patients).	8
<b>Total</b>		<b>240</b>

## Paper II: Laboratory Management and Ethics (P2) Theory

<b>Sr. No.</b>	<b>Unit</b>	<b>Sub-Unit</b>	<b>Periods</b>
1	Human Health and Disease.	a) Definition of Health-Given by WHO. b) Dimension of Health-Physical, Mental,	20

		<p>Social and spiritual.</p> <p>c) Disease-</p> <ol style="list-style-type: none"> <li>i. Concept of disease.</li> <li>ii. Classification or types of disease</li> <li>iii. Mode of Disease transmission.</li> </ol> <p>d) Disease Agent- Definition, Types- Biological, Nutritional, Physical, Chemical, Mechanical, social etc.</p> <p>e) Diagnostic procedures - History, physical examination by physician, Lab investigation like blood, urine, stool, etc. and other investigation like CT , MRI, Ultrasound, etc.</p>	
2.	Health Care system in India.	<ol style="list-style-type: none"> <li>a) Public health Sector-Elementary Knowledge of Government, Municipal Hospital, PHC, etc.</li> <li>b) Private Sector-GPs, Polyclinics, Private hospitals etc.</li> <li>c) Indigenous systems of medicine, Ayurveda, Homeopathy, Unani etc.</li> <li>d) Voluntary Health agencies</li> <li>e) National Health Programmes.</li> </ol>	08
3.	Laboratory System in India	<ol style="list-style-type: none"> <li>a) Taluka Level-PHC lab. (Community based lab)</li> <li>b) District Hospital lab at district level.</li> <li>c) Regional Level –Regional Hospital Lab</li> <li>d) National Level Lab.</li> </ol>	08
4.	Ethics	<ol style="list-style-type: none"> <li>a) Definition of Ethics.</li> <li>b) Definition, Qualification and subject knowledge of medical lab technician.</li> <li>c) Professional code of Conduct for Technician.</li> <li>d) Do's or Don't of Lab technicians.</li> <li>e) Maintaining relations with other staff of Lab &amp; Patients.</li> <li>f) Communication Skills written spoken, action.</li> </ol>	04
5.	Laboratory Planning	<ol style="list-style-type: none"> <li>a) Definition of Laboratory and its Legal aspects.</li> <li>b) General Principles of Laboratory including space, ventilation, light, water, working benches etc.</li> <li>c) Various sections or working components of a Laboratory.</li> <li>d) Different labs in major Hospitals.</li> </ol>	08

		<ul style="list-style-type: none"> <li>e) Staffing pattern of the Lab. depending upon the size and types of a lab.</li> <li>f) Work schedule-Depending upon type of lab example, Sample receiving, recording, processing, reporting etc.</li> <li>g) Develops specific goals and plans to prioritize, organise and accomplish work.</li> </ul>	
6.	Equipments, Glass - ware, Reagents, Chemicals of a lab and its care and use.	<ul style="list-style-type: none"> <li>a) List of Equipments, Glass wares, Chemicals etc. Principle, Use, and maintenance of Microscope, Centrifuge, Oven, incubator autoclave etc.</li> <li>b) Need to understand the parts replacement process of Equipments.</li> <li>c) Care and Cleaning of Glass ware- Used, Infected, Unused (New).</li> <li>d) Use of Micropipettes</li> <li>e) Making simple glass ware in Lab. (e.g. stirring rods, Pasteur Pipettes etc).</li> <li>f) Care of Chemicals, storage, and labelling, classification (Organic, inorganic, toxic and non toxic, carcinogenic, flammable etc.)</li> </ul>	12
7.	Specimen Handling	<ul style="list-style-type: none"> <li>a) Types of Specimens</li> <li>b) Collection, Precautions and Containers for specimens.</li> <li>c) Specimen packing, transport and storing.</li> <li>d) Receiving specimen in lab</li> <li>e) Acceptance and rejection criteria for specimen.</li> <li>f) Specimen preservation</li> <li>g) Disposal of specimen</li> </ul>	08
8	Bio-medical Waste Management	<ul style="list-style-type: none"> <li>a) Definition</li> <li>b) Source of health care waste (bio-waste)</li> <li>c) Classification of hazardous wastes- infectious waste, biochemical, pharmaceutical, Genotoxic, radioactive etc.</li> <li>d) Personnel at risk of Bio-waste.</li> <li>e) Treatment and disposal technology for bio-waste- segregation storage, transport treatment (Incineration, chemical disinfection, wet and dry thermal treatment and land disposal)</li> <li>f) Storage of biomedical waste categories and colour coding.</li> </ul>	12
9	Laboratory Safety	<ul style="list-style-type: none"> <li>a) General principles</li> </ul>	12

		<ul style="list-style-type: none"> <li>b) Lab hazards <ul style="list-style-type: none"> <li>i. Mechanical</li> <li>ii. Electrical</li> <li>iii. Chemical</li> <li>iv. Radioactive</li> <li>v. Bio waste etc.</li> </ul> </li> <li>c) Safety measures i) Designing safe lab ii) Fire extinguisher iii) following professional code of conduct iv) Displaying safety charts v) Personal care, hygiene and immunisation.</li> <li>d) First Aid – i) Definition ii) Contents of first aid box</li> <li>e) First Aid measures in case of accident in a lab e.g. i) Cuts ii) Burns iii) Electric shock</li> </ul>	
10	Quality Control	<ul style="list-style-type: none"> <li>a) Definition of quality control and quality assurance</li> <li>b) Quality assurance stages – pre analytical, analytical, post analytical.</li> <li>c) Pre-analytical- preparation of patient, requisition form, specimen collection, use of computer network for sample acceptance. <ul style="list-style-type: none"> <li>i. Analytical- error due to mixing of samples, interference due to washing, explain quality control – principle and standardisation of the test method, quality control of quantitative and qualitative reagents, error of imprecision or scatter error, error of inaccuracy or biased error, use of quality control charts (Levey-Jennigs charts and Cusum curve)</li> <li>ii. Post-analytical – reporting, checking (verifying), and interpretation of test results</li> </ul> </li> <li>d) Definition – Reliability, accuracy, specificity, Sensitivity, Precision with one suitable example.</li> </ul>	12
11	Material Management	<ul style="list-style-type: none"> <li>a) Procurement – where to obtain, supplies reagents, kits, chemicals, reusable parts.</li> <li>b) Purchase (cost control)</li> <li>c) Utilisation of supplies (voucher of supplier)</li> <li>d) Inventory control and analysis (stock card)</li> <li>e) inspection of storage</li> </ul>	08



		f) maintaining records and reports g) Use of computer – storing records reports and other data. h) Usage of LMIS (Laboratory Management Information System)	
12	Multi-skills for laboratory technician	a) Phlebotomist-Blood collection centers. b) E.C.G. Technician-Knowledge of different types of Leads, Procedure of recording E.C.G. c) Hospital record Technician-Maintaining information of patients. (Personal information, Health status, List of test, reports, billing) d) Preparation and distribution of reagents, Kits, chemicals etc.	08
		<b>Total</b>	<b>120</b>

### Practicals

Sr. No.	List of Practical	Periods
1.	Drawing an ideal clinical lab.	16
2.	Learning different equipments and its maintenance-Microscope, Centrifuge, Oven etc.	28
3.	Learning different chemical, Reagents and the Glassware and its uses e.g. Beaker, Conical flask, test tubes, volumetric flask, measuring cylinder.	24
4.	Washing of glassware used (Dirty and infected) and unused (new).	16
5.	Preparing reports of Lab. Test (Urine, Stool, CSF, Sputum, Semen, CBC, ESR, VDRL, HIV, Biochemistry etc).	20
6.	Learning First Aid Box (Its contents).	20
7.	Learning First Aid Procedure for accidents. e.g. Cuts, burns, electric shock, inhalation of gases, swallowing infected material, acids, alkali etc.	20
8.	Learning Vaccutainers.	12
9.	Identifying of colour code for a Bio-waste disposal bags.	8
10.	Learning Vouchers of supplier.	12
11.	Maintaining stock cards.	12
12.	Learning parts of computers and its operations. (MS-office, Excel, Power point)	28
13.	Visit to PHC, Clinical Labs etc.	24
	<b>Total</b>	<b>240</b>

**Paper III: Microbiology & Parasitology (P3)**  
**Theory**

<b>Sr. No.</b>	<b>Unit</b>	<b>Sub-Unit</b>	<b>Periods</b>
1.	Introduction to Microbiology	Introduction to Microbiology and Various definitions.	02
2.	Sterilization and disinfection.	a) Dry heat-Flamming, hot air oven. b) Moist heat-Below 100°C at 100°C and above 100°C (Autoclave in detail). c) Filtration- Sand Filter, Seitzfilter, Sinterted glass and membrane filters. d) Use of Hand wash solution and sodium hypochloride.	04
3.	Requirement and use of common Lab. equipments.	a) Microscope-Types and uses. b) Incubator c) Hot air oven. d) Autoclave-Different types. e) Anaerobic jar. f) ELISA Micro plates reader. g) Laminar air Flow and types.	04
4.	Bacterial Anatomy	Classification and morphology of bacteria. Structure of Bacterial cells, Capsule, Flagella and spore.	08
5.	Staining of Bacteria	a) Smear-Fixation-Staining. b) Grams staining in detail. c) ZNCF stain in detail. d) Albert's staining for granules. e) Negative staining for capsule. f) Silver impregnation staining for Flagella.	08
6	Bacterial Physiology	Bacterial growth requirements –pH, food, oxygen, CO <sub>2</sub> , temp. Symbiosis, bacterial growth curve.	04
7.	Cultivation of Micro organism.	a) Culture media-requirement and classification. (Solid, Liquid, semi solid) b) Composition of common lab culture media. i. Nutrient Agar ii. MacConkey's Agar	08

		<ul style="list-style-type: none"> <li>iii. Blood Agar</li> <li>iv. Selective media. (DCA, L.J, EMB media)</li> <li>c) Transport Media(AMIES, Stuarts)</li> <li>d) Anerobic media (Robertsons Cooked meat medium).</li> </ul>	
8.	Culture Methods.	Various Culture methods. Techniques of Inoculation and Isolation.	04
9	Identification of Bacteria.	<ul style="list-style-type: none"> <li>a) Staining</li> <li>b) Motility.</li> <li>c) Cultural characteristics.</li> <li>d) Biochemical reactions. (Catalase, Oxidase, Urease TSI, Gelatin liquefaction IMVP and Citrate Principle, procedure and observation).</li> </ul>	08
10	Gram Positive Bacilli.	Corynebacterium, (Classification, morphology, Cultural characteristics, Biochemical Reactions, Pathogenecity and Lab diagnosis.)	04
11	Gram Negative Bacilli.	Salmonella, Shigella, E.coli, Proteus, Vibrio, (Classification, morphology, Cultural characteristics, Biochemical Reactions, Pathogenecity and Lab diagnosis.)	08
12	Gram Positive and Gram Negative cocci.	Staphylococci, streptococci, Pneumococci and Neiseria. (Classification, morphology, Cultural characteristics, Biochemical Reactions, Pathogenecity and Lab diagnosis.)	08
13	Mycobacteria,	Mycobacterium tuberculosis and leprae.	06
14	Spirocheates.	Treponema Pallidum	02
15	Leptospira	Introduction and Lab Diagnosis.	02
16	Gram Positive Anaerobic Bacilli.	Clostridia spp.	02
17	Antibiotic Sensitivity Test	Principle and method of determination of Sensitivity and drugs resistance.	02
18	Virology	Disease wise classification, Structure, capsid, nucleocapsids, capsomere, virion. HIV-I & II- Morphology, Clinical features, diagnosis, spread and control (ELISA, W.B., and PCR.) Hepatitis, Polio – Morphology, Clinical features, diagnosis, spread and control Elementary knowledge of H1N1, Dengue and Chikungunea.	12

19	Immunity	Concept of Immunity - Active and Passive. Primary and secondary response. Antigen Antibody (Immunoglobulin Five types). Concept of Monoclonal and Polyclonal antibodies.	04
20	Serology	Principle, Procedure and Diagnostic significance of Agglutination, Precipitation, Neutralization, Complement fixation.	08
21	Collection and Processing	Specimen like Urine, stool, sputum, Blood, CSF, Aspiration and swabs.	08
22	Parasitology	Introduction, Classification, Protozoal Parasites, Nematodes & Helminths.	04
		<b>Total</b>	<b>120</b>

### Practicals

Sr. No.	List of Practical	Periods
1.	Handling and care of microscope.	4
2.	Operation of autoclave, incubator, water bath, serological water bath, pH meter, hot air oven, sterilisation, packing, loading of materials in autoclave, hot air oven, inspissator.	34
3.	Preparation of culture media – nutrient agar, Mac Conkey’s agar, blood agar (Pouring, quality control, storage)	22
4.	Hanging drop method (2 samples)	18
5.	Specimen collection - blood, urine, stool, swabs (nasal, throat, vaginal).	16
6.	ZNCF staining, Gram’s staining, Alberts staining	20
7.	Inoculation of Clinical materials into media.	12
8.	Isolation of Organism in Pure culture.	16
9.	Morphology, Cultural characteristics and Identification, Biochemical reaction of common micro organisms.	18
10.	Bacteriological Examination of water, milk, air.	16
11.	Antibiotic Sensitivity test.-Disc method, automated method.	16
12.	Fungal Examination by wet mount – Lactophenole cotton blue.	16
13.	Serology: Widal test (Slide and tube method, report preparation), VDRL (RPR method), R.A. test, CRP test. ASO test, Beta-HCG in Urine (Pregnancy test).	32
	<b>Total</b>	<b>240</b>

**Std. XII**  
**Paper I: Clinical Pathology, Haematology & Blood Banking (P1)**  
**Theory**

<b>Sr. No.</b>	<b>Unit</b>	<b>Sub-Unit</b>	<b>Periods</b>
1	Introduction to Haematology	1.1 Definition 1.2 Components 1.3 Cells-their structure & functions 1.4 Lymph	02
2	Collection of blood	2.1 Collection of capillary blood by skin puncture 2.2 Collection of blood by veni puncture 2.3 Collection of arterial blood 2.4 Vacutainers & colour coding. 2.5 Criteria for sample collection	04
3	Anticoagulants	3.1 Definition, Action of E.D.T.A., Oxalates, Double Oxalates, Fluorides, Acid citrate dextrose, Tri sodium citrate, Heparin. 3.2 Effect of anticoagulants on blood cell morphology.	02
4	Haemoglobin	4.1 Normal structure & various haemoglobins 4.2 Determination of haemoglobin by Cyanmethemoglobin method & other method of Hb. 4.3 Anemia	08
5	Study of blood cell counts	5.1 Total WBC count 5.2 RBC count 5.3 Platelet count 5.4 Absolute Eosinophil count 5.5 Reticulocyte count	10
6	Study of blood smear for differential WBC count	6.1 Preparation & staining of smears, Romanowsky stains 6.2 Counting methods 6.3 Morphology of white cells, types of white cells. 6.4 Abnormalities in morphology of blood cells & related diseases.	10

7	Erythrocyte sedimentation rate	7.1 Westergreen's method 7.2 Wintrobe's method 7.3 Landau method 7.4 Factors affecting ESR 7.5 Normal range, clinical significance & limitations	04
8	Packed cell volume (Haematocrit)	8.1 Packed cell: Principle, Procedure, Normal values, Clinical significance. Macro & micro haematocrit.	02
9	Red cell indices	9.1 Red cell indices. Determination of MCV, MCH, MCHC i.e., Colour index. Automatic cell counter, its parameters.	03
10	Sickle cell preparation	10.1 Screening for sickle cell anemia	02
11	Coagulation Tests	11.1 Mechanism of coagulation 11.2 Factors of coagulation 11.3 Determination of bleeding time 11.4 Determination of clotting time 11.5 Determination of Prothrombin time	10
12	Preparation of Bone marrow smears	12.1 Types 12.2 Collection methods 12.3 Preparation & staining of smear 12.4 Clinical significance 12.5 Detection of presence of iron in bone marrow. 12.6 Clinical significance	03
13	Urine Analysis	13.1 Collection & preservation of sample 13.2 Normal & Abnormal constituents 13.3 Physical examination 13.4 Chemical examination for abnormal constituents 13.5 Microscopic Examination 13.6 Urine report preparation	12
14	Stool examination	14.1 Physical 14.2 Chemical 14.3 Microscopic	03
15	Semen Analysis	15.1 Specimen collection 15.2 Precautions during collection. 15.3 Physical examination 15.4 Chemical examination 15.5 Microscopic examination	04
16	Sputum Examination	16.1 Method of collection, Specimen collection 16.2 Precautions during collection. 16.3 Physical examination	02

		16.4 Chemical examination 16.5 Microscopic examination	
17	C.S.F. Examination	17.1 Method of collection 17.2 Physical examination 17.3 Chemical examination 17.4 Microscopic examination. 17.5 Interpretation related with types of meningitis.	06
18	ABO Blood group system	18.1 Introduction to ABO Group System. 18.2 Types of Blood Groups and Their Antigen and Antibody. 18.3 Methods of Detection of ABO group System. i. Slide ii. Tube method. iii. Bovine Method 18.4 Applications of ABO system	06
19	Rhesus blood group system	19.1 Clinical significance 19.2 Detection of Rh antigen by Slide method & tube method 19.3 Rh confirmation test & Bombay blood group	08
20	Cross matching	20.1 Major & Minor by slide & tube method	02
21	Coomb's test	21.1 Direct & Indirect Coomb's test Principle, importance, procedure, interpretation	04
22	Blood bank	22.1 Definition, layout of blood bank 22.2 Equipments 22.3 Maintenance of records operation	03
23	Blood Transfusion	23.1 Principle, selection & screening of donor 23.2 Collection of blood 23.3 Anticoagulants used in blood bank 23.4 Testing of blood for H.I.V., HBsAg, V.D.R.L. & malaria. 23.5 Storage of blood	06
24	Complications of blood transfusion	24.1 Definition, types of blood transfusion reaction	02
25	Cell separation & transfusion of various blood components	25.1 Name of different Blood Components. Methods for Separation. Instrument used for Separation. (Differential Centrifuge).	02
		<b>Total</b>	<b>120</b>

## Practicals

Sr. No.	List of Practical	Periods
1.	Collection of blood.	16
2.	Estimation of hemoglobin	16
3.	Differential WBC Count	18
4.	Examination of peripheral blood smears	12
5.	Total RBC count	12
6.	Total WBC count	12
7.	Platelet count	12
8.	Reticulocyte count	12
9.	Estimation of ESR	8
10.	Determination of PCV	8
11.	Bleeding Time	8
12.	Clotting Time	8
13.	Prothrombin time	4
14.	Sickle cell preparation	6
15.	Urine analysis	25
16.	Stool Examination for ova and Cyst.	6
17.	Semen analysis	4
18.	Sputum examination	4
19.	C.S.F. Examination	4
20.	ABO blood grouping by slide method.	4
21.	ABO blood grouping by tube method.	4
22.	Rh typing by slide method	4
23.	Rh typing by tube method	4
24.	Cross matching (Major & Minor)	5
25.	Coombs Test Direct and Indirect.	6
	<b>VISITS</b>	
1.	For Automatic blood cell counter	8
2.	Blood Bank	10
	<b>Total</b>	<b>240</b>



**Paper II: Histotechnology (P2)**  
**Theory**

<b>Sr. No.</b>	<b>Unit</b>	<b>Sub-Unit</b>	<b>Periods</b>
1	Introduction	a) Definition of Histotechnology. b) Different terms used in histotechnology	02
2	Cell, Tissues and their functions	a) Definition of cell. b) Different parts of cell and their functions c) Classification of different tissues of body and their functions	04
3	Methods of examination of tissues and cells	a) Collection and labeling of specimens, b) Methods of preparation and examination of tissues-Fresh and Fixed tissue. c) Types of biopsy	04
4	Fixation of Tissue	a) Definition b) Criteria for an Ideal fixative c) Classification of fixative-simple and compound d) Properties of simple fixatives e) Compound fixatives and their properties - Microanatomical, Cytological and Histochemical	16
5	Decalcification	a) Definition and significance b) Different decalcifying fluids c) Detection of end point of decalcification	12
6	Tissue Processing	a) Types of tissue processing-Manual and Automatic. b) Different embedding media c) Steps of tissue processing-Dehydration, Clearing, Impregnation , d) Embedding. - Methods of embedding, embedding medium, names of Medium and moulds. e) Automatic tissue processor - Structure and working - Advantages and disadvantages	16
7	Section cutting	a) Types of microtome b) Rotary microtome - parts and their functions. c) Microtome knives – - Types - Care and maintenance - Technique of Sharpening	12

		<ul style="list-style-type: none"> <li>d) Automatic knife sharpener</li> <li>e) Technique of section cutting</li> <li>f) Preparation of an adhesive mixture</li> <li>g) Mounting</li> </ul>	
8	Frozen section	<ul style="list-style-type: none"> <li>a) Definition</li> <li>b) Advantages and disadvantages</li> <li>c) CO<sub>2</sub> freezing microtome</li> <li>d) Cryostat</li> </ul>	04
9	Staining	<ul style="list-style-type: none"> <li>a) Definition and significance</li> <li>b) Sensitivity and specificity of stain</li> <li>c) Theory of staining</li> <li>d) Methods of staining – <ul style="list-style-type: none"> <li>- Direct and Indirect staining,</li> <li>- Progressive and Regressive staining</li> </ul> </li> <li>e) Mordants and Counter stain. Accentuators- Role in staining.</li> <li>f) Haematoxyline and Eosin staining.</li> <li>g) Special stains- <ul style="list-style-type: none"> <li>(i) Connective tissue stains- <ul style="list-style-type: none"> <li>- Collagen and collagen fibres -Weigert’s von Gieson stain</li> <li>- Reticular fibres-Silver Impregnation method</li> <li>- Elastic fibres -Verhoeff’s stain</li> </ul> </li> <li>(ii) Stains for particular Substances <ul style="list-style-type: none"> <li>- Carbohydrates-PAS stain</li> <li>- Amyloid-Congo Red stain</li> <li>- Pigments and Minerals</li> </ul> </li> </ul> </li> </ul> <p>Haemosiderin and Iron- Prussian Blue method.</p> <ul style="list-style-type: none"> <li>- Calcium- Von Kossa stain</li> <li>- Melanin-Negative Prussian Blue Reaction</li> </ul> <ul style="list-style-type: none"> <li>(iii) Stains for Microorganisms <ul style="list-style-type: none"> <li>- Bacteria – Gram’s Stain, Giemsa’s stain</li> <li>- Myco. tuberculosis and Myco.leprae- Acid Fast Stain</li> <li>- Fungi- Grocott'smethenamine silver stain(GMS)</li> </ul> </li> </ul>	20
10	Exfoliative Cytology	<ul style="list-style-type: none"> <li>a) Introduction and significance</li> </ul>	14

		b) Types of specimens& preservation c) Preparation smear d) Use of cytocentrifuge e) FNAC technique f) Different cytological fixatives g) Papanicolaou staining h) DNA isolation Karyotyping i) Barr body staining- i) Introduction and significance ii) Morphology of Barr Body iii) Staining of Barr Body- • Cresyl fast violet stain • Orcein stain • Carbol Fuchsin stain	
11	Museum Technique	a) Definition and significance b) Steps of storage of specimen in pathology museum- • Reception and Preparation of specimen • Fixation - Kaiserling solution No. 1 • Color Restoration - Kaiserling solution No. 2 • Preservation - Kaiserling solution No. 3 • Presentation (Mounting in Museum jar)	08
12	Waste disposal	Types of waste Methods of disposal	08
<b>Total</b>			<b>120</b>

### Practicals

Sr. No.	List of Practical	Periods
1.	Preparation of 10% formalin.	16
2.	Preparation of 5% formic acid and Detection of end point of decalcification by chemical method.	22
3.	Manual and automatic tissue processing.	28
4.	Technique of embedding.	20
5.	Rotary microtome (Demonstration of different parts & working.)	20
6.	Sharpening of microtome knife. (Honing & stropping.)	16
7.	Preparation of an adhesive - Mayer's egg albumin and glycerol.	14
8.	Technique of section cutting.	12
9.	Haematoxyline and Eosin staining and mounting.	22
10.	Preparation of cytology smears.	18

11.	Preparation of cytological fixatives: i) 95% ethyl alcohol ii) Ether-alcohol	16
12.	Papanicolaou staining.	20
13.	Visit to Histotechnology laboratory.	16
	<b>Total</b>	<b>240</b>

### Paper III: Clinical Biochemistry (P3) Theory

Sr. No.	Unit	Sub-Unit	Periods
1	Elementary knowledge of Organic Chemistry	Organic Compounds – Alcohols, Aldehydes, Ketones, Esters and Carboxylic Acids.	04
2	Glass wares used in Biochemistry laboratory.	a) Types of glass b) Uses, their identification and application c) Cleaning, drying, maintenance and storage of glassware	04
3	Instrumentation	a) Colorimetry: Photo electric methods. Instrumentation, Principle, working, care & maintenance and application. Beer – Lambert law, Filters and choice of filter b) Spectrophotometry: Principle, types, construction and application c) Flame Photometry d) Paper Chromatography e) Electrophoresis – Principle, Types and application	12
4	Basic Laboratory Techniques	a) Methods of measuring liquid b) Separation of solids from liquids c) Centrifugation – Principle, different types of centrifuge, care & maintenance, application d) Filtration using funnel e) Weighing – Different types of balances used, care & maintenance	08
5	Carbohydrates	Importance, definition, classification and some properties (Reducing properties, osazone formation, etc). Dietary sources of Carbohydrates.	08
6	Proteins	Classification (Simple, compound and derived proteins), Amino acids- Names, tests and	08

		application, Essential amino acids, Denaturation of proteins, Functions of plasma proteins. Dietary Sources of Proteins.	
7	Lipids	Definition, Classification, Sterols particularly cholesterol, Functions. Dietary source of lipids.	08
8	Nucleic acids	DNA and RNA	04
9	Enzymes	Definition & Classification, properties, mechanism of enzyme action, diagnostic value of serum enzymes. (SGOT, SGPT, acid and alkaline phosphatase, lactate dehydrogenase, creatinine phosphokinase, amylase, lipase)	08
10	Vitamins	Classification, Functions and deficiency diseases. Dietary sources of Vitamins.	08
11	Carbohydrates metabolism	Elementary aspect, definition of glycolysis, glycogenolysis, ketosis, glycosuria, renal glycosuria, ketonuria	04
12	Lipid Metabolism	Elementary aspects, Triglycerides, Cholesterol, Plasma lipoproteins, ketone bodies. Lipid Profile	04
13	Protein Metabolism	Proteinuria, Transaminases, Renal Function Test.	04
14	Water and mineral metabolism	Dehydration; Calcium, Phosphorus, Iodine: Their physiological functions and disease.	08
15	Renal Function Test	Definition, Importance of test like, Blood urea, BUN.Creatinine, Uric Acid, Proteins. Importance of Dialysis.	08
16	Liver function test	Serum Bilirubin, SGOT, SGPT, alkaline phosphates, Total proteins, serum albumin and serum globulin, serum cholesterol, prothrombin time.	08
17	Automation in Clinical Biochemistry	Principle, types Like Semi, Fully, Sequential and batch mode Auto analyzers – Role of computers in laboratory	08
18	Blood Gas Analyzer	Laboratory determination of PCO <sub>2</sub> , PO <sub>2</sub> , pH, Bicarbonates. Components of Blood Gas Analyzer. Use and working of Blood gas Analyzer.	04
		<b>Total</b>	<b>120</b>

## Practicals

Sr. No.	List of Practical	Periods
1.	Preparation of Saturated solutions, Percent solutions, Normal solutions, Molar solutions, Buffer Solutions.	20
2.	Normal constituents – (a) Qualitative test for urea, uric acid, creatinine, calcium, phosphorous. (b) Creatinine Clearance	26
3.	Abnormal constituents of urine: (a) Qualitative test for: sugar, albumin ketone bodies, blood, bile salts and bile pigments. (b) test for phenylketonuria (FeCl <sub>3</sub> )	30
4.	Estimation of plasma glucose (GOD-POD method)	16
5.	Glucose tolerance test.	18
6.	Non protein nitrogenous compounds: - Estimation of serum urea by (DAM/Enzymatic method), uric acid and ceratinine (Endpoint method/Kinetic/Enzymatic).	30
7.	Determination of serum proteins and AG ratio.	12
8.	Serum Electrolytes :- Determination of Sodium, Potassium and Chlorides (Flame Photometry/Colorimetry)	12
9.	Determination of Inorganic phosphorus (Principle, Normal value, increase and decrease)	12
10.	Determination of Calcium (Principle, Normal value, increase and decrease)	16
11.	Determination of transaminase – SGOT and SGPT (Principle, DNPH method)	12
12.	Determination of Alkaline Phosphatase and Acid phosphatase.	12
13.	Serum Bilirubin: Determination of total and direct bilirubin.	8
14.	Serum Lipids: Determination of serum Cholesterol (enzymatic) Determination of HDL, LDL, VLDL and Triglycerides.	16
<b>Total</b>		<b>240</b>

## List of Books

Sr. Number	Title
1.	Fundamental of Biochemistry by A. C. Deb.
2.	Fundamentals of Chemistry by J. L. Jain.
3.	H. B. of Medical Technology by Dr. Mrs. Chitra.
4.	Medical Laboratory Technology by A. Ananthanarayan.
5.	Text book of Microbiology by Dr. Ramnik Sood.
6.	Parasitology Protozoology Helminthology by K. D. Chatterjee.

7.	Human Physiology I by C.C. Chatterjee.
8.	Human Physiology II by C.C. Chatterjee.
9.	Grays Anatomy by Peter C. Williams.
10.	Interpretation of common Investigation by L.C. Gupta.
11.	Anatomy & Physiology for Nurses Evelyn C. Perce.
12.	Clinicians Pocket References Leonard G. Gomellar.
13.	Notes on Chemical Lab Techniques by K. M. Samuel.
14.	Introduction of Transfusion Medicines by Zarin Bharacha.
15.	Textbook of Parasitology by S.S. Kelkar
16.	Manual of Medical Lab. Technology by A.V. Naigaonkar
17.	Practicals Clinical Biochemistry by Harold Varley.
18.	Principles & Techniques of Practical Biochemistry by Keith Wilson.
19.	Synopsis of Pathology & Microbiology by K. Chaudhary.
20.	Viva & Recent Advances in Medical Microbiology by Satish Gupta.
21.	Parasitic Diseases in man by Richard Knight.
22.	Laboratory Manual of Clinical Biochemistry by Praful B. Godkar.
23.	Bacteriology Illustrated by R. R. Gillies.
24.	Atlas of Haematology by G. A. Donald.
25.	Medical Laboratory Technology by Ramnik Sood.
26.	Medical Lab Technology V-I by Kanai Mukherjee.
27.	Medical Lab Technology V-II by Kanai Mukherjee.
28.	Medical Lab Technology V-III by Kanai Mukherjee.
29.	Human Anatomy I by B.D. Chaurasiya.
30.	Human Anatomy II by B.D. Chaurasiya.
31.	Human Anatomy III by B.D. Chaurasiya.
32.	Anatomy & Physiology in Health and Illness by Kathleen Wilson.
33.	Introduction to Medical Lab Technology by F.J. Baker.
34.	Textbook of Microbiology R. Ananthanayan.
35.	Biochemistry for Students by V. K. Malhotra.
36.	Practicals Heamatology by V. Dacie.
37.	Clinical Diagnosis & Management by J.B. Henry.
38.	Manual for Laboratory Technician at the Primary Health Center by Ministry of Health.
39.	Physiology & Anatomy for Nurses by Dr. Vijaya Joshi.
40.	HB of Medical Lab Technology by Dr. Chitra Bharucha.
41.	Viva & Recent Advance in Medical Microbiology by Satish Gupta.
42.	Viva in Biochemistry by V. K. Malhotra.
43.	A HB of Clinical Pathology by Chakravati.
44.	Textbook of Medical Biochemistry by S. Ramakrishnan.
45.	Medical Dictionary by Dauglar M. Anderson.
46.	Clinical Pathology by S. S. Kelkar.
47.	Short Textbook of Medical Microbiology by Satish Gupta.
48.	Human Histology by Inderbir Singh.

49.	Mosby's Medical Dictionary by Mosby's.
50.	A Textbook of Human Anatomy by T.S. Ranganathan.
51.	A Textbook of Human Physiology by K.M. Kuty.
52.	Text Book of Medical Lab Technology (By Ghodkar).
53.	Text Book of Biochemistry by Sattaynarayan.

**Note:** Text Book of Medical Lab Technology by B. Mukerjee and Text Book of Medical Lab Technology by P. B. Godkar at least 5 copy of each should be available in the Library .

## List of Tools and Equipments

**Power Supply** – 5 Phase K W.

### List of Tools and Equipments

1.	Autoclave	01
2.	Hot Air Oven	01
3.	Colorimeter	01
4.	37° C Incubator	01
5.	Table Centrifuge (Swing out with 6 to 8 buckets)	01
6.	Refrigerator – 165 liter	01
7.	Water bath	01
8.	Analytical Balance	01
9.	Gas Cylinder (1 with 10 burners)	01
10.	Microtome	01
11.	Tissue Floating bath	01
12.	Microscopes	20
13.	Slide warmer	01
14.	pH meter	01
15.	Thermometer	01
16.	Blood Pressure apparatus	01
17.	Stethoscope	01
18.	Weighing machine	01
19.	Voltage stabilizer	01
20.	Computer with printer	01
21.	Fire Extinguisher	01
22.	Anatomical charts and models	10
23.	Human Skelton	01



## LIST OF LABORATORY WARES

1.	Test Tubes	18 x 75 mm	50
		10 x 100 mm	50
		15 x 150 mm	50
2.	Centrifuge tubes	16 x 100 mm	30
3.	Beakers (Glass and Polypropylene)		
		50 ml	05
		100 ml	05
		250 ml	05
4.	Measuring cylinders (Stoppered)		
		50 ml	02
		100 ml	02
		250 ml	02
		500 ml	02
5.	Measuring cylinders (Non-Stoppered)		
		100 ml	02
		250 ml	02
		500 ml	02
6.	Pipettes		
	A) Volumetric capacity,		
		1 ml	10
		5 ml	10
		10 ml	10
	B) Serological blow out type-		
		1 ml in 1/100 ml	10
		2 ml in 1/100 ml	10
		5 ml in 1/100 ml	10
		10 ml in 1/10 ml	06
		1 ml in 1/10 ml	04
		2 ml in 1/10 ml	04
		0.1 ml in 1/100 ml	04
		0.2 ml in 1/100 ml	04
7.	Burette		02
8.	Reagent bottles Capacity:		
		60 ml	10
		120 ml	10
		250 ml	10
		500 ml	05
9.	Volumetric flasks		
		25 ml	02
		50 ml	04
		100 ml	04

	250 ml	04
10.	Dropper bottle	30 ml
11.	Pasteur pipettes	50
12.	Syringes and needles	2 ml
	5 ml	20
	10 ml	10
13.	Blood lancets	1 boxes
14.	Tourniquet	5
15.	Micro slides	5 packs of 50 each
16.	Microscope cover slips	10 small pcks
17.	Microscope lamps	10
18.	Blood cell counters (Manual for counting)	01
19.	Haemoglobinometer (Sahli's)	10
20.	Haemocytometer	10
21.	ESR tubes (Westgren)	20
22.	ESR stands	04
23.	Wintrob's tubes	10
24.	Plain tubes	50
25.	Anticoagulant (EDTA/Oxalate) bulb	50
26.	ACD bottles	01
27.	Donor bleeding set	01
28.	Lumbar puncture needle	01
29.	Bone marrow biopsy needle	01
30.	Filter paper-ordinary	01 Ream
31.	Whatman filter paper	
	46 x 57 cm,	
	No. 1	10 Sheets
	No. 2	10 Sheets
32.	Glass rods/Stirrer	10
33.	Rubber teats	20
34.	Cotton absorbent	1 Roll
35.	Block holder	02
36.	L-moulds	3 pairs
37.	Knife & knife sharpener	01
38.	Needle holder	02
39.	Forceps	05
40.	Petri dishes	(100 x 17)
41.	Cavity slides	05
42.	Nichrome loop/Platinum loop	10
43.	Loop holder	24
44.	Durham's tubes	24
45.	Urinometer	01
46.	Porcelain tiles	02
47.	Test tube rack	10

48.	Test tube holder	20
49.	Pipette stand	02
50.	Glass / Plastic funnel	04
51.	Spirit lamps	05
52.	Litmus paper blue (Book)	10 pcks
53.	Litmus paper red (Book)	10 pcks
54.	Gloves	10
55.	Gauze	½ kg
56.	Stop watch	02
57.	Scissors	02
58.	Glass marking pencils (RED)	05
59.	Tripod Stands	05
60.	Kidney tray	02
61.	Waste paper basket	02
62.	Brush (bottle cleaning)	10
63.	Phenyl (As per Use)	5 litres

Note:

Work benches to be fitted to the side of wall with electric switch at the bottom of the bench to be connected on the top of the bench for microscope lamp. There should be 2 wash basin with running water one in between the work bench, one on the side of the work bench, one separate wash basin with running water. One distilled water plant of 5 Liters to be fitted, 4 Nos. 3 pin plug to be fitted at the suitable place/kept the hot air oven, incubator and centrifuge etc.

## STAFF

<b>A. Lecturer: Qualification</b>	He/She will be a 'Full Timer'. M.B.B.S. Degree <b>OR</b> Two Part Time Lecturers.
<b>B. Instructors: Qualification</b>	He/She will be a 'Full Timer'. D.M.L.T. Degree (Affiliated with University/Govt. Board) Minimum 1 year of Laboratory Service Experience.
<b>C. Laboratory Attendant Qualification</b>	Minimum 1 will be required for the establishment. As per State Govt. Rules and Regulations The post will be 'Full Time'.

# Suggested Plan of Lab



